WORKSHOP ON MITIGATION MEASURES TO REDUCE BYCATCH OF SHORT-BEAKED COMMON DOLPHINS IN THE BAY OF BISCAY (WKEMBYC2)

Please note: The WKEMBYC2 report was updated in June 2023 with three annexes (annexes 6, 7 and 8). Two of these annexes relate to mitigation scenarios applied to the Bay of Biscay (Subarea 8) only.

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International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Editors

Ailbhe Kavanagh • Hélène Peltier

Authors

Nair Vilas Arrondo • Matthieu Authier • Mikel Basterretxea • Fiona Bigey • Laurent Dubroca • Sandra Farinha • Aurélien Henneveux • Allen Kingston • Kelly Macleod • Ana Marçalo • Estanis Mugerza
Paula Gutierrez Muñoz • Patrick Murphy • Simon Northridge • Camilo Saavedra Penas • Graham Pierce
Floriane Plard • Vincent Ridoux • Thomas Rimaud • Irene Fernandez Rodriguez • Gudjon Sigurdsson
Quiterie Sourget

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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i Executive summary[1]

Following the special request from the DG MARE, the Workshop on mitigation measures to minimize bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2) was established by ICES. WKEMBYC2 was tasked with updating and revaluating the scenarios previously proposed in the ICES special request advice in 2020. The group was asked to consider recent data on bycatch of common dolphins in commercial fisheries and total fishing effort in the Bay of Biscay and Iberian Coast ecosystem, as well as taking into account results from any mitigation trials carried out since the meeting in 2020.

In section 2 of this report the efficacy of the scenarios provided during WKEMBYC in 2020 were reassessed using updated bycatch estimates calculated from at-sea monitoring and stranding data collected between 2019 and 2021. Scenarios and methods remained unchanged, to ensure comparability between both evaluations. Similarly, PBR values considered in the 2020 scenarios were again considered here, with the addition of the mPBR which was developed by OSPAR since the last workshop.

The annual mortality due to bycatch inferred from French strandings in the Bay of Biscay and along the Western Channel was estimated at about 9,040 (95%CI [6640 – 13 300]) common dolphins between 2019 and 2021. In the Bay of Biscay and Iberian Coast (areas 8 and 9), the mean annual bycatch estimated from at-sea observations between 2019-2021 across all métiers was 5938 (95% CI 3081-9700) common dolphins. The abundance estimate and PBR values used in this report were the same as those used in 2020; with common dolphin abundance estimated to be 634 286 (CV=0.307) for the European Atlantic Assessment Unit, and PBR for the species calculated as 4926 individuals per year. The management objective of PBR is to ensure that "a population will remain at, or recover to, its maximum net productivity level (typically 50% of the populations carrying capacity), with 95% probability, within a 100-year period".

A modified PBR (mPBR) value of 985 was also used, with the management objective of ensuring "a population should be able to recover to or be maintained at 80% of carrying capacity, with probability 0.8, within a 100-year period". Considering bycatch estimates calculated from at-sea monitoring, scenarios with a combination of pingers on OTM/PTB and at least 4-week closure in winter can reach the management objective of bycatch remaining below the PBR. The removal bycatch over a three-month period between the January and March winter period, and an additional month closure in July/August potentially reduces bycatch below the mPBR level for at-sea monitoring bycatch estimates alone. Considering estimates inferred from strandings, a minimum of 6-week closure combined with pingers can achieve the objective of reducing bycatch below PBR. None of the scenarios can reduce bycatch below mPBR for either monitoring and stranding bycatch estimates. The narrower the fishery closure, the higher the risk of not achieving the management objective, as the peak of mortality can be missed.

In section 3 of the report the workshop participants chose to further explore the scenarios with bycatch rates and estimate bycatch at a finer spatial and temporal scale and to consider additional mitigation measures based on results of newly conducted preliminary trials. This exploratory analysis allowed particular areas, métiers or periods with evidence of elevated bycatch rates to be identified at higher resolution, however, this approach requires significant at-sea monitoring in all strata. If such data were available, this method could be used to highlight specific areas,

[1] The summary was edited based on suggestions from reviewers after the Advice Drafting Group in December 2022.

métiers and periods where particular effort in vessel observation should be deployed or mitigation measures implemented.

WKEMBYC2 also recommended a series of monitoring actions to improve bycatch estimates, monitoring to data analysis, mitigation and the assessment of the northeast Atlantic common dolphin.

In the initial WKEMBYC2 workshop and report that took place in November 2022, mitigation scenarios were applied to both the Bay of Biscay (ICES Subarea 8) and Iberian waters (ICES Division 9a). In order to facilitate direct comparison with previous work (ICES, 2020a), when only the Bay of Biscay was considered (ICES Subarea 8), an additional evaluation of mitigation scenarios, considering ICES Subarea 8 only, was conducted in May 2023 (See Annexes 7 and 8 in this report). Taking into account data from 2019–2021 and bycatch mortality estimates based on strandings data, none of the fifteen proposed mitigation scenarios can reduce bycatch of the common dolphin in the Bay of Biscay below the potential biological removal (PBR) limit. Based on data from 2019–2021 and bycatch estimates derived from at-sea monitoring data, six of the fifteen proposed mitigation scenariosare are likely to reduce bycatch of the common dolphin below the PBR limit.

ii Expert group information

Expert group name	Workshop on mitigation measures to reduce bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2)
Expert group cycle	Annual
Year cycle started	2022
Reporting year in cycle	1/1
Chairs	Hélène Peltier, France
	Ailbhe Kavanagh, Ireland
Meeting venue and dates	24-28 October 2022, Copenhagen, Denmark

1 Introduction

1.1 Review of ToRs

Following the special request from the DG MARE to the ICES, the Workshop on mitigation measures to minimize bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2) was established. Based on available information provided to ICES by the European Commission and work to be done by WKEMBYC2 has been requested to provide advice regarding three Terms of Reference:

a) consider recent data (2019-2021) on bycatch of short-beaked common dolphins in commercial fisheries and total fishing effort in the Bay of Biscay and off the Iberian coast to estimate bycatch mortality. Estimates will be based on at-sea observer schemes as well as in reverse drift modelling of strandings.

b) evaluate the scenarios that consider the application of specific bycatch mitigation measures and the proposed management objectives as previously recommended in the ICES special request advice *eu.2020.04*. Results from the mitigation trials should be taken into account in scenarios development and recommendations as appropriate.

c) For each scenario tested in the ICES special request advice *eu.2020.04*, revisit and if necessary, update i) relative risk of not achieving the specific management objective, and ii) comment on the scenario risk, as previously documented in the ICES special request advice *eu.2020.04*.

The work described under ToR a), ToR b) and ToR c) is needed to update the work carried out by WKEMBYC in 2020 in relation to bycatch of short beaked common dolphin in the Bay of Biscay.

In section 2 the efficacy of the scenarios provided during WKEMBYC in 2020 were reassessed using updated bycatch estimates calculated from at-sea monitoring and stranding data collected between 2019 and 2021. Scenarios and methods remained unchanged, to ensure comparability between both evaluations. Similarly, PBR values considered in the 2020 scenarios were again considered here, with the addition of the mPBR which was developed since the last workshop.

In section 3 the workshop participants chose to further explore the scenarios. In summary, in this section bycatch rates and estimated bycatch were explored at a finer spatial and temporal scale, with additional mitigation measures considered based on results of newly conducted trials. This exploratory analysis allowed particular areas, métiers or periods with evidence of elevated bycatch rates to be identified at higher resolution.

1.2 Summary of previous work carried out in 2020 (WKEMBYC)

Following a submission from 26 European environmental non-governmental organizations (NGOs) to the European Commission (DG MARE) concerning the introduction of emergency measures to mitigate bycatch of common dolphins (*Delphinus delphis*) in the Bay of Biscay and harbour porpoises (*Phocoena phocoena*) in the Baltic Sea, ICES was asked in 2020 to provide advice on potential emergency measures needed to mitigate bycatch of these two populations. In a standard ICES advisory process, the request formulation step is followed by a step of knowledge synthesis conducted by expert groups. A total of 26 experts participated in the first WKEMBYC meeting, including members of academic research institutions and government scientific agencies, national and EU civil service, fishers' organizations, NGOs and environmental consultancies. WKEMBYC took place online. The request from DG MARE to ICES was formulated in two steps:

Step 1

- Review the current conservation status and threats to the populations, including the threat due to commercial fisheries bycatches, taking account of any further relevant information;
- Evaluate whether the measures proposed by NGOs are necessary and appropriate, in the context of EU law, in particular Articles 2 and 12 of Regulation (EU) 1380/2013; Article 3(2) of Regulation (EU) 1241/2019, and Article 1(i) of Council Directive 92/43/EEC.

Step 2

- If evaluated measures are deemed inappropriate, to advise on any alternative measures that could be used to ensure a satisfactory conservation status of these stocks, in the context of EU law as above.

WGMME and WGBYC dedicated TORs were aimed at dealing with step 1, whereas WKEMBYC was asked to respond to step 2. In the context of the special request, the word "appropriate" is understood relative to the conservation of the species.

In this context and considering that considerable analyses of recent data had been conducted during the WGMME and WGBYC workshops (ICES, 2020a, see annexes 6 and 7), the goal of WKEMBYC was not to conduct additional analyses. Instead, the meeting aimed to build upon these previous works to formulate explicit recommendations regarding the emergency measures requested by the NGOs, possible amendments to these measures, and alternative or complementary measures that could be taken to ensure a satisfactory conservation status of the Baltic Sea harbour porpoise and the Northeast Atlantic common dolphin populations.

The work described under ToR a) and ToR b) was needed to evaluate whether the fisheries emergency measures for the Northeast Atlantic common dolphin in the Bay of Biscay, described in the information provided to ICES by the European Commission, were necessary and appropriate, in the context of EU law, in particular Articles 2 and 12 of Regulation (EU) 1380/2013; Article 3(2) of Regulation (EU) 1241/2019, and Article 1(i) of Council Directive 92/43/EEC. Also, the WKEMBYC contributed to evaluating alternative measures that could be used to ensure a satisfactory conservation status of these stocks, in the context of EU law.

WKEMBYC reviewed the conclusions of the working groups with regard to the NGO-proposed measures; and considered that measures were necessary but suggestions of closures needed to be further explored. Also, other measures (e.g. pingers), should be given due consideration.

A number of different bycatch reduction scenarios were explored using available fishing effort, bycatch rate and strandings data to assess the appropriateness of the 4-month closure proposed in the NGO document. A variety of realistic scenarios were discussed and WKEMBYC agreed they should include several different temporal fisheries closures (in line with the approach proposed by the NGOs), year-round total fishing effort reductions, technical mitigation approaches (in this case, pingers) and combinations of temporal closures and use of pingers. It was agreed that mitigation and/or closures applying to all fisheries 'responsible for causing bycatch' would be a more equitable and reliable method of achieving bycatch reduction. This raised the point that there are multiple ways of achieving a reduction in bycatch in relation to different closures and mitigation measures. However, it was noted that at the time of the workshop in 2020 there were no conclusively validated mitigation tools for common dolphin bycatch in gillnets and the widescale use of acoustic deterrents in these fisheries could exclude common dolphins from some of the Bay of Biscay. In addition, the issue of displacement of fishing effort in response to the introduction of management measures, particularly for larger vessels, needs to be addressed.

To conclude, and considering the management objectives used by WKEMBYC, the advised "emergency measures" by ICES (ICES, 2020b) were:

-to reduce annual common dolphin mortality to the Potential Biological Removal (PBR) limit:

Scenario E: 4-week closure for all métiers (mid. Jan.-mid Feb.)

Scenario B: annual fishing effort reduction of 40% in métiers of concern

Scenario J: pinger PTM/PTB year-round + 2 week closure all other fisheries (mid-Jan.-end of jan.)

-to reduce annual common dolphin mortality to less than 75% of the PBR:

Scenario G: pinger PTM/PTB year-round + 6 week closure for all other métiers of concern (mid. Jan.-end of Feb.)

Scenario I: pinger PTM/PTB year-round + 4 week closure for all other métiers of concern (mid. Jan.-mid Feb.)

Scenario D: 6 week closure (mid. Jan.-end of Feb.) for all métiers of concern

- to reduce annual common dolphin mortality to less than 50% of the PBR:

Scenario L: pinger PTM/PTB year-round + 2 month closure (mid. Jan.-mid March.) for all métiers of concern

Scenario C: 2 month closure (mid. Jan.-mid March.) for all métiers of concern

Scenario H: pinger PTM/PTB year-round + 6 week closure for all métiers of concern (mid. Jan.-end of Feb.)

- to reduce annual common dolphin mortality to less than 10% of the PBR:

Scenario M: pinger PTM/PTB year-round + 4 month closure (Dec. to March) for all métiers of concern

Scenario N: pinger PTM/PTB year-round + 4 month closure (Jan. to March + mid-July – mid.Aug.) for all métiers of concern

Scenario O: 4 month closure (Jan. to March + mid-July – mid.Aug.) for all métiers of concern

1.3 Relevant legislation

The most relevant national (FR, ES, PT) and international (EU) legislation regarding fishing and cetacean bycatch monitoring and mitigation are summarised below. We draw on the summary provided in the previous WKEMBYC report, as well as on material compiled for deliverable 3.1 of the CetAMBICion project (DG ENV / MSFD 2020). Extracts from legislation shown or highlighted here do not represent full legal obligations and are presented for information and discussion only. The views presented are the views of the authors and do not purport to represent the official views of ICES or the European Commission.

European Union environmental legislation

There are two major environmental protection Directives in the European Union that relate to marine mammals. The Habitats Directive (HD; **Council Directive 92/43/EEC** [1]), and the Marine Strategy Framework Directive (MSFD; **Directive 2008/56/EC** [2]) aimed specifically at the conservation of the marine environment.

Habitats Directive: The HD is one of the "nature directives" of the EU. It consists of 24 articles of legislation to which all Member States must comply. Article 12 requires establishing a system to monitor the incidental capture and killing of animal species listed in Annex IV (which includes all cetaceans). Based on the information gathered, Member States "*shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned*".

Marine Strategy Framework Directive: The MSFD is European legislation that aims to protect the marine environment. It requires the application of an ecosystem-based approach to the management of human activities, enabling a sustainable use of marine goods and services. It is composed of 11 Descriptors of the ecosystem. Relevant objectives include: "*Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions*" (D1 - Biodiversity), and "*All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long term abundance of the species and the retention of their full reproductive capacity*" (D4 - Food webs). Furthermore, **Commission Decision 2017/848** [3], with reference to species of birds, mammals, reptiles and non-commercially-exploited species of fish and cephalopods, which are at risk from incidental by-catch, defines the following criteria for Good Environmental Status (GES): "*The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long term viability is ensured*" (criterion D1C1) and "*The population abundance of the species is not adversely affected due to anthropo-genic pressures, such that its long term viability is ensured*" (criterion D1C2).

<u>Common Fisheries Policy and related Regulations</u>

The Common Fisheries Policy (CFP) is the fisheries policy of the EU. In 2002, the EU established a pan-European monitoring programme of commercial fleets under the CFP (**Council Regulation (EC) No 2371/2002** [4], later repealed by **Regulation (EU) No 1380/2013** [5], which rules on the collection, management and use of the data are established in **Regulation (EU) No 2017/1004** [6]), including both on-shore and at-sea sampling. The latter Regulation was mainly designed to compile discards data, however, the implementation of the Landing Obligation regulation, introduced in 2015 and fully in forced since 2019 (**Regulation 2019/1241** [7]), which replaced **Regulation 812/2004** [8], requires the sampling protocols also to include the recording of bycatch and incidental catches, and also the provisions on the use of acoustic deterrent devices for bycatch mitigation. The technical descriptions of these devices are contained in the **Commission Implementing Regulation (EU) 2020/967** [9]. The last multiannual Union programme for the collection and management of data in fisheries and aquaculture (from 2022) was established in the **Commission Delegated Decision (EU) 2021/1167** [10].

Regulation 1380/2013 includes the implementation of "*the ecosystem-based approach to fisheries management so as to ensure that negative impacts of fishing activities on the marine ecosystem are minimised, and coherence with the Union environmental legislation", in particular with the objective of achieving a good environmental status by 2020 as set out in Directive 2008/56/EC (MSFD)*. Article 12 concerns "*Commission measures in case of a serious threat to marine biological resources*", in 12(1) it states: "*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)*"; and in 12(3) states: "*Before expiry of the initial period of application of immediately applicable implementing acts referred to in paragraph 1, the Commission may, where the conditions under paragraph 1 are complied with, adopt immediately applicable implementing acts extending the application of such emergency measure for a maximum period of six months with immediate effect. Those implementing acts shall be adopted in accordance with the procedure referred to in Article 47(3).*"

Regulation (EU) No 2017/1004 establishes the rules on the collection, management and use of the data in fisheries. It is the so-called Data Collection Framework (DCF).

Regulation 2019/1241 is known as the Landing Obligation regulation. It requests Member States to "*take the necessary steps to collect scientific data on incidental catches of sensitive species*" and, given "*scientific evidence, validated by ICES, STECF, or in the frame-work of GFCM, of negative impacts of fishing gear on sensitive species*", to "*submit joint recommendations for additional mitigation measures for the reduction of incidental catches*". The relevant objectives of this regulation include: (i) ensure that incidental catches of sensitive marine species, including those listed under HD, that are a result of fishing, are minimised and where possible eliminated so that they do not represent a threat to the conservation status of these species, and (ii) ensure, including by using appropriate incentives, that the negative environmental impacts of fishing on marine habitats are minimised. Its targets include that incidental catches of marine mammals do not exceed levels provided for in Union legislation and international agreements that are binding on the Union. Provisions on vessel sizes, areas and fishing gears for monitoring and mitigation measures contained in the **Council Regulation (EC) No 812/2004** are retained in this Regulation, as well as the provisions on the use of acoustic deterrent devices from the same Regulation. The technical descriptions of these devices are contained in the **Commission Implementing Regulation (EU) 2020/967**, together with the mandate of the devices to remain functional throughout the fishing operation, not only when nets are set.

Commission Delegated Decision (EU) 2021/1167 established the multiannual Union programme for the collection and management of data in fisheries and aquaculture sectors from 2022. Art. 4.1 states that data on mammals shall be collected on occurrences (as a minimum the numbers of individuals per species).

National legislation:

In addition to transposing the European directives into national legislation, the Member States that share the waters of the Bay of Biscay and the Iberian Peninsula have taken different actions to study, protect and reduce the accidental capture of cetaceans. The main national legislation in this regard is listed below.

France:

- Arrêté du 27 juillet 1995 fixant la liste des mammifères marins protégés sur le territoire national, abrogé le 27 juillet 2011, Disponible sur [https://www.legifrance.fr] : list of protected marine mammals on French territory.
- Articles L. 219-9 to L. 219-18 and R. 219-2 to R. 219-10 of environmental code (MSFD transposition into French regulations)
- Décret n° 2017-724 du 3 mai 2017 integration of maritime planification and marine habitat action plan for metropolitan French waters
- **Arrêté DEVL1240628A du 17 décembre 2012** [11] defines the GES under the MSFD.

- **Arrêté DEVL1110724A du 1er juillet 2011** [12] protects marine mammal species and mandates fishermen to report all marine mammal bycatch that may happen during a fishing operation.
- **Plan d'action du gouvernement pour lutter contre les captures accidentelles de petits cétacés en Atlantique** [14] builds on the two previous regulations, strengthening bycatch monitoring (either by onboard observers or electronic monitoring; e.g. CCTV), advancing knowledge and finding solutions to reduce bycatch. It is the French bycatch reduction national action plan in French metropolitan waters.
- **Plan d'actions pour la protection des cétacés** [15] is the French cetacean protection action plan. Its objectives are to consolidate the knowledge of cetacean populations and to promote changes in practices in order to reduce anthropogenic pressure, particularly from fishing techniques, noise and coastal pollution.
- **Arrêté MERM2033160A du 27 novembre 2020** [16] laying down the obligation to equip pelagic trawls with acoustic deterrent devices in the Bay of Biscay.

Spain:

- **Ley 42/2007** [17] represents the basic rule for nature protection in Spain, and includes the transposition of the Habitats Directive.
- **Ley 41/2010** [18] was designed for the protection of the marine environment, and transposes the MSFD in Spain.
- **Real Decreto 139/2011** [19] develops the list of wildlife species in special protection regime and the catalogue of threatened species in Spain.
- **Real Decreto 957/2018** [20] modifies the law 41/2010 and includes the lists of characteristics, pressures and impacts of anthropogenic pressures on the marine environment, including a reference to bycatch.
- **Plan Nacional para la reducción de las capturas accidentales en la actividad pesquera** [21] establishes the plan to reduce bycatch in fisheries activities in Spain.
- **Orden APA/1200/2020** [22] establishes the obligation to comply with various mitigation measures from January 1, 2020, including the use of acoustic deterrent devices in trawlers operating in North Atlantic waters, and the application of movement rules, as well as the obligation of landing accidental catches of cetaceans, and the commitment to increase knowledge on these populations.

Portugal:

- **Decreto Lei 263/81** [23] regulates the protection of marine mammals in the Portuguese coastal zone and continental exclusive economic zone by prohibiting the deliberate capture, transport, killing and sale in markets of these animals when bycaught in fishing gears or found stranded.
- **Lei 11/87** [24], repealed by **Lei 19/2014** [25] defines the basis of environmental laws in Portugal.
- **Decreto Lei 140/99** [26], as amended by the **Decreto Lei 49/2005** [27], transposes the Habitats Directive.
- **Resolução do Conselho de Ministros 152/2001** [28], repealed by **Resolução do Conselho de Ministros 55/2018** [29] is the National Strategy for Nature Conservation and Biodiversity.
- **Decreto Lei 108/2010** [30], repealed by **Decreto Lei 201/2012** [31], **Decreto Lei 136/2013** [32], **Decreto Lei 143/2015** [33], and **Decreto Lei 137/2017** [34], transposes the MSFD and sets the legal framework for the adoption of measures to ensure the GES of marine waters.

- **Portaria nº 172/2017** [35], makes mandatory the use of acoustic deterrent devices where it operates (North-central western coast - ICES Area 9a) and especially in areas with high abundance of porpoises and common dolphins.
- **Despacho nº 19/DG/2020** [36] determines the characteristics of the use of acoustic deterrent devices in beach seines.

1.4 Common dolphin knowledge

Populations, management units and conservation status

Genetic evidence suggests that common dolphins in the Northeast Atlantic form a single panmictic population, separate from those of the Northwest Atlantic and the Mediterranean Sea (Westgate, 2007; Evans and Teilmann, 2009). ICES WGMME (ICES, 2014) supported an earlier proposal from an ASCOBANS workshop (Evans and Teilmann, 2009) that the entire Northeast Atlantic range of common dolphins should be considered as a single Management Unit (MU). Within the MU, there is some evidence for the existence of separate neritic and ocean ecological stocks (Lahaye *et al*., 2005; Caurant *et al*., 2011).

For the ICES WGBYC and WKEMBYC reports in 2020 (ICES 2020c, 2020a), the boundaries of the Northeast Atlantic "Assessment Unit" (AU) were defined by those of the SCANS-III (Hammond *et al*., 2017) and ObSERVE (Rogan *et al*., 2018) surveys as these provided the most recent summer abundance estimates and greatest coverage of the population (Figure 1.1).

Under the Habitats Directive, the 2013–2018 assessment for common dolphin status in the Atlantic Marine Region varied between Member States. France and Spain assessed the status of common dolphin as U2 (unfavourable/bad). Portugal concluded the status of common dolphin to be U1 (unfavourable/inadequate). The overall automatic assessment is a mixture of FV (favourable), XX (unknown) and U1, although it should be noted that all methods of combining the data show FV to be the smallest component.

Distribution and movements

In the Northeast Atlantic, the common dolphin occurs from the northwest of Africa to the west of Norway (it is rarely seen further north than 62°N). It is also present off the Faroe Islands and the European Macaronesian archipelagos (Azores, Madeira, and Canary Islands). It is more common in the western part of the Northeast Atlantic, at least as far as the mid-Atlantic ridge (40°W), and rarer in the eastern part, namely in the eastern English Channel, the North Sea, the Danish Belt Sea, and the Baltic Sea (Kinze, 1995; Reid *et al.*, 2003; Camphuysen and Peet, 2006; Doksæter *et al.*, 2008; Cañadas *et al*., 2009; Kinze *et al*., 2010; Evans and Bjørgec, 2013; Murphy *et al*., 2013a; Hammond *et al*., 2017; Correia *et al*., 2019; Saavedra *et al*., In Press)).

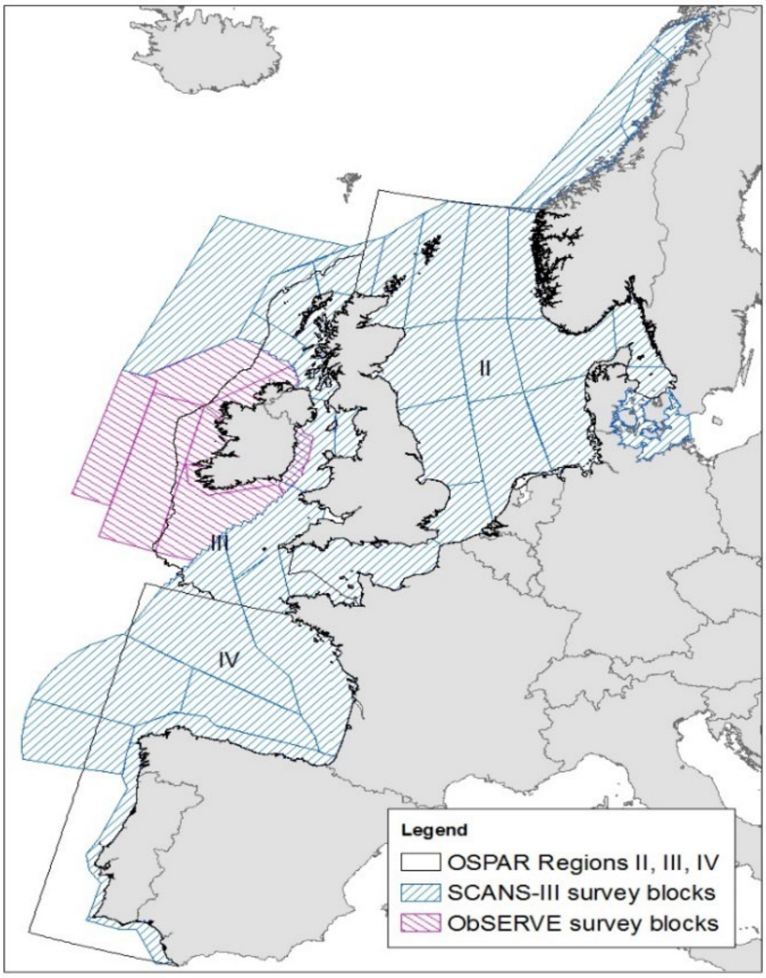

Figure 1.1. SCANS-III and ObSERVE surveys areas that approximate the Northeast Atlantic Assessment Unit (AU) for the purposes of this report. The OSPAR Regions correspond to the AU proposed by ICES Advice (2014a).

Regional surveys have provided evidence of seasonal movements of common dolphins. The ObSERVE programme undertook aerial surveys in both summer and winter 2015/2016 in Irish waters and noted that densities of common dolphins were much higher during winter than summer (Rogan *et al*., 2018). Further south, in the Western English Channel and the northern Bay of Biscay, seasonal sightings rates during fixed-transect opportunistic surveys on ferries were also higher during winter, at least over the period 1995–2002 (Macleod and Walker, 2005; Brereton *et al*., 2005). In 2019, results from four aerial surveys, conducted over part of the shelf of the Bay of Biscay to detect seasonal changes in densities and distribution of cetaceans, indicated that the density of common dolphins was highest in winter, mostly around the 100 m isobath (Van Canneyt *et al*., 2020).

Seasonal movements of common dolphins in the Northeast Atlantic were also suggested in recent work by Waggitt *et al*. (2020). The Marine Ecosystems Research Programme (MERP) collated cetacean survey effort amounting to around three million kilometres from more than fifty research groups in Northwest European seas covering the period 1978–2018 (but with most effort in the last 15 years). In the Bay of Biscay, the maps for common dolphin showed the highest densities concentrated along the shelf break (over the 200–2000 m contour), particularly in winter.

Although the small-scale surveys obviously have limited spatial coverage, the above-mentioned results suggest the occurrence of seasonal movements, with the highest densities of common dolphin seen in winter in the inner part of the continental shelf of the Bay of Biscay. It is not clear whether there is an implication that the large-scale abundance surveys in summer could have underestimated total abundance or whether these seasonal movements occur entirely within the area covered by the surveys

Abundance

Estimates of the abundance of common dolphins in European Atlantic waters are available from the large-scale multinational SCANS-II and CODA surveys in summer 2005 and 2007 (Hammond *et al*., 2013; CODA, 2009) and the SCANS-III and ObSERVE surveys in summer 2016 (Hammond *et al*., 2017; Rogan *et al*., 2018). These surveys covered the majority of EEZ waters in the European Atlantic but excluded offshore waters in the Portuguese EEZ. The area covered by the SCANS and ObSERVE surveys effectively matches most of the recommended European Atlantic Assessment Unit. SCANS-IV took place in summer 2022 but results are not yet available.

The SCANS-III survey in July 2016 estimated common dolphin abundance in the entire survey area to be 467 673 animals (95% confidence intervals 281 100–778 000). An additional 13 633 common dolphins (CV = 0.85) in Irish waters were estimated from the ObSERVE surveys in summer 2015 (Rogan *et al*., 2018).

To calculate an estimate of the total number of common dolphins for WGMME and WKEMBYC in 2020, estimates of abundance for positively identified common dolphins were corrected by adding the estimated number of common dolphins within the category "common or striped dolphins". The proportion of common dolphins in the latter category was assumed to be the same as the proportion of common dolphins within identified sightings of both species (see e.g. Rogan *et al*., 2018). This was done separately for SCANS-III ship, SCANS-III aerial and ObSERVE aerial surveys and generated a total estimate of common dolphin abundance of 634 286 (CV = 0.307; 95% CI 352 227–1 142 213).

Model-based abundance estimates for common dolphin by year for the Bay of Biscay indicated an overall increase between the 1990s and the 2010s followed by a plateau thereafter (Astarloa *et al.*, 2021).

Abundance update since WKEMBYC

In winter 2021, an aerial survey of marine megafauna within Atlantic waters of the French EEZ was completed. This winter survey is the second of the SAMM (Suivi Aérien de la Mégafaune Marine) programme, the first having taken place in 2011-2012. The SAMM surveys are part of the monitoring program implemented by France within the framework of the Marine Strategy Framework Directive.

With some 20 000 km flown on-effort, more than 1200 sightings of marine mammals were registered (Blanchard *et al*., 2021). The distribution of small delphinids (common dolphins, striped dolphins and unidentified common or striped dolphins) was more dispersed in 2021 than in 2011-2012: sightings of small delphinids over the shelf area of the Bay of Biscay were very numerous. However, the average group size of small delphinids decreased over the same period.

Common dolphin abundance in winter in the surveyed area (including the shelf area of the Bay of Biscay) was estimated at 181 620 individuals (95% confidence interval 128 600 – 258 050; Laran *et al.*, 2022).

CetAMBICIon project

The CetAMBICIon project is coordinated by the Spanish National Research Council (CSIC), and includes 15 partners from Spain, France and Portugal. It aims to strengthen collaboration and scientific work between the three countries to estimate and reduce cetacean bycatch in the subregion "Bay of Biscay and Iberian Coast". The general objective of task 2.1 in this project is to combine the data collected by the three countries to address abundance and distribution of cetacean species in their national waters and to develop a suitable methodological framework to analyse collated data together and to provide comparable and reproducible estimates of abundance and distribution among the three countries.

