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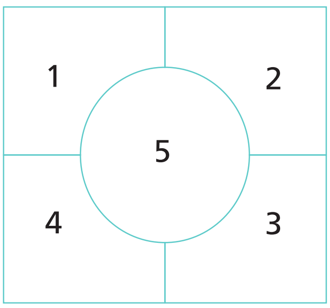
Methodology for data collection



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Preparation of this document

This document was prepared by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) in collaboration with the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) in the context of the joint project "Mitigating dolphin depredation in Mediterranean fisheries – Joining efforts for strengthening cetacean conservation and sustainable fisheries" (Depredation project), supported by the MAVA Foundation between 2018 and 2022. The project was implemented in select sites in Italy, Malta, Morocco, Spain and Tunisia in collaboration with the Specially Protected Areas Regional Activity Centre (SPA/RAC) of the United Nations Environment Programme/Mediterranean Action Plan (UN Environment/MAP) and the Low Impact Fishers of Europe (LIFE) platform. This publication provides a harmonized framework to increase knowledge on depredation in the Mediterranean and the Black Sea. It is a result of commitments taken by Mediterranean and Black Sea countries and partner organizations in line with their shared international agenda and within the context of regional strategies, including the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea, in particular its target 1, output 3 "Efficient area-based conservation measures, technical and nature based solutions strengthened to conserve biodiversity and enhance the productivity of marine living resources."

Paolo Carpentieri (GFCM Fishery Resources Monitoring Specialist) was responsible for the development of the methodology, general coordination and compilation of this document. Joan Gonzalvo (Task Manager on Interactions with Fisheries, ACCOBAMS Scientific Committee) contributed by providing expert insights that were instrumental in the final stages of this work.

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Abstract

Interactions between fishing activities and marine mammals generally occur when marine mammal individuals come into physical contact with fishing gear, causing deleterious effects on both the animals and fishers. Interactions can take one or both of two forms: incidental catch and depredation. In the case of depredation events, marine mammals, mainly dolphins, may remove and/or damage fish captured in the nets/hooks (or remove bait, in the case of longliners), resulting in breakage of fishing gear, loss of capture and consequent reduction in the value of the catch and in fisher revenues. Depredation can also lead to entanglement, which can produce a case of incidental catch. As dolphins are more frequently brought into conflict with fisheries, demands for investigation into the competitive overlap between the two groups is likely to grow. This kind of human–dolphin interaction has become a major problem worldwide, because it affects both the survival of wild dolphin populations and the livelihood of fishers, and it is a growing matter of concern for several fisheries in the Mediterranean and Black Sea region.

As such, dolphin depredation attracts the attention of most regional fisheries management organizations and other fisheries management bodies. Necessary measures should be taken to minimize and mitigate the negative impacts of anthropogenic effects on marine biodiversity, especially in relation to vulnerable species and ecosystems, and their adoption requires comprehensive knowledge of the extent of the problem. Robust data collection is therefore crucial to better understand incidental catch events in fisheries. Efficient reporting and monitoring of depredation events could allow scientists and managers to obtain a more complete overview of the situation, and on this basis, to set priority areas for management action. Worldwide, a significant amount of work is being undertaken to quantify, understand and possibly mitigate dolphin depredation. However, large gaps in knowledge of the actual extent of the problem in the Mediterranean and the Black Sea remain. Adequate regional/subregional and national monitoring programmes are therefore urgently required to obtain representative data on dolphin depredation events during sampled fishing operations.

The purpose of this protocol, which allows for replicability and comparisons among fisheries across the region, is to facilitate and improve data collection, in a harmonized and standardized way, in order:

- to improve knowledge on dolphin populations involved in depredation and understanding of their behaviour related to feeding on captures, their approach to and selection of particular types of fishing gear and their reactions and potential habituation to deployed mitigation tools;
- to assess the regional magnitude of depredation, particularly in certain areas of the Mediterranean and the Black Sea where little work has been conducted;
- to determine the economic losses suffered by fishers, taking into account reparation or substitution of damaged gear, catch loss and lost fishing time;
- to identify the typologies and complete quantitative assessments of the current fishing practices that lead to depredation events (e.g. fishing behaviour, fishing area, main species predated, seasonality);
- to collect more details on different types of fishing gear to identify potential mitigation measures (e.g. management measures and/or technical measures) and test their efficiency over time to allow for the diffusion of mitigation technology to other fisheries; and
- to collect valuable information for the conservation of marine mammals.

This protocol aims to support regional monitoring programmes and provide a framework for the development and implementation of an efficient, standardized data collection and monitoring system for depredation events. This process will be realized through on-board observations, questionnaires at landing sites and self-reporting activities. This methodology ensures minimum common standards for the collection of data on these species and allows for replicability and comparisons among fisheries across the region, thus offering a harmonized basis of knowledge, information and evidence for decision-making. The collection of the above-mentioned data should offer a harmonized basis of knowledge, information and evidence for subsequent decision-making.

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Abbreviations and acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area
CPUE	catch per unit effort
DCRF	Data Collection Reference Framework (GFCM)
DI	damage intensity
DR	depredation rate
ED	economic damage
EL	economic loss
FAO	Food and Agriculture Organization of the United Nations
GFCM	General Fisheries Commission for the Mediterranean
GSA	geographical subarea (GFCM)
GT	gross tonnage
ICCAT	International Commission for the Conservation of Atlantic Tunas
IR	interaction rate
IUCN	International Union for Conservation of Nature
IUCN-MED	IUCN Centre for Mediterranean Cooperation
kW	kilowatt
LIFE	Low Impact Fishers of Europe
MAP	Mediterranean Action Plan
REM	remote electronic monitoring
SPA/BD	Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean
SPA/RAC	Specially Protected Areas Regional Activity Center
TL	total length
UN Environment	United Nations Environment Programme
UN Environment/MAP	UN Environment/Mediterranean Action Plan

Definitions

For the purpose of this document, the following definitions have been used:

Bycatch:	The part of the catch that is unintentionally captured during a fishing operation in addition to the target species. It may refer to the catch of other commercial species that are landed, commercial species that cannot be landed (e.g. undersized, damaged individuals), non-commercial species as well as to the incidental catch of endangered, vulnerable or rare species (e.g. sea turtles, seabirds, sharks and rays, marine mammals).
Catch:	The amount of marine biological resources that are caught by the fishing gear and reach the deck of the fishing vessel. This includes individuals of the target species, which are usually kept on board and retained, as well as bycatch, which refers to species with or without commercial value that are not targeted by the fishery.
Depredation:	Depredation is defined as the removal of captured fish or bait by a predator. For the purpose of this protocol, the term depredation refers to cetaceans, in particular odontocetes, which can impact fisheries by removing bait or caught fish from a gear (e.g. hooks, nets, traps), thus reducing commercial catches and sometimes damaging fishing gear.
Discards:	The part of the catch that is not retained on board and is returned at sea, dead or alive. It may include target species, or any other species (both commercial and non-commercial) discarded at sea.
Fishing operation:	Any single action carried out during a fishing trip, whether or not a catch was made; this includes, *inter alia*, towing a trawl net, setting a net, a line and hauling pots and traps.
Fishing trip:	In the simplest cases, a fishing vessel leaves the port, steams to the fishing grounds, fishes for a certain time and returns to the port where its catch is landed. The combination of these events is called a fishing trip (Sparre, 2000). Generally, in the Mediterranean and the Black Sea, a 24-hour period (i.e. a fishing day), irrespective of the calendar day, is often used as a time unit. During a fishing trip, a fishing vessel may carry out different fishing operations.
Fishing vessel:	Any vessel used or intended to be used for the commercial exploitation of marine living resources.
Fleet segment:	The combination of a group of fishing vessels of the same size category and using the same gear type for more than 50 percent of the time at sea during a year.
Landing:	The part of the catch that is retained on board and brought ashore.
Vulnerable species:	A taxon is considered vulnerable when facing a high risk of extinction in the wild in the medium-term future. For the purpose of this document, the lists of seabirds, sea turtles, marine mammals and shark species included in Appendix II (endangered or threatened species) and Appendix III (species whose exploitation is regulated) of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (the Barcelona Convention), together with elasmobranch species included in the IUCN Red List of Threatened Species, have been used.

Background

Depredation by cetaceans – the partial or complete removal of catch from fishing gear – is a growing cause for concern in several Mediterranean fisheries. In general, interactions between cetaceans and fisheries in the Mediterranean and the Black Sea involve mainly coastal fisheries and species such as the common bottlenose dolphin (*Tursiops truncatus*), which is typically found on the continental shelf, the common dolphin (*Delphinus delphis*), and the harbour porpoise (*Phocoena phocoena relicta*). Static nets, the main fishing gear used by small-scale fisheries in the Mediterranean and the Black Sea, are prone to interactions with cetaceans. In particular, common bottlenose dolphins are increasingly interacting with set nets across the region, risking capture, in addition to depredating catch, damaging gear and causing potentially severe economic losses.

The socioeconomic impacts of damaged fishing gear and lost catch create conflicts between fishers and dolphins, undermining the conservation and sustainability efforts promoted by regional organizations such as ACCOBAMS and the GFCM. The project "Mitigating dolphin depredation in Mediterranean fisheries – Joining efforts for strengthening cetacean conservation and sustainable fisheries" (Depredation Project) is coordinated by ACCOBAMS and the GFCM, in collaboration with SPA/RAC and LIFE. Between 2018 and 2022, these organizations have initiated activities at pilot sites in different Mediterranean areas aimed at assessing the depredation issue in different types of fishing gear with a view to pursuing the identification of technical or management solutions to reduce the depredation pressure and expanding the regional network of expertise on depredation. This increase in scale will allow for comparisons between the experiences and results of different pilot sites and to consolidate lessons learned and best practices, which will be disseminated at the regional level at the end of the project. The project has built on all these experiences to develop a standardized monitoring methodology of depredation impacts, with a view to providing a harmonized framework to increase knowledge on depredation in the Mediterranean and the Black Sea. Improved information on this topic will help foster better management of marine living resources in the Mediterranean and the Black Sea.

1. Introduction

The Mediterranean and the Black Sea are recognized as areas with exceptional marine biodiversity. Nevertheless, the region's dense human population and intensive human activities make this biodiversity, and particularly marine mammals, more susceptible to threats (Coll *et al*., 2010). Pressures placed upon the marine environment (e.g. pollution, habitat disturbance, non-indigenous species and human-induced climate change, as well as fishing), continue to grow, and as a consequence the need to improve marine management practices has become more urgent. When considering interactions between aquatic populations and fisheries, it is important to note the ecological changes that the world's fisheries are affecting on the structure and function of marine ecosystems and on so-called vulnerable species (e.g. marine mammals, elasmobranchs, seabirds and sea turtles) (FAO, 2019a). Aquatic populations do not live in isolation: they exist as part of a complex marine ecosystem, consisting of biological components that may feed on, be fed on by, or otherwise interact with each other (Howard, 2019; Bastardie *et al*., 2021) and their habitats. By targeting and reducing the abundance of predators, fisheries deeply modify the trophic chain and the flows of biomass (and energy) across the ecosystem, creating changes in species assemblages, and in pathways of energy flow (Pauly, 1979; Pauly *et al*., 1998; Jackson *et al*., 2001; Myers and Worm, 2003). Among other factors, these ecological changes, as well as direct fisheries interactions, may have important and likely adverse consequences for populations of marine mammals (Northridge, 1984; DeMaster *et al*., 2001). Programmes developed to monitor the interactions between fishing activities and marine mammals are therefore fundamental to improving knowledge on the different types of interactions and are crucial for developing evidence-based policy and management measures.

Interactions between fishing activity and marine mammals generally happen when marine mammal individuals come into physical contact with fishing gear, causing deleterious effects on both marine mammals and fishers. Interaction can take one or both of two forms: incidental catch or depredation.

a. Incidental catch, by harming animals that remain entangled or entrapped in fishing gear, may become a conservation issue contributing to whale and/or dolphin population declines and impeding recovery (Read, 2005);
b. In the case of depredation events, marine mammals, mainly dolphins, may remove and/or damage fish captured in the nets/hooks (or remove bait, in the case of longliners), resulting in breakage of fishing gear, loss of capture and consequent reductions in the value of the catch and in fisher revenues. Depredation can also lead to entanglement, which can produce a case of incidental catch.

In many cases, both incidental catch and depredation can occur in the same fisheries, and addressing the latter problem may help to address the former (ACCOBAMS, 2004).

Although direct interactions (i.e. depredation) between marine mammals and fishing gear are increasingly being taken into consideration, detailed and robust information on the nature and scale of the depredation problem throughout the Mediterranean and the Black sea is still lacking. In recent years, several organizations (e.g. ACCOBAMS, GFCM, UNEP-MAP/SPA-RAC, World Wide Fund for Nature) have been trying to address this issue through different projects and activities in different Mediterranean areas and fisheries (e.g. monitoring programmes, testing mitigation measures).

In order to better understand the extent of dolphin depredation in Mediterranean and Back Sea fisheries, more robust data collection monitoring programmes must be developed with increased temporal and spatial coverage and involving all the GFCM members. These monitoring programmes can contribute to a better understanding of the impacts of depredation, filling knowledge gaps regarding this enduring conflict, identifying the most impactful types of fishing gear and determining whether fishing patterns reveal any geographical or seasonal trends. This information may help to identify depredation hotspots in the Black Sea and in the Mediterranean subregions and, in turn, be useful in applying adequate mitigation measures to reduce the negative impacts on both marine mammals and the fishing industry.

1.1 WHAT IS DEPREDATION? INCIDENCE FACTORS AND CONSEQUENCES

Depredation may be viewed as competition between two predator species for a common prey, even if the extent of this competitive overlap in feeding niches is always extremely difficult to assess. In the marine environment, removing a large portion of the biomass of a target fish stock may have severe effects on the trophic behaviour of several species (including marine mammals) if they depend on that stock as prey, reducing the population carrying capacity of the ecosystems on which they depend (Kaschner *et al*., 2001; Kaschner and Pauly, 2005). Several species of marine mammals are top predators or consumers and play control roles according to the mechanisms of trophic cascade, helping to maintain the stability of marine ecosystems' food webs and their health, meaning that their conservation and continued ecological importance must be ensured (Estes *et al*., 1998; European Union, 2008; Pennino *et al*., 2015). As marine mammals, mainly dolphins, are more frequently brought into conflict with fisheries, demands for investigation into the competitive overlap between the two groups is likely to grow. This kind of human–dolphin interaction has become a major problem worldwide as it affects both the survival of wild dolphin populations and the livelihood of fishers (Harwood *et al*., 1984; Harwood and Hembree, 1987; Northridge, 1988; Goetz, 2014; Goetz *et al*., 2014), and it is a growing matter of concern for several fisheries in the Mediterranean and Black Sea region (Reeves and Notarbartolo di Sciara, 2006; Brotons, Grau, and Rendell, 2008).

