Agenda Item 6	Relevant EU Policy Matters
Information Document 6a	**STECF Review of the Implementation of the EU Regulation on the Incidental Catches of Cetaceans**
Action Requested	Take Note
Submitted by	European Commission

Note:
Delegates are kindly reminded to bring their own document copies to the meeting, if needed.

JRC SCIENCE FOR POLICY REPORT

Scientific, Technical and Economic Committee for Fisheries (STECF)
-
Review of the implementation of the EU regulation on the incidental catches of cetaceans (STECF-19-07)

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report deals with the implementation of Regulation (EU) 812/2004 on the incidental catches of cetaceans. The report explores the annual reports of the Member States, and undertakes a holistic analysis of the overall efficacy of the regulation.

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Review of the implementation of the EU regulation on the incidental catches of cetaceans (STECF-19-07)

Background provided by the Commission

Under article 6 of REGULATION (EU) No 812/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, Member states are obliged to provide to the Commission a report on the implementation of the regulation. Under article 8 of the regulation, the Commission is also required to undertake an assessment of the effectiveness of the regulation and where appropriate submit an overarching proposal for ensuring the effective protection of cetaceans. ICES, through the Working Group on Bycatches of Protected Species (WGBYC) provides an analysis of the MS annual reports on an annual basis, however it is necessary to undertake an more in-depth and holistic analysis of the overall efficacy of the regulation. A new technical measures Regulation will shortly enter into force, see:

http://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/PECH/AG/2019/03-07/1177957EN.pdf

which carries over many of the technical provisions laid out in 812/2004 and makes provisions for the updating of the technical specifications to acoustic deterrent devices and the possible introduction of other mitigation measures. It also foresees the setting of maximum by-catch limits for marine mammals. STECF is asked to provide an overview where such maximum thresholds have been developed and applied.

Tasks for the EWG

- To provide a holistic review of the effectiveness of the current regulation based on ICES advice and other sources of information in terms of mitigating by-catches of cetaceans.
- To provide observations on potential shortcomings of the regulation and where appropriate, indicate possible revisions to the technical specifications laid out in the regulation.
- To provide a summary of candidate maximum by-catch thresholds for the species most typically caught as by-catch.

Request to the STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF observations

The report of the EWG 19-07 represents a review and commentary on issues associated with current legislation and the work undertaken to provide cetacean population estimates. It also considers incidental bycatch estimates and the data and methods to provide such estimates, as well as bycatch mitigation methods. It draws heavily on the work of the ICES WGBYC, the ICES WKPETSAMP and the results of the FishPi project and on an extensive list

of published papers and reports. The EWG report focuses on cetaceans, but other Protected, Endangered and Threatened (PET) like seabirds or turtles are also mentioned.

While much excellent work has been carried out on these issues and is well-summarised in the EWG report, significant knowledge gaps remain, notably in reliable cetacean population estimates for many species and sea areas and reliable estimates of incidental catches of cetaceans resulting from inadequate monitoring.

Consequently, to provide a comprehensive, informative and in relation to bycatch thresholds, quantitative response to each of the terms of reference has proven to be a challenge for STECF. Nevertheless, based on the report of the EWG 19-07, STECF has attempted to draw out the important issues identified and where possible, proposed a follow-up action. Such issues and proposals represent a synthesis of the conclusions and recommendations contained in the EWG 19-07 report and are given below in relation to each of the requests given in the terms of reference to the Expert Group.

STECF comments on the various points in the ToRs

To provide a holistic review of the effectiveness of the current regulation based on ICES advice and other sources of information in terms of mitigating by-catches of cetaceans

The rationale for the following conclusions and proposed actions is given in Section 2 of the EWG 19-07 report.

- ***Issue:*** The specifications for the pingers/acoustic deterrent devices (ADDs) prescribed in Reg (EU) 812/2004 mainly mitigate the bycatch of harbour porpoise. For other species, results seem to be less conclusive.
    - ***Proposed action:*** The development of new pingers/ADDs should not be constrained by technical specifications; rather the Member States should be required to provide evidence that the devices to be used are effective at reducing bycatch.
- ***Issue:*** The implementation of pingers in Member States is low and enforcement is difficult.
    - ***Proposed action:*** Requirements to use pingers must be coupled with a requirement for Member States to enforce their use. The Commission should follow-up on perceived infringements as judged through the reporting process; Member States should also be required to provide evidence that mitigation measures are effective at reducing bycatch. To ensure efficient and harmonised control of the use of ADDs it is important that the use and functionality of these is regulated, perhaps at the EU level, through delegated or implementing acts of the Control Regulation. However, it should also be noted that control of such devices at sea is difficult (the decibel level is relatively low and difficult to detect due to engine noise and other interference.)

- ***Issue:*** The restrictiveness of Article 2 of 812/2004, in particular the areas, gears and regions set out in Annex I may lead to suboptimal use of pingers, with a high use in metiers with low bycatch and low use in metiers of high bycatch;
    - ***Proposed action:*** A region by region plan for pinger use, and complementary mitigation measures is needed and should be ground-truthed with in-field monitoring for effectiveness; (The proposed technical conservation measures (TCM) allows for this). The effect of new ADDs on species other than those intended to be deterred should be monitored and assessed, distinguishing which other species would be repelled, attracted or otherwise damaged by ADDs. More flexibility is required to use a wider range of mitigation measures (such as closed areas and gear modifications) to mitigate bycatch for porpoise and other cetacean species, in the full range of fisheries, vessel sizes, metiers and regions where bycatch occurs. Member States should be required to provide evidence that such mitigation measures are effective at reducing bycatch; STECF suggests that Member States' regional groups are tasked with prescribing regional plans for pinger use and associated by-catch mitigation measures.
- ***Issue:*** In general, current monitoring and reporting of cetacean and other PET species bycatch is inadequate.
    - ***Proposed action:*** there is a need to increase monitoring in metiers with a high risk of protected species bycatch, e.g., static nets (i.e. gillnets, trammel nets and entangling nets) for cetaceans and longlines for seabirds. STECF notes that the EWG 19-07 suggested that in the absence of pertinent data and information, an initial sampling level of 5-10 % of the total, annual fleet effort is necessary in most fisheries to determine the approximate level of bycatch or detect bycatch events of rare species.
- ***Issue:*** Full implementation of monitoring on incidental catches through the EU Data Collection Framework (EU-MAP / DCF) will take some time.
    - ***Proposed action***: STECF considers that the Regional Coordination Groups (RCGs) set up a regional work plan under the DCF that foresees adequate coverage and monitoring of fisheries that have a high risk of incidental cetacean by-catches. Inputs to RCGs and Member States on how to implement monitoring programs under national and regional work plans were provided by the grants FishPi^2 and STREAM, funded under the Call for Proposals MARE/2016/22. Until this is resolved in the DCF frame, it is important to ensure that dedicated interim at-sea monitoring schemes (observers, remote electronic monitoring, validated self-sampling by means of dedicated logbooks) are implemented to maintain and improve by-catch monitoring. There is a need to increase monitoring of those metiers with a high risk of protected species bycatch, e.g., static nets for cetaceans and longlines for seabirds. In particular, gillnetters under 15m are currently not covered;

To provide observations on potential shortcomings of the regulation and where appropriate, indicate possible revisions to the technical specifications laid out in the regulation

The rationale for the following conclusions and proposed actions is given in Section 3 of the EWG 19-07 report.

- ***Issue:*** The gears and fisheries prescribed for monitoring and reporting in Regulation (EU) 812/2004 relate to fisheries that do not pose the greatest risk to cetacean populations. There is a total lack of monitoring of any gears in the Black Sea and in the European Macaronesia, and a partial lack in the Mediterranean Sea for gillnets. This lack or scarce availability of data does not allow for a reliable risk assessment of the various gear types concerned, thereby preventing any potential mitigation action in these Regional Seas. This is particularly true when considering the high number of vessels (most less than 12 m length) using entangling nets, trammel nets or gillnets of various types in those regions, which are currently outside the Regulation.
    - ***Proposed action:*** There is a need to implement and ensure adequate monitoring of those vessels, regardless of size for incidental bycatch of all protected species (i.e. to include seabird, turtle, seal, and certain elasmobranchs and protected species of fish) in all fisheries where there is a risk of bycatch in the Mediterranean Sea, Black Sea and European Macaronesia.
- ***Issue:*** There is no requirement in Regulation (EU) 812/2004 for certain high-risk fisheries to employ by-catch-mitigation measures for cetaceans and PET species.
    - ***Proposed action:*** Ensure adequate monitoring in fisheries by Member States where the risk of for incidental bycatch of cetaceans and PET species is high.

STECF notes that according to the results of the FishPi project (which covers the North-East Atlantic EU waters excluding the Baltic), gill and trammel net fisheries in Iberian Waters, Bay of Biscay and North Sea and Eastern Channel are the sea areas with highest catch risk for bycatch of PET species. The FishPi findings for each of the above highest-risk sea areas can be summarised as follows:

The FishPi risk classification ranges from 0 (no risk of being caught) to 15 (highest risk). The risk classifications of different species (excluding protected roundfish species) groups for each sea area are given below:

Bay of Biscay

Risk 12 - turtles, diving birds, seals and harbour porpoises

Risk 8 - dolphins and large whales

Iberian Waters

Risk 15 - turtles, diving birds, seals and harbour porpoises

Risk 10 - dolphins and large whales

North Sea and Eastern Channel

Risk 12 - diving birds, seals and harbour porpoises

Risk 8 - dolphins and large whales

Within PET species, turtles have been identified as the species with highest catch risk in the Bay of Biscay and Iberian waters across all fisheries. For the North Sea and Eastern Channel seals are the species with the highest risk of being caught. Harbour porpoise is the cetacean species at greatest risk of being caught from gill and trammel nets in each of the above sea areas.

STECF notes that the risk of being caught described above is different to the risk that bycatch poses to populations, since higher catch rate may be related to either high mortality rates on limited populations or lower mortality rates on more abundant population. Bycatch rates and population abundance are discussed further below.

The 2018 report of the ICES WGBYC undertook a risk assessment for the Baltic Sea, where there is also high risk for bycatch of PET species associated with the use of gill and trammel nets. All species groups were assessed to be at high risk of being caught, except lampreys (low risk of capture by both gears), and surface-feeding birds (low risk of capture by trammel nets).

The ICES WKPETSAMP did not undertake any bycatch risk assessments but indicated that the ICES WGBYC do so for the Baltic, Mediterranean and Black Sea.

Based on the results of the FishPi and FishPi^2 projects, STECF considers that, to provide much-needed quantitative information on the extent and magnitude of cetacean and PET bycatches, in the NE Atlantic, priority should be given to introducing mandatory monitoring and associated bycatch mitigation measures for gill and trammel net fisheries in Iberian Waters, the Bay of Biscay, the North Sea and Eastern Channel.

Other priority EU fisheries in waters outside of the NE Atlantic will be identified if appropriate risk assessments are undertaken. Incorporation of mandatory monitoring of cetacean and PET species bycatch in such fisheries is also desirable. In this regard, the outputs of the regional grant STREAM (MARE/2016/22) will represent a fundamental support for identifying priority fisheries and implement by catch monitoring programs in the Mediterranean and Black Sea.

To provide a summary of candidate maximum by-catch thresholds for the species most typically caught as by-catch

STECF notes that to set thresholds for cetacean populations clear conservation objectives and targets are required. A discussion on such objectives and targets is given in sections 4.1.1 and 4.1.2 of the EWG 19-07 report. The report also describes the methods currently available to estimate potential by-catch thresholds noting that there is no universally-agreed method to calculate thresholds for cetacean bycatch within EU waters (Section 4.2 of the report). Information on available data and gaps in the data required to estimate bycatch thresholds is listed in Section 4.3 of the EWG 19-07 report.

STECF notes that estimating maximum bycatch thresholds is not straightforward and estimates rely on several aspects including i) the conservation objectives and targets, ii) the timescale over which such objectives and targets are to be met and iii) available estimates of population size. Four different methods to estimate bycatch thresholds for harbour porpoise in the North Sea are given in Table 4 of the EWG 19-07 report, and the results may vary significantly among those. For example, depending on the conservation objectives, the temporal window and the method used, the available maximum potential bycatch threshold estimates for harbour porpoise in the North Sea range from 840 – 3679 individuals per year.

Available information on potential bycatch thresholds for a range of species and sea areas are given in Table 5 of the EWG 19-07 report. STECF notes that for most species, a range of values is given depending on the conservation objective, time-scale and the estimation method.

Furthermore, STECF notes the following:

- the calculation of any bycatch threshold implies specific simulations that are based on data related to a specific population;
- any change to even one factor of those considered in the modelling requires a new set of simulations;
- the most accurate models, including mortality, run for the North Sea population of harbour porpoises give a threshold of about 0.5 % of the total population, compared to the ASCOBANS 1 %, using the same conservation objectives;
- for North Sea harbour porpoise (Table 4 of the EWG 19-07 report), the value calculated with the PBR method (1246 individuals) is higher than that calculated via CLA/RLA (840 individuals), but lower than the rule of thumb example of 1% of best available abundance (2164 individuals);
- abundance estimates are periodically updated producing different thresholds (the abundance estimates for porpoise were biased downward in 2005) therefore periodic reassessments are necessary.

STECF conclusion on maximum potential by-catch thresholds

The Scientific Committee of the International Whaling Commission (IWC) agreed that, in the absence of any detailed information on stock status, an estimated annual bycatch of 1% of the estimated population size would indicate that further research should be undertaken immediately to clarify the status of the stocks (Anon, 1996). They also agreed that an estimated annual bycatch of 2% may cause the population to decline and requires immediate action to reduce bycatch.

STECF notes that ASCOBANS recommended that, to be sustainable, the maximum annual anthropogenic induced mortality (incl. bycatch) for harbour porpoises should not exceed 1.7% of the population size (ASCOBANS, 2000; ANON, 2000). ASCOBANS Parties later agreed that a take of 1% of the population size should be used as an "intermediate precautionary objective" (European Parliament, 2008). Based on ASCOBANS recommendations, Government ministers of North Sea riparian states decided under the Bergen Declaration (2002) that an unacceptable bycatch limit for harbour porpoises [*in the North Sea*] was 1.7% of the best estimate of population size. They also agreed on a precautionary objective to reduce the bycatch of all marine mammals to less than 1% of the best available population estimate.

The STECF has no objective criteria to propose any alternative threshold to those indicated above and notes that applying the maximum limit of 1.7% of the population agreed by ASCOBANS to the abundance estimate for harbour porpoise in the Northern and Southern North Sea (189,191 individuals; (ASCOBANS website, 5 July 2019 - https://www.ascobans.org/en/species/phocoena-phocoena)), the maximum bycatch threshold for harbour porpoise in the North Sea would equate to 3216 individuals. Alternatively, applying a precautionary threshold based on 1% of the population estimate of 189,191 individuals would equate to 1892 individuals.

Population estimates and candidate bycatch threshold values for cetaceans in EU waters have been computed for different species and sea areas (Table 5 of the EWG 19-07 report). However, such estimates assume different conservation objectives and timescales and in addition, the population estimates are imprecise. Consequently, in the absence of stated conservation objectives, and uncertainty in current population size estimates, the STECF has no scientific basis to advise which, if any, of the bycatch thresholds for cetaceans in EU waters presented in Table 5 of the EWG 19-07 report are likely to be appropriate.

Furthermore, the precautionary objective to reduce the bycatch of all marine mammals to less than 1% of the best available population estimate agreed under the Bergen Declaration (2002), requires that current population estimates are available, which for many species and sea areas they are not, or at best, they are imprecise. Consequently, STECF concludes that in the absence of reliable population estimates, current conservation status and stated conservation objectives for cetacean populations in EU waters, there is no objective scientific basis to propose reliable estimates for maximum potential bycatch thresholds for all the cetacean species most typically bycaught (i.e. harbour porpoises, common, striped and bottlenose dolphins and humpback whales).

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REPORT TO THE STECF

EXPERT WORKING GROUP ON Review of the implementation of the EU regulation on the incidental catches of cetaceans (EWG 19-07)

JRC, Ispra (Italy), 17-21 June 2019

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

EXECUTIVE SUMMARY

An STECF Expert Working Group (EWG 19-07) met from 17- 21 June 2019 in Ispra (Italy) to review the implementation of Regulation (EU) 812/2004 on the incidental catches of cetaceans. Previous reviews on the same topic were the basis of the EWG-19-07 response to their three ToRs.

Tor 1. To provide a holistic review of the effectiveness of the current regulation based on ICES advice and other sources of information in terms of mitigating bycatches of cetaceans

Member States are required to report annually to the European Commission on the implementation of Regulation (EU) 812/2004. ICES Working Group on Bycatch of Protected species (ICES WGBYC) reviews these reports and has repeatedly reported the inadequacy of the information provided. There is insufficient monitored effort of the relevant fisheries to enable any assessment of the overall impact of fisheries on cetaceans and compliance with the mitigation requirements appears to be low. Bycatch of marine mammals is widely observed in European waters in nets, purse seines, rod-and-pole and trawl gears. Bycatch Risk Assessments are employed to identify high-risk fisheries but due to limitations of both bycatch monitoring data and fisheries effort data, the bycatch estimates are biased.

The métiers and areas listed in Annex III of the Regulation, and carried over into the proposed Technical Measures Regulation, do not target the highest risk fisheries with regard to cetacean bycatch. Most Member States rely on data collected by fisheries observers deployed through the Data Collection Framework (DCF) sampling programme rather than dedicated marine mammal observers, which results in downwardly biased bycatch estimates compared with those from dedicated observers. In addition, cetacean bycatch occurs more frequently in métiers not represented in the DCF sampling program. Smaller vessels (<12 m) likely account for a significant proportion of bycatch, and therefore increased sampling is required on these vessels.

Since the implementation of the new EU-MAP, Regional Coordination Groups have not introduced a sampling methodology or additional monitoring effort for the purposes of protected species monitoring. There is a need for a procedure in the RCG's to raise and assess the implementation of additional monitoring of protected species under the EU-MAP and associated DCF. Until such time that effective monitoring can be achieved through the DCF, dedicated monitoring schemes for cetacean bycatch are suggested. Remote Electronic Monitoring (REM) offers the greatest potential for monitoring protected species bycatch and to meet the needs of the DCF.

The Regulation specifies Acoustic Deterrent Device (ADD or *"pinger"*) use for mitigation despite having only proven efficacy for reducing harbour porpoise bycatch. The restrictiveness of Article 2 regarding the vessels, areas and gears on which pingers are mandatory (Annex I) may lead to suboptimal deployment. The vessel size restriction alone leads to the majority of the EU fishing fleet being excluded from the provisions of the Regulation. Other issues associated with pinger use are highlighted, including the unpredictability of overlaps between the distribution of high-risk fisheries and cetacean distribution and the continuity, maintenance and need for inspections of pingers.

Enforcement of pinger use is generally low but the effort required is also likely to constitute a substantial cost for Member States. If better information on the behaviours and distributions of cetaceans were available it would inform the implementation of other specific mitigation measures, such as time-area closures, and assist development of technological fixes in fishing gears. Consequences of wide scale pinger deployment are discussed, including potential habitat exclusion effects and the impact on seals through a *"dinner bell"* effect.

Tor 2. To provide observations on potential shortcomings of the regulation and where appropriate, indicate possible revisions to the technical specifications laid out in the regulation

The vessel length criteria within Regulation (EU) 812/2004 for monitoring and mitigation actions have meant that only a very small proportion of the European fleet is impacted in any meaningful manner by the Regulation. Monitoring of the ≤15 m sector of the fleet is underrepresented despite the requirement for pilot and scientific studies and there is a lack of focus on the gears (e.g., gillnets) that pose the greatest threat of bycatch.

The inadequate provisions for monitoring are particularly heightened in the Mediterranean, Black Sea and European Macaronesia. The requirement to monitor ≤15m fleet must be strengthened, providing a legal basis for Master's to take observers if requested with resources made available to do so. Remote Electronic Monitoring (REM) is a workable alternative to observers on small vessels.

Unambiguous definitions of gear types to be monitored must to be specified. Dependency on cetacean bycatch data collection through non-dedicated observers deployed through the DCF will not be adequate for robust estimation of cetacean bycatch rates.

EWG 19-07 suggests a systematic risk assessment for cetacean bycatch to target resources towards fisheries and areas where bycatch poses the highest risk to cetacean populations. Existing risk assessments have identified static nets in the Baltic as being a serious risk for harbour porpoise and in the Mediterranean for bottlenose dolphins and EWG 19-07 suggests that the outputs of these risk assessments for cetacean bycatch are taken note of and acted upon. Robust risk assessments require bycatch monitoring data and fisheries effort data; the availability of the latter especially for the <10m sector of the fleet remains a hurdle to EU-wide cetacean bycatch estimates. Available data on cetacean bycatch could be augmented by that collected through other Regulations, such as ICCAT.

Reduction of harbour porpoise bycatch using pingers is generally effective; but there is limited evidence of their success for other species. The Regulation requirement to use pingers only on vessels of ≥12m overall length, means that the bulk of the fleet that contribute the greatest proportion of cetacean bycatch are not required to mitigate. Vessels falling within the requirements are also limited by specification of gear characteristics (e.g. mesh sizes, net lengths) and the periods in which they fish; requirements to use pingers should not be constrained by such parametres. A risk-based approach for the deployment of pingers is suggested. The approach to mitigation should not be restricted to pingers nor too tightly prescribed. Any device/gear or operational modification that is robustly demonstrated

to significantly reduce bycatch should be employed. Monitoring for the purposes of checking effectiveness and compliance must be implemented.

Bycatch Reduction Plans have had proven success in the U.S. to reduce cetacean bycatch. Such a model could operate within the EU. Monitoring and mitigation are core components of such plans and these might be coordinated in the context of Regional Advisory Groups.

Tor 3. To provide a summary of candidate maximum bycatch thresholds for the species most typically caught as bycatch

Approaches for setting thresholds to bycatch were reviewed and shown that each has different data requirements. Application of a simple "rule of thumb" is the least data-demanding approach; an example being the ASCOBANS *"1 % of best available abundance"*. Use of such an approach can be a valuable starting point but should be done in an adaptive management framework requiring monitoring of affected populations to improve the evidence base on which a threshold can be based.

