Interactions Between Cetaceans and Small-scale Fisheries in the Mediterranean

STUDY AREA 2

The Case of Central Mediterranean

Maltese Islands

LOW IMPACT FISHERS OF EUROPE

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MCAST Malta College of Arts, Science & Technology

Interaction Between Cetaceans and Small-Scale Fisheries in the Mediterranean

Study Area 2: The Case of Central Mediterranean, Maltese Islands.

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The present report is part of a Collection of Reports where interaction between cetaceans and small-scale fisheries in the Mediterranean has been analysed. This report shows the results in one out of three areas of study, concretely in the Maltese Islands, Central Mediterranean. They all proceeded with a coordinated approach with common methodology and database. Please see the other two case study reports and Conclusive Report for further information.

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Executive Summary

The fishing sector in Malta has always been one of a small-scale nature with 93% of the vessels being under 12 metres and engaging in small-scale fishing (non-towed gears), utilizing a variety of artisanal fishing gear (see Section 1.2. below). Several types of gears are used in such fisheries, such as surface longlines which are mainly used to target swordfish and tuna and bottom-longlines, trammel nets and entangling nets which are used to target groupers, various species of bream, red snappers and red porgies. Pots and traps are generally used to captured octopus and bogue. Some vessels also use fishing aggregate devices to fish for dolphinfish.

One of the main fisheries interactions with ceteceans includes the presence of dolphins. Cetaceans have been appearing in Maltese waters for a number of years and fishers remark that interactions with cetaceans are constantly increasing. It is therefore essential that proper monitoring is carried out in order to assess the factors that drive the interactions and the impact of dolphin depredation on the fishing sector to inform management measures. The focus of this study was essentially to qualify and quantify depredation factors by investigating the realities as perceived and lived by the small-scale fishing sector.

Questionnaires were mostly focused in Malta's major fishing ports, specifially Marsaxlokk in the Southern part of the island, and St Paul's Bay, towards the North. A few were conducted in other fishing ports to get a snapshot of the issues arising around the Maltese coastline. Data about technical characteristics of the fishing fleet, fisher perception of cetacean interaction with respect to gear, interaction characteristics, encounter frequency and bycatch, fishing gear characteristics and interaction damage and losses were all collected. Results show that the regular presence of bottlenose dolphins seems to have increased over the last 5 years, particularly in the vicinity of bluefin tuna, seabream and seabass fish farms locations. While the use of trammel nets remains by far the most popular gear type employed by Maltese fishers, this study showed that an around 33% of the fishing gear deployed in the past year suffered damages which account to an average of €178.33 in damages per fisher, annually.

The authors hence recommend that new prevention and mitigation measures are tested in order to try and reduce the risk of depredation by cetaceans. With existing acoustic devices not being yet sufficiently effective, it is ncessary to identify and test new devices that could address the cetacean bycatch and depredation incidents. These could include innovative projects such as DEPRED devices that include long streamers that repel cetaceans from approaching the fishing gear, as well as enhanced communicative systems where fishers communicate high risk areas frequented by dolphinfish such that hotspot areas are avoided.

CHAPTER 01

Introduction

INTERACTION BETWEEN CETACEANS AND SMALL-SCALE FISHERIES IN THE MEDITERRANEAN

Study Area 2:
The Case of Central Mediterranean Maltese Islands

1.1 - The Maltese Islands and Small-Scale Fisheries

Found in the central Mediterranean, the Maltese islands lie c.80 km south of Sicily (Figure 1). Considered as being surrounded by warm waters, sea water temperatures reach an average of 14° C between December and February and 28 °C in the summer months.

Figure 1. Location of the Maltese Islands in the central Mediterranean, south of Italy and north of the African continent.

The fishing sector in Malta has always been one of a small-scale nature with a long history of fishers engaging in traditional small-scale fishing practices (Said, 2017). However its cultural significance outweighs the economic importance which is equivalent to about 0.1 percent of the national GrossDomestic Product (FAO, 2020).

According to Carvalho, Edwards-Jones and Isidro (2010) and Natale, Carvalho and Paulrud (2015), there are several differences between large-scale and small-scale fisheries. The European Maritime and Fisheries Fund defines Small Scale Fisheries (SSF) as “Fishing carried out by fishing vessels of an overall length of less than 12m and not using towed fishing gear” (EC) No 26/2004. Therefore, for the purpose of this study, a small-scale vessel has been considered as any vessel with LOA whichis less than 12m and which does not use towed fishing gear, and which operates in Malta’s 25 nautical mile zone, which is considered as a Fisheries Management Zone as per EC1967/2006.

Most of the industry is composed of small-scale vessels which has been noted to be facing degeneration due to multiple challenges, predominantly resulting from governance systems which do not always cater for the needs of the small-scale fisheries sector (Said, 2017). In fact, between 2000 and 2010 alone, the small-scale fishing fleet in Malta faced a decline of 30% in the number of vessels, ranking among the top EU countries experiencing such degeneration (Said et al. , 2018). Since large-scale commercial fisheries have increased in terms of capacity and effort, the small-scale fisheries fleet has been in direct competition with the large-scale fleet and their artisanal and traditional fishing activities have been under threat. Evidently, this is happening as large-scale fisheries have been more apt to adapt to new policies and more resilient to changes brought forward by a globalized world including markets.

However, it is essential that small-scale fisheries are still safeguarded since they are considered to be relatively more sustainable given that they utilize low-impact fishing gear and are more species-selective (University of Malta, 2020). Moreover, since they form part of Malta’s maritime heritage, they have more to offer to the national economy in terms of positive externalities such as tourism.

1.2 - The Maltese fishing fleet and fishing gear

1.2.1 The Maltese fishing fleet

During the time of writing the small-scale fishing fleet is composed of 916 fishing vessels, which are either full-time (MFA license) or part-time (MFB license) in line with Malta's Subsidiary Legislation 425.07. The full-time registered vessels account for around 41% and part-time fishing vessel account for around 59%, all considered as professional commercial vessels. Around 93% of professional vessels have an overall length of less than 12m and those over 12m amount to 64 vessels. The range of length of the Maltese vessels is between 3m and 35m (Department of Fisheries and Aquaculture, 2019).

The Maltese fishing fleet constitutes a number of different varieties of vessels that are utilized to target different species and they also operate in varying distances from the coast. Around 56% of the fleet includes various sea crafts such as '*luzzu*' , ' *firilla*' , ' *kajjik*', '*frejgatina*', '*lanca*' and ' *bimbu*' . Other vessels such as multi-purpose vessels and trawlers account for 43.2% and 0.8% respectively (Environment and Resource Authority, n.d.).

1.2.2 The Maltese fishing gear

The gear utilized in the Maltese capture fisheries are described as Mediterranean artisanal fisheries which generally includes the use of multiple gears across the year to target multiple fishing seasons.

Demersal longlines are used to capture demersal and benthic species. This consists of a mainline with baited hooks at regular intervals and are set near the bottom (Food and Agriculture Organisation of the United Nations, 2020). The demersal longlines are used to capture *Pagellus* spp., *Dentex dentex, Polyprion americanus, Pagrus pagrus* and *Epinephelus alexandrines* (de Leiva *et al* ., n.d.). The drifting longlines are

suspended in the water column and they are made of a mainline with hooks and a float and they are used to target *Xiphias gladius, Thunnus thynnus* and *Thunnus alalonga* (Food and Agriculture Organisation of the United Nations, 2018).

Other types of fishing gear that are used are varying forms of trammel nets and entangling nets as well as pots and traps. Gillnets are passive netting walls that are used to entangle fish that swim into them. They mainly used to catch fish with uniform size morphology since the mesh size of the gillnet must match the girth of fish's body. On the other hand, trammel nets are gillnets which are specifically designed, by joining three parallel netting sheets. The two outer layers of nettings have a large mesh size while the inner wall of netting has a smaller mesh size allowing the fisher to capture fish through gilling and entangling and by trapping larger fish in the inner netting. Gillnets are considered to be more size selective than trammel nets. These two types of nets are used to capture several species such as *Mullus surmuletus, Spicara maena, Boops, boops, Pagellus acarne, Diplodusm annularis, Serranus scriba, Chromis chromis* and *Spicara smaris* (Karakulak and Erk, 2008).

In Malta, the dolphin fish *(Coryphaena hippurus)* fishery is considered to be a traditional fishery, whereby Fish Aggregating Devices are utilized to aggregate dolphin fish which are then surrounded with a net similar to a purse-seine net. Baited traps made out of wire are generally used to target the common octopus *(Octopus vulgaris)* and cane traps baited with bean flour and laced with salted herring essence are used to target bogue *(Boops boops)* (Food and Agriculture Organisation of the United Nations, 2005).

1.3 - Cetaceans and Depredation

1.3.1 Cetaceans in Maltese waters

Approximately 87 living cetacean species are found in the world's oceans and seas and around 8 species are considered to be residents of the Mediterranean Sea (EcoMarine Malta, 2018). Several naturalists have noted cetacean presence in Maltese waters, specifically the common bottlenose dolphin *(Tursiops truncatus)*, however other species of cetaceans have been recorded in the seas around Malta. These include the striped dolphin *(Stenella coeruleoalba)*, sperm whale, *(Physeter macrocephalus)* Cuvier's beaked whale *(Ziphius cavirostris)*, rough toothed dolphin *(Steno bredanesis)* (Savona-Ventura, n.d.). The fin whale *(Balaenoptera physalus)* has also been sighted in Maltese seas as well. Sciara (2002) further mentions other species which have been described as occasional (UNEP/MAP, 2015), these being, the minke whale *(Balaenoptera acutorostrata)*, the killer whale *(Orcinus orca)* and the false killer whale *(Pseudorca crassidens)*.

During the project MIGRATE which took place in Maltese waters in the summers of 2014 and 2015, there was a high number of sightings of cetaceans (50), the latter identified as bottlenose dolphin (38%), striped dolphin (30%), common dolphin (24%) and sperm whale (2%). In the same study, the number of cetaceans was considered low when compared to other areas in the Mediterranean Sea (ERA, 2016).

Described as one of the most frequently observed dolphins in the Mediterranean, *Tursiops truncatus* (Montagu, 1821) has been appearing the Maltese waters for a number of years. When investigating the number of bottlenose dolphins in 2014, a range of between 79 and 224 bottlenose dolphins were recorded in Maltese waters. However, 79 individuals is considered to be a more realistic feature. This study was based on the identification of marked individual dolphins over 780 hours at sea (Malta Today, 2020).

The interactions observed between bottlenose dolphins *(Tursiops truncatus)* and fishing gear are on the increase and it is essential that proper research is carried out in order to assess the factors that drive the interactions and the impact of dolphin depredation on the fishing gear. A similar study carried out in the Balearic Islands showed that both the cost of the net damage and loss amounted to 6.5% of the total catch value and an annual loss of 3.4% of the total catch by weight. This study also showed that two dolphins died from entanglement in fishery operations (Brotons, Grau and Rendell, 2008).

A study carried out in Northern Cyprus showed that bottlenose dolphins were present in fishing grounds and interactions with set-nets such as trammel nets amounted to 28% and net damage was six times more when dolphins were present (Snape *et al*., 2018). In Valencia, a study on the interaction of dolphins with fishing gear was also carried out with 131 fishers. 86.1% stated that dolphins damaged their fishing gear and 76.1% reported financial losses (Revuelta *et al*., 2018).

Wise *et al*. (2007) studied the interactions of marine mammals with Portuguese purse-seines. Three species were observed and 31 total sightings during fishing operations were seen, however, *Delphinus delphis* and other Delphinidae interacted with the fishing operations resulting in the sinking,

1.3.2 Cetacean depredation in Maltese waters

collecting The interactions observed between bottlenose dolphins (Tursiops truncatus) and fishing gear are on the increase and it is essential that proper research is carried out in order to assess the factors that drive the interactions and the impact of dolphin depredation on the fishing gear. A similar study carried out in the Balearic Islands showed that both the cost of the net damage and loss amounted to 6.5% of the total catch value and an annual loss of 3.4% of the total catch by weight. This study also showed that two dolphins died from entanglement in fishery operations (Brotons, Grau and Rendell, 2008).

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The realities occurring in different countries have been crucial to inform this study, as it provided a baseline on the type, frequency and impact of interactions. Such detail, together with the regional insights gathered from the parallel studies in Sicily and Spain, helped authors in orienting the Maltese depredation inquiry.

CHAPTER 02

Methodology

INTERACTION BETWEEN CETACEANS AND SMALL-SCALE FISHERIES IN THE MEDITERRANEAN

Study Area 2:
The Case of Central Mediterranean Maltese Islands

2.1 - Sampling methodology

The questionnaires were administered through face-to-face interviews with fishers in different ports around Malta, using convenience sampling. Convenience sampling is considered to be a type of non-probability sampling that requires the collection of data from members of the population that are available. This method was the most ideal given that interviewers did not have access to a list of fishers' contact details, predominantly due to GDPR matters, thus derailing the possibility of implementing a fully stratified sampling system. Nonetheless, interviewers strived to conduct a represantative sample of active vessels belonging to small-scale fisheries operating in the coastal waters. the sample is representative of the local fleet taking into account the respective fishing port, the type of fishing gear and also the exploited resource; the target species, the fishing time and fishing area.

