# Mitigating interactions between endangered marine species and fishing activities | 2015-2018

## ACCOBAMS-GFCM
## PROJECT

### Main outcomes

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# ACCOBAMS-GFCM
## PROJECT on mitigating interactions between endangered marine species and fishing activities | 2015-2018

# THE PROJECT

**BYCATCH,** which is the incidental capture of non-target species in fisheries, is a serious threat to marine endangered species such as seabirds, sea turtles, elasmobranchs and marine mammals and one of the main causes of mortality for these species. In an effort to fulfil their international commitments, Mediterranean countries have committed to conserving natural resources through the sustainable development of their fisheries. To do so, bycatch must be assessed and reduced or controlled to levels below those that threaten the conservation status of endangered species. Depredation, which occurs when predators such as cetaceans partially or completely remove catches from fishing gear, is an increasing matter of concern in several Mediterranean fisheries

because it causes economic loss to fishers and can generate conflict. However, there is little knowledge about the effects of bycatch and depredation on endangered marine species and fishers, and efforts are needed to properly address both issues.

The project, "Mitigating interactions between endangered marine species and fishing activities", covering the period from 2015 to 2018, was launched to improve efforts to conserve endangered marine species listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol), by promoting responsible fishing practices in selected fisheries in the western and central Mediterranean. It was coordinated by the Secretariats of the Agreement

on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) and the General Fisheries Commission for the Mediterranean (GFCM), in collaboration with the Specially Protected Areas Regional Activity Center (UNEP/MAP-SPA/RAC).

The project had two objectives: 1) to learn more about how endangered marine species were being affected by fishing activities, and how fishers were being affected by incidental catches and depredation; and 2) to promote the introduction of fishing-tourism and opportunistic whale watching, as a way of generating additional income for fishers, reducing the fishing pressure on targeted fish stocks and, potentially, decreasing their negative interactions with endangered species.

In this context, the project:
- implemented eight pilot actions in selected fisheries to serve as practical case studies creating a base of preliminary information as a starting point;

- developed capacity-building and ecotourism initiatives; and
- published outreach materials.

This is an overview of the main project outcomes. The pilot actions are outlined, together with some of the main technical results and recommendations, followed by information on complementary project activities and a set of conclusions. The information provided is based on reports from the pilot actions produced by national coordinators, on data compiled throughout the project duration, and on analyses performed by the relevant experts. All project deliverables, including awareness material, the full reports of the pilot actions and of the project's meetings, trainings and workshops, are available on the websites of ACCOBAMS and GFCM. ■

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# FIELD
# WORK

**BASED ON A PARTICIPATORY APPROACH** implemented by national partners with fishers, eight pilot actions were implemented in Algeria, France, Morocco, Spain and Tunisia. Each pilot action had a specific objective, and all were aimed at better understanding the interactions between endangered marine species and fisheries. The information gathered through these actions was intended to provide insight into how to approach the issue. After a preliminary phase during which data were collected and the main issues were identified, possible fisheries mitigation measures were implemented to reduce the incidental catch of endangered marine species and to decrease depredation in a number of fisheries.

Given the limited resources allocated to each pilot action in this project, it was not possible to implement equal monitoring efforts across the different pilot actions. The results obtained and presented in each summary, therefore, cannot be compared from one context to another. Yet, for some of the national partners involved, these pilot actions represent a first attempt to establish a cooperative framework between researchers and fishers to better understand and to assess the interactions between endangered marine species and fisheries. All of which contributes to building a regional network of expertise and to supporting the development of future activities.

## EIGHT PILOT ACTIONS:

**1** Interactions between killer whales and bluefin tuna artisanal fisheries in the Strait of Gibraltar (Morocco and Spain)

**2** Interactions between endangered species and swordfish longline fisheries in southern Spain

**3** Interactions between pelagic longline and gillnet fisheries and sea turtles around the Balearic Islands (Spain)

**4** Interactions between gillnet fisheries and sea turtles in southern France

**5** Dolphin and seabird interactions with purse seine small-pelagic fisheries in Kelibia (Tunisia)

**6** Interactions between bottom and surface longline fisheries and endangered species in the Gulf of Gabès (Tunisia)

**7** Preliminary study of the interactions between cetaceans and artisanal fisheries in Algeria

**8** Dolphin interactions with purse seine sardine fisheries in the Moroccan Mediterranean

# Outreach material

**THERE WERE SEVERAL PUBLICATIONS** prepared during the project, which supported the endeavours of national coordinators committed to the field work and who developed the pilot actions. A review of fisheries bycatch mitigation measures was prepared by a regional expert. The review provides a detailed description, by fleet segment and group of animals, of all fishing techniques available and that have been tested worldwide to mitigate incidental catches of endangered species, with insights on feasibility in the Mediterranean area (Sacchi, forthcoming).

In addition, illustrated and water-proof good practice guides for handling sea turtles, seabirds, pelagic sharks and rays, and cetaceans caught incidentally in Mediterranean fisheries were produced in English, French and Arabic (FAO and ACCOBAMS, 2018). These guides were specifically designed for fishers and illustrate simple techniques to release these animals from fishing gear and to handle them once onboard the fishing vessel.

They also include illustrations to identify the species and guidelines to register properly the incidental catches on the logbooks.