There is a long history of depredation events involving marine mammals and commercial fisheries in the Mediterranean and the Black Sea (Di Natale, 1989; UNEP, 1998; ICRAM, 2001; Bearzi, 2002; Notarbartolo di Sciara, 2002; ACCOBAMS, 2006; Frantzis, 2007). In the Mediterranean, this type of interaction involves, among others, mainly common bottlenose dolphins (*Tursiops truncatus*) and common dolphins (*Delphinus delphis*), occurring most significantly in areas where the distribution of marine mammals' most preferred and easily accessible prey overlaps with the distribution of a fishery's target species (Azzali and Virno Lamberti, 1993; ICRAM, 2001; Kaschner *et al*., 2004; Pusineri *et al*., 2004; Bearzi *et al*., 2008, 2010; Zappes *et al*., 2016). In several areas of the Mediterranean, the main types of fishing gear from which dolphin–fisheries interactions have been reported are bottom-set trammel nets and gillnets targeting demersal species (Casale, Milani and Kallianiotis, 1999; Gazo *et al*., 2001; Northridge, Vernicos and Raitsos-Exarchopolous, 2003; Gönener and Özdemir, 2012; Lauriano and Di Muccio, 2002; Benmessaoud, 2008. Lauriano *et al*., 2004, 2009; Mitra *et al*., 2014; Blasi and Pace, 2006; Fossa, Lammers and Orsi Relini, 2012; Milani *et al*., 2012, 2019; Pennino *et al*., 2015; Bouhadja *et al*., 2017; Benmessaoud *et al*., 2018; Revuelta *et al*., 2018; Geraci *et al*., 2019; Snape, 2019; Monaco *et al*., 2020), although dolphins can also interact with small purse seines targeting pelagic schools of fish (Abad, 2002; Benmessaoud, 2011; INRH, 2015; Marçalo, 2015; Tsagarakis *et al*., 2021).

In some areas, dolphins have also been recorded near fish farms taking advantage of the concentration of wild prey gathered around fish cages (Diaz López, 2012; Bearzi and Bonizzoni, 2018; Benmessaoud *et al*., 2021; Carmen, Cardona and Gonzalvo, 2021), and cases of depredation on longlines by killer whales have also been recorded near the Strait of Gibraltar (Camiñas *et al*., 2018). The situation for trawlers is yet another story.

Worldwide, the trawlers involved in depredation events varied greatly in gear and target species, implying that marine mammals have developed behavioural specializations to forage under a variety of conditions (i.e. venturing into a moving trawl net to feed on the organisms trapped in the net, feeding on fish stirred up by the net, extracting fish from the outer mesh, feeding on catch lost during hauling, and scavenging on discarded catch) (Addink and Smeenk, 2001; Bonizzoni, *et al*. 2022). In the Mediterranean, only a few cases were reported of individuals catching fish before the mouth of the trawling net, taking advantage of the fish concentration effect (Scheinin *et al*., 2010; Gonzalvo *et al*., 2008). In this case, beyond the possible damages for fishers, these behaviours can be dangerous for the dolphins themselves, potentially leading to harm, capture or entanglement (Goffman, Kerem and Spanier, 1995; Kent *et al*., 2005; Gonzalvo *et al*., 2008; Carpentieri *et al*., 2021).

In the Black Sea, harbour porpoises (*Phocoena phocoena relicta*) not only suffer high bycatch rates in set nets (i.e. trammel nets and gillnets), but are also responsible for damages to catch and fishing gear (Birkun Jr, 2002; Birkun Jr *et al*., 2014; Bilgin, Kose and Yesilcicek, 2018; Bengil, Bengil and Ozaydinli, 2020).

Generally, depredation negatively affects fisheries (Fritts, 1982; ICRAM, 2001; Bearzi, 2002; Cox *et al*., 2003; Lauriano *et al*., 2004; Zollet and Read, 2006; Rocklin *et al*., 2009; Gönener and Özdemir, 2012, Marçalo, 2015; Monaco *et al*., 2020; Benmessaoud *et al*., 2021) through:

- damage done to fishing gear, in the form of holes in nets (e.g. gillnets, trammel nets, combined nets, purse seines), as the dolphins attempt to remove fish;
- removal of bait and/or damage to hooks in longlines;
- reductions in the amount or value of catch when the dolphins mutilate or remove caught fish from different types of gear;
- reductions in the size or quality of catch, as the dolphins' presence could cause fish to flee from the vicinity of the fishing operation; and
- loss of time spent repairing fishing gear.

Furthermore, depredation can also have negative consequences for dolphins (Wells and Scott 1994; Gorzelany, 1998; Wells, Hofmann and Moors, 1998; Wells *et al*., 2008; Gomerčić *et al*., 2009; Pennino *et al*., 2015) through:

- increased likelihood of dolphins suffering serious injury (e.g. cuts on the body, larynx strangulation, laryngeal snaring by ingested fishing nets) and/or death due to possible entanglement or entrapment;
- changes in group formation (number and composition), respiratory rhythm, distribution areas, diet, as well in feeding habits and techniques; and
- inducing fishers to take retaliatory measures against dolphins, given the reductions experienced in the quantity and/or quality of their catch and their consequent economic losses.

However, there also exist signs of mutually beneficial effects. These may involve dolphins "cooperating" in fishing operations, as their presence can increase the chances of higher catch in a fishery (Busnel, 1973; Pryor *et al*., 1990; Bearzi, 2002; Neil, 2002; Silva *et al*., 2002; Rocklin *et al*., 2009). Recently, some fishers in the Mediterranean reported frequent cases of positive interactions with common dolphins and striped dolphins who led fish into their nets (Monaco, *et al*., 2020). Although the behavioural and ecological nature of these interactions is poorly understood, it seems to be a win–win situation, requiring that humans and dolphins synchronize and understand each other's behaviour to access and share the same prey (Peterson, Hanazaki and Simões-Lopes, 2008; Santos, Lemos and Vieira, 2018; da Rosa *et al*., 2020). Other indirect advantages may also arise from dolphins enhancing the attractiveness of an area for tourism, such as providing economic benefits (e.g. increased demand for seafood, development of sustainable ecotourism) that may positively influence local fisheries (Bearzi, 2002).

1.2 WHY DO WE NEED THIS PROTOCOL?

Previous studies conducted to assess depredation demonstrated that important knowledge gaps on the actual extent of this issue still remain. One of the main problems is a lack of standardization of the methods used by researchers in different countries/areas; the parameters that should always be taken into account are numerous, difficult to obtain, complex to evaluate, which makes it extremely challenging to secure good and comparable results. The absence of a regional, standardized monitoring programme and data collection protocol can affect data reliability, preventing quantitative comparisons between studies, areas and temporal scales, as well as hamper the possibility of testing potential methods to mitigate depredation, reducing the capacity of policymakers to manage this issue. Even if several research studies have been carried out in attempt to quantify the competitive interactions between dolphins and fisheries in Corsica (Rocklin *et al.*, 2009), Greece (Conides and Papacostantinou, 2001), Italy (ICRAM, 2001; Lauriano *et al*., 2004; Díaz López, 2006), Morocco (INRH, 2015; Abid *et al*., 2017), Spain (Brotons, Grau and Rendell, 2008; Gazo, Gonzalvo and Aguilar, 2008) and Tunisia (Ben Naceur *et al*., 2004; Benmessaoud *et al*., 2021), few attempts have been made to evaluate the extent and magnitude of this phenomenon at the regional and subregional scales. The lack of national data collection programmes and regional/subregional standard information on the frequency and amount of depredation, as well as the main areas of interactions/hotspots and on its economic effects, makes any effort to solve or manage the conflict very difficult (Lauriano *et al*., 2009). Limiting these interactions requires national baseline quantitative information and a robust regional analysis of the extent and cost of the impacts of dolphin depredation on fisheries (Matthiopoulos *et al*., 2008). More detailed studies are therefore needed on the spatio-temporal distribution of fishing activity, on the distribution, habitat use and movements of dolphins, as well as *in situ* data on the nature of interactions between dolphins, fish and gear. Data collection obligations should include efficient monitoring and reporting to obtain a complete picture of the situation, not only locally, but also by country, region and fishery. Based on these results, priority areas/fisheries can be set for solutions to be developed and for further management actions, where needed.

The purpose of this protocol, which allows for replicability and comparisons among fisheries across the region, is to facilitate and improve data collection, in a harmonized and standardized way, in order to:

- improve knowledge on dolphin populations involved in depredation and understanding of their behaviour related to feeding on captures, their approach to and selection of particular types of fishing gear and reactions and potential habitation to deployed mitigation tools;
- assess the regional magnitude of depredation, particularly in certain areas of the Mediterranean and the Black Sea where little work has been conducted;
- determine the economic losses suffered by fishers, taking into account reparation or substitution of damaged gear, catch loss, and lost fishing time;
- identify the typologies and complete quantitative assessments of the current fishing practices that lead to depredation events (e.g. fishing behaviour, fishing area, main species predated, seasonality);
- collect more details on different types of fishing gear to identify potential mitigation measures (e.g. management measures and/or technical measures) and test their efficiency over time to allow for the diffusion of mitigation technology to other fisheries; and
- collect valuable information for the conservation of marine mammals.

The collection of the above-mentioned data should offer a harmonized basis of knowledge, information and evidence for following decision-making.

1.3 DIVERSITY AND CONSERVATION STATUS OF CETACEANS IN THE MEDITERRANEAN AND THE BLACK SEA

The marine mammal species inhabiting the Mediterranean and the Black Sea belong to two different infraorders of the class Mammalia: Pinnipedia and Cetacea. At present, 21 different cetacean species and three subspecies have been sighted in the Mediterranean and the Black Sea (IUCN, 2012; Notarbartolo di Sciara and Tonay, 2021). Eight of these species have resident populations in the Mediterranean Sea, the three subspecies are endemic to the Black Sea (*Delphinus delphis ponticus* Barabasch-Nikiforov, 1935; *Tursiops truncatus ponticus* Barabash-Nikiforov, 1940 and *Phocoena phocoena relicta* Abel, 1905) and 12 species are visitors and appear in these seas from time to time (Table 1). The Mediterranean monk seal (*Monachus monachus*) is the only pinniped species inhabiting the Mediterranean.

The size, distribution and state of conservation of the different cetacean populations in the Mediterranean and the Black Seas are highly variable, depending on species and area. Overall, their conservation status has changed over time (IUCN, 2022). The Mediterranean monk seal is one of the world's most seriously endangered large mammal species. While both the bottlenose and common dolphins are globally abundant, their Mediterranean populations are thought to be geographically isolated from their Atlantic Ocean populations. Common dolphins have declined considerably throughout the Mediterranean basin and have been recently evaluated as endangered on the IUCN Red List of Threatened Animals. The status of bottlenose dolphins in this region is less certain, but some researchers believe that they have also declined. Therefore, it is obvious that depredation monitoring programmes that can improve knowledge on dolphins represent an important tool for conservation, as they provide not only a clear picture of the relationship between fisheries and dolphins but also information on their presence, behaviour and distribution.

TABLE 1.
Cetacean taxa assessed for their risk of extinction in the Mediterranean and the Black Sea

Common name	Scientific name	IUCN category	Population	Last assessed
Striped dolphin	*Stenella coeruleoalba* (Meyen, 1833)	Least concern	Global & Mediterranean	17 July 2020
Common bottlenose dolphin	*Tursiops truncatus* (Montagu, 1821)	Least concern	Mediterranean subpopulation	6 January 2021
Common bottlenose dolphin	*Tursiops truncatus* (Montagu, 1821)	Critically endangered	Gulf of Ambracia subpopulation	30 July 2020
Black Sea common bottlenose dolphin	*Tursiops truncatus ponticus**	Endangered	Black Sea	Not available
Common dolphin	*Delphinus delphis* (Linnaeus, 1758)	Endangered	Mediterranean	30 April 2003
Common dolphin	*Delphinus delphis* (Linnaeus, 1758)	Endangered	Inner Mediterranean subpopulation	15 November 2020
Black Sea common dolphin	*Delphinus delphis ponticus**	Vulnerable	Black Sea	Not available
Black Sea harbour porpoise	*Phocoena phocoena relicta** (Linnaeus, 1758)	Endangered	Black Sea	30 June 2008
Risso's dolphin	*Grampus griseus* (G. Cuvier, 1812)	Endangered	Mediterranean subpopulation	24 November 2020
Long-finned pilot whale	*Globicephala melas* (Traill, 1809)	Endangered	Mediterranean	29 March 2021
Long-finned pilot whale	*Globicephala melas* (Traill, 1809)	Critically endangered	Strait of Gibraltar subpopulation	12 April 2021
Cuvier's beaked whale	*Ziphius cavirostris* (Cuvier, 1823)	Vulnerable	Mediterranean subpopulation	27 January 2018
Sperm whale	*Physeter macrocephalus* (Linnaeus, 1758)	Endangered	Mediterranean subpopulation	16 November 2020
Fin whale	*Balaenoptera physalus* (Linnaeus, 1758)	Endangered	Mediterranean subpopulation	12 January 2021
Rough-toothed dolphin	*Steno bredanensis* (Cuvier in Lesson, 1828)	Near threatened	Mediterranean subpopulation	30 March 2020
Killer whale	*Orcinus orca* (Linnaeus, 1758)	Critically endangered	Strait of Gibraltar subpopulation	20 March 2019
False killer whale	*Pseudorca crassidens* (Owen, 1846)	Not applicable	Europe	26 January 2007
Common minke whale	*Balaenoptera acutorostrata* (Lacépède, 1804)	Least concern	Europe	16 March 2018
Humpback whale	*Megaptera novaeangliae* (Borowski, 1781)	Least concern	Europe	26 January 2007
Sei whale	*Balaenoptera borealis* (Lesson, 1828)	Endangered	Europe	26 January 2007
North Atlantic right whale	*Eubalaena glacialis* (P.L.S. Müller,1776)	Critically endangered	Europe	26 January 2007
Grey whale	*Eschrichtius robustus* (Lilljeborg, 1861)	Regionally extinct	Europe	26 January 2007
Dwarf sperm whale	*Kogia sima* (Owen, 1866)	Not applicable	Europe	26 January 2007
Northern bottlenose whale	*Hyperoodon ampullatus* (Forster, 1770)	Data deficient	Europe	26 January 2007
Blainville's beaked whale	*Mesoplodon densirostris* (Blainville, 1817)	Data deficient	Europe	26 January 2007
Gervais' beaked whale	*Mesoplodon europaeus* (Gervais, 1855)	Data deficient	Europe	26 January 2007

Source: IUCN. 2022. The IUCN Red List of Threatened Species. Version 2021–3. https://www.iucnredlist.org/
Notes: In grey, species that are considered visitors and vagrants (IUCN, 2012; Notarbartolo di Sciara and Tonay, 2021) or recorded only occasionally (modified from Pace, Tizzi and Mussi, 2015).
* Endemic subspecies of the Black Sea.

2. Data sources

Quantifying the overall levels and impacts of depredation is very difficult. Despite potential effects on fishery economics and problems related to the incidental capture of dolphins, there is no single system or methodology to collect depredation data on a routine basis or in an exhaustive manner. Therefore, depending on the area, fleet, and available resources, it is generally recommended to combine different data sources to obtain better coverage and more reliable results.

The most rigorous and reliable method to collect such data is to use fishery-independent onboard observations (Northridge and Fortuna, 2008; Snape *et al.*, 2018) (Section 2.1). Additional information can also be collected through interviews and/or questionnaires carried out at landing sites (Section 2.2), directly from fishers (Section 2.3) and through remote electronic monitoring (REM) systems (Section 2.4) or ad hoc experimental surveys (Section 2.5).

2.1 PROFESSIONAL OBSERVERS ON BOARD FISHING VESSELS

The most accurate methods for collecting data on depredation events and properly describing the associated fishing activities is to place independent professional observers onboard a representative selection of fishing vessels (Northridge and Fortuna, 2008; Moore *et al.*, 2010). Professionally trained observers should gather first-hand data on what is caught and discarded by commercial fishing vessels. They should also record interactions with marine mammals, sea turtles, and seabirds. At-sea data collection by observer programmes would provide many additional opportunities to understand, quantify and mitigate the problem of interactions between fisheries and dolphins. Once on board, observers can record a wide range of data on fishing operations (e.g. fishing area, duration of fishing trip, sorting behaviour, gear characteristics; Annex 1/A), as well as on catch data (i.e. landings and discards; Annex 1/B), and interactions (i.e. depredation and/or incidental catch, Annexes 2, 3, 4 and 7) with vulnerable species – not only with marine mammals (Table 1) but also with sea turtles, seabirds, sharks and rays (Annexes 16/A and 16/B).