A total of 38 questionnaires (33 of which were used for analytical purposes) were administered over an eight-month period, namely between July 2019 and February 2020 in around 6 fishing ports.

These include St.Paul's Bay W Marsaxlokk, Cirkewwa, Mgarr (Gozo), Marsaskala, Gnejna, Msida and Mellieha (Figure 2, Figure 3, and Table 1).

These sites were chosen to reflect the presence of fishers across the Maltese islands. Marsaxlokk is the largest fishing village in Malta and most of the fish sold in the Maltese islands are captured by fishers who reside at Marsaxlokk. During the week fishers generally land their catch at Marsaxlokk and take them to fish market in Marsa. However, on Sundays fishers sell their catch at Marsaxlokk, making it a highly touristic destination (Malta Uncovered, 2020). St. Paul's Bay was more centralised around fishing in the past, however, the locality has still remained a low-key fishing village with several fishing activities occuring at Veccja fishing port (The Malta Independant, 2019).

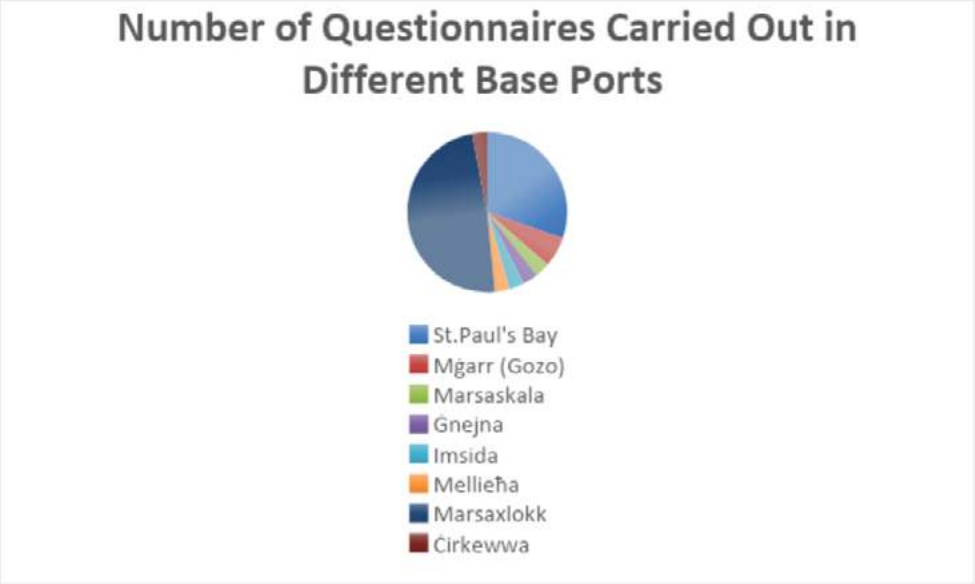


Figure 3. The number of questionnaires carried out in the different base ports

Moreover, full-time fishers were easier to locate since in good weather they would be preparing their gear and they carry out their job on a daily basis, as opposed to part-time fishers whose schedule is unpredictable. Table A1 (Annex 1) was compiled in order to understand the characteristics of the SSF in further detail. This helped the researchers filter the data according to the definition of European Maritime and Fisheries Fund in Table 3 of Annex I to Commission RegulThation (EC) No 26/2004.

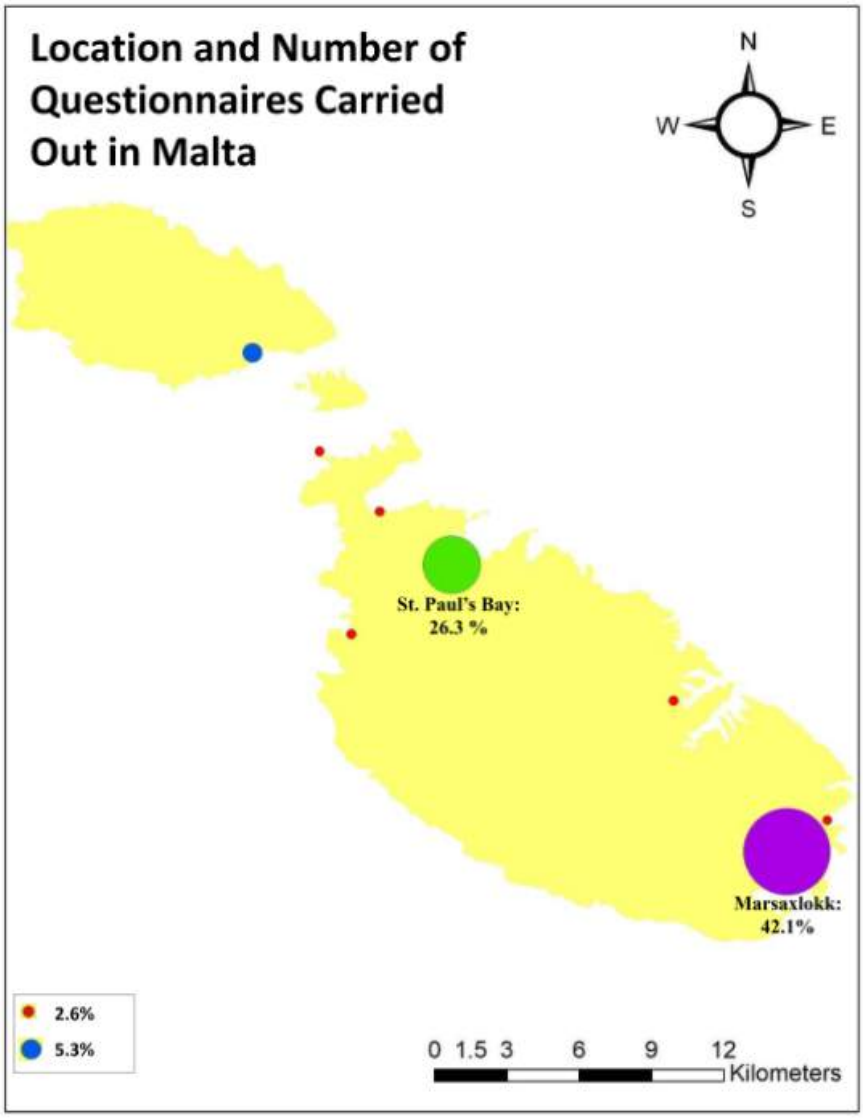
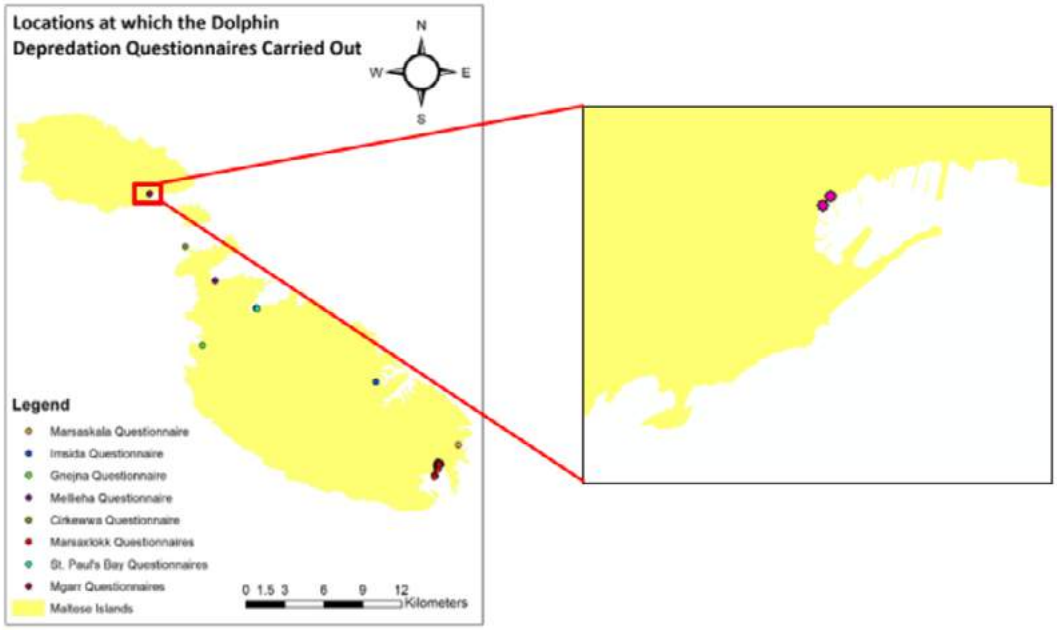


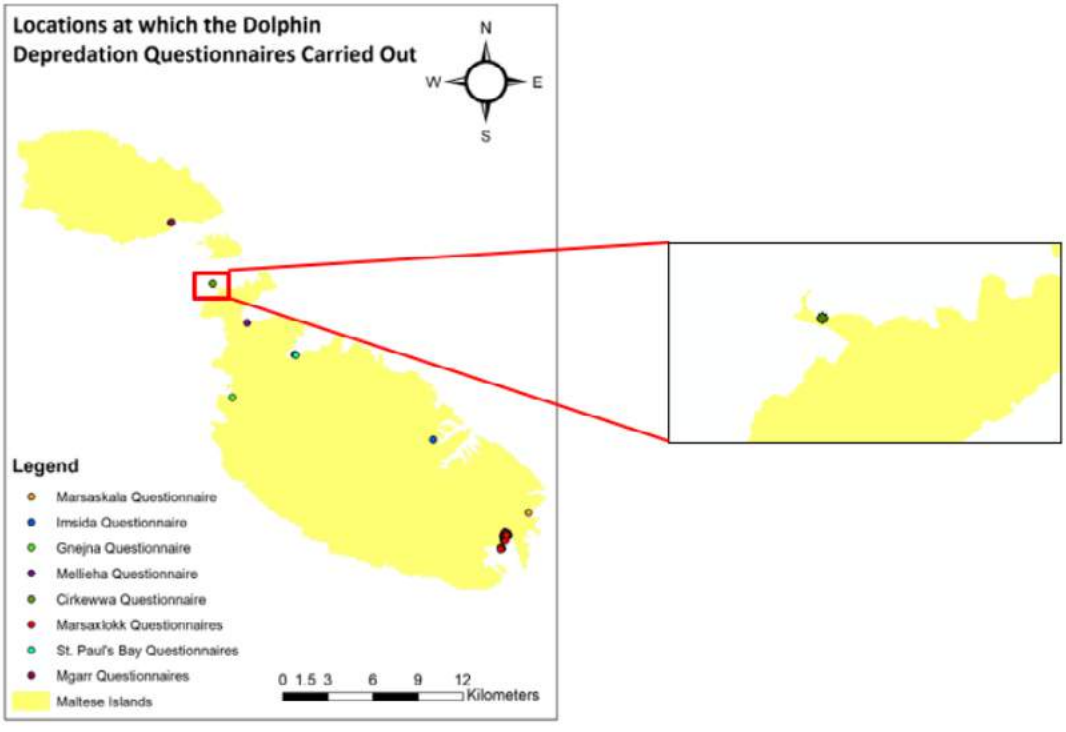
Figure 2. Locations and Number of questionnaires which were collected from around the Maltese Islands

Table 1. Location around the Maltese Islands where interviews were carried out

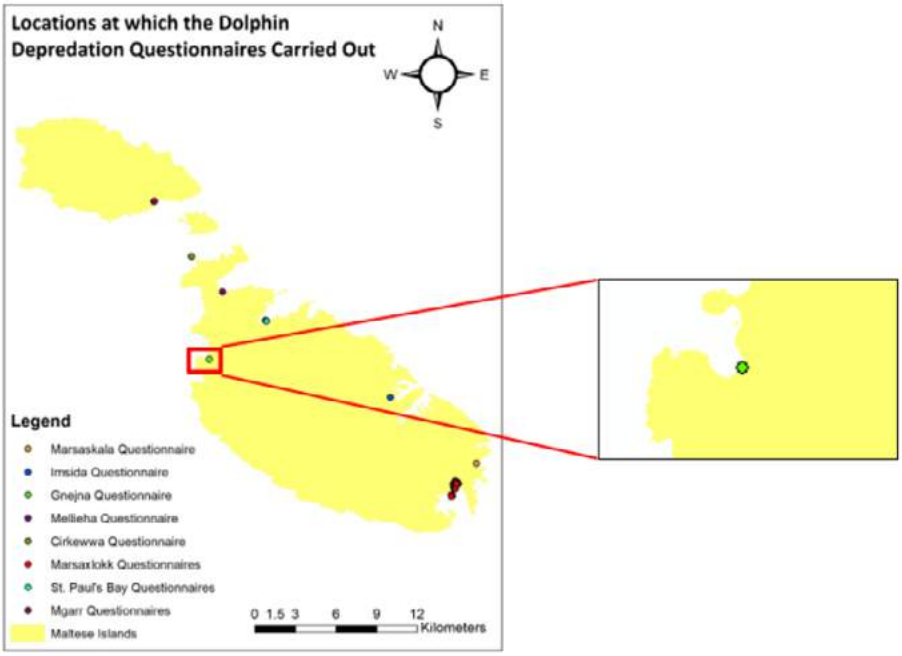
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Mgarr (Gozo)