GOOD PRACTICE GUIDE FOR THE HANDLING OF SEA TURTLES CAUGHT INCIDENTALLY IN MEDITERRANEAN FISHERIES

GOOD PRACTICE GUIDE FOR THE HANDLING OF SEABIRDS CAUGHT INCIDENTALLY IN MEDITERRANEAN PELAGIC LONGLINE FISHERIES

GOOD PRACTICE GUIDE FOR THE HANDLING OF SHARKS AND RAYS CAUGHT INCIDENTALLY IN MEDITERRANEAN PELAGIC LONGLINE FISHERIES

GOOD PRACTICE GUIDE FOR THE HANDLING OF CETACEANS CAUGHT INCIDENTALLY IN MEDITERRANEAN FISHERIES

## Pilot action ❶
# Interactions between killer whales and bluefin tuna artisanal fisheries in the Strait of Gibraltar (Morocco and Spain)

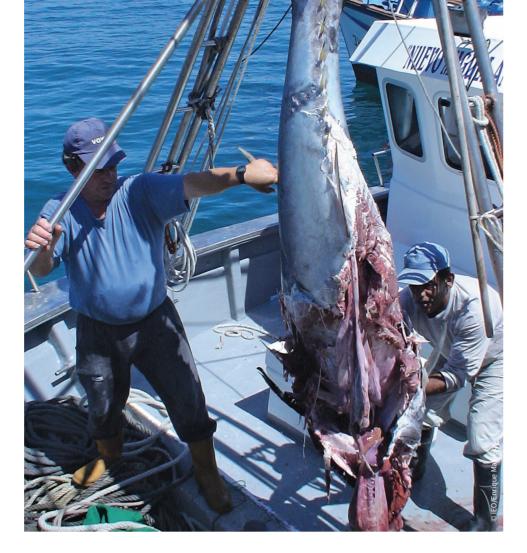| LOCATION | NATIONAL PARTNERS | MAIN OBJECTIVE |
|---|---|---|
| Strait of Gibraltar, Morocco and Spain | National Institute for Fisheries Research (INRH) and Spanish Institute of Oceanography (IEO) | Evaluate the socioeconomic and ecological impacts of killer whale (*Orcinus orca*) depredation |

### Study area and description of the interactions

The Strait of Gibraltar is the transition area between the Atlantic and the Mediterranean Sea and it represents a natural corridor for many species, in particular migratory species like the Atlantic Bluefin tuna (*Thunnus thynnus*). Bluefin tuna have been known in the Strait of Gibraltar since ancient times. The fishing method (trap) used to catch them has been in use in this area since before the Roman era. Moroccan and Spanish artisanal hand line tuna fleets started operating in the Strait of Gibraltar in the 1990s. The Strait of Gibraltar is an important feeding area for killer whales (*Orcinus orca*), with an estimated five stable social groups of this species in the area, for a total of 39 individual whales. These groups depend on Bluefin tuna as their primary source of food, influencing their reproduction and survival rate. The killer whales observed in this area hunt tuna in two different ways: i) by chasing individual fish until they are exhausted and can be overcome; and ii) by interfering with the catch of local artisanal fisheries (direct depredation on captured tuna before they are brought on board).

### Main activities and results

**Spain** - For this pilot action, IEO compiled information on the Spanish fisheries targeting Bluefin tuna in the area, hand-line and bait-boat fleets, as well as on the Bluefin tuna with orca bites that landed at Tarifa port. IEO also carried out a survey with a part of the fleet owners and skippers at the Spanish landing port of Tarifa (30 percent of the hand-line fleet was covered). A sample of the landing in Tarifa showed that most of the Bluefin tuna with bite marks are found in July, with a maximum at the beginning of the data series (2000–2017) and then decreasing until almost zero from 2005 onward. The significant difference in the number of tuna with bite marks landing over the years could be explained by the fact that fishers might be discarding tuna that have been bitten; landing damaged fish would reduce their quota and their selling price. Even though damaged Bluefin tuna are no longer landed, the fishers still reported depredation by killer whales during their interviews, with an increase in reports in recent years.

**Morocco** - INRH carried out a survey at the Moroccan landing port of Ksar Sghir, covering 72 percent for 2015 and 41 percent for 2016 of the fishing effort. The assessment of depredation of the Bluefin tuna catch in the Strait of Gibraltar has shown that the frequency of attacks in 2016 increased by 11 percent over the total fishing trips, compared to only 3 percent in 2015. The loss of tuna catches has been estimated at 1.1 tonnes in 2015 and 4.7 tonnes in 2016. The total cost of killer whale depredation, including the catch loss and the costs for repairing the gear, was estimated to be MAD 88 000 (EUR 8 200) in 2015 against MAD 274 000 (EUR 25 000) in 2016.