As the evidence builds, more sophisticated and robust approaches to setting thresholds may be possible for certain species and regions (e.g. Potential Biological Removal and Removals Limit Algorithm).

Thresholds are integral to Bycatch Risk Assessments and these should be conducted regularly (e.g. every 2-3 years) at a regional level as part of an adaptive management framework. This would help the prioritisation of populations in each region for immediate bycatch measures. Bycatch mitigation may be required in parallel to data collection for high-risk fisheries.

The EWG was unable to provide candidate maximum bycatch thresholds for all the cetacean species most typically bycaught and reiterates the advice presented in ICES (2014) that the European Commission establishes a process involving both scientists and managers to derive these thresholds, based first on agreement of conservation objectives. Conservation objectives and targets are integral to threshold setting methods and must be clearly quantified. The EWG suggests that Regional Fishery Management Organisations (RFMOs) and Member States adopt roadmaps to help prioritise and implement bycatch monitoring and mitigation, including carrying out full assessments for populations and species most affected. The latter might lead to the establishment of regional bycatch reduction teams.

1 INTRODUCTION

1.1 Background

Regulation (EU) 812/2004 of the European Parliament and of the Council lays down measures for the reporting of incidental catches of cetaceans in a small number of defined fisheries and one single measure to mitigate against such catches. The Regulation identifies fisheries where the use of acoustic deterrent devices (ADDs or "pingers") is mandatory, the technical specifications and conditions of use of these devices, and fisheries where observer schemes to obtain representative data in order to assess the extent of bycatch of cetaceans.

Member States are also responsible for enforcing the use of ADDs and monitoring their efficacy over time, as well as implementing monitoring schemes according to the guidelines under this Regulation. In 2011, the European Commission carried out two separate reviews of the Regulation (EU) 812/2004 (COM(2009) 368; COM(2011) 578) as required under Article 7 of the Regulation.

In 2012, ICES WGBYC (Working Group on Bycatch of Protected Species) [1] (see chapter 3) gives a summary of the conclusions. In an attempt to address the shortcomings in the monitoring part of the Regulation, the main conclusion of these reviews led to the Commissions' decision to implement the monitoring of incidental bycatch of sensitive species into the Data Collection Framework (DCF), which began in January 2017. The report of this meeting builds on the remaining shortcomings, which refer mainly to the technical part of the Regulation. For the monitoring part, it re-addresses the shortcomings that were already recognised by previous reviews and reflects on the current effectiveness of incidental bycatch monitoring under the new DCF.

An STECF Expert Working Group (EWG-19-07) met from 17 to 21 June 2019 in Ispra (Italy) to review the implementation of the Regulation (EU) No 812/2004. Under Article 6 of the Regulation, Member States are obliged to provide an annual report on the implementation of the Regulation to the Commission. Under Article 8 of the Regulation, the Commission is also required to undertake an assessment of the effectiveness of the regulation and where appropriate submit an overarching proposal for ensuring the effective protection of cetaceans.

ICES, through the Working Group on Bycatch of Protected Species (WGBYC) provides a review of the Member State data reports on an annual basis; however, it is necessary to undertake a more in-depth and holistic analysis of the overall efficacy of this Regulation.

The Council has signed off the new Technical[1] Measures Regulation that carries over many of the technical provisions laid out in Regulation (EU) No 812/2004 and makes provisions for updating the technical specifications of acoustic deterrent devices and the possible introduction of other mitigation measures. The proposal also foresees the setting of maximum bycatch limits for marine mammals. EWG 19-07 was asked to provide an overview on where such maximum thresholds have been developed and applied.

EWG 19-07, also provided a broader overview of the whole problem of cetacean bycatch in the many areas covered by Regulation (EU) 812/2004. Various aspects related to population status, bycatch rates, fishery effort and observation effort have different levels of scientific knowledge. These aspects affect a better or a worse understanding of the whole problem, likely biasing the conceptual framework of the Regulation itself.

1.2 Terms of Reference for EWG-19-07

The EWG 19-07 was requested to address the following Terms of Reference:

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1 https://www.consilium.europa.eu/en/press/press-releases/2019/06/13/final-greenlight-on-new-technical-and-conservation-measures-in-fisheries/

Tor 1. To provide a holistic review of the effectiveness of the current regulation based on ICES advice and other sources of information in terms of mitigating bycatches of cetaceans.

Tor 2. To provide observations on potential shortcomings of the regulation and where appropriate, indicate possible revisions to the technical specifications laid out in the Regulation.

Tor 3. To provide a summary of candidate maximum bycatch thresholds for the species most typically caught as bycatch.

1.3 General context of the discussion on the cetacean bycatch issue

In order to contextualise the EWG 19-07 discussions there are three aspects that are worth noting. Firstly, there are a number of scientific and technical international standing working groups and initiatives that are focusing on or contribute to assessment, monitoring and mitigation of cetacean bycatch, which are relevant in the European context. These include:

- International Whaling Commission (IWC)
    - IWC Scientific Committee Subcommittee on Human-Induced Mortality
    - IWC Bycatch Mitigation Initiative and its Bycatch Mitigation Expert Panel
- International Council for the Exploration of the Sea (ICES)
    - ICES Working Group on Bycatch of Protected Species (ICES WGBYC)
    - ICES Working Group on Marine Mammal Ecology (ICES WGMME)
- ASCOBANS/ACCOBAMS Joint Bycatch Working Group
- North Atlantic Marine Mammal Commission (NAMMCO)
    - Scientific Committee Working Group on Bycatch
    - NAMMCO Council Working Group on Bycatch, Entanglements and Live Strandings (BYCELS)
- OSPAR
    - ICG-COBAM Marine Mammal Expert Group

There are also national working groups focusing on this matter (e.g. the French '*Groupe national sur les captures accidentelles de petits cétacés dans le golfe de Gascogne'* coordinated by *Direction des Pêches et de l'Aquaculture du Ministère de l'Agriculture*; UK's Bycatch Focus Group led by its Department of Environment, Food and Rural Affairs). In addition, there are a number of international and regional initiatives on this topic scheduled for the coming months (e.g. the joint OSPAR-HELCOM workshop to examine possibilities for developing indicators for incidental bycatch of birds and marine mammals to be held in Denmark in September 2019).

In this regard, the EWG **believes** that any regional discussion and assessment on cetacean bycatch should include at least one representative of these existing working groups and initiatives. At present, strong networking is fundamental to facilitate, through creating a critical mass of knowledge and expertise, consistency and efficiency in ongoing processes (e.g. discussions on bycatch of species of conservation concern carried out within the Common Fisheries Policy [CFP], the Habitats Directive [HD], and the Marine Strategy Framework Directive [MSFD] frameworks).

Secondly, various Regional Fishery Management Organisations (i.e. CSSBT, GFCM, IATTC, ICCAT, IOTC, WCPFC) have binding resolutions and recommendations on the cetacean bycatch issue (both on data collection and mitigation measures). The main ones are:

- ICCAT, 2011. Recommendation by ICCAT on information collection and harmonization of data on bycatch and discards in ICCAT fisheries. REC. 2010-11: 1-2.
- GFCM, 2012. Recommendation GFCM/36/2012/2 on mitigation of incidental catches of cetaceans in the GFCM area: 1-3. IOTC, 2013. Resolution 13/04 on the conservation of cetaceans: 1-3.
- WCPFC, 2012. Conservation and management measure for the protection of cetaceans from purse-seine fishing operations. 2011-03: 1-2.
- GFCM, 2013. Recommendation GFCM/37/2013/2 on the establishment of a set of minimum standards for bottom-set gillnet fisheries for turbot and conservation of cetaceans in the Black Sea: 1-2.
- IAATC, 2017. Agreement on the International Dolphin Conservation Program (amended): 1-23.

Concerning monitoring activities, all these rules include the mandatory collection of data on cetacean bycatch. Some of these RMFOs (e.g. GFCM, ICCAT, IATTC) also impose regional or national observer programmes for some specific fisheries, where the data to be collected also include cetaceans. These are binding rules for the EU fleet operating in those areas and those fisheries, under the competence of these RFMOs.

Finally, it is worth noting that a recent amendment to the U.S. Marine Mammal Protection Act (MMPA) related to marine mammal bycatch, came into force from 1st January 2017 and has potential implications for European fisheries exports. From 10th January 2021, the U.S. MMPA Import Provision Act, and every four years thereafter, a fishing nation must apply for and receive a *comparability finding* for its fisheries to export fish and fish products to the U.S., otherwise they may not be imported. A comparability finding is based on adoption and implementation of a regulatory programme that is comparable to the US regulatory programme under the MMPA (i.e. PBR).

2 TOR 1: HOLISTIC REVIEW OF REGULATION (EU) 812/2004

2.1 Background

ICES WGBYC reviews and summarises the annual national reports submitted to the European Commission under Regulation (EU) 812/2004 in order to evaluate the impact of bycatch in fisheries on cetaceans. Member States are obliged to implement monitoring schemes for incidental catches of cetaceans using on-board observers, on boats with an overall length of 15 m or over, for the fisheries in defined métiers and areas (Annex I).

Member States are also obliged to establish pilot or scientific studies on smaller vessels operating in the defined métiers. In addition, Member States need to report their monitored effort to the Commission yearly.

To review the effectiveness of Regulation (EU) 812/2004 and evaluate the impact of fisheries on cetaceans, the ICES WGBYC created a database with data included in the Regulation (EU) 812/2004 reports. Over the past two years WGBYC has also made a formal ICES data call requesting Member States and other ICES countries to deliver data on incidental catches of protected species and fishing effort.

From 2011 to 2019, ICES WGBYC [1-9] concluded that information provided through the Member States' Regulation (EU) 812/2004 reports and other additional sources of information is limited. There is insufficient monitored effort to enable any assessment of the overall impact of fisheries on cetaceans. Monitoring coverage per métier and vessel varies greatly, with some countries relying on monitoring vessel sizes and gear types only specified in the Regulation (EU) 812/2004 (i.e. focused on larger vessels only and not incorporating pilot studies).

Most Member States rely on data collected from fisheries observers deployed through the DCF sampling programme rather than collected through dedicated marine mammal observers; bycatch rates are underestimated by fisheries observers compared to dedicated observers, which biases the estimates downwards.

Estimates of the overall incidental catches of cetaceans in each of the fisheries concerned should be provided by Member States in the Regulation (EU) 812/2004 report but, due to limited monitoring, only two Member States have provided estimates of bycaught cetaceans [9].

In 2019, ICES WGBYC [9] summarised the species bycaught per year in the observed métiers and ICES ecoregions along with the observed days at sea and total fishing effort. The data available provide an indication of the range of bycatch rates for various taxa by gear and ecoregion. Bycatches of marine mammals are observed in all ecoregions in set nets, purse seines, rod-and-pole, and trawl gears [9].

In past years, WGBYC has not been able to do an overall impact assessment of the bycatch on cetaceans. However, Bycatch Risk Assessments (BRA), as described in WKREV812 [10] are being carried out for areas and métiers where information is available. To carry out a full risk assessment, detailed information on bycatch rates as well as data on fishing effort is needed, both of which are incomplete. Fishing effort is not available for the majority of the Member States for boats below 10 metres.

A BRA relies on the use of the ICES WGBYC database, which holds data on fishing effort and bycatch information submitted by Member States that are subject to Regulation (EU) 812/2004. In recent years, there has been BRA analysis on harbour porpoise in the Kattegat and Belt Sea in static nets in 2015 [7]; in the Celtic Sea in static nets in 2016 [8], in the Celtic Sea in static nets and bottom trawls in 2017 and in static nets in the North Sea [9]. There has also been a BRA assessment on common dolphins in the Celtic Sea (CS) and Bay of Biscay in midwater trawl and static nets in 2017 [9]. However, ICES WGBYC stressed that the bycatch estimates are likely biased due to limitations in both the bycatch data as well as the fishing effort data [9].

2.2 Article 2

Article 2(1) prohibits vessels of 12 m or over in length to use the fishing gear defined in Annex I in the areas, for the periods, and as from the dates indicated therein without the simultaneous use of active deterrent devices (ADDs). ADDs are the only prescribed mitigation measure in the Regulation. Other measures could include temporal closures of an area for a fishery with a known high bycatch rate and/or gear modification. Article 12 of the Regulation (EU) 1380/2013 states that a fishery can be closed provided there is scientific evidence available to show that there is excessive bycatch in an area.

In addition, in Article 2(4), it is stated that Member States shall take necessary steps to monitor and assess, by means of scientific studies or pilot projects, the effects of pinger use over time in the fisheries and areas concerned.

Implementation of Article 2 is to be reported in the Member States' annual reports to the Commission. However, due to the lack of consistent reporting by some Member States [8], it is difficult to ascertain the level of compliance with Article 2. Based on the Regulation (EU) 812/2004 reports submitted to ICES WGBYC, the full implementation of the requirements of Article 2 appear to be low [6-9]. WGBYC has not been able to carry out a thorough review of Member States compliance with the requirements of this Article and thereby the effectiveness of pinger use with regards to bycatch of cetaceans. In 2018, WGBYC [8] summarised which Member States implemented ADDs in accordance with the Regulation. Five of the eight member states that were required to use ADDs in the relevant fisheries did report pinger use, to some degree, but levels of use and enforcement varied between Member States. EWG 19-07 suggests that any legal requirement to use pingers must be coupled with a requirement for Member States to enforce their use; there is also opportunity for the Commission to put pressure on Member States to implement and enforce pinger use based on the adequacy of the information they receive through Regulation (EU) 812/2004 reports and related advice.

The current use of pingers (with the exception of one Member State) focuses mainly on dedicated studies in cooperation with fisheries. There is currently no data to indicate the extent to which acoustic deterrents are being used by fishers beyond dedicated studies. Similarly, in cases where pingers have been reported as "implemented" by Member States', there is very little information available on the enforcement of pingers' usage. Based on the information available to national experts, fishery inspectors in Member States do not actively check for the use of pingers and/or whether they are being deployed correctly (i.e. at suitable spacing, and are fully functional).

The restrictiveness of Article 2, particularly regarding the areas and gears on which pingers are mandatory (Annex I of the Regulation) may lead to suboptimal use of pingers. In particular, the restrictions on use of pingers on vessels greater than 12 metres in length and on their use on nets less than 400 metres long. The restrictions regarding set gears and areas can lead to redundant use of pingers in areas where bycatch is low and no use of pingers in other areas where bycatch is high. The vessel size restriction alone causes the majority of the EU fishing fleet to be excluded from Regulation (EU) 812/2004 (Eurostat 2018).

Results from studies which examined the effect of pingers on harbour porpoise bycatch [8,9,11] indicate that they are an effective mitigation method for this species. However, these results are based on small scale, dedicated studies. One exception to this is Palka et al. [12], who demonstrated the successful implementation of pingers over a broad scale.

2.2.1 Unpredictability of overlaps between distribution of high risk fisheries and cetacean distribution

The overlap between fisheries and cetacean occurrence varies considerably seasonally due to the unpredictability of both cetacean distributions and fishing grounds. This can create major problems in the successful deployment of pingers in the confines of the Regulation. The SCANS survey of 1994 (and other regional surveys during the 1990s) indicated a more northerly distribution for harbour porpoise in the North Sea. The southwards shift had already occurred by 2000, and was picked up also by the SCANS 2 survey in 2005. By 2004, the distribution had already shifted south. [13,14]. This caused local concern about the overlap with set net fisheries in the Netherlands [15] and subsequently a 4-year Remote Electronic Monitoring (REM) study was established in 2013-2017.

In 2018, only six bycaught harbour porpoises were recorded in Duthc waters in 900 days by Scheidat et al. [16], illustrating the unpredictable nature of cetacean distributions and highlighting the need for regulations to be adaptive but also presenting a challenge for providing timely responses to react appropriately to temporarily high bycatch rates.

Studies such as Kindt-Larsen et al. [17] identify areas of high risk of bycatch by using a combination of REM and harbour porpoise telemetry data to predict where bycatch is likely to be high and to inform on areas where pinger use is necessary. Identifying areas of high risk of bycatch could be used in an adaptive management of bycatch of fisheries. However, the costs and effort in that study were high.

Monitoring programmes that provide evidence of the spatio-temporal nature of interactions will be important in determining the nature of response needed to mitigate these short-term "high-risk events". Without these, mitigation through CFP implementing measures could fall short of the evidence bar required and lead to a conservation risk. Having good monitoring programmes would ensure data are collected to understand the interactions and facilitate predictions of their likely occurrence in time and space, but in their absence there may be situations where "emergency measures" are required until the true nature of the problem can be established.

This is in line with the precautionary principle but would also shift the onus on fishers and fisheries managers to work to understand and resolve any issue. In the U.S. Take Reduction Plans they have employed a strategy of "*consequence closures*" to gillnet fisheries if target bycatch rates are not met, which places the burden on fishers to improve their performance in complying [18], for example through observers or REM to collect monitoring data or for the use of pingers/other mitigation.

2.2.2 Continuity, maintenance and inspections

Pingers constitute a major initial cost in fisheries; and also they require continuous maintenance, which hinders Member States making widespread use of them. Incorrect

deployment (e.g., incorrect spacing deployment) or non-functional pingers (e.g., no operational batteries) means they are not effective. This highlights the need for continual inspection and enforcement by fishers and authorities. The effort required to do this will also constitute a substantial cost for Member States.

Broader scale studies may be effective if proper enforcement is implemented. If better information on the behaviours and distributions of cetaceans were available it would inform the implementation of other specific mitigation measures, such as temporary restrictions in specific fisheries in regions with high harbour porpoise mortality and technological advancement in fishing gears.

2.3 Article 3

Article 3 relates to technical specification and condition of use of pingers (or ADDs). The implementation and technical specification of pingers presented in Article 3 and Annex II of Regulation (EU) 812/2004, respectively, were appropriate and effective when the Regulation entered into force [19,20]. The Regulation allows the use of pingers outwith the specification of Annex II under derogation. However, the evaluation and further development / implementation are not described clearly in these articles.

The "signal" characteristics of the pingers specified in Annex II of the Regulation are employed in a range of commercially available pingers and have been shown to be effective for reducing harbour porpoise bycatch. However, the signals endorsed in the Annex II are also at frequencies audible to seals.

Audiogram studies of harbour seals showed maximum hearing sensitivity between 1 and 40 kHz [21], which is assumed to approximate that of grey seals too. This may lead to a dinner bell effect (e.g., seals learn to associate the pinger sound with the fishing gear), which would guide them to an easily accessible food resource, and hence lead to increased depredation as well as possible increased bycatch of seals. In areas where there are seals, a solution could be to increase pinger frequency: between 50 kHz and 150 kHz (±2 kHz) outside the hearing range of seals, to avoid seal depredation, if they are still effective for bycatch reduction.

A number of pingers have come onto the market in recent years, including, for example, Porpoise Alert (PAL), Banana Pingers, and the Dolphin Deterrent Device (DDD and DiD) [8,9]. Such newly developed or additional technologies may not be in agreement with those presented in Annex II of the Regulation but can be used under derogation if proven effective (e.g., as obtained by the UK for use of the DDD03 pinger).

Other technical specifications such as the deployment spacing between devices (Annex II dictates that the maximum spacing between devices must be 200 m), has also been studied, and it has been shown that wider spacing between pingers is optimal (e.g., up to 455 m in Larsen et al. [22]). This will vary depending upon the strength of the specific pinger being deployed.

According to the Regulation, the effectiveness of new specifications needs to be sufficiently documented but there is no guidance on the procedure and standards required to demonstrate this. There should be a clear mechanism to update Annex II of the Regulation,

so that the Member States will be able to choose the most up-to-date and effective pinger. Currently, the specifications in Annex II have not been transferred into the new Technical Measures Regulation, which would allow more flexibility on how Member States aim to address bycatch.

2.4 Articles 4 and 5

Articles 4 and 5 under Regulation (EU) 812/2004 require Member States to '*design and implement monitoring schemes for incidental catches of cetaceans using observers on board the vessels flying their flag* [...]' under certain conditions. The overall aim of this monitoring scheme is to provide representative data of the fisheries concerned. A well-designed, robust monitoring strategy using best practice will underpin all other future mitigation efforts including appropriate use of ADDs, setting maximum bycatch limits/thresholds, as well as other potential mitigation strategies not currently listed under the Regulation.

2.4.1 Limitations to monitoring programmes under Articles 4 and 5

Regulation (EU) 812/2004 reports

All Member States are required to submit a comprehensive annual report on the implementation of Regulation (EU) 812/2004. The quality and scope of the information provided by the reports has been variable, with some Member States simply repeating the information provided in previous years [1-9]. Many Member States do not use the reporting template and summarise data at their own discretion, which makes using the information difficult. The development of the WGBYC database and formal data calls have improved data delivery from Member States.

General monitoring

The Regulation states that general monitoring schemes shall be based on a sampling strategy designed to allow the estimation of bycatch rates of those cetacean species, most frequently bycaught (per unit effort by a given fleet) to achieve a Coefficient of Variation (CV) not exceeding 0.30. If this cannot be achieved then Member States shall introduce pilot projects lasting two years. The fisheries to be monitored are set out in Annex III of the Regulation.

The interpretation of compliance varies among Member States. Given low bycatch rates for most cetacean species, in some of the areas and métiers defined in Annex III, achieving a CV <0.3 is impossible and Member States have instead carried out two-year pilot studies and, thereafter, relied on data collection through non-dedicated observers in the DCF programme. In addition, even though the Regulation also asks for scientific data on incidental catches of cetaceans for vessels with an overall length less than 15 metres in fisheries defined in Annex III of the Regulation, the majority of Member States have not reported such studies. In the case of pelagic trawlers, this could be due to such gear not being operated by small boats (<15 m) (e.g. as in Italy).