To reduce bias in density predictions, only survey data collected with distance sampling protocols have been gathered. Distance sampling is a robust method for estimating detection probabilities for each survey. Surveys collected from Spain, France and Portugal as well as European surveys (SCANS II, SCANS III and CODA), and ObSERVE have been gathered. A total of 242,646 km of multidisciplinary survey effort accomplished between 2005 and 2021 were compiled to an approximate tally of 55,000 common dolphins. The temporal coverage of these data reflected an increase in the amount of data over time and a higher proportion of data in spring and summer than in autumn and winter. Gap analyses revealed a very low coverage in offshore areas, particularly in the Iberian coast and in winter.

Detection probabilities were estimated using a new statistical model that has been developed within the task 2.1 of CetAMBICIon to analyze different surveys together and which accounts for the heterogeneity among surveys while using the gathered information to reduce uncertainty in probability estimates. From these detection functions and the number of detected dolphins, estimates of animal densities have been derived within areas sampled by the survey. Species distribution models were used to obtain model-based density predictions throughout the area with survey coverage. These models link animal densities to combinations of environmental variables that represent dolphin habitat to predict animal densities within areas larger than the areas sampled by the surveys. The distribution predicted from model-based density estimates are smoother over the Northeast Atlantic and less influenced by annual variability than distributions derived from conventional distance sampling because model-based distributions integrate information included in multiple surveys. An independent species distribution model has been performed for each season and temporal variability was accounted for using the dynamic environmental variables over time, only. Animal densities were predicted as an average of the five best models and for each season.

The final results of these analyses will be available at the end of the CetAMBICIon project. At WKEMBYC 2, preliminary results were presented, including maps of winter and summer common dolphin densities together with their standard errors. To summarise, densities of common dolphin are high within the Bay of Biscay and near the Portugal coast, particularly around the slope. In winter, more dolphins seem to occur inshore in southern France and densities offshore are lower. Predicted abundance and comparison with estimates from analyses of SCANS III data show that predicted inshore abundances are similar between the present analyses and SCANS III estimates (Hammond *et al.*, 2021) while offshore predicted abundances are more variable. In conclusion, predicted distributions and abundance of common dolphin in inshore areas are robust and comparable among methods today, particularly in summer. Uncertainty is still high in offshore areas, particularly in winter in the Iberian coast.

1.5 Bycatch

Summary of historical rates

Bycatch of common dolphins is documented in various métiers in the Celtic Sea and Western Approaches to the English Channel (ICES Division 7.h), the western English Channel (ICES Division 7.e), Bay of Biscay (ICES Division 8.a), and along the shelf edge of Atlantic Spain and Portugal (ICES Divisions 8.c, 9.a) (Morizur *et al.,* 1999; Fernández-Contreras *et al*., 2010; Marçalo *et al.,* 2015; ICES, 2015, 2016, 2020a).

In the Bay of Biscay and Iberian Coast Ecoregion (Subarea 27.8 and 27.9), WGBYC (ICES, 2018) estimated 924-2187 common dolphins bycaught in pelagic trawls (OTM and PTM) and a further 683-2168 in nets (GTR, GNS, GND) based on 2015-2016 data.

The common dolphin bycatch rates estimated based on 2016-2018 data are reported in WKEMBYC (ICES, 2020a and summarised in Table 2.5 for reference). For Bay of Biscay and Iberian Coast common dolphin bycatch was highest in trammel nets targeting demersal species (GTR_DEF), with a bycatch rate of 0.035 dolphins/DaS (95%CI = 0.021- 0.053) amounting to 2062 animals (95% CI = 1203 – 3092). Bycatch in pair bottom trawls (mixed pelagic and demersal species, PTB_MPD) and in pelagic pair trawls (demersal species, PTM_DEF) were also relatively high, with 775 (95% CI = 388 – 1163; 0.149 dolphins/DaS 95%CI = 0.075-0.224) and 481 (CI 95% = 408 – 555; 0.706 dolphins/DaS 95%CI = 0.598-0.813) dolphins, respectively.

New bycatch rates since WKEMBYC

ICES WKMOMA (ICES, 2021) estimated the bycatch of common dolphins in the entire northeast Atlantic Assessment Unit (AU) (Areas 4,6,7,8,9) to be 6404 (95% CI 3051 – 9414) in 2020, based on pooled bycatch monitoring data from 2015 – 2020, using haul level data and a gamma-hurdle model[†]. At the scale of the AU, the fisheries with the highest bycatch of common dolphin were pelagic trawls (PTM) (1543, 95% CI 709-2414) followed by gillnetters (GNS/GND) with 1152 (95% CI 616-1780) and 925 (95% CI 549-1080) for trammel nets (GTR).

In the Bay of Biscay (Subarea 27.8), the mean bycatch rate was highest in PTM and OTM at 0.146 bycatch events/day at sea (95% CI 0.105-0.201). Bycatch of groups of dolphins, rather than single animals was more common in these gear types with a mean 3.58 individuals per bycatch event (range of 2.3 – 5.6 individuals). The estimated bycatch for PTM based on 2020 fishing effort data, was three times higher than the estimate for the same métier based on 2016-2018 data (ICES 2020a); this is explained by a revision to the French fishing effort data between WKEMBYC (ICES, 2020a) and WKMOMA (ICES, 2021).

Along the Iberian Coast (Subarea 27.9), Dias *et al.* (2022) reported cetacean interactions in 10% of observed sets in the Portuguese purse seine fishery between 2003-2018; 86% of which were with common dolphin. Accidental capture occurred in just 1.6% of the interactions, and the mortality rate was 0.8% (all common dolphin). The occurrence of these interactions was related to season and the local abundance of sardine and chub mackerel.

1.6 Mitigation Trials

1.6.1 Review of ongoing pinger trials focused on common dolphin

Since 2018, several projects have been set up in France to develop and test mitigation devices for pelagic trawler and gillnetters:

- PIC (2018) funded by France Filière Pêche (FFP) lead by Les Pêcheurs de Bretagne with partnership, IFREMER and *Observatoire Pelagis*, La Rochelle University-CNRS
- LICADO (2019-2022) funded by EMFF-FFP / lead by CNPMEM with partnership IFREMER and *Observatoire Pelagis*, La Rochelle University-CNRS, Les Pêcheurs de Bretagne, AGLIA and OCTech
- DOLPHINFREE (2020-2023) funded by EMFF-FFP / lead by Montpellier University (MARBEC & LIRMM labs), with partnership IFREMER, *Observatoire Pelagis*, La Rochelle University-CNRS, Les Pêcheurs de Bretagne, AGLIA and OCTech

[†] Sentence modified based on reviewers' comments after the Advice Drafting Group in December 2022.

- PIFIL 2022-2023 funded by French State lead by CNPMEM with partnership Ifremer, OCTech, AGLIA, CRPMEMs and Producers Organizations.

The different devices tested by Métier are summarized in Figure 1.2:

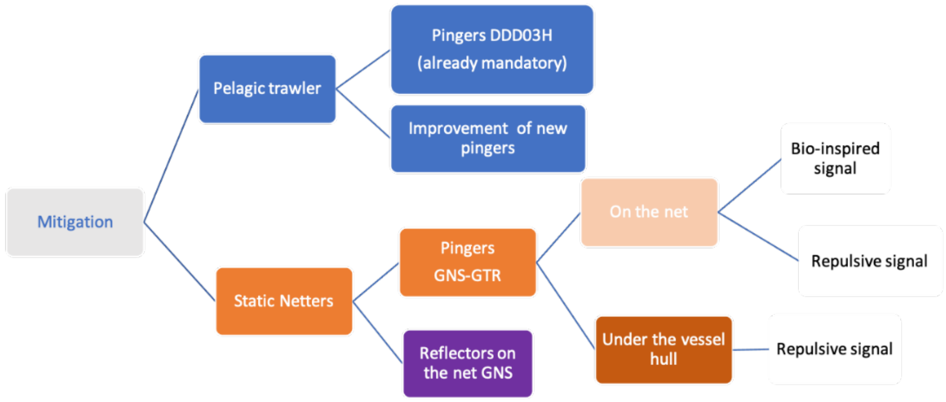

Figure 1.2. Mitigation devices developed and tested to limit common dolphin bycatch in French fleet.

1.6.1.1 Pelagic pair trawler (PTM)

the PIC project aimed to test the efficiency of the DDD-03H (STM Products). 218 hauls, referred to as fishing operations (FOs) hereafter, on 3 pairs trawlers, alternating operations with and without DDD-03H pingers were carried out by a combination of observers and self-samplings by fishers (Table 1.1). The study found that the use of pingers reduced common dolphin bycatch by 65% [15,98] (Rimaud *et al.*, 2019). Since 2019 and confirmed by at-sea observers, almost all PTM vessels have voluntarily equipped themselves with pingers in winter. The fleet is today limited to a dozen of pairs operating in winter in the Bay of Biscay. Their equipment in pinger (today DDD-03H) has been mandatory for French PTM/OTM/PTB >12 m in the first 4 months of the year since 2020 (Arrêté du 26 Décembre 2019) and year-round for all PTM/OTM/PTB since 2021 (Arrêté du 27 Novembre 2020). One of the LICADO project objectives was to compare the efficiency of DDD-03H with a new pinger developed during the project updated with a new deterrent signal and enhanced battery life (CETASAVER). Four pairs of midwater trawlers were equipped with both pinger types in 2020 and 2021. A total of 165 FOs were monitored using DDD and CETASAVER alternatively. During these trials, 3 bycatches of common dolphin were observed (Table 1.1). The relative efficiency of the pingers could not be reliably determined due to the wide 95% confidence intervals obtained. It is therefore not possible to determine if there is a significant difference in efficiency between these 2 pingers, with the data currently available.‡

1.6.1.2 Gillnetters

Studies examining the response of dolphin species to pingers on gillnets have found varying results, with some studies recording no repellent effect on dolphin's behaviour of many commercial models of pinger on gillnets, and others recording strong dolphins' responses for DDD pingers (ex. Van Canneyt *et al.*, 2006; Morizur, 2008). Furthermore, 1) the results of the different experiments are case- specific to the fisheries and target species (Hamilton & Baker, 2019, Pereira, 2019) and 2) the limitations of acoustic pollution due to high number of pingers on static netters has to be considered. As a result, the different partners involved in the programs described above concluded the need to develop specific devices for gillnets and decided to work on complementary mitigation devices (Figure 1.2).

‡ Paragraph modified based on reviewers' comments after the Advice Drafting Group in December 2022.

Reflectors

The results of the LICADO project concluded that common dolphins can easily detect the lead and float rope but can only detect the nylon mesh at short distances. Different materials and shapes were tested as reflectors. Partners selected a rope that could increase the Target Strength (TS) of the nylon mesh of 15dB. This means that the acoustic visibility of nylon mesh increases and that the detection distance of the net is multiplied by 5. This chosen linear reflector is thread over the length of the net, in the nylon mesh at two locations, at a distance of one third and two thirds of the head rope. The experiment was only carried out on gillnets with a height of 5 to 8 m stretched, as equipping low height nets (ex. Sole trammel net) with reflectors is considered unnecessary as dolphins are able to detect the head rope of gillnets, with or without floats. Over two winters 2021 and 2022, 136 FOs were conducted on 3 vessels; 50 FOs with nets equipped with reflectors and 86 without. Two bycaught common dolphins were observed in the deployed nets not equipped with reflectors (Table 1.1). The effect on commercial catches has yet to be confirmed (low number of FOs). An evaluation of the efficiency of this device is still necessary, however, as yet, only manually made prototypes of the device on short lengths have been produced. To date, no technical solution exists among equipment manufacturers for mounting reflectors on longer lengths of nets and constitutes the main barrier to considering reflector equipment on a larger scale. Work is ongoing to try to find a solution to this issue.

Different materials and shapes have been tested as reflector. Partners selected a rope that could increase the Target Strength (TS) of the nylon mesh of 15dB. This means that the acoustic visibility of nylon mesh increases and that the detection distance of the net is multiplied by 5.

Pingers on the net (repulsive signal and bio-inspired signal)

The objective of the LICADO project was to develop an interactive pinger (i.e. passive listening and emission when dolphins are detected) set on the net to limit acoustic noise. During the trial one pinger was deployed on nets and the efficiency of the signal was tested during dedicated campaigns (Van Canneyt *et al.,* 2021). Over two winters 2021 and 2022, 362 fishing operations (FOs) were observed on 8 different vessels: 234 FOs with pingers and 128 without. Two bycaught common dolphins were observed with pingers, however, malfunction/mal-operated of the pinger was suspected during these incidents (Table 1.1). It was noted that these pingers have ergonomics issues (too big/dangerous, low autonomy) and can't be set regularly on the net, so their signals don't cover the entire length of the nets. More trials to supplement current data levels are required to quantify the potential efficiency of this device.

The main aim of the project DOLPHINFREE "Dolphins free from fishery bycatch" is to develop prototypes of a new bio-inspired acoustic beacon, which emits signals linked to the echolocation system of common dolphins, alerting animals to the presence of a net in order to reduce their risk of bycatch. Behavioral changes of common dolphins in response to beacon emission have been assessed during at sea experiments in the summer of 2020 & 2021. The results of the study showed that the use of the bio-inspired prototype led to an increase in common dolphin echolocation signals and communicate (x2.46 and x3.38 in mean, respectively). Such changes in behaviour would favor net detection, and animals were observed calmly leaving the source emission's area (Lehnhoff *et al.*, 2022). A study was conducted during the fishing activities of gill netters in the Bay of Biscay to assess the practicality and to provide preliminary assessment of the efficiency of the new device. Between April to June 2012 12 days at sea were surveyed by scientific observers onboard two gill net fishing vessels simultaneously, while between February and August 2022, 228 days onboard four vessels were observed more or less simultaneously. This represents a total of 1043 FOs, including 409 FOs with beacons set on nets, and 634 FOs without (Table 1.1). During these observations, two bycaught common dolphin were reported in 2 nets without devices and 3 were reported at the end of July and August within three different nets equipped with beacons (Table 1.1). Inaccurate beacons settings were observed for these FOs with bycatch (battery discharged; positioning). A second-generation device is in development to enhance ergonomy and improve battery life. Complementary tests of the bio-inspired acoustic beacon during fishing activities of gill netters, including more boats and number of FOs, will be necessary to assess statistically its efficiency in reducing common dolphin bycatch.

Pinger on the vessel hull

The LICADO project also developed a pinger to be set on the hull of the gill-netters vessel, and activated during the set-up operation of the net. This was in response to the assumption made by fishermen that accidental catches mainly occur during fishing gear set-up. The power supply to the device is provided directly by the vessel, (resulting in no charging issues. In addition, acoustic emissions are limited in time to periods when the risk of interaction between common dolphins and fishing gear is perceived to be important. The efficiency of the signal was tested during dedicated campaigns (Van Canneyt *et al*., 2021).

Given the encouraging initial results of this study, the PIFIL project was launched to experiment the device on a larger scale in the Bay of Biscay (number of vessels, seasons, net gears, target species). From December 2021 to August 2022, 25 gill-netters were incrementally equipped with the device and a scientific protocol was applied on board by volunteers (alternated FOs with and without pingers), as part of their usual fishing activity targeting sole, pollack, monkfish and/or hake. The initial analyses undertaken by the University of Pau related to 1538 FOs, 16 of which recorded bycatch of *D. delphis* (Table 1.1). The rate of FOs with common dolphin bycatch is lower with the pinger activated during the set up (0.006) than without (0.015). However, initial data confirm that incidental catches are rare events and that too few FOs and bycatches were observed to allow a statistical conclusion to be drawn on the efficiency of pingers, however, preliminary results are encouraging. 5 additional vessels will be equipped with this pinger before the end of 2022 and data collection is going on from the equipped vessels and will continue at least until April 2023.

For all trials on static gillnets, a very low rate of accidental catches was recorded with or without device. These bycatch rates are consistent with bycatch rates from observation onboard but means it is difficult to evaluate the efficiency of different devices. Trials with the several devices are still in progress and need to be continued.

Table 1.1. Synthesis of different devices set during fishing operations (FOs), observation during French trials mitigation project

Métier Level 4	Programme	Device	Type of observation	Nb of FO observed	Nb of FO with BYC (DCO)	Nb of FO with BYC but FO maloperated or mal functioning	Bycatch Rate (Events/FO)	Nb of BYC (DCO)
PTM	PIC	None (Control)	Observer and Self Sampling	134	19	/	0,1418	55
		DDD03H		84	5	0	0,0595	6
	LICADO	CETASAVER	Observer	75	2	0	0,0267	2
		DDD03H (Control)		90	1	0	0,0111	1
GNS GTR	LICADO	None (Control)	Observer	86	2	/	0,0233	2
		Reflectors		50	0	0	0,0000	0
	LICADO	None (Control)	Observer	128	0	/	0,0000	0
		CETASAVER on the net		234	2	2	0,0085	2
	Dolphinfree	None (Control)	Observer	634	2	0	0,0032	2
		Dolphinfree on the net		409	3	3	0,0073	3
	LICADO	None (Control)	Observer and Self Sampling	25	0	0	0,0000	0
		CETASAVER under the hull		80	0	0	0,0000	0
	PIFIL	None (Control)	Self Sampling	706	11	/	0,0156	11
		CETASAVER under the hull		816	5	NA	0,0061	5

LIFE DELFI Project (LIFE18 NAT/IT/000942) funded by EU in **Italy**, to reduce dolphin fishing interactions through the next following steps: (a) encouraging the use of pots as dolphin-safe and alternative gear to passive nets (in some harbours fishing fleets have completely replaced gillnets with pots, at least during the summer period of maximum interaction); (b) testing deterrent devices, including interactive pingers (STM's DiD-01) and visual deterrents (LEDs), in both gillnets and trawlers; (c) spreading the project Citizen Science App (Marine Ranger), enabling the collection of opportunistic observations of live, injured or by-caught marine mammals. An acoustic passive device was used to monitor the presence of dolphins near fishing gear due to the variability of the result obtained with pingers in some areas since 2021 LIFE DELFI project. Furthermore, there was use autonomous underwater recorders with a sampling rate up to 384 kHz are used. The project is also developing a low-cost underwater recording systems to acquire dolphin's vocalizations near the fishing gears, which could be used as a prototype pinger trigger or it can be implemented in an automatic alarm system, able to warn fishers in real time of the presence of dolphins near their net.

Portugal conducted mitigation trials in the Portuguese Southern Coast (Algarve) with DDD and DiD pingers (Dolphin deterrent devices, STM Industrial Electronics, Italy) from 2019 to March

2021 (Marçalo *et al.,* 2021, in Portuguese) within the project Mar2020-iNOVPESCA coordinated by CCMAR/University of Algarve. These same trials have been continued within one specific task in the CetAMBICion project and finished in June 2022. In GNS for boats larger or smaller than 12m, were tested DiD in 360 hauls (151 control and 209 with alarms) and DDD-03N in 517 (185 control and 332 with alarms). During the trials there were 3 bottlenose dolphin bycatch in the control and one common dolphin in an alarm haul. The capture in the alarm treatment was suspected of malfunction of the device, as an observer was onboard and noticed the alarm closer to the captured animal was not operating. The depredation from bottlenose dolphin in nets has been increasingly reported mostly in southern Portuguese waters, so the mitigation is also used to solve it. The use of alarms significantly reduced depredation for both alarm models, especially in gears targeting European hake, *Merluccious merluccious* and striped red mullet, *Mullus surmuletus*.

Furthermore, in the same project, trials were carried out during the years 2020 and 2021 in purse seining with most effort in the season that the fishery targets sardine, *Sardina pilchardus*, and to reduce bycatch of common dolphins that mostly feed on small pelagics and have sardine as favourite prey. DDD -03H pingers were tested in 518 hauls (228 control and 233 using DDD). Incidental captures of 38 common dolphins (80% released alive) were observed in control nets and none in nets using alarms.

The beach seine fishery operating in the North_central western coast was enforced by law in 2017 (Portaria nº 172/2017 of May 25th) to use deterrents in areas with high bycatch evidence of harbour porpoises and common dolphins. The fishery has been equipped with pingers since 2019 in considered risk areas (especially for harbour porpoise), but the application and functioning of the pingers and their effectiveness has never been monitored.

Spain conducted the Project "CetAMBICion" (Coordinated Cetacean Assessment, Monitoring and Management strategy in the Bay of Biscay and Iberian Coast sub-region). It brings together France, Spain and Portugal, in a joint program, to estimate and reduce cetacean bycatch in the ABI, in collaboration with the fishing industry. The objectives are aligned with the Habitats Directive and the Common Fisheries Policy. A mitigation measures WP "Evaluation of the effectiveness of strategies to reduce accidental capture of cetaceans and proposal of technical fishing measures" and a subtask 4.2. "Pilot project: Trawling (CEDs and pingers)" leader by IEO. This subtask is a case of study for the development and application of cetacean excluder devices (CEDs) in pair bottom trawlers in Spanish water. This task will comprise the following aspects: 1) Description of the fishery: species targeted, vessels, gears, fishing operations; 2) Characterization of the bycatch: species involved, type of interactions, distribution of bycatch events in space and time, and mortality rates; 3) Technical details of the mitigation devices proposed to address the problem: CED (cetacean excluder devices in trawling) and pingers; 4) Trials onboard collaborative fishing vessels and research vessels.

The project "MERMA CIFRA" (Monitoring, Assessment and Reduction of Accidental Mortality of Cetaceans due to Interactions with the Spanish Fleet - Review and Action), coordinated by the IIM-CSIC, also includes a WP focused on mitigation: "Technical measures for the reduction of accidental capture of cetaceans in Spanish fisheries in the Atlantic-Northwest national fishing ground" led by the IEO, which comprises 3 subtasks: a) to evaluate the technical fishing measures available to reduce the accidental capture of cetaceans in Spanish fisheries in the Atlantic-northwest national fishing ground; b) to carry out experimental reduction tests in the fisheries with the highest catch rate (trawl and gillnet); and c) to propose the most appropriate-ate technical measures for the fisheries and the fishing ground based on the results and the best available scientific information.

During the period 2021-2022 under the MITICET project, were carried out trials to test the effectiveness of pingers to reduce bycatch of common dolphin in the Bay of Biscay. This trial was on board a unit of pair bottom trawlers. The protocol for this study was an alternate- haul experimental design (with and without pingers) to compare between each other the incidental bycatch of dolphins. An Electronic Monitoring System (EMS) was used to document any cetacean bycatch on board in the total of the hauls. A statistically significant difference in the number of bycatch events was observed between the pingered and non-pingered hauls, indicating a reduction of more than 90% of common dolphin bycatch.

Currently, in 2022, MITICET project continues, with the same experimental scheme, (alternate hauls experimental, one haul with pingers and other one without pingers, to compere between each other the incidental bycatch of dolphins. Electronic Monitoring Systems (EMS) was used to visualize any cetaceans bycatch on board in the total of the hauls). The only difference is that the pinger that will be used in these trials will be of a different model. This new pinger is less powerful, the signal is less intensity so the acoustic impact in the environment is smaller, the battery life is much higher, and it does not need to be recharged every 2-3 days, so the usability in a commercial fishery is much easier.

The effectiveness of pingers will also be tested in gillnet fisheries of the Basque Country. Few vessels will be equipped with pingers, and remote electronic monitoring systems will be used to identify the bycatch level of PETs species.

In the tuna purse seine fishery, experimental sea trials will continue to reduce the mortality rate of bycaught threatened species.

According to results of mitigation trials performed in Areas 8 and 9, the group concluded that a bycatch reduction of 65% on PTM, 95% on PTB and 99% on PS were significant and could be applied (Table 1.2).

Table 1.2. Summary of different mitigation trials and their characteristics carried out on midwater pair trawlers in France, on purse seiners in southern Portugal and on bottom pair trawlers in Spain.

	PIC Project	iNOVPESCA Project	Miticet Project
Métier	Midwater Pair Trawlers (PTM)	Purse seiners (PS)	Bottom pair trawlers (PTB)
Country	France	Portugal	Spain
Area	Bay of Biscay (mainly ICES 8ab)	Southern Portugal (Algarve)	Bay of Biscay (ICES 8bc)
Year	2018 (winter)	2020-2021 (May to October)	2021 (spring) and 2022 (winter)
Pinger	DDD-03H	DDD-03H	DDD-03H
Vessels (n)	3 vessel pairs (20% of the fleet)	9 vessels (30% of the fleet)	1 vessel pair (7% of the fleet)
Protocol	1 FO with pinger/1 FO without pinger	1 FO with pinger/1 FO without pinger	1 FO with pinger/1 FO without pinger
Monitoring	1 observer and the rest self-sampling	Observers and self-sampling	Remote electronic monitoring
Fishing operations (FO)	134 without pinger/84 with pinger	228 without pinger/233 with pinger	244 without pinger/223 with pinger
Bycatch	-55 dolphins in 19 FO without pinger -6 dolphins in 5 FO with pinger	-38 dolphins in 15 FO without pinger -no bycatch with pinger	-25 dolphins in 14 FO without pinger -1 dolphins in 1 FO with pinger
Efficiency	Reduction of 65% (CI95% [15-98])	Close to 100%	95%
Used in scenarios	Yes, both in earlier (ICES, 2020a) and current advice. Also for PTB with the same efficiency of 65%	No. Results are promising but still preliminary.	No. Results are promising but still preliminary.
Source	Rimaud *et al.,* 2019 https://www.pecheursdebretagne.eu/ wpcontent/uploads/2019/03/ 20190214_rapportPIC_VF.pdf	Marçalo, pers. comm. University of Algarve.	Basterretxea, pers. comm. AZTI

1.7 Input data and Data Sources

1.7.1 Input data and data sources

On 18 May 2022, ICES issued an official data call (ICES, 2022a)in support of the work of WGBYC and WKEMBYC2 (https://doi.org/10.17895/ices.pub.19745809.v3).

The data call aimed to collect data describing total fishing effort, monitoring/sampling effort and protected species bycatch records for marine mammals, seabirds, turtles and fish species of relevance to bycatch advice.

The data obtained through the annual data call supports ICES annual advice to the European Commission on the impacts of fisheries on the marine environment. In addition, data received in 2022 are used by WKEMBYC2 to inform a request for advice from DG MARE on mitigation measures to reduce bycatch of common dolphin (*Delphinus delphis*) in the Bay of Biscay.

For details on data format and submissions please see the WGBYC 2022 report (ICES, 2022b).

Some data issues were discovered during WGBYC in September 2022 and were corrected in advance of WKEMBYC2 in October 2022:

- France reported fishing effort in units that did not follow the data call specifications and a new data submission was received in advance of WKEMBYC2.
- Estonia resubmitted data to the database after WGBYC 2022 and changed the monitoring type from PO (Port Observer) to LB (Logbook) in advance of WKEMBYC2.
- Portugal reported monitoring data as collected with monitoring method Logbooks (LB) (http://vocab.ices.dk/?CodeID=251115) when it had been collected by Vessel Crew Observer (VO). This was corrected in the database in advance of WKEMBYC2.
- Spain submitted one record with incorrect area allocation (i.e. 27.10.b instead of 27.8.c) and two records with incorrect métier allocation at level 3 (i.e. L3SX instead of L3PS). This was corrected in the database in advance of WKEMBYC2.

In addition, WKEMBYC2 had access to total fishing effort data held in the Regional Database (RDB) (https://www.ices.dk/data/data-portals/Pages/RDB-FishFrame.aspx).

2 Update of the mitigation scenarios considered in 2020

The efficacy of the scenarios provided during WKEMBYC in 2020 were reassessed using updated bycatch estimates calculated from at-sea monitoring and stranding data collected between 2019 and 2021. Scenarios and methods remained unchanged, to ensure comparability between both evaluations.

2.1 Data

Different sources of data at different spatial scales were required to update bycatch estimates and efficiency of scenarios (Figure 2.1).[§]

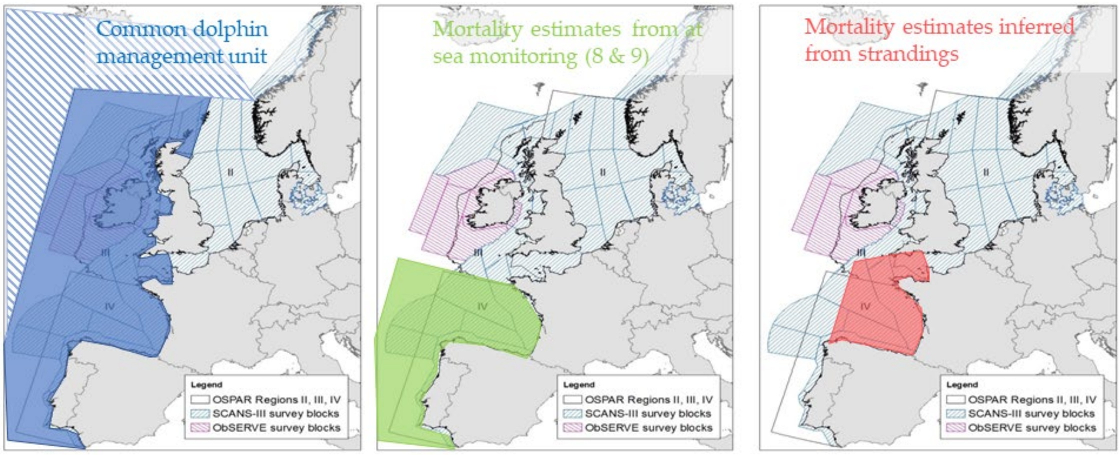

Figure 2.1. Different spatial scales of common dolphin management unit, mortality estimates from at-sea monitoring and from strandings. The design of SCANSIII/Observe surveys are shown in background. (Adapted from Hammond *et al.*, 2021).

2.1.1 Fishing Effort

An exploration of the fishing effort contained in the RDB and the WGBYC database in Areas 8 and 9 by year and by country for Spain, France and Portugal (the countries representing the majority of effort) was carried out.

The WGBYC data for France were more consistent and more gear specific than those in the RDB where it appears some métiers have been aggregated. In addition, for consistency with stock assessment data, France have been submitting PTM as OTM in the RDB. We therefore opted to use the WGBYC data for France, taking an average annual effort for the years 2019, 2020 and 2021.

We used the Portuguese RDB fishing effort data for 2021 alone which were disaggregated better than in previous years and are available in more detail than the data in the WGBYC dataset. Effort data from 2019 and 2020 have not been considered.

[§] Sentence and Figure 2.1. added based on reviewers' comments after the Advice Drafting Group in December 2022.

The fishing effort data for Spain are very similar between the WGBYC and RDB datasets and are consistent year to year in most métiers between datasets. For consistency with the analysis in WKEMBYC (ICES, 2020a), we have used the RDB dataset for Spanish fishing effort and taken the average annual effort for the years 2019, 2020 and 2021.

Other countries with fishing effort in the Bay of Biscay and Iberian Coast Ecoregion include Ireland and the UK, data from the WGBYC dataset were used in both cases due to the provision of information in relevant units (days at sea) and the better resolution of data. The average annual effort for the years 2019, 2020 and 2021 was used.

2.1.2 Monitoring Effort

The monitoring effort was analysed using the WGBYC dataset. Figure 2.1 presents the evolution of the monitoring effort from 2017 to 2021 for the three ecoregions studied in this report (see the definition below), and the métiers related to high bycatch risk (see Table 2.2). The main monitoring method is at-sea-observer, with some changes since 2019, where vessel-crew observation increased in the divisions 7efghj, and port observer became predominant in 8c9a. Such changes may in part be due to changes in monitoring during the Covid-19 restrictions, for more details see ICES (2021b and 2022b).[**] However, only the data obtained from at sea observers and vessel crew observer methods in the case of Portugal, were used to provide the estimates of bycatch rate.

[**] Sentence added based on reviewers' comments after the Advice Drafting Group in December 2022.