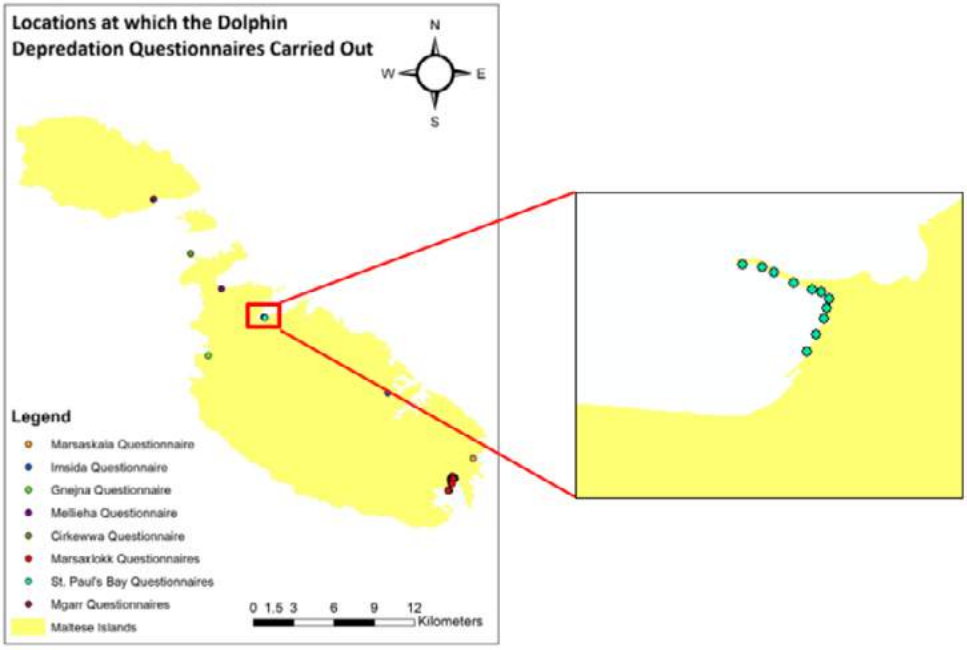
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Cirkewwa



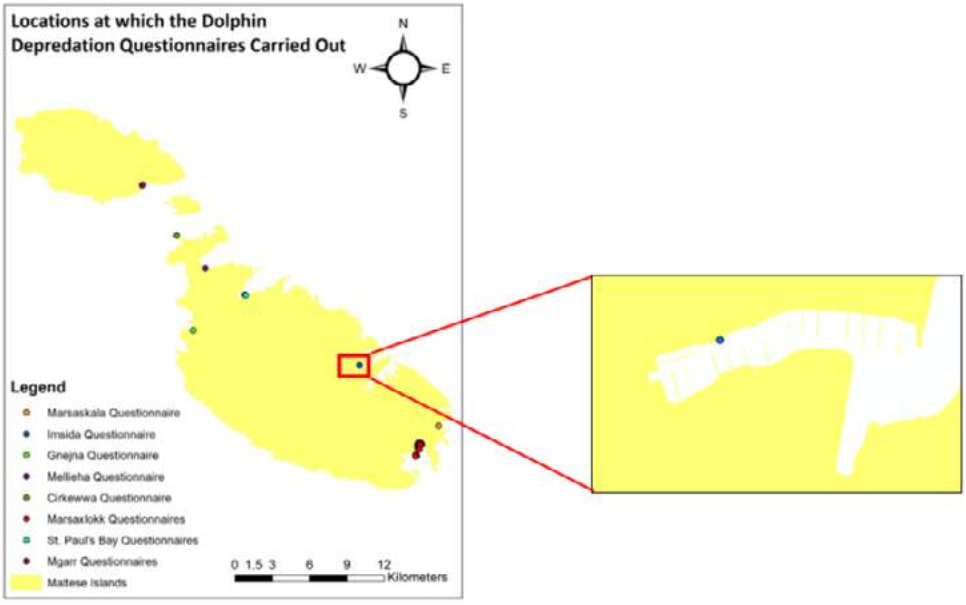
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Ġnejna



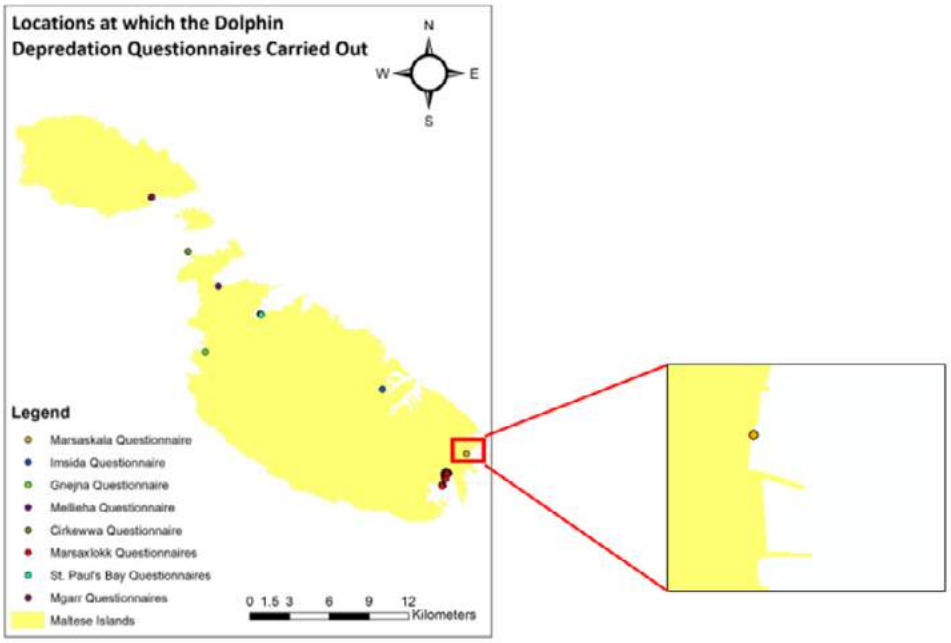
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at St. Paul's Bay



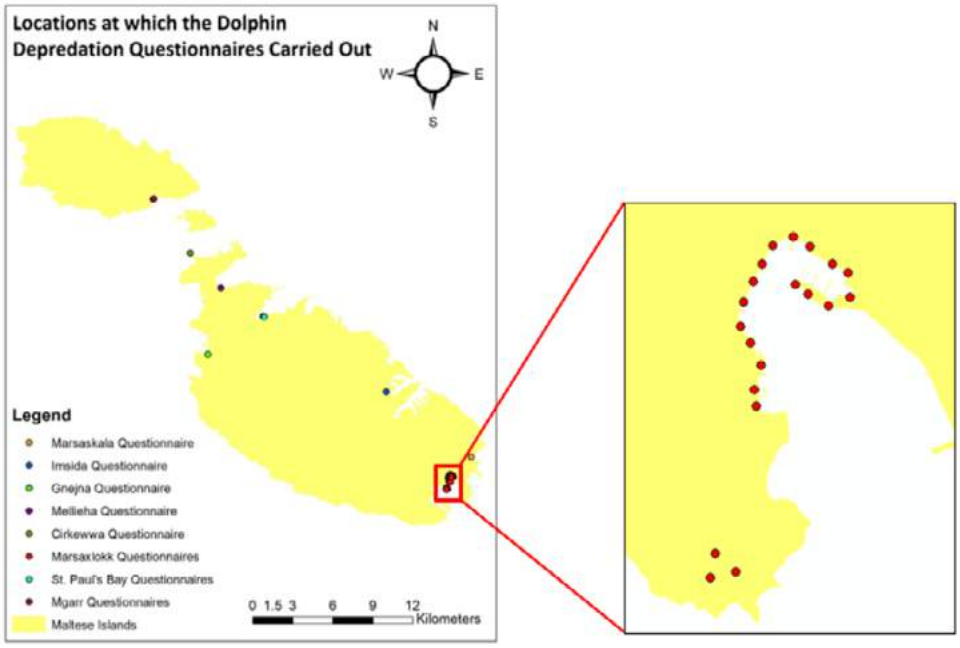
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Imsida



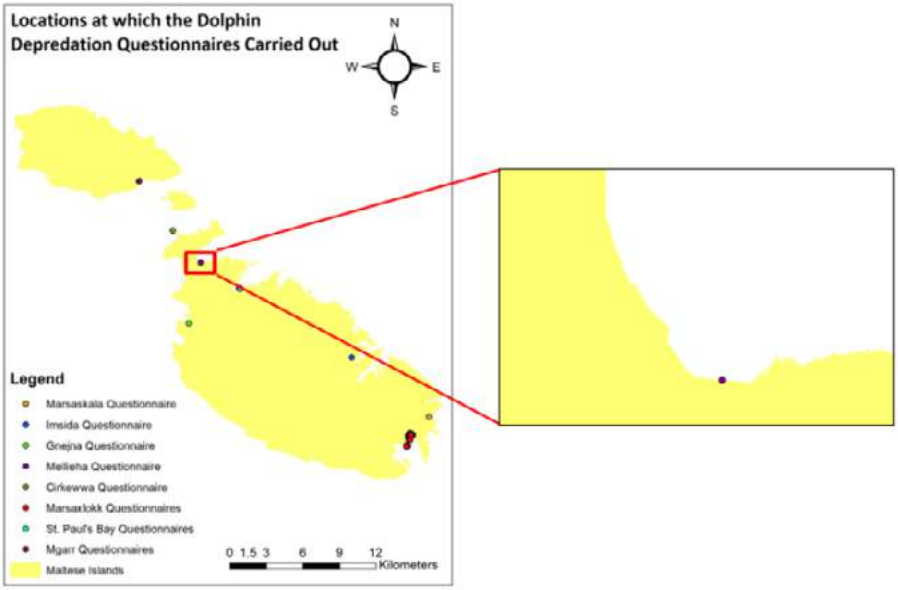
Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Marsaskala



Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Marsaxlokk



Zoomed in Image of the Location at which the Dolphin Depredation Questionnaires were carried out at Mellieha



The questionnaires were carried to assess the opinion of full-time and part-time fishers, all of which were men. Interestingly, the wives of fishers were observed making amendments to the fishing gear while the surveys were being carried out, indicating the role of women in these fisheries.

2.2 - Variables Investigated through the Questionnaire

2.2.1 Small Scale Fisheries Fleet Characteristics

The questionnaire was used to collect a wide spectrum of data on the SSF in Malta including data on the port at which the vessel is berthed, the GT tonnage of the vessels, the Length Over All (LOA) of the vessel, the engine power (kW) and the Year of Construction of the fishing vessels. The fishing gears utilized by both full-time fishers and part-time fishers were recorded in codes as per Table 2 below.

Fishing Gear Code	Common Name of Fishing Gear	Demersal/Pelagic/Both
GTR	Trammel Nets	Demersal
GTN	Combined Gillnets-trammel nets	Both
GNS	Set Gillnets	Demersal
FPO	Pots	Demersal
LLS	Set Longlines	Demersal
LTL	Troll lines	Pelagic
LLD	Drifting longlines	Pelagic
LHP	Handlines and pole-lines (Hand-operated)	Both
LHM	Handlines and pole-lines (mechanized)	Both
GND	Drifting gillnets	Pelagic
PS	Purse-seines	Pelagic
LA	Lampara nets	Pelagic

Table 2. A list of fishing codes recorded in the 8 fishing ports where the questionnaire data was collected from

2.2.2 Fishing Gear Characteristics

Data was also gathered on the characteristics of the fishing gear used. The type of gear used by the fishers was outlined and information on the fishing gear characteristics was collected. For example, information on the material utilized, the mesh size of the fishing nets and the number and sizes of hooks utilised, the length and height of the gear and the days and times spent at sea. The cost of fishing gear – construction from scratch - was also collected.

2.2.3 Investigation of interaction characteristics

The cetacean interactions were analyzed further by analyzing the frequency of the encounters over the past 5 years and if any bycatch had been caught during these interactions. The fishers were also asked whether they have ever heard of any mitigation measures with regards to warding off cetaceans so as to decrease negative interactions with these marine organisms. The fishers were also asked whether they would benefit from this mitigation and whether they would be willing to participate in an online voluntary survey to inform s on the locations at which they encountered cetaceans, for further research.