Vessel size and métiers monitored

The general monitoring obligation only requires monitoring on vessels of overall length of15 metres or over. The majority of countries only monitor these vessel sizes and gears (>15 m for set-nets and pelagic trawls). With regards to set net fisheries, most vessels are below 15 metres in length. ICES WGBYC [1-9] have stressed that increased sampling is required on those smaller vessels, which likely account for a significant proportion of bycatch. However, only a limited number of Member States have delivered data to ICES WGBYC from pilot projects required by Regulation (EU) 812/2004 on incidental catches from vessels less than 15 m. Remote Electronic Monitoring has been carried out by Denmark and Sweden [9] whilst dedicated-observers have monitored <15 m vessels in the UK.

The Regulation also sets out métiers to be monitored in different areas. Some of the defined métiers and areas listed in Annex III do not target the highest risk fisheries with regard to bycatch of cetaceans. For example, in the Baltic, monitoring is required on pelagic trawls and set net fisheries over 15 metres. However, the set net fishery in the Baltic mainly consists of boats below 15 metres, meaning that the majority of monitoring in the Baltic is carried out on pelagic trawls. The Baltic hosts a resident, small and critically endangered population of harbour porpoise for which the risk of bycatch is low in pelagic trawls but high in set nets [23]. The current monitoring requirements under Regulation (EU) 812/2004 therefore focus monitoring effort on the low-risk fishery and ignore the high-risk fishery where bycatch monitoring is most urgently required. The requirements to establish a system of surveillance of incidental capture under the Habitats Directive (Article 12) appear to have been overshadowed by other monitoring requirements (Article 11) and those in the Regulation (EU) 812/2004. There are similar issues in the Mediterranean where there is only a requirement to monitor pelagic trawls. In this region, there is a large set net fishery which consists mainly of boats below 15 metres for which no monitoring has been implemented, despite the fact that set nets are known to be a high risk for cetacean bycatch compared to the pelagic trawls required under Regulation (EU) 812/2004 [25].

Data Collection Framework versus dedicated monitoring programmes

A limited number of countries have implemented dedicated monitoring programmes for protected species whilst most countries fulfil their requirements under Regulation (EU) 812/2004 through combined monitoring within the Data Collection Framework (DCF). From the beginning of 2017, Member States are obliged to record all protected species when monitoring for the DCF. Table 1 summaries the number of observed days carried out under the DCF and the number of observed days carried out for dedicated surveys of protected species in 2017 for fishing grounds within relevant ICES areas. Dedicated observed days was defined as any monitoring that took place which was not carried out following the DCF monitoring and included surveys carried out under Regulation (EU) 812/2004 monitoring in Member States which was combined with the DCF.

In total, there were 7198.2 observed days in 2017. Observed days under the DCF exceeded dedicated observed days in all fishing grounds apart from in the Azores, with dedicated observed days representing approximately 12 % of all sampling. Despite higher effort in

DCF monitoring, this does not lead to improved recording of bycatch of cetaceans. In 2015, the ICES report [5] concluded that dedicated surveys reported substantially higher bycatch rates compared to DCF monitoring, with similar patterns recorded in 2011 and 2012 [3-5]. The lack (or low rate) of observed bycatch events in DCF is likely due to a combination of various factors including: the specific fisheries monitored, differences in data collection protocols, observer vigilance and downstream data handling procedures.

Table 1. Number of observed days carried out under the DCF and the number of observed days carried out for dedicated surveys of protected species in 2017 for fishing grounds within relevant ICES areas.

Fishing Ground	**Subarea & Divisions**	**DCF observed days**	**Dedicated observed days**
Bay of Biscay	8a,b,d,e	715	0
Azores	10b, 10a1&2	0	608
Celtic Sea	7f,g,h,	819	71
Iberian	8c, 9a	780	0
Irish Sea	7a	117	1
North Sea and Eastern Channel	4, 7d	1829	22
Skagerrak and Kattegat	3a	429	0
Western Channel	7e	419.2	123
West of Ireland	7b,c,k,j,	221	6
West Scotland	6a,6b	723	2
Eastern Arctic	1, 2	313	0
Total		**6365.2**	**833**

Fishing effort

Reliable data on fishing effort is crucial for analysing areas of high risk for bycatch, carrying out Bycatch Risk Assessments (BRA), evaluating the impact of fisheries on bycatch of cetaceans or designing monitoring strategies. Regulation (EU) 812/2004 does not specifically ask Member States to collect data on fishing effort. For Member States to fulfil the obligation to provide bycatch estimates, data on fishing effort from both large and small vessels is needed. For a majority of vessels with an overall length of 10 metres or less there is no information available on fishing effort, such as days at sea or soak time. It is therefore challenging to assess the impact of bycatch on cetaceans, along with designing where to monitor incidental catches, if area specific fishing effort data are lacking.

Earlier reviews of Regulation (EU) 812/2004 regarding monitoring

ICES WKBYC [3] noted that management objectives for all protected species were unclear at the EU level and that whilst there are broad commitments to Good Environmental Status (GES) under the MSFD and to Favourable Conservation Status (FCS) under the Habitats Directive, how these objectives are linked to Regulation (EU) 812/2004 had yet to be clarified. WKBYC proposed that the monitoring commitments of Regulation (EU) 812/2004 could be extended to improve monitoring of all protected species, i.e. to include seabird, turtle, seal, and certain elasmobranchs and protected species of fish, which Member States are also required to monitor.

The two separate reviews of Regulation (EC) 812/2004 (COM(2009) 368; COM(2011) 578) carried out by the European Commission concluded that incidental bycatch should be implemented within the Data Collection Framework. The DCF currently focuses on métiers targeting commercial species, over-representing monitoring in these métiers and using observation coverage that are sufficient to look at target species for which the probability of capture must be 1 (as opposed to cetacean bycatch species with extremely low capture probabilities) [25]. In addition to the reviews carried out in 2009, described above, a request from EU to ICES WGBYC concerned assessing whether monitoring of bycatch of cetaceans in DCF and Regulation (EU) 812/2004 provided an acceptable means to assess the impact of bycatch of cetaceans [3]. This advice concluded that monitoring under the DCF focuses on the métiers that discard the most fish, which were not necessarily the same métiers that have the largest catch of protected species. For example, bottom trawling is oversampled with respect to monitoring of protected species bycatch, while in most fishing areas, set nets, longlines, and purse seines are under-sampled. Hence, there is a need for increased monitoring in these high-risk métiers (e.g., Annex 4). Alternative methods may be used to monitor incidental catches under the DCF. Remote Electronic Monitoring (REM) seems to have the greatest potential to be developed to meet the needs of the existing DCF and in addition improve monitoring of bycatch of protected species within the DCF framework.

The observer effort required will depend on the objectives of the monitoring program, species, area and gear. Generating observer coverage values also depends upon having historical bycatch data or other reliable bycatch data e.g. stranding data. However, EWG 19-07 reviewed documents, which suggested that an initial sampling level of 5-10 % of the total, annual fleet effort is necessary in most fisheries to determine the approximate level of bycatch or detect bycatch events of rare species [26], which is in line with Regulation (EU) 812/2004.

The STECF EWGs (14-01, 16-01, and 18-13) that drafted the new sampling designs and protocols in the new DCF between 2012 and 2017 took note of the ICES advice. However, they pointed out that the list of protected species in conventions, treaties, and directives (as currently listed in table D1 of EU Reg. 1251/2016) contains more than 350 species groups. As the threats in terms of temporal and spatial distributions and vulnerability to different métiers differ for different species, it is impossible to specify general monitoring requirements other than the on-board sampling practices, including REM. The proposed

over-arching solution is for the RCGs (Regional Coordination Groups) to identify the fisheries and/or species in which (additional) sampling is required.

Developing a regional sampling plan for data collection of protected species within the DCF

Following the conclusions of the three reviews described above, the implementation of protected species bycatch monitoring in the DCF started in January 2017. To facilitate this, ICES WGBYC has worked together with ICES WGCATCH (Working Group on Commercial Catches) and RDBES (Regional DataBase and Estimation System) considering the design of sampling of commercial catches and collection of Protected, Endangered and Threatened Species (PETS). A joint workshop between ICES WGCATCH and WGBYC called WKPETSAMP (Joint WGBYC/WGCATCH Workshop on sampling of bycatch and PET species) was organised in 2018 with a view to focus on data collection protocols and survey design. During the workshop, two major difficulties to best practice for sampling design were highlighted: (1) generating suitable samples (this is constrained by factors such as unwilling skippers or owners, no legal obligation to carry observers, insufficient space for observers, health and safety issues with vessels), and; (2) a lack of funding for sufficient sampling to allow extrapolation to suitable spatial scales.

Sampling effort required to provide sufficient data for marine mammals is generally much higher than current sampling under the DCF. During WKPETSAMP, the process to adapt the RDBES to include bycatches of protected species was initiated. New data fields to be included in the RDBES were proposed at WKPETSAMP, modified intersessionally in a meeting between WGBYC members and members of SCRDBES (Steering Committee of the Regional Database and Estimation System). Thereafter, WGBYC and WGCATCH agreed on the proposed modifications to the database.

In parallel with this work, there has also been an ongoing EU Project called FishPi [25] regarding developing a regional sampling plan for data collection of protected species not currently collected within the DCF.

Since the implementation of the new EU MAP (Multi-Annual Programme) there has not been a request by the RCG's to introduce another methodology or to add monitoring effort for protected species. This is particularly important for Regional Fisheries Management Organisations (e.g., GFCM, ICCAT, IATTC, IOTC, CCSBT), Regional Sea Conventions (e.g., OSPAR, HELCOM, Barcelona Convention, Bucharest Convention, ACCOBAMS, ASCOBANS), and NGOs. RCGs have no established lines of communication with these potential end-users. There is a need for an agreed procedure in the RCG's to increase and assess the implementation of additional monitoring of protected species under the DCF.

The mandatory observer programs adopted by the various RFMOs for monitoring of bycatch (including cetacean species), which should already be included in the DCF, are currently not included even if they are mandatory for all MS concerned, according to international obligations.

The large number of protected species in need of monitoring should not be used as an excuse not to re-allocate sampling effort to relevant métiers. The assessments carried out by WKBYC [3] and FishPi [25] have shown that for almost all groups, trawl fisheries are oversampled and set nets are under sampled. In 2013, ICES Advice [3] specifically states for protected species that priority should be given to monitoring in set nets. It is therefore important to ensure that there is a dedicated monitoring observer scheme in place until monitoring of incidental catches is fully and appropriately implemented within the DCF.

2.5 Conclusions

- The prescribed pinger/ADD specifications only mitigate bycatch of harbour porpoise;
- The implementation and enforcement of pingers in Member States is low. Requirements to use pingers must be coupled with a requirement for MS to put in place enforcement. The Commission must follow-up on perceived infringements as judged through the reporting process;
- The restrictiveness of Article 2, in particular the areas, gears and regions set out in Annex I may lead to suboptimal use of pingers, with a high use in métiers with low bycatch and low use in métiers with high bycatch;
- Although it has been proven that pingers do reduce the rate of incidental bycatch, their broad scale use is affected by costs, enforcement, and the unpredictability of cetacean and fisheries overlaps;
- We need much better information in order to use pingers more effectively on a broad scale. Monitoring programmes are needed to improve the information;
- The development of new pingers/ADDs should not be constrained by a technical specification; rather Member States should be required to provide evidence that the devices they are using are actually reducing bycatch;
- The development of ADDs should be mindful of potential unwanted effects on non-target species;
- Other mitigation measures such as closed areas and gear modification may be required for species where pingers are of limited value. Member States should be required to provide evidence that these mitigation measures are effective at reducing bycatch;
- Highest risk gears for bycatch of cetaceans, seals, some marine birds, and turtles are set nets, drift nets and pelagic trawls; longlines for birds and turtles; and pot/creel lines for baleen whales;
- Adequate implementation of monitoring of incidental catches within the DCF will take some time. It is therefore important to ensure that there is an interim dedicated monitoring observer scheme in place until monitoring of incidental catches in the DCF is fully functional;

- Any advantage of moving the monitoring of all protected species to the DCF by changing the national monitoring schemes, developing a database that can take data on incidental catches and developing sampling schemes and protocols will take time. However, the focus of the DCF observer schemes is on commercial fish species with the main effort applied to trawl fisheries. It is therefore advisable to increase monitoring in métiers with a relatively high risk of protected species bycatch, e.g., set nets for cetaceans and longlines for seabirds;
- There is a need for an agreed procedure in the RCG's to assess and improve the implementation of additional monitoring of protected species under the DCF.

2.6 Remarks

- More flexibility is required to use a wider range of mitigation measures (such as closed areas and gear modifications) to mitigate bycatch for porpoise and other cetacean species, in the full range of fisheries, vessel sizes, métiers and regions where bycatch occurs. Such flexibility should also enable timely response to temporarily high bycatch rates (short term "emergency" scenarios).
- Member States should be required to provide evidence that mitigation measures are effective at reducing bycatch. A region by region plan for pinger use, as compared to other mitigation measures, is needed and should be ground-truthed with field monitoring for effectiveness; (TCM allows for this).
- There may be situations where "emergency measures" are required until the true nature of the problem can be established.
- More information is required on the effectiveness of pinger use, including optimal spacing, avoiding seal bycatch and depredation.
- Requirements to use pingers must be coupled with a requirement for MS to put in place enforcement. The Commission must follow-up on perceived infringements as judged through the reporting process.
- Well-designed, robust monitoring strategies using best practice should underpin all other future mitigation efforts; in particular, increased monitoring in high-risk métiers.
- Dedicated observer coverage in métiers with a high bycatch risk such as set nets should be calculated from previous available information on bycatch. In the absence of this information, 5-10% seems a reasonable starting point, which can be reviewed and refined as part of an adaptive approach to management. This is in line with Regulation (EU) 812/2004.

3 TOR 2: POTENTIAL SHORTCOMINGS OF REGULATION (EU) 812/2004

3.1 Background

In 2010, ICES WKREV812 [10] was held in order to address three questions from the European Commission:

a) identify areas outside the scope of the Regulation (EU) 812/2004 [24] where measures would be necessary to be applied to reduce the incidental catches of cetaceans;

b) provide an evaluation of mitigation measures currently in place and an assessment of the most recent developments of mitigation measures used to reduce the incidental catches of cetaceans, including information on cost; and

c) following the assessment made in point b), identify the most efficient mitigation measure for each species concerned under Regulation (EU) 812/2004 and according to the fishing gear in use.

Following this, a further request was received in 2013, and ICES WKBYC [3] was held to:

1. assess the extent to which current fishery monitoring schemes, including *inter alia* those conducted under the DCF and Regulation (EU) 812/2004, provide an acceptable means of assessing the nature and scale of cetacean and other protected species bycatch. Consider alternative means and other sources of data that could be used to improve our understanding of the conservation threat posed to cetaceans and protected species from bycatch in European fisheries.

2. advise on how Annex II of Regulation (EU) 812/2004 defining technical specifications and conditions of use ADDs could be best revised in light of technical and scientific progress in this field.

3. based on the methodology used and the estimates of bycatch limits (take limits) generated by region at WKREV812 and other relevant analyses, propose effective ways to define limits or threshold reference points to bycatch that could be incorporated into management targets under the reformed CFP. Limits or threshold reference points should take account of uncertainty in existing bycatch estimates, should allow current conservation goals to be met, and should enable managers to identify fisheries that require further monitoring, and those where mitigation measures are most urgently required.

The key findings of ICES WKREV812 and ICES WKBYC are still valid today. The main issues were identified as:

- ✓ fisheries focus of the Regulation and misinterpretation of the requirement to monitor
- ✓ monitoring and use of non-dedicated observers
- ✓ incomplete and/or incorrect gear specifications
- ✓ overly prescriptive mitigation measures

EWG 19-07 have used these reports as a basis for identifying the shortcomings of Regulation (EU) 812/2004 and have updated the issues where new evidence and information has subsequently become available.

3.2 Fisheries focus of the Regulation

The Regulation is focused on pelagic trawl and static net fisheries, although the requirement to monitor these varies by regional sea area. WKREV812 noted that very little is known about gillnet fishing effort or cetacean bycatch in the Mediterranean, but there is a clear potential threat to bottlenose dolphins given the scale of static net fisheries. Regulation (EU) 812/2004 makes no mention of these fisheries, which has led to a lack of monitoring. Similarly, the Regulation does not include a requirement for Black Sea Member States to report incidents of bycatch, despite very high bycatch rates of cetaceans having been reported from this area in bottom-set gillnets and entangling net fisheries (see Annex 2 and Annex 4 for details). Considering the coastal small-scale nature of the fisheries, EWG 19-07 suggests that monitoring schemes be considered for bottom-set gillnet or entangling nets deployed from vessels with an overall length under 12 m.

In Greece, the incidental bycatch of Protected Endangered and Threatened (PET) species was recorded by on-board/on-shore observers in eight different métiers (i.e., FPO, GNS, GTR, LLD, LLS, OTB, PS, SB) of the Greek fishing fleet. It is worth noting that in Greece a long-term data series has been developed concerning cetacean and marine turtle strandings. In Greek waters, during the period 2016-March 2019 the following stranded cetaceans have been reported from the Port Authorities: 9 ind. of *Z. cavirostris*, 178 ind. of *S. coeruleoalba*, 24 ind. of *D. delphis*, 125 ind. *T. truncatus*, 5 ind. *P. macrocephalus*, 3 ind. *P. phocaena* and an additional 80 unidentified delphinids. Despite no bycatch of mammals being reported in the Greek Data Collection Programme in 2018 in all three Greek GSAs (see Annex 4 for details), there is evidence that bycatch of cetaceans exists with cause of death of 10-20 % of the stranded mammals in the period 2016-2019 attributed to bycatch. It is worth noting that an additional high proportion of the remaining total stranded mammals was attributed in some way to fishery activities (e.g. injuries by fishing gears).

As a result, there is a lack of monitoring of fisheries causing potential bycatch of cetacean species, particularly in the Mediterranean Sea, the Black Sea and the European Macaronesia. The scarce availability of data does not allow for a reliable risk assessment of the various gear types concerned, therefore preventing any potential mitigation action in these Regional Seas. This is particularly true when considering the high number of vessels (most less than 12 m length) using entangling nets or gillnets of various types in those regions, which are currently excluded by the Regulation.

With the notable exception of bass, hake and tuna pair trawl fisheries, monitoring to date has indicated that pelagic trawl fisheries generally present little or limited threat to cetacean populations. A large number of fishing trips and days at sea have been monitored under Regulation (EU) 812/2004 without any cetacean bycatch having been observed. In contrast, monitoring of the bass, hake and tuna pair trawl fisheries have recorded relatively high rates of cetacean bycatch so there is a clear case for mitigation measures to be adopted in

these fisheries. This presents a clear case to refocus monitoring activity to those fisheries in which cetacean bycatch could be an issue.

However, for tuna and tuna-like fisheries, Regulation (EU) 812/2004 takes no account of the monitoring requirements of other regulations (e.g. ICCAT), which also impose a certain level of observer coverage of the vessels concerned by their fisheries. No observer reports from those fisheries were made available for EWG 19-07 and, therefore, this implies that it would be more difficult to assess the level of bycatch for the individual cetacean species without taking into account all fisheries where this problem does or potentially exists.

WKREV812 concluded that Regulation (EU) 812/2004 focused on the vessels with limited impact on cetaceans in some areas. The Regulation requires certain fleets of set netters and pelagic trawlers to be monitored to obtain bycatch estimates with a specified level of precision.

The EWG 19-07 support the ICES recommendation that the monitoring requirements are poorly specified in Regulation (EU) 812/2004. This is a clear shortcoming of the Regulation. Going forward, much greater clarity on the monitoring requirements will be needed if Member States are expected to change current approaches. This would also have the added benefit of further supporting Member States to meet monitoring requirements under the Habitats Directive, Marine Strategy Framework Directive, Regional Fishery Management Organisations (e.g., ICCAT, IOTC, IATTC, CCSBT) and international agreements such as OSPAR, ACCOBAMS, and ASCOBANS.

The EWG 19-07 suggests a systematic risk assessment for cetacean bycatch based on available data, covering all regional seas at an appropriate spatial resolution (GSA regions for Mediterranean and Black Sea, ICES subdivisions for Baltic, ICES divisions), all fleet segments and also include all vessel size ranges. The outputs of the risk assessment should be used to target resources towards fisheries and areas where bycatch poses the highest risk to cetacean populations. Such approaches have already been developed.

A more pragmatic and precautionary approach would be to prescribe monitoring requirements in term of risk which, potentially, could be linked to some predefined reference limit or threshold (see Tor 3, Section 4). For example, Parties to ASCOBANS (all of which are EU Member States) have committed to: reduce bycatch to less than 1 % of the best available abundance estimate; to minimise bycatch (i.e. to ultimately reduce to zero); and to address the challenges for monitoring cetacean bycatch as a consequence of working under the EU DC-MAP. These include an appropriate sampling design (e.g. taking account of areas, métiers, number of vessels to be sampled, amount of sampling days/hauls), and ensuring that trained and dedicated observers are deployed in sufficient numbers and adequately engaged in monitoring cetaceans, drawing upon knowledge of high-risk areas and fisheries, noting that additional dedicated monitoring may be required.

3.3 Bycatch monitoring and collation of fisheries effort

In addition to the monitoring issues identified above, monitoring of fisheries is problematic for many Member States because on-board observer monitoring can be very expensive, and/or it is difficult to place observers on smaller vessels. Monitoring of small vessels using

remote electronic monitoring (REM) techniques can provide an alternative to the use of on-board observers. As an example, a Danish study demonstrated that the use of REM was a good approach to collect data on fishing behaviour and catch composition and that with relatively low cost, a high sampling intensity can be achieved [28,29].

WKREV812 also identified the unreliable or unavailable nature of European fishing effort data. Efforts have been made to standardise the collection of effort data but the data submitted are often too difficult to compare and collate for assessment purposes. However, whilst there are common standards of recording fishing effort across Member States and in central databases (e.g. the ICES Regional Database [RDB]) these do not have a unit of effort that is compatible with the bycatch monitoring data. The latter currently uses "days at sea" but this is not submitted routinely in the fishing effort data by all Member States, as it is not a mandatory requirement of data submission to the ICES RDB.