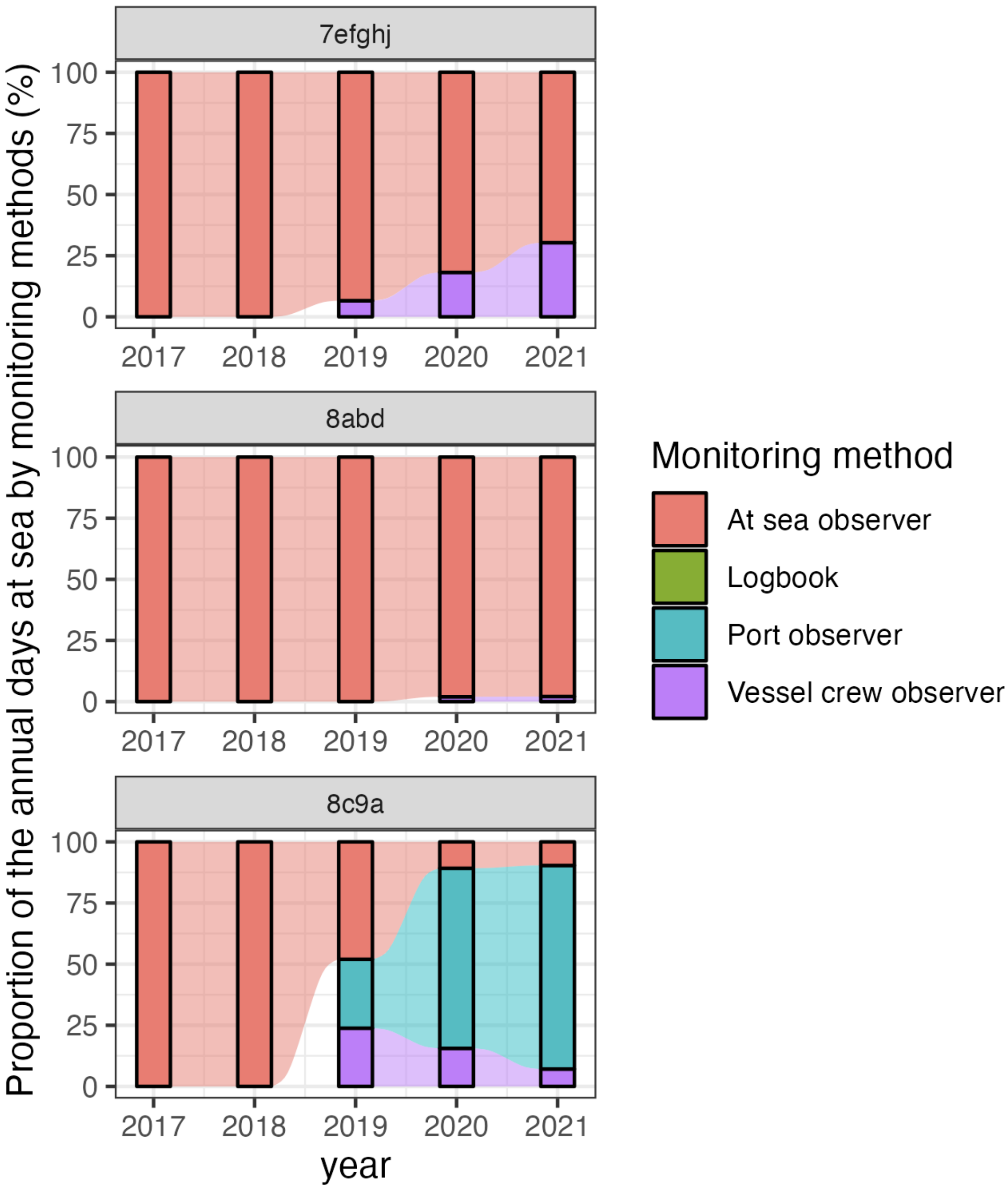

Figure 2.2. Proportion of the annual days at sea by monitoring methods as reported in the WGBYC database. Top = Celtic Seas ecoregion; Middle: Bay of Biscay; Bottom: Iberian coast

The bycatch observation coverage is detailed in Figure 2.3. Vessel Lengths (VL) were aggregated into two categories to summarize the outputs as follows: the VL0012, VL0015, VL0815 were labelled VL0012 (the majority of which were small vessels less than 12m) and the other length VL12XX (vessel approximately longer than 12 m) including VL1218, VL15XX, VL1824, VL2440 and VL40XX. Figure 2.2. illustrates the variability of the observation rates (from 0.01% to 17.27%) and how each métier covers a large range of vessel sizes.

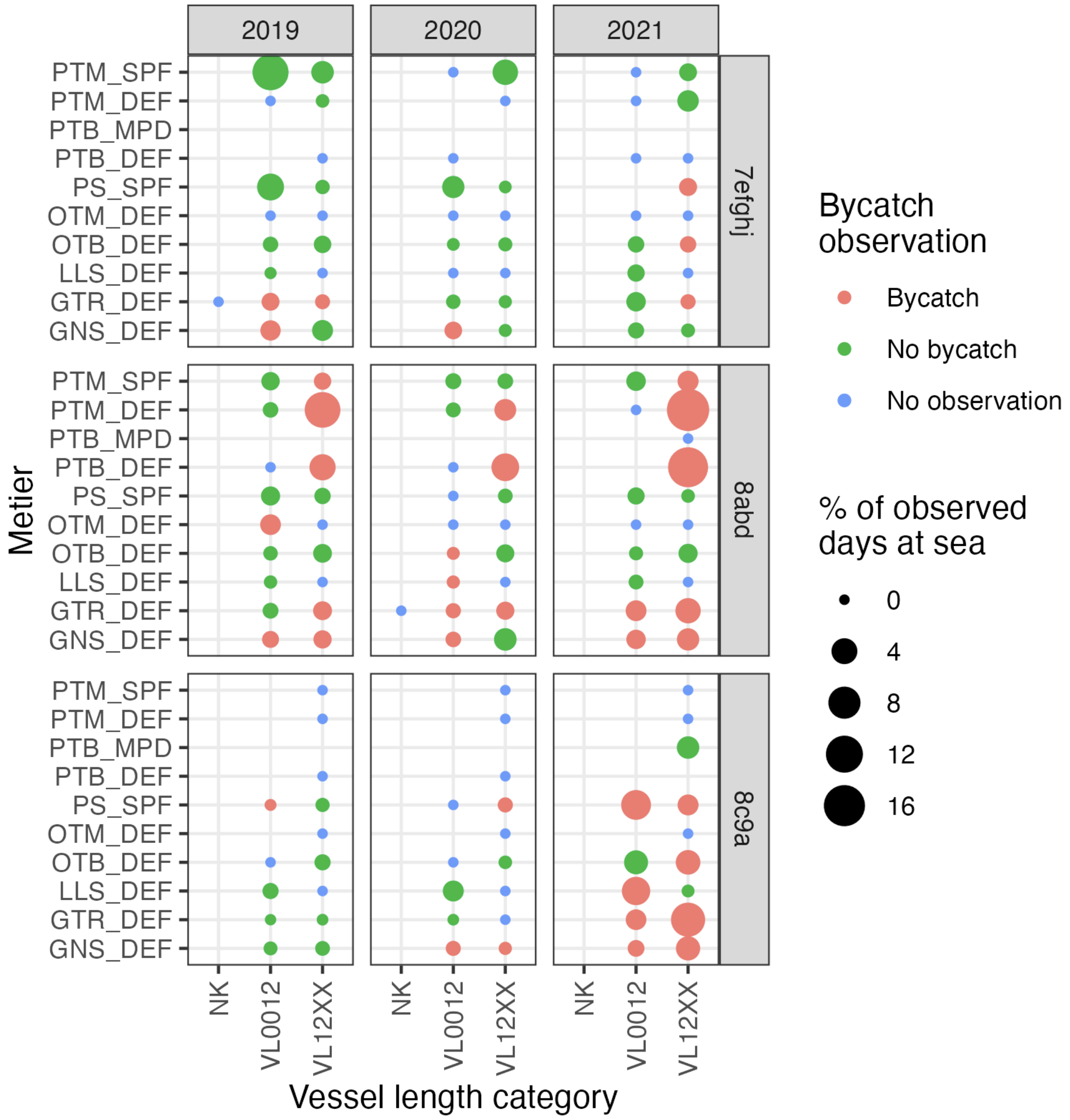

Figure 2.3: Bycatch observation coverage in % of days at sea observed (size of the dots), by métier and grouped vessel length (see text above) for the year 2019 to 2021 and the three areas. The dot colour indicates if bycatch of common dolphin in that métier and vessel length class was observed (in red), not observed (in green), or not monitored (in blue). All the blue dots are associated with 0% of observed days at sea. NK is for métier with unknown length reported in the WGBYC database. VL0012: vessel length <12 m, VL12XX: vessel length>12 m.

Overall, some differences in % coverage of days at sea between 2019 and 2021 are evident for many gear types (Figure 2.3), with an increase in net fisheries between 2020 and 2021 in Areas 8 and 9. Between 2019 and 2020, a decrease in monitored effort was seen for PTM_DEF in Area 8abd with an increase again in 2021. Some of these changes in % coverage may be due to restrictions to monitoring during the Covid-19 pandemic, but also to changes in the reporting of fishing effort described in section 2.1.[††]

[††] Paragraph added based on reviewers' comments after the Advice Drafting Group in December 2022.

2.2 Bycatch estimates using at-sea observations

2.2.1 Methods

Bycatch was estimated for each métier reported in the WKEMBYC report or those with records of common dolphin bycatch (PTM_DEF, PTB_MPD/DEF, GTR_DEF, OTM_DEF, PS_SPF, GNS_DEF, PRM_LPF, PTM_SPF, OTB_DEF, and LLS_DEF) in Subareas 8 and 9. Bycatch rates were calculated (using the number of animals recorded bycaught divided by days at sea observed over the 2019-2021 period for each métier) from monitoring data from observer programmes or vessel-crew-observers (Portugal) only[‡‡]. Confidence intervals around the bycatch rates were estimated assuming a Poisson distribution using the function qpois in R statistical software as haul data is not available to calculate actual confidence intervals around the rates. A Poisson distribution was selected rather than binomial that was commonly used in the past, after an analysis conducted in 2020 investigating which error distribution was the most suitable for data in the WGBYC database found that Poisson distribution was more suitable for instances where more than one animal are caught together (ICES 2020c). As incidents were more than one dolphin are caught are common, the Poisson should be a better fit than the binomial. These bycatch rates were then used to determine annual bycatch removal using a combination of fishing effort data from either the RDB or the WGBYC database for subareas 8 and 9 combined (see section 2.1. for details) (Table 2.1). The temporal pattern of bycatch mortality obtained from the strandings data along the French coast (Subarea 8) was used to allocate the total bycatch derived from monitoring programmes to fortnights. These fortnightly distributions of bycatch for each métier allowed the different closure scenarios to be associated to specific bycatch level reductions.

2.2.2 Results

At-sea monitoring and bycatch event data were used from the WGBYC database for 2019 – 2021 and extracted for the Bay of Biscay and the Iberian Coast ecoregion (Divisions 8 a, b, c, d, e and 9 a). Bycatch rates for common dolphins (number of specimens per days at sea observed) are summarised in Table 2.1 for those métiers where incidents were observed. Bycatch incidents of more than 1 dolphin occur more frequently in trawls. The highest bycatch rate observed was for OTM_DEF of 1.33 common dolphin per day at sea observed; however, it is important to note that this is based on less than one day of at-sea monitoring (Table 2.1). Total bycatch estimates for each métier for the Bay of Biscay and Iberian Coast ecoregion are presented in Table 2.2.

[‡‡] Sentence modified based on reviewers' comments after the Advice Drafting Group in December 2022.

Table 2.1 Summary of common dolphin bycatch rate per métier from WGBYC at-sea monitoring data in the Bay of Biscay and Iberian Coast ecoregion (Subareas 8 and 9) for 2019 - 2021. Data used were collected by at-sea observers for all countries as well as vessel observers for Portugal‡‡. DaS obs = days at sea observed

Ecoregion	Métier L4	Métier L5	DaS obs.	# speci-mens	# inci-dents	Lower 95% Confidence limit	Bycatch rate (speci-mens/ DaS Obs) §§	Upper 95% Confidence limit
Bay of Bis-cay and the Iberian Coast	GNS	DEF	2103.36	16	13	0.005	0.008	0.011
	GTR	DEF	970.13	13	13	0.007	0.013	0.020
	LLS	DEF	186.04	1	1	0.000	0.005	0.016
	OTB	DEF	508.23	2	2	0.000	0.004	0.010
	OTM	DEF	0.75*	1	1	0.000	1.333	4.000
	PS	SPF	626.5	11	10	0.010	0.018	0.027
	PTB	DEF/MPD	465.61	71	22	0.125	0.154	0.185
	PTM	DEF	344.09	36	15	0.076	0.105	0.134
	PTM	SPF	47.56	21	8	0.294	0.442	0.610

*** Less than 1 day at sea of observation**

§§ Column added based on reviewers' comments after the Advice Drafting Group in December 2022.

Table 2.2. Summary of common dolphin bycatch per métier from WGBYC at-sea monitoring data in the Bay of Biscay and Iberian Coast ecoregion (Subareas 8 and 9) for 2019-2021. Data used were collected by at-sea observers for all countries as well as vessel observers for Portugal[***]. Da Sobs = days at sea observed

Ecoregion	Métier L4	Métier L5	Fishing effort (DaS)	Lower 95% Confidence limit	Estimated bycatch [†††]	Upper 95% Confidence limit
Bay of Biscay and the Iberian Coast	GNS	DEF	75428	359	574	825
	GTR	DEF	162389	1172	2179	3180
	LLS	DEF	51196	0	275	826
	OTB	DEF	26049	0	103	256
	OTM	DEF	312	0	416*	1248
	PS	SPF	67890	650	1192	1842
	PTB	DEF/MPD	4725	582	731	879
	PTM	DEF	663	50	69	88
	PTM	SPF	911	268	402	555
Total					5938	

*** Less than 1 day at sea of observation**

2.3 Bycatch estimates inferred from strandings

Strandings are collected along the coasts of France by the French stranding network, that currently includes over 400 trained volunteers distributed along the entire French coast. Carcasses are examined using a standardized protocol. The observation effort has been relatively stable since 1990 (Authier *et al.,* 2014).

The analysis was restricted to stranded "bycaught" common dolphins from multiple stranding events along the coasts of the Bay of Biscay and Western Channel, which were fresh and slightly decomposed and examined by trained members of the French stranding network. Evidence of lethal encounters with fishing gear include: net marks; good nutritional condition; evidence of recent feeding; jaw and rostrum fractures; froth in the airways; oedematous lungs; and dorsal fin, pectoral fin or tail fluke amputations (Bernaldo de Quirós *et al.*, 2018; Kuiken, 1994). This choice can underestimate the number of bycaught cetaceans found stranded, and is therefore a minimal estimation.

The reverse drift trajectories of stranded examined animals diagnosed as bycaught were calculated from the stranding locations to the likely area of mortality at sea by using the drift prediction model to predict the drift of floating objects under the influence of tides and wind. Several parameters must be considered for the use of the drift prediction model MOTHY (Modèle Océanique de Transport d'Hydrocarbures), developed by MétéoFrance (e.g. date and stranding location, buoyancy rate, drift duration). Drift duration is established according to external visual criteria (Peltier *et al.*, 2012). Animals categorized as "fresh" were estimated to be <5 days post-

[***] Sentence modified based on reviewers' comments after the Advice Drafting Group in December 2022.

[†††] Column added based on reviewers' comments after the Advice Drafting Group in December 2022.

mortem and animals classified as "slightly decomposed" to be 5–15 days post-mortem (Peltier *et al.*, 2021). Tagged bycaught carcasses recovered stranded allowed to define external visual criteria of drift duration (Peltier *et al.*, 2012), and demonstrated a relative stability in the decomposition kinetic in the Bay of Biscay between winter and summer. In most cases, and following French regulation, most stranded animals are examined less than 48 hours after discovery.[‡‡‡]This temporal uncertainty would be directly converted into spatial uncertainty when calculating the reverse drift trajectories. Variation in buoyancy of ±10% is associated with an error of 8–16% in distance drifted. The average uncertainty around the model predictions was 27.1 ±24.5 km. This could be explained by some aspects of drift model simulations. The model mostly takes into account the effects of wind and tide on a floating object (Daniel *et al.*, 2002); in contrast, general circulation and details of coastal currents are not considered, and these could potentially have an impact on the outcomes.

The estimation of bycatch mortality at sea inferred from strandings is calculated following Peltier *et al.*, 2016. Stranding numbers are corrected by drift conditions and by the proportion of buoyant animals, based on an *in situ* experiment (which estimated the probability for a bycaught dolphin to float). The most recent estimate of floatability rate used in the present report is 24% (95% IC [17-32]). This last correction factor has a major effect on final estimates and could be further improved by increasing the number of experimentally released carcasses and by refining estimates of discovery rates along the French coasts. Small changes in proportion of buoyant animals could notably modify mortality estimates.

Following methodology, bycatches were estimated at about 9480 (95%CI [6890; 14 210]) in 2019 and about 8700 (95%CI [6330; 13 050]) in 2020 (Figure 2.4).

During winter 2021, the dominating winds were mostly orientated from East to West (Peltier *et al.*, 2022). As a consequence of this rare and unusual wind regime compared to previous years, stranded dolphins reported in the winter 2021 came from very narrow area close from the coast, and therefore can only inform on a much smaller fraction of the Bay of Biscay surface area than in previous winters. Indeed, cells with stranding probability from 50-100% (probability of dead animals to reach the coasts between 50 and 100%) extended on average over 30% of the Bay of Biscay surface area during the years 2016-2020, for all three months of January, February and March. By comparison, this area with highest stranding probability (50-100%) reached 35% of the Bay of Biscay in January, 20% in February, and was reduced to 10% in March 2021. As a consequence, the stranded carcasses recovered in the winter 2021 can hardly be compared to previous years, as from mid-February onwards they only inform on a narrow coastal fringe of the Bay of Biscay. Therefore, a modified methodology was used to estimate bycatch mortality in winter in 2021.

During the SAMM-II aerial survey held from January to March 2021 in the waters of the Bay of Biscay and the English Channel, 28 drifting carcasses of small delphinids were reported. The vast majority of these sightings (82%) were made during March 2021. By comparison, only 3 carcasses were observed during the SAMM-I winter survey conducted in 2011-2012 (Blanchard *et al.*, 2021).

By using a distance sampling approach (Buckland *et al.*, 2001), a detection function was fitted to the sightings and the abundance of drifting carcasses was estimated for the Bay of Biscay in March 2021. From the 19 observations of small delphinids (most likely common dolphins) carcasses made on the transects in March 2021, a total of 750 carcasses [395-1626] was estimated to be available at the surface in March 2021. Corrected by the proportion of sinking animals (floatability rate), a total of 3125 [1646; 6775] small delphinids are estimated to have died in the Bay of

[‡‡‡] Two sentences added based on reviewers' comments after the Advice Drafting Group in December 2022.

Biscay in March 2021. Most of these carcasses could not reach the coast because of the wind conditions prevailing in March 2021, hence the low number of stranded dolphins recorded during this period.

Taking the winter 2021 wind conditions into account, we propose to estimate the total winter mortality of dolphins in the Bay of Biscay by combining an estimate based on the stranding data set for the whole year except for March and an estimate obtained from the SAMM-II aerial survey data set for the month of March 2021. As a result, the mortality of small delphinids for the whole year 2021 can be estimated at about 8950 (95%CI [6710; 12 630]) individuals. This annual estimate is of the same order of magnitude as those made since 2016. Therefore, it cannot be concluded that there was any decrease in the mortality of common dolphins during the winter of 2021.

The average annual bycatch inferred from strandings was estimated at 9040 (95%CI [6640 – 13 300]) common dolphins between 2019 and 2021 in area 8.

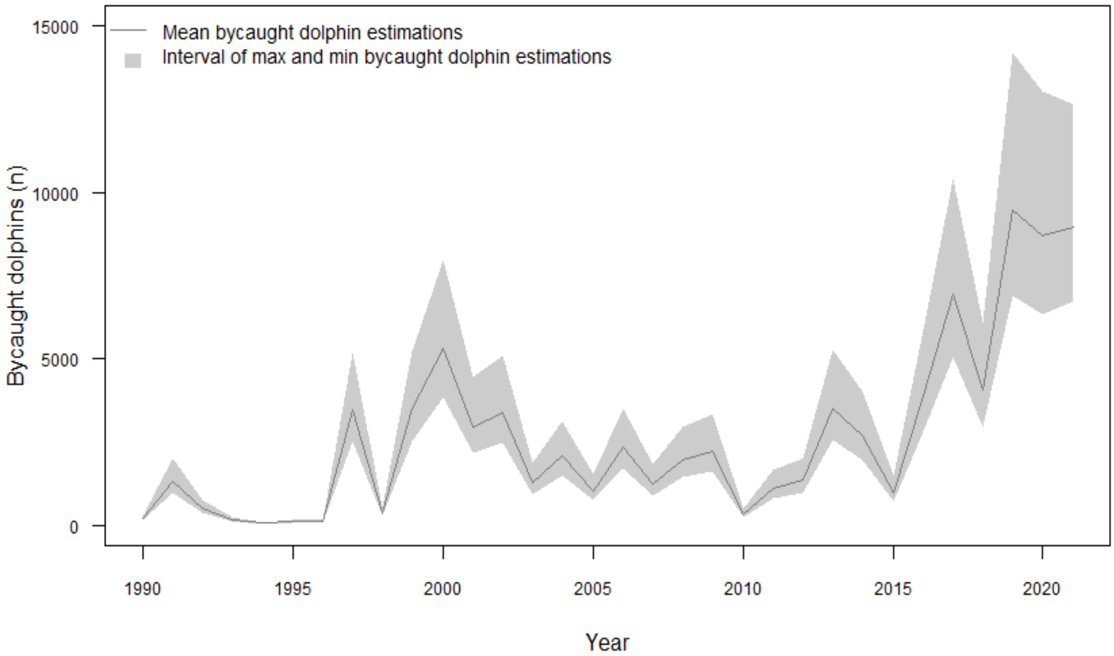

Figure 2.4. Common dolphin bycatch inferred from strandings along the coasts of the Bay of Biscay and Western Channel between 1990 and 2021.

2.4 Thresholds

Thresholds for cetacean incidental bycatch (i.e. limits not to be exceeded) are dependent on the quantitative conservation objectives set. While conservation objectives are ultimately driven by policy (ICES WGMME, 2008), European legislation does not provide quantitative and explicit conservation objectives for marine mammals from which thresholds can be calculated. Consequently, in order to assess the impact of bycatch for the purposes of, for example, MSFD assessments, it is necessary to first define existing objectives in a quantitative manner.

WKEMBYC (ICES, 2020a) used the Potential Biological Removal (PBR) as the methodological approach (control rule) to set a threshold for bycatch of common dolphin in the management unit, using population abundance inferred from SCANSIII/Observe surveys[§§§]. PBR has been

[§§§] Sentence modified based on reviewers' comments after the Advice Drafting Group in December 2022.

tuned to the US Marine Mammal Protection Act whose conservative objective is to ensure that "a population will remain at, or recover to, its maximum net productivity level (typically 50% of the populations carrying capacity), with 95% probability, within a 100-year period" (Wade 1998). WKEMBYC (ICES 2020a, page 100) stressed that "the conservation objectives to which PBR is tuned are not entirely reflected in the relevant EU legislation (Habitats Directive, Common Fisheries Policy, Marine Strategy Framework Directive)."

Two plausible management objectives were agreed by WKEMBYC (ICES 2020a), in the context of proposed fishery emergency measures. These objectives were adapted from provisions under the US MMPA for strategic stocks of marine mammals which are experiencing by-catch levels exceeding PBR. Under the MMPA, take-reduction plans are adopted, under which the objective is to reduce, within six months of their implementation, the incidental mortality to less than (i.e. equal to some fraction of) the PBR level. WKEMBYC agreed to consider the management objectives to reduce bycatch to 1) 50% and 2) 10% of PBR. The latter comes from ASCOBANS conservation objective (minimize and where possible eliminate bycatch).

OSPAR Marine Mammal Expert Group (OMMEG) revisited this question using Management Strategy Evaluation (MSE; e.g. Punt and Donovan 2007; Punt 2010) (OSPAR, 2021). Quantitative conservation objectives facilitate the use of MSE, which provides the framework to test, with numerical simulations, the effect of different management choices on hypothetical populations. The MSE framework was developed in fishery sciences to test and select the most robust management objectives than can allow to meet the conservation objectives despite uncertainty and possible biases in the data available for managers. Management objectives are, for example, "bycatch shall not exceed the limits set by the Potential Biological Removal (PBR) control rule". Appropriate inputs values for PBR are then determined by extensive testing of several values under different plausible scenarios (e.g. bycatch underestimated by a factor 2) reflecting current knowledge, knowledge gaps and likely biases. Input values that allows to reach the conservation objective in some high proportions of the simulations (e.g. 95% of simulations under a given scenario) are selected, and provide proximal management objectives that align with the distal conservation objective. Testing and selection of input values for the control rules is sometimes called tuning (e.g. Wade, 1998).

MSE are based on computer simulations to compare and assess the robustness of different scenarios, in terms of thresholds, management objectives and methodology, with a given certainty and considering potential sources of uncertainty in the process (biased bycatch rate estimates, monitoring effort, etc.). In summary, an MSE requires (i) a specific conservation objective, that the modelling framework should achieve (e.g. ASCOBANS interim conservation objective); (ii) a simulator (or operating model) (e.g. generalized logistic model); (iii) a so-called harvest control rule to set removal limits (e.g. PBR); and (iv) performance metrics to assess which strategy is the best under the several scenarios and policy goals. As a result, the MSE framework allows to assess the performance of each management decision and select the best given the best available evidence (Genu *et al.*, 2021).

OMMEG (OSPAR, 2021) used the modified PBR (mPBR), which is the PBR control rule tuned to the following conservation objective: "a population should be able to recover to or be maintained at 80% of carrying capacity, with probability 0.8, within a 100-year period". This conservation objective is the OMMEG interpretation of the ASCOBANS interim conservation objective of "restor[ing] and/or maintain[ing] stocks/populations to 80% or more of the carrying capacity" (ASCOBANS 1997). OMMEG chose a time horizon of 100 years to align with the recommendation of ICES (2013); and a probability level of 0.8 as suggested by ASCOBANS (2015). This resulted in new threshold values (OSPAR, 2021). WKEMBYC2 has followed this revised approach, considering it to be the best currently available and to be fully consistent with conservation objectives under EU legislation.

2.5 Scenarios

All scenarios are based on mortality estimates from (1) monitoring data scaled up for the entire Bay of Biscay and Iberian Coast Ecoregion (ICES areas 8 and 9) and (2) strandings data for the French coast of ICES area 8 (Figure 2.5). Due to the insufficient temporal resolution of the observer data from bycatch monitoring, the temporal pattern of bycatch mortality obtained from the strandings data along the French coast (ICES subarea 8) was used to allocate the total bycatch derived from monitoring programmes to fortnights. As strandings data cannot currently provide métier information on bycatch, the monitoring bycatch estimates for each métier were used to proportionally allocate the total bycatch derived for strandings to individual métiers. The joint use of these datasets enabled us to derive fine-scale temporal and métier specific bycatch estimates for both monitoring methods. Finally, the efficiency of each scenario was evaluated for both monitoring and stranding estimates. The two series of métier-specific bycatch estimates were seen as two views of the same phenomenon and were considered, within their uncertainty range, to contain the true bycatch level. [****]

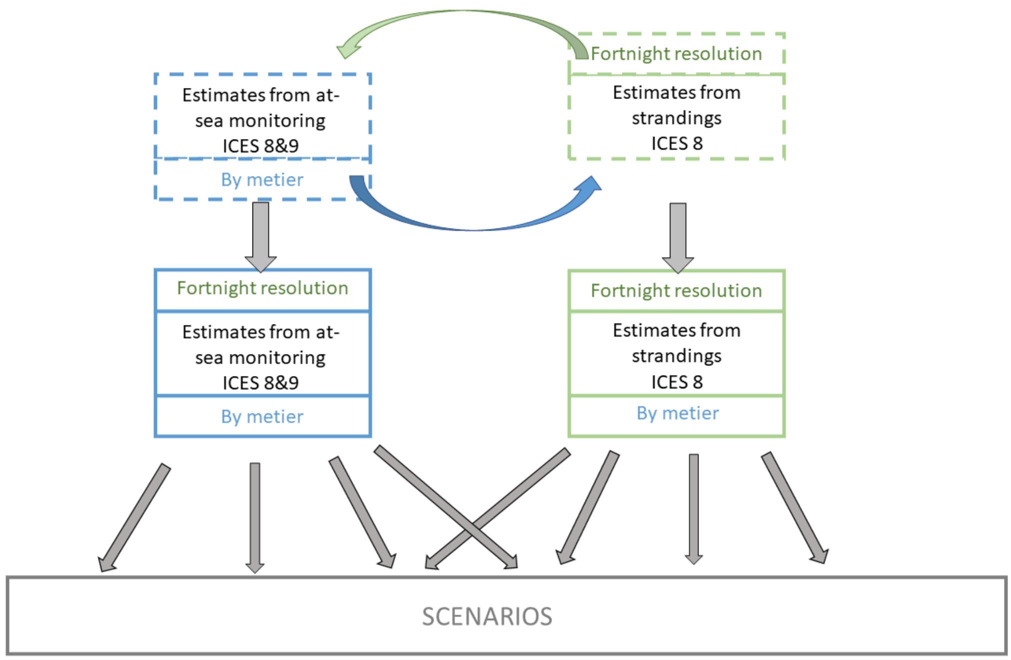

Figure 2.5. General strategy for bycatch estimates inferred from at-sea monitoring and strandings, and their combined use.

For each scenario, the bycatch reduction rate was calculated as well as the fishing effort reduction rate. For scenarios with a temporal component, the % of bycatch mortality estimated from strandings within each fortnightly time period (data years 2019–2020) was used to calculate the reduction from the annual estimate that would result from closure during that specific time period.

[****] Paragraph and Figure 2.5. added based on reviewers' comments after the Advice Drafting Group in December 2022.

The scenario with a flat effort reduction did not make reference to the temporal pattern of strandings.

In French midwater pair trawl fleet, the use of pingers was generalized in winter 2019 and became mandatory in winter in January 2020, therefore we can assume that all French PTM were seasonally equipped with pingers during the evaluation period (2019-2021). The use of pingers is mandatory on Spanish bottom pair trawl fleet since January 2020. For these scenarios, the workshop assumed full compliance with pinger use on all PT métiers, and correct use of pingers in all cases. Therefore, for scenarios including pingers on PTM and PTB no reduction in bycatch rates were applied to these métiers. As a result, scenarios combining temporal closures and pingers used will result in identical bycatch estimates as temporal closure scenarios. All scenarios were retained in the table for consistency with the ICES (2020a) WKEMBYC report and for ease of comparison (Table 2.3).[††††]

An efficiency score for each scenario was obtained by dividing the bycatch reduction rate by the effort reduction rate. The results from testing each scenario as reported in Table 2.4 including the resulting bycatch obtained (according to monitoring and to stranding), PBR level achieved with colour code (for monitoring and stranding results), bycatch reduction rate, effort reduction rate and efficiency.

PBR values considered in the 2020 scenarios (WKEMBYC, ICES 2020a) were again considered here: <10% of PBR, <50% of PBR, <75% of PBR, <PBR and >PBR. However, in these scenario analyses the mPBR was also considered as it was developed since the last workshop. All PBR values are described in section 2.4.

[††††] Paragraph modified based on reviewers' comments after the Advice Drafting Group in December 2022.

Table 2.3. Scenarios used for assessing possible alternative bycatch reduction approaches. All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases. As a result, no additional reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M*, C = L*, D = H*, N = O* are indicated in the table). The asterisk here and in the table indicate scenarios that are ultimately replicas/identical to other scenarios‡‡‡‡. All scenarios were retained in the table for consistency with the ICES (2020a) WKEMBYC report and for ease of comparison.