Professional onboard observations can be expensive, but costs should be considered as part of the national investment in managed, sustainable fisheries and in protecting the marine environment. Observers of cetacean interactions and depredation can also participate in other onboard scientific activities involving the same methodology (e.g. monitoring programmes for discards and/or incidental catch, sampling of biological catch), allowing for several objectives to be met at once (FAO, 2019a, 2019b). In general, collaboration with existing programmes is likely to produce synergistic effects with benefits to both areas of research (Northridge and Fortuna, 2008). However, there are some constraints and disadvantages that may hinder a successful onboard observer programme (FAO, 2019b). Aboard commercial vessels, the work of observers must interfere minimally with the daily work of the crew, and often, observers have very limited time to collect information. If taking observers on board is not common practice, the presence of an observer may also influence fishers' behaviour (e.g. change in fishing practices, fishing grounds). Additionally, in the case of observer programmes, fishers may experience extra inconveniences from activities that involve another person (or persons) occupying deck space on the vessel (for small vessels, there may be strict space and safety limitations and the use of onboard observers may not be logistically possible) and conducting activities outside the scope of normal fishing practices.

PLATE 1
Onboard observers evaluating a damaged fishing gear

Ideally, days at sea onboard commercial vessels should be proportionally allocated across different fishing periods to identify potential seasonality in depredation events. For spatial stratification, the monitoring programme should cover all main fishing ports and fleets in the area under study.

2.2 QUESTIONNAIRES

Information can also be collected through individual questionnaire-based interviews following a standardized sampling questionnaire in different ports and/or landing sites. The questionnaires forms (Annex 5) are designed to collect information on vessel characteristics, fishing gear, catch (Annex 5/A), depredation events (Annex 5/B) and incidental catch of vulnerable species (i.e. marine mammals, sea turtles, seabirds, sharks and rays) (Annex 5/C).

Fishers are an important source of information for improving the body of knowledge on dolphin behaviour and interactions with fishing activities, given their familiarity with local resources, marine environment and fishing practices (Johannes, Freeman and Hamilton, 2000; Goetz, 2014; Camiñas *et al.*, 2018; Aguilera, Camiñas and Molina, 2020). Maps can also be provided to fishers for them to identify the location of the fishing grounds they frequent each fishing season and the main areas of interactions with and sightings of dolphins. This method should always involve professionally trained interviewers to ensure that interviews are complete and questionnaires are filled out properly. Interviewers should perform primary quality controls. Although direct interviews are more time-consuming, this approach should be preferred in any questionnaire survey. The "face-to-face" questionnaire-based interviewing method is more reliable than a mere distribution of questionnaires to be filled out by the fishers themselves, since personal interviews foster more trust between the interviewer and respondents (FAO, 2019a, 2019b). Following in this theme, interviews are best conducted by experts who are experienced in this data collection method and are independent and without any preconceptions (Northridge and Fortuna, 2008) and able to guide the conversation toward the survey objectives and sort through the amount of information collected. Interviews can also be a relatively inexpensive way to obtain some initial information in areas where no information is yet available. However, it has been documented that fishers show the general human tendency to describe situations with a possible lack of objectivity, often failing to remember specific details, such as numbers, species, areas of interactions and types of damages (Lien *et al*., 1994). Therefore, cross-checking the data collected through questionnaires with those obtained through on-board observations is always encouraged.

The questionnaires suggested in this protocol are designed to collect a minimum set of information on the following:

- fishing activity (Annex 5/A);
- depredation events by single fishing trip/fishing operation along with associated socioeconomic data (Annex 5/B); and
- incidental catch of vulnerable species (Annex 5/C)

2.3 SELF-REPORTING

Self-reporting, generally through ad hoc logbooks (Annexes 6/A, 6/B and 6/C), is a method for fishers to report depredation information by fishing trip and fishing operation themselves (FAO, 2019b). Self-reporting requires that fishers are well trained, guidelines are well developed and collected data are further scrutinized for flaws and controlled for bias. Participation by fishers in any data collection activity can represent a first step towards their increased involvement in further fishery management decisions, thereby making them more likely to comply and ultimately leading to more sustainable fisheries practices (Almany *et al.*, 2010; Prescott *et al.*, 2016).

This method has the main advantage of being inexpensive, as fishers gather most of the data themselves. The self-reporting approach allows for a larger number of trips to be sampled at a lower cost since it is possible to gather data (on depredation, interactions with other vulnerable species, catch composition, vessel characteristics, etc.) that are more representative of the entire fleet without involving many observers (FAO, 2019b). Self-reporting is sometimes the only methodology that can be used for certain vessels, such as very small or unsafe vessels (generally shorter than 12 m), that are difficult or impossible to monitor with onboard observers. Furthermore, self-reporting can also complement other programmes and activities conducted by observers, providing a cost-effective alternative. However, some inconveniences may result from the low reliability and quality of collected data. Logbook data, compared with onboard observations, may underrepresent reality (e.g. differences in the recorded number of depredation events, catch composition, incidental catch data). These data can also be inaccurate and biased, particularly when fishers perceive reporting information on vulnerable species as a subject of controversy that could potentially lead to increased regulation (Northridge, 1988; Northridge and Fortuna, 2008; FAO, 2019a). Therefore, it is important to ensure that the vessel captain and crew members understand the objectives of the programme and that they are able – and possibly trained – to collect the requested information (as in Annexes 6/A, 6/B and 6/C). For this purpose, establishing a participatory framework to build mutual trust and collaboration and to set common goals for researchers and vessel owners/crews is encouraged. Training and informative sessions should provide fishers with the necessary knowledge and skills to carry out the requested activities (Hoare, Graham and Schön, 2011; FAO, 2019b).

2.4 ELECTRONIC MONITORING

The difficulty of ensuring adequate statistical coverage of a fleet presents a challenge for the implementation of any monitoring programme and may reduce the usefulness of the data obtained for management purposes and/or for the implementation of ad hoc mitigation measures. One cost-effective alternative is remote electronic monitoring (REM). Remote electronic monitoring systems represent one of the many applications of cameras in marine environmental research that are increasingly being used to complement and replace conventional human onboard observer programmes and to initiate at-sea monitoring efforts where none previously existed (Rist *et al*., 2010; Bicknell *et al*., 2016; Carnes, Stahl and Bigelow, 2019). Remote electronic monitoring systems may consist of sensors and cameras positioned on vessels to remotely record footage of fishing activity and catches, as well as damages caused by depredation events and the incidental catch of vulnerable species, and to register the exact location of different types of interactions (Carnes, Stahl and Bigelow, 2019). Several studies have been carried out to measure the effectiveness of REM systems in monitoring industrial fishing activities, recording data on target commercial species (Hold *et al*., 2015; van Helmond *et al*., 2020), incidental catch (Kindt-Larsen *et al*., 2012) and the use of mitigation technologies (Ames, Williams and Fitzgerald, 2005); these systens have also had moderate success in using recorded video to assess the volume of discards produced by the onboard sorting of catch (Piasente, Stanley and Hall, 2012; Plet-Hansen *et al*., 2017; Carnes, Stahl and Bigelow, 2019). The use of REM should be investigated as an alternative and/or a supplement to onboard independent observers, particularly on vessels where deck space for onboard observers is lacking (e.g. small-scale vessels) (Bartholomew *et al.*, 2018; FAO, 2019a).

2.5 EXPERIMENTAL SURVEYS-AT-SEA

Implementing experimental surveys-at-sea to monitor depredation it is not an easy task. These surveys are conducted aboard commercial/research vessels traveling along pre-determined transect routes simulating normal fishing activities. Experimental surveys can provide more detailed data than questionnaires and logbook data or data collected by observers placed onboard a commercial vessel, as they allow for the collection of supplementary and more accurate data (e.g. exact position of the depredation event, type of damages, measurements and biological data for both commercial catches and vulnerable species). Collecting this information, although it should be considered as supplemental to other methodologies, is valuable. On the other hand, there are limitations of experimental surveys, such as potentially misrepresenting the reality of interactions between vulnerable species and commercial fleets, restricted temporal and spatial coverage and, in some cases, high costs of conducting the surveys (FAO, 2019a). Data from these surveys should not be used to extrapolate estimates for a target population or fishing gear. They cannot be considered representative, as they do no fall into the category of probabilistic sampling, but rather opportunistic (or convenience) sampling, and thus the resulting estimates are not statistically valid and cannot be generalized to the commercial fleet population.

Surveys can also be conducted by observing normal fishing operations from another platform in the sea (e.g. onboard a research vessel/inflatable boat) (Monaco *et al.*, 2020). In this way, it is possible to investigate and collect information on depredation and bycatch events, fishing areas, the number and duration of fishing operations, and fishing gear, without disturbing fishing activities. The participation of and dialogue with fishers are essential for the effectiveness of this activity as well.

Other types of surveys (e.g. tracking and aerial sea surveys) can provide useful information on dolphin (and whale) habitat use, as well as on hotspots of abundance and diversity, though they offer less information on depredation events. Monitoring the abundance, distribution and density of cetaceans can be achieved by dedicated line-transect surveys and long-term studies based on photo-identification techniques. In recent decades, for example, the use of satellite systems and drone surveys for remote data collection have proven particularly useful for vulnerable species conservation (e.g. sea turtles and cetaceans) by enabling the collection of data on species and their habitats over larger areas than can be covered by other types of monitoring programmes (Rees *et al*., 2018). Remote sensing data are becoming increasingly important in understanding the spatial ecology of marine systems and, when used in tandem with tracking data, they can provide important insights into the specific environmental niches and spatial distribution of target species (do Amaral *et al*., 2015; Nachtsheim *et al*., 2017).

Different typologies of experimental surveys can be used to report accurate information on species distribution and to identifypotential hotspots of interactions between marine mammals and fishing activities. The templates provided in Annexes 1/A and 1/B and Annexes 2, 3 and 4 can be used to report the collected data.

3. Sampling strategy

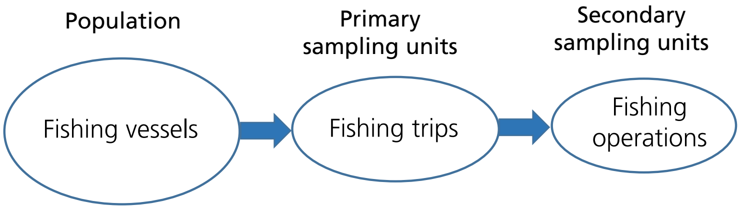
In an ideal data collection project, all members of a population should be measured. But because monitoring programmes usually cannot cover 100 percent of vessels and fishing trips/fishing operations in an identified area – due, among other factors, to the multispecificity of fisheries in many Mediterranean and Black Sea countries (e.g. different types of gear, target species and fishing grounds) – it is often required to rely on a sample from a smaller portion of the population that is robust in its design and large enough to be representative.

Generally, stratified sampling schemes, in which individuals may be selected on an opportunistic or ad hoc basis, are among the most common methods applied to collect information related to fisheries. Stratified sampling involves dividing the identified population into smaller groups, known as strata, based on shared attributes or characteristics. For example, aggregating fishing vessels with the same operational gear (e.g. trawls, purse seines, trammel nets, gillnets; Annex 13) into homogenous and well-defined strata (e.g. fleet segments) according to the provisions included in the GFCM Data Collection Reference Framework (DCRF) (Annex 12), can help to reduce variability between trips and, as a consequence, in final estimates (Borges *et al*., 2005; FAO, 2019b). For each identified stratum, a random sample is then selected, whose size (number of population members) is proportional to the size of the stratum in relation to the entire population. In general, relatively few strata are preferred, so that more than one sample can be obtained from each stratum, instead of many strata, some of which may only be sampled once or not at all (e.g. fishing gear or fleet segment with few operating vessels). This solution allows for reduced sampling costs and an optimized allocation of human resources and funds across the strata. Some basic truths about sampling activity to keep in mind include: biases are ubiquitous; assumptions must be recognized and, ideally, addressed; the sampled population should be clearly identified before beginning any kind of field activity, and caution used when extending inferences beyond that population.

As in any sampling activity, the first essential step is to define the population to be sampled. For example, once the specificities of each area/port/country have been taken into account, the population of interest may comprise all the vessels using a given gear in a fleet. This information not only determines the absolute level of sampling required to achieve a useful result, but also helps to inform the strategy for appropriate stratification of the sampling activity (Northridge and Fortuna, 2008).

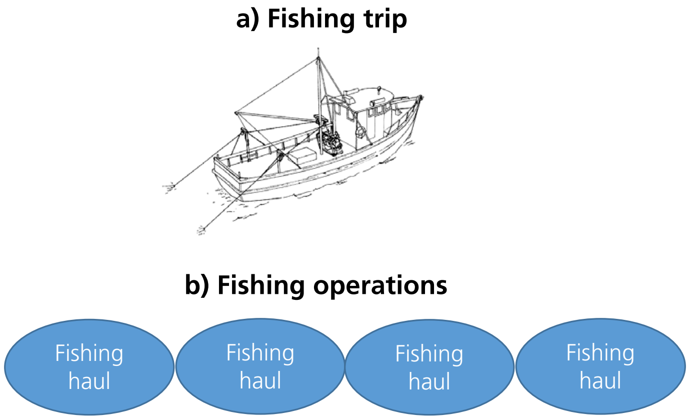
Once identified, the target population should be sampled on the basis of ad hoc sampling units that cover the whole population without overlap (Jessen, 1978). The sampling unit should be selected according to the hierarchical nature of the population (Figure 1): the fleet consists of a number of vessels (population), each of which carrying out a variable number of fishing trips (primary sampling units) throughout the year, with each trip consisting of a variable number of fishing operations (secondary sampling units), such as fishing hauls, pulling traps, setting nets (Figure 2).

FIGURE 1
Sampling population, primary and secondary sampling units



Source: FAO. 2019b. *Monitoring discards in Mediterranean and Black Sea fisheries: Methodology for data collection*. FAO Fisheries and Aquaculture Technical Paper No. 639. Rome, FAO. https://www.fao.org/3/ca4914en/ca4914en.pdf

FIGURE 2
Trawler performing several fishing hauls (b) during a fishing trip (a)



Source: FAO. 2019b. *Monitoring discards in Mediterranean and Black Sea fisheries: Methodology for data collection*. FAO Fisheries and Aquaculture Technical Paper No. 639. Rome, FAO. https://www.fao.org/3/ca4914en/ca4914en.pdf

The fishing trip duration is the time that elapses between the moment the vessel leaves the port and the moment it returns to port. In the Mediterranean and the Black Sea, a fishing trip is equivalent in most cases to a fishing day (i.e. one fishing trip equals one fishing day). The basic assumption is that when a fishing trip includes more than one fishing day, it should be broken down into fishing days. This assumption is necessary in order to harmonize and standardize data and results between areas, fleet segments, and years (GFCM, 2018; FAO, 2019b).

Questions then arise on what sampling procedures to adopt, how to set the level of sampling coverage and how to interpret the resulting data (Hilborn and Mangel, 1997; FAO, 2019a).