Fishing effort for small vessels (<12 m) is particularly challenging to obtain accurate estimates of and Member States have different ways of generating the effort data which creates challenges in using it collectively. ICES WGCATCH [30] is trying to progress a methodology to estimate small-scale fisheries effort data. Gear definitions used by Member States will also need to be addressed and the ICES RDB will need to be adapted to store cetacean-related metrics, such as data on cetaceans falling out of the net as it is hauled. Monitoring of gillnets has shown that a considerable portion of bycaught porpoises fall out of the net and do not come on board for (further) sampling (31).

3.4 Gear specifications

There has been some confusion regarding the gears that are covered by the Regulation due to the ambiguous descriptions used. WKREV812 identified the term static nets (i.e. gillnets, entangling nets, trammel nets and driftnets) were often grouped erroneously under the general terms gillnets or set-nets. Currently, the Regulation merely specifies "bottom-set gillnets"; "entangling nets" or "driftnets" which has been interpreted by some Member States to exclude trammel nets or midwater fixed nets. In some areas, combination gillnet/trammel nets and hybrid driftnets, classified as fixed/semi-driftnets or long surface gillnets, have similarly been deemed by certain Member States to be outside the Regulation. Since WKREV812, these issues have continued for some Member States, having been discussed as recently as the ASCOBANS Advisory Committee in 2018 [32]. In order to avoid gears that are likely to have an impact on cetaceans falling outside that the scope of the CFP implementing Regulations, clear definitions encompassing all static nets and pelagic or semi-pelagic trawl types are required. This could be overcome through inclusion of a reference to the FAO Gear Classification (see for details Annex 1).

3.5 Mitigation measures - pingers

Acoustic deterrent devices (ADDs or pingers) provide the most simple and effective solution for a reduction of harbour porpoise bycatch in set-net fisheries [33-35]. There is less conclusive evidence of their effectiveness for preventing common dolphin bycatch in gillnets. For bottlenose dolphin, the majority of studies carried out have been in relation to the reduction of depredation and damage to fishing nets as opposed to bycatch mitigation or deterrent effect of ADDs.

EWG 19-07 identified a problem in Regulation (EU) 812/2004. Art. 2, par. §1 reads: *"it shall be prohibited for vessels of 12 m or over in overall length to use the fishing gear defined in Annex I in the areas, for the periods, and as from the dates indicated therein without the simultaneous use of active acoustic deterrent devices"*. However, Art. 4, par. §1, 2 and 6, specify that the observer scheme is mandatory for vessels over 15 m in overall length. The Regulation states that "Member States shall take necessary steps to monitor and assess, by means of scientific studies or pilot projects, the effects of pinger use over time in the fisheries and areas concerned". And is thus putting vessels between 12 and 15 m in a different category.

The two different overall lengths generate a mismatch concerning the statistical assessment of the data, because those vessels between 12 and 15 m might not be incorporated into any monitoring scheme. This shortcoming should be considered in the revision of the Regulation.

Only a relatively small proportion of the European fleet comprises vessels of overall length of 12 metres or above, and therefore a very small proportion of all set gillnets are equipped with pingers in accordance with the Regulation. Furthermore, data from the UK monitoring scheme indicate that bycatch can be a significant issue in gillnets deployed form vessels less than 12m in length. For example, harbour porpoise bycatch was estimated under two scenarios for the UK fleet, first on the assumption that no vessels were using pingers in 2017 (the baseline scenario) by using only observations made on nets without pingers, and secondly, assuming all vessels over 12 m in length were using pingers (regardless of mesh size or net length; the 'best case' scenario). If no pingers were used, the bycatch estimate was approximately 1300 individuals, whereas with full deployment of pingers this estimate is reduced to 1100 individuals; i.e. the use of pingers as outlined on the Regulation only saves 200 animals [36]. EWG 19-07 suggests that the use of pingers as a mitigation measure should be extended to include all relevant vessels in high-risk fisheries.

Article 2(2) of Regulation (EU) 812/2004 requires that the masters of the Community fishing vessels shall ensure that the acoustic deterrent devices are fully operational when setting the gear. WKBYC [3] concluded that pingers should ideally have a means of showing whether they are functioning correctly, showing not just the battery level, but also whether the transducers are functioning.

This would make it easier for the fishers to determine if their pingers are functioning and will also make it easier to monitor compliance. Some Member States do have active enforcement through national fisheries patrol vessels that conduct at-sea inspections or operate with "pinger detection units". However, the specification for functioning pingers only at the point the gear is set, makes it impossible to prove an infringement if pingers are not heard on deployed gear or not functioning/absent on hauling. This is a clear shortcoming of the Regulation.

Annex I of Regulation (EU) 812/2004 outlines the fisheries in which the use of acoustic deterrent devices are mandatory. For ICES subarea 4 and Division 3a, pingers are not required for gillnets >400 m in length or on gillnets deployed in these locations from 1 November through to 31 July. The need for fishers to deploy pingers is therefore easily circumvented by extending the total length of the nets (e.g. by linking two or more

together). There is also no evidence to support the need for a seasonal requirement of pingers. Harbour porpoise are present in these areas year-round. In the Baltic Sea, the area listed as requiring pingers completely misses the summer distribution range of the critically endangered Baltic Sea harbour porpoise population. EWG 19-07 suggests the requirement to use pingers should not be constrained by net length or season or specific areas but should instead be based on risk.

Annex II of Regulation (EU) 812/2004 specifies in some detail what the characteristics of pingers should be, which means that any new design has difficulty in gaining legal recognition. Although the Regulation stresses that the development of new devices should not be hindered by Annex II and allows a two-year derogation for the testing of new devices, WKREV812 noted that two years was not a very long time to demonstrate the effectiveness of a new device in a seasonal fishery.

WKBYC noted that Annex II was too prescriptive regarding how signals were synthesized which would constrain future designs and that the source level was not adequately specified.

In addition, WKREV812 and WKBYC noted that the pinger spacing outlined in the Regulation had been suggested in order to minimise the possibility of bycatch through pinger failure. A number of studies have subsequently shown that the maximum effective spacing of ADDs on gillnets in terms of cetacean bycatch reduction is greater [37]. This has advantages in that fewer ADDs are required, reducing pollution from lost or damaged pingers, noise pollution and associated potential porpoise habitat exclusion, lower cost and less handling for fishers. WKBYC also noted that the effect of pingers may vary between areas, for example due to differences in background noise, salinity, temperature, traffic, bottom type, depth and predators. This needs to be taken into consideration when spacing pingers.

Many of the commercial pinger types available that meet the specification of Annex II in Regulation (EU) 812/2004 tend to run on rechargeable lithium batteries. Whilst the batteries are entirely enclosed in the waterproof housing of the pinger, over the lifetime of the pinger, there is the potential for leaks due to repeated exposure to seawater and the arduous conditions in which the pingers are used. Seawater seepage into the battery pack will lead to battery failure, including electrolyte leakage, which poses a threat of fire [39]. Alternatives using alkaline batteries are available (e.g banana pinger) and could offer a safer alternative. Additionally, ensuring pingers are robust to deployment in water depths of at least 500m reduces the chances of pinger failure and ensures they remain operational.

3.5.1 Habitat exclusion effects of pingers

Whilst pingers have been proven to have a deterrent or bycatch reducing effect on harbour porpoise and this has obvious benefits in terms of reduction in mortality and conservation of the species, concerns have been raised over collateral effects such as habitat exclusion, particularly in areas where there is a population which has a restricted distribution with individuals having spatially limited home ranges (e.g. in the inner Danish Belt).

Pingers can affect porpoise distribution patterns and it is believed that this could lead to habitat exclusion [40,41], and some level of habitat exclusion is inevitable when using pingers since their function is to keep the porpoises away from the net.

However, assessing the exact exclusion zone is difficult as it depends on factors such as pinger type, background noise level, seabed type, and level of habituation over time. A different way of approaching the issue is through modelling of the effects of habitat exclusion at the population level by use of a spatially explicit individual-based simulation model (IBM). For example, van Beest et al. [42] demonstrated that frequent and recurrent noise avoidance behaviour in high-quality foraging habitat negatively affected individual harbour porpoise survival and the total population size. These kinds of model predictions will depend on the pinger type and specific effects of the pinger used. The question of habitat exclusion remains a concern if pingers are used in areas of preferred porpoise habitat [33]. Therefore, there are valid concerns around the wide-scale deployment of pingers in all gillnet fisheries. The widespread use of pingers in such areas may not be suitable in coastal areas, as this may restrict the movements and distribution of harbour porpoise [43,44].

3.5.2 Risk-based approach to deploy pingers

EWG 19-07 suggest a more focused risk-based approach to the deployment of pingers where required, i.e. in métiers with known high bycatch rates or fisheries with a perceived high risk of bycatch. Concurrent monitoring will also be required to confirm the effectiveness of the mitigation and/or the "high risk" status of the fishery while at the same time developing or improving monitoring schemes in areas where there is evidence of a potentially dangerous level of bycatch in order to identify subregions or métiers where pingers may be most effectively deployed.

3.6 Other mitigation options

Other mitigation options include passive acoustic devices, exclusion devices (e.g. Turtle Exclusion Devices) and other gear modifications, operational and time/area closures and alternative gears. Although there has been some research and commercial studies implementing some of these, with the use of pingers specified in certain fisheries and areas, relatively little progress has been made. The USA has brought about large reductions in cetacean bycatch through the use of Bycatch Reduction Plans which incorporate a combination of pinger use, time/area closures and other restrictions.

3.6.1 Take Reduction Plan (TRP)

Where excessive bycatch in a fishery or a 'stock' of cetaceans is identified in the USA, a Bycatch Reduction Plan (BRP) will be implemented to meet the requirements of the U.S. Marine Mammal Protection Act. These plans outline a suite of approaches and potential measures, such as the use of more selective gears, area closures, real-time closures, avoidance measures and move-on rules that could be implemented to reduce bycatch. If such a BRP is to be successful, it is vital that the group devising the plan should be inclusive and should involve stakeholders, particularly fishers or their representatives.

In the U.S., the bycatch reduction plan is developed by a stakeholder "Take Reduction Team (TRT)"; the TRT work through a process of negotiated rulemaking, assisted by a federally

appointed mediator to develop a plan that will reduce bycatch below defined thresholds within six months of its implementation.

In EU waters, the group devising the BRP could operate on a national level, but it might be more suitable for these groups to be international. They could, for instance, meet within the context of the Regional Advisory Groups. Clearly, where more than one country is involved, multi-lateral BRP should be agreed between all relevant countries. Such plans will also need to take into account the commitments made by Member States through ASCOBANS, ACCOBAMS and similar agreements to reduce bycatch.

The basics of any planning should apply to bycatch reduction plans, and these should be detailed enough to define objectives, targets, who should do what and by when, how success will be measured and review arrangements to determine if the plan requires revision. Any necessary training arrangements, such as in the use of pingers, should be built into the BRP. Incentives to ensure effective implementation of the plan should be considered.

After the BRP has been implemented, it is essential that surveillance be continued. It is suggested that monitoring be at such a level as to ensure that the predicted reduction in bycatch can be confirmed over an extended time period.

It is suggested that such a programme be incorporated into any BRP, along with the justification for continued monitoring. Monitoring results can further be used to determine any necessary adjustment of the BRP.

The enforcement of bycatch mitigation measures will differ depending on the strategy used. In relation to time/area closures, the current satellite-based system for monitoring large fishing vessels may be sufficient, but may require adaptation for smaller inshore boats. These might be monitored from land or by existing mechanisms to monitor other inshore fishery closures. Clearly, all regulations for bycatch reduction, particularly pinger implementation, needs to be carefully thought through, and regulations are likely to have greatest success if they are adopted or accepted by the fishers being regulated.

See sections *§4.3 (Potential management frameworks)* and *§4.5 (Roadmap)* for more discussion and options on potential management frameworks.

3.6.2 Effort reductions

In general, a reduction in fishing effort should lead to a reduction in bycatch. The simplest way to address this is to consider restricting fishing effort within certain times or certain areas with a high bycatch rate. EWG 19-07 noted, however, that where effort reductions were being implemented across several gear types for other management objectives (e.g., Mediterranean Management Plan for demersal resources), reductions of effort in those gears with the highest bycatch rates would achieve a proportionally greater reduction in bycatch than would be achieved by equal reductions across all gear types.

3.6.3 Time and area closures

For area and time closures to be effective, they must be directed towards areas or times of relatively high bycatch, and they should be framed within some management target for

bycatch reduction. EWG 19-07 noted that if an area is closed to a particular gear type, either permanently or seasonally, fishers may either switch to a different and permitted gear type or they may move away from the area and continue fishing with the same gear elsewhere. The economic and environmental effects of either of these consequences need to be considered in any management strategy.

EWG 19-07 also stressed the need to continue monitoring any closed area or season in order to assess the effects and ensure that management goals are achieved. If an area with high bycatch rate is identified, managers must be confident that this is not a transient or a random effect, and that fishery closure in that area will have long-term benefits. Continued monitoring is therefore required after the closure is implemented to ensure its efficacy.

3.6.4 Bycatch Reduction Devices (BRD)

Mortality of protected species, such as cetaceans and sea turtles, due to trawling is mainly caused by forced apnoea (asphyxia) and drowning during towing activity [45]. Excluder devices were proposed in the early 1980s to reduce turtle and/or cetacean submergence and mortality. Grid-like devices can divert large objects (including turtles and cetaceans) towards an exit positioned before the codend [46].

Some authors report that the currently available devices are probably not a realistic solution for reducing protected species bycatch because they are designed for the shrimp trawl fishery and would exclude larger commercial fish [47].

However, other studies [45,48,49] found promising results in excluding both sea turtles and cetaceans, as well as unwanted incidental catches such as jellyfish, sharks, and rays. Although there are currently no proven means of minimising bycatch in both pelagic and demersal trawl fisheries other than effort reduction, the EWG 19-07 agreed that the development of mitigation methods should be encouraged and developed as a more appropriate course of action than closure of seasons / areas. It was noted that an understanding of animal behaviour is of critical importance in development of any such methods. Different approaches to gear modification may have to be considered depending on the fishery concerned, the target species, and the behaviour of both the target and the bycaught species.

3.7 Conclusions

EWG 19-07 built on the work of WKREV812 in 2010 and WKBYC in 2013, where a series of shortcomings have been identified in the implementation of Regulation (EU) 812/2004.

There is a total lack of monitoring of all gears, particularly in the Black Sea and in European Macaronesia, and a partial lack in the Mediterranean Sea for gillnets. This lack or scarce availability of data does not allow for a reliable risk assessment of the various gear types concerned, therefore preventing any potential mitigation action in these Regional Seas. This is particularly true when considering the high number of vessels (most less than 12 m length) using entangling nets or gillnets of various types in those regions, which are currently excluded by the Regulation.

Implementing PETS bycatch monitoring is not just a matter of adjusting DCF protocols to include cetaceans and other protected species in their lists, but should include some degree of reallocation and an overall increase of sampling effort to cetacean-bycatch relevant fisheries. For example, monitoring of gillnets has shown that a considerable portion of bycaught porpoises may fall out of the net and go undetected. In 2018, WKPETSAMP reviewed existing sampling programmes that provide data on PETS bycatch at national level. These include both DCF at-sea catch sampling programmes and studies that target primarily PETS bycatch. In 2018, WGBYC utilised the FishPi approach to provide a general assessment of the risk for a species group to get bycaught in a specific gear type (métier level 4, done by expert judgement).

A clear understanding of bycatch in commercial fisheries is required to implement Ecosystem Based Management of Fisheries and will also provide better coherence and support for Member States in meeting their obligations through, for example, the Marine Strategy Framework Directive, the Habitats Directive and Birds Directive.

The current prescribed approach defines the gears, vessels and areas in which monitoring and mitigation is required, limiting its utility and flexibility to react to shifts in the distribution of both fisheries and protected species, such as cetaceans.

There are valid concerns around the wide-scale deployment of pingers in all gillnet fisheries (also see ToR1). These include spacing, life of the pinger, and displacement from important habitats.

In addition to pingers, there is a need to consider other mitigation measures, which could, for example, include effort reductions, time/area closures, bycatch reduction devices and use of alternative gears. The environmental effects of these will need to be considered in any management strategy.

3.8 Remarks

- In a future Regulation, the coverage of monitored effort should be extended to incorporate all fleet segments, all vessels regardless of size and all protected species (i.e. to include seabird, turtle, seal, and certain elasmobranchs and protected species of fish) in all EU waters (to include the Mediterranean Sea, Black Sea and European Macaronesia).
- There should be a reallocation and an increase of sampling effort to cetacean-bycatch relevant fisheries, at a level that would allow calculation of the distribution and rate of expected incidental bycatch. The outputs of these risk assessments for cetacean bycatch undertaken by WKBYC, WKPETSAMP and FishPi should be taken note of and acted upon.
- A systematic risk-based approach is proposed to enable greater flexibility for Member States to react to shifts in the distribution of both fisheries and protected species, such as cetaceans.

- A more focused risk based approach is required, that would deploy pingers where required (to include all relevant vessels), i.e. in métiers with known high bycatch rates or fisheries with a perceived high risk of bycatch.
- Concurrent monitoring will confirm the effectiveness of the mitigation and/or the "high risk" status of the fishery while at the same time developing or improving monitoring schemes in areas where there is evidence of a level of bycatch that is above thresholds set (see ToR3) in order to identify subregions or métiers where pingers may be most effectively deployed.
- A management strategy is needed to consider mitigation measures other than pingers, including effort reductions, time/area closures, bycatch reduction devices and use of alternative gears.
- In high risk areas and fisheries, where these can be identified, the introduction of an approach similar to the USA's Bycatch Reduction Plans is suggested. These plans outline a suite of approaches and potential measures, such as the use of more selective gears, area closures, real-time closures, avoidance measures and move-on rules, that could be implemented to reduce bycatch. Importantly, the plan is developed with all relevant stakeholders. In the EU, such plans could be developed within the context of the Regional Advisory Groups.

4 TOR 3: SUMMARY OF CANDIDATE MAXIMUM CETACEANS BYCATCH THRESHOLDS

4.1 Background

To set thresholds for cetacean populations, clear conservation objectives and targets are required (Sections *§4.1.1* and *§4.1.2*). These may need to be quantifiable as they define the parametres needed in some approaches to setting thresholds (see Section *§4.2*). In this latter section, EWG 19-07 provides a summary of methods to estimate *"maximum bycatch thresholds"* for the species most typically caught as bycatch, while information on existing data and gaps to implement such methods is given in Section *§4.3*). Some existing examples of estimated thresholds for particular species in some regions are provided in the paragraph *§Examples of estimated maximum bycatch thresholds* (Table 5).

The EWG 19-07 is unable to provide candidate maximum bycatch thresholds for all species and populations most typically bycaught in European waters by the European fleet (e.g., harbour porpoise, common, striped and bottlenose dolphin). However, the EWG reiterates the ICES Advice [50] that the European Commission establish a process involving both scientists and managers to derive these thresholds, based first on agreement of conservation objectives (Section *§4.6*). In this regard, the EWG 19-07 briefly reviews the potential framework in which different threshold-setting approaches could be used (Section *§4.5*) and highlights, via a roadmap (Section *§4.5*), which is most appropriate depending on data availability. This is supported by a summary of existing data and we identify a number of data gaps on cetacean bycatch rates and population abundance estimates that are needed to support the process of setting maximum thresholds (Section *§4.4*). The data gaps could be lessened with the implementation of a representative cetacean bycatch monitoring programme (see ToR 1 and 2, Sections *§2 and §3,* respectively).

4.1.1 Conservation objectives within European fisheries and environmental legislation of relevance to setting maximum thresholds for cetacean bycatch

Any existing tool for estimating "*maximum bycatch thresholds*" requires the definition and quantification of conservation or management objectives. These objectives will influence the final output of a threshold-setting process in a quantitative manner and, therefore, need to be fully defined at the outset.

A Conservation Objective (CO) sets the overall conservation goal of a legal/policy instrument from which management objectives can be defined to ensure the objective is reached. The management objective should be a measurable standard that you are trying to achieve and may set a target, which sets out the result that management measures are aiming to achieve.

The Marine Strategy Framework Directive (MSFD) defines '*environmental target*' as a qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters in respect of each marine region or subregion. The term *target* is often used interchangeably with *threshold.* However, *a* threshold (or *limit*) can be defined to indicate a 'critical' or 'unacceptable' value in the environment that should not be exceeded [51]. The relationship between the types of objective and threshold is shown in Figure 1. Thresholds can be useful for prioritising

introduction or acceleration of measures and are often numerical in nature. Thresholds may be set using a variety of approaches (Section *§4.2*) but they are not themselves essential to management.

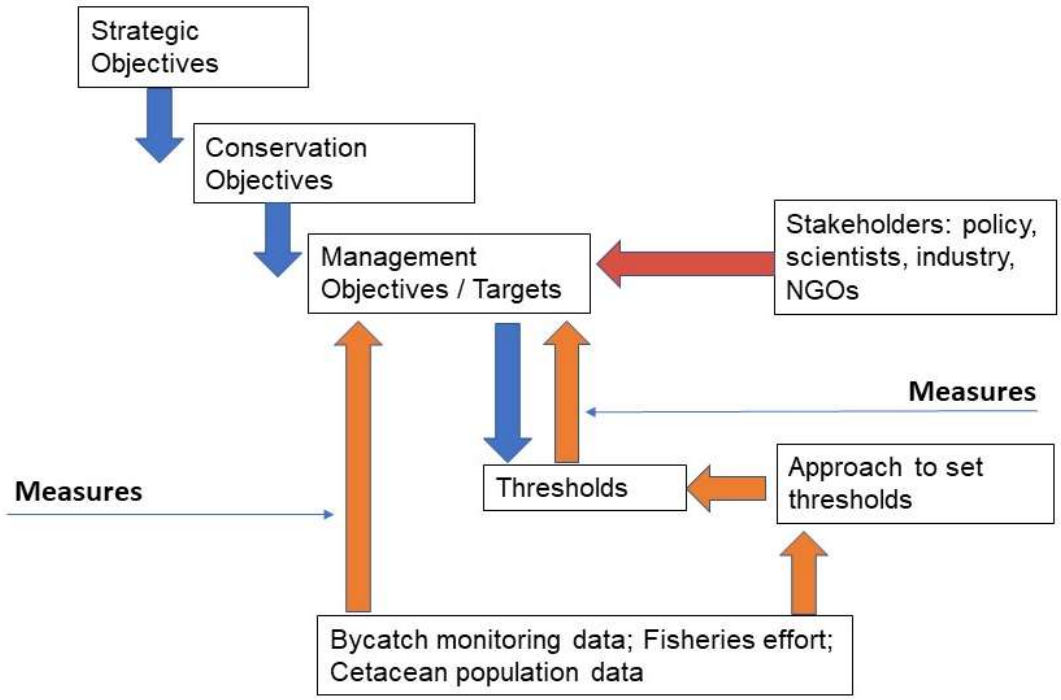

Figure 1. Schematic of the relationship between objectives and thresholds for cetacean bycatch.