Scenario	Description	Explanation
A	4-month closure (Dec-Mar) all métiers §§§§	4-month closure from December to March of all relevant métiers§§§§
B	Annual effort reduction of 40% all métiers	Flat annual 40% reduction in total effort for relevant métiers, does not consider strandings patterns
C	2-month closure (mid-Jan to mid-Mar) all métiers	2-month closure of all relevant métiers determined using the % mortality in that peak period based on strandings
D	6-week closure (mid-Jan to end Feb) all métiers	6-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
E	4-week closure (mid-Jan to mid-Feb) all métiers	4-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
F	2-week closure (mid-Jan to end Jan) all métiers	2-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
G	Pinger all PTM/PTB all year and same 6 week closure all other métiers	PTM/PTB to use pingers all year + a 6-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings (Assuming correct pinger implementation on all vessels since 2019, no additional reduction applied to bycatch levels in this scenario)
H *	6-week closure (mid-Jan to end Feb) all métiers (including PTM/PTB) and pinger PTM/PTB rest of year	6-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings + PTM/PTB to use pingers during the rest of the year
I	Pinger all PTM/PTB all year and same 4 week closure all other métiers	PTM/PTB to use pingers all year + a 4-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings
J	Pinger all PTM/PTB all year and same 2 week closure all other métiers	PTM/PTB to use pingers all year + a 2-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings
K	Pinger all PTM/PTB all year	PTM/PTB to use pingers all year, no other measures introduced.
L *	2-month closure all (mid-Jan to Mid-Mar) + pingers	2-month closure for all fleets + pingers on PTM/PTB the rest of the year
M *	4-month closure all (mid-Jan to Mid-Mar) + pingers	4-month closure for all fleets + pingers on PTM/PTB the rest of the year

‡‡‡‡ Sentence added based on reviewers' comments after the Advice Drafting Group in December 2022.

§§§§ Modified based Advice Drafting Group comments in December 2022.

Scenario	Description	Explanation
N	4-month closure (3 in winter + 1 in summer) + pingers	Closure during 3 months in winter (Jan – March) and 1 month in summer (mid-July – mid-August) for all fleets + pingers on PTB/PTM the rest of the year
O *	4-month closure (3 in winter + 1 in summer)	Closure during 3 months in winter (Jan – March) and 1 month in summer (mid-July – mid-August) for all fleets

Table 2.4. Synthesis of scenarios' performances. For scenarios A to O, key information given are scenario title, total bycatch mortality as of monitoring programmes, total bycatch mortality as of stranding data, bycatch reduction obtained, effort reduction implied, and efficiency score. A colour code indicated how each scenario reach the different management objectives is presented below the table. The efficiency score of each scenario is bycatch reduction rate divided by effort reduction rate. This efficiency could be considered as a rough cost effectiveness for each scenario considering that a reduction effort is a cost for the industry (see main text for further detail). All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases (see main text for further detail). As a result, no reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M, C = L, D = H, N = O as indicated in the table). All scenarios were retained in the table for consistency with WKEMBYC ICES 2020a report and for ease of comparison. Information provided is based on average annual bycatch estimates for the period 2019-2021.[*****]

	A / M	B	C / L	D / H	E	F	G	I	J	K	N / O
Scenario	4 month closure all metiers + (M: pinger PTM / PTB rest of year)	Annual effort reduction of 40% all metiers	2 month closure all metiers + (L: pinger PTB / PTM rest of year0	6 week closure (mid Jan - end Feb) all metiers + (H: pinger PTM / PTB rest of year)	4 week closure (mid Jan - mid Feb) all metiers	2 week closure (mid Jan - end Jan) all metiers	Pinger PTM / PTB all year & same 6 week closure all other metiers	Pinger PTM / PTB all year and same 4 week closure all other metiers	Pinger PTM / PTB all year and same 2 week closure all other metiers	Pinger PTM / PTB all year	3 month (Jan–Mar) + 1 month (mid-Jul–mid-Aug) closure all metiers + (N: pinger PTB / PTM rest of year)
Total resulting bycatch - monitoring mortality	1188	3563	2019	2731	3919	4869	3381	4328	5085	5938	713
Total resulting bycatch - strandings mortality	1808	5424	3074	4158	5966	7413	5147	6589	7742	9040	1085
Bycatch Reduction obtained	0,80	0,40	0,66	0,54	0,34	0,18	0,43	0,27	0,14	0,00	0,88
Effort reduction needed	0,33	0,40	0,17	0,12	0,08	0,04	0,11	0,07	0,04	0,00	0,33
Efficiency score	2,4	1,0	4,0	4,7	4,4	4,7	3,9	3,7	3,9	NA	2,6

% of PBR	<10%	mPBR	<50%	<75%	<PBR	>PBR
Number bycatches	493	985	2464	3695	<4927	>4927

[*****] Caption and Table updated after the Advice Drafting Group in December 2022.

All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases. As a result, no reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M, C = L D = H, N = O). All scenarios were retained in the tables for consistency with WKEMBYC ICES (2020a) report and for ease of comparison.

Looking at PBR performance first, followed by bycatch reduction rate and measure efficiency, scenarios could be classified or ranked as follows:

Scenarios N & O (three-month closure from January through March and from mid-July to mid-August all métiers, and pingers on PTM/PTB the rest of the year) performs best in terms of PBR thresholds (10-50%) and bycatch reduction (bycatch reduction rate=0.88). Its efficiency is intermediate because the closure period is broader than the typical duration of the period of high bycatch.

Scenarios M & A (four-month, December through March closure all métiers and pingers on PTM/PTB the rest of the year) performs second best in terms of bycatch reduction (bycatch reduction rate=0.8). Its efficiency is intermediate because the closure period is broader than the typical duration of the period of high bycatch.

Scenario C & L (two-month, mid-January to mid-March closure all métiers and pingers on PTM/PTB the rest of the year) ranked fifth on the first two criteria (PBR: 10-50%; bycatch reduction rate=0.66) and displayed an efficiency is higher as scenarios M&A because it was more focused on the peak period of mortality.

Scenarios D & H, G, B, E, I, F and J ranked 7th to 14th on bycatch reduction and achieved bycatch reduction rates between 0.14 and 0.54.

The least effective in terms of bycatch reduction was K (pingers PTM/PTB all year with no closure, bycatch reduction rate=0). This scenario provides no reduction in bycatch and does not reach the PBR.

Finally, scenarios based on a temporary closure which includes the winter peak period of mortality are the most effective ones provided that the closure's duration is at least six weeks but longer closures can substantially further reduce bycatch (compare scenarios D (six-week closure, 54% reduction) and O (three-month winter closure plus one-month summer closure, 88% reduction).

Comparison with 2020 WKEMBYC bycatch estimates

Comparing bycatch estimates for relevant métiers for 2016-2018 (WKEMBYC, ICES 2020) and 2019-2021 (WKEMBYC 2, current report) (Table 2.5), shows that the source of highest common dolphin bycatch continues to be trammel nets for demersal species (GTR_DEF). A relatively low bycatch rate was observed in GNS_DEF for both periods, but for the most recent period, the number of days fished has doubled resulting in a significantly higher bycatch estimate. The change in fishing effort is likely due to changes in assignment of effort to different métiers during the data submission process. In addition, monitoring effort in 2021 due a targeted increase in monitoring effort on set nets related to common dolphin bycatch issues in this Ecoregion.

The more recent data show that there has been a significant decline in the number of bycaught common dolphins in the pelagic trawl fisheries for demersal fisheries (PTM-DEF). The fishing effort is comparable between the two time periods and the reduction in observed bycatch rate is driving the significantly lower estimate of bycatch. In 2020, the use of pingers in French and Spanish pelagic trawlers became mandatory and this operational change in the fishery has contributed to this ~85% reduction. Such a reduction is not evident in PTB_DEF which continues to contribute approximately 750 common dolphin per annum to the total mortality in the Bay of Biscay and Iberian coast ecoregion.

The estimate of 1192 common dolphin (95% CI 650 – 1842) bycaught in purse seine fisheries targeting small pelagic fish (PS_SPF) makes a significant contribution to the total mortality in the ecoregion, and is a significant increase compared with the 2016-2018 estimates (213, 95% CI 0-532). However, the fishing effort in this métier has effectively doubled between the two time periods, but is thought to be an artifact of the data submission from Portugal which has reallocated effort previously reported under MIS_MIS to the PS_SPF métier. The majority of effort in this métier is undertaken by Spain, but evidence from observer monitoring on Portuguese vessels show that 76% of dolphins caught are released alive (Marçalo, A. *pers comm.*). Please note that only bycatch of cetaceans recovered dead were recorded and used for analyses. [†††††]

In other métiers (OTM_DEF and PTB_DEF/MPD) levels of bycatch are effectively unchanged between the two periods and contribute an estimated 416 (95% CI 0-1248) and 731 (95% CI 582-879) dolphins, respectively. Bycatch in PTM_LPF is also unchanged and there were no bycatches reported between 2019-2021 with good observer coverage of the fishery (22%).

Monitoring effort was very low in the OTM_DEF métier, and this métier recorded the highest bycatch rates as a result. Effort is inadequate in this métier and a substantial increase in monitoring is needed to be better understand bycatch rates in this métier.

[†††††] Sentence added after the Advice Drafting Group in December 2022.

Table 2.5 Comparison of summary of common dolphin bycatch rates and mortality estimates (based on data raised using the mean annual fishing effort data for the areas) by métier in the Bay of Biscay and Iberian coast between data collated for 2016-2018 (WKEMBYC) and 2019-2021 (WKEMBYC2)‡‡‡‡. Bycatch rate = animals/Days at Sea (DaS) observed; %cov. = % monitoring coverage.

Métier		WKEMBYC – data 2016-2018								WKEMBYC 2 – data 2019-2021								
L4	L5	Fishing effort (DaS)	DaS obs. (%cov.)	By-catch rate	L95% CI	U95% CI	Est. by-catch	L95% CI	U95% CI	Fishing effort (DaS)	DaS obs. (%cov.)	By-catch rate	L95% CI	U95% CI	Est. by-catch	L95% CI	U95% CI	Change in by-catch estimate
GNS	DEF	36836	536.84 (1.46)	0	0	0.01	137	0	343	75428	2103.36 (2.79)	0.01	0.01	0.01	574	359	825	↑
GTR	DEF	58365	339.74 (0.58)	0.04	0.02	0.05	2061	1203	3092	162389	970.13 (0.60)	0.01	0.01	0.02	2179	1172	3180	~
LLS	DEF									51196	186.04 (0.36)	0.01	0.00	0.02	275	0	826	
OTB	DEF									26049	508.23 (1.95)	0.00	0.00	0.01	103	0	256	
OTM	DEF	243	0.82 (0.34)	1.22	0.00	3.67	297	0	890	312	0.75 (0.22)	1.33	0.00	4.00	416	0	1248	↑
PS	SPF	35564	334.5 (0.94)	0.01	0.00	0.02	213	0	532	67890	626.5 (0.92)	0.02	0.01	0.03	1192	650	1842	↑
PTB	DEF/ MPD	5195	67 (1.29)	0.15	0.08	0.22	775	388	1163	4725	465.61 (9.85)	0.15	0.13	0.19	731	582	879	~
PTM	DEF	682	167.17 (24.51)	0.71	0.60	0.81	481	408	555	663	344.09 (51.90)	0.11	0.08	0.13	70	50	88	↓
PTM	SPF									911	47.56 (5.22)	0.44	0.29	0.61	402	268	555	
PTM	LPF	510	65.16 (12.78)	0.02	0.00	0.05	8	0	23	1209	265.04 (21.92)	0.00	0.00	0.00	0	0	0	[illegible]

‡‡‡‡ Sentence modified based on reviewers' comments after the Advice Drafting Group in December 2022.

2.6 Discussion

Scenario discussion

As the same methodology was used to build and test the efficiency of these scenarios, it is unsurprising to detect similar results to those in the previous WKEMBYC report (Table 2.40). As bycatch estimates were higher for years 2019-2020, no scenario could attain mortality below 10% of PBR, whereas at least two did in the previous evaluation. Also, seven scenarios would not achieve the objective of reducing mortality below PBR. This was the case for only two of them with 2016-2018 data.

It is noticeable that scenario B, a year-round flat rate reduction of effort, has the lowest efficiency (efficiency=1). In that case, the reduction of bycatch is directly proportional to the reduction in effort because it does not take advantage of the strong temporal pattern in bycatch to draw optimal benefit of effort reduction.

Scenarios F and K showed the lowest conservation performance (bycatch reduction) and scenario B had the lowest efficiency score (one can get the same conservation benefit with less constraint to the industry).

Although scenarios A & M and N & O performed the best in terms of conservation and bycatch reduction, they performed less well in terms of the efficiency score than all other scenarios except B, because of the breadth of the proposed closure period. A broad closure window can be sought to accommodate year-to-year variation in the timing of the period of acute bycatch mortality. However, recent strandings records show that the period of acute bycatch mortality did not start earlier than mid-January in the past five years. However, further work is needed to explore the timing of peak mortality outside the areas covered by the stranding data and on the Iberian Peninsula, to ensure scenarios are relevant across the entire region considered. [§§§§§]

As French PTM are equipped with pingers in winter since 2019, and their use is mandatory in Spain on PTB fleet since 2020, the benefits of all scenarios was reliant on the spatial closure component. As such, the likely efficiency of additional pinger use or successful implementation of pinger use are explored in section 3.

2.7 Recommendations

Relative risk toward management objectives

The relative risk of not achieving the management objective depends on two main processes. Firstly, bycatch estimates are here provided by two different methods and considered as two different views of the same process. They can be seen as the lower and upper limits of bycatch mortality. Among different scenarios presented in Table 2.6, some of them achieved different management objectives following the choice of bycatch estimates.[******].

Secondly, the risk can be set to high when closures are too narrow, increasing the risk of missing the peak of mortality. Seasonal changes in common dolphin distribution could be slightly different from the 2019-2021 scheme, and all scenarios with 2 to 4 weeks closure could change their efficiency and therefore the benefit of fishing effort reduction (scenarios E and I).

[§§§§§] Sentence added based on reviewers' comments after the Advice Drafting Group in December 2022.

[******] Paragraph modified after the Advice Drafting Group in December 2022.

The success of the above measures is dependent on fishing effort being reduced and not redistributed and is sensitive to: enforcement of correct pinger use is in place; and pinger performance is validated.

-to reduce bycatch mortality below PBR: scenarios H (6-week closure + pingers), E (4-week closure) and I (pingers+4week closure other métiers). Note that only scenario H can achieve the objective with both bycatch estimates. Risks of not achieving the objective are therefore very high for the two other scenarios, as they combined both sources of risk.

-to reduce bycatch mortality between 50% and 75% of PBR:, G (pingers+-week closure other métiers), and B (reduction 40% all métiers). Scenario G has a very high risk and B has a high risk of not achieving the objective. Moreover, the benefit of fishing closure is very low regarding to the reduction of bycatch in scenario B, therefore is the efficiency score very low (1)

- to reduce bycatch mortality between 50% of PBR and mPBR: scenarios L (2-month closure + pingers) and M (4-month closure + pingers). Score efficiency is higher in scenario L, but the management objective is achieved only with observer monitoring data.

-to reduce bycatch mortality between mPBR and 10% of PBR: scenarios N (3+1-month closure + pingers). Scenario N present a moderate risk of not achieving the objective, mostly because of the short summer closure that could miss the peak of mortality. If the risk is considered as low for scenario M, his efficiency score is lower than scenario M. In other words, for the same fishing reduction effort (33%), the bycatch reduction is higher in scenario N (88% reduction) than in scenario M (80%).

It is important to note that in all proposed scenarios it is assumed that fishing effort in métiers of concern is not redistributed into areas where bycatch would still occur. Furthermore, all scenarios would imply large reductions in fishing effort for some fleets fishing in ICES Subarea 8 and 9. ICES has not evaluated the consequences of such reductions, neither in terms of potential effort redistribution towards other gears nor in terms of socio-economic impacts.

Table 2.6. Proposed scenarios for the four tested management objectives, and evaluation of associated risks, for the common dolphin in ICES Subarea 8 and 9. For further information on performance of scenarios, please see Table 2.4.

Scenarios that meet the objective	Expected outcomes	Relative risk of not achieving the objective	Comment on the scenario risk	Bycatch from strandings above threshold
Management objective : PBR				
H- 6-week closure (mid-Jan.-end of Feb.) of all métiers and pingers on PTB and PTM gears for the rest of the year	Bycatch reduction : 54% Efficiency score : 4.5	Medium	Closure achieves the greatest proportion of the bycatch reduction and a 6-week closure is more likely to capture the peak in mortalities. [††††††]	No
E- 4 week closure of all métiers (mid-Jan.-mid.-Feb)	Bycatch reduction : 34% Efficiency score : 4.4	Very high	4-week closure is still relatively short and could miss the peak in mortalities. Does not rely on pinger deployment. High risk of not achieving the objective, reached only with monitoring estimates. Bycatch inferred from strandings remain above PBR.	Yes
I- Pinger PTM/PTB year-round and 4-week closure of all other métiers of concern (mi-Jan.-mid-Feb.)	Bycatch reduction: 27% Efficiency score: 3.7	Very high	Closure achieves the greatest proportion of the bycatch reduction but 4-week closure is still relatively short and could miss the peak in mortalities. High risk of not achieving the objective, reached only with monitoring estimates. Bycatch inferred from strandings remain above PBR.[††††††]	Yes
Management objective:<75% of PBR				
G- pinger PTM/PTB all year and 6-week closure of all other métiers of concern (mid-Jan.-end of Feb.)	Bycatch reduction: 43% Efficiency score: 3.9	Very high	Closure achieves the greatest proportion of the bycatch reduction and a 6-week closure more likely to capture the peak in mortalities. High risk of not achieving the objective, reached only with monitoring estimates. Bycatch inferred from strandings remain above PBR.[††††††]	Yes

[††††††] Modified based on reviewers' comments after the Advice Drafting Group in December 2022.

Scenarios that meet the objective	Expected outcomes	Relative risk of not achieving the objective	Comment on the scenario risk	Bycatch from strandings above threshold
B- Annual fishing effort reduction of 40% in métiers of concern	Bycatch reduction: 40% Efficiency score: 1	High	Does not rely on pinger deployment. High risk of not achieving the objective, reached only with monitoring estimates. Bycatch inferred from strandings remain above PBR. [††††††]	Yes
Management objective:<50% of PBR				
L- 2 month closure (mid-Jan.-mid-March.) of all métiers and pingers on PTB and PTM gear for the rest of the year	Bycatch reduction: 66% Efficiency score: 4	Very high	Longer-term closure that would cover the peak mortality. Bycatch inferred from strandings remain above 50% of PBR. [††††††]	Yes
M- 4 month closure all métiers (Dec.-end of March) and pingers on PTM/PTB gears for the rest of the year	Bycatch reduction: 80% Efficiency score: 2.4	Low	Long term closure that would cover the peak mortality. [††††††]	No
Management objective: < mPBR				
N- 3 month (jan. - Mar h) and 1 month (mid-July-mid- Aug.) closure all métiers and pingers on PTM and PTB gears for the rest of the year	Bycatch reduction: 88% Efficiency score: 2.6	Medium	Risk around the timing of the shorter second closure. Observer monitoring data provide estimates below mPBR, whereas strandings provide estimates just above mPBR (n=985) [††††††]	Yes

Mitigation[‡‡‡‡‡‡]

A combination of technical mitigation measures and/or effort reduction in trawls and static nets could be used to reduce mortality safely below PBR. WKEMBYC2 highlighted possible management objectives that may satisfy the requirements of EU legislation.

1. To achieve a level of bycatch that would ensure the viability of the population is maintained (50% of PBR), scenario M or N would need to be implemented. Scenario M contains a four-month winter closure for all métiers (PTM_DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF, and GNS_DEF) from December to March; and the use of acoustic deterrents, that have been proven

‡‡‡‡‡‡ Section edited based on reviewers' comments after the Advice Drafting Group in December 2022.

to be effective (e.g. DDD_03) for reducing common dolphin bycatch in trawls, on PTM and PTB the rest of the year.

2. To achieve a level of bycatch that would reduce bycatch below levels of mPBR, scenario N would need to be implemented. Scenario N contains three measures: a three-month winter closure for all métiers PTM_DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF, and GNS_DEF) from January to March; a one-month summer closure for PTM_DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF and GNS_DEF; and the use of acoustic deterrents, that have been proven to be effective (e.g. DDD_03) for reducing common dolphin bycatch in trawls, on PTM and PTB the rest of the year.
3. It was suggested that spatio-temporal closure measures could be relaxed if and when specific fleets or métiers were able to demonstrate that they are 'dolphin-safe', i.e. when fisheries demonstrate their involvement in scientific monitoring programmes, compliance with taking observers or EM on board, pinger use, demonstrated no or agreed low levels of bycatch.
4. The provision of funding for fishers to transition in the long-term to alternative fishing practices to help reduce common dolphin bycatch, while ensuring that these measures are also safe to other Protected, Endangered or Threatened Species (PETS).
5. Mitigation trials to reduce cetacean bycatch in various métiers must be encouraged, associated with power analysis in order to optimize their capacity to detect efficiency of mitigation devices.

Monitoring

1. Adequate monitoring through dedicated observers or incentivised use of REM should be implemented in Subareas 8 and 9. These monitoring protocols need to be based on a random sampling design that ensures representative coverage of the relevant métiers and vessel sizes throughout the area of dolphin distribution; likewise, the at-sea control system should check if pingers are adequately deployed and in working order.
2. Developing bycatch estimate methodology that consider the unequal and non-representative sampling scheme of at-sea monitoring programmes. The ratio-based approach requires representative and exhaustive monitoring strategy, which is not the case in European waters. At a national level, improved reporting of data on certain net dimensions (length and height) as an indication of the capacity of the net to bycatch dolphins for GNS and GTR métiers; similarly, the vertical opening of trawls, in particular HVO and VHVO trawls, should be clearly documented as it seems to be critical to assess their capacity to catch common dolphin.
3. The elevated levels of bycatch appear to be primarily driven by changes in the seasonal distribution of common dolphin, rather than elevated winter fishing effort. The seasonal distribution could change in the future and the need for spatio-temporal measures might also change as a result. Therefore, stranding networks need to be supported along both the French and Iberian coastlines to help determine the efficacy of and requirement for on-going bycatch reduction measures. More broadly, maintain or reinforce existing stranding networks in the NE Atlantic common dolphin range states and encourage joint analyses and experimentations, including tagging experiments of dolphin carcasses to refine key parameters allowing bycatch mortality to be estimated.

This could allow to provide bycatch estimates inferred from strandings at broader scale (areas 7 to 9).[§§§§§§]

4. Large scale surveys to estimate the abundance of common dolphins should be implemented more regularly than the current decadal interval of the SCANS surveys; this is particularly relevant for any management decisions based on PBR or other thresholds.
5. Regional scale (e.g. Bay of Biscay) abundance surveys should also be carried out on a seasonal basis to monitor short-term changes in distribution and density of common dolphins which will also help determine the appropriateness of management measures. In the absence of adequate monitoring of common dolphin in the Bay of Biscay, it will be difficult to gauge the effectiveness of any mitigation measures adopted (e.g. an observed decrease in strandings could not definitely be attributed to the mitigation measures without concurrent knowledge of the at-sea distribution and abundance of common dolphins).

[§§§§§§] Sentence added after the Advice Drafting Group in December 2022.

3 Further Exploration of Scenarios and Data

We further explored available data (see section 2) using a more detailed stratification approach that considers finer spatial and temporal scales. This chapter constitutes a methodological exercise only. Data available in section 2 are here presented at finer spatial and temporal scales, but cannot be considered as "better" or "more precise" data as the monitoring protocols did not cover all strata (either métiers, quarter or areas).[*******]

The bycatch estimates produced in 2020 under WKEMBYC (ICES 2020a) and repeated with more recent data in Section 2 of this report are at the ICES ecoregion scale, meaning métier specific bycatch rates calculated from observer monitoring data were extrapolated to the full fishing effort data for that métier across the whole ecoregion. If finer-scale spatial and temporal patterns in bycatch rates exist, and observer monitoring data used to calculate bycatch rates were not representative of the full distribution of fishing effort, there is the potential for under/over estimation using this approach. Furthermore, this broadscale analysis does not allow particular areas, métiers or periods with evidence of elevated bycatch rates to be identified at higher resolution.

In this section we present an additional analysis using a more detailed stratification approach that considers finer spatial and temporal scales, in order to examine particular areas, métiers, and periods for evidence of elevated bycatch rates. The data utilised in this analysis was the same as that used in section, however, data were stratified spatially and temporally as described below[*******]:

Spatially: For this analysis, the Bay of Biscay and Iberian Peninsula ecoregion was separated into two smaller areas consisting of (1) ICES Divisions 8abd (French coast and offshore Biscay), and (2) ICES Divisions 8c9a (Spanish and Portuguese coasts). We also included a third spatial strata consisting of (3) ICES Divisions 7efghj (Western English Channel and Celtic Sea). This latter area was not considered in the scenarios developed in 2020 under WKEMBYC (ICES, 2020a).

Temporally: The data were also stratified by quarter to provide a seasonal component.

All fishing activity was stratified to métier level 5 as in the previous assessments and the analysis in section 2.

Bycatch rates were calculated from at-sea observer monitoring data for each spatial, temporal and métier 5 combination, and were then extrapolated to the same strata using the same fishing effort dataset as used in Section 2, to produce more highly stratified bycatch estimates. Bycatch rates were calculated only for those strata that had at least 1 common dolphin bycatch recorded between 2017 and 2021. The resulting estimates provide a partial mortality assessment as bycatch rates have only been extrapolated for those strata with direct evidence of bycatch occurrence. However, they are informative from a management and mitigation perspective because they provide a more focussed and reliable view of recent patterns of bycatch evident in the fisheries observer monitoring data.

Similar scenarios as used in WKEMBYC and in section 2 were then applied to the resulting stratified estimates to provide a more detailed assessment of how different mitigation approaches might affect bycatch levels in those métiers, areas and seasons with evidence of common dolphin

[*******] Paragraph modified based on reviewers' comments after the Advice Drafting Group in December 2022.

bycatch. Some changes were made to the scenarios to account for the preliminary results from recent mitigation trials as follows:

1. Research in Portugal by Marcalo *et al.* (pers comm) found a 99% reduction in bycatch associated with the use of a single pinger (DDD) in purse seine fisheries targeting small pelagics. This efficiency rate was applied to all PS strata in the scenarios in Table 3.2. Note that this efficiency was calculated by ICES during WKEMBYC-2 meeting using t-test.[†††††††]
2. Research in Spain indicated that the correct use of ADDs in PTB fisheries would reduce bycatch rates by 95% (Basterretxea, pers. Com.). Although ADD use is mandated by France and Spain for part of the year in these fisheries there is no clear signal in the observer monitoring data of reduced bycatch rates. This is considered to be because of suboptimal use of pingers in this métier. Consequently, a 95% efficiency rate was applied to PTB in those scenarios that included use of pingers to indicate how bycatch levels might be expected to change if pingers were used appropriately. The same efficiency rate was also applied to PTM effort outside of the currently mandated period.
3. The effects of spatio-temporal closures were not applied in the Celtic Sea strata because a significant proportion of the fishing effort in that area is from UK vessels to which EU management measures would not apply. There was insufficient time to separate EU from UK fishing effort to explore how EU closures in that area would affect overall mortality levels.

3.1 Data

Fishing Effort

Fishing effort data for Table 3.1 were taken from the RDB and WKBYC databases as described in Section 2.1. The effort data for Subarea 27.7 were taken from the WKBYC database for Ireland, UK and France as effort data in the RDB for these countries were either missing or incomplete with DaS not recorded. Effort data for other countries were taken from the RDB. Data were averaged over the calendar years 2019, 2020 and 2021, except in the case of Portugal where RDB data for 2021 alone were used. All pair trawl effort data were halved to account for the fact that days at sea are reported by both vessels in a pair team in these fisheries.

3.2 Bycatch estimates using at-sea observations

Method

To enable comparison with the results of the previous workshop in 2020 (WKEMBYC) bycatch rates of common dolphins were estimated using a ratio-based approach which divides the number of animals recorded bycaught by the days at sea observed over the 2017-2021 period (pooled) for each métier within the Bay of Biscay and Iberian Peninsula ecoregion and in ICES Divisions 7efghj. Confidence intervals around the bycatch rates were estimated assuming a Poisson distribution using the function qpois in R. Poisson distribution was selected rather than binomial. An analysis conducted in 2020 (ICES WGBYC, 2020c) to investigate which error distribution was the most suitable for data in the WGBYC database found that Poisson distribution was acceptable for all taxa (ICES 2020c). The average annual bycatch rates for 2019-2021 were then extrapolated

[†††††††] Sentence added after the Advice Drafting Group in December 2022.

using the appropriately stratified fishing effort data. It should be highlighted that data were extrapolated to strata with records of common dolphin bycatch and not to the entire area. ‡‡‡‡‡‡

As more monitoring records were available to this workshop (WKEMBYC 2), further stratification of the data was possible. Three spatial strata (as described above) were selected based on both geographical similarity and expert judgment on which areas had the most similar fishing practices.

Results

Based on the bycatch estimations for these more detailed strata, 41% of common dolphin bycatch came from area 8abd, 34% from area 8c9a and 25% from area 7efghj. In Area 7efghj the highest proportion of estimated bycatch came from métiers PS_SPF and GNS_DEF in quarter 3, in Area 8c9a the highest proportion came from PS_SPF in quarters 2 and 3, while in Area 8abd it came from GTR_DEF in quarter 2 and LLS_DEF in quarter 1 (Table 3.1). Again, it should be noted that as only strata (areas/métiers/quarters) with observed bycatch are included in these results, therefore, all possible strata were not covered in this analysis. As such, no bycatch estimates outside these strata were calculated and therefore no total bycatch estimates are presented here. ‡‡‡‡‡‡

Table 3.1 Summary of annual average common dolphin bycatch per métier from WGBYC at-sea observer monitoring data in the Celtic Sea and Bay of Biscay and Iberian Coast ecoregions for 2019-2021.Proportion of Total Bycatch all Regions (%) is also presented. DaS = days at sea. Only strata (areas/métiers/quarters) with observed bycatch are included in the analysis . Strata with monitoring effort but no bycatch and strata with no monitoring effort are not included in this table. As this table only includes information for strata with bycatch recorded, % coverage information was not included. ‡‡‡‡‡‡‡

Ecoregion	Strata	Métier 4	Métier 5	Quarter	Fishing Effort (DaS)	Monitored Effort (DaS)	Estimated Bycatch	Lower	Upper	(%)
Celtic Seas	7efghj	GNS	CRU	2	1727	56	124	31	249	3.56
	7efghj	GNS	DEF	3	5196	181	172	57	287	4.93
	7efghj	GNS	DEF	4	4322	194	22	0	67	0.64
	7efghj	GTR	DEF	1	1130	41	27	0	82	0.78
	7efghj	GTR	DEF	2	1666	66	50	0	125	1.44
	7efghj	GTR	DEF	4	964	33	29	0	87	0.83
	7efghj	OTB	CEP	4	1393	25	112	0	280	3.20
	7efghj	OTB	CRU	4	418	56	15	0	37	0.43
	7efghj	OTB	DEF	3	9872	615	96	32	160	2.76
	7efghj	OTB	DEF	4	7951	514	77	31	139	2.22
	7efghj	OTT	CRU	1	83	63	3	0	7	0.08
	7efghj	PS	SPF	3	805	27	149	60	268	4.27
	7efghj	TBB	DEF	1	3456	370	9	0	28	0.27

‡‡‡‡‡‡ Paragraph modified after the Advice Drafting Group in December 2022.