Sampling can be carried out in a variety of ways, and the level of monitoring, in whatever form it takes, will ultimately be determined by the financial and human resources available for the task. Regardless of the selected data source(s), it is important to try to ensure that a representative sample of vessels is observed. As illustrated in Section 2.1, in most areas, the only realistic way to collect data on depredation is through a sampling survey involving onboard observers. Ideally, for an unbiased estimate, fishing trips with onboard observers should be randomly distributed across the pool of selected vessels operating in the main ports of the investigated area. However, true random samples are often difficult to achieve, and observers tend to work with some vessels more than others as relations with captains and crews develop (Northridge and

Fortuna, 2008; ICCAT, 2016). Assuming that the unobserved part of the fleet behaves in the same way as the observed part, it would only require the application of a raising factor to extend sample estimates to the entire population of interest. To increase coverage, information from onboard sampling can be complemented by interviews or questionnaires (Section 2.2) carried out at landing places, especially when the fishing fleet is mainly composed of small-scale vessels, and/or through the collection of sample data by fishers (Section 2.3).

Regardless of the selected data source(s), it is important to try to ensure that a representative sample of vessels is observed. Furthermore, any monitoring programme should be designed to take into account spatial and temporal variations in fishing activities in order to identify possible seasonal and geographical differences in depredation events.

4. Overview of the investigated area

Before the start of a monitoring programme, it is essential to provide a general overview of the investigated area where the programme will be carried out in order to understand the existing background conditions.

The most crucial information concerns the fishing fleet (Section 4.1), the environmental characteristics of the area (Section 4.2) and the presence of marine mammals (Section 4.3).

4.1 FISHING FLEET

Depending on the area, dolphins can interact with some specific types of gear more than with others, and it is therefore important to understand the area's fleet structure, what gear types are being used (as well as where, when and by how many vessels) and the catch composition. Common information that should be collected before beginning a monitoring programme on depredation includes:

- total number of active vessels, aggregated by fleet segment (based on the DCRF segmentation; Annex 12), operating in the area, together with:
  - the fishing techniques (e.g. type of gear and modifications; Annex 13)
  - the fishing strategy (duration of the day at sea; working solitarily or in collaboration with other vessel(s); days of the week at sea, fluctuations in landing prices, etc.)
  - the fishing effort (e.g. total number of fishing days by fleet segment);
- amount (i.e. weight) of landings per main commercial species and fleet segment or gear;
- spatial and temporal variations in landings (if possible).

This information is normally available through official reports and/or statistical accounts collated by the local and national fishery departments (though in some cases, data on small fishing vessels may not be fully represented in official statistics). What are usually more difficult to ascertain, particularly for small-scale vessels, are indications of what gear types are being used by vessels, values of fishing effort (e.g. fishing days at sea) and catch composition by species.

4.2 ENVIRONMENTAL CHARACTERISTICS

Knowledge of the main fishing grounds (i.e. areas in which most of the fishing effort is deployed; Russo, Parisi and Cataudella, 2013), as well knowledge of the fishing grounds' physical features (e.g. the inflows of nutrients and other non-biological processes) associated with the characteristics of the substratum and depth, are also key pieces of information to collect for a good understanding of fisheries practices and the factors that could induce possible interactions with dolphins. Several studies have shown that the bathymetry of an area, distance to shore and sea floor features can be significant factors in determining the abundance and distribution of dolphins and their potential prey; depth is among the variables with the strongest influence (Cañadas, Sagarminaga and García-Tiscar, 2002; Yen, Sydeman and Hyrenbach, 2004).

4.3 CETACEAN POPULATION PRESENCE

Information on local dolphin populations (as well as on other species of marine mammals) and incidental sightings, coupled with preliminary information on interactions with fishing activities (i.e. depredation and incidental catch), and eventually with stranding information, can generate initial insights and a list of marine mammal species potentially present in the investigated area. This may often be considered a preliminary phase of collecting information to be followed by more rigorous data collection later on. Sightings of dolphins by fishers, previous monitoring programmes, ship-based line-transect surveys or by any other source can provide an inexpensive basis for gathering such information. Basic data such as date, time and location of the sighting are very straightforward to record by anyone. Species identification and group formation are slightly more complicated but represent additional useful data that can often be collected. Photographs or video footage can corroborate the reported data. This kind of information can provide a rough measurement of the distribution and abundance patterns of the most common species and can potentially allow researchers to detect seasonal occurrence rates, which in turn provide a preliminary idea of residency patterns. However, caution is needed in interpreting results from such records, because the information provided by non-experts may not always be reliable and seasonal peaks in sightings may reflect seasonal peaks in the number of visitors to the area. This method of monitoring provides no quantitative measure for assessing population change.

Another information source is opportunistic sightings. Opportunistic sighting reports provide a source of potentially useful, low-cost information on the spatio-temporal distribution of cetacean species. Several studies on the distribution of cetacean species have reduced costs by capitalizing on opportunistic platforms such as ferries, using unconventional information sources that are not limited to fixed routes but that take away control over sampling. This type of data provides relevant information at a relatively low cost (Torreblanca *et al*., 2018).

5. Minimum required data

Even if depredation is a complex issue, monitoring and collecting data on this kind of interaction is essential for implementing measures that could reduce, or at least minimize, its impacts. Consequently, a multidisciplinary and systematic approach should be applied in order to better understand the singular and composite effects of the different elements that can influence the occurrence of depredation events. Based on the variety of data sources available (Chapter 2), this chapter describes the minimum data that should be collected for each of three different components:

a. fishing activity (Section 5.1), which covers the peculiarities of the fleet and fishing strategy, fishing effort and the catch of different fishing gear/fleet segments;
b. different interaction events (Section 5.2), which takes into account depredation, incidental catch and the presence/absence of dolphins during monitored fishing activities; and
c. basic economic information (Section 5.3), which is oriented toward determining the real losses of dolphin interference and fishers' feelings toward this type of interaction.

5.1 DATA ON FISHING ACTIVITY

A key objective of any fisheries monitoring programme is to provide good information on the fishing activity (e.g. vessel and gear characteristics) and the catch (e.g. landed species, discards composition, impacts on vulnerable species and species depredated). Without accurate information, knowledge of the impacts that depredation can have on fisheries, as well as of the impacts that fisheries can have on dolphins and on the ecosystem in general, becomes more uncertain and conservative.

The following minimum information per fishing trip and/or fishing operation (Annex 1/A), regardless of the methodology used, should always be collected:

- fishing area (geographical subarea [GSA], ports of departure and return);
- technical characteristics of the vessel (e.g. power, gross tonnage, total length);
- general information on fishing activity (e.g. date, depth range, number of fishing operations);
- particular fishing strategy of the fleet;
- coordinates of fishing trip/fishing operations; and
- information on fishing gear (e.g. type, size and length of net, mesh size, number of hooks, bait, soak time, modifications from the standard), following the classification in Annex 13.

Concerning the catch composition, data collected should also include (Annex 1/B):

- specific composition of the catch;
- species depredated
- estimated weight (in kilograms) and number of marketable species in the commercial portion of the catch
- estimated weight of the total depredated catch;
- weight (or estimate in kilograms) of discards from the total catch, with indications of the species discarded; and
- general information on marine litter.

Once the priority item (i.e. depredation events) has been assessed, and if there is space and time on board to estimate discarded species composition and weight, discards are the next important component of the catch that should be monitored. Previous studies have shown how some dolphin species may approach fishing vessels to obtain easy food from discards produced by fisheries and how discards may attract prey species into an area, which in turn attract dolphins (Leatherwood and Reeves, 1983; Santos *et al*., 2004; Svane, 2005).

Concerning the importance of collecting information on marine litter as well, several studies have shown how macro-litter in the marine environment not only has negative economic and social impacts on fisheries (UNEP-MAP, 2015; Anastasopoulou and Fortibuoni, 2019), but also represents a growing concern for marine animals, including cetaceans, for which a developing body of evidence warns of the impacts of both entanglement and ingestion (Fossi, Baini and Simmonds, 2020; Eisfeld-Pierantonio, Pierantonio and Simmonds, 2022). Solid materials such as wood, plastic, metal, glass, rubber, textiles and lost gear may be ingested by marine mammals for several reasons. They may mistake plastic for prey, accidentally ingest plastic when it is floating close to prey, or they may try to catch it out of curiosity, especially in the case of immature dolphins, which results in them swallowing an item (Baulch and Perry, 2014; Puig-Lozano *et al*., 2018; Đuras *et al*., 2021). Although a compete assessment of marine litter is beyond the scope of this protocol, it can be important to provide, for each fishing trip and/or fishing operation, a rough estimate of the quantity (weight) and the quality (type) of any human material brought aboard the boat during fishing activities (Annex 10). To date, data collection on marine litter has been inconsistent and geographically restricted to only a few areas of the Mediterranean and the Black Sea, which explains why the understanding of these impacts is still limited (Lambert *et al*., 2020). Harmonized research data for statistical purposes regarding the issue of marine litter across the whole region are necessary; in this case as well, any monitoring programmes on depredation can serve as a valuable source of information.

5.2 INTERACTIONS BETWEEN DOLPHINS AND FISHING ACTIVITIES

5.2.1 Data on depredation

Number and size of holes, damaged fish, damaged nets, depredation of bait and bite marks found on catch or fish heads, are all information that can provide evidence of dolphin depredation and are the minimum data that should be recorded to classify damages and quantify the impact of depredation events (Lauriano *et al*., 2004; Gazo, Gonzalvo and Aguilar, 2008; Monaco *et al*., 2020).

a) Holes and gear damage

The most common methods used to identify holes caused by dolphins is through fisher reports (Gazo, Gonzalvo and Aguilar, 2008) or direct visual observation made by observers counting the number of new holes at the end of each fishing operation (Lauriano *et al*., 2004; López, 2006; Monaco *et al*., 2020). Already identified holes can be numbered, marked, photographed and mapped to avoid confusion with new holes produced during subsequent fishing operations. Depending on the situation (including the possibility of onboard work), instead of counting holes at the end of each single fishing operation, another option would be to count the total number of holes at the end of the fishing day or fishing trip (the use of this option should be made very clear when presenting the results). Once identified, holes and/or gear damages should then be classified according to their shape, size and location in the net (Buscaino *et al*., 2009).

PLATE 2
Holes in fishing nets caused by dolphins during depredation events

For the purpose of this protocol, and to harmonize and compare data between different areas and periods, it is recommended to classify holes according to three general categories: small, medium and large (adapted from Brotons, Grau and Rendell, 2008; Terribile, Laspina and Said, 2020):

– small (holes with a diameter of less than 30 cm);
– medium (holes with a diameter between 30 and 80 cm); and
– large (holes with a diameter of more than 80 cm).

This information, especially in the case of static nets (e.g. trammel nets, gillnets) and purse seines, should be reported in conjunction with the vertical position of the damage. Identifying the vertical position of the damage, (simply differentiating between the bottom, middle, or upper third of a gear) enables researchers to distinguish between damages caused by dolphins and those caused either by contact with the sea floor, particularly rocks, (generally damage on the bottom part of the net) or by contact with floats when the net is hauled in (generally on the upper third of the net) (Brotons, Grau and Rendell, 2008; Marçalo, 2015; Pennino *et al*., 2015; Benmessaoud *et al*., 2021). All this information can be reported according to the template in Annex 3.

b) Catch damages

In order to assess catch damages, the morphological damage to each specimen caught can be reported (Annex 4) under one of five categories: (i) "Head", when only the head remains (i.e. the body has been removed at the level of the gills); (ii) "Tail", when only the tail remains; (iii) "Bite", when the specimen shows one or more parts removed; (iv) "Fragment", when only parts of the specimen remain; (v) "Vestigial", an empty body with only the skin and bones left (Lauriano and Di Muccio, 2002; Lauriano *et al*., 2004).

PLATE 3
Fisher showing the remainder of a fish after a dolphin depredation event

Both the size of the holes (a) and catch damage (b) are important to record because it is crucial to distinguish between holes caused by dolphins and holes caused by depredation by other fish (e.g. sharks, tuna, conger, moray eel), cephalopods (e.g. octopus, squids) and/or other vulnerable species (e.g. sea turtles, seabirds, Mediterranean monk seal). The presence on the net/hooks of fish heads, other fish body parts or bites on the fish prey, and the recentness and texture of these bites, are some characteristic signs that could provide proof for attributing these damages to dolphins (Gönener and Özsandıkçı, 2015; Rabearisoa *et al.*, 2018). However, distinguishing between these depredation types is not always that obvious. Uncertainties regarding the predator group still remain, and bias may arise due to possible misidentifications of predators involved. For example, fish damage caused by dolphins can be distinguished from damage caused by sea turtles, since dolphins bite behind the gills, leaving bite marks with ragged borders and often leaving behind just the head or body of the fish, whereas sea turtles leave different small bites on the fish (Hernandez-Milian *et al.*, 2008; Pennino *et al.*, 2015). Some shark species generally leave crescent-shaped cuts with clean-cut edges and the overall damage to the fish is often represented by a few single bites (Rabearisoa *et al.*, 2018). European conger (*Conger conger*) produces holes and tangles in nets, as opposed to bottlenose dolphins, which only make holes. Cormorants can also damage nets by making small holes when they steal fish from the net (Aguilera, Camiñas and Molina, 2020).

5.2.2 Data on incidental catch

Depredation-related incidental catch, injuries and mortality (caused, for example, by ingesting parts of a net), are also a cause for concern. Monitoring depredation offers a good opportunity to obtain different and reliable information complementing data from existing programmes on the incidental catch of marine mammals (Table 1) and other vulnerable species (sea turtles, seabirds, sharks and rays; Annexes 16/A and 16/B). Essential information to be collected in case of incidental catch include (Annex 7):

- gear characteristics;
- species of marine mammals concerned;

- total number of individuals incidentally caught during fishing operation and/or by fishing trip;
- whether the individual(s) caught have been released alive, dead or in an unknown status;
- area (e.g. coordinates; description; some main features) of the interactions; and
- position in the gear of the incidental catch event.

Depending on various factors (e.g. condition of the individual caught, possibility to work onboard), and whenever possible, observers should also collect and report biological information (e.g. length, weight and sex; Annex 9) of the dolphin specimens incidentally caught. The collection of such information can also help to improve knowledge on the biological traits of these species, which would be difficult to sample in any other way.

5.2.3 Presence or absence of dolphins around the vessel

Information on the presence/absence of dolphins around a fishing vessel or fishing gear and whether their presence is connected to possible interactions should also be recorded (Annex 8). Distribution models that predict species occurrence and/or density by quantifying relationships with environmental variables (e.g. temperature, salinity, weather conditions, depth) and human activities (e.g. fishing) are commonly used for a variety of scientific investigations and management applications. For marine mammals in general, these models could help in understanding the factors influencing variability in distributions and to assess potential risks for the animals from fishing and/or from other anthropogenic activities (e.g. shipping, sailing). During each fishing trip or fishing operation, it is therefore important to report information on the presence or absence of dolphin specimens around the vessel (Benmessaoud *et al*., 2018; Monaco *et al*., 2020) (Annexes 1/A and 8). "Not observed" should be used if either the observer did not have time to gather information or conditions (e.g. weather conditions, nocturnal conditions) did not allow for observation. This is the minimum requirement for assessing dolphin spatial distributions and patterns and to understand whether depredation is occurring at any noticeable level and for making observations. It is important to remark that "presence" only provides information on where specimens were sighted and therefore may be biased in both geographical and niche space (Monaco *et al*., 2020). Owing to the difficulty of specifying the exact number of observed animals, an approximate value (e.g. 0 individuals, >5, >10) can already provide useful information. Presence data can be reported in conjunction with a short description of the behaviour (e.g. feeding, playing). Behaviour can be generally defined as the activity in which the majority of individuals in the group are initially participating upon detection. Several criteria make it possible to determine the activity of the animals from one of their typical behaviours. These criteria include group size and structure, duration of behaviour, time before diving, the occurrence of occasional activities on the surface (e.g. jumping, caudal strike, exposure of a body part). As in most behavioural studies on cetaceans, it is also assumed that activities visible at the surface are representative of activities beneath the surface (López, 2006).