4.1.2 Existing conservation objectives, targets and thresholds

Several European and international instruments designed for the purposes of marine nature conservation state aims and overarching conservation objectives; these are summarised in Table 2. Management objectives or targets are often absent or less well defined, which may present obstacles to designing the implementation of mitigation measures to pressures which risk achievement of conservation objectives. Management objectives need to be unambiguous, measurable and defined through a process informed ideally by all stakeholders but will ultimately be driven by policy/decision makers.

The proposal for a Technical Measures Regulation (COM (2016) 134[2]) sets out a conservation objective around minimising impacts of fishing activities on sensitive species to comply with the objectives of the Habitats Directive (HD) and Marine Strategy Framework Directive (MSFD). Both HD and MSFD have different conservation objectives but they are

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2016:134:FIN

broadly aimed at achieving and maintaining healthy status of species (and habitats) and promoting biodiversity.

However, the management objectives relevant to bycatch which underpin how the conservation objectives will be achieved are different; one (HD) requiring that measures be put in place to ensure that bycatch has "*no significant impact*" and the other to "*ensure long-term viability*" of the populations concerned.

Neither of these management objectives are operational without further definition of key terms/concepts embedded within them e.g. "*significant impact*" or "*long-term*".

However, the Technical Measures Regulation includes a management objective for bycatch of "*minimising and where possible eliminate*", which aligns with that of ASCOBANS[3]. In particular, Paragraph 17 (preamble) of the Technical Measures Regulation and then Article 3(2b) (Objectives) explicitly state that "*incidental catches* [...] *are minimised and where possible eliminated*". Management/conservation objectives in Directives and Regulations need to be reconciled to clarify and quantify operative objectives that are used to assess both the bycatch impact on species and populations, and the success of implemented mitigation measures. If this clarification does not take place, the existing confusion ultimately hinders the application of any approach.

Currently, only ASCOBANS sets out conservation and management objectives, from which thresholds for bycatch have been prescribed, at an ASCOBANS/IWC workshop [52]. See Section *§4.2.1* for full details. With regards to bycatch, ASCOBANS set an intermediate precautionary objective (threshold) to reduce bycatches to less than 1 % of the best available population estimate. The thresholds defined within ASCOBANS have been widely applied to risk assessments of bycatch [5,6,8]. It is an operational limit for harbour porpoise requiring only information on population size and an estimate of total bycatch; however, the limit was specifically developed for harbour porpoise and the efficacy of the limit should be reviewed (based on new data on population demographics) and, if to be used, developed for other species which are bycaught.

The MSFD Commission Decision 2017 (EU) 2017/848[4]) defines characteristics of thresholds, and the key points for consideration here are that they must be:

1. consistent with Union legislations;
2. set at appropriate geographic scales of assessment to reflect the different biotic and abiotic characteristics of the regions, subregions and subdivisions;
3. set on the basis of the precautionary principle, reflecting the potential risks to the marine environment;
4. make use of the best available science;

[3] https://www.ascobans.org/

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D0848&from=EN

5. based on long time-series data, where available, to help determine the most appropriate value.

Table 2. Summary of objectives given in European and international instruments with relevance to cetacean conservation.

Legislation / Convention	Aim / Strategic Objective	Conservation Objective	Management objective (target) of relevance to bycatch	Threshold	Approach to set threshold
Environmental					
Council Directive 92/43/EEC Habitats Directive	To contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies.	Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest.	Ensure that incidental capture and killing does not have a significant negative impact on the species concerned.	None	None
Directive 2008/56/EC Marine Strategy Framework Directive[5]	Establishes a thematic strategy for the protection and conservation of the marine environment with the overall aim of promoting sustainable use of the seas and conserving marine ecosystems.	Achieve or maintain good environmental status in the marine environment by the year 2020 at the latest	The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long-term viability is ensured[6]	None	None

[5]file:///T:/Programme%20074%20Marine%20Species%20Advice/0241%20Marine%20species%20advice/Committees_WorkingGroups_Meetings/MSFD/MSFD_CELEX_32008L0056_EN_TXT.pdf

[6]file:///T:/Programme%20074%20Marine%20Species%20Advice/0241%20Marine%20species%20advice/Committees_WorkingGroups_Meetings/MSFD/CommissionDecisions_EU2017_848.pdf

Legislation / Convention	Aim / Strategic Objective	Conservation Objective	Management objective (target) of relevance to bycatch	Threshold	Approach to set threshold
OSPAR North-East Atlantic Environment Strategy (2010-2020) (Biological diversity and Ecosystems)[7]	Halt and prevent by 202 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems and to restore, where practicable, marine areas which have been adversely affected	AIm to ensure that the effects of human activities and pressures on the marine environment, individually or cumulatively, do not adversely affect species, habitats and ecosystems, in particular those on the OSPAR List of Threatened and/or Declining Species and Habitats	None	None	None
ASCOBANS[8]	Parties undertake to cooperate closely in order to achieve and maintain a favourable conservation status for small cetaceans	To restore and/or maintain stocks/populations to 80% or more of the carrying capacity in the long-term ('infinite' time).	Minimise and ultimately reduce to zero total anthropogenic removals within an unspecified time frame. Intermediate target levels should be set.	Short term: 1.7 % N Medium term: 1% N	Modified PBR

[7]https://www.ospar.org/site/assets/files/1200/ospar_strategy.pdf#page=7

[8] https://www.ascobans.org/fr/species/threats/bycatch

Legislation / Convention	Aim / Strategic Objective	Conservation Objective	Management objective (target) of relevance to bycatch	Threshold	Approach to set threshold
International Whaling Commission	Conservation of whales and management of whaling	To restore and/or maintain stocks/populations to 72% or more of the carrying capacity in 100 years			CLA
Fisheries					
Regulation (EU) No 1380/2013 Common Fisheries Policy (CFP)	Conservation and sustainable exploitation of fisheries resources	1. The CFP shall ensure that fishing and aquaculture activities are environmentally sustainable in the long-term [..] 2. apply the precautionary approach to fisheries management and shall aim to ensure that exploitation of living marine biological resources restores and maintains populations of harvested species above levels which can produce the maximum sustainable yield [...].	3. shall implement the ecosystem-based approach to fisheries management so as to ensure that negative impacts of fishing activities on the marine ecosystem are minimised [...]	None	None
Proposal on the Regulation of the European Parliament and of the Council on the conservation of fishery resources and the protection	Contribute to achieving the CFP objectives to fish at maximum sustainable yield levels, reduce unwanted catches and eliminate discards and to contribute to the achievement of good environmental status (GES)	Technical measures should [also] minimise impacts of fishing gears on sensitive species and habitats [..] contribute to having in place management measures for the purposes of complying with obligations under Council Directive 92/43/EEC [Habitats Directive) [..]	To afford strict protection for sensitive marine species such as marine mammals [...] provided for in Directives 92/43/EEC [..] Member states	None	None

Legislation / Convention	Aim / Strategic Objective	Conservation Objective	Management objective (target) of relevance to bycatch	Threshold	Approach to set threshold
of marine ecosystems through technical measures[9] (COM (2016) 134)	as set out in Directive 2008/56/EC of the European Parliament and of the Council4	and Directive 2008/56/EC (MSFD) Technical measures shall aim to ensure that: [...] (b) incidental catches of marine mammals, marine reptiles, seabirds and other non-commercially exploited species do not exceed levels provided for in Union legislation and international agreements that are binding on the Union	should put in place mitigation measures to minimise and where possible eliminate the catches of those species from fishing gears		

Key: **PBR**=Potential Biological Removal; **CLA** = Catch Limit Algorithm; **N**=abundance estimate.

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

4.2 Procedures to estimate maximum bycatch thresholds for bycaught cetacean species

For any given cetacean population, at some point its growth rate will plateau or level off. This population size, which is determined by the maximum population size that a particular environment can sustain, is called the 'carrying capacity', or K. It is important to reiterate here that, beside the concept of carrying capacity, any procedure estimating maximum bycatch thresholds for bycaught cetacean species must incorporate a quantification of the concept of a timeframe over which a certain objective needs to be achieved.

4.2.1 Rule of Thumb

Among the possible ways to set limits to anthropogenic mortality of cetaceans there are fixed percentages that were obtained through simple modelling exercises or chosen as simple "rule of thumb". For example, the precautionary objective of ASCOBANS [53] was stated as "to reduce bycatches to less than 1 % of the best available population estimate". This approach can be used in cases where data are scarce as it requires only estimates of population abundance and an estimate of the total mortality due to bycatch. However, compared to other approaches when applied to harbour porpoise populations (See Section *§4.2.6*, Table 4) it was the least conservative approach; given the uncertainty around population data it should be adopted only on a temporary basis until more data are available and more accurate models to define thresholds can be used (See Section *§4.2.6*, Table 4).

4.2.2 Potential Biological Removal (PBR)

The Potential Biological Removal (PBR) has been developed [54] and used by the U.S. government for the purposes of implementing the Marine Mammal Protection Act. It is a relatively simple deterministic population dynamics model that calculates the maximum number of animals that may be removed from a population while allowing it to reach or maintain its optimum sustainable population (at or above the level that will result in maximum productivity). The model does not include mortality (M).

$$Removal \quad limit = N_{\min} \times \frac{1}{2} R_{\max} \times F_R$$

The input information is the "*current minimum population estimate*" (N_{min}: 20th percentile of a log-normal distribution surrounding the abundance estimate, *N*, equivalent to the lower limit of a 60 % 2-tailed confidence interval), maximum population growth rate (R_{max}), and a tuning factor related to conservation objectives (F_R; assumed value for cetaceans of 0.04). Parametres can be estimated, assumed or based on proxies. The target in cetacean PBRs used by the U.S. government is 50 % of carrying capacity within a 100-year period. Of the available algorithms for calculating thresholds, this is the least data demanding.

ASCOBANS 1.7 %

Another example is the IWC-ASCOBANS [52] 1.7 % of best population estimate for harbour porpoises. This was based on a simple deterministic population dynamics model with

assumed maximum net productivity rate of 4 %, which found that 1.7 % total annual removal would allow a population to achieve 80 % of its carrying capacity over a very long time horizon (over un "*infinite*" period of time or until stabilisation).

As stated in the IWC-ASCOBANS report [52] '*Using a basic population model for harbour porpoises and* ***assuming no uncertainty in any parametre*** [emphasis added]*, the maximum annual bycatch that achieves the* ***ASCOBANS interim objective over an*** **infinite** ***time horizon is 1.7 %*** [emphasis added] *of the population size in that year. If uncertainty is considered, such as measurement error in estimating population size, maximum annual bycatch must be less than 1.7 % to ensure a high probability of meeting the ASCOBANS objective.* ***Meeting the objective in a shorter time will require that annual bycatch be reduced to an even lower fraction of the abundance*** [emphasis added]. *Additional sources of uncertainty and potential biases will also require more conservative management to ensure a high probability of meeting the objective*'.

4.2.3 Catch Limit Algorithm (CLA) and Removal Limit Algorithm (RLA)

Catch Limit Algorithm (CLA) and Removal Limit Algorithm (RLA) fit a population dynamics model to a time series of abundance estimates and removals data (input data). The CLA was developed by the International Whaling Commission [55] and Removal Limit Algorithm (RLA), based on the CLA approach, has been developed by Hammond et al. [56].

$$CLA = \alpha \times R_{\max} \times (D_T - \beta) \times N_T$$

where D_T represents the current population status, N_T the current population size, α and β are tuning factors related to conservation objectives. The conservation objective used by the IWC for CLA is 72 % *K* within a 100-year period. The conservation objective applied for the RLA on harbour porpoise in the North Sea [56] was 80 % K within a 100-year period. Of the available algorithms for calculating thresholds, CLA and RLA are the most data demanding, as they require regular estimates of abundance and of total bycatch.

4.2.4 Population Viability Analysis

Population viability analysis (PVA) is a species-specific method of risk assessment frequently used in conservation biology. As with the previous methods (i.e., PBR, CLA, and RLA) this is a process that determines the probability that a population will go extinct within a given number of years. This method is more useful for target setting, rather than setting thresholds, but it represents a good modelling framework for better understanding how a population is likely to respond to different management scenarios. This method needs several types of demographic data (e.g. population age structure, age at maturity, etc.), but for exploratory purposes can use proxies and it has been used already for some cetacean populations [57,58].

4.2.5 Input data

The different approaches to setting thresholds have different data needs; the availability of those data are often the deciding factor in which approach will be used. Table 3 summarises the data needs and shows that in general, an analysis like PBR and the application of a simple *"rule of thumb"* is the least that can be done and the least data-demanding. Use of such approaches can be a valuable starting point, but only in an adaptive management

framework that requires adequate data collection to validate and improve on the evidence base on which the threshold can be determined. As the evidence base builds, then more sophisticated and robust approaches may be possible for certain species and regions (i.e., PBR, followed by CLA/RLA). Regardless of approach, the threshold should be estimated for a discrete population or management unit and so an understanding of population structure is crucial and needs to be reviewed as part of a chosen management framework.

For example, recent discussions on assessment units at a North Atlantic harbour porpoise workshop [59] suggested the revision of the Celtic and Irish Seas and West Scotland assessment unit previously advised [50].

Demographic data for many cetacean populations are unknown, but expert opinion can be used to provide best estimates. However, this introduces uncertainties into the modelling approaches. Abundance estimates and bycatch estimates/rates also have associated uncertainty. Bycatch estimates generated from monitoring data collected under Regulation 812/2004 provide only imprecise estimates with wide confidence intervals [8]. The RLA is probably the most robust of all the approaches and the uncertainties around parametre estimates are implicit in the model and changes in these estimates (e.g. population abundance is actually half of the best estimate) are explored through simulation to provide thresholds robust to uncertainties.

Approaches that require total bycatch mortality are derived by scaling up estimates of bycatch rates in monitored métiers with the fishing effort data for those métiers. The quality of fishing effort data from the European fleet is variable and problems within available datasets have been identified [8]. Effort data from small scale fisheries is particularly challenging to derive robust estimates for [60] and without it, there will be an unquantifiable bias in derived bycatch estimates. Bycatch monitoring is also not representative throughout the European fleet, and introduces bias to total bycatch estimates. Coverage is low in the static gillnet fleet and biased towards the larger vessels. Finally, there may be uncertainty around estimates of total anthropogenic removals beyond bycatch alone.

Table 3. Summary of data needs of the various approaches to setting bycatch thresholds. Key: CO=Conservation objective; N=population abundance estimate; *CV*=Coefficient of Variation; *BYC*=total bycatch mortality; $N_1, \ldots, N_t$=Time series of population abundance estimates; $BYC_1, \ldots, BYC_t$ = Time series of bycatch estimates; *Dem*=Demographic parameters; *E*=Estimated, *A*=Assumed; Y=Yes.

Approach		CO	N (& CV)	BYC	$N_1, \ldots, N_t$	$BYC_1, \ldots, BYC_t$	Dem	Robustness of the approach
Rule of thumb type (examples)	20 % bycatch	Y				E		None
	1 % of N	Y	E	E				Low

Population model	1.7 % of N	Y	E	E				Low
	PBR	Y	E				E/A	Medium
	RLA	Y	E		E	E	E/A	High
	PVA	Y	E				E/A	Medium

4.2.6 Comparing threshold method outputs

There is no universally agreed method to calculate thresholds for cetacean bycatch within EU waters. The ASCOBANS threshold of 1.7 % is probably the most widely cited, but for porpoises in the North Sea, other limits have been estimated using PBR and CLA/RLA methods [56,61]. PBR was used without any testing for the western Black Sea on harbour porpoises, common and bottlenose dolphins [66]. Table 4 below from Scheidat et al. [61] shows a comparison for harbour porpoises in the North Sea, based on an abundance estimate of 216,415 individuals [62].

The cases that rely on little data are not reliable and are often the least precautionary. Table 4 shows that of the different threshold approaches that are possible, the CLA/RLA is more than 4 times more precautionary than the very basic model, with assumed parametres, that was produced by ASCOBANS (1.7 %). Scheidat et al. [61] provided a preliminary estimation of CLA, that has been recalculated based on more accurate simulations [56] (see paragraph *§Examples of estimated maximum bycatch thresholds*).

Table 4. Comparison of estimated removal limits for North Sea Harbour Porpoise [61], in relation to conservation objectives and temporal windows.

	Conservation objective	**Temporal window**	**Removal limit**
IWC/ASCOBANS 1.7 %	80 % K 95 % of cases	"infinite"	3679
ASCOBANS 1 %	NA	NA	2164
PBR	50 % K 95 % of cases	100 years	1246
*CLA/RLA	72 % K 50 % of cases	100 years	840

Examples of estimated maximum bycatch thresholds

Table 5 shows the available estimated maximum bycatch thresholds for some species and population of cetaceans in European waters. It is worth noting that:

- the calculation of any such threshold implies specific simulations that are based on data related to a specific population;
- any change to even one factor of those considered in the modelling requires a new set of simulations;
- the most accurate models, including mortality, run for the North Sea population of harbour porpoises (i.e. RLA from Hammond et al. [56]) give a threshold of about 0.5 % of the total population, compared to the ASCOBANS 1 %, using the same conservation objectives;
- for North Sea harbour porpoise, it has been shown that PBR values are higher than those calculated via CLA/RLA, but lower than the rule of thumb example of 1% of best available abundance;
- abundance estimates are periodically updated [63] producing different thresholds (the abundance estimates for porpoise were biased low in 2005 [64]), therefore periodic reassessments are necessary. Changes to the assessment of management units will also affect these parameters.

Table 5. Available estimated maximum bycatch thresholds for some species and population of cetaceans in European waters.

Species	Area	Bycatch thresholds	Conservation objectives	Abundance	Reference
Common dolphin	North East Atlantic	PBR: 345-1061-1524 (3 scenarios)	80 % of carrying capacity over 200 years	180075 (56915-246740)	CODA final report [65]
		CLA:227-860-1547 (3 scenarios)		180075 (56915-246740)	
	Western Black Sea	PBR=513 1.7%=1027 1%=604 2%=1208	PBR: 50 % of carrying capacity over 100 years	60400 (CV=19.25)	Birkun et al. [66]
Harbour porpoise	Inner Danish Waters	CLA:17-55-87 (3 scenarios)	80 % of carrying capacity over 200 years	23227 (CV=0.36)	SCANS II [63]

Species	Area	Bycatch thresholds	Conservation objectives	Abundance	Reference
	Northern North Sea	CLA:90-287-456 (3 scenarios)		37968 (CV=0.23)	
	Central North Sea	CLA:71-228-362 (3 scenarios)		58706 (CV=0.31)	
	Southern North Sea	CLA:420-1338-2124 (3 scenarios)		134434 (CV=0.19)	
	West of Britain and Ireland	CLA:130-414-657 (3 scenarios)		128637 (CV=0.33)	
	waters around SW France, Portugal, Spain	CLA:0-0-0 (3 scenarios)		2646 (CV=0.8)	
	North Sea	RLA=1856 /year (6-year period)	80% of carrying capacity over 100 years	345373 (CV=0.18)	SCANS III [56,64]
	Western Black Sea	PBR=247 1%=295 1.7%=501 2%=589	PBR: 50 % of carrying capacity over 100 years	29465 (CV=20.77)	Birkun et al. [66]
Bottlenose dolphin	Western Black Sea	PBR=225 1 %=265 1.7 %=450 2%=529	PBR: 50% of carrying capacity over 100 years	26462 (CV=15.24)	Birkun et al. [66]

4.3 Potential management frameworks

4.3.1 Bycatch Risk Assessment (BRA)

The ICES WGBYC Bycatch Risk Assessment (BRA) is a straightforward approach that can be used to obtain provisional indications of potential risks in "data poor" cases [4-6]. The concept is that given a species abundance estimate and/or bycatch rates, as well as an estimate of total fishing effort, '*one can ask what overall bycatch rate would be needed to exceed the bycatch reference limit*" and then evaluate the likelihood that such limit is exceeded or if the assumed population can sustain such levels of bycatch. This allows

consideration of the following steps: (a) assessing the feasibility of obtaining refined data (i.e. the bycatch rate that would produce the bycatch reference), (b) applying mitigation measures based on a precautionary approach, and (c) building a programme to combine these two aspects.

The main justifications to apply the BRA can be summarised as follows [4]:

- Existing data on observed bycatch rates can and should be used to help understand the risk that fishing gears pose to the conservation status of a particular species.
- BRA allows identification of fisheries that should be prioritised for sampling: uncertainty in bycatch rate estimates is greatest and the effect of that uncertainty is likely to have the greatest negative impact on conservation and/or economic activity.
- Perfect data to estimate bycatch levels will probably never be available for all species and populations, but we should use the existing data while ensuring that uncertainty is clearly stated.
- Estimates of bycatch levels (numbers per year being killed) are meaningless unless we have a reference level [threshold] against which to compare them.
- Reference levels [thresholds] can be derived in many ways and a range can be used if necessary, but they are reflections of societal choices about conservation or welfare priorities (See Section *§4.2*).
- To assess the risk to a population from bycatch, all that we need is a conservation reference level or threshold, a bycatch rate or rates with a measure of uncertainty, and an estimate of total fishing effort by all vessels in the region of concern.
- Applying estimated bycatch rates to the estimate of fleet effort provides a number to compare with the reference level [threshold].
- Even where bycatch rates are very poorly known, we can use the conservation reference level and the estimate of total fishing effort to ask what bycatch rate would correspond to a bycatch that exceeds the reference level, and then ask how likely such a rate might be.