Ecoregion	Strata	Métier 4	Métier 5	Quarter	Fishing Effort (DaS)	Moni-tored Effort (DaS)	Esti-mated Bycatch	Lower	Upper	(%)
Bay of Biscay	8abd	GNS	DEF	1	5233	436	60	24	108	1.72
	8abd	GNS	DEF	2	4062	230	18	0	53	0.51
	8abd	GNS	DEF	3	4664	181	155	52	258	4.43
	8abd	GTR	DEF	1	5553	555	120	70	180	3.44
	8abd	GTR	DEF	2	6683	292	183	92	297	5.24
	8abd	GTR	DEF	3	6092	154	158	39	316	4.52
	8abd	GTR	DEF	4	4225	188	22	0	67	0.64
	8abd	LLS	DEF	1	3851	22	175	0	526	5.02
	8abd	OTB	DEF	3	3727	53	70	0	211	2.02
	8abd	OTM	DEF	1	89	2	114	0	284	3.25
	8abd	PTB	DEF/MPD	1	134	57	118	92	147	3.39
	8abd	PTB	DEF/MPD	3	110	9	49	12	98	1.40
	8abd	PTB	DEF/MPD	4	100	47	19	9	31	0.55
	8abd	PTM	DEF	1	285	111	18	8	31	0.51
	8abd	PTM	DEF	2	264	44	24	6	48	0.68
	8abd	PTM	SPF	1	69	10	119	73	165	3.40
Iberian Coast	8c9a	GNS	DEF	1	14189	304	140	47	280	4.01
	8c9a	GNS	DEF	3	15893	398	80	0	200	2.29
	8c9a	GNS	DEF	4	12249	488	25	0	75	0.72
	8c9a	OTB	DEF	1	3035	118	26	0	77	0.74
	8c9a	PS	SPF	2	20386	171	358	119	715	10.25
	8c9a	PS	SPF	3	25781	386	401	134	668	11.48
	8c9a	PS	SPF	4	11356	160	142	0	355	4.07
	8c9a	PTB	DEF\MPD	4	913	92	10	0	30	0.28
	8c9a	PTM	LPF	3	398	236	2	0	5	0.05

3.3 Scenarios

	Updated Scenarios **Table 2.4**	**Scenario Exploration** **Table 3.2**
Areas	8 and 9	7efghj, 8abd, 8c9a
Métiers	Level 5	Level 5
Bycatch rates – data years used to calculate bycatch rates[§§§§§§§]	2019-2021	2017-2021
Temporal resolution – data years used to estimate average annual bycatch[§§§§§§§]	2019-2021	2019-2021 by quarter
Mitigation included	65% bycatch reduction on PTM/PTB implied as effectively all vessels were using pingers since 2019 during currently mandated period[§§§§§§§]	95% bycatch reduction on PTM outside currently mandated period 95% bycatch reduction on PTB 99% bycatch reduction on PS
Advantages	-can be compared to previous WKEMBYC report -more consistent with bycatch estimates inferred from strandings	-higher resolution (areas and seasons) -highlights specific combinations of métier/quarter/areas with higher bycatch levels
Limitations	-extrapolate bycatch rate in specific area or quarter to the whole métier fishing effort -does not distinguish 0 bycatch from no monitoring effort -moderate to high risk of over/underestimation.	- currently does not provide a total mortality estimate due to more detailed stratification (as a result, no comparison with management objectives are undertaken). [§§§§§§§] - would require representative monitoring in all subareas/métiers/quarters to produce a full mortality estimate -does not distinguish 0 bycatch from no monitoring effort - did not consider effects of closures in 7efghj due to aggregated EU/UK fishing effort
Main results	-higher bycatch estimates in 2019-2021 than in 2016-2018. -no scenario to achieve the <10%PBR objective	-efficiency of pingers on PS -bycatch estimates and scenarios at higher resolution, under condition of significant and robust at-sea monitoring (all strata at sufficient level). -could be used to target mitigation measures more efficiently than in less stratified analyses -could be used to highlight areas that might require additional monitoring

[§§§§§§§] Modified after the Advice Drafting Group in December 2022.

Table 3.2 Scenarios' performances. For scenarios A to O, key information given are scenario title, bycatch reduction obtained, effort reduction implied, and efficiency score. The efficiency score of each scenario is bycatch reduction rate divided by effort reduction rate. This efficiency could be considered as a rough cost effectiveness for each scenario considering that a reduction effort is a cost for the industry (see main text for further detail). No colour code indicating how each scenario reached the different management objectives is included the table as estimates are stratified and do not represent complete bycatch estimates for the regions explored. Information provided is based on average annual bycatch estimates for the period 2019-2021, see table 3.2 for more information.[29]

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Scenario	4-month closure (Dec-Mar) all métiers	Annual effort reduction of 40% all métiers	2-month closure (mid Jan - mid Mar) all métiers	6-week closure (mid Jan - end Feb) all métiers	4-week closure (mid Jan - mid Feb) all métiers	2-week closure (mid Jan - end Jan) all métiers	Pinger PTM / PTB / PS all year & same 6 week closure all other métiers	6-week closure (mid Jan - end Feb) all métiers and pinger PTM / PTB/PS rest of year	Pinger PTM / PTB / PS all year and same 4 week closure all other métiers	Pinger PTM / PTB / PS all year and same 2 week closure all other métiers	Pinger PTM / PTB / PS all year	2 month closure all métiers + pinger PTB / PTM / PS rest of year	4-month closure all métiers + pinger PTM / PTB / PS rest of year	3 month (Jan–Mar) + 1 month (mid-Jul–mid-Aug) closure all métiers + pinger PTB / PTM /PS rest of year	3-month (Jan–Mar) + 1-month (mid-Jul–mid-Aug) closure all métiers
Number of bycaught animals remaining if scenario introduced.	2372	2094	2711	2850	3082	3324	1776	1678	1945	2120	2241	1555	1302	937	1683
Bycatch Reduction obtained	0,32	0,40	0,22	0,18	0,12	0,05	0,49	0,52	0,44	0,39	0,36	0,55	0,63	0,73	0,52
Effort reduction needed	0,3	0,40	0,17	0,12	0,08	0,04	0,11	0,12	0,07	0,04	0,00	0,17	0,3	0,3	0,3
Efficiency score	1,0	1,0	1,3	1,6	1,5	1,2	4,4	4,3	6,0	10,7	NA	3,3	1,9	2,2	1,6

[29] Caption modified based on reviewers' comments after the Advice Drafting Group in December 2022.

Based on bycatch reduction rates and measures of efficiency, scenarios in Table 3.2 are ranked similarly to those in the Scenario Table 2.4. Scenario N, four-month closure from January through March and from mid-July to mid-August on all métiers, and pingers on PTM/PTB/PS the rest of the year, performs best in terms of bycatch reduction (bycatch reduction rate=0.73), however, its efficiency is intermediate because the closure period is broader than the typical duration of the period of high bycatch. Scenarios H, L, M, and O all result in a bycatch reduction rate of over 50%.

3.4 Discussion

The decrease in common dolphin bycatch rates between 2016-2018 and 2019-2021 on PTM-DEF fishery suggests an efficient deployment of pingers, mandatory in high risk seasons since 2020 but commonly used since winter 2019 by the French fishery. However, common dolphin bycatch rates were relatively stable between 2016-2018 and 2019-2021 for PTB métiers, despite mandatory pinger use since 2020. This suggests that pingers are either not being used correctly or are not being deployed in this fishery. As a result, the potential effect of their correct use and full deployment was incorporated into this more stratified exploratory approach to scenario building (for PTB only). However, the deployment of pingers on purse seiners targeting small pelagic fishes in all areas could result in significant reductions in bycatch levels. Mitigation trials using DDD-03H were performed in Southern Portuguese waters and showed a very high efficiency in this métier (>99%). The application of these efficiencies to the Spanish and French purse seine fleet, which share similar fishing practices, suggests some potential for comparable bycatch reduction across all PS fisheries. It should be noted that the incorporation of pinger efficiency on pair trawls and purse seines did not consider any potential habituation of dolphins and it is not clear if this would occur over time. As such, ongoing research across all regions is necessary. [30]

For three métiers, PTB, PTM, PS, the appropriate use of pingers may significantly reduce cetacean bycatch rates and therefore decrease fisheries induced mortality. However, the successful mitigation trials performed over the last three years only concern these active fishing gears. Bycatch levels were the highest in net métiers in Celtic Seas (GNS-DEF) and Bay of Biscay (GTR-DEF) areas and ranked in second place in Iberian coast areas (GNS-DEF). To date, no mitigation trials have reported statistically significant results for mitigating common dolphin bycatch in static gears, mostly due to low sampling effort in the trials and associated relatively low bycatch rates in these métiers. The high levels of bycatch estimated for these passive gears are likely in part due to the high number of vessels and therefore high fishing effort for these fisheries which encompass a large diversity of fishing practices. The net length (up to several kilometres) and soak times (up to several days) can be variable among target species and specific practices. These specificities hindered the deployment of efficient mitigation trials at large scales, but further mitigation trials in these fisheries should be encouraged.

The exploration of fishing and monitoring effort at finer spatial and temporal resolutions highlighted the potential of this more stratified method to identify métiers, areas and quarters with higher bycatch rates. In future, with additional data from all areas, this stratification methodology could be used to adapt and fine-tune the mitigation scenarios, both spatially and temporally. The spatial resolution (Celtic Seas, Bay of Biscay, Iberian coasts), appears to be sufficiently broad to avoid wide scale fishing effort redistribution in response to closures. This approach could consider spatial and temporal specificity, such as seasonal mandatory use of pingers in Bay of Biscay for PTM or the seasonal use of métiers. Nevertheless, the method used to estimate bycatch is a simple ratio-based approach that does not currently differentiate between a lack of

[30] Paragraph edited based on reviewer's comments after the Advice Drafting Group in December 2022.

monitoring effort and monitoring with no observed bycaught dolphins. Future work should consider more detailed and statistically robust methodologies as they become available.

4 Future considerations

4.1 Mitigation trials

Scenarios are a combination of fishery closures and use of pingers. These combinations are a balance between pinger efficiency and temporal window closure. In order to reduce the temporal fishery closures the use of efficient mitigation devices should be encouraged. To date, the testing and use of pingers has been primarily developed and encouraged through individual scientific programmes; however, other devices such as reflectors, Cetacean Excluder Devices associated with cameras and trawls and other technological gear modifications should also be considered and tested.

Promising trials were performed with pingers on static gears, and are described in detail in the introduction section. However, the low sample size of equipped vessels did not allow robust and statistically significant efficiency measures to be estimated. As an example, in the French net fisheries, a power analysis was conducted in order to optimize the sampling strategy of PiFil project, aimed at testing the efficiency of pingers under the hull. The analysis highlighted that no efficiency could be detected (or at an extremely low statistical power) with 95% or 80% confidence interval on a sample size of 20 vessels. Power analysis are very useful as they can provide a frame and help in sampling strategy, in order to ensure statistically robust results of mitigation trials.

4.2 Abundance estimates

The **Small Cetaceans in European Atlantic waters and the North Sea surveys** (SCANS) are large-scale surveys that started almost 30 years ago with the aim of monitoring whales, dolphins and porpoises on the shelf and offshore waters of the Northeast Atlantic. Since 1994, the survey expanded in the European Atlantic to cover all shelf waters in 2005, and to include offshore waters in 2007. In 2016, SCANS-III used three ships and seven aircraft to monitor cetaceans: it provided knowledge on the abundance and distribution of ten species, enabling all countries to report under the Marine Strategy Framework Directive, the Habitats Directive as well as to complete assessments within OSPAR and HELCOM.

Coordinated by the Institute for Terrestrial and Aquatic Wildlife Research at the University of Veterinary Medicine Hannover in Büsum (Germany), with partner institutes from other supporting countries (Denmark, France, the Netherlands, Portugal, Spain, Sweden and the United Kingdom); the fourth SCANS survey (SCANS-IV) took place in the summer of 2022. It covered shelf (with 8 planes) and offshore waters (with one ship) of the Northeast Atlantic Ocean. The survey covered 1.75 Mio of km² in the Northeast Atlantic (https://storymaps.arcgis.com/stories/6435641aed5745d1b2471e5e59e6af94).

The objectives of SCANS-IV are manifold, including:

- to estimate the abundance and distribution of the regularly occurring cetacean species;
- to estimate trend in abundance since the beginning of the SCANS surveys;
- to provide outputs for Member States to report under the Marine Strategy Framework Directive (Article 8: due 2024), the Habitats Directive (Article 17: 2019 - 2024) and for OSPAR/HELCOM assessments; and
- to provide outputs for impact assessments of offshore industries and fisheries.

The first results of the survey will be released in 2023, including abundance estimates for common dolphin (*Delphinus delphis*). A presentation of the survey to ASCOBANS is available here : https://www.ascobans.org/sites/default/files/document/ascobans_ac27_pres2.4b_scans-iv_gilles.pdf.

The availability of new abundance estimates should be considered in the context of revising and updating bycatch thresholds based on PBR.

4.3 Bycatch estimates

A novel analytical approach for analysing non-representative samples to infer by-catch was presented by M. Authier.

The Data Collection Framework (DCF) provides a common framework in the European Union (EU) to collect, manage, and share data within the fisheries sector (Anonymous, 2019). The Framework indicates that the Commission shall establish a Multi-Annual Union Programme (EU-MAP) for the collection and management of fisheries data which should be inclusive of data that allows the assessment of fisheries' impact on marine ecosystems.

With respect to Protected, Endangered and Threatened Species (including cetaceans ; hereafter PETS), the collection of high quality data usually requires a dedicated sampling scheme and methodology, and is generally different from those applied under the DCF (Stransky and Sala, 2019): "EU MAP remains not well-suited for the dedicated monitoring of rare and protected by-catch in high-risk fisheries since its main focus is the statistically-sound random sampling of all commercial fisheries (Ulrich and Doerner, 2021, p. 126)." In practice, the introduction of any programme on PETS by-catch under the DCF may be met with caution because of its perceived potential to disrupt data collection for fisheries management (Stransky and Sala, 2019). Data on by-catch of PETS cannot usually be assumed to be representative given the non-dedicated (with respect to PETS) nature of onboard observer schemes. Having non-representative samples severely limits the scope for inferring the magnitude of by-catch as scaling-up estimates from non-representative samples is anything but straightforward.

The issue of non-representativeness is however widespread (*e.g.* in epidemiology, election forecasts, *etc.*), and new statistical methodologies have been developed over the last 20 years: « Multilevel regression with Post-Stratification » (hereafter MrP). Multilevel regression modeling allows to summarize how predictions of an outcome of scientific interest vary across statistical units defined by a set of attributes or covariates (Gelman *et al.*, 2021, p. 4): for example, bycatch events are a binary outcome at the fishing operation level (a unit) associated with attributes, such as date-time, location, gears and vessels. Post-stratification is a tool to generalize inferences from a sample to the population (e.g. the whole fleet) by adjusting for known discrepancies between the former and the latter. Post-stratification is a form of adjustment whereby statistical units are sorted out according to an auxiliary variable (hereafter a stratum) after completion of data collection; stratum-level effects (i.e. effects within each stratum or cell) are then estimated, and finally averaged with weights proportional to stratum size to obtain the population-level estimate. Poststratification differs from blocking as the latter is done before data collection to ensure balance and representativeness at the design stage. Post-stratification is a post hoc statistical adjustment done at the analysis stage: it can remove bias, but at the price of an increased variance in estimates.

Authier *et al.* (2021) developed a workflow to use MrP on non-representative samples such as those collected on cetacean by-catch under the DCF. They showcased the ability of MrP to yield better estimate of the true magnitude of by-catch at fleet-level, even when onboard observers are not allocated randomly to vessels. In particular, MrP yielded unbiased estimates of the true number of by-catch events (under some assumptions) even when observers were preferentially sampling during periods of low or high by-catch risk. The ratio-estimator yielded, in contrast, under- and over-estimates as expected. Rouby *et al*. (2022) applied the workflow to data collected onboard pelagic pair-trawlers flying the French flag and operating in the Bay of Biscay to estimate common dolphin by-catch. The results of Rouby *et al*. (2022) showed a decrease in the inferred number of by-catch events in recent years, due to a decrease in both by-catch risk at the level of a single haul; and a decrease in the numbers of Days at Sea. Both studies show-cased the used of the MrP methodology and its successful application in the context of estimating by-catch events. However, results still hinges on assumptions (such as correct post-stratification, and accurate information collected at the fleet-level for scaling up estimates from sample to population, among others). That the MrP methodology can be applied is helpful in analysing already collected data, but does not dispense from improving current data collection schemes as the MrP framework yields also good results when samples are representative.

Annex 1: Pinger trials from published literature

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Timothy B. Werner, Simon Northridge, Kate McClellan Press, Nina Young, Mitigating bycatch and depredation of marine mammals in longline fisheries, ICES Journal of Marine Science, Volume 72, Issue 5, May/June 2015, Pages 1576–1586, https://doi.org/10.1093/icesjms/fsv092	marine mammals	all	all	all	2015	Literature review of mitigation measures	To provide an introduction to the articles that appear in this themed set of the ICES Journal of Marine Science, and to help fishermen, fisheries managers, and research scientists advance solutions to this global problem.
Hamilton, S., & Baker, G. B. (2019). Technical mitigation to reduce marine mammal bycatch and entanglement in commercial fishing gear: lessons learnt and future directions. Reviews in Fish Biology and Fisheries, 29(2), 223-247. https://doi.org/10.10 07/s11160-019- 09550-6	marine mammals	all	miscellaneous	all	2019	literature review of mitigation methods	Points generally to pingers as an effective tool to reduce small cetacean bycatch in gillnets and notes that there are no good tools to prevent small cetacean bycatch in trawl nets, but that loud pingers show some potential
ICES (2020a). Workshop on fisheries Emergency Measures to minimize BYCatch of short-beaked common dolphins in the Bay of Biscay and harbour porpoise in the Baltic Sea (WKEMBYC).	Small cetaceans	*Delphinus delphi* and *Harbour porpoise*	all	Bay of Biscay and Baltic sea	2020	A group of experts meet in a workshop to mitigate the bycath.	Workshop on Emergency Measures to mitigate BYCatch of harbour porpoise in the Baltic Sea and common dolphin in the Bay of Biscay
Read, F.L. (2021). Cost-benefit Analysis for Mitigation Measures in Fisheries with High Bycatch. ASCOBANS Secretariat, Bonn, Germany. 81 pages. ASCOBANS Technical Series No.2. https://www.ascobans.org/en/publication/cost-benefitanalysis-mitigationmeasures-fisherieshigh-bycatch.	marine mammals	all	all	all	2021	literature review of mitigation methods	The report reviews different mitigation measures (acoustic deterrent devices, porpoise alerting devices, reflective nets, acrylic echo enhancers, lights and various technical modifications and changes to fishing practices) that have been trialled in the ASCOBANS region. The cost of implementation and pros and cons of each method are discussed.

Annex 2: References

ASCOBANS 1997. Towards Development of Conservation Objectives for ASCOBANS. ASCOBANS MOP 2 DOC.4. https://www.ascobans.org/en/document/towards-development-conservation-objectives-ascobans

ASCOBANS 2015. Report of the Workshop on Further Development of Management Procedures for Defining the Threshold of 'Unacceptable Interactions' – Part I: Developing a Shared Understanding on the Use of Thresholds / Environmental Limits. 22nd Advisory Committee Meeting, Document Inf.4.1.c. https://www.ascobans.org/sites/default/files/document/ascobans_ac26_doc8.3_rev1_prioritisation-activities.pdf

Anonymous (2019). Commission Implementing Decision (EU) 2019/910. Establishing the Multiannual Union Programme for the Collection and Management of Biological, Environmental, Technical and Socioeconomic Data in the Fisheries and Aquaculture Sectors. European Commission.

Astarloa, A,, Louzao, M,, Andrade, J,, Babey, L,, Berrow, S,, Boisseau, O,, Brereton, T,, Dorémus, G,, Evans, PGH,, Hodgins, NK,, Lewis, M,, Martinez-Cedeira, J,, Pinsky, ML,, Ridoux, V,, Saavedra, C,, Santos, MB,, Thorson, JT,, Waggitt, JJ,, Wall, D, and Chust, G., 2021. The Role of Climate, Oceanography, and Prey in Driving Decadal Spatio-Temporal Patterns of a Highly Mobile Top Predator. Front. Mar. Sci. 8:665474. doi: 10.3389/fmars.2021.665474

Authier, M., Peltier, H., Dorémus, G., Dabin, W., Canneyt, O.V., Ridoux, V., 2014. How much are stranding records affected by variation in reporting rates? A case study of small delphinids in the Bay of Biscay. Biodivers. Conserv. 23, 2591–2612. https://doi.org/10.1007/s10531-014-0741-3

Authier M, Rouby E and Macleod K. (2021) Estimating Cetacean Bycatch From Non-representative Samples (I): A Simulation Study With Regularized Multilevel Regression and Post-stratification. Front. Mar. Sci. 8:719956. doi: 10.3389/fmars.2021.719956 (https://gitlab.univ-lr.fr/mauthier/regularized_bycatch)

Bernaldo de Quirós, Y., Hartwick, M., Rotstein, D.S., Garner, M.M., Bogomolni, A., Greer, W., Niemeyer, M.E., Early, G., Wenzel, F., Moore, M., 2018. Discrimination between bycatch and other causes of cetacean and pinniped stranding. Dis. Aquat. Organ. 127, 83–95. https://doi.org/10.3354/dao03189

Blanchard, A., Doremus, G., Laran, S., Nivière, M., Sanchez, T., Spitz, J., Van Canneyt, O., 2021. Distribution et abondance de la mégafaune marine en France métropolitaine. Rapport de campagne SAMM II Atlantique-Manche - Hiver 2021, de l'Observatoire Pelagis (UMS 3462, La Rochelle Université / CNRS) pour la Direction de l'Eau et de la Biodiversité et L'Office Français de la Biodiversité.

Brereton, T., Williams, A., and Martin, C. (2005). Ecology and status of the common dolphin *Delphinus delphis* in the English Channel and Bay of Biscay 1995–2002. Proceedings of the workshop on common dolphins: current research, threats and issues, Special Issue April 2005, pp 15–22. Kolmarden, Sweden 1st April, 2004. K. Stockin, A. Vella & P. Evans (Eds).

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., Thomas, L., 2001. Introduction to distance sampling: Estimating abundance of Biological Populations, Oxford University Press. ed. Oxford.

Caurant F., Chouvelon T., Lahaye V., Mendez-Fernandez P., Rogan E., Spitz J., and Ridoux V. (2011). The use of ecological tracers for discriminating dolphin population structure: the case of the short-beaked common dolphin *Delphinus delphis* in European Atlantic waters. 18th ASCOBANS Advisory Committee Meeting, AC18/Doc.5-02 (P). Available from: https://www.ascobans.org/sites/default/files/document/AC18_5-02_EcologicalTracersCommonDolphins_1.pdf

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

Cañadas, A., Donovan, G.P., Desportes, G., and Borchers, D.L. (2009). A short review of the distribution of short beaked common dolphins (*Delphinus delphis*) in the central and eastern North Atlantic with an abundance estimate for part of this area. NAMMCO Sci Publ 7:201–220.

Coda (2009). Cetacean Offshore Distribution and Abundance in the European Atlantic (CO-DA). 43pp without appendices; 164pp with appendices.

Correia, A.M., Gil, A., Valente, R. et al (2019). Distribution and habitat modelling of common dolphins (*Delphinus delphis*) in the eastern North Atlantic. J Mar Biol Assoc UK 99:1443-1457.

Daniel, P., Jan, G., Cabioc'h, F., Landau, Y., Loiseau, E., 2002. Drift Modeling of Cargo Containers. Spill Sci. Technol. Bull. 7, 279–288.

Dias, I. C., Marcalo, A., Feijo, D., Domingoes, I. and Silva, A. 2022. Interactions between the common dolphin, Delphinus delphis, and the Portuguese purse seine fishery over a period of 15 years (2003–2018). Aquatic Conserv: Mar Freshw Ecosyst. 2022;1–14

Doksæter, L., Olsen, E., Nøttestad, L., and Fernö, A. (2008). Distribution and feeding ecology of dolphins along the Mid-Atlantic Ridge between Iceland and the Azores. Deep Res Part II Top Stud Oceanogr 55:243–253. doi: 10.1016/j.dsr2.2007.09.009

Evans, P.G.H., and Bjørge, A (2013). Marine Climate Change Impacts Partnership: Science Review. Mar Clim Chang Impacts Partnersh Sci Rev 134–148.

Evans, P.G.H., and Teilmann, J. (editors) (2009). *Report of ASCOBANS/HELCOM Small Cetacean Population Structure Workshop*. ASCOBANS/UNEP Secretariat, Bonn, Germany. 140pp. https://www.ascobans.org/sites/default/files/publication/Report_PopulationStructureWorkshops2007_small.pdf.

Gelman, A., Hill, J., and Vehtari, A. (2021). Regression and Other Stories, 1st Edn. Cambridge, MA: Cambridge University Press. doi: 10.1017/9781139161879

Genu M., Gilles A., Hammond PS., Macleod K., Paillé J., Paradinas I., Smout S., Winship AJ. and **Authier M.** (2021) Evaluating Strategies for Managing Anthropogenic Mortality on Marine Mammals: An R Implementation With the Package RLA. Front. Mar. Sci. 8:795953. doi: 10.3389/fmars.2021.795953

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., *et al.* (2021). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. SCANS-III Report. Available at: https://scans3.wp.st-andrews.ac.uk/files/2021/06/SCANS-III_design-based_estimates_final_report_revised_June_2021.pdf

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

Hammond, P.S., Macleod, K., Berggren, P., Borchers, D.L., Burt, M.L., Cañadas, A., Desportes, G., Donovan, G.P., Gilles, A., Gillespie, D., Gordon, J., Hiby, L., Kuklik, I., Leaper, R., Lehnert, K., Leopold, M.F., Lovell, P., Øien, N., Paxton, C.G.M., Ridoux, V., Rogan, E., Samarra, F., Scheidat, M., Sequeira, M., Siebert, U., Skov, H., Swift, R., Tasker, M.L., Teilmann, J., Van Canneyt, O., and Vázquez, J.A. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation* 164**,** 107–122.

ICES. 2008. Report of the Working Group on Marine Mammal Ecology (WGMME), February 25–29 2008, St. Andrews, UK. ICES CM 2008/ACOM:44. 86 pp.

ICES 2013. Report of the Working Group on Marine Mammal Ecology (WGMME), February 4-7, Paris, France. ICES CM 2013/ACOM:26. 117 pp.

ICES (2014). Report of the Working Group on Marine Mammal Ecology (WGMME), 10–13 March 2014, Woods Hole, Massachusetts, USA. ICES CM 2014/ACOM:27. 234pp.

ICES. 2015. Report of the Working Group on Bycatch of Protected Species (WGBYC), 2-6 February 2015, ICES Headquarters, Copenhagen, Denmark. ICES CM 2015\ACOM:26. 82 pp.

ICES. 2016. Report of the Working Group on Bycatch of Protected Species (WGBYC). Copenhagen: ICES, 2016. 82 p.

ICES. 2020a. Workshop on fisheries Emergency Measures to minimize BYCatch of short-beaked common dolphins in the Bay of Biscay and harbour porpoise in the Baltic Sea (WKEMBYC). ICES Scientific Reports. 2:43. 354 pp. http://doi.org/10.17895/ices.pub.7472

ICES, 2020b. EU request on emergency measures to prevent bycatch of common dolphin (Delphinus delphis) and Baltic Proper harbour porpoise (Phocoena phocoena) in the Northeast Atlantic. In Report of the ICES Advisory Committee, 2020. ICES Advice 2020, eu.2

ICES (2020c). Working Group on Bycatch of Protected Species (WGBYC). ICES Scientific Reports. 2:81. 216 pp. http://doi.org/10.17895/ices.pub.7471

ICES. 2021a. Workshop on estimation of MOrtality of Marine MAmmals due to Bycatch (WKMOMA). ICES Scientific Reports. 3:106. 95 pp. https://doi.org/10.17895/ices.pub.9257ICES. 2022a. WGBYC Data call 2022: Bycatch of protected species for ICES advisory work. ICES Data Calls. https://doi.org/10.17895/ices.data.19745809

ICES 2021b. Working Group on Bycatch of Protected Species (WGBYC). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.9256

ICES 2022b. Working Group on Bycatch of Protected Species (WGBYC). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.21602322.v1

Kinze CC, Jensen T, Tougaard S, and Baagøe HJ (2010). Danske hvalfund i perioden 1998-2007 [Records of cetacean strandings on the Danish coastline during 1998-2007]. Flora og Fauna 116:91–99.

Kuiken, T., 1994. Diagnosis of bycatch in cetaceans, Proceedings of the second ECS workshop on cetacean pathology. European Cetacean Society, Montpellier, France.

Laran, S., Genu, M., Authier, M., Blanchard, A., Dorémus, G., Sanchez, T., Spitz, J. and Van Canneyt, O. (2022) Distribution et abondance de la mégafaune marine en France métropolitaine. Rapport final de la campagne SAMM II Atlantique-Manche - Hiver 2021, de l'Observatoire Pelagis (UAR 3462, La Rochelle Université / CNRS) pour la Direction de l'Eau et de la Biodiversité et L'Office Français de la Biodiversité. 72 pp.

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

Loïc Lehnhoff, Hervé Glotin, Serge Bernard, Willy Dabin, Yves Le Gall, *et al*.. Behavioural Responses of Common Dolphins Delphinus delphis to a Bio-Inspired Acoustic Device for Limiting Fishery ByCatch. Sustainability, 2022, 14 (20), pp.13186. ff10.3390/su142013186ff. ffhal-03820889ff

Macleod, K., and Walker, D. (2005). Highlighting potential common dolphin-fisheries interactions through seasonal relative abundance data in the westen channel and Bay of Biscay. Proceedings of the 19th Annual European Cetacean Society Conference, La Rochelle, France, April, 2005.

Marçalo, A.; Katara, I.; Feijo, D.; Araujo, H.; Oliveira, I.; Santos, J.; Ferreira, M.; *et al.* Quantification of interactions between the Portuguese sardine purse-seine fishery and cetaceans. ICES Journal of Marine Science 72 8 (2015): 2438-2449. DOI:10.1093/icesjms/fsv076

Marçalo, A., Carvalho, F., Frade, M., Alexandre, S., Bentes, L., Soares, C., Zabel, F., Rangel, M. Oliveira, F., Monteiro, P., Ressurreição, A., Erzini, K., Gonçalves, J.M.S., 2021. Redução de capturas acidentais de espécies marinhas protegidas em pescarias costeiras algarvias: inovação de procedimentos e técnicas de mitigação. Relatório técnico iNOVPESCA, Programa MAR2020, MAR-16-01-03-FMP-0020, Universidade do Algarve, CCMAR, Faro 62p + annexes.

Murphy S, Pinn EH, Jepson PD (2013) The Short-Beaked Common Dolphin (*Delphinus delphis*) in the North-East Atlantic: Distribution, Ecology, Management and Conservation Status. Oceanogr Mar Biol An Annu Rev 51:193–280.

Peltier, H., Authier, M., Deaville, R., Dabin, W., Jepson, P.D., van Canneyt, O., Daniel, P., Ridoux, V., 2016. Small cetacean bycatch as estimated from stranding schemes: The common dolphin case in the northeast Atlantic. Environ. Sci. Policy 63, 7–18. https://doi.org/10.1016/j.envsci.2016.05.004

Peltier, H., Authier, M., Dabin, W., Dars, C., Demaret, F., Doremus, G., Laran, S., Mendez-Fernandez, P., Meheust, E., Ridoux, V., Spitz, J., Van-Canneyt, O. 2022. Common dolphin mortalities in fisheries off the French Atlantic coast in the winter 2021: combining stranding and aerial survey data. SC/68D/HIM/08. 68th Meeting of the International Whaling Commission, Portoroz, Slovenia.

Punt, A. E. & Donovan, G. P. (2007) Developing Management Procedures That Are Robust To Uncertainty: Lessons from the International Whaling Commission. ICES Journal of Marine Science, 2007, 64, 603-612

Punt, A. E. (2010) Harvest Control Rules and Fisheries Management in Handbook of Marine Fisheries Conservation and Management. Grafton, R. Q.; Hilborn, R.; Squires, D.; Tait, M. & Williams, M. (Eds.) Oxford University Press, 2010

Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S., and Jessopp, M. (2018). Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015–2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp. Available from: https://secure.dccae.gov.ie/downloads/SDCU_DOWNLOAD/ObSERVE_Aerial_Report.pdf.