The frequency of encounters was also recorded and what species depredated the gear suffered was also noted. The questionnaire also identified which gear was mostly affected and which species are generally targeted using that type of gear. The type of bycatch captured, and the frequency of bycatch was also noted mainly focusing on what bycatch species was captured such as dolphins, whales, sharks, turtles, birds or any others.

2.2.4 Investigation of cetacean interaction in terms of gear used

Further analysis was carried out to show which type of fishing gear encountered any interactions with dolphins and at which fishing areas these interactions occurred. The questionnaire was also used to collect data on the period of time, the number of hours at which these fishing activities were carried out and at what depth and distance these fishing activities occur, as well as the cetacean interactions encountered. The questionnaire was also used to obtain an idea of the target species that are captured with this gear, in order to understand what fishers were fishing for when they encountered the cetaceans.

2.2.5 Interaction Damage and Losses

Information on whether the interactions with cetaceans were positive, indifferent or negative were also recorded. The percentage of the negative interaction and the type of damage the fishing gear may have undergone due to a negative interaction was documented. This was classified through a typology of the interaction on the fishing catch such as the depredation of catch, scattering of prey, depredation of lures, holes (including the size of the holes), bite marks found on the catch or whether the cetacean only leaves the fish head. This questionnaire was also used to analyze the percentage of the reduction of the catch and whether the catch was completely lost due to the cetacean interaction, along with costs incurred from a negative interaction and the percentage of the gear that was damaged during the negative cetacean interaction.

2.3 - Challenges Encountered During Data Collection

These questionnaires were carried out while the fishers were either fixing or arranging their fishing gear or preparing their vessels for their fishing trip, therefore the time was limited as the fishers needed to leave to commence their fishing trips and this was sometimes rather challenging to accomplish the questionnaires in full. Another challenge encountered during the data collection was that fishers did not want to answer certain questions with regards to their fishing locations, since they were afraid that their fishing locations may be revealed through the study. They also deemed the questionnaire to be lengthy since some fishers complained about this issue. Other fishers seemed to disagree with certain questions such as those with regards to the type of material they use to construct their gear since they believed that these had nothing to do with dolphin depredation. It was time-consuming to explain the importance of collecting data on the materials used to construct fishing gear, however, such conversations were also important to collect data that was not readily-collectible through the interviews

CHAPTER 03

Results and Data Analysis

INTERACTION BETWEEN CETACEANS AND SMALL-SCALE FISHERIES IN THE MEDITERRANEAN

Study Area 2:
The Case of Central Mediterranean Maltese Islands

The results brought forward a number of characteristics related to the depredation phenomenon in small-scale fisheries, and enabled us to understand what type of fisheries are mostly affected, and how these are interplaying with the socio-ecological resilience of the fishing sector. Results show that the fishing gear that is generally used by these respondents are trammel nets, gillnets and various types of longlines which are considered to be types of passive gear since they are not dragged or towed through the water column furtherly classifying these respondents as being part of the SSF in Malta (Natale, Carvalho and Paulrud, 2015).

3.1 - Small Scale Fisheries Fleet Characteristics

Of the surveyed fishers, 19 work on a full-time basis and 14 fishers work on a part-time basis. This is portrayed in Figure 4. The characters of these vessels, as illustrated in Annex 1, indicate that the average gross tonnage of the vessels analysed was 3.558GT and the average LOA was 7.2m, with an average main engine power of 101.89kW. The year of construction of the vessels ranged from 1923 to 2018.

With respect to the material used for fishing gear, all the respondents used monofilament nylon. Further specifications on individual gear types used are provided in Annex 2.

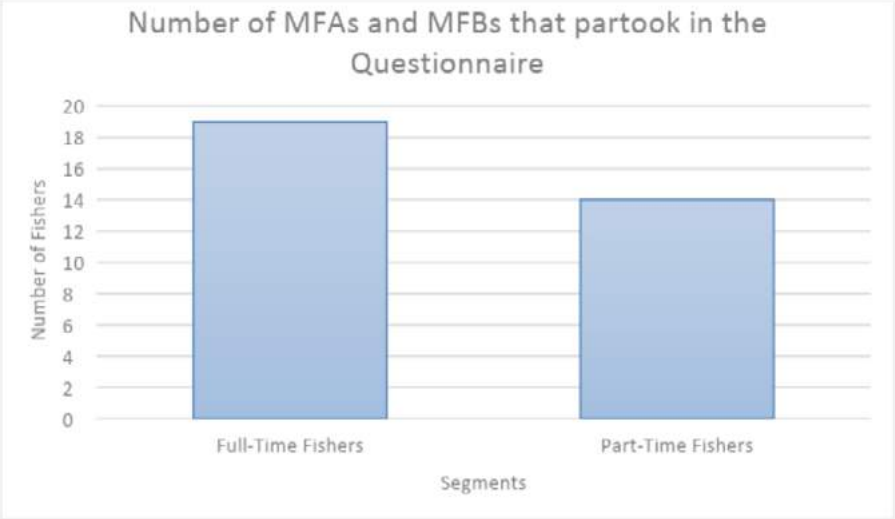


Figure 4. The Number of full-time and part-time fishers (where MFA refers to full-time professional fishing vessels and MFB stands for part-time professional fishing vessels

3.2 - Investigation of interaction characteristics

Results from the questionnaires show that out of the Cetacea infraorder, all fishers stated that only dolphins interacted with fishing gear. Subsequently, fishers were asked whether interactions have increased, decreased or stayed the same during the past 5 years. 76% agreed that the interaction of fishers with cetaceans has increased over the past 5 years. A percentage of 9% stated that they had no interaction, while 12% believe dolphin encounters remained the same. Only 3% of the fishers that were questioned agree that the frequency of encounters decreased (Figure 6).

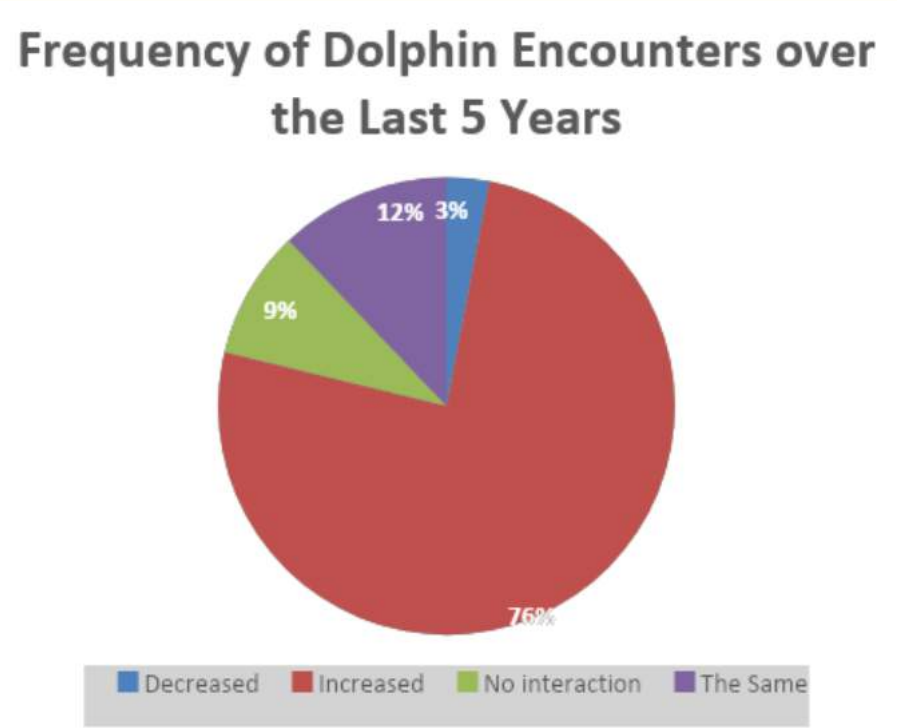


Figure 6. The frequency of dolphin encounters by Maltese fishers in the last 5 years

Fourteen of the fishers (42%) stated that most of the encounters with dolphins occurred near the fish farms. However, 11 of the fishers (33%) did not disclose any locations, since they were concerned on revealing fishing grounds they regularly exploit (Figure 7).

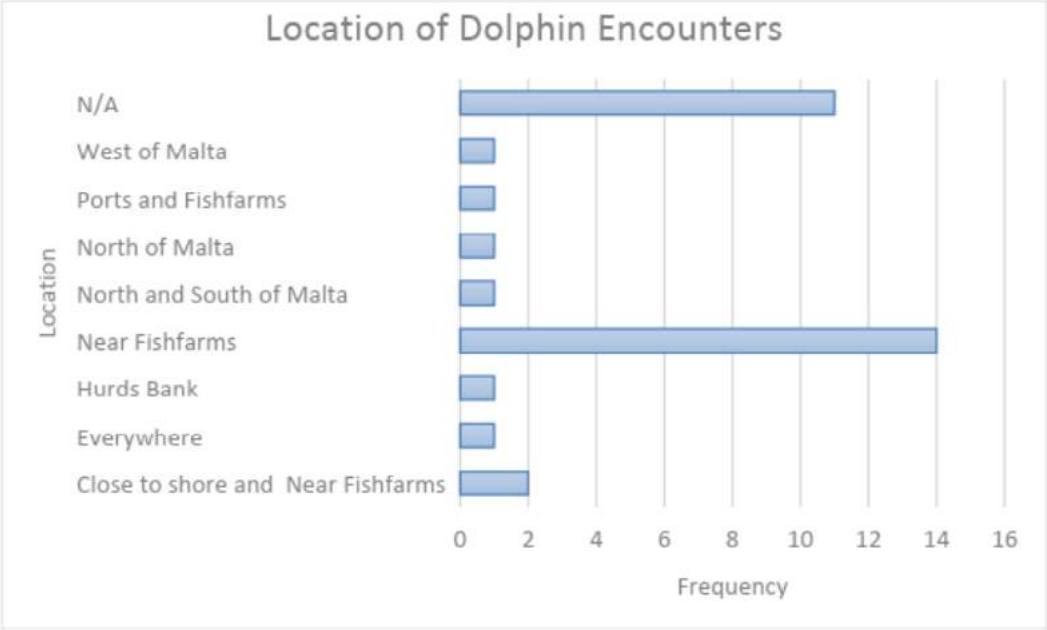


Figure 7. The location of dolphin encounters in Maltese waters

Despite that 76% of the fishers interviewed claimed that encounters increased (Figure 6), their willingness to participate in a pilot study to test mitigation measures to decrease dolphin depredation on fishing gears was not as high. As illustrated in Figure 8, most fishers (18 Fishers) are not willing to participate while some are willing to participate (15 fishers). This lack of willingness might derive from the fact that fishers did not exactly understand what the mitigation measure project could mean to their fishing activity, and thus were cautious.

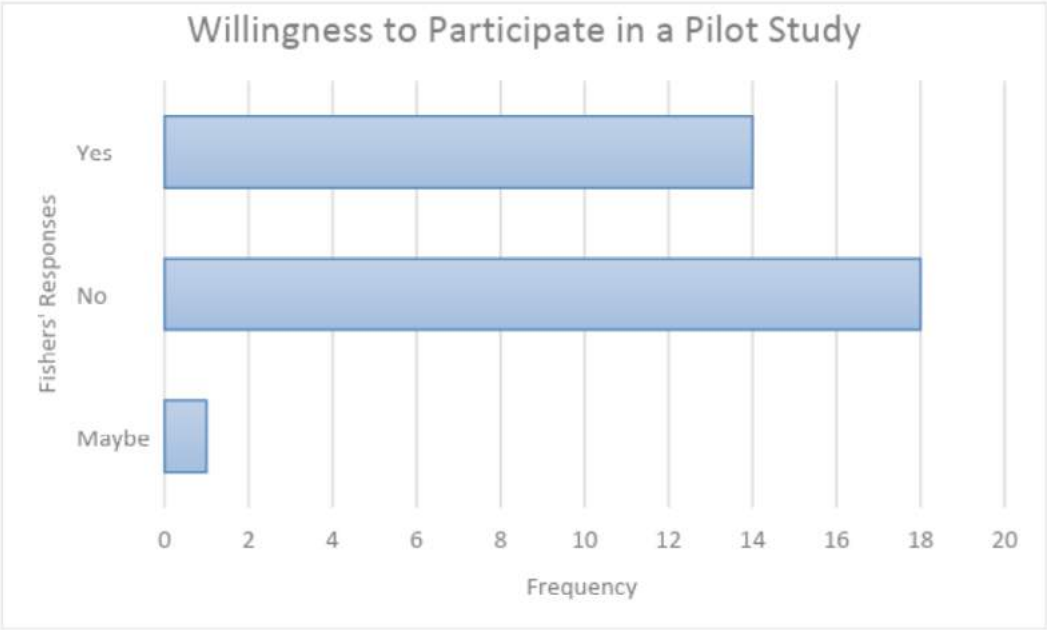


Figure 8. Fishers' willingness to participate in a pilot study to test mitigation measures to decrease dolphin depredation on fishing gears

3.3 - Investigation of cetacean interaction in terms of gear used

In order to understand cetacean interaction better, the fishers were asked as to what their target species are. 30% fish for swordfish and/or tuna, while the remainder 70% fish for various species including bogue, cuttlefish, bream, rockfish, octopus, red mullet, brown combers, scorpionfish and grouper amongst others. In terms of gear used, the use of trammel nets is by far the most popular gear type employed, followed by set longlines, set gillnets and FAD purse-seines for dolphinfish respectively.