There are a number of reservations about this methodology relating to the existing fishing effort data, to the bycatch thresholds to be used and to the bycatch rate estimates. However, if BRA is used as an exploratory tool and all uncertainty is well described and understood, it constitutes a very useful way to flag potentially unsustainable cases and help prioritise research and management actions. Two examples of BRAs for the Kattegat and Belt Seas harbour porpoise (3a21, 3b23, 3c22) and the common dolphin in the Northeast Atlantic (Subareas 7, 8 and 9) are reported in ICES WGBYC [5,6].

4.3.2 FAO Expert Workshop on Means and Methods for Reducing Marine Mammal Mortality in Fishing and Aquaculture Operations

FAO convened in Rome, Italy (March 2018) the Expert Workshop on Means and Methods for Reducing Marine Mammal Mortality in Fishing and Aquaculture Operations [67]. The

workshop produced some key technical outputs, including a draft decision-making tool ('decision tree') which could be used to support management decision-making processes.

A tool such as a decision tree (see Annex 5) is useful to expedite the identification and implementation of effective bycatch mitigation measures. Workshop participants agreed a decision tree can guide decision-makers in identifying assessment needs, possible management or mitigation measures, and adaptive management strategies through ongoing bycatch and population monitoring and evaluation. Workshop participants produced a draft decision tree that would benefit from further elaboration and refinement. This decision tree provides an example of the type of steps and decision points a fisheries manager might consider in developing a strategy for addressing marine mammal bycatch.

4.3.3 The U.S. Bycatch Framework

The U.S. framework to tackle the fishery bycatch issue includes the use of PBR (see also Sections *§2* and *3*) as a component of its Marine Mammal Take Reduction Plans (TRP) which are developed and implemented through Take Reduction Teams. The TRP also includes the need for annual or 3 yearly Stock Assessment Reports and associated monitoring. Take reduction teams develop take reduction plans to help recover and prevent the depletion of strategic marine mammal stocks that interact with identified fisheries by putting in place measures to reduce take below identified PBR thresholds.

The immediate goal of take reduction plans is to reduce, within six months of their implementation, the incidental mortality or serious injury of marine mammals from commercial fishing to less than the PBR level. The long-term goal is to reduce, within five years of their implementation, the incidental mortality and serious injury mortality of marine mammals from commercial fishing operations to insignificant levels, approaching a zero mortality and serious injury rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans.

For further details, see the NOAA Fisheries webpage:

www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-take-reduction-plans-and-teams.

4.4 Summary of existing data

The EWG-19-07 updated the table compiled by the subgroup on fishery and environment on the *Incidental Catches of Small Cetaceans* regarding all fisheries where bycatch is known or suspected in European waters (SEC(2002)1134). Major changes from the initial table are with regards to:

1. The addition of Black Sea records of known or suspected cetacean bycatch;
2. The EU ban on driftnets targeting highly migratory species such as tuna and swordfish, as of 1 January 2002. Fishing with small-scale driftnets is still a practice in Bulgaria, France (both mainland and DOM), Italy, Portugal, Romania, Slovenia and the UK, and;
3. The full ban of any kind of driftnets in the Baltic as of 1 January 2008.

4. Driftnets continue to pose a serious problem for marine megafauna as Illegal, Unregulated and Unreported fisheries (IUU), and in the case of non-EU fleets operating large-scale driftnets in EU waters [68].

Additional evidence of cetacean bycatch in EU waters is given Table 6. The updated table is a non-exhaustive summary. Regional effort should be focused on compiling a complete list, searching for local unpublished reports, to run BRAs and prioritise, in each region, for immediate bycatch monitoring and mitigation measures. Populations of serious conservation concern (for example, Baltic harbour porpoise) for which no bycatch is acceptable [69] should be prioritised for mitigation.

Table 6. Non-exhaustive list of evidence of known cetacean bycatch in EU waters (after SEC(2002)1134).

Gear type	**Nation**	**Location**	**Bycatch species**	**Reference**
Gillnets (turbot, dogfish)	Ukraine	NW Black Sea	*PPHO, TTRU, DDEL*	Birkun et al. [66]; Birkun and Krivokhizin [70]
Gillnets	Bulgaria	NW Black Sea	*PPHO, TTRU, DDEL*	Birkun et al. [66]
Gillnets	Romania	NW Black Sea	*PPHO, TTRU, DDEL*	Radu and Anton [71], Birkun et al. [66]
Entangling nets (e.g., gillnets, trammel nets)	Cyprus	North Cyprus	*DDEL*	Snape et al. [72]
Unidentified (mainly set nets)	Greece	Greek waters	*PPHO, TTRU, DDEL, SCOE, ZCAV, PMAC*	Kapiris [73]
Set nets	Greece	North Aegean	*PPHO*	Cucknell et al. [74]
Set nets (gillnets and trammel nets)	Spain	Alicante	*TTRU*	Revuelta et al. [75]
Purse seines (sardine)	Portugal	EU Atlantic waters, SW Portugal	*DDEL*	Marçalo et al. [76]
Pelagic trawls	France	Atlantic	*DDEL*	Morizur et al. [77]
Entangling nets	France	English Channel	*PPHO, TTRU, DDEL, SCOE*	ICES [6]

Gear type	Nation	Location	Bycatch species	Reference
Entangling nets	-	Celtic Sea and Bay of Biscay	*DDEL*	ICES [8]
Entangling nets	-	Celtic Sea	*GMEL*	ICES [8]
Entangling nets	Ireland, UK	Celtic and Irish sea	*PPHO*	ICES [8]; NAMMCO and IMR [59]
Pots (crustacean)	-	Eastern North Atlantic	*MNOV, BACU*	Northridge et al. [78]; Van der Hoop et al. [79]; Pace et al. [80]; Ryan et al. [81]
Set nets	-	North Sea	*LALB*	ICES [5]; Van Bressem et al. [82]
Set nets	-	North Sea	*LACU*	ICES [5]

Key: *TTRU=Tursiops truncatus, DDEL=Delphinus delphis, PPHO=Phocoena phocoena, MNOV=Megaptera novaeangliae, BACU=Balaenoptera acutorostrata, SCOE=Stenella coeruleoalba, ZCAV= Ziphius cavirostris, PMAC=Physeter macrocephalus, LALB=Lagenorhynchus albirostris, GMEL=Globicephala melas, LACU=Lagenorhynchus acutus.*

4.4.1 Key gaps

Available cetacean data to estimate thresholds

A preliminary gap analysis was undertaken to assess the areas for which bycatch thresholds (PBR, CLA/RLA) could be estimated (Table 7). Very basic estimations of bycatch thresholds or risk analyses require at least abundance estimates. As shown in Figure 2 sampling effort in the EU Atlantic region is more complete and homogenous than in the Mediterranean and in the Black Sea. Data on European Macaronesia are not available. Data availability for the EU Atlantic allows for more sophisticated methods to be applied, incorporating data on population structure, incidental catch and fishing effort per fishing gear.

In the Mediterranean, survey coverage (and thus data collection) is highly heterogeneous in space and time [84], and most of the effort is concentrated in the Western basin (Figure 2b). Partial abundance estimates for the Western Mediterranean are available mainly for the Pelagos Sanctuary, Tyrrhenian Sea and French Mediterranean and to a much lesser extent

Spanish waters, thus allowing for preliminary, nevertheless more sophisticated, bycatch threshold estimates.

For the Eastern Mediterranean, with the exception of the Adriatic, there are no abundance estimates available for the cetacean species by-caught in fishing gear. However, the latest ACCOBAMS Survey Initiative will provide additional preliminary estimates that could be used, at least, for initial assessments in some regions.

Nevertheless, more sophisticated methods will require time-series on abundance, incidental catches, other human related mortality and fishing effort, and some more robust information on cetacean population structure. Screening of data availability should be made at a Regional level to establish data gaps and then make detailed recommendations for bycatch action.

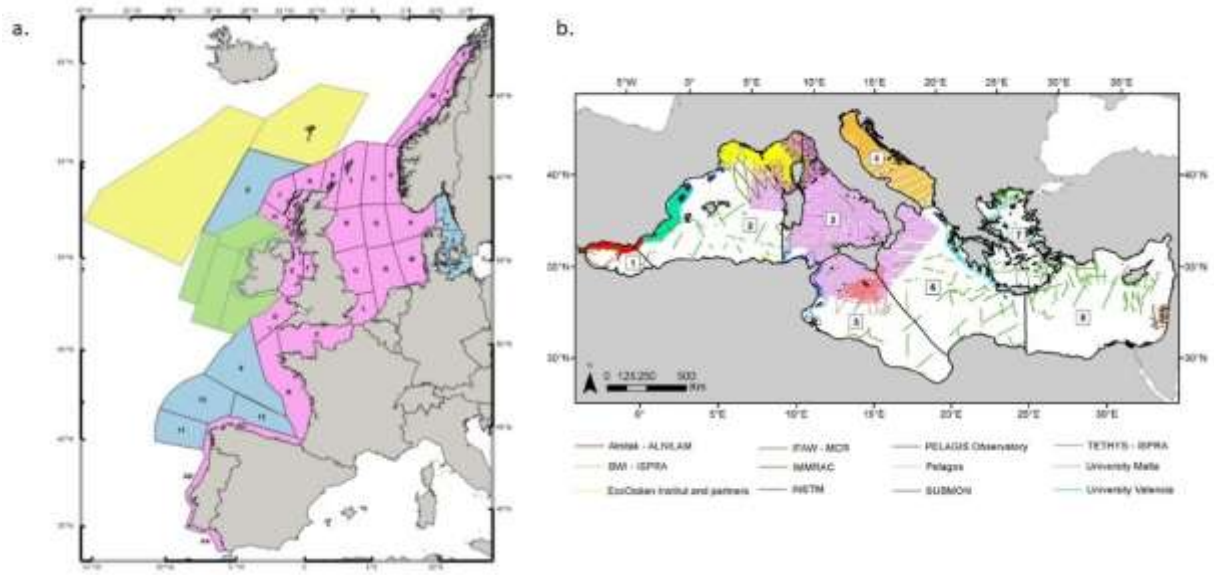

Figure 2. A schematic of the area coverage of various surveys in (a) EU Atlantic waters (and adjacent areas; from Hammond et al. [83]) and (b) the Mediterranean Sea (from Mannocci et al. [84]).

Fisheries data

Data on cetacean bycatch collected by non-dedicated fisheries observers under the Data Collection Framework are inadequate for estimating cetacean bycatch mortality, given very low effort in relevant métiers. The use of non-dedicated observers also introduces bias (See Sections *§2* and *§3* for full discussion). Furthermore, in relation to Regulation (EU) 812/2004 and its transposition into the new Technical Measures, in different regions additional cetacean mortality caused by other not listed fishing activities is not considered in the mortality assessment (i.e., gillnets and entangling nets in the Mediterranean and the Black Sea, or small-scale fisheries). ICCAT imposed a mandatory observer program on the

fisheries under its competence, under the responsibility of all ICCAT CPCs, including also a bycatch reporting scheme (cetaceans are specifically mentioned). The same situation exists for the mandatory observer programs under the responsibility of IATTC and IOTC. The ICCAT Regional Observer program, directly managed by ICCAT for compliance purposes and fully covering some bluefin tuna activities, do not include any provision for reporting cetacean bycatch. Data on such mortalities, when collected, were not made available to EWGs or ICES WGBYC, therefore providing an unassessed bias in the calculations. Furthermore, bycatch data from other non-EU fisheries existing in the same area where EU fleets operate are simply not provided (when they exist), increasing the bias and the uncertainty of the estimates.

Table 7. Non-exhaustive list of cetacean bycatch data availability to support threshold-setting methods PBR and/or CLA/RLA.

Marine Area	Sub-areas	Data Availability	Bycaught Species	Potential tool to estimate bycatch	Surveys	References	Comments
EU Atlantic	North Sea, Baltic Sea, Irish & Celtic Sea, English Channel, Bay of Biscay, SW Portugal and Spain	Abundance, population structure, time-series of abundances, incidental catches, anthropogenic mortality, fishing effort	Harbour porpoise, bottlenose, common, Risso's, white-beaked, white-sided, striped dolphins, pilot, beaked whales, sperm whale, minke, fin whale	PBR, CLA/RLA depending on species vs. data availability	SCANS (1994); SCANS II (2005); CODA (2007); SAMM (2011, 2012); ObSERVE (2015, 2016); SCANS III (2016); CETUS project	Hammond et al. 2002, SCANS-II 2006, Macleod et al. 2006, CODA 2009, Hammond et al. 2013, Hammond et al. 2017, Laran et al. 2017a	NASS survey data (1987, 1989, 1995, 2001, 2007 & 2015) although not in EU waters could be used complementary for species with wide distributions
West. Medit.	-	Abundance, time-series of abundances, fishing effort	striped dolphin, bottlenose dolphin, fin whale sperm whale	PBR	SAMM (2011- 2012, 2018-2019); ACCOBAMS-ASI 2018; GDEGeM project; Tethys projects; GBR-Malta Uni.; SUBMON; PELAGIS Observatory; INSTM; EcoOcéan; Alnitak – ALNILAM; University of	Cañadas & Hammond 2006, Panigada et al. 2011, Lauriano et al. 2014, Laran et al. 2017b, Mannocci et al. 2018	-

Marine Area	Sub-areas	Data Availability	Bycaught Species	Potential tool to estimate bycatch	Surveys	References	Comments
					Valencia		
East. Medit.	Adriatic, Ionian Sea, Aegean Sea, Levantine	Abundance & population structure (Adriatic), time-series of abundance (Adriatic), fishing effort (availability gear variable)	sperm whale, bottlenose dolphin (Adriatic; Amvrakikos gulf; Gulf of Corinth), common dolphins (Gulf of Corinth), striped	PBR (Ionian), CLA/RLA depending on species vs. data availability (applicable only in the Adriatic)	ACCOBAMS-ASI 2018; BlueWorld; ISPRA Rome; Tethys projects; Pelagos Cetacean Research Institute projects; IMMRAC	Fortuna et al. 2011, Kerem et al. 2012, Manocci et al. 2018	Data on dolphin populations for the Aegean and Levantine Sea are essentially non-existent. Urgent need of data collection and monitoring programs.
Black Sea	North Western Black Sea	Abundance / incidental catches / fishing effort	harbour porpoise, common dolphin, bottlenose dolphin	PBR	CeNOBS project (2019)	Birkun et al. 2014	-

4.5 Roadmap

The roadmap is intended to be an aid for adaptive decision making. The roadmap considers the outcomes of Habitats Directive assessments on Conservation Status, but goes beyond these to consider the level of bycatch pressure to set out a course of action on mitigation and monitoring. The roadmap must also account for data poor situations (see Table 8) and so should be precautionary. It should also deal with situations that arise unexpectedly where measures need to be implemented urgently, due to unforeseen bycatch circumstances of concern. It is worth noting that Regulation (EU) No 1380/2013 of the Common Fisheries Policy has a mechanism in place for the Commission (Article 12) and/or for MS (Article 13) to react at such circumstances.

Article 12.1 (***Commission measures in case of a serious threat to marine biological resources***) states that "*1. On duly justified imperative grounds of urgency relating to a serious threat to the conservation of marine biological resources or to the marine ecosystem based on evidence, the Commission, at the reasoned request of a Member State or on its own initiative, may, in order to alleviate that threat, adopt immediately applicable implementing acts applicable for a maximum period of six months in accordance with the procedure referred to in Article 47(3)*". Article 13.1 (***Member State emergency measures***) states "*1. On the basis of evidence of a serious threat to the conservation of marine biological resources or to the marine ecosystem relating to fishing activities in waters falling under the sovereignty or jurisdiction of a Member State that require immediate action, that the Member State may adopt emergency measures to alleviate the threat. Such measures shall be compatible with the objectives set out in Article 2 and no less stringent than those provided for in Union law. Such measures shall apply for a maximum period of three months*".

Where a species is at '*Favourable Conservation Status*' (according to Habitats Directive assessments), and the bycatch risk is identified as being low, the Roadmap suggests that dedicated monitoring to a predetermined rate will still be required, and mitigation might still be needed, depending upon the target that is set.

4.5.1 Bycatch mitigation measures

Under EU environmental legislation, bycatch prevention should be a priority. To design cetacean bycatch mitigation measures, including monitoring required to assess bycatch rates, it is necessary both to know current conditions and to have an identified target for a desired outcome. This knowledge allows measures to be designed, which are sufficient to reach the target that has been agreed and complies with EU biodiversity conservation legislation, without imposing unnecessary burdens in terms of costs, control or loss of fishing opportunities.

In order to estimate current bycatch rates, a proven, efficient and well-designed monitoring scheme must be implemented. This could be designed either to estimate incidental mortality within an acceptable confidence interval, or alternatively to detect any transgression of a specified target level with an acceptable statistical power.

In line with Article 11 of the HD, the population abundance of species of Community interest shall be assessed independently of bycatches, their distribution shall be known, and life history parametres shall be estimated or assigned. For species where such information is known, these parametres can be used to set bycatch thresholds that align with EU biodiversity conservation objectives and ensure targets are met (see Table 5 and Table 7).

For other European cetacean populations where data do not exist or are very scarce (see Table 6 and Table 7), BRAs, 1 % or some more developed estimations of thresholds can be applied. This

approach requires data that should be collected in accordance to Article 12.4 of the HD and in accordance to regulations on CFP and TCM.

Where reliable bycatch estimates or biological parametres are not available to robustly calculate the level of bycatch and assess against a threshold, high-risk situations can still be identified, for example through the BRA approach, where there is an overlap of:

- ✓ a population with unknown status or that is clearly at a historical low level (e.g., Iberian harbour porpoise);
- ✓ a fishery which is known to cause 'significant' incidental mortalities (e.g. gillnets and Baltic harbour porpoise).

Under this approach, the priority should be given to implement mitigation measures on a precautionary basis until either the overlap can be reduced or eliminated, or the population shows significant signs of ongoing recovery (e.g. ICCAT/CCAMLR approach to seabird protection) and monitoring studies should be designed to assess this situation. In the absence of data on monitoring and on the level of impact to the population, the commercial fishery is supported if it is not possible to identify safe alternatives. As a result, the following cetacean bycatch management actions are identified in Table 8.

Table 8. Example of assessment of management requirements to mitigate cetacean bycatch in fisheries, depending upon the conservation status, size of population and level of cetacean bycatch risk.

Bycatch risk	**Favourable conservation status**		**Unfavourable / unknown status**	
	Large	**Small**	**Large**	**Small**
High	2	1	1	1
Medium	2/3	2/3	1/2	1/2
Low	4	4	2	2
Unknown	3 or 4	3	2	2

Key: 1 = technical and spatial (for example, spatio-temporal-depth restrictions or dynamic move-on measures) management and concurrent intensive, dedicated monitoring, at a predetermined rate and time period, 2 = On-board technical mitigation or gear modifications/alternative gears or management measures and concurrent monitoring, at a predetermined rate and time period, 3 = Monitoring only – level to be determined, as required, 4 = Minimal monitoring only - very low-risk fisheries with existing evidence of no bycatch (locally or elsewhere): dedicated *X* year monitoring study.

Adequate measures are required for the range of possible situations that might arise. Priority action should be available in data poor situations or where a bycatch issue has been recognised (including provisions for emergency response, should a new and urgent bycatch situation arise). In these situations, technical and spatial management and concurrent intensive, dedicated monitoring, at a predetermined rate and for a predetermined time period, are anticipated. For these circumstances, the roadmap may point to the need for a "bycatch reduction team" to further develop the mitigation plan (see TOR 2). Where some bycatch is recognised or where the

population status is unfavourable or unknown, on-board technical mitigation (for example, pingers, escape hatches, etc.), gear modifications (e.g. setting net at a different depth) or alternative gears and concurrent monitoring, at a predetermined rate are required.

Where the population status is known, and is favourable, and the risk of bycatch is low, with existing evidence of no bycatch (locally or elsewhere), only dedicated monitoring, at a level to be determined, is required. Assessment and implementation of measures would benefit from being coordinated at the appropriate scale (i.e. in relation to species' ranges) across Member States. Regular assessment of the effectiveness of mitigation measures is a requirement under the Technical Conservation Measures, and will help ensure an ongoing adaptive approach (Figure 3) and achievement of conservation objectives.

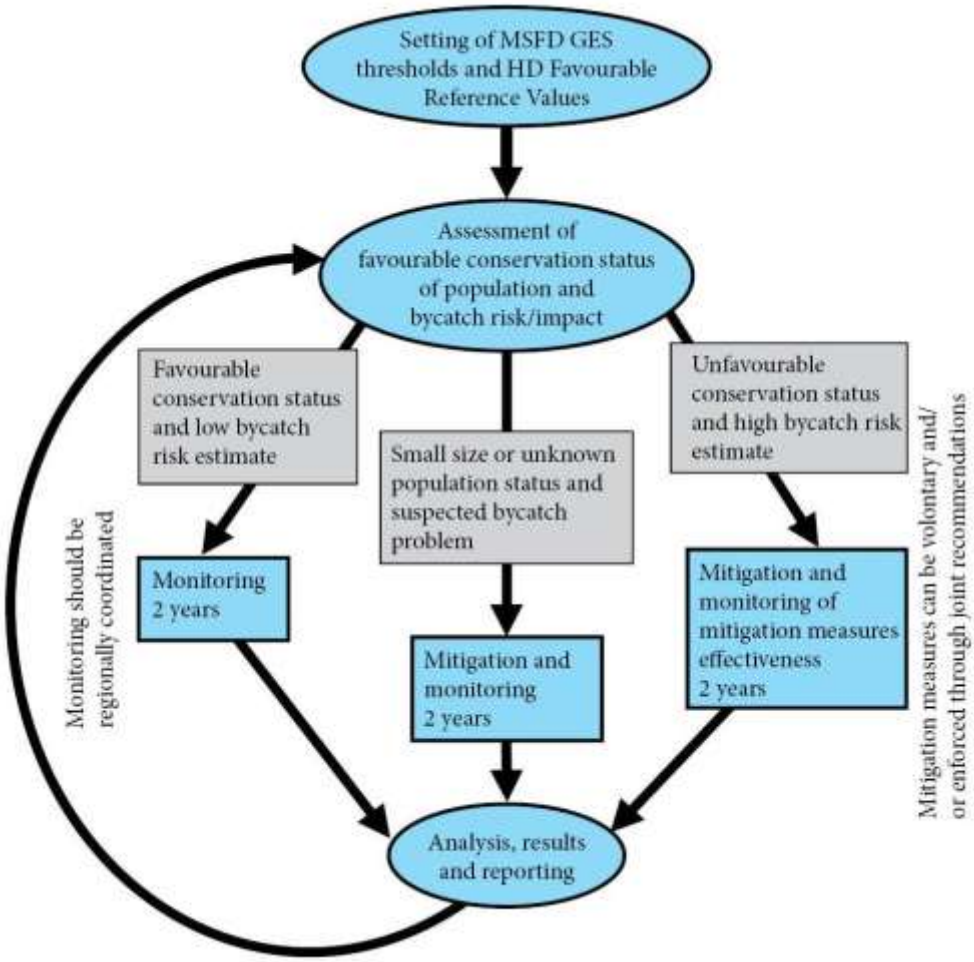

Figure 3. Framework that would enable assessment and adaptive management of bycatch measures for cetacean populations in European waters.