### Conclusions and recommendations

Although the sampling plan was too limited to draw precise conclusions on the interaction between the orca and the fisheries, it was a first step towards obtaining more accurate information. The economic losses due to killer whale bites on tuna were considered to be the main problem (the damage to the fishing gear was not seen as a major issue). Even though an increase in the number of interactions between the fishers and the killer whales was reported by fishers over the last few years, they did not consider depredation as an issue because they could catch undamaged tuna fairly easily. ∎


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## Pilot action ❷
# Interactions between endangered species and swordfish longline fisheries in southern Spain

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Northern Alboran Sea, Spain | Spanish Institute of Oceanography (IEO) | Assess and mitigate interactions between seabirds, sea turtles and marine mammals with surface pelagic longline fisheries |

### Study area and description of the interactions

The study area is the Alboran Sea, which is considered to be a transition area connected to the Atlantic Ocean through the Strait of Gibraltar and opening onto the Balearic Basin in the east. This area is surrounded by three countries, Spain in the north, and Morocco and Algeria in the south. Because of its oceanographic characteristics, the Alboran Sea is an important area for the migration of sea turtles and mammals, and it is a wintering area for many sea birds. The Strait of Gibraltar is one of the main passes used by birds and sea turtles during migration. It is also an important fishing area for the Spanish pelagic longline fleet. While targeting swordfish and tuna species, this fleet uses different gears according to the target species, the season and the fishing strategy. Each gear has a different effect on target and bycatch species.

### Main activities and results

Several different data sources were used to assess the incidental catches of surface pelagic longline fisheries such as, on-board observations, landing interviews, a bibliographic review and a tagging scientific survey.

There were 17 sets observed onboard longline vessels over the duration of the pilot action. Observations were concentrated during the months of May, September and December following the fishing strategy of the vessels in this area. The data were collected by IEO scientific observers who were onboard a vessel with semi-pelagic longline (LLSP) and on a vessel targeting bluefin tuna with a Japanese type longline (LLJAP). The observers conducted surveys (questionnaires) with 72 percent of the longline fleet whose home ports are located in the Alboran Sea to better understand the fishers' proposals to implement mitigation measures, to know which tools were available to reduce the bycatch of seabirds, marine mammals and sea turtles, and to understand the fishers' method of releasing bycaught animals. In the surface longline fishery, 90 percent of respondents thought the incidental capture of sea turtles, cetaceans and seabirds had decreased. All the fishers interviewed agreed that the incidental capture of these species is due to a change in the type of fishing gear being used (i.e. increased use of the LLSP).

During two campaigns to tag blue shark (*Prionace glauca*) on board commercial longline vessels fishing in the north of the region, observations were made of the way that marine mammals, seabirds and sea turtles interacted with the gear. The gear type used during the campaign was a home-based surface longline (LLHB). There was no report of any incidental catch of marine mammals, sea turtles and seabirds during these tagging surveys.

### Conclusions and recommendations

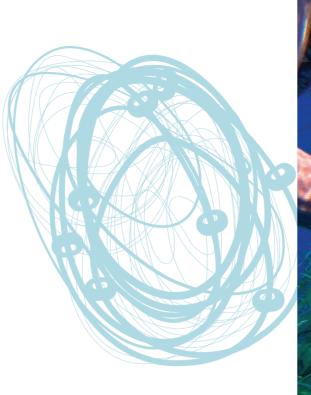The activities carried out in the framework of the pilot action do not provide an estimate of the bycatch of endangered species in the total catches of the longline fleet operating in the Alboran Sea. Considering the limitations of the sampling plan of this pilot action as well as the abundance of species in the area and of the changing fishing strategy according to the seasons, it would be necessary to make a quarterly or monthly sampling plan at least in order to obtain the information necessary to analyse the interactions between the Spanish surface pelagic longline fisheries and the marine mammals, seabirds and sea turtles. The results obtained from this pilot action indicate that the fishers are interested in taking complementary training on bycatch species management. Fishers also proposed several mitigation measures that could be tested in the future; for example, using streamer lines to scare seabirds, using plastic bait as a tool to reduce the fishers' interactions with marine mammals and sea turtles, not fishing too close to the coast, and increasing the depth of fishing to reduce their interactions with sea turtles. A specific programme to monitor the activities of the surface longline fleets operating in Alboran would allow for a clearer view of the importance of the interactions of protected or endangered species of seabirds, mammals and sea turtles in the area. ∎

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## Pilot action ❸
# Interactions between pelagic longline and gillnet fisheries and sea turtles around the Balearic Islands (Spain)

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Balearic Islands, Spain | Alnitak Marine Research and Education Center | Assess the risk of incidental catches of sea turtles in pelagic longline and gillnet fisheries |

### Study area and description of the interactions

In this pilot action, the objective was to understand the factors affecting the risk of bycatch of loggerhead sea turtles (*Caretta caretta*) in longlines and fixed nets for lobsters in the Balearic Islands. The activity was carried out in the Algero-Balearic basin and around the islands of Cabrera, Mallorca and Menorca in Spain, within coastal waters (between 20 and 120 metres depth along the continental shelf of the islands) and also in deep waters off the continental shelf (along the Emile Baudot escarpment) on both pelagic longline and gillnet fisheries. Loggerhead sea turtles share their foraging habitat with coastal fisheries – specifically with the artisanal fleet – and in deep waters they are exposed to surface longlining fleets.

**Pelagic longlines:** juvenile and sub-adult sea turtles in the oceanic phase (foraging habitats in oceanic zone) can be found all year throughout the basin. The following risk factors were identified with respect to longline gear:
• fishing zone - avoid areas where the density of sea turtles is especially important;
• fishing season - the risk of incidental captures is increased between May and September when the warm waters activate the metabolism of sea turtles; and
• bait illumination - avoid pelagic longlines in the photic part of the water column after sunrise and avoid LED lights because they increase the risk of incidental captures.