Rouby E, Dubroca L, Cloâtre T, Demanèche S, Genu M, Macleod K, Peltier H, Ridoux V and Authier M (2022) Estimating Bycatch From Non-representative Samples (II): A Case Study of Pair Trawlers and Common Dolphins in the Bay of Biscay. Front. Mar. Sci. 8:795942. doi: 10.3389/fmars.2021.795942 (https://gitlab.univ-lr.fr/mauthier/cdptmbycatch)

Sala, A., Konrad, C., and Doerner, H. (eds.). (2019). Review of the Implementation of the EU regulation on the Incidental Catches of Cetaceans (STECF-19-07). Publications Office of the European Union, Luxembourg.

Saavedra, C., Petitguyot, M., Bearzi, G. and Pierce, G.J. (In Press). Common dolphin, *Delphinus delphis* (Linnaeus 1758). In: Weir, C.R., Evans, P.G.H. & Rasmussen, M.H. (Editors), *Cetaceans.* Handbook of the Mammals of Europe, Springer, Switzerland. Series ISBN: 2730-7387.

Ulrich, C., and Doerner, H. (eds.). (2021). Scientific, Technical and Economic Committee for Fisheries (STECF) - 66th Plenary Report (PLEN-21-01). Publications Office of the European Union, Luxembourg.

Van Canneyt, O., Laran, S., Authier, M., Dars, C., Doremus, G., Genu, M., Nivière, M., and Spitz, J. (2020). Suivi de la mégafaune marine au large des Pertuis charentais, de l'Estuaire de la Gironde et de Rochebonne par observation aérienne, Campagne SPEE–Rapport de campagne mi-parcours–année 2019. Observatoire PELAGIS – UMS 3462, La Rochelle Université / CNRS, France.

Wade, P. R. 1998. Calculating Limits to the Total Allowable Human-Caused Mortality of Cetaceans and Pinnipeds. Marine Mammal Science, 14(1), 1--37. https://doi.org/10.1111/j.1748-7692.1998.tb00688.x.

Waggitt, J.J., Evans, P.G.H., Andrade, J., Banks, A.N, Boisseau, O., Bolton, M., Bradbury, G., *et al.* (2020) Distribution maps of cetacean and seabird populations in the North-East Atlantic. *Journal of Applied Ecology*, 57: 253–269. DOI: 10.1111/1365-2664.13525.

Westgate, A.J. (2007) Geographic variation in cranial morphology of short-beaked common dolphins (*Delphinus delphis*) from the North Atlantic. *Journal of Mammalogy*, 88, 678–

Annex 3: Legislation

[1] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Union L 206, 22/07/1992, pp. 7–50. http://data.europa.eu/eli/dir/1992/43/oj

[2] Directive 2008/56/EC (2008) of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union L 164, 25/6/2008, pp. 19-40. http://data.europa.eu/eli/dir/2008/56/oj

[3] Commission Decision (EU) 2017/848 (2017) of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU. Official Journal of the European Union L 125, 18/5/2017, pp. 43–74. http://data.europa.eu/eli/dec/2017/848/oj

[4] Council Regulation (EC) No 2371/2002 (2002) of the 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy. Official Journal of the European Union L 358, 31/12/2002, pp. 59–80. http://data.europa.eu/eli/reg/2002/2371/oj

[5] Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC. Official Journal of the European Union L 354, 28/12/2013, pp. 22-61. http://data.europa.eu/eli/reg/2013/1380/oj

[6] Regulation (EU) No 2017/1004 of the European Parliament and of the Council of 17 May 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008 (recast). Official Journal of the European Union L 157, 20/6/2017, pp. 1-21. http://data.europa.eu/eli/reg/2017/1004/oj

[7] Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005. Official Journal of the European Union L 198, 25/7/2019, pp. 105-201. http://data.europa.eu/eli/reg/2019/1241/oj

[8] Council Regulation (EC) No 812/2004 of 26.4.2004 laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98. Official Journal of the European Union L 150, 30/4/2004, pp. 12-31. http://data.europa.eu/eli/reg/2004/812/oj

[9] Commission Implementing Regulation (EU) 2020/967 of 3 July 2020 laying down the detailed rules on the signal and implementation characteristics of acoustic deterrent devices as referred to in Part A of Annex XIII of Regulation (EU) 2019/1241 of the European Parliament and of the Council on the conservation of fisheries resources and the protection of marine ecosystems through technical measures. Official Journal of the European Union L 213, 6/7/2020, pp. 4-6. http://data.europa.eu/eli/reg_impl/2020/967/oj

[10] Commission Delegated Decision (EU) 2021/1167 of 27 April 2021 establishing the multiannual Union programme for the collection and management of biological, environmental, technical and socioeconomic data in the fisheries and aquaculture sectors from 2022. Official Journal of the European Union L 253, 16/7/2021, pp. 51-91. http://data.europa.eu/eli/dec_del/2021/1167/oj

[11] Arrêté du 17 décembre 2012 relatif à la définition du bon état écologique des eaux marines. NOR: DEVL1240628A. JORF n°0304 du 30 décembre 2012. Texte n° 89. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000026864150/2019-09-26/?isSuggest=true

[12] Arrêté du 1er juillet 2011 fixant la liste des mammifères marins protégés sur le territoire national et les modalités de leur protection. NOR: DEVL1110724A. JORF n°0171 du 26 juillet 2011. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000024396902/

[13] Arrêté du 27 novembre 2020 portant modification de l'arrêté du 26 décembre 2019 portant obligation d'équipement de dispositifs de dissuasion acoustique pour les chaluts pélagiques dans le golfe de Gascogne. NOR: MERM2033160A. JORF n°0292 du 3 décembre 2020. Texte n° 54. https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000042602319

[14] Plan d'action du gouvernement pour lutter contre les captures accidentelles de petits cétacés en Atlantique. Publié le 17/05/2022. https://www.mer.gouv.fr/cetaces

[15] Plan d'actions pour la protection des cétacés. https://www.ecologie.gouv.fr/sites/default/files/DGALN_plan-actions-protection-cetaces_web.pdf

[16] Arrêté du 27 novembre 2020 is in fact Arrêté du 26 décembre 2019 portant obligation d'équipement de dispositifs de dissuasion acoustique pour les chaluts pélagiques dans le golfe de Gascogne. NOR: MERM2033160A. JORF n°0292 du 3 décembre 2020. Texte n° 54. https://www.legifrance.gouv.fr/eli/arrete/2020/11/27/MERM2033160A/jo/texte

[17] Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. BOE-A-2007-21490. https://www.boe.es/eli/es/l/2007/12/13/42/con

[18] Ley 41/2010, de 29 de diciembre, de protección del medio marino. BOE-A-2010-20050. https://www.boe.es/eli/es/l/2010/12/29/41/con

[19] Real Decreto 139/2011, de 4 de febrero, para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas. BOE-A-2011-3582. https://www.boe.es/eli/es/rd/2011/02/04/139

[20] Real Decreto 957/2018, de 27 de julio. BOE-A-2018-12097. https://www.boe.es/eli/es/rd/2018/07/27/957

[21] Plan Nacional para la reducción de las capturas accidentales en la actividad pesquera. BOE-A-2022-4961. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2022-4961

[22] Orden APA/1200/2020, de 16 de diciembre, por la que se establecen medidas de mitigación y mejora del conocimiento científico para reducir las capturas accidentales de cetáceos durante las actividades pesqueras. Orden APA/1200/2020. https://www.boe.es/eli/es/o/2020/12/16/apa1200

[23] Decreto Lei 263/81, de 3 de setembro - Regulamento de Protecção dos Mamíferos Marinhos na Zona Costeira e Zona Económica Exclusiva Continental Portuguesa. Diário da República n.º 202/1981, Série I de 1981-09-03, páginas 2344 - 2345. https://dre.pt/dre/detalhe/decreto-lei/263-1981-565194

[24] Lei n.º 11/87, de 7 de abril. Lei de Bases do Ambiente. Diário da República n.º 81/1987, Série I de 1987-04-07, páginas 1386 - 1397. https://dre.pt/dre/detalhe/lei/11-1987-666148

[25] Lei n.º 19/2014. Diário da República n.º 73/2014, Série I de 2014-04-14. https://dre.pt/dre/legislacao-consolidada/lei/2014-107758109

[26] Decreto Lei 140/99, de 24 de abril. Diário da República n.º 96/1999, Série I-A de 1999-04-24, páginas 2183 - 2212. https://dre.pt/dre/detalhe/decreto-lei/140-1999-531828

[27] Decreto Lei 49/2005, de 24 de fevereiro. Diário da República n.º 39/2005, Série I-A de 2005-02-24, páginas 1670 - 1708. https://dre.pt/dre/detalhe/decreto-lei/49-2005-608175

[28] Resolução do Conselho de Ministros 152/2001, de 11 de Outubro. Diário da República n.º 236/2001, Série I-B de 2001-10-11. https://dre.pt/dre/detalhe/resolucao-conselho-ministros/152-2001-621510

[29] Resolução do Conselho de Ministros 55/2018, de 7 de maio. Diário da República n.º 87/2018, Série I de 2018-05-07, páginas 1835 - 1880. https://dre.pt/dre/detalhe/resolucao-conselho-ministros/55-2018-115226936

[30] Decreto Lei 108/2010, de 13 de outubro. Diário da República n.º 199/2010, Série I de 2010-10-13, páginas 4462 - 4472. https://data.dre.pt/eli/dec-lei/108/2010/10/13/p/dre/pt/html

[31] Decreto Lei 201/2012, de 27 de agosto. Diário da República n.º 165/2012, Série I de 2012-08-27, páginas 4713 - 4717. https://data.dre.pt/eli/dec-lei/201/2012/08/27/p/dre/pt/html

[32] Decreto Lei 136/2013, de 7 de Outubro. Diário da República n.º 193/2013, Série I de 2013-10-07. https://dre.tretas.org/dre/312249/decreto-lei-136-2013-de-7-de-outubro

[33] Decreto Lei 143/2015, de 31 de Julho. Diário da República n.º 148/2015, Série I de 2015-07-31. https://dre.tretas.org/dre/1033264/decreto-lei-143-2015-de-31-de-julho

[34] Decreto Lei 137/2017, de 8 de Novembro. Diário da República n.º 215/2017, Série I de 2017-11-08. https://dre.tretas.org/dre/3144631/decreto-lei-137-2017-de-8-de-novembro

[35] Portaria nº 172/2017, de 30 de Junho. Diário da República n.º 125/2017, Série II de 2017-06-30. https://dre.tretas.org/dre/3015670/portaria-172-2017-de-30-de-junho

[36] Despacho nº 19/DG/2020, de 25 de maio. DGRM Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos. https://www.dgrm.mm.gov.pt/documents/20143/46478/Despacho+19_DG_2020.pdf/6a1bb004-127e-61a4-1adb-257a1225c766

Annex 4: List of participants

Member	Dept/Institute	Email
Ailbhe Kavanagh	Marine Institute	Ailbhe.Kavanagh@Marine.ie
Allen Kingston	University of St Andrews	ark10@st-andrews.ac.uk
Ana Marçalo	Algarve Centre of Marine Sciences (CCMAR)	amarcalo@ualg.pt
Aurélien Henneveux	OP Pêcheurs d'Aquitaine	aurelien.henneveux@pecheursdaquitaine.eu
Camilo Saavedra Penas	The Spanish Institute of Oceanography	camilo.saavedra@ieo.csic.es
Estanis Mugerza	AZTI Sukarrieta	emugerza@azti.es
Fiona Bigey	OP Vendée	fiona.bigey@opvendee.fr
Floriane Plard	University of La Rochelle	floriane.plard@univ-lr.fr
Graham Pierce	Institute of Marine Sciences Andalusia	g.j.pierce@iim.csic.es
Gudjon Sigurdsson	Marine and Freshwater Research Institute	gudjon.mar.sigurdsson@hafogvatn.is
Hélène Peltier	University of La Rochelle	hpeltier@univ-lr.fr
Irene Fernandez Rodriguez	OPP-90 OPASTURIAS	opasturias@hotmail.com
Kelly Macleod	HiDef Aerial Surveying Ltd	Kelly.Macleod@hidefsurveying.co.uk
Laurent Dubroca	IFREMER	laurent.dubroca@ifremer.fr
Matthieu Authier	University of La Rochelle	matthieu.authier@univ-lr.fr
Mikel Basterretxea	AZTI Sukarrieta	mbasterretxea@azti.es
Nair Vilas Arrondo	The Spanish Institute of Oceanography	nair.vilas@ieo.es
Patrick Murphy	The Irish South & West Fish Producers Organisation Ltd.	patrick@irishsouthandwest.ie
Paula Gutierrez Muñoz	IEO	paula.gutierrez@ieo.csic.es

Member	Dept/Institute	Email
Quiterie Sourget	Association du Grand Littoral Atlantique	quiterie.sourget@aglia.fr
Ruth Fernandez	International Council for the Exploration of the Sea	ruth.fernandez@ices.dk
Sandra Farinha	The Portuguese Association of Purse Seine Producer Organisations	anopcerco@gmail.com
Simon Northridge	University of St Andrews	spn1@st-andrews.ac.uk
Thomas Rimaud	Association du Grand Littoral Atlantique	thomas.rimaud@pecheursdebretagne.eu
Vincent Ridoux	University of La Rochelle	vincent.ridoux@univ-lr.fr

Annex 5: WKEMBYC2 resolution

2021/WK/HAPISG18 **The Workshop on mitigation measures to reduce bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2)**, chaired by Hélène Peltier*, France, and Ailbhe Kavanagh*, Ireland, will be established and will meet online on 10-11 October for a data meeting and as a hybrid meeting at ICES HQ, Copenhagen, on 24-28 October 2022 to:

a) consider recent data (2019-2021) on bycatch of short-beaked common dolphins in commercial fisheries and total fishing effort in the Bay of Biscay and off the Iberian coast to estimate bycatch mortality. Estimates will be based in at-sea observer schemes as well as in reverse drift modelling of strandings.
b) evaluate the scenarios that consider the application of specific bycatch mitigation measures and the proposed management objectives as previously recommended in the ICES special request advice *eu.2020.04*. Results from the mitigation trials should be taken into account in scenarios development and recommendations as appropriate.
c) For each scenario tested in the ICES special request advice *eu.2020.04*, revisit and if necessary, update i) relative risk of not achieving the specific management objective, and ii) comment on the scenario risk, as previously documented in the ICES special request advice *eu.2020.04*.

WKEMBYC2 will report by 18 November 2022 for the attention of ACOM.

Supporting information

Priority	The workshop is directly linked to a special request for advice from DGMARE on 'Additional request on mitigation measures to reduce by-catches of common dolphin in the Bay of Biscay (ref. ICES advice of 26.5.2020).'
Scientific justification	Bycatch is the major threat to the common dolphin in the Northeast Atlantic. ICES has previously advised that a combination of temporal closures of all métiers of concern and application of pingers on pair trawlers can mitigate bycatch. The analysis of new available data will help increase precision in bycatch mortality estimates and assess the effectiveness of current management measures.
Resource requirements	None beyond funding for the workshop to be provided by DGMARE.
Participants	The workshop will be attended by approximately 15 experts.
Secretariat facilities	SharePoint access and Secretariat support including assistance from the ICES Data Centre.
Financial	Financed through specific budget linked to a special request for ICES advice.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	HAPISG, WGFTFB, WGMME, WGBYC, WGECO, WGSFD
Linkages to other organizations	OSPAR, ASCOBANS

Annex 6: Report from the Review Group for the ICES WKEMBYC2 2022 Report (EU request)

Participants: Peter Evans (Chair, UK), Sinéad Murphy (IRE), and Jason Boucher (USA)

Review group participants worked both via correspondence and using a web conferencing platform.

8 December 2022

Caveat*: A draft of the report from the Workshop on mitigation measures to minimize bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2) was reviewed in early December. Some of the comments below may not be applicable to the final version of the workshop report, as the report may have been altered between the time that it was sent for review and the time that it was finalised.*

RGEMBYC2 were provided with the following sections of the WKEMBYC2 report for the purposes of this review:

1. Section 1 - Introduction
2. Section 2 – Updated on mitigation scenarios considered in 2020
3. Section 3 – Further exploration of scenarios and data
4. Section 4 – Future considerations
5. Appendix 1 – Pinger trials from published literature

Key points:

- Observer monitoring is still below 1% in many métiers, including GTR DEF, LLS DEF, OTM DEF, and PS SPF.
- Lack of clarity where most of the % coverage was achieved within Subareas 8 and 9; information on bycatch rate and % coverage was missing from Table 3.1 for comparison.
- There is a question over extrapolating results from strandings data from France to the coasts of the Iberian Peninsula, particularly where other métiers (e.g. PS) are involved. The Celtic Seas are poorly considered but we know that strandings

data show bycatch. Is the lack of bycatch in Subarea 7efghj from at-sea monitoring for GNS in Q1 and OTB in Q1-2, for example, due to no/low monitoring effort?

- Key details were missing on the pinger mitigation studies employed within the different scenarios. For their results on percentage bycatch reduction to be employed, a full critical review of those studies is required.
- Unless further information is available, it cannot be assumed that pair trawl fisheries (PTM and PTB) in Subareas 8 and 9 employed pingers voluntarily during 2019. Thus, bycatch reductions would need to be included within the scenario testing for the year 2019, for example in the case of scenario G.
- The total mortality estimate was not available for further exploration of scenarios and data, and total resulting bycatch mortality for the different scenarios were not compared to the management objectives.
- The executive summary should include not only the scenario names but also what the management objective is for PBR and mPBR. The population unit and area covered should be specified as well as whether the abundance estimate used incorporates a proportion of unidentified (common/striped) dolphins.
- Some further investigation, particularly in the light of Section 3 results, should be made to support the scenario proposals for fisheries closures in specific months and to determine whether these should be applied generally or to specific areas. Consideration should be given to areas outside Subarea 8 and other métiers such as PS.
- Since the estimates for the PBR and other management objectives (mPBR) are based on population level data, it is appropriate to undertake the assessment at the range of the population – and not just Subareas 8 and 9.

The Workshop on mitigation measures to reduce bycatch of common dolphins in the Bay of Biscay (WKEMBYC2), chaired by Hélène Peltier, France, and Ailbhe Kavanagh, Ireland, met online on 10-11 October for a data meeting and as a hybrid meeting at ICES HQ, Copenhagen, on 24-28 October 2022. Its three main aims were to:

a. consider recent data (2019-2021) on bycatch of common dolphins in commercial fisheries and total fishing effort in the Bay of Biscay and the Iberian coast to estimate bycatch mortality. Estimates to be based in at-sea observer schemes as well as in reverse drift modelling of strandings.
b. explore the scenarios that consider the application of specific bycatch mitigation measures and the proposed management objectives as previously used in the ICES special request advice *eu.2020.04*. Results from the current mitigation trials to be considered, and applied as appropriate.
c. For each tested scenario, revisit and if necessary, update i) relative risk of not achieving the specific management objective, and ii) provide comments on the scenario risk, as previously documented in the ICES special request advice eu.2020.04.

The workshop was directly linked to a special request for advice from DGMare on ‘Additional request on mitigation measures to reduce by-catch of common dolphin in the Bay of Biscay (ICES Advice of 26.5.2020)’, following an earlier NGO submission to the EC for emergency measures to reduce common dolphin bycatch in the NE Atlantic. After reviews of the evidence by ICES WGMME and WGBYC, ICES advised that a combination of temporal closures of all métiers of concern and application of pingers on pair trawlers could mitigate bycatch. The analysis of new available data should help increase precision in bycatch mortality estimates and assess the effectiveness of current management measures.

Key parameters when assessing levels of bycatch, their impact on common dolphins in the European Atlantic, and what mitigation measures to recommend to reduce those rates to meet conservation objectives are the boundaries of the population affected, its population size and trend (given that other anthropogenic pressures may exist as well), the gear types (métiers), areas and times of year that bycatch is greatest, a best estimate of overall bycatch affecting the population, and an assessment of mitigation options to reduce it at least to levels that the population can sustain. WKEMBYC2 attempted to address these and update the recommendations from WKEMBYC.

Common dolphin populations, management units, distribution and movements, abundance and trends

Common dolphins in the Northeast Atlantic are considered a single panmictic population ranging from NW Africa to Norway and west at least to the mid-Atlantic ridge. Abundance estimates rely largely upon the SCANS surveys of July 2005 (supplemented by an offshore CODA survey in July 2007), and July 2016 (abundance estimates from the latest one (SCANS-IV) in summer 2022 not yet being available to WKEMBYC2). The SCANS-III survey in 2016 excluded much of the Irish EEZ but this was surveyed in the same season as part of the ObSERVE survey programme. Those areas surveyed exclude offshore North Atlantic waters well beyond the shelf, all waters west of the shelf off NW and SW Spain and all of Portugal, south to NW Africa. Thus, the overall size of the eastern North Atlantic population remains unknown. Large-scale and regional surveys indicate strong movements within its range both seasonally and from year to year. A total estimate of common dolphins, focused largely upon shelf seas, from the 2016 surveys (SCANS-III and ObSERVE) of 634 286 (95% CI: 352 227- 142 213) was used by WKEMBYC2.

In 2021, the abundance of common dolphins in the SCANS-II and CODA surveys (2005/2007) was revised by Hammond *et al.* (2021) and produced an estimate of 468,400 (CV = 0.33) common dolphins. A combined estimate of common dolphins and unidentified dolphin/common dolphins is not available for SCANS II and CODA dataset for comparison with the 634,286 individuals estimate, used in the WKEMBY2 report.

Aerial surveys (SAMM-II) of French waters of the Bay of Biscay (largely also their shelf seas) in winter 2020/21 indicated 181,620 individuals (95% CI: 128,600–258,050), although it is not clear whether this estimate is used in any of the analyses. Similarly, there is a description of the CetAMBICIon Project, and mention of a tally of 55 000 common dolphins from a collation of French, Spanish and Portuguese surveys but no overall seasonal abundance estimates are presented, and presumably the information from this project was not used directly in any of the workshop analyses. As found in other studies, common dolphin densities were high within the Bay of Biscay and near the Portugal coast, particularly around the slope, but in winter, more dolphins apparently occurred inshore in southern France with lower densities offshore. Predicted overall abundance was similar in winter to summer, and to SCANS-III estimates. These conclusions are tempered by the fact that information from offshore beyond the Biscay shelf and around the Iberian Peninsula is relatively poor. The similarities in abundance estimates noted between summer and winter begs the question why common dolphin bycatch is reported to be much higher in winter given the comparable levels of fishing effort for gear types known to cause bycatch between the two seasons. This could be explained by a general inshore movement; on the other hand, the bycatch estimates from strandings in NE Biscay (8b) using drift models only really apply to the inshore region anyway.

Further information on the range of the unit for the common dolphin abundance estimate should be provided. In WKMOMA, the range of the common dolphin Assessment Unit (AU) was extended to encompass all marine waters of MSFD reporting units, designated in the Northeast Atlantic. Whereas OSPAR Regions II, III and IV were proposed as the range for the common dolphin Management Unit/Assessment Unit by ICES (2014) and not the entire Northeast Atlantic range of the common dolphin as described in the WKEMBYC2 report. This was done largely as samples for genetic analysis for the assessment of population structure were obtained only from continental shelf and contiguous waters (Murphy *et al*., 2013, 2021). Nonetheless, the population size spanning the full range of common dolphins in the eastern North Atlantic has not been assessed. While the existence of neritic and oceanic ecological stocks has been discussed, the conclusion of the ASCOBANS Population Structure workshop in 2009 (Evans and Teilmann, 2009) and the IWC Scientific Committee on Small Cetaceans in the same year was that further work is required for such designation (Murphy *et al*., 2021). This is something that should be prioritised for the species concerned.

Further information should be provided on the different modelling approach used in WKMOMA to estimate bycatch.

Common dolphin bycatch rates overall and by métier

Bycatch rate estimates depend largely upon two sources of information: observer schemes operating at a low level, although somewhat improved in French waters in recent years; and estimates from drift modelling of stranded common dolphins on the French coast of NE Biscay. It is widely acknowledged that bycatch rates are likely to be underestimated from observer schemes because of the very low level of sampling. WKEMBYC2 attempts to address this by inclusion of data from other sources (logbooks, port observers, and vessel crew observers), mainly for the coastal waters of the Iberian Peninsula (8c, 9a) where large numbers of small (<12m) vessels operate, and are known to cause bycatch. Although these latter methods are better than no monitoring at all, there remains large uncertainties over bycatch rates generated by those means. The problem is that there is very little other data available in these fisheries for calculating bycatch.

In French Biscay (8abd), the métiers showing the highest bycatch rates are trammel nets (GTR) and pair trawls (PTM & PTB). From at-sea monitoring, the highest bycatch rate (expressed as number bycaught per days at sea) actually comes from OTM, but this is based upon less than one day of observation. Of other métiers, gill netting (GNS) and bottom otter trawling (OTB) also have resulted in bycatch.

Around the Iberian Peninsula (8c, 9a), there is extensive purse seine (PS) fisheries (including many small vessels) resulting in significant bycatch. Bycatch has also been recorded in longlines (LLS). These are not well-monitored and it is unclear how bycatch rates were extrapolated to these métiers. Were bycatch rates from French fisheries observer data extrapolated to Iberian waters? Maps of fishing effort and monitoring effort would have been useful to include.

Over the region (Subareas 7, 8 & 9), estimated bycatch when rates are multiplied by fishing effort (as days at sea) is highest for GTR and PS. Based on the bycatch estimations for the more detailed strata from at-sea observations, 41% of common dolphin bycatch came from area 8abd, 34% from area 8c9a and 25% from area 7efghj. It is not clear how this was applied to the fisheries in subarea 9 which had very little at-sea observation monitoring. It is noted that the total estimated bycatch from this analysis (Table 3.1) is calculated at 3,491 common dolphins and therefore well below the estimate of 5,938 (Table 2.2). Some explanation for this difference would be useful.

In Area 7efghj, the highest proportion of estimated bycatch came from metiers PS and GNS in quarter 3, in Area 8c9a, the highest proportion came from PS in quarters 2 and 3, while in Area 8abd, it came from GTR in quarter 2 and LLS in quarter 1. For Area 8a at least, these do not concord with the conclusions from the strandings analysis, suggesting that Q1 may not be the period with highest bycatch in Biscay. This is important to resolve as it affects the timing of the various scenarios proposed.

The legend of Figure 2.1 should note that only the data obtained from at sea observers and vessel crew observer methods in the case of Portugal, were used to calculate estimates of bycatch rates.

Abbreviations for VL0012 and VL112xx should be included in the legend of Figure 2.2.

Regarding Section 2.3 Bycatch estimates from strandings, the categories defined in the text for 'fresh' (<5 days post mortem) and 'slightly decomposed' (5-15 days post mortem), would be highly contingent on the time of year, as an animal would decompose more rapidly during hotter weather. But even for colder weather conditions, after 10 days, animals would be more than slightly decomposed – and carcasses stranded onshore for a period of time would have been scavenged. For reverse drift modelling, it also depends on how quickly an animal is reported along the coastline – it is not clear how quickly animals are observed along coastlines in France. A main concern is that even if only the freshest animals are included in the analysis, wind and tide can have enormous effects on drift & buoyancy, and there are likely to be strong seasonal biases due to weather being much more unsettled over the winter months. Although one assumes the analyses incorporated these factors at a finer temporal scale, it is not clear whether it is applied across months and years. For the discussion on estimates from strandings, it would be appropriate to present the results for the year 2021, using the same method as for the years 2019 and 2020, in addition to the new modified methodology.

Figure 2.1 shows variation in common dolphin bycatch between 1990 and 2021 inferred from French strandings. In the text, there is a note explaining the lower bycatch rates estimated in winter 2021 as being due to easterly winds predominating (Peltier *et al.*, 2022). Did this occur in any of the other years within the time series plotted?

Section 1.6 Mitigation Trials

The workshop was tasked with reviewing published and ongoing mitigation trials for reducing common dolphin bycatch, and largely focused on pingers, both their testing and implementation. A summary of published pinger trials was presented in Appendix 1, but this listed four pieces of literature that reviewed pinger trials and did not explicitly review the pinger trials themselves, published to date on common dolphins, in terms of the pinger type used (and their characteristics), study design, outcome of the study including statistical significance, sample sizes, etc. This is an important omission so that the details can be reviewed and a full, critical assessment made. It would be a necessity in the US bycatch take reduction programme, for example. It is noted that the results of some trials are cited as personal communications. Those especially need closer scrutiny with more detail.

Either for this report or in the future, it is therefore recommended that: (1) A technical document is produced that is provided to the review group, and the ICES advice drafting group for reference. This document does not need to be published with the main workshop report if there are constraints on publication; (2) A framework is developed for the evaluation of mitigation trial studies. Such an evaluation would include confidence scoring for mitigation trials – assessing information on study design (e.g. the haul experimental design, with and without pingers, as used in the MITCET study), sample size of the trial, inclusion of a control group, incorporation of spatial and temporal aspects of bycatch, whether there was sufficient power in the study to detect a significant effect of the device(s), the sample size required (FOs, hauls, etc) for monitoring of mitigation measures if bycatch is a rare event, etc. Further, if the study was highly imbalanced, such as the LICADO interactive pinger trial (234 FOs with pingers and 128 without), and the CetAMBICion project in Portugal (DiD trial of 360 hauls (151 control and 209 with alarms) and DDD-03N trial of 517 (185 control and 332 with alarms), whether this is taken into consideration within the statistical analysis, since imbalanced designs can lead to less powerful analysis. Only some of this information was provided for certain studies.

For evaluation of published and ongoing pinger trials within the workshop report, a table of the specifications of all pinger types discussed should be included – name of pinger, pinger SL, frequency and range, where pingers were placed, distance between pingers, whether one or more pingers were used, battery life of pingers, costs, references, etc. A lot of this information is missing in the text within the report, and even the pinger type used in some cases. When referencing this table, a summary in the text on the hearing range of common dolphins may be appropriate.

Bycatch mitigation trials in French fisheries have focused upon testing devices on PTM and GNS/GTR. These have included DDD-03H and CETASAVER pingers on nets or under hauls, and reflectors. In Spain, pingers were tested on pair trawlers (PTB & PTM) and gill netters (GNS). In southern Portugal (Algarve), either DDD or DiD pingers have been tested on GNS, purse seine and beach seine fisheries.

WKEMBYC2 concluded that from the trials performed in subareas 8 and 9, a bycatch reduction of 65% on PTM, 95% on PTB, and 99% on PS were significant and could be applied.

Some specific points:

Although most pinger trials indicated a significant reduction in bycatch, trials particularly in Spain and Portugal involved small sample sizes so the resulting differences between pingered gear and controls are not very robust.

Whereas the report summarises the development of new pinger technologies, there are other pingers available on the market (Fishtek and Future Oceans pingers), and it would be appropriate to summarise why these are not suitable for the species concerned. Presumably this is because of lower source levels in the latter.

The main body of the text within the report focused on recent and ongoing studies within the region of interest. Previous (and ongoing) UK pinger trials were not summarised within section 1.3, but waters outside subareas 8 and 9 were included in section 3.

Table 1.1 should use the term ‘control’ instead of ‘none’ if these were run as controls. For those projects that undertook both observers and self-sampling, information is missing on what % was monitored by observers and what % was self-sampled by fishers. Were all 'control' nets self-sampled, for example? The table should note the position of the pinger on all gear/vessels, and number of pingers used. Table 1.1. should be expanded to include other pinger studies discussed in the report – from other countries.

Figure 1.2 needs to include in the legend the country that this information pertains to – where the DDD03H pinger is mandatory.

When discussing the voluntary and mandatory pinger requirements of French pelagic trawls, it would be good to include information on the sizes of these fleets and if vessels were checked for compliance.