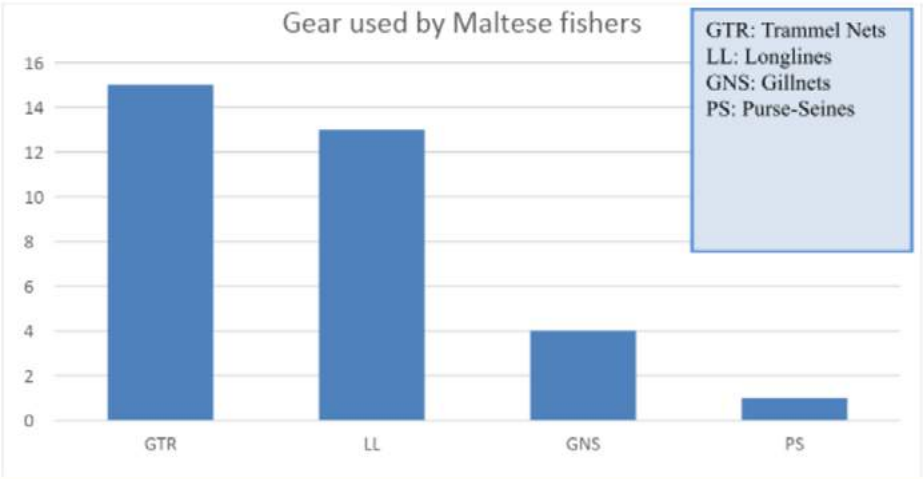


Figure 10. A bar graph showing the type of specific gear as used by Maltese fishers

In terms of distance (in Nm) that is usually travelled, Table 3 shows that in most cases (56% of the cases), the fishers do not travel further than 10Nm. Therefore this indicates that most vessels prefer to fish closer to the coast at around 1-10 miles rather than further out, even though they are able to fish throughout the 25 NM zone.

Range of distance (Nm) travelled by the fisher away from the coastline	Frequency
1-10	18
11-20	4
21-30	7
31-40	0
41-50	1
51-60	1
61-70	1

Table 3. A table showing frequency distribution of the fishers that participated in this study and the distancy they travel away from the coastaline

3.4 - Interaction Damage and Losses

Several of the fishers stated that their catch was depredated, due to the identification of bite marks on their catch or due to the presence of decapitated fish which were captured in their fishing gear. Some fishers also complained that when dolphins were present, the scattering of the catch entangled in their gear, resulting in a loss of catch. Fishers stated that both artificial and natural lures were depredated whilst nets were damaged due to presence of holes made by dolphins. The results are shown in Table 4.

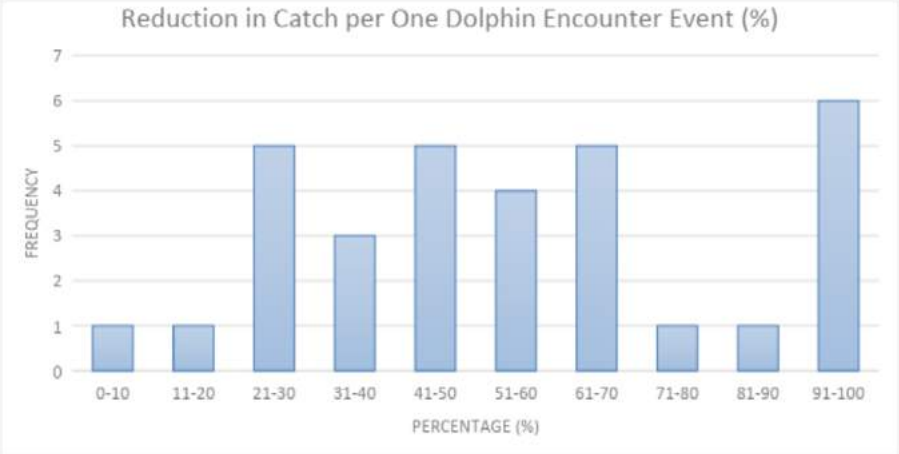


Figure 11. Reduction in catch per dolphin encounter event

The average of the reduction in catch sustained by a fisher from one dolphin encounter event is 59.22% which suggests that losses do occur due to dolphin depredation. For this analysis, the owner of survey vessel number 18 refrained from giving an exact reply and stated that the percentage fluctuates on every event. The bar graph in Figure 11 shows that 6 fishers agreed that the catch decreases by 91% or over which indicates a high loss. Only fisher seemed stated that his catch decreases by less than 10%. However, five fishers seemed to agree that their catch decreases by 21 to 30%, another five fishers also agreed that their catch decreases by 41-50% and another five seemed to agree that their catch decreased between 61-70%.

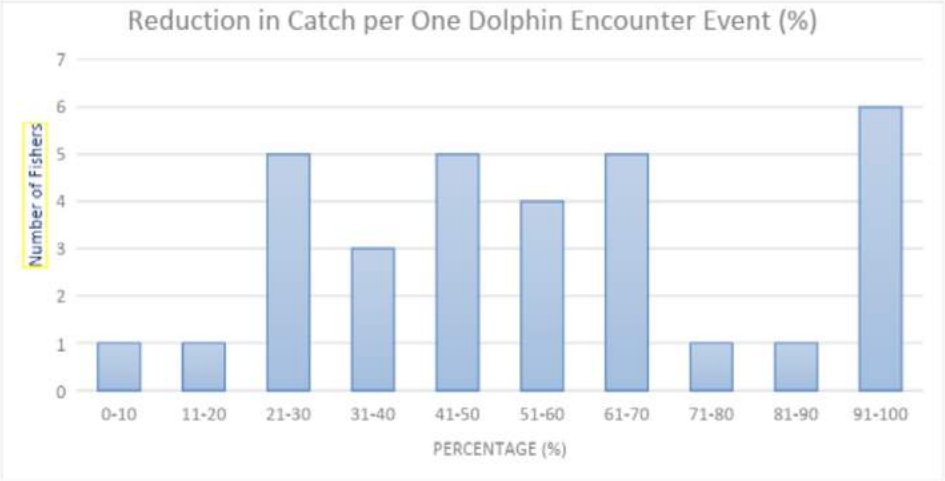
		Fishing Gear Damage from a Single Dolphin Encounter		
Survey Vessel	**Depredation on Catch**	**Scattering Prey**	**Lures Depredated**	**Holes**
1	Bite Marks; Fish head;	No	-	Yes
2	Bite Marks; Fish head;	Yes	-	Yes
3	Fish head;	No	-	Yes
4	Other	No	Empty Hooks	-
5	Bite Marks; Fish head;	Yes	-	Yes
6	Other	No	Eat the bait off the hooks	-
7	Bite Marks; Fish head;	Yes	-	Yes
8	Fish head;	No	-	Yes
9	Other	No	Empty Hooks	-

10	Other	No	Empty Hooks	-
11	Other	No	Empty Hooks	-
12	Bite Marks; Fish head;	Yes	-	Yes
13	Bite Marks; Fish head;	No	-	Yes
14	Bite Marks; Fish head;	No	-	Yes
15	Other	No	Empty Hooks	-
16	Bite Marks; Fish head;	Yes	-	Yes
17	Other	Yes	-	Yes
18	Other	Yes	Empty Hooks	-
19	Other	Yes	-	Yes
20	Bite Marks; Fish head;	No	-	Yes
21	Bite Marks; Fish head;	Yes	-	Yes
22	Other	No	Yes	-
23	Bite Marks	No	Yes	-
24	Fish head;	Yes	-	-
25	Bite Marks; Fish head;	Yes	Yes	-
26	N/A	Yes	-	-
27	Bite Marks	-	-	-
28	Bite Marks	-	-	-

29	Bite Marks	-	-	Yes
30	Bite Marks; Fish head;	Yes	-	-
31	N/A	-	Yes	-
32	N/A	Yes	Leaves Bite	-
33	Bite Marks	-	-	-

Table 4 – Fishing gear damage from a single dolphin encounter

Most fishers stated that only 0% to 10% of their fishing gear was damaged during a dolphin encounter



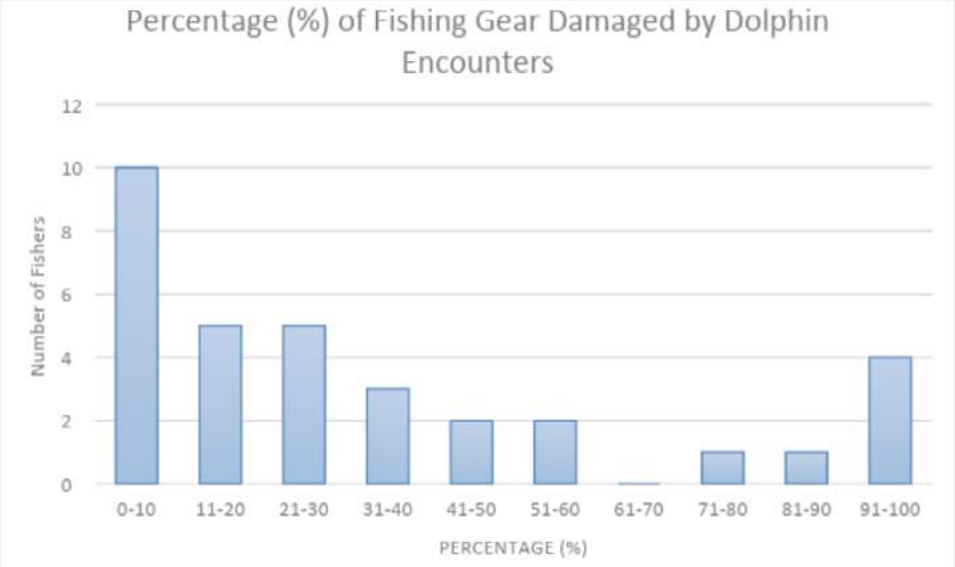


Figure 12 – The percentage of fishing gear that was damaged for each dolphin encounter

The results however indicate that, on average, fishing gears undergo 33% worth of damages due to dolphin interactions. The bar chart (Figure 13) shows that 10 fishers seemed to agree that the percentage of their gear that was damaged was between 0-10%. Only 4 fishers seemed to complain that 91-100% of their gear was damaged.

In terms of costs, the bar graph in Figure 13 shows the costs incurred by the different SSF.

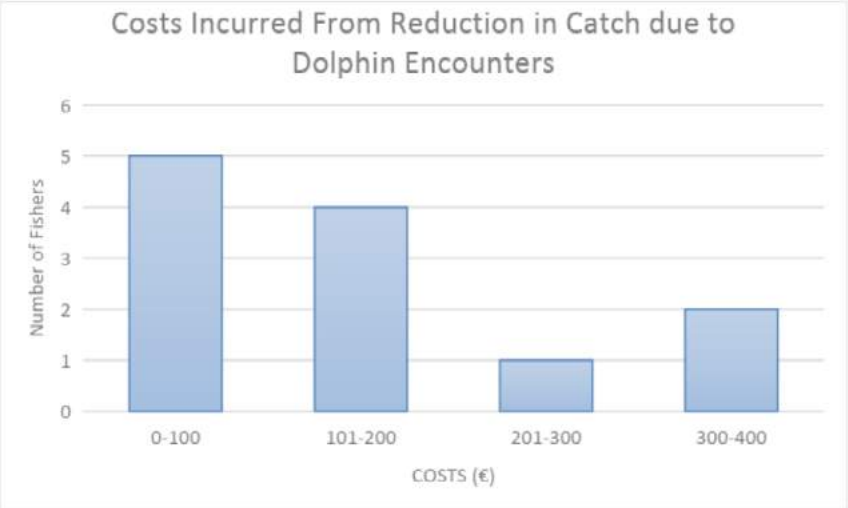
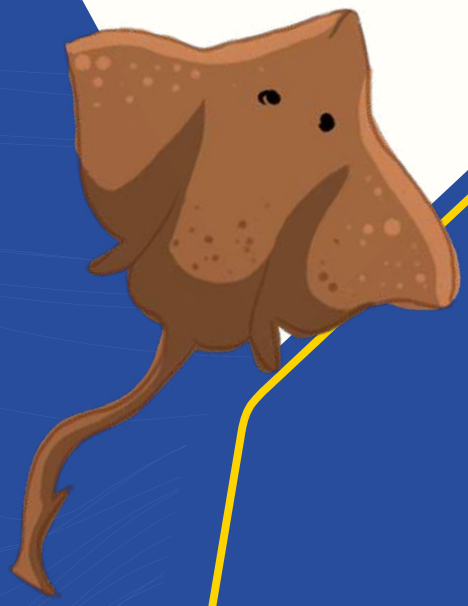


Figure 13 – Costs incurred from reduction in catch due to dolphin encounters

Only 12 individuals answered this question since the other fishers preferred not to provide an answer. An average cost of €178.33 per year was calculated based on the data obtained from the questionnaires. The costs ranged from €30 to €400. Five fishers agreed that the costs incurred from the reduction in catch due to dolphin encounters was between €0-€100. Four fishers complained that the costs did go up over a €101 to a maximum of €200. Only one fisher seemed to complain that costs range from €201 to €300 and two other fishers seemed to complain that costs range between €300 to €400.