**Gillnets:** juvenile and sub-adult sea turtles in the neritic phase (foraging habitats in coastal waters) pass near the Balearic Islands and alternate between the oceanic phase and a neritic phase to eat crustaceans on the ground around the islands. During these phases in coastal waters, they are exposed to the danger of incidental capture in the different types of fixed nets. The following risk factors were identified:
• fishing time - the risk of death by drowning is directly related to the immersion time of the nets;
• depth - the reactivity of a sea turtle recovered alive after a deep immersion must be tested to determine if decompression is necessary before it is released; and
• Illumination - unlike the case of pelagic longlines, illuminating nets could reduce the risk of incidental capture.

### Main activities and results

Nine sea turtles have been tagged, in collaboration with the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA NMFS) and the Balearic Islands Coastal Observing and Forecasting System (SOCIB), to better understand their movements and especially their habitat use and immersion behaviours. Satellite tracking helped to better understand the movements and ecology of loggerhead sea turtles in the Balearic Islands, and the risks associated with both fisheries. The project was carried out for longline targeting swordfish and whitefin tuna, and for gillnets targeting lobster.

### Conclusions and recommendations

It must be emphasized that the project consisted of pilot actions, and, therefore, the results could not lead to developing concrete bycatch mitigation measures. Nevertheless, the project identified risk factors based on the preliminary results of the trials, especially on the studies of the movements and ecology of loggerhead sea turtles. Further work is needed in order to i) test the technical mitigation measures to minimize negative interactions between these fisheries and sea turtles; ii) involve professional fishers in decision-making processes, in order to take into account both their needs and their cultural and socialcon-tribution to the health of marine ecosystems; and iii) adopt realistic and effective management measures. ∎


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## Pilot action ④
# Interactions between gillnet fisheries and sea turtles in southern France

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Camargue, France | **CESTMed** Center for Research and Conservation of Mediterranean Sea Turtles (CESTMed) | Reduce incidental catches of sea turtles in gillnet fisheries |

### Study area and description of the interactions

The study area was the Natura 2000 Camargue area that stretches up to three nautical miles. The site is administered by the PNRC (*Parc Naturel Régional de Camargue*), which covers three towns in the Rhone delta: Arles, les Saintes-Maries-de-la-Mer and Port-Saint-Louis-du- Rhône, as well as more than 140 000 hectares of Marine Protected Areas (MPA). This is an important feeding area for the loggerhead turtles, particularly during the summer. Fisheries in this area are essentially small-scale and use gillnets and trammel nets. The sea turtles are frequently caught in the nets and are reported when they are brought to the CESTMed sea turtles rescue centre.

characteristics were positioned next to the equipped nets to assess the impact of the LED lights on the target commercial species. The results obtained were identical for the four nets: ~1 kg of fish every 100 metres. It is worth noting that the four nets were settled in the turbid waters of the Rhône mouth, thus reducing their visibility and the LEDs radiation (the reach) and creating shaded areas.

This pilot action also included several awareness raising activities among the artisanal fishers of the study area to involve them in sea turtle conservation. They were invited to the rescue centre, involved in releasing sea turtles, given leaflets explaining good practice guidance and stickers to highlight their involvement, they were invited in scientific programmes, etc. The fishers gladly answered the questionnaires. There were reports that some fishers were reluctant to give information to scientists/conservation stakeholders that could prejudice their profession. But once they were involved, they wanted to understand what was at stake if they were to participate; they wanted to be consulted (if necessary) and informed of the results.

### Conclusions and recommendations

This pilot action created an environment of trust between fishers and the CESTMed rescue centre for sea turtles by involving the fishers in conservation actions and encouraging them to report observations or incidental catches of sea turtles. The short duration of the LED experiment, the lack of information on the reach of the LEDs and the weaknesses in data collection (position of caught individuals: lighted areas/shaded areas, species and number of individuals caught, exact weight of caught individuals) made it impossible to measure the real impact of LEDs on the targeted species (although there seems to have been no impact). Nevertheless, this first experiment has allowed for a better understanding of the advantages and disadvantages of using LEDs on fishing nets, and allowed for testing the ergonomics of this possible deterrent. According to this first experiment, LED lights did not appear to be adapted to the study area fisheries for economical, ergonomic and safety reasons. Strong cooperation among fishers, scientists and managers is essential and must be based on a relationship of trust. The consultation between all involved actors will make it possible to co-construct solutions adapted to the realities on the ground, and to the ecological imperatives that also respect the technical and socio-economic needs of the fishers. ■