4.5.2 Timeframes

The first European Commission report to Parliament under the Technical Conservation Measures is due in December 2020. Subsequent Commission report to Parliament occurs on a 3-yearly cycle, with the second being due in December 2023. National reporting requirements for MSFD and the Habitats Directive Article 17 occur on a 6-yearly cycle, in 2021 and 2025 respectively. The assessment process should be established so that it prioritises populations and sets out

timeframes for action (Figure 3). In each situation, 2-year cycles of monitoring or monitoring and mitigation are suggested, allowing a year for analysis and conducting the assessment (allowing timely reporting to the Commission) to fit within the cycles identified above. At the point of assessment, the monitoring and mitigation are adapted as required, for the next 3-year cycle.

4.5.3 Case studies

Three case studies are identified where thresholds have been calculated and used to reduce pressures on the populations identified. Subsequent management measures have been successfully implemented to continually reduce cetacean bycatch in the Gulf of Maine and to reduce the number of seals being shot for fisheries and fish farm interests in Scotland. A third case study is provided for common dolphins in the Bay of Biscay where threshold calculations have demonstrated a high and likely population level bycatch impact regionally, but sufficient bycatch measures are yet to be implemented.

Harbour porpoise bycatch in the U.S. Gulf of Maine

The U.S. successfully implemented a PBR to reduce gillnet bycatch in a population of ~15,000 harbour porpoise in the Gulf of Maine. Using a combination of dedicated observer monitoring (2-6 % of fishing trips), and a dual approach to mitigation, using both technical measures (pingers) and spatial measures (time-area closures) as part of a "Take Reduction Plan", annual bycatch of porpoises was reduced from a high of 2,900 in 1990 to 323 in 1999, the first year in which bycatches fell below the potential biological removal (PBR) level, [85]). The monitoring programme provided important feedback on the efficacy of measures in reducing bycatch.

Seal licensing in Scotland

Part 6 Conservation of seals of the Marine (Scotland) Act 2010 concerns authorising the killing or taking of seals under licence (with conditions), including to prevent serious damage to fisheries or fish farms. This activity was previously unlicensed and unmonitored. Scottish Government has adopted PBR to estimate permissible anthropogenic takes for each of the ten grey and harbour seal management regions and uses this information to assess licence applications for seal control and for other licensable marine activities. The numbers of seals reported as shot in each region is now below PBR and has been reduced year-on-year since the licensing system was put in place.

Common dolphin bycatch in the Bay of Biscay

North-east Atlantic common dolphin bycatch in the Bay of Biscay provides an example of a large cetacean population but one which is subject to likely high levels of bycatch. Bycatch levels are uncertain due to inadequate monitoring data across the range of the gear types operating in the region. In 2017, the International Whaling Commission Scientific Committee (IWC SC) noted serious concerns over the large number of stranded common dolphins reported at the beginning of 2017 along the French Atlantic coast [86]. 2019 was the highest strandings year on record [87]. IWC [87] recommendations to understand and reduce bycatch in this population identified:

1. a very intensive observer effort is required to identify the fisheries involved, produce reliable estimates of total bycatch, and determine the relative contribution from each fishery. The complexity of the situation and highly over-dispersed bycatch rates indicate that 100 % coverage may be required;
2. compliance with and monitoring of 'moving on' procedures as a mitigation measure, and implementation of measures (1) and (2) above may remove the need for time-area closures, that would otherwise have to be considered.

4.6 Conclusions

EWG 19-07 is unable to provide candidate maximum bycatch thresholds for all the cetacean species most typically bycaught (i.e. harbour porpoises, common, striped and bottlenose dolphins and humpback whales). In general, the EWG **reiterates** the advice presented in ICES (2014) that the European Commission establishes a process involving both scientists and managers to derive these thresholds, based first on agreement of conservation objectives. During this meeting, the EWG briefly reviewed the maximum threshold-setting approaches and highlighted which is most appropriate depending on data availability and an adaptive approach. The data presented show that, in general, an analysis like BRA and the application of a simple "rule of thumb" is the least that can be done (as a temporary step) and the least data-demanding approach. Use of such an approach can be a valuable starting point, but only in an adaptive management framework that requires adequate data collection and modelling to validate and improve on the evidence base on which the threshold can be determined and appropriate measures continually applied. As the evidence base builds, then more sophisticated and robust approaches may be possible for certain species and regions (e.g. PBR, followed by CLA/RLA).

The EWG developed a roadmap to help prioritise and implement bycatch monitoring and mitigation, including carrying out full assessments for population and species most affected. Section *§4.5* provides some guidance on necessary elements and approaches under different scenarios. A component of the roadmap could be the development of regional "bycatch reduction teams" for those species most at risk.

4.7 Remarks

- EWG **reiterates** the advice presented in ICES (2014) that the European Commission establish a process involving stakeholders to derive candidate maximum bycatch thresholds for all the cetacean species most typically bycaught (i.e. harbour porpoises, common, striped and bottlenose dolphins, minke and humpback whales), based first on agreement of conservation objectives.
- The EWG **remarks** that this type of assessment is conducted regularly (e.g. every 2-3 years) at a regional level. This would help the prioritisation of populations in each region for immediate bycatch measures. Bycatch mitigation may be required in parallel to data collection and modelling (as identified in Figure 2).
- The EWG **remarks** that conservation objectives and targets, which are an integral part of these assessments and simulations, be clearly quantified (see Sections *§4.1.1* and *§4.1.2*). Existing examples from CLA/RLA seem appropriate, as a starting point, but should be further tested and officially agreed.
- The EWG **remarks** that RFMOs and MSs adopt roadmaps to help prioritise and implement bycatch monitoring and mitigation, including carrying out full assessments for populations and species most affected.

5 FINAL CONCLUSIONS

5.1 General

- Bycatch of cetaceans and other marine mammals is widely observed throughout European Union waters in nets (set- and drift-), purse seines, trawls, rod and pole gears. Highest risk gears for bycatch of cetaceans (as well as seals, seabirds and turtles) are set- and drift-nets although pelagic trawls can cause significant bycatch for some delphinids and creel lines can entrap baleen whales.
- A clear understanding of bycatch in commercial fisheries is required to implement Ecosystem Based Management of Fisheries and will also provide better coherence and support for Member States in meeting their obligations through, for example, the Marine Strategy Framework Directive, the Habitats Directive and Birds Directive.
- The requirements to establish a system of surveillance of incidental capture under the Habitats Directive appears to have been overshadowed by other monitoring requirements (Article 11) and those in the Regulation (EU) 812/2004.
- The coverage of Regulation (EU) 812/2004 with regards to monitoring incidental catches of protected species should have included all fleet segments, all vessels regardless of size and all protected species (i.e. to include seabird, turtle, seal, and certain elasmobranchs and protected species of fish) in all EU waters. The carryover of the monitoring requirements of Regulation (EU) 812/2004 into the proposed Technical Measures Regulation in Annex XIII is unhelpful.

5.2 Monitoring

- There is insufficient monitored fishing effort to enable any assessment of the overall impact of fisheries on cetaceans. Monitoring coverage per métier and vessel varies greatly, and Member States rely on data collected from fisheries observers deployed through the DCF sampling programme rather than dedicated marine mammal observers; this has introduced downward bias in bycatch estimates.
- The collection of cetacean bycatch data through the DCF has now been formalised in the EU-MAP. The advantage of monitoring all protected species through the DCF is that it has a large observer coverage. However, its focus is on commercial species (which do not require high percentage coverage) and mostly on trawl fisheries and on other activities on-board. Implementing protected species bycatch monitoring is not just a matter of adjusting DCF protocols to include cetaceans and other protected species in their lists, but should include some degree of reallocation of sampling effort to cetacean bycatch relevant fisheries.
- Until cetacean bycatch monitoring is being implemented effectively through the DCF, dedicated monitoring observer schemes of relevant métiers are to be encouraged and supported.

5.3 Mitigation

- There are valid concerns around the wide-scale deployment of pingers in all gillnet fisheries.
- The development of other types of pingers is currently constrained by technical specifications in Regulation (EU) 812/2004.

- The Regulation puts forward the use of Acoustic Deterrent Devices (pingers) as the only mitigation measure, whereas there are more measures possible and needed.

5.4 Setting bycatch thresholds

- Integral to management is a clear understanding of the conservation and management objectives to be achieved. Currently, those specified in European environmental legislation require further definition to be able to be used quantitatively in the modelling approaches to threshold setting.
- Candidate maximum bycatch thresholds are not available for all of the cetacean species most typically bycaught due to limited population and bycatch data, but also due to the lack of explicit conservation objectives and targets. A simple "rule of thumb" threshold, such as the ASCOBANS 1 % of best available abundance, is the least data-demanding and can be a valuable starting point for assessments. However, such thresholds should be only used as part of an adaptive management framework that includes data collections to improve the evidence base on which more robust estimators for these thresholds can be applied. As the evidence base builds, then more sophisticated and robust approaches may be possible for certain species and regions (e.g. PBR, followed by CLA/RLA).
- The EWG 19-07 developed a roadmap to help prioritise and implement bycatch monitoring and mitigation, including carrying out full assessments for populations and species most affected.

6 FINAL REMARKS

6.1 General

- A systematic risk-based approach is proposed in which monitoring and mitigation is prioritised in relation to potential estimated impact, rather than the current prescribed approach defining the gears, vessels and areas. This will enable greater flexibility for Member States to account for shifts in distribution of both fisheries and highly mobile protected species.
- A management strategy is needed to consider mitigation measures other than pingers, including effort reductions, time/area closures, bycatch reduction devices and use of alternative gears.
- In high-risk areas and fisheries, where these can be identified, the introduction of an approach similar to the U.S. MMPA Take Reduction Plans is suggested. These plans outline a suite of approaches and potential measures, such as the use of more selective gears, area closures, real-time closures, avoidance measures and move-on rules, that could be implemented to reduce bycatch. Importantly, the plan is developed with all relevant stakeholders. In the EU, such plans could be developed within the context of the Regional Advisory Groups.

6.2 Monitoring

- There should be a reallocation and an increase of sampling effort to cetacean-bycatch relevant fisheries, at a monitoring effort that would allow calculation of the distribution and rate of expected incidental catch. The outputs of these risk assessments for cetacean bycatch undertaken by WKPETSAMP and FishPi should be noted and acted upon.

- A systematic risk-based approach is proposed to enable greater flexibility for Member States to react to shifts in the distribution of both fisheries and protected species, such as cetaceans.
- The coverage of Regulation (EU) 812/2004 should be extended to incorporate all fleet segments, all vessels regardless of size and all protected species (i.e. to include seabird, turtle, seal, and certain elasmobranchs and protected species of fish) in all EU waters (to include the Mediterranean Sea, in the Black Sea and in European Macaronesia.
- Well-designed, robust monitoring strategies using best practice should underpin all other future mitigation efforts; in particular, increased monitoring in high-risk métiers.
- Dedicated observer coverage should be calculated from available information on bycatch. In the absence of this information, 5-10 % seems a reasonable starting point, which can be reviewed and refined as part of an adaptive approach to management.
- Observer coverage should be independent of vessel size.

6.3 Mitigation

- In addition to pingers, there is a need to implement other mitigation measures, which could, for example, include effort reductions, time/area closures, bycatch reduction devices and use of alternative gears. The environmental effects of these will need to be considered in any management strategy.
- More flexibility is required to use a wider range of mitigation measures (such as effort reduction, closed areas and gear modification) to mitigate bycatch for porpoises and other cetacean species, in the full range of fisheries, vessel sizes, métiers and regions where bycatch occurs. Such flexibility should also enable timely response to temporarily high bycatch rates (short-term "emergency" scenarios).
- Member States should be required to provide evidence that these mitigation measures are effective at reducing bycatch. A region-by-region plan for pinger use, as compared to other mitigation measures, is needed and should be ground-truthed with field monitoring for effectiveness.
- Requirements to use pingers must be coupled with a requirement for Member States to put in place enforcement. The Commission must follow-up on perceived infringements as judged through the reporting process.
- The use of pingers as a mitigation measure should be extended to include all relevant fisheries. A more focused risk-based approach is required for mitigation, pingers should be deployed only where necessary (to include all relevant vessels), i.e. in métiers with known high bycatch rates or fisheries with a perceived high risk of cetacean bycatch.
- The development of other types of pingers should not be constrained by technical specifications; rather Member States should be required to provide evidence that the devices they are using do indeed reduce bycatch.
- In high-risk areas and fisheries, the introduction of an approach similar to the U.S. Bycatch Reduction Plans is suggested. These plans outline a suite of approaches and potential measures, such as the use of more selective gears, area closures, real-time closures, avoidance measures and move-on rules, that could be implemented to reduce bycatch. In the EU, such plans could be developed within the context of the Regional Advisory Groups.

- Concurrent monitoring will confirm the effectiveness of the mitigation and/or the "high-risk" status of the fishery while at the same time developing or improving monitoring schemes in areas where there is evidence of a level of bycatch that is above thresholds set in order to identify sub-regions or métiers where pingers may be most effectively deployed.

6.4 Setting bycatch thresholds

- The EWG 19-07 **reiterates** the advice presented in ICES [4] that the European Commission establishes a process involving policy, scientists, managers and other stakeholders to derive candidate maximum bycatch thresholds for all the cetacean species most typically bycaught (e.g., harbour porpoises, common, striped and bottlenose dolphins, minke and humpback whales), based first on agreement of conservation objectives.
- The EWG 19-07 **remarks** that this type of assessments is conducted regularly (e.g., every 2-3 years) at regional level. This would help the prioritisation of populations in each region for immediate bycatch measures. Bycatch mitigation may be required in parallel to data collection and modelling.
- The EWG 19-07 **remarks** that conservation objectives and targets, which are an integral part of these assessments and simulations, be clearly quantified. Existing examples from CLA/RLA seem appropriate, as a starting point, but should be further tested and officially agreed.
- The EWG 19-07 **remarks** that RFMOs and Member States adopt roadmaps that help to define the overarching framework for management strategies. The EWG 19-07 developed a roadmap to help prioritise and implement bycatch monitoring and mitigation, including carrying out full assessments for populations and species most affected. The roadmap would identify those species and areas most at risk; the establishment of a regional bycatch reduction team may be an appropriate response to plan bycatch mitigation in such cases.

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[1] - Information on EWG participant's affiliations is displayed for information only. In any case, Members of the STECF, invited experts, and JRC experts shall act independently. In the context of the STECF work, the committee members and other experts do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members and experts also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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9 ANNEX 1. INTERNATIONAL STANDARD STATISTICAL CLASSIFICATION OF FISHING GEAR (ISSCFG)

The International Standard Statistical Classification of Fishing Gear (ISSCFG) was originally adopted during the 10th Session of the CWP (Madrid, 22-29 July 1980). The revised Classification – ISSCFG Revision 1 (Table 9) – has been endorsed and adopted for CWP Member's implementation by the CWP at its 25th Session (Rome, 23-26 February 2016).

Table 9. List of revisions and correspondences between International Standard Statistical Classification of Fishing Gear (ISSCFG) adopted in 1980 [88] and revised in 2013 [89].

Gear categories	Standard abbreviations	ISSCFG code	
		(Rev.1) 21/10/2010	29/07/1980
SURROUNDING NETS	-	**01**	01.0.0
Purse seines	PS	**01.1**	01.1.0
Surrounding nets without purse lines	LA	**01.2**	01.2.0
Surrounding nets (nei)	SUX	**01.9**	-
SEINE NETS	-	**02**	02.0.0
Beach seines	SB	**02.1**	02.1.0
Boat seines	SV	**02.2**	02.2.0
Seine nets (nei)	SX	**02.9**	02.9.0
TRAWLS	-	**03**	03.0.0
Beam trawls	TBB	**03.11**	03.1.1
Single boat bottom otter trawls	OTB	**03.12**	03.1.2
Twin bottom otter trawls	OTT	**03.13**	03.3.0
Multiple bottom otter trawls	OTP	**03.14**	-
Bottom pair trawls	PTB	**03.15**	03.1.3
Bottom trawls (nei)	TB	**03.19**	03.1.9
Single boat midwater otter trawls	OTM	**03.21**	03.2.1
Midwater pair trawls	PTM	**03.22**	03.2.2
Midwater trawls (nei)	TM	**03.29**	03.2.9
Semipelagic trawls	TSP	**03.3**	-
Trawls (nei)	TX	**03.9**	03.9.0
DREDGES	-	**04**	04.0.0
Towed dredges	DRB	**04.1**	04.1.0
Hand dredges	DRH	**04.2**	04.2.0
Mechanized dredges	DRM	**04.3**	11.2.0
Dredges (nei)	DRX	**04.9**	-

Gear categories	Standard abbreviations	ISSCFG code	
		(Rev.1) 21/10/2010	29/07/1980
LIFT NETS	-	**05**	05.0.0
Portable lift nets	LNP	**05.1**	05.1.0
Boat-operated lift nets	LNB	**05.2**	05.2.0
Shore-operated stationary lift nets	LNS	**05.3**	05.3.0
Lift nets (nei)	LN	**05.9**	05.9.0
FALLING GEAR	-	**06**	06.0.0
Cast nets	FCN	**06.1**	06.1.0
Cover pots/Lantern nets	FCO	**06.2**	-
Falling gear (nei)	FG	**06.9**	06.9.0
GILLNETS AND ENTANGLING NETS	-	**07**	07.0.0
Set gillnets (anchored)	GNS	**07.1**	07.1.0
Drift gillnets	GND	**07.2**	07.2.0
Encircling gillnets	GNC	**07.3**	07.3.0
Fixed gillnets (on stakes)	GNF	**07.4**	07.4.0
Trammel nets	GTR	**07.5**	07.5.0
Combined gillnets-trammel nets	GTN	**07.6**	07.6.0
Gillnets and entangling nets (nei)	GEN	**07.9**	07.9.0
TRAPS	-	**08**	08.0.0
Stationary uncovered pound nets	FPN	**08.1**	08.1.0
Pots	FPO	**08.2**	08.2.0

ANNEX 2. CETACEAN BYCATCH IN THE BLACK SEA SET NET FISHERIES

Information on bycatch rates of cetaceans comes from two sources (see Birkun et al. [66]):

1. Independent monitoring using on-board observers in the Black Sea fisheries;
2. Data collection by fishers' interviews.

It is generally accepted that by far the most reliable and useful way to estimate cetacean bycatch is through the use of independent monitoring using on-board observers, or more recently, fishery independent video surveillance and recording of fishing operations. A limited amount of such monitoring has been achieved in Turkey, Romania, Bulgaria and the Ukraine, with different levels of coverage and slightly different aims in each case.

Independent monitoring using on-board observers in the Black Sea fisheries (data source No. 1)

A summary of the number of observed hauls, reported number of cetaceans and bycatch rates per haul is given in Table 10. A striking aspect of these data is the relatively high cetacean bycatch rate, and specifically of harbour porpoise. There are several possible reasons why observed bycatch rates might be relatively high in the Black Sea. The most obvious is that the samples may have been taken from a biased sample of vessels, specifically those with high bycatch rates. Although this issue is not discussed in the published account of the sampling at Sinop (Turkey) in 2009 [66], it would seem plausible that an area of known high bycatch rate would have been chosen in order to test a mitigation device (in this case a pinger) in order to maximise power to detect a difference.

Certainly, the bycatch rates reported in 2009 by Gönener and Bilgin [66] are higher than those reported in western Turkish waters. Most of the Romanian samples were collected from survey boats inspecting nets that may have been illegally set – and these might also therefore represent a biased sample of fishing nets. However, the observations from Bulgaria and Ukraine were intended to be representative of the fleets concerned and it is much harder to propose any obvious bias in these samples.

Table 10. Summary of number of observations and bycatch rates by sampling base port.

Country	Base Port	Hauls observed	Porpoises	Porpoises per haul	Bottlenose dolphins	Bottlenose dolphins per haul
Bulgaria	Varna	24	19	0.79	2	0.083
Romania	Constanta	5	52	10.40	0	0.000
Turkey	Karaburun	14	24	1.71	1	0.071
Turkey	R.Feneri	4	3	0.75	0	0.000
Turkey	Sinop	20	92	4.60	0	0.000
Ukraine	Mirnyi	84	517	6.15	5	0.060

The possibility that the observed high bycatch rates might be due to higher porpoise densities in the Black Sea than elsewhere can be discounted based on the results from the sightings

survey reported in Table 10, which suggest densities of around 0.3 porpoise per km^2. The rates are in line with average densities found in the North Sea, and where the highest reported density for a single survey block was 0.598 animals per km^2.