CHAPTER 04

Discussion

INTERACTION BETWEEN CETACEANS AND SMALL-SCALE FISHERIES IN THE MEDITERRANEAN

Study Area 2:
The Case of Central Mediterranean Maltese Islands

The depredation of fishing gear by cetaceans is considered to be an economic concern (Snape et al., 2018). Depredation has attracted international attention in the last few decades due to the constant technological advancement of fishing gear. According to Romanov et al. (2013) depredation is defined as the "the partial or complete removal of bait or captured fish in fishing gear" by aquatic organisms such as cetaceans, fish, birds, sharks and turtles. This generally occurs in stationary gear such as bottom longlines, traps, trammel and gillnets, and line fisheries (Romanov et al., 2013). However, mobile fisheries such as trolling, purse-seining and trawling may still undergo depredation, with various cetaceans. In this study, the results show that out of all the infraorder of Cetacea, fishers only encountered dolphins. This fits the findings reported by Debono (2020), who used systematic surveys to show the regular presence of bottlenose dolphins, with 59 dolphin pod sightings with a median of 12 individuals per pod occuring between 2013 to 2016. Debono (2020) also states that it is believed that bottlenose dolphins are widely distributed in Maltese waters and they are highly common in the southern regions. Since most of the questionnaires were carried out in Marsaxlokk, this explains why all of the respondents reported that dolphins were encountered on several fishing trips. Debono (2020) also states that their population is stable, furtherly proving the results obtained.

The pie-chart in Figure 6, shows that 75% of the fishers have stated that dolphin encounters have increased over the last 5 years. López (2006) carried out a study on the interaction of dolphins with gillnet fisheries in Sardinia, and showed that out of 317 days of observation, dolphins were observed for 330.6 hours. According to Panigada and Labach (2018), bottlenose dolphins are highly comomon in the Strait of Sicily making Malta a highly-vulnerable spot for dolphin depredation as seen in Figure 6 (European MSP Platform, n.d.). This may be because bottlenose dolphins tend to feed on fish such as mackerel, bogue, squids anchiovies and mullet (Whale and Dolphin Conservation, n.d.) which are all species that are captured in Malta.

Figure 7 clearly denotes that 18 fishers are not willing to participate in a pilot study due to unsuccessful acoustic studies carried out in the past while 14 fishers were willing and only 1 fisher stated that he may participate. Researchers' encounters with the fishers had revealed that fishers had already been testing some acoustic devices provided for by another study, and to their knowledge, these had been unsuccessful in warding off bottlenose dolphins. However, this may be due to the fact that not all dolphins are affected by acoustic deterrent devices, since in a study carried out by Berrow et al. (2008) in Ireland, the intitial two acoustic deterrent devices were unsuccessful in warding off dolphins. Berrow et al. (2008) also utilised a new signal output device to try and reach a range of signals. However there were no significant results and commercial acoustic devices were also used and only a mild evasive behaviour was observed. These results may explain the fishers' reluctance on partaking in such a pilot study.

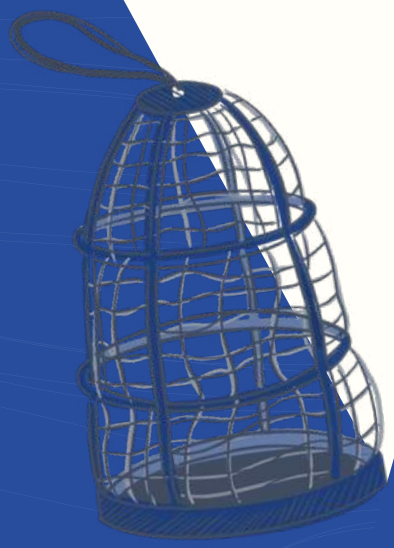
The results in Figure 8 clearly denotes that most of the dolphin encounters occur near the fish-farms. This echoes findings reported by Vella (2016) who showed that Tursiops truncatus seem to frequently forage very close to the tuna fish-farms in the South East of Malta resulting in depredation of fishing gear. Similary, Bonizzoni et al. (2014) showed that bottlenose dolphins interact regularly with fish farming activities in Greece, while López (2005), confirmed that dolphin activity seems to increase around fish farms due to the abundant supply of food in a concentrated areas. This study thus suggests that the accumulation of dolphins is a result of opportunistic feeding of mackarel which is used as bait for tuna ranching. Such a behavioural feeding strategy increase the feeding rate of dolphins and decrease their energy in foraging activities (López, 2005).

When the questionnaires were being carried out the fishers commented that trammel nets and gillnets are also taken advantage of by dolphins, since they feed on the catch captured by these fishing gears. These fishers stated that they set their fishing gears during the night and the dolphins depredate the catch early in the morning prior to retrieving the gear. This was

also confirmed by Lauriano et al. (2009) who stated that their study on Italian artisinal fisheries showed that trammel nets and gillnets were the most vulnerable fishing gear to dolphin depredation. In fact this study showed that 72.2% if fishing gear had been damaged by dolphins, therefore resulting in a decrease in catch. The longline fishers that were questioned also stated that their swordfish longline mackerel bait is also depredated also resulting in a decrease in catch. According to Zollett and Read (2006) mackerel is the most depredated bait by dolphins.

In terms of interaction damage and losses, Table 4, which provides a summary of fishing gear damage from a single dolphin encounter, describes how the commonest depradation was 'Bite Marks' and in most cases, respondents suffered holes in their fishing gear. Similar issues were found in Sardinia by Diaz Lopez (2006) who reported that bottlenose dolphins biting and damaging nets and forming small holes on fish farm cages were observed (Diaz Lopez, 2006). Gomerčić et al. (2009) further argue that feeding on fish from gill nets is not an inborn behaviour in bottlenose dolphins, and that it is instead learned from other conspecifics. In their study, this was supported by the estimated age distribution of the affected animals which were all older than 7 years.

Figure 11 portrays that the average reduction in catch sustained by a fisher from one dolphin encounter event is 59.22% which implying that losses occur due to dolphin depredation. In fact, Zollet et al. (2006) confirm that dolphins engaging in depredation activities cause damage to fishing gear and decrease the value and quantity of catches. This was further confirmed by Rocklin et al. (2009) who reported that common bottlenose dolphins attacked, on average, 12.4% of the nets and damaged 8.3% of the catch. Apart from the damage caused due to dolphin interactions, an average 33.43% (Figure 12) of the fishing gear, worth an average of €178.33 per year (Figure 13) in damages was also reported. Such costs, coupled with depleting fish stocks, market changes and other socio-cultural factors, are compounding the already-existing burdens on small-scale fisheries in the Mediterranean.



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CHAPTER 05

Conclusions and Recommendations

INTERACTION BETWEEN CETACEANS AND SMALL-SCALE FISHERIES IN THE MEDITERRANEAN

Study Area 2:
The Case of Central Mediterranean
Maltese Islands

5.1 - Conclusions

In this study, questionnaires were used to understand the perception of dolphin depredation phenomenon and how fishers are mostly affected in the Maltese islands. The regular presence of bottlenose dolphins seems to have increased over the last 5 years, with most dolphin encounters occuring near fish-farms. While the use of trammel nets remains by far the most popular gear type employed by Maltese fishers, this study showed that an average 33.43% of the fishing gear, worth an average of €178.33 per year in damages was also reported. This results in an increased pressure on artisanal fishers that is already highly burdened by other threats (Said et al. 2018). It is to be noted that other species and external factors other than dolphins could have been responsible for part of the damage. In addition, questionnaires carried out during this study could have been perceived by some fishermen as an opportunity to influence future decision-making regarding monetary compensation for the impact of depredation and therefore, economic values cited by fishers may be slightly inflated or erroneous overall.

Nonetheless, the reporting of depredation is a good start in analysing the current status of dolphin depredation in the Maltese Islands. Depredation is generally not reported in fisheries statisitcs and this is considered to be a source of mortality that is not taken into consideration for current fish stock assessments which are highly essential in the management of fisheries (Gilman et al., 2007). There is an obvious need to closely monitor the depredation of gear and amalgamate it with fisheries management and provide proper mitigation measures (Romanov et al., 2007). It is essential that dolphin depredation is recorded and given to STECF in order to provide proper consultations to the European Commission with regards to the proper management and conservation of marine resources (European Commission, n.d.).

5.2 - Recommendations

The authors of this study evaluated a number of recommendations which could be taken into consideration:

1) Further studies and investigation:

Further research is needed such as the implementation of floating laboratories as has been implemented in Sicily by LIFE, such that the findings of the questionnaires are triangulated with the on-site investigations

The authors also suggest the use of onboard observers as suggested by Lauriano et al. (2004) who proposed that surveys are carried out on a regular basis to determine the frequency of the dolphin interactions, through ongoing research. This would provide a more holistic picture of the current status of dolphin depradation and its effects on small-scale fisheries in the Maltese Islands.

2) Prevention and Mitigation measures:

The authors recommend that new prevention and mitigation measures are tested in order to try and reduce the risk of depredation by dolphins.

Since acoustic devices may not be as successful since dolphins may get used to a certain acoustic frequencies and it may augment their capability to find fishing gear, it may be beneficial to utilise acoustic devices that emit random pulses that occur over a broader frequency range as suggested by ACCOBAMS (2019).

Other mitigation measures that can be used to decrease interactions are by communicating the cetacean hotspots with other fishers to decrease chances of depredation as suggested by Gilman et al.(2006).

It may be also beneficial to carry out regular monitoring surveys at sea to try and assess which areas are mostly considered to be cetacean breading and feeding grounds.

Studies on the damage done on fishing gear should be also carried out to assess the level of depredation fishing gears are undergoing.

The authors also suggest that the use of fishing gear or bait with unpleasant tastes or smells could be an option as also proposed by Gilman et al.(2006).

Another mitigation measure which may be utilised was referenced in the "Paraped" project. This project focused on construction of masking nets in order to protect gear used in the longline fishery. However this mitigation still needs to be improved, therefore further testing may be carried out in the phase 2 of this project (Rabearisoa et al., 2019).

Another measure which could be considered was described by Rabearisoa et al (2015). This measure involves the use of the "DEPRED" mitigation device. This is a device has two main goals. These include the startling of predators when they are in the vicinity of the fishing gear to protect captured fish. The prototype of the "DEPRED" device includes the eight one metre long streamers that are constructed from tarpaulin and they are fixed on a PVC tube of a 2cm diameter. The upper streamers function as a form of a deterrent to cetaceans while the lower 4 streamers are weighted and they cover the captured providing it a protective effect. There are several other varieties of the umbrella-and-stones technique, however even though depredation prevention was successful this prototype had a detrimental effect on the catches. (Rabearisoa et al., 2015).

Ultimately it would be essential to organise conferences, publish reports and promote information online in order educate the public especially fishers on the results achieved.

3) Opportunities for fishers

The dolphin presence could be exploited for the local coastal economy, which includes activities such as dolphin watching, merchandising, and fishing tourism, as a diversification activity for fishers.

References

ACCOBAMS (2019) "Seventh Meeting of the Parties to ACCOBAMS", Available at: https://accobams.org/wp-content/uploads/2019/04/MOP7.Doc30_Mitigation-measures-for-protected-species.pdf, (Accessed on: 26th July, 2020).

Berrow, S., Cosgrove, R. Leeney, R., O'Brien, J., Mcgrath, D., Dalgard, J. and Le Gall, Y. (2008) 'Effect of acoustic deterrents on the behaviour of common dolphins *(Delphinus delphis)*', *Journal of Cetacean Research and Management,* 10(3):227-233.