### Main activities and results

The fishing practices in the study area (target species, gear, fishing period, etc.) and the circumstances of sea turtle bycatches were identified through informal exchanges and questionnaires with the most engaged fishers from the three main ports of the study area. All the fishers who were consulted had incidentally caught sea turtles in their fishing gear. They said that incidentally catching sea turtles is relatively new. They did not capture sea turtles in their nets 30 to 40 years ago. Sea turtles are usually caught near the head rope because they tend to follow it.
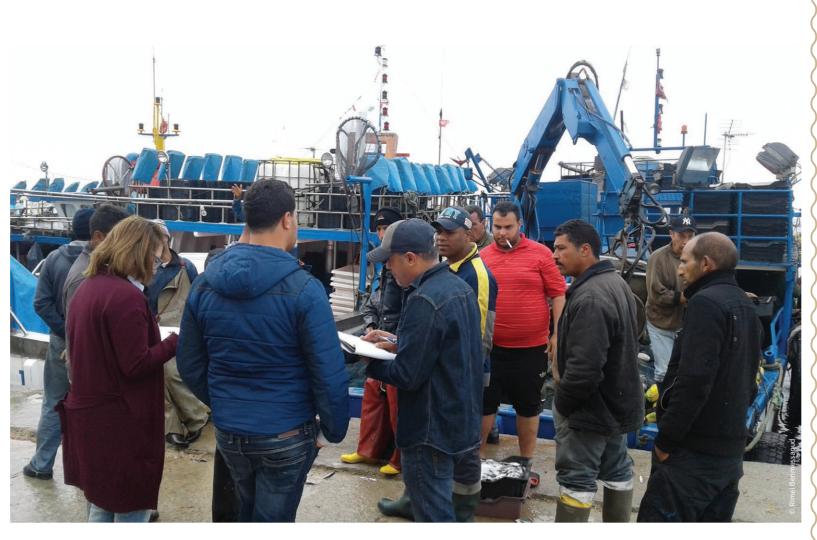
The feasibility of testing mitigation measures to reduce incidental catches of sea turtles was discussed with fishers, and one of them agreed to test LED lights on his nets. Two fishing nets (one trammel and one gillnet) were equipped with LED lights positioned every 50 metres on the top and bottom part of the nets (staggered positioning). Two other nets with the same

## Pilot action ⑤
# Dolphin and seabird interactions with purse seine small-pelagic fisheries in Kelibia (Tunisia)

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Cape Bon, Tunisia | **INSTM** National Institute of Marine Sciences and Technologies (INSTM) | Evaluate bottlenose dolphins and seabird interactions with purse seine small-pelagic fisheries |

### Study area and description of the interactions

The Kelibia region, located in north-eastern Tunisia, covers 300 kilometres of coastline and constitutes the transition zone between the western and eastern basins of the Mediterranean. Considering its geomorphological characteristics, it is a highly productive area. The main fishery, in terms of production, is the purse seine small-pelagic fishery, with around 50 fishing units in the port of Kelibia. It is also an area of importance for both the Scopoli's shearwater (*Calonectris diomedea*) and bottlenose dolphin (*Tursiops truncatus*). Both species interact with purse seine fisheries with different consequences: the depredation caused by dolphins results in damages to the fishing nets and partial loss of the catch, whereas shearwaters are incidentally caught in the floating upper part of the net.

### Main activities and results

This pilot action was carried out through a bibliographic review, questionnaires, and through onboard observations (to better assess the risks of depredation and potential bycatch).

Seventeen surveys at-sea onboard commercial fishing vessels were carried out during this pilot action to monitor the ecological behaviour of bottlenose dolphins and shearwaters. The study confirmed the importance of the study area as a feeding area for both species, and feeding associations between dolphins and

shearwaters were sometimes observed. During these surveys, there were 40 sightings: 45 groups of bottlenose dolphins (from 1 to 8 individuals) and 98 groups of shearwaters (from 1 to 87 individuals) were observed. The presence of immature animals also confirmed that this area is an important breeding ground for both species.

Furthermore, to better analyse the depredation caused by dolphins, 20 commercial purse seiners were monitored during a one-year period through onboard observations and interviews with fishers. The results of the statistical analyses showed that the average frequency of fishing trips affected by depredation is around 30 percent. Different hypotheses were tested to determine the factors influencing the depredation: the type of catches, the net size, the mesh size, the duration of the encirclement phase, the set depth as well as the distance to the coast. The tears in the nets were also monitored, with regard to their form, their size and their position, to determine if they were caused by dolphins or by solid structures (such as wrecks). It was assessed that 77 percent of the tears were due to dolphin depredation. The associated costs for repairing the nets was estimated to be around EUR 365 per month per net.

Regarding interactions between shearwaters and purse seine fisheries, and according to the results of the questionnaires, it was assessed that around four birds are incidentally caught per purse seine, per month.

### Conclusions and recommendations

The increased abundance of bottlenose dolphins has increased the risk of them interacting with fishing activities in the area, with consequences that could be severe for both fishers and cetacean populations. The most affected sector is that of sardine fishing (purse seine) where the depredation issue causes a net loss of income for the entire small-pelagic fishery sector in the study area. These repercussions may partly explain the change in activity (some fishers moved from purse seine fishing to trawling) or in fishing areas. In the worst cases, they can lead to fishers abandoning the sector. Mitigation measures that could be tested include acoustic repellents; strengthening the most fragile parts of the net; or promoting fishing-tourism activities that could also help change and improve the image of the dolphins within the fishing community, and create a new source of income. With respect to seabird incidental catch, professionals have suggested adapting and testing mechanisms similar to the trawl scaring system in purse seiners. ■

## Pilot action ⑥
# Interactions between bottom and surface longline fisheries and endangered species in the Gulf of Gabès (Tunisia)