Quantification of presence and absence data, even if observers do not record any numbers, enables to gain a rough estimate of presence and absence trends over time as well as to gain information on densities, groups, and hotspot areas. Photographs and video recording can be used to monitor and verify activities visible at the surface.

5.3 ECONOMIC DATA

Assessing the economic damage caused by dolphins or any other marine animals during depredation events is not an easy task. Most information on the economic effects of dolphin interactions is qualitative and inadequately documented. Although it is evident that in some areas fishers suffer from either gear damage, reduced catch and/or or loss of time or money, very few attempts have been made to evaluate trends, nor to quantify the costs of such interactions (ICRAM, 2001; Snape *et al*., 2018; Monaco *et al*., 2020). Generally, a first estimate, considering both gear damage and catch loss, is provided directly by fishers. Although useful, this information can be inaccurate and biased. It is therefore sometimes requested to balance these fishers' estimates with ad hoc studies and socioeconomic data collection carried out by trained observers. Several efforts have been made to assess rates of dolphin depredation and economic damage, but due to variation among studies in the parameters measured and the methods employed, it is often difficult to draw comparisons between fisheries and dolphin populations. In Spain, Italy and France, studies in commercial fisheries have estimated the annual cost of damage to catch at around EUR 1 000–2 000 per vessel, corresponding to 6.5–8.3 percent of total catch value (Lauriano *et al*. 2004; Brotons, Grau and Rendell, 2008; Gazo, Gonzalvo and Aguilar, 2008; Rocklin *et al.* 2009, Aguilera, Camiñas and Molina, 2020). In some other areas in Italy and Greece (Bearzi, Bonizzoni and Gonzalvo, 2011; Gonzalvo, Giovos and Moutopoulos, 2015), fishers claim that dolphin depredation can cost between EUR 500 and 20 000 per vessel annually. Unpublished studies carried out in Morocco reported annual economic loss due to bottlenose dolphins in the purse seine fishery as high as 36 percent of the total catch value, with annual loss per ship owner varying between 9 and 19 percent (Zahri *et al*., 2004). More recently, in Tunisia, the costs for repairing nets damaged by dolphins were estimated at EUR 363.9 per month (Benmessaoud *et al*., 2018; Carpentieri *et al.*, 2021).

Although difficult, it is important to try to provide a first estimate of both the lost profits and the costs associated with repairing fishing gear. To better understand the economic impacts and to compare outcomes, it is crucial to have data on landings and prices according to species and sampled fleet orgear, both in the presence and absence of depredation events (Noureddine *et al*., 2017; Aguilera, Camiñas and Molina, 2020).

PLATE 4
Fisher repairing damage caused by dolphins to fishing nets

The indicative list of relevant economic information that should be gathered per area and fleet or gear over the period of investigation includes:

- the local commercial value (a mean value) of the main target/commercial species per kg;
- the profit derived from the catch by fishing trip or fishing operation during onboard observations, both in the presence and absence of depredation events (Annex1/B);
- an estimate of the costs of repairing gear (e.g. net holes, hook damages) in the case of depredation events; and
- the price of replacing a damaged unit of fishing gear.

6. Catch and depredation indicators

To better analyse the impacts and to estimate spatial and temporal trends (if any) in the occurrence of this kind of interaction, the literature suggests estimating and applying several catch and depredation indicators (Lauriano *et al*., 2004; Maccarone *et al*., 2014; Pennino *et al*., 2015; Rabearisoa *et al*., 2018). For the purpose of this protocol, the following basic indicators, among others and depending on the fishing gear investigated, are proposed: the depredation rate (DR), used to assess the rate of fish lost due to depredation; the interaction rate (IR), used to assess the frequency of depredation events; the damage intensity (DI), used to assess the overall rate of depredated fish versus the number of fishing activities; the catch per unit effort (CPUE), to estimate the differences in total catches between fishing operations with depredation events and fishing operations without depredation events.

6.1 DEPREDATION RATE

The DR, in its simplest formula, can be defined as the total number of fish depredated or damaged by dolphins divided by the total number of fish caught. It can be calculated by single fishing trip or by single fishing operation and for a single species and/or pooling together all species. The number of damaged fish can be estimated based on the remains still present in nets or hooks after dolphin attacks.

DR = Number of fish depredated and/or damaged / Total number of fish caught

Depredation rate can be also expressed as

$$DR = \frac{\sum_0^i F_D}{\sum_0^i Fc}$$

where F_D (damaged catch) is the pooled number of marketable fish individuals that were damaged, F_C (total catch) is the number of fish caught and is the number of fishing operations (Donoghue, Reeves and Stone, 2003; Romanov *et al*., 2008, 2013).

6.2 INTERACTION RATE

The IR, or damage interaction, used to assess the frequency of depredation events, is the proportion of the total number of fishing operations that are depredated by dolphins (Nishida and Tanio, 2001; Romanov *et al*., 2008, 2013). A fishing operation can be considered depredated if at least one fish (either a target species or not) is depredated from the fishing gear (e.g. trammel net, longlines). It can be calculated by single fishing operation and/or by single fishing trip (i.e. 24 hours).

IR = Total number of depredated fishing operations / Total number of fishing operations

Interaction rate can be also expressed as

$$IR = \frac{\sum_0^i FO_D}{\sum_0^i FO}$$

where FO_D is the pooled number of fishing operations that were damaged/depredated (it can be expressed in terms of number of hooks, number of set nets, number of fishing hauls, etc.) and FO is the total number of fishing trips or operations (either total, positive, affected) over a certain period of time (e.g. a day, a month, a season).

6.3 DAMAGE INTENSITY

The DI can be quantified by dividing the number of fish damaged by dolphins and left (in the form of a head or other body part) on the gear/hook by the total number of fishing operations/trips.

Damage intensity can be expressed as

$$DI = \frac{\sum_0^i F_D}{\sum_0^i FO}$$

Where, F_D (damaged catch) is the pooled number of marketable fish individuals that were damaged, FO is the total number of fishing trips or operations (either total, positive, affected) over a certain period of time (e.g. a day, a month, a season) (Rabearisoa *et al*., 2018; Romanov *et al*., 2013).

6.4 CATCH PER UNIT EFFORT

In its basic form, the CPUE can be expressed as the total catch or the captured biomass (number and/or kg) of a species or a pool of species divided by unit fishing effort (Annexes 15/A and 15/B).

Usually, fishing effort is calculated by multiplying the fishing capacity deployed (i.e. total gross tonnage or power, number of hooks on longlines, net length) by a certain unit of activity, generally a period of time (e.g. number of hours or days spent fishing). Fishing effort is then combined with catch or biomass to estimate the CPUE.

CPUE = total catch (kg or number) / fishing effort (unit of capacity × unit of activity)

The CPUE can be modelled both in terms of biomass as kilograms caught per selected unit effort (e.g. fishing days, metres of net set, number of hooks) and in economic terms as current value/kg (e.g. EUR/kg) per the same unit effort. Declining trends of this indicator could indicate overexploitation, while constant values could indicate sustainable fishing.

To obtain an estimate of the impact of depredation, it is possible to roughly calculate the differences in CPUE between fishing trips/operations with no depredation events and fishing trips or operations with depredation events. For cases of conflict with dolphins, low CPUE values are expected. Fishing operations with zero catch should be removed from the analysis.

6.5 ECONOMIC ASSESSMENT OF DOLPHIN DEPREDATION

The lost profits and the costs of repairing fishing gear can be calculated using the methods and formulas already applied and reported in several studies, depending on the types of gear dolphin interaction (Lauriano *et al*., 2004; Brotons, Grau and Rendell, 2008; Gazo, Gonzalvo and Aguilar, 2008; Bearzi, Bonizzoni and Gonzalvo, 2011; Gönener and Özdemir, 2012; Waples *et al*., 2013; Maccarone *et al*., 2014; Snape *et al*., 2018).

The economic damage (ED) caused by dolphins can be determined from the difference observed between fishing vessels that experienced dolphin interactions and those that did not, adapting the equation proposed by Lauriano *et al*. (2004) for static nets (e.g. trammel net, gillnet, combined net):

$$ED = L \times l \times F \times d \times p$$

where L is the average catch loss of the main target species (expressed as kg per km of net – kg/km); l is the average net length used daily by fisher (km), F is the frequency of interactions with dolphins, d is the number of days of fishing activity and p is the commercial price of the target species (per kg).

Maccaraone *et al*. (2014) also suggested measuring the surface areas of damaged nets and estimating the corresponding economic damage as follows:

$$\textbf{Total net damages} = \textbf{Cost of 1 } \mathbf{m^2} \textbf{ of fishing net} \times \textbf{surface area of net}$$

Surfaces damages is expressed in m^2.

A raw assessment of the economic loss (EL) can be based on the DR indicator previously calculated (Section 6.1) and on the catch loss (in weight) due to depredation (Rabearisoa *et al*., 2018). Firstly, catch loss can be assessed from the weighted landed catch (in kg, by single species or of the total landing):

$$\text{Catch loss} = \frac{\text{Landing (kg)}}{1 - \text{DR}} - \text{Landing (kg)}$$

Then, based on the average landing price (again for a single species and/or for the total landing), the EL can be calculated as follow

$$\text{EL} = \text{Catch loss} \times \text{average landing price}$$

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Annexes

ANNEX 1/A

Description of fishing activity

Annex 1/A. Fishing activity					
Name of data collector(s)			Data source		
Date					
ID fishing trip					
Country					
GSA					
Port					
Vessel characteristics					**Notes**
Vessel name*					
Fleet segment					
Total length of the vessel					
Power (kW)					
Gross tonnage (GT)					
Port of departure					
Port of arrival					
Total number of fishing operations					
Gear specifications					
	1st gear	2nd gear	3rd gear	4th gear	**Notes**
Gear type					
Net length (m)					
Mesh size (codend, mm)/Inner mesh size					
Number of hooks					
Type of bait					
Number of nets units; Number of lines					
Soak time (time during which the fishing gear is actively in the water)					
Other					
General information on the catch composition					**Notes**
Total landing (kg)					
Main commercial species in the landing fraction					
Discards (kg and percentage) in the catch composition	kg		%		**Notes**
Main species in the discarded fraction					
General information on interactions with vulnerable species					**Notes**
Depredation events (Y/N)					
Damages caused by dolphins (Y/N)					
Presence of dolphins around the vessel (Y/N/Not observed)					
Bycatch of vulnerable species (Y/N)					

* If available.

Instructions:

- Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day). Please, assign a unique code to the fishing trip (i.e. fishing day) sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- GSA: insert the code of the geographical subarea (GSA) as reported in Annex 11.
- Fleet segment: insert fleet segment code (i.e. vessel group and length class) as reported in Annex 12.
- Total number of fishing operations: insert the total number of fishing operations carried out during the same fishing trip.
- Gear type: insert the fishing gear code as reported in Annex 13 (e.g. GNS). If, during a fishing trip, different types of gear have been used, insert each code separately in their respective columns. Then, based on the type of gear, provide the different measures of effort (e.g. mesh size, number of hooks) in the corresponding column and row.
- Total landing: insert the total landing (or estimate) in kilograms (kg) of commercial species caught during the same fishing trip.
- Main commercial species in landing fraction: insert the name (preferably scientific name, otherwise common name) of the main commercial species present in the landed fraction.
- Discards in catch composition: insert the total, cumulative discarded fraction (or estimate) during the same fishing trip in kg and percentage (%).
- Main species in discarded fraction: insert the name (preferably scientific name, otherwise common name) of the main species discarded.
- Depredation events (Y/N): insert "yes" if depredation events have been recorded, otherwise insert "no". If "yes", detailed data, by fishing trip/fishing operation, should be reported in the ad hoc template (see Annex 2).
- Damaged caused by dolphins (Y/N): insert "yes" if damages caused by dolphins have been observed and recorded, otherwise insert "no". If "yes", detailed data, by fishing trip or fishing operation should be reported in the ad hoc template (see Annexes 2, 3 and 4).
- Presence of dolphins around the vessel (Y/N/Not observed): insert "yes" if, during a fishing trip or fishing operation, the presence of dolphins around the vessel has been observed and recorded; insert "no" if, during a fishing trip or fishing operation, no dolphins have been observed; insert "not observed" if, during a fishing trip or fishing operation, the observer did not have time to gather information, or if conditions (e.g. weather conditions, nocturnal conditions) did not allow for observation. If "yes", detailed data, by fishing trip/fishing operation, should be reported in Annex 8.
- Bycatch of vulnerable species (Y/N): insert "yes" if during a fishing trip there has been incidental catch of any vulnerable species (i.e. marine mammals, sea turtles, seabirds, sharks and rays); otherwise insert "no". In the case of incidental catch of marine mammals, detailed information by specimen should be reported in Annex 9/A.
- Notes: any additional information.

ANNEX 1/B

Catch data

Annex 1/B. Catch data					
Collector					
Date				Data source	
ID fishing trip				ID fishing operation	
Species	kg*	Number*	Commercial (C)/Discard (D)	Economic value* (per kg)	Notes

* Whenever possible report the real values; otherwise insert an estimate (e.g. for purse seiners, perhaps calculate the number/kg of fish inside a single box and then multiply by the total number of boxes)

Instructions:

- Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day) and/or to the fishing operation sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering).
- Commercial (C)/Discard (D): insert C if the species has been commercialized, insert D is the species has been discarded at sea.

ANNEX 2

Depredation data

Annex 2. Depredation data			
Collector			
Date/Collector		Data source	
ID fishing trip		ID fishing operation	
			Notes
Time of starting operation			
Time of ending operation			
Latitude (start and end) of fishing operation*			
Longitude (start and end) of fishing operation*			
Area			
Gear type			
Details on gear configuration*			
Depth (in metres)			
Species of dolphin responsible for the depredation event			
Damages* (by fishing trip or fishing operation)			**Notes**
Description of the type of damage to the net			
Number of holes			
Description of the type of damage to the hooks			
Number of damaged hooks			
Number of damaged baits			
Number of missing baits			
Total number of damaged fish			
Total number of damaged fish by species 1			
Total number of damaged fish by species 2			
Total number of damaged fish by species 3			
Total number of damaged fish by species 4			
General information on depredation* (by fishing trip and/or fishing operation)			**Notes**
Other species potentially responsible for gear or catch damages			
Differences (e.g. size, type of bait) between gear/catch damages caused by dolphins and other species			
Estimated value of catch loss			
Estimated cost of gear or hook damage			
Estimated time to repair the gear			

Environmental variables* (by fishing trip and/or fishing operation)		**Notes**
Cloud cover		
Wind direction		
Visibility		
Lighting conditions		
Sea state		
Lunar phase		

* If available

Instructions:

- Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering as in Annex 1/B).
- Latitude (start and end) of fishing operation: insert the latitude at the beginning and at the end of each fishing operation (e.g. fishing hauls). This information is mandatory for ad hoc experimental monitoring surveys. Data should be in degrees, minutes and seconds (e.g. 40°51’59”N).
- Longitude (start and end) of fishing operation: insert the longitude at the beginning and at the end of each fishing operation (e.g. fishing hauls). This information is mandatory for ad hoc experimental monitoring surveys. Data should be in degrees, minutes and seconds (e.g. 124°4’58”W).
- Gear type: insert the fishing gear code as reported in Annex 13 (e.g. GNS).
- Details of gear configuration: if needed, more potentially relevant information on gear could be reported here (e.g. distribution of weights, floats, signals).
- Depth (in m): mean depth or depth range in metres (e.g. from 55 m to 100 m) of the fishing operation carried out during the fishing trip.
- Species of dolphin responsible for the depredation event: report only if there has been a direct observation or some other evidence. If uncertain, simply report “unknown”.
- Total number of damaged fish: insert the total number of damaged fish (total number and, whenever possible, by species).
- Environmental variables: whenever possible, indicate the state of requested environmental variables, using the codes in Annex 14.