A third potential issue is that the bycatch rates reported in Table 10 are in terms of number of animals *per observed haul*. Most of the observed hauls were set for turbot, while some (Ukrainian) samples were of dogfish nets. The length of the nets and the duration of time they had been fishing may have varied considerably, and may be greater in either respect (length or duration) than equivalent nets observed in other areas such as the North Sea. To try to address this, one can also consider the catch per unit of net length (km) or the bycatch per unit of effort (km of netting x days soak time). Unfortunately, not all the relevant data are available to generate such estimates for the entire data set, as net length and soak times are missing for some countries. It should be stressed that despite the seemingly consistent high bycatch rates observed in the four countries, sampling at the Black Sea level has still so far been limited both in terms of the geographical extent and in terms of absolute number of hauls observed. In no way can the observations made so far be seen as an adequate sample with which to obtain a regional overview of the scale of cetacean bycatch in the Black Sea. Most sampling has been focused at the time of year - late spring and early summer - which interview sampling suggests are when bycatch rates may be highest.

Bycatch estimates from fishers' surveys (data source No. 2)

It is widely thought that the most threatening fishing gear for cetacean bycatch in the Black Sea are turbot gillnets (Table 11). In addition, mid-water trawls were reported to bycatch cetaceans in Ukraine, but not in Bulgaria. There were no reports of cetacean bycatch in pound nets in Bulgaria, but some incidents were reported in both Turkey and Ukraine. About three-quarters of respondents in Bulgaria and Ukraine said that cetacean bycatch occurs in turbot nets, while this rose to 95 % among Turkish fishers, whereas only 33 % of Romanian respondents agreed. For other gillnets, the responses suggest a lower incidence, with 12-33 % of respondents noting cetacean bycatch in other types of gillnet.

Table 11. Stated porpoise bycatch rates (per boat per year) by gear type.

Gear Description	No of records	Represented no of boats	Total by-catches reported per year	Mean annual porpoise by-catch	Standard deviation of by-catch rate
Pound nets	20	30	0	0.00	0.00
Set gillnets	35	85	24	0.69	1.71
Set gillnets demersal	59	65	171	2.90	3.03
Set gillnets turbot	156	294	642	4.12	3.99
Set gillnets pelagics	2	2	0	0.00	0.00
Hand lines	2	4	0	0.00	0.00
Lift nets	2	12	0	0.00	0.00
Midwater trawls	10	22	2	0.20	0.42
Purse seine	41	41	48	1.17	2.25
Purse seine small pelagics	4	4	0	0.00	0.00

Recommendations from national experts

Experts from the national scientific teams from Romania, Bulgaria, Ukraine and Turkey have jointly proposed bycatch and general management measures for the Black Sea. The proposed measures are listed below:

1. Increase control of the Turbot fishery. This is needed particularly in the turbot closed season, from the 15th of April to the 15th of June. It was suggested that this control measure should include searching and grappling for both abandoned and illegally set gillnets during this period.
2. Improve enforcement of existing and newly proposed legislation. This can be achieved through improved Monitoring, Control and Surveillance (MCS) which should reduce (by detection or as a deterrent) illegal fishing activity and a large part of the fishing effort. Subsequently, the levels of bycatch will decrease depending on the fishery. This will be particularly applicable to 1.
3. Introduce a programme of education for fishers. This is recommended to improve their knowledge of the current legislation, how it is applied practically in the fishery and to develop an understanding in the fishing community of why measures to protect cetaceans are needed. Fishers may also be able to make suggestions for practical bycatch mitigation measures as they experience it first-hand, and will be more likely to comply with proposed mitigation measures if they are involved in their development.
4. Implement pilot projects for pingers on gillnets. This might be considered for at least the turbot gillnet fishery. However, this approach was seen as somewhat unlikely to be effective in the circumstances prevailing in the Black Sea.
5. Switch to alternative fishing gear. This should be considered for turbot, switching gear from gillnets to trawl or long-line, possibly in some restricted well-defined zones. Similarly, longlines might be used for dogfish rather than gillnets
6. Ban the use of Dogfish nets. Dogfish gillnets were considered dangerous to cetaceans (in particular for younger individuals) and juvenile turbot. They are also implicated in the illegal catch of sturgeon. This fishery should be replaced by long-lining.
7. Investigate the impact of the new 400mm mesh size with a max twine diametre of 0.5 mm. These nets are now in use in Romania and Bulgaria. They are to be introduced to Turkey in September 2016. Research into the impact of these gear modifications on cetacean bycatch should be initiated.
8. Establish a regionally coordinated observer programme. This is required to sufficiently monitor cetacean bycatch and establish a more robust series of estimates of bycatch rate by fishery. It should be conducted using randomised stratified sampling, and with clear sampling targets to determine bycatch levels with predefined measures of certainty. Existing data do not provide a coherent or reliable picture of the extent of bycatch, except that it appears to greatly exceed expected conservation targets. This will only be effective if there is better quantification of total fishing effort among the sampled sectors.

ANNEX 3. CETACEAN BYCATCH IN GREEK FISHERIES

Information on bycatch rates of cetaceans comes only from the Data Collection Programme, which is co-ordinated by the General Directorate of Sustainable Fisheries, Ministry of Rural Development and Food. Unfortunately, no other resources exist regarding the bycatch cetaceans in Greece. In the last year, a preliminary list of vulnerable species occurring in Greece and tentatively threatened by fisheries, including, among other, 7 mammals (Table 12), was established considering the results of the pilot study for monitoring of Protected Endangered and Threatened (PET) species carried out in 2017.

In 2018, the incidental bycatch of Protected Endangered and Threatened (PET) species was recorded by on-board/on-shore observers in eight different métiers (i.e., FPO, GNS, GTR, LLD, LLS, OTB, PS, SB) of the Greek fishing fleet. The number of professional fishing trips monitored during 2018 were 544 for GSA20, 1254 for GSA22, and 76 for GSA23. It is worth noting here that in Greece we have developed a long time series concerning cetacean and marine turtle strandings. According to these results, the majority of standings are due to set nets. In the eastern Ionian Sea (GSA20) bycatches of 18 PET species were recorded during demersal fisheries, including 8 elasmobranchs, 7 bony fish and 2 cephalopod species, whereas only 2 bony fish species were bycaught during small pelagic fisheries, and no mammals. In the Aegean Sea (GSA22), bycatches of 24 PET species were recorded in total. Twenty-two of them including 1 reptile, 12 elasmobranchs, 6 fish, 1 gastropod and both Eledonid species, but no mammals. In the waters around Crete Island (GSA23), among bycatches of demersal fisheries were identified 3 species of elasmobranchs, 2 of bony fish, but no mammals.

In conclusion, no bycatch of mammals was reported from Greek fisheries in all the three Greek GSAs.

Table 12. Preliminary list of vulnerable species for which bycatches were monitored in Greece in 2018 and recorded specimen per GSA. Source: Greek General Directorate of Sustainable Fisheries, Ministry of Rural Development and Food (Greek Data Collection Programme, Annex I-1F: Incidental bycatch of birds, mammals, reptiles and fish).

Vulnerable species group	Species	GSA20	GSA22	GSA23
mammals	*Delphinus delphis*			
mammals	*Stenella coeruleoalba*			
mammals	*Tursiops truncatus*			
mammals	*Grampus griseus*			
mammals	*Ziphius cavirostris*			
mammals	*Phocoena phocoena*			
mammals	*Monachus monachus*			

Data quality

In order to record the incidental bycatch of PET species, Greece has adopted the sampling protocols provided by MARE/2014/19 project. These protocols are dedicated to particular marine species groups, namely fish, sharks & rays (Protocol 2), cetaceans (Protocol 3), and sea turtles (Protocol 4).

These protocols, apart from the standard data collection measurements, require the recording of a series of additional information, such as several species-specific body size measurements, weight, sex determination, the estimation of the condition of the by-caught specimen, etc.

At the same time, the on-board observers followed a training course on rare PET species identification as well as on the completion of the relevant data sheets. Specifically, as far as bottom trawls are concerned, observers have been instructed to check for PET specimens in the catch at the opening of the codend; whenever this was not possible, observers were instructed to indicate that the cod-end was not checked in a haul.

In gillnets and hook-and-line fisheries, on board observers, were instructed to observe during the entire hauling process in order to be able to record any large incidental bycatches that never came on board. They were also instructed to observe the whole process of shooting. In circumstances where this was not feasible, observers were instructed to give an estimate of the proportion of the shooting process that they observed. Additionally, even though mitigation devices are hardly ever used by the Greek fishing fleet, observers have been instructed to report their use, whenever it is observed.

Finally, an additional measure to ensure the quality of provided data was the instruction to photograph the entire haul at the opening of the cod-end and before the shooting process begins. Whenever it was possible, observers also photographed the specimens of rare species caught, and, if feasible, they retained them in order to record biological parametres in the laboratory. The recorded data are stored in the databases of the institutions implementing the work plans, which was appropriately modified to be able to accept the corresponding data.

ANNEX 4. CETACEAN BYCATCH WITHIN THE ACCOBAMS AREA

Table 13 includes the outputs of ACCOBAMS-GFCM meeting held in 2008 [90], updated with the data reported by Di Natale [91], Di Natale and Navarra [56], and the experts knowledge available at EWG 19-07.

Definitions

- ✓ Bycatch: incidental catches
- ✓ Depredation: fish removal from gears by cetaceans
- ✓ Competition: exploitation of the same resources by both cetaceans species and fisheries to the detriment of one or other
- ✓ Positive interaction: any cooperative behaviour between cetaceans and fishers during fishing/hunting.

Table 13. Summary of interactions between cetacean and fisheries within the ACCOBAMS area. The areas (Geographical Statistic Area, GSA) are those adopted by GFCM (http://www.fao.org/gfcm/data/maps/gsas/en). Source: adapted from ACCOBAMS [90].

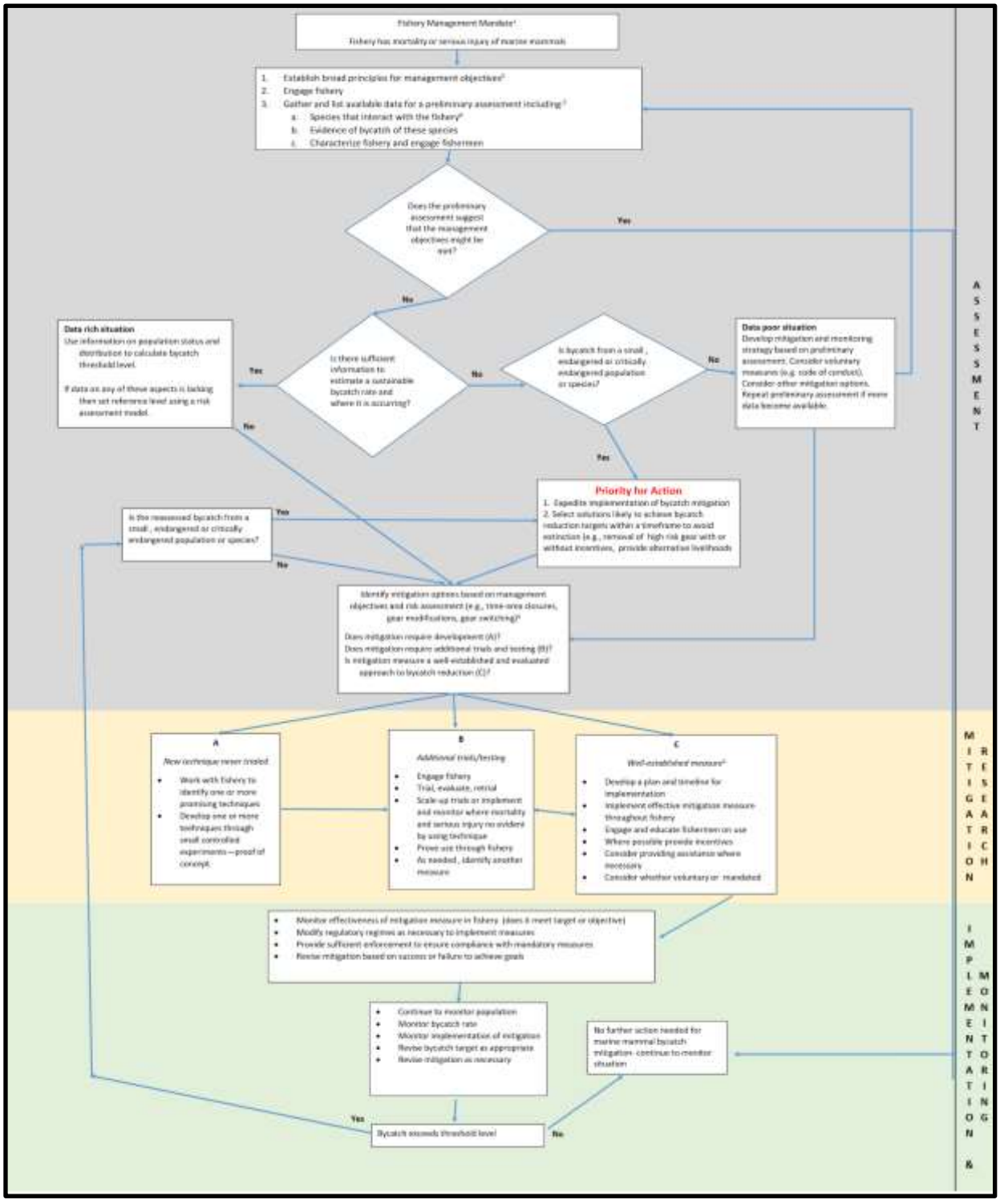
Species involved (species code)	**Bycatch**	**Depredation**	**Competition for resources**	**Positive interaction**	**When**	**Gear type (code)**	**GFCM GSA Concerned (& Country)**
Fin whale (*Balaenoptera physalus*)	**X**				Past	**LLD**	19 (Italy)
	X				Past	**GND**	10 (Italy)
			X		Past	**TBB**	10 (Italy)
Minke whale (*Balaenoptera acutorostrata*)	**X**				Present	**GN**	27 (Israel)
	X				Past	**GND**	10 (Italy)
Sperm whale (*Physeter macrocephalus*)	**X**				Past	**GND**	1 (Spain), 10-19 (Italy), 25 (Greece)
	X				Past	**LLD**	10-19 (Italy)
	X				Past	**HARP**	10 (Italy)
	X				Past	**GTR**	10 (Italy)
Long-finned pilot whale (*Globicephala melas*)	**X**	**X**	**X**		Past	**LLD**	9–21 (Italy)
	X				Past	**GND**	9–21 (Italy)
	X				Past	**LHP**	10 (Italy)

Species involved (species code)	Bycatch	Depredation	Competition for resources	Positive interaction	When	Gear type (code)	GFCM GSA Concerned (& Country)
		X	X		Present	**JHL**	10 (Italy)
		X			Present	**LX**	19 (Italy)
Cuvier's beaked whale (*Ziphius cavirostris*)	X				Present	**LL**	1, 5, 6 (Spain)
	X				Past	**GND**	1, 5, 6 (Spain), 10 (Italy)
	X				Past	**LLD**	10 (Italy)
Killer whale *(Orcinus orca)*		X	X		Present	**LHP**	0 Gibraltar Strait (Morocco, Spain)
		X	X		Past & Present	**LHM**	0 Gibraltar Strait (Morocco, Spain)
	X	X	X		Past & Present	**TRAP**	Atlantic/Gibraltar Strait (Morocco, Spain), 10 (Italy)
False killer whale (*Pseudorca crassidens*)	X				Past	**GND**	10 (Italy)
		X			Past	**LHP**	10 (Italy)
Risso's dolphin (*Grampus griseus*)	X				Present	**LL**	1, 5, 6 (Spain), 22 (Greece), 10 (Italy)
		X	X		Past	**LX**	10, 19 (Italy)
	X	X			Past & Present	**LLD**	9, 10, 15, 18, 21 (Italy & International waters)
		X	X		Present	**JHL**	10 and 19 (Italy)
	X				Past	**GND**	9, 10 (Italy), 22 (Greece)
	X				Past & Present	**GTR**	10, 18 (Italy)
Bottlenose dolphin (*Tursiops truncatus*)	X	X	X		Past & Present	**TBB**	1, 5 (Spain), 20 (Greece), 10, 13, 14, 15, 16 (Italy & International waters), 27 (Israel)
	X				Past	**GND**	9, 10, 18, 19 (Italy), 22 (Greece)
	X	X	X		Present	**GTN**	29 (Romania)
	X	X	X		Present	**GNS**	29 (Romania, Bulgaria and international waters)
	X	X	X	X	Past & Present	**GTR**	5 (Spain), 8 (France), 9, 10, 11, 15, 16, 18, 19 (Italy & International waters)

Species involved (species code)	Bycatch	Depredation	Competition for resources	Positive interaction	When	Gear type (code)	GFCM GSA Concerned (& Country)
	X	**X**	**X**	**X**	Past & Present	**GN**	8 (France), 10 (Italy), 17 (Montenegro), 20, 22 (Greece), 27 (Israel)
	X	**X**	**X**		Past & Present	**GNS**	9, 10, 11, 15, 16, 18, 19 (Italy & International waters), 20 (Greece)
	X	**X**	**X**		Past & Present	**NK**	1, 5, 6 (Spain), 20, 22 (Greece),
	X	**X**			Past & Present	**LLD**	9, 10, 11, 13, 15, 16, 18, 19, 21 (Italy & International waters)
	X				Past	**HARP**	10 (Italy)
	X	**X**	**X**		Past & Present	**PS**	10, 15, 16, 18, 19 (Italy & International waters)
		X			Present	**PS1**	9 (Italy)
		X			Present	**FPO**	10 (Italy)
		X	**X**		Present	**JHL**	10 (Italy)
	X	**X**	**X**		Past & Present	**LX**	10, 16, 19 (Italy)
Short-beaked common dolphin (*Delphinus delphis*)			**X**		Past & Present	**PS1**	10 (Italy)
	X		**X**		Past & Present	**PS2**	20 (Greece)
	X				Past & Present	**GN**	22(Greece)
	X				Past	**GND**	00, 0, 1(Morocco & Spain), 4, 5 (International waters); 10 (Italy)
	X	**X**	**X**		Present	**GTN**	29 (Romania)
	X	**X**			Past	**LLD**	9, 10, 11, 18, 19 (Italy and international waters)
	X				Past & Present	**NK**	1 (Spain)
Striped dolphin (*Stenella coeruleoalba*)	**X**				Present	**RG**	7 (France)
	X		**X**		Past	**GND**	00, 0, 1 (Spain), 4, 5, 9, 10, 11, 18, 19 (Italy and international waters), 22 (Greece)
	X				Present	**GN**	17 (Montenegro), 27 (Israel)

Species involved (species code)	Bycatch	Depredation	Competition for resources	Positive interaction	When	Gear type (code)	GFCM GSA Concerned (& Country)
	X				Past & Present	**LLD**	10 (Italy and international waters)
		X	**X**		Past & Present	**LX**	10, 19 (Italy and international waters)
		X	**X**		Present	**JHL**	10 and 19 (Italy)
	X				Past	**HARP**	10 (Italy and international waters)
	X				Present	**NK**	1, 6 (Spain), 20, 22 (Greece)
Harbour porpoise (*Phocoena phocoena*)	**X**				Present	**NK**	00 (Spain), 22 (Greece)
	X	**X**	**X**		Present	**GTN**	29 (Romania)
	X	**X**	**X**		Past & Present	**GNS**	29 (Romania, Bulgaria and international waters)
Rough-toothed dolphin (*Steno bredanensis*)	**X**				Present	**GN**	27 (Israel)
		X			Present	**LLD**	21 (International waters)
Unidentified delphinid species	**X**				Past	**GND**	10, 19 (Italy)
	X				Present	**NK**	20, 22 (Greece)

ANNEX 5. DECISION TREE FOR THE IDENTIFICATION AND IMPLEMENTATION OF EFFECTIVE BYCATCH MITIGATION MEASURES



Source: FAO Expert Workshop on Means and Methods for Reducing Marine Mammal Mortality in Fishing and Aquaculture Operations [67].

ANNEX 6. LIST OF ABBREVIATIONS

ACCOBAMS ..... Agreement for the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area

ADD ..... Acoustic Deterrent Devices

ASCOBANS..... Agreement on the Conservation of Small Cetaceans of the Baltic, Northeast Atlantic, Irish and North Seas

BES..... Regional database and estimation system

BRA ..... Bycatch Risk Assessment

BRP ..... Bycatch Reduction Plan

CCSBT..... Commission for the Conservation of Southern Bluefin Tuna

CFP..... Common Fisheries Policy

CLA..... Catch Limit Algorithm

CO ..... Conservation Objective

DCF..... Data Collection Framework

EWG ..... European Working Group

FCS..... Favourable Conservation Status

GES..... Good Environmental Status

GFCM ..... General Fishery Commission for the Mediterranean

GSA ..... Geographical subareas

HD ..... Habitats Directive

HELCOM..... Baltic Marine Environment Protection Commission (Helsinki Commission)

IATTC ..... Inter American Tropical Tuna Commission

ICCAT ..... International Commission for the Conservation of Atlantic Tunas

ICES ..... International Council for the Exploration of the Sea.

IOTC..... Indian Ocean Tuna Commission

IWC..... International Whaling Commission

MAP..... Multi-Annual Programme

MMPA ..... Marine Mammal Protection Act

MSFD ..... Marine Strategy Framework Directive

MOP..... Meeting of the parties

MS ..... Member State

NAMMCO..... North Atlantic Marine Mammal Commission

OSPAR ..... Convention for the Protection of the Marine Environment of the North-East Atlantic

PBR ..... Potential Biological Removal

PETS..... Protected, Endangered and Threatened Species

RCG ..... Regional Coordination Group

RDBES ..... Regional DataBase and Estimation System

REM ..... Remote Electronic Monitoring

RFMO ..... Regional Fishery Management Organisation

RLA ..... Removal Limit Algorithm

SCRDBES ..... Steering Committee of the Regional Database and Estimation System

WCPFC ..... Western and central pacific fisheries commission

WGBYC ..... Working Group on Bycatch of Protected Species (ICES)

WGCATCH ..... Working Group on Commercial Catches (ICES)

WKPETSAMP ... Joint WGBYC/WGCATCH Workshop on sampling of bycatch and PET species

WKREV812 ..... Workshop to Evaluate the Implementation of Council Regulation (EU) 812/2004

10 BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
https://stecf.jrc.ec.europa.eu/

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STECF

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