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Gulf of Gabès, Tunisia | **INSTM** National Institute of Marine Sciences and Technologies (INSTM) | Mitigate bycatch and depredation of elasmobranchs, sea turtles, seabirds and cetaceans in bottom and pelagic longline fisheries |

### Study area and description of the interactions

The pilot action was developed in the Zarzis region, in the Gulf of Gabès, one of the most important fishing grounds in Tunisia. With its high biodiversity, several iconic species of the Mediterranean find it a favourable habitat. It is a wintering and feeding area for loggerhead sea turtles (*Caretta caretta*), a nursery area for several species of sharks and groupers, and a migratory corridor for several seabirds. Cetaceans are also frequently observed in the area. Bottom longlines, used during the summer season for grouper fishing, and surface pelagic longlines, designed originally for swordfish

fishing, affect bottlenose dolphins, sea turtles, elasmobranchs and seabirds.

### Main activities and results

Over the 2016 and 2017 summer seasons (from June to September), 162 bottom longline sets (corresponding to 235 550 hooks) and 96 surface pelagic longline sets (corresponding to 116 500 hooks) were observed. Some mitigation measures (e.g. different types of hooks and baits) were also tested on the pelagic longline.

During the bottom longlines observations period, the bycatch was dominated by sharks (24 percent) and rays (23 percent).

Loggerhead sea turtles, and also leatherback turtles, were observed in 3.5 percent of sets, whereas seabirds were only observed in 0.4 percent. The presence of bottlenose dolphins (*Tursiops truncatus*) was observed during the majority of the fishing operations (80 percent of the cases), but only two specimens were bycaught and then released alive. Similarly, the presence of seabirds was noted during all the actions of spinning and hauling (13 shearwaters were bycaught during the study period). Except for seabirds and for some species of elasmobranchs, the low mortality rates of bycaught endangered species allowed for them to be released alive. The composition of the catch for the pelagic longline fisheries was dominated by the sandbar sharks (*Carcharhinus plumbeus*), which represented 80 percent of the catches during the study period. This species, abundant in the Gulf of Gabès is landed in large quantities by the pelagic longline. The swordfish, which is the target species of this fishing activity, represented only 3 percent of the catch. The incidental catch of loggerhead and leatherback sea turtles accounted for 2.3 percent of the catch during the study. Seabirds, in particular shearwaters, were rarely caught incidentally (less than 1 percent). This is likely because the fishing zones are far from the coast and longline fisheries mainly operate at night. There were no interactions between cetaceans and the pelagic longlines recorded during the study period.

### Conclusions and recommendations

The distribution of bottom longline fishing efforts at depths of between 20 and 60 metres poses a threat to endangered marine large-vertebrate species, mainly the elasmobranchs that usually frequent shallow areas for feeding and reproduction. The short duration of bottom longline gear setting (two hours) could provide an opportunity to release incidentally captured species alive, but the survival rate of the released individuals strongly depends on the position of the hook, as injuries can be serious or lethal. Mitigation measures (i.e. hook shape) have been tested only for pelagic longline; however, some measures could also be applied to the bottom longline. In general, the circle hooks seem to produce significantly larger catches than the "J" hooks for grey sharks and mako sharks. The type of hook has no effect on the capture of sea turtles. Considering the challenge of identifying mitigation measures that are applicable to multiple taxa, the set of recommendations that come from this pilot action included: leaving more space between the snoods to avoid entangling animals (especially sea turtles); dropping bottom lines very quickly to limit seabirds' attraction to hooks with bait; laying bottom longlines at depths greater than 30 metres to reduce catches of guitarfish; replacing traditional "J" hooks with circular hooks; not using attractive bait such as tuna for elasmobranchs. ■

## Pilot action ❼
# Preliminary study of the interactions between cetaceans and artisanal fisheries in Algeria
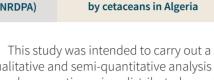
| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Algiers, Algeria | National Centre for Research and Development of Fisheries and Aquaculture (CNRDPA) | Gather baseline information on the extent of depredation events by cetaceans in Algeria |

### Study area and description of the interactions

El Marsa, formerly called Jean Bart, is located in the eastern suburbs of Algiers. This zone constitutes the eastern tip of Algiers Bay. It is an area characterized by small-scale fishing activities. Most boats are between four and nine metres long, and they are part of the local, historical and economic heritage. Artisanal fishers operate near the coast and their landings are sold locally. The majority of the fishing boats use seasonal gear, but the trammel net and the gill net are used all year long. In Algeria, depredation has never been declared by fishers; the objective of this study was to assess the existence of such interactions and to quantify the economic losses caused by these interactions.

This study was intended to carry out a qualitative and semi-quantitative analysis based on questionnaires distributed among artisanal fishers in the El Marsa region.

### Main activities and results

The pilot action was carried out through questionnaires that allowed fishers to describe interactions between cetaceans and fishing activities, and to assess the consequences on the artisanal fishery of this zone. The results of the study indicated that:
- the species responsible for depredation, especially in the trammel nets and the gill nets, is the bottlenose dolphin (*Tursiops truncatus*).
- the average frequency of interactions is around 11.38 percent, with gillnets and trammel nets having the same probability of being affected by depredation.
- the phenomenon studied occurs throughout the year with a marked intensity during the spring.
- Dolphin depredation appears to be dependent on the size of the mesh and the depth of the fishing. Fishing operations in areas with depths greater than 100 metres have a pronounced frequency of depredation (52.68 percent). It seems that stretched meshes smaller than 40 mm are unaffected by dolphin depredation. The average frequency of the fishing trips affected by depredation when using mesh nets greater than 80 mm is around 26.62 percent, while those smaller than 80 mm do not exceed 7.68 percent.
- The cost of repairing the nets due to dolphin depredation accounts for more than half the overall cost of net repairs.
- Mitigation measures lose their effectiveness over time because dolphins tend to adapt to these measures.