ANNEX 3

Hole size and position

Annex 3. Hole size and position					
Collector					
Date			Data source		
ID fishing trip			ID fishing operation		
Hole number*	Hole size and position*				
	Small* (0–30 cm)	Medium* (31–80 cm)	Big* (> 80 cm)	Position of hole* (e.g. on the bottom, in the middle, on the upper third of the net)	Photo (Y/N)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

* If available

Instructions:

– Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.

– ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).

– ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering as in Annex 1/B).

– Hole size and position: whenever possible, for each identified hole (caused by dolphins) insert an "X" corresponding to the size (i.e. small, medium, big) and report one of the suggested positions in the net (i.e. bottom, middle, upper third of the net)

– Photo (Y/N): insert "yes" or "no" to indicate whether the hole has been photographed and, if so, assign an identification code to each photo.

ANNEX 4

Condition of damaged fish

Annex 4. Condition of damaged fish			
Date/Collector		Data source	
ID fishing trip		ID fishing operation	
Species*	Type of damage* (e.g. head, tail, bite, fragment, vestigial)	Proportion of specimen damaged* (%)	Position of the individual damaged* (e.g. on the bottom, in the middle, on the upper third of the net)

* If available

Instructions:

- Data source: indicate if the data come from on-board observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering as in Annex 1/B).
- Whenever possible, for each damaged specimen, insert the name of the species (or the genus, the family, etc.), the type of damage (e.g. only the head remaining, only the tail remaining, fragment, vestigial, only a bite taken out); indicate, always in percentage (%), the proportion of the body damaged, and, if possible, indicate the position of the damaged specimen in the net, selecting one of the three suggestions (i.e. on the bottom of the net, in the middle, on the upper third of the net)

ANNEX 5/A

Questionnaire on fishing activity

Annex 5/A. Questionnaire on fishing activity by fishing trip and/or fishing operation					
Interviewer					
Date of interview					
Identification code assigned to each questionnaire (ID Questionnaire)					
Vessel name					
Port of departure					
Port of arrival					
Vessel length					
Power (kW)					
Gross tonnage (GT)					
Specify whether the information is collected by fishing trip or by fishing operation					
Identification code assigned to each fishing trip (i.e. fishing day) **ID fishing trip**		Total number of fishing operations			
Identification code assigned to each fishing operation **ID fishing operation**					
Gear specifications					
	1st gear	**2nd gear**	**3rd gear**	**4th gear**	**Notes**
Gear type or name					
General information on the catch composition					**Notes**
	kg		%		
Total landings (kg)					
Main commercial species in the landing fraction					
Discards (kg and percentage) in the catch composition					
Main species in the discarded fraction					
General information on interactions with dolphin and/or other vulnerable species					**Notes**
Have you experienced depredation events? (Y/N)					
Were the damages caused by dolphins? (Y/N)					
Bycatch of vulnerable species (Y/N)?					

Instructions:

– Not all data are mandatory, please only fill in with information that is available.

– Data from questionnaire can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation.

ANNEX 5/B

Questionnaire on depredation events

Annex 5/B. Questionnaire on depredation events			
Interviewer		**ID questionnaire**	
Date of interview		**ID fishing trip**	
Port		**ID fishing operation**	
Fishing gear affected by the depredation event			
Gillnet		Longlines	
Mesh size		Hook size	
Number of gillnets		Number of hooks	
Total net length		Distance between branch-lines	
Net width		Number of lines	
Soak time (time during which the fishing gear is actively in the water)		Type of bait	
Depth, range or position		Soak time (time during which the fishing gear is actively in the water)	
Total catch (kg)		Depth, range orposition	
		Total catch (kg)	
Purse seine or surrounding seine		**Trammel net**	
Mesh size		External mesh size	
Total net length		Internal mesh size	
Net width		Number of trammel nets	
Depth, range/position		Total net length	
Total catch of target species (kg)		Net width	
Trawl or towed nets		Soak time (time during which the fishing gear is actively in the water)	
Mesh size (codend)		Depth, range or position	
Opening size		Total catch (kg)	
Average speed during fishing operation			
Depth, range or position			
Total catch (kg)			
2. Data on depredation by fishing trip and/or fishing operation			
Do you recognize the species of dolphin(s) responsible for depredation?			
Can you provide an estimate of the number of holes (or %) in the net?			
Can you describe the type of damage to the net?			
Can you provide an estimate of the number of hooks damaged (or %) along the longline?			
Can you provide an estimate of the number of hooks (or %) depredated?			
Can you provide an estimate of the number of specimens (or %) damaged and/or depredated?			

Main species damaged			
Can you provide an estimate of the total catch loss (kg and/or %)			
Are you sure that all damages have been caused by only dolphins?			
Other species potentially responsible?			
How do you recognize the differences between damages caused by dolphins and those caused by other species?			
3. Socioeconomic information by fishing trip and/or fishing operation			
What are the economic consequences of this depredation?			
Can you provide an estimated value of catch loss?			
Can you provide an estimated cost of gear or hook damages?			
Can you estimate the time needed to repair the gear? (longline, trammel net, lines, etc.)			
General information on depredation (e.g. by whole year or other identified period)			
How many times over one year do you suffer damages?		Main gear suffering damages	
Could you recognize the dolphin species responsible for main depredation events?			
Can you describe the main type of damages that occur? (e.g. damages to catch, fishing gear)		What is the trend in the number of dolphin interactions/depredation events in recent years (e.g. increasing, decreasing, stable)?	
Can you provide an overall estimate of the economic loss of losing catch/ damages to catch?		Can you provide an overall estimate of the economic loss of losing/receiving damage to nets/hooks?	
What are the commercial species particularly affected by depredation?			
Have you ever tested mitigation measures? (Y/N)			
If yes, provide a description of the mitigation measure tested			
How did you feel about adopting this mitigation measure?			
Are there other animals causing damages to the gear/catch? (Y/N)		If yes, could you indicate which other species (group, family, genus) are responsible for the damages?	

Instructions:

– Not all data are mandatory, please fill in only with information that is available.

– Data from questionnaire can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation.

– The first part of this questionnaire can be used to collect information on depredation events by fishing trip and/or fishing operation. The last part ("General information on depredation") can be used to provide information related to a longer period (e.g. by whole year or by month or quarter).

ANNEX 5/C

Questionnaire on incidental catch of vulnerable species

Annex 5/C. Questionnaire on incidental catch of vulnerable species					
Interviewer			ID Questionnaire		
Date of interview			ID fishing trip		
Port			ID fishing operation		
Main gear					
Did you catch any of the following groups of vulnerable species? (Y/N)	Yes/No	Species			
Dolphins and whales					
Seals					
Sharks and rays					
Seabirds					
Sea turtles					
If yes, on average, how many individuals have been caught?	0	1–10	10–50	50–100	> 100
Dolphins and whales					
Seals					
Sharks and rays					
Seabirds					
Sea turtles					
When more than one gear is used, please report the name of the gear					
How many have been released alive? (Insert a number or a percentage)					
Dolphins and whales					
Seals					
Sharks and rays					
Seabirds					
Sea turtles					
General information on incidental catch *(e.g. over a whole year or other identified period)*					
In which months or seasons do you most commonly catch vulnerable species?					
What is (are) the species most affected?					
Generally, in which location/area/depth do you catch them (including distance offshore)?					
Generally, when you catch a vulnerable species, what do you do with it?					
What are your opinions on the factors influencing bycatch and on how best to mitigate (if any) these interactions?					
Additional Comments					

Instructions:

– Not all data are mandatory, please fill in only with available information.

– Data from questionnaire can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation.

– The first part of this questionnaire can be used to collect information on depredation events by fishing trip and/or fishing operation. The last part (namely "General information on incidental catch") can be used to obtain information related to a longer period (e.g. by whole year or by month or quarter).

ANNEX 6/A

Self-reporting – Logbook for vessel characteristics and catch data

Annex 6/A. Logbook for vessel characteristics and catch data					
Collector					
Country					
GSA					
Date					
Identification code assigned to each self-reporting activity **(ID self-reporting)**					
Identification code assigned to a single fishing trip (i.e. fishing day) **(ID fishing trip)**					
Total number of fishing operations during fishing trip (i.e. fishing day)					
Identification code assigned to a single fishing operation **(ID fishing operation)**					
Fleet segment					
					Notes
Vessel name*					
Port of departure					
Port of arrival					
Total length of the vessel					
Power (kW)					
Gross tonnage (GT)					
Depredation events (Y/N)					
Damages caused by dolphins (Y/N)					
Presence of dolphins around the vessel (Y/N)					
Bycatch of vulnerable species (Y/N)					
Gear specifications*					Notes
	1st gear	2nd gear	3rd gear	4th gear	
Gear type					
Net length (m)					
Mesh size (codend – mm)					
Number of hooks					
Bait					
Number of lines					
Number of pots or traps					
Soak time (time during which the fishing gear is actively in the water, i.e. from setting to hauling time)					
Others					
General information on the catch composition*					**Notes**
Total landing (kg)					
Main commercial species in the landing fraction					
Discards (kg and percentage) in the catch composition	kg		%		**Notes**
Main species in the discarded fraction					

*If available

Instructions:

– Not all data are mandatory, please fill in only with information that is available.

– Data from self-reporting activity can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day) and/or to the fishing operation sampled.

ANNEX 6/B

Self-reporting – Logbook for depredation data

Annex 6/B. Logbook for depredation data		
Collector		
Date		
Identification code assigned to each self-reporting activity **(ID self-reporting)**		
Identification code assigned to a single fishing trip (i.e. fishing day) **(ID fishing trip)**		
Identification code assigned to a single fishing operation **(ID fishing operation)**		
		Notes
Starting time of fishing trip or fishing operation		
Ending time of fishing trip or fishing operation		
Latitude (start and end) of the fishing trip or fishing operation*		
Longitude (start and end) of the fishing trip or fishing operation*		
Area		
Gear type		
Details on gear configuration*		
Depth (in metres)		
Species of dolphin responsible for the depredation event		
Types of damages*		**Notes**
Description of the type of damage to the net		
Number of holes		
Description of the type of damage to the hooks		
Number of damaged hooks		
Number of damaged baits		
Number of missing baits		
Total number of damaged fish		
Total number of damaged fish by species 1		
Total number of damaged fish by species 2		
Total number of damaged fish by species 3		
Total number of damaged fish by species 4		
General information on depredation*		**Notes**
Are you sure that all damages have been caused by only dolphins?		
Other species potentially responsible?		
How do you recognize the differences between damages caused by dolphins and those caused by other species?		

What are the economic consequences of this depredation?			
Can you provide an estimated value of catch loss?			
Can you provide an estimate cost of gear or hook damages?			
Can you estimate the time needed to repair the gear? (Longline, trammel net, lines, etc.)			
Presence of specimens around the vessel during the fishing operation*			
Species/Family/Genus	Number*	Behaviour	Notes

*If available

Instructions:

– Not all data are mandatory, please fill in only with information that is available.

– Data from self-reporting activity can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day) and/or to the fishing operation sampled.

ANNEX 6/C

Self-reporting – Logbook for incidental catch data on vulnerable species

Annex 6/C. Logbook for incidental catch data on vulnerable species					
Collector					
Date				Notes	
GSA					
Identification code assigned to each self-reporting activity **(ID self-reporting)**					
Identification code assigned to a single fishing trip (i.e. fishing day) **(ID fishing trip)**					
Identification code assigned to a single fishing operation (ID fishing operation)					
Fishing gear					
Starting time of fishing trip or fishing operation					
Ending time of fishing trip or fishing operation					
Latitude (start and end) of the fishing trip or fishing operation*					
Longitude (start and end) of the fishing trip or fishing operation*					
Groups of vulnerable species*					
	Marine mammals	Sea turtles	Seabirds	Sharks and rays	
Family*					
Genus*					
Species*					
Photo (Y/N)*					
Total number of individual(s) caught*					
Total weight of individual(s) caught (kg)*					
Biological data collected (Y/N)					
Condition at capture*					
Species*	Alive (Y/N)	Dead (Y/N)	Almost dead (Y/N)	Unknown (Y/N)	Notes
Condition at release*					
Species*	Alive (Y/N)	Dead (Y/N)	Almost dead (Y/N)	Unknown (Y/N)	Notes
Comment					

*If available

Instructions:

– Not all data are mandatory, please fill in only with information that is available.

– Data from self-reporting activity can be reported per whole fishing trip (i.e. fishing day) and/or per single fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day) and/or to the fishing operation sampled.

ANNEX 7

Incidental catch data

Annex 7. Incidental catch data				
Collector				
Date			Data source	
ID fishing trip			ID fishing operation	
				Notes
Time of starting operation				
Time of ending operation				
Latitude (start and end) of the fishing operation*				
Longitude (start and end) of the fishing operation*				
Gear type				
Details on gear configuration*				
Depth (in metres)				
Environmental variables*				Notes
Cloud cover				
Wind direction				
Visibility				
Lighting conditions				
Sea state				
Vulnerable species incidentally caught				
	Species 1	**Species 2**	**Species 3**	**Notes**
Group of vulnerable species				
Family*				
Genus*				
Species*				
Photo (Y/N)*				
Total number of individual(s) caught				
Total weight of individual(s) caught (kg)				
Condition at capture*				
Alive				
Dead				
Almost dead				
Not known				
Condition at release*				

Alive				
Dead				
Almost dead				
Not known				
Biological data collected (Y/N)				

* If available.

Instructions:

- Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering).
- Latitude (start and end) of fishing operation: insert the latitude at the beginning and the end of each fishing operation (e.g. fishing hauls). This information is mandatory for ad hoc experimental monitoring surveys. Data should be inserted in degrees, minutes and seconds (e.g. 40°51’59”N).
- Longitude (start and end) of fishing operation: insert the longitude at the beginning and the end of each fishing operation (e.g. fishing hauls). This information is mandatory for ad hoc experimental monitoring surveys. Data should be in degrees, minutes and seconds (e.g. 124°4’58”W).
- Gear type: insert the fishing gear code as reported in Annex 13 (e.g. GNS).
- Details of gear configuration: if needed, more potentially relevant information on gear for assessing bycatch could be reported here (e.g. distribution of weights, floats, signals).
- Depth (in m): mean depth or depth range (from 55 m to 100 m) of the fishing trip/operation carried out.
- Environmental variables: whenever possible, indicate the condition of requested environmental variables, using the codes in Annex 14.
- Photo (Y/N): insert “yes” or “no” to indicate whether the specimen has been photographed and, if so, assign an identification code to each photo.
- Total weight of individual(s) caught (kg): whenever possible, report precise value, otherwise insert estimate.
- Condition at capture and at release: for each species, indicate number of individuals caught and released alive, dead, almost dead or in a state not known.
- Biological data collected (Y/N): insert “yes” if, at least for the dolphin species, biological data have also been recorded, (e.g. length, weight, sex and age). Those data should then be reported as requested in Annex 9/A “Template for biological data”; otherwise insert “no”.