It would have been appropriate for the LICADO project which evaluated two pinger types, to also include a control group where pingers were not used. Although pingers may have been mandatory, allowances may have been made for a control group requirement.

In section 2.1 on pingers in gillnets, further information is required to explain '*limitations of acoustic noise for static netters has to be considered*'. Lehnhoff et al. 2022 is missing in the references.

The pinger type used in the MITICET project was not included, nor was further information on the study to evaluate the 90% reduction in common dolphin bycatch.

The conclusion of section 1.6 on mitigation trials notes "*According to results of mitigation trials performed in Areas 8 and 9, the group concluded that a bycatch reduction of 65% on PTM, 95% on PTB and 99% on PS were significant and could be applied*". It is not clear as to what studies these numbers relate to. And in what way were these percentages significant, as 'significant' should only be used when statistically significant results were obtained. Also, such estimates are largely congruent on the type of pinger used and the target species of the fishery, among other variables, which are not specified either.

On review of the full report, the 95% is referenced again in the introduction to section 3, where it states "*Research in Spain indicated that the correct use of ADDs in PTB fisheries would reduce bycatch rates by 95% (Basterretxea, pers. comm.). Although ADD use is mandated by France and Spain for part of the year in these fisheries there is no clear signal in the monitoring data of reduced bycatch rates. This is considered to be because of suboptimal use of pingers in this metier. Consequently, a 95% efficiency rate was applied to PTB in those scenarios that included use of pingers to indicate how bycatch levels might be expected to change if pingers were used appropriately. The same efficiency rate was also applied to PTM effort outside of the currently mandated period*."

The 99% for PS pertains to "*Research in Portugal by Marcalo et al. (pers. comm.) found a 99% reduction in bycatch associated with the use of a single pinger (DDD) in purse seine fisheries targeting small pelagics. This efficiency rate was applied to all PS strata in the scenarios in Table 3.2*" as noted in section 3.

The 95% for PTB and 99% for PS are presented in the report as personal communications, and as such the review group is unable to evaluate such work. Section 1.6 notes regarding PS, "*trials were carried out during the years 2020 and 2021 in purse seining with most effort in the season that the fishery targets sardine, Sardina pilchardus, and to reduce bycatch of common dolphins that mostly feed on small pelagics and have sardine as favourite prey. DDD -03H pingers were tested in 518 hauls (228 control and 233 using DDD). Incidental captures of 38 common dolphins (80 % released alive) were observed in control nets and none in nets using alarms*." Assuming this is the study in question, further details are required.

It is assumed that the 65% for PTM refers to the Rimaud *et al.* (2019) study, that was referenced in the ICES 2020 advice on Emergency Measures, which noted that there was limited, but promising evidence of the effectiveness of pingers to mitigate common dolphin bycatch. The French study included data from three pairs of vessels, only one of which had an independent observer, for the other two data were collected via self-sampling by fishers.

Update of Mitigation Scenarios

The various mitigation scenarios depend upon the common dolphin abundance and bycatch rate estimates, the management thresholds set using PBR (and a modified, more conservative, mPBR), and the effectiveness of specific measures as estimated from the trials that have been performed. They are also informed by the variation in estimated impacts by métier, area and season.

WKEMBYC2 based all scenarios initially on mortality estimates from monitoring data, scaled up using fishing effort data for the entire Bay of Biscay and the Iberian Coast ecoregion (ICES subareas 8 and 9), which were then raised, by métier, to the strandings mortality estimate, using a factor of 1.52 (calculated by dividing the strandings mortality point estimate by the monitoring mortality point estimate). The temporal strandings patterns were based on data from the French coast only and yet seem to be applied across the wider region.

For each scenario, the bycatch reduction rate was calculated as well as the fishing effort reduction rate. For scenarios with a temporal component, the % of bycatch mortality estimated from strandings within each fortnightly time period (data years 2019–2020) was used to calculate the reduction from the annual estimate that would result from closure during that specific time period. An efficiency score for each scenario was obtained by dividing the bycatch reduction rate by the effort reduction rate.

PBR values considered by WKEMBYC, were followed by WKEMBYC2: <10% of PBR, <50% of PBR, < 75% of PBR, <PBR and >PBR. However, in these later scenario analyses, the more conservative mPBR developed by OSPAR was also considered. PBR for the species was calculated as 4,926 individuals per year. A modified PBR (mPBR) value of 985 was used.

WKEMBYC2 concluded that bycatch estimates calculated from at-sea monitoring, scenarios with a combination of pingers on PTM (in the Exec. Summary, it states OTM)/PTB and an at least 4-week closure (mid-Jan to mid-Feb) could reach the management objective of bycatch remaining below the PBR (Scenario E?). The removal bycatch over a three-month period between the January and March winter period, and an additional month closure in July/August potentially reduces bycatch below the mPBR level for monitoring bycatch estimates (Scenario O?). Considering estimates inferred from strandings (total annual bycatch estimated at about 9,040 (95%CI: 6,640-13,300), a minimum of a 6-week closure combined with pingers could achieve the objective of reducing bycatch below PBR (Scenario N?). None of the scenarios could reduce bycatch below mPBR for estimates inferred from strandings. The narrower the fishery closure, the higher the risk of not achieving the management objective, as the peak of mortality could be missed.

The scenarios proposed depend upon the various parameters broadly corresponding to the actual situation. Some of these need further investigation. These include the timing of any fishery closures (is the focus upon Jan-Mar valid for the entire ecoregion? The evidence suggests not); the nature of bycatch around the Iberian Peninsula where bycatch from purse seines (and beach seines) become much more relevant; and the extent to which deployment of various pinger types will actually reduce bycatch by significant amounts given some of the limited sample sizes in the mitigation trials (particularly around the Iberian Peninsula). A further consideration is that there needs to be full compliance to recommended procedures of pinger deployment within the commercial fishery if one is to replicate the results of the experimental trials.

Some specific points:

Reference should be made to the type of mandatory pingers that were employed by French and Spanish trawls within the introductory text to the scenarios.

The updated scenarios assume a 65% reduction in common dolphin bycatch in PTM and PTB (see table in Section 3.3). The period for the updated scenario assessment was 2019-2021 and the assessment assumed that pingers were employed on all PTM and PTB as they became mandatory within that assessment period. It appears that this assumption was made because "Since 2019, most PTM vessels have voluntarily equipped themselves with pingers in winter." (Page 14). However, it is not clear why the same assumption should be applied to PTB. Pingers did not become mandatory until January

2020 in the case of PTM in French vessels, and PTB in Spanish vessels and, as such, the year 2019 should be considered differently when reviewing estimates of bycatch.

Thus, additional bycatch reduction should be applied to scenario G for example. It cannot be assumed that all fishers took up voluntary use of pingers in 2019 – unless there is evidence to suggest otherwise.

While the results on scenarios in the workshop report are presented in terms of % bycatch reduction, and efficiency, Table 2.6 in the discussion, which presents the results in the same way as Table 2 in ICES advice 2020 on emergency measures, i.e by management objective, should be moved up to the results section.

Information provided in Table 2.5 are results and should not be in the discussion section. Table 2.5 should be presented and discussed before the Scenario's section. The legend of Table 2.5 should include additional information. The legend of a similar table in the ICES 2020 Advice document noted '*Summary of the bycatch rate and mortality of common dolphins for métiers of concern from monitoring (Subareas 8 and 9; data pooled 2016–2018) and strandings (French coast, Subarea 8), raised using the annual mean of the available fishing effort data (RDB) for 2016–2018*'

When discussing Table 2.5, the WK report notes "*In 2020, the use of pingers in French and Spanish pelagic trawlers became mandatory and this operational change in the fishery has contributed to this ~85% reduction*." What is notable in Table 2.5, is the observer effort increase from 25% to 52% between both time periods. The question arises whether this could be partly due to mitigation trials. If that was the case, increased observer coverage could also have an impact on bycatch rates, due to their presence and the studies being undertaken.

Further clarification is required for the following statement, discussing Table 2.5: '*The majority of effort in this métier is undertaken by Spain, but evidence from observer monitoring on Portuguese vessels show that 76% of dolphins caught are released alive (Marçalo, A. pers comm.)*.' Is this assuming that only animals that are caught and died are reported as bycatch in Table 2.5. Is there any further information available on survival rates following release, and is there a rationale for application elsewhere in the region under consideration?

Section 2.7 Recommendations

As a general point, it would be best to refer to 'monitoring data' as 'fisheries observer monitoring data' to distinguish it from other forms of monitoring.

There is some repetition within the recommendations summarising the different scenarios. This could be tightened up a bit – although this would reduce if Table 2.6 is moved to the results. Information presented on the scenario of risk in Table 2.6 needs to be reviewed – as it still notes (from ICES 2020 advice) that '*this approach enables the pinger trials already begun in the French PTM and Spanish PTB fleet to continue to verify effectiveness*'. If pingers are employed on all trawls, there are no control groups to verify effectiveness. And any reduction in bycatch may be due to other reasons. Why would scenario B showing a reduction in annual fishing effort of 40% in métiers of concern result in '*Lost the opportunity to continue pinger trials already begun in French PTM and Spanish PTB fleet to continue to verify effectiveness*'. Assuming that pinger trials will continue, that may prevent a 40% reduction in effort in the future.

Table 2.6 should include an additional column, indicating where bycatch estimated from bycatch observer monitoring is above the management objective and where bycatch inferred from strandings mortality data is above the stated objective – as it reads, it is difficult to review that information easily.

The workshop report notes '*The elevated levels of bycatch appear to be primarily driven by changes in the seasonal distribution of common dolphin, rather than elevated winter fishing effort*.' An updated seasonal fishing effort graph for the region would be appropriate within the report.

Further recommendations for this work should be the incorporation of an assessment of strandings data from the Iberian Peninsula into the modelling process, not only for the bycatch estimates inferred from strandings, but also within the scenario testing. Currently, for example, the temporal strandings patterns are based upon data from the French coasts only.

The numbers of animals bycaught in fishing gear have increased since 2016-2018. While Table 2.5 includes information on % coverage, were the monitoring programmes evaluated to see if they were representative of the whole fishery/metier? For example, were high risk fisheries targeted for mitigation trials?

COVID was not discussed at all within the text of the WKEMBYC2 report. ICES WGBYC (2021) reviewed evidence for changes in observer monitoring coverage during the COVID lockdowns and concluded there was a general decrease between 2019 and 2020. What impact did this have on the % of metiers monitored in 2019-2021? Over the three-year period, is it correct to assume that observer coverage increased, and was highest for the year 2021 - following ICES advice in 2020, and COVID lockdowns? What was the difference in the % observer coverage between 2019, 2020, and 2021? Additional figures on fishing effort by year (2016 to 2021) and by season would be appropriate.

WKEMBYC2 report notes that '*Furthermore, all scenarios would imply large reductions in fishing effort for some fleets fishing in ICES Subarea* 8'. It needs to be clear in the text (and all Table legends) as to what ICES subareas the information pertains to – and not use the term Bay of Biscay and Iberian coast. As presented in the scenarios Table in section 3.3, the area of focus for the updated scenarios was subareas 8 & 9.

As noted in the ICES 2020 Advice and the WKEMBYC2 report, **ICES has not evaluated the consequences of such reductions, neither in terms of potential effort redistribution towards other gears or regions within the range of the Northeast Atlantic common dolphin population, nor in terms of socio-economic impacts** which is the next logical step in this process.

As shown by the work within the WKMEBYC2 report, increased monitoring is required for a range of métiers, and further work is also required reviewing countries' monitoring programmes, to ensure that no bias exists in coverage and reporting, i.e. that countries are employing proportional monitoring and were randomly selecting vessels within a stratified random sampling approach. Any departure from those procedures should be highlighted.

Section 3. Further exploration of scenarios and data

The scenario exploration approach was congruent on 95% bycatch reduction on PTM outside the currently mandated period, 95% bycatch reduction on PTB, 99% bycatch reduction on PS.

Within the results section of Section 3, more detailed explanatory text is required to accompany the Tables.

Based on the estimated bycatch data presented in Table 3.1 (7efghj, 8abd, 8c9a), total bycatch was 3,491 common dolphins, which is lower than for ICES subareas 8 and 9 along (section 2) of 5,938 common dolphins. Is this because the assessment was undertaken for a longer time period 2017-2021?

The total bycatch estimate for the 'Scenario exploration' was not presented nor discussed within the text. It is noted in the Table on scenarios that the scenario exploration '*currently does* *not provide a total mortality estimate due to more detailed stratification*.' Further information is required to explain why this was not possible, as it is not clear why an approach was taken that cannot produce an overall bycatch estimate to compare against management objectives. It was appropriate to extend the spatial area of assessment to include a wider range for the common dolphin population, as the impacts on the population in ICES Subareas 8 and 9 should not be viewed in isolation.

Table 3.1 currently does not include GNS or PT data from Q1 for the Celtic Seas ecoregion. Was no bycatch reported in GNS or PT? That seems surprising given that there is strandings evidence of bycatch mortality in this region. Information on bycatch rate should be included to undertake comparisons between métiers and subareas within Table 3.1, and within the column 'Monitored Effort (DaS)', data on '% coverage' should also be included.

Table 3.2, discussing the 'Synthesis of scenarios' performances, does not provide an evaluation against management objectives. The rows indicating 'Total resulting bycatch - monitoring mortality' in Table 2.4 has been replaced with 'Number of bycaught animals remaining if scenario introduced' in Table 3.2. For consistency, if these mean the same thing, then the text in Table 2.4 should be used. The legend of Table 3.2 should include the period of assessment (2017-2021), as should Table 2.4.

A comparison with the range of management objectives is not directly provided – Table 3.2 is not colour coded to highlight what management objectives each scenario achieves. Based on the management objectives outlined below, all scenarios in Table 3.2 meet the PBR objective. This was not noted in the text. Scenario K, which includes deployment of pingers on PTM/PTB vessels all year, reduces bycatch to <50% of PBR.

With respect to colour coding, these should take account of readers with colour vision issues. One of the reviewers, for example, was unable to differentiate between the 'Bycatch' and 'No bycatch' categories (red-green) in Figure 2.2. It appears these were created in R which has several colour-blind friendly colour palettes such as viridis, that could be used. This applies also to Figure 2.1 where it was not possible for the reviewer to tell whether the 'Logbook' category was represented in any of the figures.

Citations should be included for the following statement in the discussion in this section - where it notes '*To date, no mitigation trials have reported statistically significant results for mitigating common dolphin bycatch in static gears, mostly due to low sampling effort in the trials and associated relatively low bycatch rates in these métiers*'.

Annex 7: Additional analyses: mitigation measures to reduce bycatches of common dolphin (*Delphinus delphis*) in the Bay of Biscay (Subarea 8).

Note that some of the wording in this annex was modified based on reviewers' comments received in June 2023.

Authors:

Ailbhe Kavanagh, Allen Kingston, Estanis Mugerza, Helene Peltier

Introduction

Following the special request from the DG MARE, the Workshop on mitigation measures to minimize bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2) was established by ICES. WKEMBYC2 was tasked with updating and revaluating the scenarios previously proposed in the ICES special request advice in 2020. The group was asked to consider recent data on bycatch of common dolphins in commercial fisheries and total fishing effort in the Bay of Biscay and Iberian Coast ecosystem. In this report the efficacy of the scenarios provided during WKEMBYC in 2020 were reassessed using updated bycatch estimates calculated from at-sea monitoring and stranding data collected between 2019 and 2021. This report addresses the implementation of mitigation scenarios in the Bay of Biscay only (ICES Subarea 8) following methodologies used in the previous workshop in 2020 (ICES, 2020). However, any comparison with previous work should be approached with caution as improvements in fishing effort reporting and categorisation, as well as changes in effort calculation in French métiers in 2023, mean results are not directly comparable. For details of the data used in the analysis or the methodologies employed please refer to the report of the WKEMBYC2 workshop (ICES, 2023).

None of the scenarios, when evaluated with the data from 2019–2021, met the candidate management objective of reducing estimated bycatch to less than 50% of the PBR. This is in contrast to the previous results using 2016–2018 data (ICES, 2020) and is likely due to greater bycatch estimates arising from a combination of improvements to the knowledge base (including bycatch rates, métiers covered, and effort reporting), changes in the distribution of common dolphin within the Bay of Biscay, and increased bycatch levels.

Scenarios

All scenarios are based on mortality estimates from (1) at-sea monitoring data scaled up for the entire Bay of Biscay and Iberian Coast Ecoregions (ICES area 8 and 9a) and (2) strandings data for the French coast of ICES area 8a-b and 7e, 95% of which were collected from the coast of divisions 8a and b (Figure 1.1) (following analysis methods of WKEMBYC in 2020). As 95% of strandings were recorded in areas 8ab, it was assumed that bycatch inferred from this data source primarily represented mortality in areas 8ab. Bycatch reduction measures were applied to ICES area 8 bycatch estimates **only** (following analysis methods of ICES WKEMBYC in 2020). Due to the insufficient temporal resolution of the observer data from bycatch at-sea_monitoring, the temporal pattern of bycatch mortality obtained from the strandings data along the French coast (ICES subarea 8) was used to allocate the total bycatch derived from at-sea monitoring programmes to fortnights. As strandings data cannot currently provide métier information on bycatch, the at-sea monitoring bycatch estimates for each métier were used to proportionally allocate the total bycatch derived for strandings to individual métiers. The joint use of these datasets enabled us to derive fine-scale temporal and métier specific bycatch estimates for both at-sea monitoring methods. Finally, the efficiency of each scenario was evaluated for both at-sea monitoring and stranding estimates. The two series of métier-specific bycatch estimates were seen as two views of the same phenomenon and were considered, within their uncertainty range, to contain the true bycatch estimate.

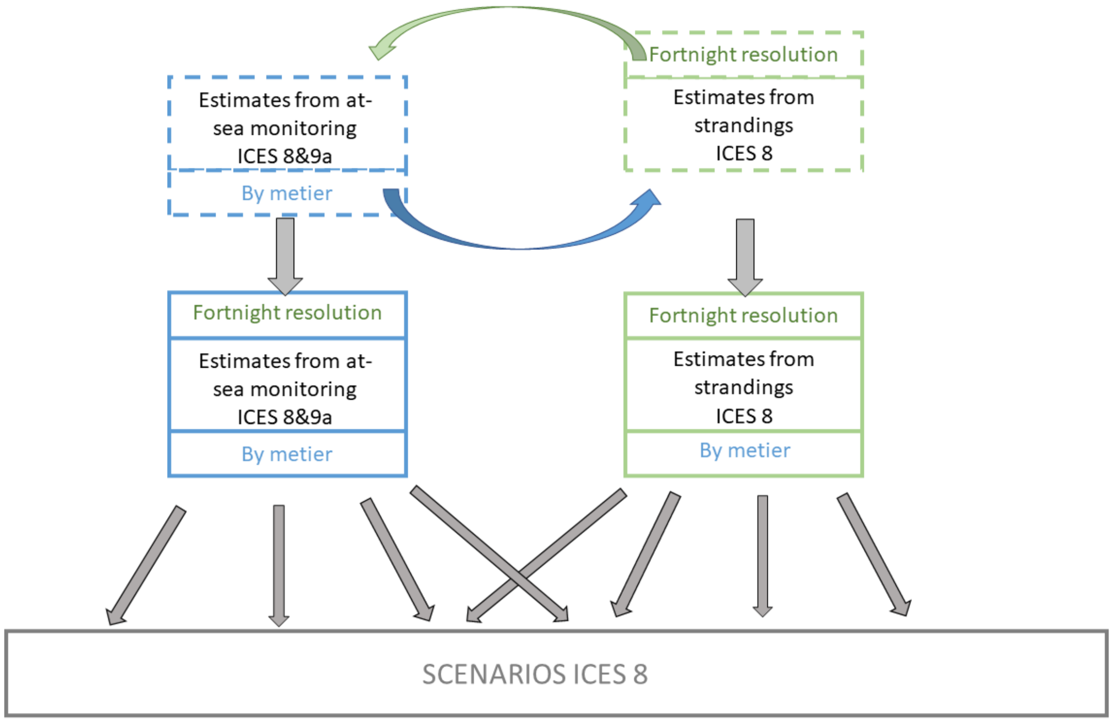

Figure 1.1. General analysis strategy for bycatch estimates inferred from at-sea monitoring and strandings, and their combined use. Bycatch reduction scenarios were applied to fishing effort from ICES area 8 only (Bay of Biscay). At-sea monitoring data was scaled up for the entire Bay of Biscay and Iberian Coast Ecoregions (ICES area 8 and 9a) and (2) strandings data for the French coast of ICES area 8a-b and 7e**,** 95% of which were collected from the coast of divisions 8a and b.

For each scenario, the bycatch reduction rate was calculated as well as the fishing effort reduction rate. For scenarios with a temporal component, the % of bycatch mortality estimated from strandings within each fortnightly time period (data years 2019–2021) was used to calculate the reduction from the annual estimate that would result from closure during that specific time period. The scenario with a flat effort reduction did not make reference to the temporal pattern of strandings.

In French midwater pair trawl fleet, the use of pingers was generalized in winter 2019 and became mandatory in winter in January 2020, therefore we can assume that all French PTM were seasonally equipped with pingers during the evaluation period (2019-2021). The use of pingers is mandatory on Spanish bottom pair trawl fleet since January 2020. For these scenarios, the workshop assumed full compliance with pinger use on all PT métiers, and correct use of pingers in all cases. Therefore, for scenarios including pingers on PTM and PTB no reduction in bycatch rates were applied to these métiers. As a result, scenarios combining temporal closures and pingers used will result in identical bycatch estimates as temporal closure scenarios. All scenarios were retained in the table for consistency with the ICES (2020a) WKEMBYC report and for ease of comparison (Table 1.1). For pinger details please refer to the ICES WKEMBYC2 report (ICES, 2023).

An efficiency score for each scenario was obtained by dividing the bycatch reduction rate by the effort reduction rate. The results from testing each scenario as reported in Table 1.2 including the resulting bycatch obtained (according to at-sea monitoring and to stranding), PBR level achieved with colour code (for at-sea monitoring and stranding results), bycatch reduction rate, effort reduction rate and efficiency.

PBR values considered in the 2020 scenarios (WKEMBYC, ICES 2020a) were again considered here: <10% of PBR, <50% of PBR, <75% of PBR, <PBR and >PBR. However, in these scenario analyses the mPBR was also considered as it was developed since the last workshop. All PBR values are described in section 2.4 of WKEMBYC2, ICES 2022.

Table 1.1. Scenarios used for assessing possible alternative bycatch reduction approaches. All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases. As a result, no additional reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M*, C = L*, D = H*, N = O* are indicated in the table). The asterisk here and in the table indicate scenarios that are ultimately replicas/identical to other scenarios. All scenarios were retained in the table for consistency with the ICES (2020a) WKEMBYC report and for ease of comparison. For pinger details please refer to the ICES WKEMBYC2 report (ICES, 2023).

Scenario	Description	Explanation
A	4-month closure (Dec-Mar) all métiers	4-month closure from December to March of all relevant métiers
B	Annual effort reduction of 40% all métiers	Flat annual 40% reduction in total effort for relevant métiers, does not consider strandings patterns
C	2-month closure (mid-Jan to mid-Mar) all métiers	2-month closure of all relevant métiers determined using the % mortality in that peak period based on strandings
D	6-week closure (mid-Jan to end Feb) all métiers	6-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
E	4-week closure (mid-Jan to mid-Feb) all métiers	4-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
F	2-week closure (mid-Jan to end Jan) all métiers	2-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings
G	Pinger all PTM/PTB all year and same 6 week closure all other métiers	PTM/PTB to use pingers all year + a 6-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings (Assuming correct pinger implementation on all vessels since 2019, no additional reduction applied to bycatch levels in this scenario)
H *	6-week closure (mid-Jan to end Feb) all métiers (including PTM/PTB) and pinger PTM/PTB rest of year	6-week closure of all relevant métiers determined using the % mortality in that peak period based on strandings + PTM/PTB to use pingers during the rest of the year
I	Pinger all PTM/PTB all year and same 4 week closure all other métiers	PTM/PTB to use pingers all year + a 4-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings
J	Pinger all PTM/PTB all year and same 2 week closure all other métiers	PTM/PTB to use pingers all year + a 2-week closure of all other relevant métiers determined using the % mortality in that peak period based on strandings
K	Pinger all PTM/PTB all year	PTM/PTB to use pingers all year, no other measures intro-duced.
L *	2-month closure all (mid-Jan to Mid-Mar) + pingers	2-month closure for all fleets + pingers on PTM/PTB the rest of the year
M *	4-month closure all (mid-Jan to Mid-Mar) + pingers	4-month closure for all fleets + pingers on PTM/PTB the rest of the year
N	4-month closure (3 in winter + 1 in sum-er) + pingers	Closure during 3 months in winter (Jan – March) and 1 month in summer (mid-July – mid-August) for all fleets + pingers on PTB/PTM the rest of the year
O *	4-month closure (3 in winter + 1 in summer)	Closure during 3 months in winter (Jan – March) and 1 month in summer (mid-July – mid-August) for all fleets

Table 1.2. Synthesis of scenarios' performances. For scenarios A to O, key information given are scenario title, total bycatch mortality as of at-sea monitoring programmes, total bycatch mortality as of stranding data, bycatch reduction obtained, effort reduction implied, and efficiency score. A colour code indicated how each scenario reach the different management objectives is presented below the table. The efficiency score of each scenario is bycatch reduction rate divided by effort reduction rate. This efficiency could be considered as a rough cost effectiveness for each scenario considering that a reduction effort is a cost for the industry (see main text for further detail). All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases (see ICES, 2023 for details). As a result, no reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M, C = L, D = H, N = O as indicated in the table). All scenarios were retained in the table for consistency with WKEMBYC ICES 2020a report and for ease of comparison. Information provided is based on average annual bycatch estimates for the period 2019-2021. For details of the data used in the analysis or the methodologies employed please refer to the report of the WKEMBYC2 workshop (ICES, 2023).

	A / M	B	C / L	D / H	E	F	G	I	J	K	N / O
Scenario	4-month closure all métiers + (M: pinger PTM / PTB rest of year)	Annual effort reduction of 40% all métiers	2-month closure all métiers + (L: pinger PTB / PTM rest of year0	6-week closure (mid Jan - end Feb) all métiers + (H: pinger PTM / PTB rest of year)	4-week closure (mid Jan - mid Feb) all métiers	2-week closure (mid Jan - end Jan) all métiers	Pinger PTM / PTB all year & same 6 week closure all other métiers	Pinger PTM / PTB all year and same 4 week closure all other mé-tiers	Pinger PTM / PTB all year and same 2 week closure all other mé-tiers	Pinger PTM / PTB all year	3 month (Jan–Mar) + 1 month (mid-Jul–mid-Aug) closure all metiers + (N: pinger PTB / PTM rest of year)
Total resulting bycatch - moni-toring mortality	3571	4755	3985	4340	4932	5406	4886	5276	5588	5938	3334
Total resulting bycatch - strand-ings mortality	5436	7238	6067	6608	7509	8229	7439	8032	8507	9040	5076
Bycatch Reduction obtained	0,40	0,20	0,33	0,27	0,17	0,09	0,18	0,11	0,06	0,00	0,44
Effort reduction needed	0,33	0,40	0,17	0,12	0,08	0,04	0,11	0,07	0,04	0,00	0,33
Efficiency score	1,2	0,5	2,0	2,3	2,2	2,3	1,6	1,5	1,6	NA	1,3

% of PBR	<10%	mPBR	<50%	<75%	<PBR	>PBR
Number bycatches	493	985	2464	3695	<4927	>4927

All scenarios assume full compliance with pinger use on all PT métiers since 2019 and correct use of pingers in all cases. As a result, no reduction in bycatch rates were applied to these métiers. Scenarios combining temporal closures and pinger use will therefore result in identical bycatch estimates as temporal closure only scenarios in a number of cases (Scenario A = M, C = L D = H, N = O). All scenarios were retained in the tables for consistency with WKEMBYC ICES (2020a) report and for ease of comparison.

Looking at PBR performance first, followed by bycatch reduction rate and measure efficiency, scenarios could be classified or ranked as follows:

Scenarios N & O (three-month closure from January through March and from mid-July to mid-August all métiers, and pingers on PTM/PTB the rest of the year) performs best in terms of PBR thresholds (<75%) and bycatch reduction (bycatch reduction rate=0.44). Its efficiency is intermediate because the closure period is broader than the typical duration of the period of high bycatch.

Scenarios M & A (four-month, December through March closure all métiers and pingers on PTM/PTB the rest of the year) performs second best in terms of bycatch reduction (bycatch reduction rate=0.4). Its efficiency is intermediate because the closure period is broader than the typical duration of the period of high bycatch.

Scenario C & L (two-month, mid-January to mid-March closure all métiers and pingers on PTM/PTB the rest of the year) ranked fifth on the first two criteria (<PBR; bycatch reduction rate=0.33) and displayed an efficiency is higher as scenarios M&A because it was more focused on the peak period of mortality.

Scenarios D & H, G, B, E, I, F and J ranked 7th to 14th on bycatch reduction and achieved bycatch reduction rates between 0.06 and 0.27.

The least effective in terms of bycatch reduction was K (pingers PTM/PTB all year with no closure, bycatch reduction rate=0). This scenario provides no reduction in bycatch and does not reach the PBR.

Finally, scenarios based on a temporary closure which includes the winter peak period of mortality are the most effective ones provided that the closure's duration is at least six weeks but longer closures can substantially further reduce bycatch (compare scenarios D (six-week closure, 27% reduction) and O (three-month winter closure plus one-month summer closure, 44% reduction).

Discussion

Scenario discussion

As the same methodology was used to build and test the efficiency of these scenarios, it is unsurprising to detect similar results to those in the previous WKEMBYC2 report (Table 1.2). As overall bycatch estimates were higher for years 2019-2021, no scenario could attain mortality below 50% of PBR (and mPBR), whereas at least twelve did in the previous evaluation. Also, five scenarios would not achieve the objective of reducing mortality below PBR with at-sea monitoring, and none with stranding estimates. This was the case for only two scenarios with 2016-2018 data. The potential effects of covid on sampling is explored in the WKEMBYC2 report (ICES, 2023).

It is noticeable that scenario B, a year-round flat rate reduction of effort, has the lowest efficiency (efficiency=0.5). In that case, the reduction of bycatch is directly proportional to the reduction in effort because it does not take advantage of the strong temporal pattern in bycatch to draw optimal benefit of effort reduction.

Scenarios F, J and K showed the lowest conservation performance (bycatch reduction) and scenario B had the lowest efficiency score (one can get the same conservation benefit with less constraint to the industry).

Although scenarios A & M and N & O performed the best in terms of conservation and bycatch reduction, they performed less well in terms of the efficiency score than all other scenarios except B, because of the breadth of the proposed closure period. A broad closure window can be sought to accommodate year-to-year variation in the timing of the period of acute bycatch mortality. However, recent strandings records show that the period of acute bycatch mortality did not start earlier than mid-January in the past five years. However, further work is needed to explore the timing of peak mortality outside the areas covered by the stranding data, to ensure scenarios are relevant across the entire region considered.

As French PTM are equipped with pingers in winter since 2019, and their use is mandatory in Spain on PTB fleet since 2020, the benefits of all scenarios was reliant on the spatial closure component.

Recommendations

Relative risk toward management objectives

The relative risk of not achieving the management objective depends on two main processes. Firstly, bycatch estimates are here provided by two different methods and considered as two different views of the same process. They can be seen as the lower and upper limits of bycatch mortality. Among different scenarios presented in Table 1.2, some of them achieved different management objectives following the choice of bycatch estimates.

Secondly, the risk can be set to high when closures are too short, increasing the risk of missing the peak of mortality. Changes in common dolphin seasonal distribution may affect the efficiency of scenarios depending on the length and timing of the closure period.

The success of the above measures is dependent on fishing effort being reduced and not redistributed and is sensitive to: enforcement of correct pinger use is in place; and pinger performance is validated.