### Conclusions and recommendations

The assessment of cetacean interactions with fishing activities is an important issue in the area. Measures to ensure that these marine mammals are not negatively affected in their natural environment by fishing activities are necessary to conserve these species, and also to minimize the negative economic consequences on fisheries. As in other Mediterranean countries, dolphins are considered by fishers to be competitors for fishery resources. However, fishers in El Marsa region understand that the presence of cetaceans in their fishing zones is also an important factor in contributing to increased catches, despite the issues of depredation. Further research and regular monitoring are needed to better understand the behaviour of cetaceans within the ecosystem and to better understand the interactions of cetaceans with fishing activity (pros and cons). ∎

## CAPACITY BUILDING and ECOTOURISM ACTIVITIES

A TRAINING WORKSHOP was held in Barcelona, Spain, from 14–16 September 2015, at the Fundación para la Conservación y Recuperación de Animales Marinos (CRAM Foundation), to improve the skills and increase the knowledge of the coordinators of the pilot actions in talking to and dealing with the stakeholders (e.g. fishing community), in handling incidentally caught animals, and in order for them to become familiar with the most recent veterinary lessons learned. The CRAM Foundation's activities focus on clinical and marine wildlife rescue and research. Its centre hosts veterinarians and provides veterinary assistance to wild marine species that have been incidentally caught during fishing operations. The workshop provided the coordinators of the pilot actions with the opportunity to learn from the different experiences of the international and regional scientists and veterinarians who have long been working to recover marine animals caught in fishing gear and on bycatch mitigation measures in fisheries (ACCOBAMS and GFCM, 2015).

In areas where fish stocks are overexploited and where there are issues with dolphins and depredation in fishing nets, such as in Morocco and Tunisia, ecotourism could help artisanal fishers to generate complementary and alternative incomes, and it could reduce the pressure on marine resources and risks to endangered species. Activities that aimed to support the development of fishing-tourism and whale watching, building upon the link between traditional fishing and observation of marine fauna, considering fishers as "ambassadors" of the seas, were developed in Morocco and Tunisia. Legal and institutional issues to be considered for fishing-tourism and sustainable dolphin watching activities, and standards to prevent disruption and harassment of the animals, in particular the "High Quality Whale-Watching®" Certificate, were presented to relevant stakeholders (such as ministries of fisheries, transport and tourism sectors, etc.) during training workshops. There were study visits for Moroccan and Tunisian delegations to discover fishing-tourism and whale-watching activities in France and Italy and to learn from the experiences of professional operators. Demonstration projects were carried out in both countries to demonstrate the feasibility of ecotourism activities in close coordination with fishers' organizations, national authorities, and local non-governmental organizations.

# CONCLUSIONS AND PERSPECTIVES

UNDERSTANDING the interactions between Mediterranean fisheries and endangered species (i.e. marine mammals, sea turtles, seabirds and elasmobranchs) is important for the management and conservation of these species. Whether by incidental capture or depredation, these **interactions often have negative consequences for both fisheries and the affected species**. Mitigating the effects of these interactions poses several issues: first, it is difficult to identify which part of the fishing operation and/or fishing gear is involved in the interaction and when; second, it is important to choose mitigation solutions that are sufficiently effective, ergonomic and economically compatible with fishing so that they can be adopted readily by fishers. Moreover, care must be taken to ensure that these solutions do not have adverse effects on other endangered species, which requires a multi-taxa approach.

Although the issue of interactions between fisheries and endangered species is not new in the Mediterranean, **initiatives to seek mitigation solutions are rare and limited to one-off operations that do not integrate the concerns of all parties**. Often it comes down to fishers on one side and administrations, conservation associations and organizations on the other. This project addressed interactions as an issue affecting both fishers and endangered species. Thus, the strategy adopted for developing the pilot actions of the project integrated practical trials carried out with fishers, as well as workshops bringing together scientists, professionals and representatives of the national authorities. The pilot studies have fully benefitted from a participatory approach involving scientific local knowledge and users' skills to solve complex issues that affect not only the preservation of the ecosystem but also the sustainability of the fisheries concerned. This participatory approach has made it possible to identify the circumstantial elements that can lead to incidental capture or depredation and to reflect on the possibilities of adopting local mitigation solutions that have also been tried elsewhere in the world.

Any mitigation measure, whether it is the use of repellents, modifications of capture gear or even a change of the stocks exploitation strategy, should be supported with better **knowledge about the interaction mechanisms** and should be **tested on time scales long enough** to convince fishers that they will be effective. It also became clear during the exchanges with the fishers that many of the negative interactions were due to certain "bad" practices or to the design of the fishing gear, e.g. taking too much time setting up, or using non-corrodible hooks. Whatever the mitigation measure tested, fishers should be made aware of "good" fishing practices, including how to treat incidentally caught endangered species and how to release them.