ANNEX 8

Presence of dolphins around the vessel

Annex 8. Presence of dolphins around the vessel				
Collector				
Date		Data source		
ID fishing trip		ID fishing operation		
Dolphins around the vessel or fishing gear*				
Species	Number of individuals	Behaviour	Number of calves	Notes

* If available.

Instructions:

– Data source: indicate if the data come from on-board observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.

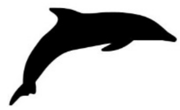
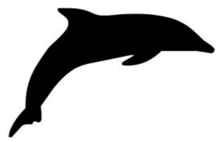
– ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).

– ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering).

– Dolphins around the vessel or fishing gear: if during a fishing trip or fishing operation, there are sightings of dolphins, insert the name of the species (or the genus or family) with a short description of the behaviour (e.g. feeding, playing) and the number of calves (if any).

ANNEX 9/A

Biological data

Annex 9. Biological data											
Collector											
Source	Onboard observers (Y/N)		ID fishing trip				ID self-reporting operation				
	Self-reporting operation (Y/N)		ID fishing operation				Date				
Species	**ID specimen**	**Total body length (TBL cm)***	**Girth in front of dorsal fin (GFD cm)***	**Other body measurements (cm)*** (see Annex 9/B)			**Weight (kg)***	**Sex***	**Photo (Yes/ No)***	**Position of the specimen in the gear***	**Notes**
Comments											

* If available.

Instructions:

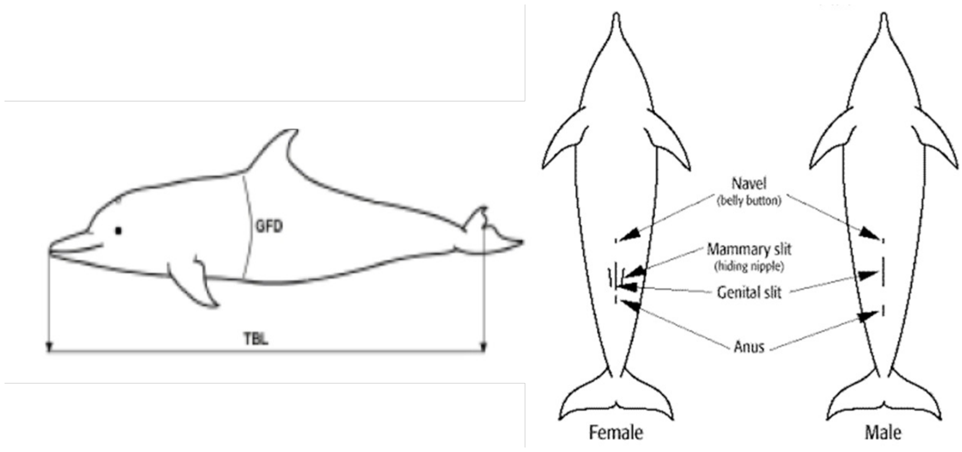
- Source: indicate the source of the data and then report the code for:
  - ID fishing trip: identification code assigned to each fishing trip (as in Annex 1/A).
  - ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering as in Annex 1/B).
  - ID self-reporting operation: identification code assigned to the self-reporting operation (as in Annex 6/A).
- ID specimen: identification code assigned to each single individual caught.
- Total body length (TBL in cm): insert the requested length measurement as detailed in Annex 9/B (Figure A).
- Girth in front of dorsal fin (GDF in cm): insert the requested length measurement as detailed in Annex 9/B (Figure A1).
- Other body measurements: whenever possible, insert other length measurements as detailed in Annex 9/B (Figure A2).
- Weight (kg): whenever possible, and for each specimen caught, report the total weight, otherwise insert an estimate.
- Sex: when available, insert the code for the sex of individual(s) – M (male), F (female), U (undetermined), ND (not determined).
- Photo (Y/N): insert "yes" or "no" to indicate whether the specimen has been photographed and, if so, assign an identification code to each photo. For cetaceans, detailed photos of dorsal fin or any remarkable sign would also be useful, facilitating the identification of the animal in existing photo-identification catalogue(s) for the area (where available).
- Position of the specimen in the gear: whenever possible, please specify the position of the specimen in the gear at the time of capture (e.g. near float or lead lines, in the middle of net).

ANNEX 9/B

Dolphin length measurements

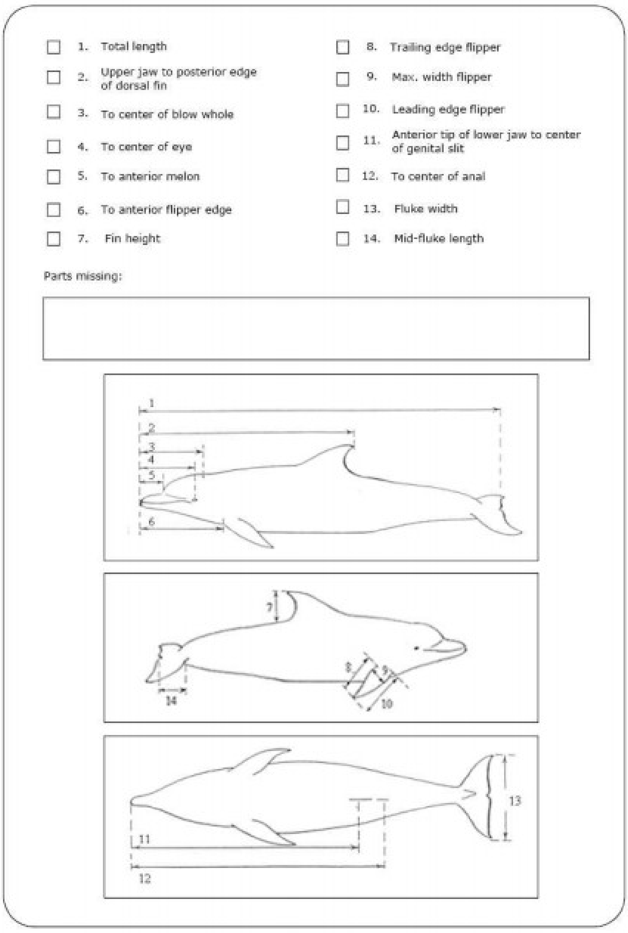
- Total body length (TBL, in cm, Figure A1): from tip of snout to the tip of the caudal fin.
- Girth in front of dorsal fin (GFD, in cm, Figure A1): girth measured in front of the frontal fin.

FIGURE A1
Details of biological information (i.e. length and sex) for dolphins



Source: MASTS. 2016. Strengthening regional cooperation in fisheries data collection: Report to the European Commission in Fulfilment of Grant Award EU MARE/2014/19. The fishPi project. https://www.masts.ac.uk/media/36266/fishpi-final-report.pdf

FIGURE A2
Other body measurements that could be collected for dolphins


☐ 1. Total length
☐ 2. Upper jaw to posterior edge of dorsal fin
☐ 3. To center of blow whole
☐ 4. To center of eye
☐ 5. To anterior melon
☐ 6. To anterior flipper edge
☐ 7. Fin height
☐ 8. Trailing edge flipper
☐ 9. Max. width flipper
☐ 10. Leading edge flipper
☐ 11. Anterior tip of lower jaw to center of genital slit
☐ 12. To center of anal
☐ 13. Fluke width
☐ 14. Mid-fluke length

Parts missing:

Source: UNEP/MAP. 2015. Marine litter assessment in the Mediterranean. https://wedocs.unep.org/handle/20.500.11822/7098

ANNEX 10

Data on marine macro-litter

Annex 10. Data on marine macro-litter		
Collector		
Date		
ID fishing trip		
ID fishing operation		
Data source		
Total quantity of marine litter (kg)		
Percentage (%) of marine litter in the catch		
Marine litter composition*	kg	Notes
Plastic		
Rubber		
Fishing gears		
Metal		
Glass		
Ceramic		
Cloth		
Processed wood		
Other (please specify)		
Comments		

* If available.

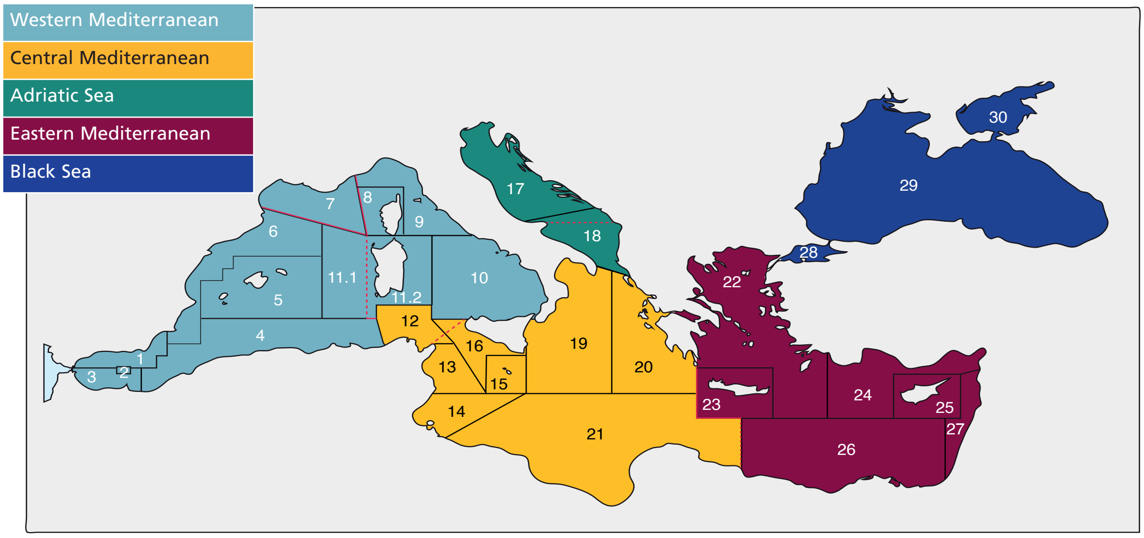
Instructions:

- Data source: indicate if the data come from onboard observations, questionnaires, self-reporting, etc. Data can be reported per fishing trip (i.e. fishing day) and/or per fishing operation. Please, assign a unique code to the fishing trip (i.e. fishing day), and/or to the fishing operation sampled.
- ID fishing trip: identification code assigned to each fishing trip (unique) (as in Annex 1/A).
- ID fishing operation: identification code assigned to each fishing observation during the same fishing trip (following a progressive numbering as in Annex 1/B).
- Total quantity of marine litter (kg): insert the total weight in kg (or an estimate) of marine litter caught during a fishing trip or fishing operation.
- Percentage (%) of marine litter in the catch: insert the total, cumulative marine litter fraction (as a percentage) of the catch from a fishing trip or fishing operation.
- Marine litter composition: whenever possible, insert the weight (or an estimate) in kg and the percentage of the different components of marine litter in the catch from a fishing trip or fishing operation.

ANNEX 11

GFCM geographical subareas and subregions

GFCM subregions



FAO Statistical Divisions — GFCM Geographical Subareas (GSAs)

GFCM GSAs

01 - Northern Alboran Sea	07 - Gulf of Lion	13 - Gulf of Hammamet	19 - Western Ionian Sea	25 - Cyprus
02 - Alboran Island	08 - Corsica	14 - Gulf of Gabès	20 - Eastern Ionian Sea	26 - South Levant
03 - Southern Alboran Sea	09 - Ligurian Sea and Northern Tyrrhenian Sea	15 - Malta	21 - Southern Ionian Sea	27 - Eastern Levant Sea
04 - Algeria	10 - South and Central Tyrrhenian Sea	16 - South of Sicily	22 - Aegean Sea	28 - Marmara Sea
05 - Balearic Islands	11.1 - Sardinia (west) 11.2 - Sardinia (east)	17 - Northern Adriatic Sea	23 - Crete	29 - Black Sea
06 - Northern Spain	12 - Northern Tunisia	18 - Southern Adriatic Sea	24 - North Levant Sea	30 - Azov Sea

Source: GFCM 2018a.

ANNEX 12

Fleet segmentation

Annex 12. Fleet segmentation				
Vessel groups	**Length classes (LOA)**			
Small-scale vessels without engine using passive gear	< 6 m	6–12 m	12–24 m	> 24 m
Small-scale vessels with engine using passive gear	< 6 m	6–12 m	12–24 m	> 24 m
Polyvalent vessels	< 6 m	6–12 m	12–24 m	> 24 m
Purse seiners	< 6 m	6–12 m	12–24 m	> 24 m
Tuna seiners	< 6 m	6–12 m	12–24 m	> 24 m
Dredgers	< 6 m	6–12 m	12–24 m	> 24 m
Beam trawlers	< 6 m	6–12 m	12–24 m	> 24 m
Pelagic trawlers	< 6 m	6–12 m	12–24 m	> 24 m
Trawlers	< 6 m	6–12 m	12–24 m	> 24 m
Longliners	< 6 m	6–12 m	12–24 m	> 24 m

Source: Fleet segmentation as defined by Recommendation Recommendation GFCM/41/2017/6 on the submission of data on fishing activities in the GFCM area of application. Modified from GFCM. 2018. *Data Collection Reference Framework (DCRF) version 21.2.* GFCM Secretariat. https://www.fao.org/gfcm/data/dcrf

Instructions:

– A vessel is assigned to a group based on the dominant gear used, which corresponds to the gear used more than 50 percent of the time at sea over the course of the year.

– Polyvalent vessels' are defined as all vessels using more than one gear, with a combination of passive and active gear, none of which are used for over 50 percent of the time at sea over the course of the year.

– A vessel is considered "active" when it executes at least one fishing operation during the reference year in the GFCM area of application.