-to reduce bycatch mortality below PBR: scenarios H (6-week closure + pingers), L (2-month closure + pingers) and G (pingers+-week closure other métiers). Note that none of these scenarios achieve the objective with both bycatch estimates. Risks of not achieving the objective are therefore very high for the three scenarios, as they combined both sources of risk.

-to reduce bycatch mortality between 50% and 75% of PBR: scenarios N (3+1-month closure + pingers). Scenario N present a moderate risk of not achieving the objective, mostly because of the short summer closure that could miss the peak of mortality. If the risk is considered as low for scenario M, its efficiency score is lower than scenario M. In other words, for the same fishing reduction effort (33%), the bycatch reduction is higher in scenario N (44% reduction) than in scenario M (40%).

None of these scenarios can achieve the management objective of reducing bycatch below 50% PBR with at-sea monitoring, and none can reduce bycatch below PBR with stranding estimates.

It is important to note that in all proposed scenarios it is assumed that fishing effort in métiers of concern is not redistributed into areas where bycatch would still occur. Furthermore, all scenarios would imply large reductions in fishing effort for some fleets fishing in ICES Subarea 8. ICES has not evaluated the consequences of such reductions, neither in terms of potential effort redistribution towards other gears nor in terms of socio-economic impacts.

Table 1.3. Proposed scenarios for the tested management objectives, and evaluation of associated risks, for the common dolphin in ICES Subarea 8. For further information on performance of scenarios, please see Table 1.2.

Scenarios that meet the objective	**Expected out-comes**	**Relative risk of not achieving the objective**	**Comment on the scenario risk**	**Bycatch from strandings above thresh-old**
Management objective : PBR				
B: Annual fishing effort reduction of 40% in mé-tiers of concern	Bycatch re-duction: 20% Efficiency score: 0.5	High	High risk of not achieving the objective because by-cath is only reduced by 20%. Bycatch inferred from strandings remains above PBR.	**B:** Annual fishing effort reduction of 40% in mé-tiers of concern
C and L. C: two-month closure (mid-Jan–mid-Mar) of all métiers; and L: C + pingers on PTB and PTM gears for the rest of the year	Bycatch re-duction : 33% Efficiency score : 2	High	Two month closure that may miss part of the peak mortality. Bycatch inferred from strandings remains above PBR.	**C and L.** C: two-month closure (mid-Jan–mid-Mar) of all métiers; and L: C + pingers on PTB and PTM gears for the rest of the year
D and H. D: six-week clo-sure (mid-Jan–end of Feb.) of all métiers; and H: D + pingers on PTB and PTM gears for the rest of the year	Bycatch re-duction: 27% Efficiency score: 2.3	Very high	A six-week closure is less likely to capture the peak in mortality compared to longer closures. Bycatch inferred from strandings remains above PBR.	**D and H.** D: six-week clo-sure (mid-Jan–end of Feb.) of all métiers; and H: D + pingers on PTB and PTM gears for the rest of the year
G. Pinger PTM/PTB all year and six-week clo-sure of all other métiers of concern (mid-Jan–end of Feb)	Bycatch re-duction: 18% Efficiency score: 1.6	Very high	A six-week closure is less likely to capture the peak in mortality compared to longer closures and by-catch reduction was only 18%. Bycatch inferred from strandings remains above PBR.	**G.** Pinger PTM/PTB all year and six-week clo-sure of all other métiers of concern (mid-Jan–end of Feb)
Management objective:<75% of PBR				
A and M. A: 4-month clo-sure all métiers; and **M**: **A** + pingers on PTB and PTM gears for the rest of year	Bycatch re-duction: 40% Efficiency score: 1.2	Medium	A 4-month closure is more likely to capture the peak in mortalities when com-pared to shorter closures. Bycatch inferred from strandings remains above PBR.	**A and M. A:** 4-month clo-sure all métiers; and **M**: **A** + pingers on PTB and PTM gears for the rest of year
N and O. N: 3 month (Jan–Mar) + 1 month (mid-Jul–mid-Aug) clo-sure all metiers; and **O**: **N** + pingers on PTB and PTM gears for the rest of year	Bycatch re-duction: 44% Efficiency score: 1.3	Medium	Risk around the timing of the shorter second clo-sure. Bycatch inferred from strandings remains above PBR.	**N and O. N:** 3 month (Jan–Mar) + 1 month (mid-Jul–mid-Aug) clo-sure all metiers; and **O**: **N** + pingers on PTB and PTM gears for the rest of year

Mitigation

A combination of technical mitigation measures and/or effort reduction in trawls and static nets could be used to reduce mortality safely below PBR. WKEMBYC2 highlighted possible management objectives that may satisfy the requirements of EU legislation.

1. None of these scenarios can achieve a level of bycatch that would ensure the viability of the population is maintained (50% of PBR and mPBR).Please refer to the WKEMBYC2 report (ICES 2023) for details of management objectives relating to each PBR level.
2. To achieve a level of bycatch that would reduce bycatch below 75% PBR, scenario N or M would need to be implemented. Scenario N contains three measures: a three-month winter closure for all métiers PTM_MPD/DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF, GNS_DEF, PTM_SPF, OTB_DEF, and LLS_DEF) from January to March; a one-month summer closure for PTM_ MPD/DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF, GNS_DEF, PTM_SPF, OTB_DEF, and LLS_DEF; and the use of acoustic deterrents, that have been proven to be effective (e.g. DDD_03) for reducing common dolphin bycatch in trawls, on PTM and PTB the rest of the year. Scenario M contains a four-month winter closure for all métiers (PTM_ MPD/DEF, PTM_LPF, PTB_MPD, GTR_DEF, OTM_DEF, PS_SPF, GNS_DEF, PTM_SPF, OTB_DEF, and LLS_DEF) from December to March; and the use of acoustic deterrents, that have been proven to be effective (e.g. DDD_03) for reducing common dolphin bycatch in trawls, on PTM and PTB the rest of the year.

3. It was suggested that spatio-temporal closure measures could be relaxed if and when specific fleets or métiers were able to demonstrate that they are ‘bycatch-safe’, i.e. when fisheries demonstrate their involvement in scientific at-sea monitoring programmes, compliance with taking observers or EM on board, pinger use, demonstrated that levels of bycatch have been minimise and where possible eliminated.
4. The provision of funding for fishers to transition in the long-term to alternative fishing practices to help reduce common dolphin bycatch, while ensuring that these measures are also safe to other Protected, Endangered or Threatened Species (PETS), as well as the implementation of mitigation measures on non-PT vessels.
5. Mitigation trials to reduce cetacean bycatch in various métiers must be encouraged, associated with power analysis in order to optimize their capacity to detect efficiency of mitigation devices.

Monitoring

1. Adequate at-sea monitoring through dedicated observers or incentivised use of REM should be implemented in all areas. These at-sea monitoring protocols need to be based on a random stratified sampling design that ensures representative coverage of the relevant métiers and vessel sizes throughout the area of dolphin distribution; likewise, the at-sea control system should check if pingers are adequately deployed and in working order.

2. Developing bycatch estimate methodology that consider the unequal and non-representative sampling scheme of at-sea monitoring programmes.. At a national level, improved reporting of data on certain net dimensions (length and height) as an indication of the capacity of the net to bycatch dolphins for GNS and GTR métiers; similarly, the vertical opening of trawls, in particular HVO and VHVO trawls, should be clearly documented as it seems to be critical to assess their capacity to catch common dolphin.
3. The elevated levels of bycatch appear to be primarily driven by changes in the seasonal distribution of common dolphin, rather than elevated winter fishing effort. The seasonal distribution could change in the future and the need for spatio-temporal measures might also change as a result. Therefore, stranding networks need to be supported along the French coastline to help determine the efficacy of and requirement for on-going bycatch reduction measures. More broadly, maintain or reinforce existing stranding networks in the NE Atlantic common dolphin range states and encourage joint analyses and experimentations, including tagging experiments of dolphin carcasses to refine key parameters allowing bycatch mortality to be estimated. This could allow to provide bycatch estimates inferred from strandings at broader scale (areas 7 to 9).
4. Large scale surveys to estimate the abundance of common dolphins should be implemented more regularly than the current interval of the SCANS surveys, for example at a temporal scale that matches the timing of the management decision framework; this is particularly relevant for any management decisions based on PBR or other thresholds.
5. Regional scale (e.g. Bay of Biscay) abundance surveys should also be carried out on a seasonal basis to monitor short-term changes in distribution and density of common dolphins which will also help determine the appropriateness of management measures. In the absence of adequate at-sea monitoring of common dolphin in the Bay of Biscay, it will be difficult to gauge the effectiveness of any mitigation measures adopted (e.g. an observed decrease in strandings could not definitely be attributed to the mitigation measures with-out concurrent knowledge of the at-sea distribution and abundance of common dolphins).

References

ICES. 2020. Workshop on fisheries Emergency Measures to minimize BYCatch of short-beaked common dolphins in the Bay of Biscay and harbour porpoise in the Baltic Sea (WKEMBYC). ICES Scientific Reports. 2:43. 354 pp. http://doi.org/10.17895/ices.pub.7472

ICES. 2023. Workshop on mitigation measures to reduce bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2). ICES Scientific Reports. 5:3. 66 pp. https://doi.org/10.17895/ices.pub.21940337

Annex 8: Review of the update to the ICES WKEMBYC2 2023 Analysis (Annex 7)

Jason M. Boucher, USA
June 2023

Additional review of WKEMBYC2 was requested due to the change in spatial areas for effort reduction scenarios in 2023. The current report includes fishing effort data from Subarea 8 in the mitigation scenrarios considered. Two documents were provided for review.

Reviewer Comments:

- In the final paragraph on page 6, I had trouble comprehending the statement at first. Are the scenarios based on a temporary closure the most effective ones? Or did you mean that "Finally, *of the* scenarios based on a temporary closure *those* which include the winter peak period of mortality are the most effective ones provided that the closure's duration is at least six weeks but …."
- In the Scenario discussion on page 7, the authors note that "overall bycatch estimates were higher for years 2019-2021". A similar pattern has been observed with increasing bycatch of Atlantic sturgeon in the northeastern United States through 2021, which may be partially attributable to reduced observer coverage and reduced effort during the COVID-19 restrictions. This is also briefly mentioned in the WKEMBYC2 report. Have any other impacts of restrictions on bycatch estimates been considered here?
- In paragraph 4 in the Scenarios discussion on page 7, there is discussion of further work needed to explore timing of peak bycatch. If time allows, would it be possible to include a simple metric, such as the median/quartiles for the most recent ten years to illustrate the range?
- Item 4 of Monitoring indicates that large scale surveys should occur more regularly than decadal, but does not indicate a preferred time frame. I would recommend that it requests surveys occur on a temporal scale that matches the timing of the management decision framework (new decisions occur when updated data is available to support).

Peter G.H. Evans, UK
June 2023

Background

The mitigation scenarios (Table 8 in 2020 ICES advice and Table 4 in 2023 ICES advice) used different geographical areas considered for effort reduction. The 2023 advice included management scenarios using fishing effort data from Subarea 8 and Division 9a, whereas the 2020 advice used fishing effort data from Subarea 8 only. Three additional metiers were also included in the 2023 scenarios because recent additional monitoring allowed the production of estimates for those metiers that was not possible in 2020. It was therefore necessary to revisit the ICES advice 2023 taking account of this larger area and inclusion of additional metiers.

Points to Consider

Bycatch estimates rely upon two sources of information: direct onboard monitoring at sea and counts of stranded animals with evidence of bycatch taking account of estimated time from death and use of drift modelling. Both have their limitations. In the former case, unless there are data on areas swept by trawls or soak times and net lengths for static nets, the numbers recorded as bycaught are difficult to extrapolate from crude measures of fishing effort used such as days at sea. Furthermore, sample sizes are typically well below the levels that power analysis demonstrate is required for robust estimates, and sampling needs to be stratified according to variables known to affect bycatch rates. Fishing effort is calculated using VMS but this excludes vessels <12m length which form significant components of fleets in coastal shelf seas particularly around the Iberian Peninsula (8c, 9a). For strandings, there are uncertainties around cause of death, time of death, and extent of drift given variable weather and current conditions. Thus, the application of drift modelling on the north coast of the Iberian Peninsula (Division 8c) will be different, for example, to that on the west French Biscayan coast (Division 8a). Animals dying offshore are also likely to be under-represented amongst strandings so that the locations in which bycatch occurs (e.g. along the shelf edge vs in offshore shelf seas vs in coastal shelf seas) may have a significant effect on bycatch estimates. In Division 9a, there is a narrow shelf compared with Division 8a, so that the large fleet of unmonitored small vessels that operate in coastal waters may come into greater contact with common dolphin numbers near the shelf edge. To date, a quantitative comparison of common dolphin bycatch rates between these locations has not been possible in a robust manner but could have further ramifications on overall bycatch of this species.

Analyses of fishing effort by métier in the Bay of Biscay & Iberian coast ecoregion show relatively little change between time periods over the last decade (see ICES Fisheries Ecoregion Overview, 2013, 2016, 2019, 2022; Evans et al., 2021). The temporal variation observed in bycatch rates is therefore thought to relate more to variation in common dolphin abundance in the area than to variation in fishing effort by gear type. Seasonal variation in bycatch rates has also been observed. Strandings data show highest bycatch in winter between December and March. Although this is mirrored also by onboard observation data, the latter also show peaks in late summer (July-August). The wide-scale abundance estimates from SCANS surveys that are used to determine population numbers of common dolphins are obtained in and around July, although smaller-scale surveys have been conducted at other times of the year.

All of the above have implications on the success of mitigation measures that involve reductions in fishing effort and/or the deployment of alerting/deterrent devices such as pingers that from experimental trials have indicated relatively high success. Furthermore, whereas pinger deployment in various trials have shown high success not only on static nets but also on trawls (WKEMBYC, 2020, 2022-23), when applied at the fleet level, effectiveness is generally much lower. This is due to a combination of reasons: battery failure, inappropriate spacing, non-compliance of deployments, etc. This is an important consideration when estimating the likely success of pinger deployment as a mitigation measure unless it is fully monitored and compliance ensured through regular inspections.

Review

The following documents were reviewed: 'WKEMBYC2 2023_Scenario analysis for Area 8_20230526' and a table giving a 'comparison WKEMBYC1 and WGEMBYC2_270323'.

The addition of Division 9a in the analysis increases the bycatch estimates for all scenarios (cf. Table 1.2 in report draft vs Table 4 in ICES advice 2023). As a result, none of the scenarios achieve the management objective of reducing bycatch to below PBR using the stranding estimates, or less than 50% of PBR for the estimates from the onboard monitoring. It should be noted that these are likely to under-estimate actual bycatch because they do not include monitoring of the <12m fleets. More than 1100 vessels are under 12m length in French waters, the main gears used by the coastal vessels being nets, lines, pots, scoop nets, dredges and bottom trawls (ICES, 2022). In Spanish waters, around 3600 vessels (of c. 7m length) are operating in artisanal fisheries with gears including dredges, trammel nets, gillnets, pots, lines, purse seines and beam trawls (ICES, 2022). In Portuguese waters, a polyvalent fleet of around 3500 vessels operate several gear types including gill nets, trammel nets, lines, pots, dredges, and small purse-seines; most of these vessels are under 12 metres length and therefore not monitored (ICES, 2022), and yet they are known to cause bycatch. Although no request was made by the European Commission to consider the small vessel fleets, these obviously are relevant to the effectiveness of proposed mitigation scenarios in terms of reducing overall bycatch levels.

In the latest analysis, it is not clear how the stranding estimates were calculated for the different ICES Divisions bearing in mind the points made earlier. Also, if Division 7.e was included which seemed to be the case, presumably that included bycaught stranded animals along both the French and English coasts since there are numbers bycaught and stranding on both coasts. For all analyses, it is important that the Divisions to which the estimates apply are detailed here (along with which country's coasts are included in the analyses).

Throughout the document, it is important that the type of pinger deployed is mentioned since different pinger types have different levels of success.

Scenarios A & M and N & O are identified as the mitigation approaches that performed best. However, an important consideration is likely to be the extent to which mitigation is applied during the summer period and for how long since if bycatch turns out to be higher than predicted during summer (due to more common dolphins being present in those areas where fishing is concentrated), then the effectiveness of mitigation measures proposed here may be changed radically.

There are several minor points that need clarification – see Sinead Murphy's review. Otherwise, the recommended changes generally sound reasonable so long as the points made above for consideration are noted as they could alter the outcomes to the various scenarios recommended. The seasonal variation in bycatch rates estimated by the two methods could usefully be compared. Although the results from the onboard monitoring almost certainly are too low (for the reasons given earlier), if the two approaches yield similar seasonal trends, it would give more confidence in the predictions from the different scenarios.

References

Evans, P.G.H., Carrington, C., and Waggitt, J. (2021) Risk Assessment of Bycatch of Protected Species in Fishing Activities. European Commission, Brussels. 213pp.

https://ec.europa.eu/environment/nature/natura2000/marine/docs/RISK MAPPING REPORT.pdf

ICES (2013) Bay of Biscay and Iberian Coast ecoregion – Fisheries overview, including mixed-fisheries considerations. ICES, Copenhagen.

ICES (2016) Bay of Biscay and Iberian Coast ecoregion – Fisheries overview, including mixed-fisheries considerations. ICES, Copenhagen.

ICES (2019) Bay of Biscay and Iberian Coast ecoregion – Fisheries overview, including mixed-fisheries considerations. ICES, Copenhagen.

ICES (2022) Bay of Biscay and Iberian Coast ecoregion – Fisheries overview, including mixed-fisheries considerations. ICES, Copenhagen.

ICES WKEMBYC (2020) Workshop on mitigation measures to reduce bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC). ICES, Copenhagen.

ICES WKEMBYC 2 (2022-23) Workshop on mitigation measures to reduce bycatch of short-beaked common dolphins in the Bay of Biscay (WKEMBYC2). ICES, Copenhagen.

Sinéad Murphy, Ireland
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Further analysis was requested of WKEMBYC2 to ensure consistency with approaches undertaken by WKEMBYC1. When applying the mitigation scenarios (Table 8 in ICES Advice 2020 advice and Table 4 in ICES advice 2023), the geographical area considered for effort reduction scenarios was larger in 2023. The latest advice included management scenarios using fishing effort data from Subarea 8 and Division 9a, whereas the 2020 advice used fishing effort data from Subarea 8 only. Three additional metiers were also included in the 2023 scenarios because recent additional monitoring allowed the production of estimates for those metiers that was not possible in 2020.

Reducing the geographical area considered has resulted in higher bycatch estimates for all scenarios (Table 1.2 in the current report draft vs Table 4 in ICES advice 2023). For the current analysis, none of the scenarios achieved the management objective of reducing bycatch below 50% of PBR with at-sea monitoring, and none reduced bycatch below PBR with stranding estimates. Whereas within ICES advice 2023, by extending the geographic scale considered when applying mitigation scenarios, one of the scenarios achieved the management objective of reducing bycatch below 20% of PBR for at-sea monitoring, and two achieved the management objective of less than 50% of PBR based on strandings estimates.

Two documents were provided for review, a table on 'comparison WKEMBYC1 and WGEMBYC2_270323' and 'WKEMBYC2 2023_Scenario analysis for Area 8_20230526'. The documents included updated analysis by WKEMBYC2, focusing on the production of an updated Scenarios Table for ICES Sub-area 8.

The addition of the new **table** on parameters employed by WKEMBYC1 (ICES Advice 2020) and WGEMBYC2 (ICES Advice 2023) enables a direct comparison of the temporal and spatial considerations, among others, between the two assessments. A legend was not included with the Table.

When referring to Sub-area 8 in this Table, this should include the names of all ICES Divisions assessed within Sub-area 8. Alternatively, if all Divisions 8 a-e were included in all analyses, this could be included in a footnote or within the legend.

The estimates of bycatch from strandings included Division 7.e, and the bycatch estimate from fisheries observer programmes included Division 9a. Just wondering how much bycatch can be attributed to Division 7.e within the estimate of bycatch from strandings? Likewise for the at-sea monitoring, how much bycatch can be attributed to Division 9a?

Information on 'mitigation included' for ICES 2020 and 2023, incorporated both mitigation expected, and mitigation assumed, and further clarification is required. For the ICES 2020 advice, this is presented as the bycatch that 'could' be addressed by pinger mitigation as pingers were not employed fleet wide for the 2016-2018 period. Thus, the bycatch estimate was reduced, by the future employment of pingers within different scenarios. Whereas for the ICES 2023 advice, it is presenting the mitigation already employed for that period and thus no further reductions to the bycatch estimates were made. This would need to be included in a footnote to the comparison table.

A footnote should be included for the pinger type employed within the study that estimated a '*65% bycatch reduction on PTM/PTB applied to all vessels'* within the ICES 2020 advice. Pinger type employed within the Rimaud *et al.* (2019) study.

Additionally, a footnote should be included where noting *'65% bycatch reduction on PTM/PTB implied as effectively all vessels were using pingers since 2019'* that:

pingers were voluntary employed by most PTM vessels in 2019, with pingers mandatory (DDD-03H) for French PTM/OTM/PTB >12 m in the first 4 months of the year since 2020 (Arrêté du 26 Décembre 2019) and year-round for all PTM/OTM/PTB since 2021 (Arrêté du 27 Novembre 2020). The use of pingers is mandatory on Spanish bottom pair trawl fleet since January 2020. Pinger use for French and Spanish PTB vessels in the year 2019 is unknown.

If the latter was the case – going by the text from the WKEMBYC2 report extract below.

'*Since 2019 and confirmed by at-sea observers, almost all PTM vessels have voluntarily equipped themselves with pingers in winter. The fleet is today limited to a dozen of pairs operating in winter in the Bay of Biscay. Their equipment in pinger (today DDD-03H) has been mandatory for French PTM/OTM/PTB >12 m in the first 4 months of the year since 2020 (Arrêté du 26 Décembre 2019) and year-round for all PTM/OTM/PTB since 2021 (Arrêté du 27 Novembre 2020).*'

The text within the draft report on '**Scenarios'** should keep terminology consistent referring to ICES 'Sub-area' 8 and ICES 'Division' 9a. Further, 'at-sea' monitoring data should be employed throughout, and not just 'monitoring data', as strandings monitoring data are also employed within the analysis.

The opening statement on scenarios notes that '*strandings data for the French coast of ICES area 8*' were considered, but in the comparison table that was provided, it notes that Division 7.e was included for the spatial resolution of the analysis of the strandings data for both ICES 2020 and ICES 2023 advice. As the new analysis now includes different spatial considerations, I would recommend a third column in the comparison table, which includes the updated parameters employed by WKEMBYC2.

For the period 2019-2021, it would be good to include a statement if any other 'at sea' monitoring data were included, apart from observer data, e.g. electronic monitoring data.

As noted within the ICES 2020 advice document, and within the Scenarios revised text, the '*two series of métier-specific bycatch estimates were seen as two views of the same phenomenon and were considered, within their uncertainty range, to contain the true bycatch level*'. However as explained in the text on page 1 of the draft report, these datasets were not considered independently within the scenario setting approach. Data from strandings monitoring was used to allocate the total bycatch derived from at-sea monitoring programmes to fortnights, and the at-sea monitoring programme was then used to proportionally allocate the total bycatch derived for strandings to individual métiers.

Thus, a bias in one monitoring method may be amplified through this process. Just wondering if the extent of the variability of the total bycatch estimates for both strandings and at-sea monitoring were considered within this process?

The report text outlines the assumptions made for PT vessels operating in Sub-area 8 within the analysis (see below). As far as I can see, the analysis did not consider a bycatch reduction for French PTB in 2019, nor Spanish PTB for the year 2019. If such a bycatch reduction was applied, how much would this alter the results? If this was considered to be negligible, this would need to be noted.

'In French midwater pair trawl fleet, the use of pingers was generalized in winter 2019 and became mandatory in winter in January 2020, therefore we can assume that all French PTM were seasonally equipped with pingers during the evaluation period (2019-2021). The use of pingers is mandatory on Spanish bottom pair trawl fleet since January 2020. For these scenarios, the workshop assumed full compliance with pinger use on all PT métiers, and correct use of pingers in all cases. Therefore, for scenarios including pingers on PTM and PTB no reduction in bycatch rates were applied to these métiers. As a result, scenarios combining temporal closures and pingers used will result in identical bycatch estimates as temporal closure scenarios.'

Table 1.2 - the column title for **Scenario B** '*Annual effort reduction of 40% all métiers*' should be updated to include employment of pinger PTM / PTB all year, as full compliance with pinger use on all PT metiers was assumed for the period of assessment. Thus, a direct comparison with ICES 2020 advice cannot be made, and this should be noted in the associated explanatory text for Table 1.2. The same for **Scenario E** (4-week closure (mid Jan – mid Feb) all métiers), and for both scenarios in Table 1.1 – and not just noted in the legend.

The legend of Table 1.2 should note what data were used to create these estimates. As both monitoring and strandings data were available for the ICES subarea 8, the scenarios were tested for subarea 8 only – in addition to the spatial scale of the assessments for estimates of bycatch from at-sea monitoring and strandings.

Text in Table 1.3 needs updating from the ICES WKEMBYC2 or Advice docs, for example '*Observer monitoring data provide estimates below mPBR, whereas strandings provide estimates just above mPBR (n=985)*' as none were below the mPBR within the current analysis. And not sure what this symbol relates to ††††††

Table 1.3 – Not a large difference between N and M, 44% vs 40% bycatch reduction, and 1.3 vs 1.2 efficiency score, respectively, but one labelled medium and the other low. It noted that N was given a medium risk due to 'Risk around the timing of the shorter second closure', but M does not consider a second closure in the summer.

Within the '**scenario discussion'** text, it needs to be noted as well, that pinger employment was now included within Scenarios B and E.

Within the '**recommendations**' text, though while it was considered that the bycatch estimates provided by the two different methods were two different views of the same process, the estimates provided within the scenarios Table 1.2 were not estimated independently of each other, as noted earlier.

When listing scenarios to reduce bycatch mortality below PBR, the list is missing Scenario B.

For consistency, include D/H when discussing H, N/O when discussing N, etc.

It was noted that '*the same fishing reduction effort (33%), the bycatch reduction is higher in scenario N (44% reduction) than in scenario M (40%)*'. Thus, while both are due to a 4-month period fishery closure, the slightly higher bycatch reduction for N, is due to a 1-month summer closure – and 3-month winter closure.

Within the '**mitigation**' text it was noted that '*None of these scenarios can achieve a level of bycatch that would ensure the viability of the population is maintained (50% of PBR and mPBR)*'. In terms of whether 50% of PBR or mPBR (which aims to maintain/restore populations/assessment units at or above 80% of K, 80% of the time) would ensure viability, this text needs revision, as ICES advice in both 2020 and 2023 noted that the PBR mortality limit was used as a quantitative interpretation for a potential management objective that could satisfy the aims of ensuring the "long-term viability" (EU, 2017) of the population and as a means to measure the limit to mortality that might threaten the conservation status of the species (EU, 2019). Whereas, reducing bycatch to less than 10% of PBR was used as a quantitative interpretation of what "minimise and where possible eliminate" bycatch (EU, 2019) might mean, while acknowledging that this may be insufficient to meet the requirements of strict protection under Council Directive 92/43/EEC (EU, 1992).

The PBR framework has been applied in the U.S. to restore their marine mammal stocks to 50% of K, within 100 years (the recovery goal) **under ideal conditions,** for 95% of cases[31]. The PBR

[31] https://academic.oup.com/icesjms/article/77/7-8/2491/5903506

employs the conservation objective of the U.S. Marine Mammal Protection Act (MMPA), where populations should be at Optimum Sustainable Population level, which ranges between Maximum Net Productivity Level (MNPL) and carrying capacity (K). More recent work has suggested that MNPL is 'typically' around 50% of K, originally thought to be 60% or higher, though this can vary depending on density dependent responses, and environmental variability – as well as other factors that may hinder reproduction.

In the U.S., the PBR acts as a trigger for management action and under the MMPA, a take reduction plan must be put in place for those strategic stocks (i.e. 'threatened' or 'endangered' under the Endangered Species Act, or 'depleted' under the MMPA) that interact with a Category I or II fishery. Other stocks are categorized as 'strategic' if estimates of human-caused mortality and serious injury for the stock exceed its PBR level. Fisheries are classified as Category I if marine mammals are frequently taken (>50% of a stock's potential biological removal [PBR]), and Category II if marine mammals are occasionally taken (1–50% of stock's PBR)[32]. Within the reduction plans, take reduction teams, composed of a wide range of stakeholders including state agencies, fisheries management organizations and researchers, are responsible for developing recommendations for mitigation measures and monitoring requirements for implementation of the plan and measuring goals. Ultimately the goals of the reduction plan are: (1) to reduce serious injury and mortality to **less than a marine mammal stock's PBR within 6 months of the plan's implementation date**, and (2) to reduce serious injury and mortality to insignificant levels, approaching **a zero rate within 5 years**. That insignificance threshold is defined by the National Marine Fisheries Service as less than 10% of PBR, or the zero mortality rate goal (Marine Mammal Commission).

Recent presentations at the ASCOBANS Conservation Objective Workshops by NOAA personnel reported that while the focus was originally on reducing bycatch to less than 10% of PBR within 5 years, reducing the bycatch level even below the PBR limit for some fisheries has proved challenging, and results to date have been mixed.

Within the **mitigation** text, I would employ a different term than 'dolphin-safe', as this has associations/connotations with the *dolphin-safe* label employed to show compliance with U.S. laws and regulations.

Further revision of the following wording is required 'demonstrated no or agreed low levels of bycatch'. Employing wording that complies with EU legislation, i.e. 'minimise and where possible eliminate' bycatch.

A larger emphasis should be placed on recommendations for mitigation measures employed by other métiers, i.e. non-PT vessels. While alternative fishing practices were noted, this may need to be considered further. As outlined within the draft ASCOBANS conservation management plan for the harbour porpoise in the North Sea, within the UK, due to the cost of switching gear, relicensing a vessel and learning to fish using a different technique, the use of alternative gear types is unviable for many smaller vessels[33]. A focus on gear adaptation has therefore been advocated by industry.

[32] https://www.mmc.gov/priority-topics/fisheries-interactions-with-marine-mammals/mmpa-provisions-for-managing-fisheries-interactions-with-marine-mammals/

[33] Ryan, K., Mynott, S., Lyons, C., Clare, T., Day, E., Bell, C., et al. (Eds) (2022) Hauling Up Solutions 2: Exploring new ways to expand the wildlife bycatch reduction toolkit. Final Workshop Report. 27 pp. Available at: www.cleancatchuk.com/HUS2-Report

Within the '**monitoring**' text, monitoring protocols need to be based on a stratified random sampling design, whereby fishing effort is subdivided into relatively homogenous subgroups with respect to a particular variable, for example, area or season.

SCANS surveys are now running every six-years and not decadal.

Measuring the effectiveness of mitigation measures in the short-term is best assessed via at-sea monitoring, in addition to strandings monitoring. Including stipulations/mandates to carry fisheries observers within fishing licences, as occurs in the US and elsewhere, would improve the coverage of at-sea monitoring, and métier level bycatch estimates within EU waters.

The WKEMBYC1 workshop arose from an EU request to ICES to evaluate proposed measures by a consortium of NGOs to mitigate bycatch under CFP Emergency Measures - to prevent bycatch of common dolphin (*Delphinus delphis*) and Baltic Proper harbour porpoise (*Phocoena phocoena*) in the Northeast Atlantic. ICES concluded in 2020 that the proposed NGO measures were appropriate to reduce bycatch, though spatial-temporal and technical amendments were recommended. If such an assessment were to be undertaken again in the future, this assessment should include the application of additional bycatch mitigation scenarios for other (non-PT) métiers. Recommendations within the WKEMBYC2 report would need to outline work that is required to be undertaken to achieve such.

Further, as ICES has not evaluated the consequences of employing the bycatch mitigation scenarios, neither in terms of potential effort redistribution towards other gears or regions within the range of the Northeast Atlantic common dolphin population, nor in terms of socio-economic impacts, this is the next logical step in this process.