Bonizzoni, S., Furey, N., Pirotta, E., Valcanis, V.D., Wursig, B. And Bearzi, G. (2014) 'Fish farming and its appeal to common bottlenose dolphins: Modelling habitat use in a Mediterranean embayment', *Aquatic Conservation Marine and Freshwater Ecosystems*, 24(5), DOI: 10.1002/aqc.2401

Brotons, J.M., Grau, A. and Rendell, L. (2008) 'Estimating the impact of interactions between bottlenose dolphins and artisanal fisheries around the Balearic Islands', *Marine Mammal Science*, 24(1): 112 -127, doi: 10.1111/j.1748-7692.2007.00164.x

Carvalho, N., Edwards-Jones, G. and Isidro, E. (2010) 'Defining scale in fisheries: Small versus large-scale fishing operations in the Azores', *Fisheries Research*, 109(2011) 360-369.

De Leiva, I., Busuttil, C., Darmanin, M. and Camilleri, M. (n.d.) Project: FAO COPEMED: Artisinal Fisheries in the Western Mediterranean. [online], Available at: http://webco.faocopemed.org/old_copemed/vldocs/0000174/maltafisheries.pdf, (Accessed on: 3rd August, 2020).

Debono, J. (2020) *Malta's bottlenose dolphin population estimated at 79*. Available at: https://www.maltatoday.com.mt/environment/nature/101632/maltas_bottlenose_dolphin_population_estimated_at_79#.Xxw_Wp4zbIU, (Accessed: 25th July 2020).

Department of Fisheries and Aquaculture (2019) *Annual Report on efforts to achieve a sustainable balance between fishing capacity and fishing opportunities for the year 2018.* [online], Available at: https://ec.europa.eu/fisheries/sites/fisheries/files/docs/2018-fleet-capacity-report-malta_en.pdf, (Accessed: 21st July 2020).

Department of Fisheries and Aquaculture (n.d.) Artisanal fisheries in the Western Mediterranean - Malta Fisheries [online], Available at: http://webco.faocopemed.org/old_copemed/vldocs/0000174/maltafisheries.pdf, (Accessed: 26th July 2020).

Diaz Lopez, B. (2006) 'Bottlenose dolphin *(Tursiops truncatus)* predation on a marine fin fishfarm: Some underwater observations', *Aquatic Mammals*, 32: 305–310.

EcoMarine Malta (2018) Dolphins and Whales of Mediterranean Sea. [online], Available at: https://www.ecomarinemalta.com.mt/malta/cetaceans/, (Accessed on: 14th September, 2020)

Environment and Resource Authority (2016) *After-LIFE Conservation Plan for the logger head turtle and the bottlenose dolphin in Maltese waters*. [online], Available at: https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE11_NAT_MT_001070_AfterLIFE.pdf (Accessed: 24 July 2020).

Environment and Resource Authority (n.d.) Initial MSFD Assessment Fisheries. [online], Available at: https://era.org.mt/en/Documents/MSFD-InitialAssessment-Fisheries.pdf, (Accessed: 21st July 2020).

European Cetacean Bycatch Campaign (n.d.) Trammel Nets. Available at: http://www.eurocbc.org/page177.html, (Accessed: 25th July, 2020).

European Commission (2008) *Fisheries Operational Programme for Malta*. [online], Available at: https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/malta_en.pdf, (Accessed: 21st July, 2020).

European Commission (2016) *Protecting whales, dolphins and porpoises against incidental catch.* [online], Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:l66024&from=EN, (Accessed on: 26th July, 2020).

European Commission (n.d.) STECF. [online], Available at: https://stecf.jrc.ec.europa.eu/, (Accessed on: 26th July, 2020).

European MSP Platform (n.d.) *Case Study: Straight of Sicily-Malta.* [online] Available at: https://www.msp-platform.eu/practices/case-study-strait-sicily-malta, (Accessed: 25th July, 2020).

FAO (2016) *The Republic of Malta - Country brief.* [online] Available at: http://www.fao.org/fishery/facp/MLT/en, (Accessed: 22 July 2020).

FAO (2020) *Fishery Sector Structure.* [online] Available at: http://www.fao.org/fi/oldsite/FCP/en/MLT/profile.htm, (Accessed: 22 July 2020).

Fisheries Control Directorate (2013) *Fisheries Management Plan.* [online] Available at: https://stecf.jrc.ec.europa.eu/documents/43805/595618/Maltas+Fisheries+Management+Plan+-+Trawler+and+Lamapra.pdf, (Accessed: 21st July 2020).

Fishing Vessels Regulations 2004 (MLT) Retrieved from http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=10743

Food and Agriculture Organisation of the United Nations (2014) Deep-water rose shrimps, European hake and related fisheries in the MedSubMed Project Area. [online] Available at: http://www.faomedsudmed.org/pdf/2014_06_24_Terms_Reference_Meet_DeepWater_Shrimp_hake.pdf, (Accessed: 21st July, 2020).

Food and Agriculture Organisation of the United Nations (2020) Coordinating Working Party on Fishery Statistics (CWP). [online], Available at: http://www.fao.org/cwp-on-fishery-statistics/handbook/capture-fisheries-statistics/fishery-fleet/en/, (Accessed: 21st July, 2020).

Food and Agriculture Organisation of the United Nations (2020) Set Longlines. [online], Available at: http://www.fao.org/fishery/geartype/232/en, (Accessed on: 3rd August, 2020).

Food and Agriculture Organisation of the United Nations (2020) Small-Scale Tuna Longlining. [online], Available at: http://www.fao.org/fishery/fishtech/10/en, (Accessed: 25th July, 2020).

Food and Agriculture Organisation of the United Nations (n.d.) Fishing Gear Selectivity and Performance. [online], Available at: http://www.fao.org/3/AC749E08.htm, (Accessed on: 3rd August, 2020).

Food and Agriculture Organisation of the United Nations (n.d.) The Republic of Malta. [online], Available at: http://www.fao.org/fi/oldsite/FCP/en/MLT/profile.htm, (Accessed: 21st July, 2020).

Food and Agriculture Organisation United Nations (2018) The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome. 172 pp Licence: CC BY-NC-SA 3.0 IGO.

Gilman, E., Brothers, N. McPherson, G. and Dalzell, P. (2006) 'Review of cetacean interactions with longline gear', Journal of Cetacean Research and Management, 8(2): 215-223.

Gilman, E., Clarke, S., Brothers, N., Alfaro-Shigueto-J., Mandelman, J., Mangel, J., Petersen, S., Piovano, S., Thomson, N., Dalzell, P., Donoso, M., Goren, M., Werner, T. (2007) Shark depredation and unwanted bycatch in pelagic longline fisheries: industry practices and attitudes, and shark avoidance strategies. Western Pacific Regional Fishery Management Council, Honolulu, USA.

Gomerčić, M. D., Galov, A., Gomerčić, T., Škrtić, D., Ćurković, S., Lucić, H., Vuković, S., Arbanasić, H., and Gomerčić, H. (2009) 'Bottlenose Dolphin (Tursiops truncatus) Depredation Resulting in Larynx Strangulation with Gill-Net Parts', Marine Mammal Science 25: 392–401.

Karakulak, F.S. and Erk, H. (2008) "'Gill net and trammel net selectivity in the northern Aegean Sea, Turkey'", Scientia Marina, 72:(33).

Lauriano, G, Caramanna, L., Scarrno, M. and Andaloro, F. (2009) "An overview of dolphin depredation in Italian artisanal fisheries", Journal of the Marine Biological Association of the UK, 89(05):921 – 929, DOI: 10.1017/S0025315409000393.

Lauriano, G., Fortuna, C.M., Moltedo, G. and Notarbartolo di Sciara, G. (2004) "Interactions between common bottlenose dolphins (Tursiops truncatus) and the artisanal fishery in Asinara Island National Park (Sardinia): Assessment of catch damage and economic loss", Journal of Cetacean Research and Management, 6(2):165-173.

Lloret, J., Cowx, I. G., Cabral, H., Castro, M., Font, T., Gonçalves, J. M. S., Gordoa, A., Hoef-

nagel, E., Matić-Skoko, S., Mikkelsen, E., Morales-Nin, B., Moutopoulos, D.K., Muñoz, M., Santos, M.N., Pintassilgo, p., Pita, C., Stergiou, K.J., Ünal, V., Veiga, P. And Erzini, K. (2018) 'Small-scale coastal fisheries in European Seas are not what they were: ecological, social economic changes', Mar. Policy. doi: 10.1016/j.marpol.2016.11.007

López, B.D. (2005) '"The impact of a fish farm on a bottlenose dolphin population in the Mediterranean Sea"', Thalassas, 21(2): 65-70.

López, B.D. (2006) 'Interactions between Mediterranean bottlenose dolphins (Tursiops truncatus) and gillnets off Sardinia, Italy', ICES Journal of Marine Science, 63(5), 946–951, DOI: https://doi.org/10.1016/j.icesjms.2005.06.012

Maccarrone, V., Buffa, G., Di Stefano, V., Filiciotto, F., Mazzola, S., and Buscaino, G. (2014) 'Economic Assessment of Dolphin Depredation Damages and Pinger Use in Artisanal Fisheries in the Archipelago of Egadi Islands (Sicily)', Turkish Journal of Fisheries and Aquatic Science, 14: 173–181.

Malta Today (2020) Malta's bottlenose dolphin population estimated at 79. [online], Available at: https://www.maltatoday.com.mt/environment/nature/101632/maltas_bottlenose_dolphin_population_estimated_at_79#.X19aPXkzbIU, (Accessed on: 14th September, 2020).

Malta Uncovered (2020) Marsaxlokk: Malta's fishing village-travel guide and tips. [online], Availbale at: https://www.maltauncovered.com/malta-island/marsaxlokk-fishing-village/, (Accessed: 25th July, 2020).

Muscat, C. (2018) Malta risks missing EU deadline for plans to safeguard Marine Protected Areas. Available at: https://theshiftnews.com/2018/01/31/malta-risks-missing-eu-deadline-for-plans-for-safeguard-marine-protected-areas/, (Accessed on: 26th July, 2020).

Natale, F., Carvalho, N. and Paulrud, A. (2015) 'Defining small-scale fisheries in the EU on the basis of their operational range of activity The Swedish fleet as a case study', Fisheries Research, 164(2015) 286-292.

Panigada, S. and Labach, H. (2018) Tursiops truncatus in the Mediterranean and Black Seas, Available at: https://ec.europa.eu/environment/nature/natura2000/platform/documents/second_marine_biogeographical_process_seminar/Day3_Session3%2C%203b%20-%20Panigada.pdf, (Accessed: 25th July, 2020).

Rabearisoa N., Guinet C., Guérin P., Bach P. (2019). Depredation mitigation device for pelagic longline fisheries: the PARAPED project. World Marine Mammal Conference, Barcelona, December 2019.

Rabearisoa, N., Bach, P., & Marsac, F. (2015). Assessing interactions between dolphins and small pelagic fish on branchline to design a depredation mitigation device in pelagic longline fisheries. ICES Journal of Marine Science, 72(5), 1682-1690.

Revuelta, O., Domenech, F., Fraija-Fernandez, N., Gozalbes, P., Novillo, O., Penades-Suay, J. And Tomas, J. (2018) 'Interaction between bottlenose dolphins (Tursiops truncatus) and artisanal fisheries in the Valencia region (Spanish Mediterranean Sea)', Ocean & Coastal Management, 165: 117-125, doi: 10.1016/j.ocecoaman.2018.08.001.

Richard Caddell (2005) "By-Catch Mitigation and the Protection of Cetaceans: Recent Developments in EC Law", Journal of International Wildlife Law & Policy, 8:2-3, 241-259, DOI: 10.1080/13880290590965302.

Rocklin, D., Santoni, M. C., Culioli, J. M., Tomasini, J. A., Pelletier, D. and Mouillot, D. (2009) 'Changes in the Catch Composition ofArtisanal Fisheries Attributable to Dolphin Depredation in a Mediterranean Marine Reserve', ICES Journal of Marine Science, 66: 699–707.

Romanov, E.V., Sabarros, P.S., Le Foulgoc, L., Richard, E., Lamoureux, J.P, Rabearisoa, N. and Bach, P. (2013) Assessment of depredation level in Reunion Island pelagic longline fishery based on information from self-reporting data collection programme. [online], Available at: http://www.fao.org/3/a-bh068e.pdf, (Accessed: 25th July, 2020).

Said A. (2017) 'Are the FAO Small-Scale Fisheries Guidelines Sufficient to Halt the Artisanal Fisheries Decline in Malta?' in Jentoft, S., Chuenpagdee, R., Barragan-Paladines, M.J. and Franz N. 'The Small-Scale Fisheries Guidelines: Global Implementation', MARE Publication Series, Chapter: 11, Springer.

Savona-Ventura (n.d.) Marine Mammals in the Central Mediterranean. [online], Available at: http://www.shadowservices.com/nature/Maltese/biology/mar-mam.htm, (Accessed on: 14th September, 2020).

Sciara, G.N. (2002) Action Plan for the Conservation of Cetaceans in Maltese Waters. [online], Available at: http://www.disciara.net/downloads/NotarbartolodiSciara_Mifsud_2002.pdf, (Accessed on: 17th September, 2020).