ANNEX 13

Fishing gear

Annex 13. Fishing gear			
Gear Name	**Code**	**Gear Name**	**Code**
Purse seine without purse lines (lampara)	LA	Cast nets	FCN
Purse seine with purse lines (purse seines)	PS	Falling gear (not specified)	FG
One boat-operated purse seines	PS1	Gillnets and entangling nets (not specified)	GEN
Two boat-operated purse seines	PS2	Gillnets (not specified)	GN
Beach seines	SB	Encircling gillnets	GNC
Danish seines	SDN	Driftnets	GND
Pair seines	SPR	Fixed gillnets (on stakes)	GNF
Scottish seines	SSC	Set gillnets (anchored)	GNS
Boat or vessel seines	SV	Combined gillnets-trammel nets	GTN
Seine nets (not specified)	SX	Trammel nets	GTR
Otter trawls (not specified)	OT	Aerial traps	FAR
Bottom otter trawls	OTB	Traps (not specified)	FIX
Midwater otter trawls	OTM	Stationary uncovered pound nets	FPN
Otter twin trawls	OTT	Pots	FPO
Pair trawls (not specified)	PT	Stow nets	FSN
Bottom pair trawls	PTB	Barriers, fences, weirs, etc.	FWR
Midwater pair trawls	PTM	Fyke nets	FYK
Bottom trawls	TB	Handlines and pole-lines (mechanized)	LHM
Bottom beam trawls	TBB	Handlines and pole-lines (hand operated)	LHP
Bottom nephrops trawls	TBN	Longlines (not specified)	LL
Bottom shrimp trawls	TBS	Drifting longlines	LLD
Midwater trawls	TM	Set longlines	LLS
Midwater shrimp trawls	TMS	Trolling lines	LTL
Other trawls (not specified)	TX	Hooks and lines (not specified)	LX
Boat dredges	DRB	Harpoons	HAR
Hand dredges	DRH	Pumps	HMP
Lift nets (not specified)	LN	Mechanized dredges	HMD
Boat-operated lift nets	LNB	Harvesting machines (not specified)	HMX
Portable lift nets	LNP	Miscellaneous gear	MIS
Shore-operated stationary lift nets	LNS	Recreational fishing gear	RG
		Gear not known or not specified	NK

ANNEX 14

Environmental variables

Annex 14. Environmental variables		
Variable	**Code**	**Description**
Cloud cover	0	0% of the sky covered
	25	25% of the sky covered
	50	50% of the sky covered
	100	100% of the sky covered
Wind direction	N	north
	E	east
	S	south
	W	west
	NE	northeast
	SE	southeast
	SW	southwest
	NW	northwest
Visibility	A	< 2 km
	B	2–5 km
	C	6–9 km
	D	≥ 10 km
Lighting conditions	0	dawn
	1	dusk
	2	day
	3	night
Sea state	0	sea like a mirror
	1	small ripples
	2	small wavelets
	3	crest break
	4	numerous white caps
	5	moderate waves, some spray
	6	larger waves, more spray
Lunar phase	1	New moon
	2	Waxing crescent
	3	First quarter
	4	Waxing gibbous
	5	Full moon
	6	Waning gibbous
	7	Third quarter
	8	Waning crescent

ANNEX 15/A

Fishing effort measurements by fishing gear

Annex 15/A. Effort measurements by fishing gear				
Fishing gear	Gear code (FAO)	Unit of capacity	Unit of activity	Nominal effort
With purse lines (purse seines)	PS	Gross tonnage	Fishing sets[1,2]	Gross tonnage × fishing sets
One boat-operated purse seines	PS1			
Two boat-operated purse seines	PS2			
Without purse lines (lampara)	LA			
Beach seines	SB	Net length and drop[3,4]	Fishing days	Net length and drop × Fishing days
Boat or vessel seines	SV			
Danish seines	SDN			
Scottish seines	SSC			
Pair seines	SPR			
Seine nets (not specified)	SX			
Bottom trawls	TB	GT	Fishing days	GT × Fishing days
Bottom beam trawls	TBB			
Bottom otter trawls	OTB			
Bottom pair trawls	PTB			
Bottom nephrops trawls	TBN			
Bottom shrimp trawls	TBS			
Midwater trawls	TM			
Midwater otter trawls	OTM			
Midwater pair trawls	PTM			
Midwater shrimp trawls	TMS			
Otter twin trawls	OTT			
Otter trawls (not specified)	OT			
Pair trawls (not specified)	PT			
Other trawls (not specified)	TX			
Boat dredges	DRB	Gross tonnage	Fishing days	Gross tonnage × Fishing days
Mechanized dredges	HMD			
Hand dredges	DRH			
Set gillnets (anchored)	GNS	Net length and drop	Fishing days	Net length × Fishing days
Driftnets	GND			
Encircling gillnets	GNC			
Fixed gillnets (on stakes)	GNF			
Trammel nets	GTR			
Combined gillnets-trammel nets	GTN			
Gillnets and entangling nets (not specified)	GEN			
Gillnets (not specified)	GN			

1 Number of times the gear has been set or shot, whether or not a catch was made (FAO)
2 Should this information not be available, "fishing days" may be used as activity capacity
3 Length of net expressed in 100 metre units (FAO)
4 Should this information not be available, "gross tonnage" may be used as activity capacity

Stationary uncovered pound nets	FPN	Number of traps or pots[5]	Fishing days	Number of traps or pots × Fishing days
Pots	FPO			
Fyke nets	FYK			
Stow nets	FSN			
Barriers, fences, weirs, etc	FWR			
Aerial traps	FAR			
Traps (not specified)	FIX			
Handlines and pole-lines (hand operated)	LHP	Number of hooks[5]	Fishing days	Number of hooks × Fishing days
Handlines and pole-lines (mechanized)	LHM			
Set longlines	LLS			
Drifting longlines	LLD			
Longlines (not specified)	LL			
Trolling lines	LTL			
Hooks and lines (not specified)	LX			

[5] Number of times the gear has been set or shot, whether or not a catch was made (FAO).

ANNEX 15/B

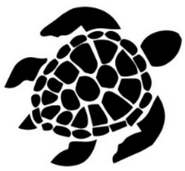
Fishing effort measurements by fleet segment

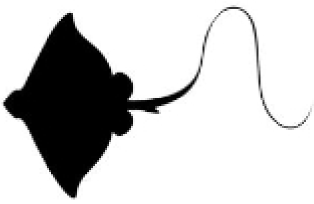
Annex 15/B. Effort measurements by fleet segments				
Fleet segments		Effort measurements		
Vessel groups	Length classes (LOA)	Unit of capacity	Unit of activity	Nominal effort
Purse seiners or tuna seiners	< 6 m	Gross tonnage	Fishing sets	Gross tonnage × fishing sets
	6–12 m			
	12–24 m			
	> 24 m			
Small-scale vessels without engine using passive gear	< 6 m	Net length	Fishing days	Net length × Fishing days
Small-scale vessels with engine using passive gear	6–12 m			
Polyvalent vessels	12–24 m			
Polyvalent vessels	> 24 m			
Beam trawlers	< 6 m	Gross tonnage	Fishing days	Gross tonnage × Fishing days
Pelagic trawlers	6–12 m			
Trawlers	12–24 m			
Trawlers	> 24 m			
Dredgers	< 6 m	Gross tonnage	Fishing days	Gross tonnage × Fishing days
	6–12 m			
	12–24 m			
	> 24 m			
Small-scale vessels without engine using passive gear	< 6 m	Number of traps or pots	Fishing days	Number of traps or pots × Fishing days
Small-scale vessels with engine using passive gear	6–12 m			
Polyvalent vessels	12–24 m			
Polyvalent vessels	> 24 m			
Longliners	< 6 m	Number of hooks	Fishing days	Number of hooks × Fishing days
	6–12 m			
	12–24 m			
	> 24 m			

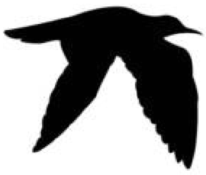
ANNEX 16/A

Vulnerable species

The list of vulnerable species is included in Appendix II (endangered or threatened species) and Appendix III (species whose exploitation is regulated) of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention). The list also contains the amendments to Annexes II and III to the Protocol Concerning Specially Protected Areas and Biological Diversity (SPA/BD) in the Mediterranean (2012/510/EU: Council Decision of 10 July 2012 establishing the position to be adopted on behalf of the European Union with regard to the amendments to Annexes II and III to the SPA/BD in the Mediterranean, of the Barcelona Convention, adopted by the Seventeenth Meeting of the Contracting Parties, Paris, France, 8–10 February 2012).

<table>
<tr><th>Group of vulnerable species</th><th>Family</th><th>Species</th><th>Common name</th></tr>
<tr><td rowspan="7">Sea turtles
</td><td rowspan="5">Cheloniidae</td><td>Caretta caretta</td><td>Loggerhead turtle</td></tr>
<tr><td>Chelonia mydas</td><td>Green turtle</td></tr>
<tr><td>Eretmochelys imbricata</td><td>Hawksbill turtle</td></tr>
<tr><td>Lepidochelys kempii</td><td>Kemp’s Ridley sea turtle</td></tr>
<tr><td>Lepidochelys olivacea</td><td>Olive Ridley sea turtle</td></tr>
<tr><td>Dermochelyidae</td><td>Dermochelys coriacea</td><td>Leatherback sea turtle</td></tr>
<tr><td>Trionychidae</td><td>Trionyx triunguis</td><td>African softshell turtle</td></tr>
</table>

Group of vulnerable species	Family	Species	Common name
Sharks, rays, chimaeras 	Alopiidae	*Alopias vulpinus*	Common thresher
	Carcharhinidae	*Carcharias taurus*	Sand tiger
		Carcharhinus plumbeus	Sandbar shark
		Carcharodon carcharias	Great white shark
		Prionace glauca	Blue shark
	Centrophoridae	*Centrophorus granulosus*	Gulper shark
	Cetorhinidae	*Cetorhinus maximus*	Basking shark
	Gymnuridae	*Gymnura altavela*	Spiny butterfly ray
	Hexanchidae	*Heptranchias perlo*	Sharpnose sevengill shark
	Lamnidae	*Isurus oxyrinchus*	Shortfin mako
		Lamna nasus	Porbeagle
	Myliobatidae	*Mobula mobular*	Devil fish
	Odontaspididae	*Odontaspis ferox*	Small-tooth sand tiger shark
	Oxynotidae	*Oxynotus centrina*	Angular rough shark
	Pristidae	*Pristis pectinata*	Smalltooth sawfish
		Pristis pristis	Common sawfish
	Rajidae	*Dipturus batis*	Common skate
		Leucoraja circularis	Sandy ray
		Leucoraja melitensis	Maltese skate
		Rostroraja alba	Bottlenose skate
	Rhinobatidae	*Rhinobatos cemiculus*	Blackchin guitarfish
		Rhinobatos rhinobatos	Common guitarfish
	Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead
		Sphyrna mokarran	Great hammerhead
		Sphyrna zygaena	Smooth hammerhead
	Squatinidae	*Squatina aculeata*	Sawback angel shark
		Squatina oculata	Smoothback angel shark
		Squatina squatina	Angel shark
	Triakidae	*Galeorhinus galeus*	School/Tope shark

Group of vulnerable species	Family	Species	Common name
Seabirds 	Falconidae	*Falco eleonorae*	Eleonora's falcon
	Cerylidae	*Ceryle rudis*	Pied kingfisher
	Charadriidae	*Charadrius alexandrinus*	Kentish plover
		Charadrius leschenaultii columbinus	Greater sand plover
	Halcyonidae	*Halcyon smyrnensis*	White-throated kingfisher
	Hydrobatidae	*Hydrobates pelagicus melitensis**	European storm petrel
		*Hydrobates pelagicus pelagicus**	European storm petrel
	Laridae	*Larus audouinii**	Audouin's gull
		*Larus armenicus**	Armenian gull
		*Larus genei**	Slender-billed gull
		*Larus melanocephalus**	Mediterranean gull
	Pandionidae	*Pandion haliaetus*	Osprey
	Pelecanidae	*Pelecanus crispus*	Dalmatian pelican
		Pelecanus onocrotalus	Great white pelican
	Phalacrocoracidae	*Phalacrocorax aristotelis desmarestii*	European shag
		Phalacrocorax pygmaeus	Pygmy cormorant
	Phoenicopteridae	*Phoenicopterus ruber*	American flamingo
	Procellariidae	*Calonectris diomedea**	Scopoli's shearwater
		*Calonectris borealis**	Cory's shearwater
		*Puffinus yelkouan**	Yelkouan shearwater
		*Puffinus mauretanicus**	Balearic shearwater
	Scolopacidae	*Numenius tenuirostris*	Slender-billed curlew
	Sternidae	*Sternula albifrons**	Little tern
		*Sterna bengalensis**	Lesser crested tern
		*Sterna sandvicensis**	Sandwich tern
		*Hydroprogne caspia**	Caspian tern
		*Gelochelidon nilotica**	Gull-billed tern

* The only birds that can be considered seabirds. The other species in the table are mentioned as "aves" in Annex II of the Barcelona Convention. Some of them belong to the so-called "waterbirds" or "aquatic birds" (e.g. birds that inhabit or depend on bodies of water or wetland areas).

ANNEX 16/B

Rare elasmobranch species

This list reports elasmobranch species that are included in the IUCN Red List of Threatened Specieswww.iucnredlist.orgwww.iucnredlist.org (www.iucnredlist.org) or that are considered rare in the Mediterranean and the Black Sea (Bradai, M.N., Saidi, B. & Enajjar, S. 2012. Elasmobranchs of the Mediterranean and Black Sea: Satus, ecology and biology. Bibliographic analysis. GFCM Studies and Reviews No. 91. Rome, FAO. https://www.fao.org/3/i3097e/i3097e.pdf)

Group of rare species	Family	Species	Common name
Sharks, rays, chimaeras 	Alopiidae	*Alopias superciliosus*	Bigeye thresher
	Hexanchidae	*Hexanchus nakamurai*	Bigeye sixgill shark
	Echinorhinidae	*Echinorhinus brucus*	Bramble shark
	Squalidae	*Squalus megalops*	Shortnose spurdog
	Centrophoridae	*Centrophorus uyato*	Little gulper shark
	Somniosidae	*Centroscymnus coelolepis*	Portuguese dogfish
		Somniosus rostratus	Little sleeper shark
	Lamnidae	*Isurus paucus*	Longfin mako
	Scyliorhinidae	*Galeus atlanticus*	Atlantic catshark
	Carcharhinidae	*Carcharhinus altimus*	Bignose shark
		Carcharhinus brachyurus	Bronze whaler shark
		Carcharhinus brevipinna	Spinner shark
		Carcharhinus falciformis	Silky shark
		Carcharhinus limbatus	Blacktip shark
		Carcharhinus melanopterus	Blacktip reef shark
		Carcharhinus obscurus	Dusky shark
		Galeocerdo cuvier	Tiger shark
		Rhizoprionodon acutus	Milk shark
	Torpedinidae	*Tetronarce nobiliana*	Great torpedo
		Torpedo sinuspersici	Variable torpedo ray
	Rajidae	*Dipturus nidarosiensis*	Norwegian skate
		Leucoraja fullonica	Shagreen skate
		Leucoraja naevus	Cuckoo skate
		Raja brachyura	Blonde skate
		Raja montagui	Spotted skate
		Raja polystigma	Speckled skate
		Raja radula	Rough skate
		Raja undulata	Undulate skate
	Dasyatidae	*Bathytoshia centroura*	Roughtail stingray
		Dasyatis marmorata	Marbled stingray
		Dasyatis pastinaca	Common stingray
		Dasyatis tortonesei	Tortonese's stingray
		Himantura uarnak	Honeycomb whipray
		Taeniurops grabatus	Round fantail stingray
	Myliobatidae	*Aetomylaeus bovinus*	Bullray
	Rhinopteridae	*Rhinoptera marginata*	Lusitanian cownose ray
	Sphyrnidae	*Sphyrna tudes*	Smalleye hammerhead

When marine mammals come into physical contact with fishing gear, there can be harmful effects to both the animals and fishers. The animals may be incidentally caught in fishing gear, or in the case of depredation, marine mammals – usually dolphins – may remove and/or damage fish captured in nets or hooks, resulting in damage to fishing gear, loss of capture and consequently lower catch values and fisher revenues. Depredation can also lead to entanglement, which can in turn produce incidental catch. The competitive overlap between dolphins and humans at sea represents a worldwide issue, as it affects both the survival of wild dolphin populations and the livelihoods of fishers, and it is receiving growing attention from fisheries management organizations around the globe. Many gaps still remain, however, in the knowledge of the actual extent of the problem, including in the Mediterranean and the Black Sea. In order to understand and mitigate dolphin depredation in the region through effective management measures, adequate regional/subregional and national monitoring programmes are required to obtain representative data on dolphin depredation events during sampled fishing operations. The purpose of this protocol, which allows for replicability and comparisons among fisheries across the region, is to facilitate and improve data collection in a harmonized and standardized way. Its aim is to improve understanding of the dolphin populations involved in depredation events, assess the regional magnitude of depredation to determine the economic losses suffered by fishers, identify the typologies of fishing practices that lead to depredation, as well as potential mitigation measures, and collect information for the conservation of marine mammals.

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