The way that endangered species interact with fishing gear must be **clearly assessed** to identify existing knowledge gaps and to make it easier to define suitable and effective management tools. Education, training and outreach should be made available to fishers and other stakeholders to **raise awareness about bycatch and the practical solutions available**.

The results of the pilot actions have shown that improving mitigation technical solutions requires the **full participation of the fishers**, considering the modification of the gear and of the fishing practices that are needed, **as well as of the scientists** to better understand the behaviour of the endangered species concerned. The choice and implementation of such mitigation measures should, in some cases, follow a **step-by-step approach, with a balance of conservation objectives, economic profitability and safe working conditions for fishers**. Even where individual bycatch estimates could be considered sustainable, **uncertainties around the scale of bycatch should not delay management**.

## Pilot action ❽
# Dolphin interactions with purse seine sardine fisheries in the Moroccan Mediterranean

| LOCATION | NATIONAL PARTNER | MAIN OBJECTIVE |
|---|---|---|
| Southern Alboran Sea, Morocco | National Institute for Fisheries Research (INRH) | Evaluate the impact of bottlenose dolphin (*Tursiops truncatus*) depredation in purse seine sardine fisheries |

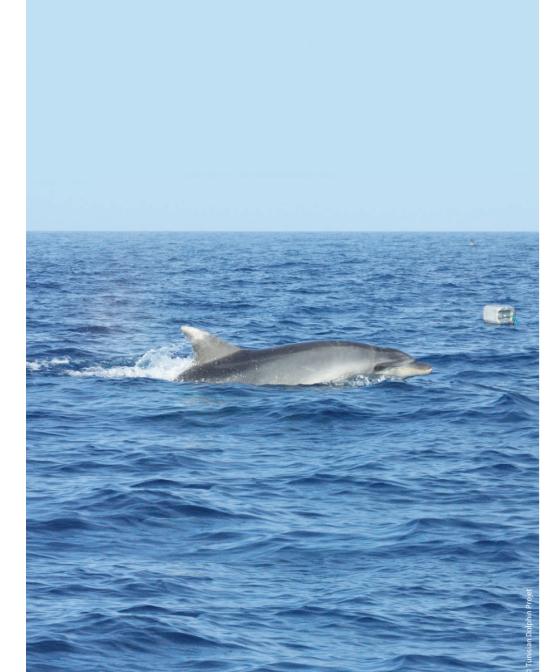### Study area and description of the interactions

Interactions between the bottlenose dolphins and purse seine fisheries take place throughout the Moroccan Mediterranean, from the borders with Algeria to the Strait of Gibraltar. The sardine fishing units operate mainly in four fishing areas: Cap de l'Eau-les-Rochers, Nador, Al Hoceima and M'diq. There are 113 purse seine fishing units employing nearly 3 200 people. This fishery targets small pelagic fish, mainly sardines, whose stock is overfished. In all fishing areas, the extent of interactions between fisheries and bottlenose dolphins seems unpredictable and irregular from one year to the next.

### Main activities and results

Since 2001, the National Institute for Fisheries Research (INRH) has been conducting interviews and onboard observations to study and monitor the interactions between dolphins and purse seine fisheries, including assessing the economic losses due to the impacts of depredation. Some acoustic deterrent devices have also been tested.

Depredation occurs during the encirclement and pursing phases, when dolphins surround the fish school and tear the net. The fish then escape from the torn net. When the dolphins make large tears, purse seiners are sometimes forced to change fishing grounds or to operate with damaged nets, which reduces their catch. On average for the four fishing areas, the frequency of depredation increased steadily from 16 percent in 2002 to 35 percent in 2014, with an average increase in interaction of nearly 7 percent per year. Economic losses as a result of depredation by bottlenose dolphins and the damage they cause to fishing nets cannot be neglected. Much of the losses are due to the damaged fishing gear, with associated costs for mending the net, and to the reduction in their catch. During this study, the total economic loss due to depredation by bottlenose dolphins is an estimated MAD 80 million (EUR 8 million) for one year.

Professional fishers complain about the damage caused by the bottlenose dolphins during fishing operations. INRH has tested acoustic devices over the years to see if they will reduce the interactions, but they have not shown any reduction. These devices appeared to work satisfactorily when the experiments were first started, but they became less effective after a few trials because dolphins quickly become used to the sounds of the acoustic devices. However, the results obtained from the experiments conducted with acoustic devices cannot lead to the conclusion that acoustics are ineffective for limiting the interaction of the dolphins and fisheries, as long as the behaviour of these dolphins is not fully understood.

### Conclusions and recommendations

Depredation by bottlenose dolphins on purse seine fishing has been increasing in Mediterranean Moroccan waters in recent years. Monitoring activities (interviews and onboard observations) must be continued to allow for a long-term assessment of this complex interaction, and to better identify the factors that affect the level of depredation caused by bottlenose dolphins. Several variables related to the environment and the fishing activity can influence the frequency of the interactions; further studies should be conducted to identify the environmental factors that can be controlled to reduce this phenomenon. Acoustic methods should also be investigated further to identify an effective acoustic emission system that does not negatively affect the bottlenose dolphin population. ∎

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