Snape, R.T.E, Broderick, A.C., Çiçek, B.A., Fuller, W.J., Treganza, N., Witt, M.J. and Brodley, B.J. (2018) 'Conflict between Dolphins and a Data-Scarce Fishery of the European Union', Hum Ecol Interdiscip J., 46(3): 423-433, doi: 10.1007/s10745-018-9989-7.

The Malta Independent (2019) Then and Now: St. Paul's Bay-from fishing village to most populous locality in Malta. [online], Available at: https://www.independent.com.mt/articles/2019-09-16/local-news/Then-and-Now-St-Paul-s-Bay-from-fishing-village-to-most-populous-locality-in-Malta-6736213563, (Accessed: 25th July, 2020).

Times of Malta (2005) Malta 'against' use of driftnets. Available at: https://timesofmalta.com/articles/view/malta-against-use-of-driftnets.77740, (Accessed on: 26th July, 2020).

Times of Malta (2010) Whales in Maltese waters, and we hardly know about them! [online], Available at: https://timesofmalta.com/articles/view/whales-in-maltese-waters-and-we-hardly-know-about-them.308247, (Accessed on: 14th September, 2020).

UNEP/MAP (2015) Sicily Channel /Tunisian Plateau: Status and conservation of Cetaceans. Twelfth Meeting of Focal Points for Specially Protected Areas, Athens (Greece), 25-29 May 2015 [online], Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/14671/15wg408_inf05_engonly.pdf?sequence=1&isAllowed=y (Accessed on: 17th September, 2020).

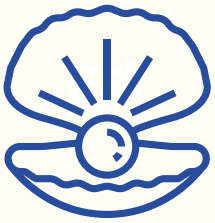
University of Malta (2020) New Publication on the status of Maltese small-scale fisheries. [online], Available at: https://www.um.edu.mt/newspoint/news/2020/06/publication-status-maltese-fisheries, (Accessed: 22nd July, 2020).

Vella, A. (2016) Resolving Bottlenose Dolphin-Fisheries Association Problems in Maltese Waters, Central Mediterranean. [online], Available at: https://www.um.edu.mt/library/oar/bitstream/123456789/43854/1/Resolving_bottlenose_dolphin_fisheries_association_problems_in_maltese_waters_central_mediterranean.pdf, (Accessed: 25th July, 2020).

Whale and Dolphin Conservation (n.d.) What do Dolphins Eat?. [online], Available at: https://us.whales.org/whales-dolphins/what-do-dolphins-eat/, (Accessed on: 3rd August, 2020).

Wise, L., Silva, A., Ferreira, M., Silva, M.A. and Sequeira, M. (2007) 'Interactions between small cetaceans and the purse-seine fishery in western Portuguese waters', Scientia Marina, 71(2): 405-412.

Zollet, E.A. and Read, A.J. (2006) 'Depredation of catch by bottlenose dolphins (Tursiops truncatus) in the Florida king mackerel (Scomberomorus cavalla) troll fishery', Fish. Bull., 104: 343-349.



Annexes

Annex 1. Table A1 - A table showing the different fleet characteristics of Maltese small-scale fishers

Surveyed Vessel	*Base Port*	*GT tonnage*	*LOA*	*Main Power (kW)*	*Year of construction*	*Gears type*
1	St Paul's Bay	1.72	5.49	170	2004	GTR, GTN
2	St Paul's Bay	3.24	4.88	120	1998	GNS, FPO
3	Mgarr (Gozo)	0.44	7.92	163	1976	LLS, LTL
4	St Paul's Bay	10.03	10.67	199	1991	LLS, LLD
5	St Paul's Bay	0.83	4.27	26	1994	FPO, GTR
6	St Paul's Bay	10.03	10.67	370	2002	LLS, LLD
7	Marsaskala	1.09	4.88	31	2009	GTR, FPO
8	Ġnejna	1.84	5.50	91.76	1998	LLS, LHP
9	Imsida	11.28	11.88	272	2007	LLD, LLS
10	St Paul's Bay	3.22	8.53	256	2002	LLS, LTL
11	Mgarr (Gozo)	9.93	11.89	224	2018	FPO, LHM
12	Mellieħa	2.26	7.92	153	1977	LLS, GTR
13	St Paul's Bay	2.11	8.53	216	2005	FPO

14	St Paul's Bay	3.18	7.80	44.76	1969	GTR,LLS
15	St Paul's Bay	13.03	11.98	160	1983	GTR, LLS
16	Marsaxlokk	1.08	5.72	7.46	1983	GTR, FPO
17	Marsaxlokk	1.09	5.33	13.4	1993	
18	Marsaxlokk	4.39	9.88	74	1972	LLS
19	Marsaxlokk	-	-	-	-	GTR, FPO
20	Marsaxlokk	2.34	8.2	123.09	-	LLS, GTR
21	Marsaxlokk	2.33	6.95	55.95	-	GTR, LLS
22	Marsaxlokk	1.86	5.56	7.46	1930	GTR
23	St Paul's Bay	1.72	5.49	70	2004	GND
24	Marsaxlokk	4.33	7.75	80.9	1990	LLS
25	Marsaxlokk	4.39	9.88	74	1972	GTR, LLS
26	Marsaxlokk	2.79	6.55	59.65	1995	LLS, LLD, GTR
27	Marsaxlokk	6.01	8.55	85.79	1964	GTR, LTL
28	Marsaxlokk	1.86	6.71	11.19	-	LLS
29	Marsaxlokk	0.83	5.18	7.46	1923	GTR, LTL
30	Ċirkewwa	1.42	4.2	11.19	1994	LLS, GTR
31	Marsaxlokk	4.54	7.6	147	2002	LLS
32	Marsaxlokk	1.1	5.33	13.43	-	GTR, LTL
33	Marsaxlokk	1.1	4.88	23.78	-	LLS

Annex 2. Table A2 – A table showing the fishing gear specifications as used by the 33 respondents who were interviewed in this research study

Respondent Number	Fishing Gear (Common name)	Material used	Mesh size (mm)	Length (m)	Height (m)
1	Trammel Nets	Nylon	2.8 - 3.5	120/ piece of net	1
2	Trammel Nets	Nylon	2.8 - 3.3	130/ piece of net	0.75
3	Trammel Nets	Nylon	2.5 - 3.5	130/ piece of net	1
4	Drifting Longline	Nylon	-	-	-
5	Trammel Nets	Nylon	2.8	125/ piece of net	1
6	Drifting Longline	Nylon	-	-	-
7	Gillnets	Nylon	2.6	150/ piece of net	2
8	Trammel Nets	Nylon	2.8 - 4.5	160/ piece of net	1
9	Drifting Longline	Nylon	-	-	-
10	Drifting Longline	Nylon	-	-	-
11	Drifting Longline	Nylon	-	-	-
12	Trammel Nets	Nylon	2.8 - 3.5	170/ piece	1
13	Trammel Nets; Gillnets	Nylon	2.5 - 4.5	130/ piece of net	1
14	Gillnets	Nylon	2.6 - 2.8	130/ piece of net	1
15	Drifting Longline	Nylon	-	-	-

16	Trammel Nets	Nylon	2.8 - 3	150/ piece of net	1.5
17	Gillnets	Nylon	2.2 - 3.2	600	5
18	Drifting Longline	Nylon	-	-	-
19	Gillnets	Nylon	2 - 3.2	600	6.5
20	Trammel Nets	Nylon	3	150/ piece of net	3
21	Trammel Nets	Nylon	3.5	-	1.5
22	Longlines	Nylon	n/a	10 miles	n/a
23	Longlines	Nylon	n/a	-	-
24	Trammel Nets	Nylon	3.5	600 m	2.5
25	Surface Longlines	Nylon	-	35	-
26	Lampira	Nylon	18	400	80
27	Trammel Nets	Nylon	2.8 - 3.0	160	3
28	Trammel Nets	Nylon	2.7 - 2.8	4000m total nets	25
29	Trammel Nets	Nylon	3	-	2
30	Trammel nets	Nylon	2.5	150m / net	2
31	Longlines	Nylon	n/a	15 miles	n/a
32	Longlines	Nylon	-	-	-
33	Longlines	Nylon	-	-	-

Project: Interaction between cetaceans and small-scale fisheries in Mediterranean Sea

QUESTIONNAIRE

Date _____
Sampler _____

Single general module

Technical characteristics

Ext. Marking _____ , Name of the vessel _____ *(optional)*

or Port _____ , GT tonnage ___ , LOA ___ , Main Power ___ , Year of construction _____

Licenses *(gear type acronym)* _____

Segment _____ , Permission _____

WHAT FISHING GEARS (**METIERS**) DO YOU USE ALONG THE YEAR:

Put an "X" on the number of the metier with which you have had any interaction with cetaceans

N.	Name of the gear, mesh size	Target species	Period (months)	Depth	Time of fishing	Distance from the base port
1						
2						
3						

4						
5						
6						
7						
8						
9						
10						

Did you ever see cetaceans while fishing? ☐ No ☐ Yes (specify if : ☐ dolphins or ☐ whales)

In the last 5 years, interference with cetaceans or any other vulnerable species is

☐ increased ☐ the same ☐ decreased Specify what other species

_____

Does any fishing area you use more subject of interference? ☐ No ☐ Yes

If Yes, specify

_____

Do you know solutions implemented in other fisheries to reduce the interactions?

_____

Personal suggested solutions _____

_____

Are you able to implement in your own vessel some interactions reducer devices and/or alternative fishing gears if a pilot project could be applied in your area/port of activity?

☐ No ☐ Yes ☐ Maybe ☐ Why

_____

Notes and other opinions _____

_____

_____

_____

_____

Would you like to participate in a permanent voluntary on-line survey for fishers to report SSF-Cetaceans interactions and cost-damages incurred during your fishing trips?

If yes, give our preferential contacts _____

INDICATE THE AREAS SUBJECTED TO NEGATIVE INTERACTION DURING THE SEASONS

Winter	Spring
Repeat 4 times a map of the investigated area in your country. Preferable with indication of the North, the scale used and the bathymetries.	
Summer	Autumn

Module to repeat for each metier experienced in interaction with cetaceans

Metier N.__ Gear type _____ Common names _____

Material _____ Mesh size _____ Length _____ Height _____ Age _____

Number of pieces or hooks _____ Size _____ Quantity of other parts _____

When using lures, specify if ☐ artificial baits or ☐ natural (species)

_____

Number of days using this gear in one year ____ , Number of times using this gear in one day ____

Bottom _____ , Price of a complete new gear € _____

Kg of catch per day: Minimum ____ Maximum _____ Average value of the catch €/kg _____
Number of bycatch events ☐ dolphin ___ ☐ whale ___ ☐ shark ____
per species in one year ☐ turtle ____ ☐ bird ____ ☐

_____

Incidence of **positive or cooperative interaction** with cetaceans _____ */100 times*

Type _____

Incidence of **indifferent presence** of cetaceans _____*/100 times*

Incidence of **negative interaction** (damage for fishermen) _____ */100 times*
Types of **damage** ☐ depredation on catch → If yes, specify if leaving:
(per one event) ☐ bite marks ☐ fish head in the gear ☐ *other signs*
☐ scattering prey
☐ lures depredated → If yes, specify _____

☐ holes → If yes, specify size and number: ☐ small (0-30 cm) ____ ☐ medium (31-80 cm) ____ ☐ big (81-120 cm) _____ ☐ very big (>120cm) _____

Losses incurred: ☐ reducing catch How much _____ *%*
(per one event) ☐ complete loss of the catch

Costs incurred per one event of negative interaction (€ or time):
Medium percentage of the fishing gear damaged _____ % Fishing days not worked _____
Number of people working in for fixing up the gear _____ Number of days in which they are involved to repair _____ Material used _____

Price of the piece to substitute (€ per piece) _____

Price of the other parts to substitute _____

_____

Total cost of a failed fishing trip (*considering n. of operators, fuel consumed, missing catch etc.)*

_____

Number of pieces necessary to eliminate after one event of interactions _____

During one year, are you sure that all the damages have been caused only by cetaceans?

☐ No ☐ Yes ☐ Other suggestion?

_____

How many times animals different to cetacean damage your fishing gear? ____ */100*

How do you recognise differences? _____

_____

If responsible are cetaceans, what species? (name and %) _____

_____

Generally, how many individuals of cetacean interact with the same gear? _____

Do you usually continue to fish with a damaged gear? ☐ No ☐ Yes If yes, how many times?

____

In the case above, describe the entity of the damage of the fishing gear _____

_____

Amount of reducing catch using a damaged fishing gear _____ *%*

Mitigation measures employed ☐ No ☐ Yes What

_____

→ Results _____

_____

_____

What and how many parts do you lose in one year? _____

_____

Other notes related to this specific metier _____

_____

_____

Return at the first page if you have any other general comment to do.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