



BYCATCH AND POST RELEASE SURVIVAL

2022 BRIEF

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The MedBycatch project aims to address the gaps in knowledge regarding the incidental catches (bycatch) of vulnerable species during fishing operations in the Mediterranean, conduct trials of mitigation measures, and support the development of policies and formulation of national/regional strategies to reduce incidental catches and increase the sustainability of fisheries. Project implementation involves field observation programmes covering different fishing gears, together with trainings, awareness raising, identification and testing of mitigation techniques, and engagement on policy at national, European and regional levels with the aim of developing tools and building knowledge applicable to the entire region. Activities in the target countries are implemented in collaboration with national partners: BIOM, and WWF Adria (Croatia), LPO (France), LIPU and WWF Italia (Italy), GREPOM and INRH (Morocco), AAO/BirdLife Tunisia, DGPAQ, INSTM, and WWF North Africa (Tunisia), SEO BirdLife (Spain), DEKAMER, Doga Derneği, TUDAV, and WWF Turkey (Turkey).

The following brief is partially based on findings of two consultancies conducted within the framework of the ‘MedBycatch’ project:

Dimitrios Moutopoulos (University of Patras), Ioannis Giovos, Roxanie Naasan Aga-Spyridopoulou (iSea) (2021) Post-release mortalities from bycatch of vulnerable species data collection, improvement of handling protocols, and recommendations for bycatch mitigation measures.

Dr. Sanja Matić-Skoko, Dr. Dario Vrdoljak, Mr. Mišo Pavičić (2021) Local ecological knowledge on bycatch mitigation in relation to vulnerable species.



ELASMOBRANCHS CAN END UP AS BYCATCH IN ALMOST ALL FISHING GEARS, MOST COMMONLY IN LONGLINES, GILLNETS AND TRAWLS DEPENDING ON THE REGION OVERFISHING CAN QUICKLY DECIMATE STOCKS, WHICH FAIL TO REGENERATE. THIS CAN CAUSE A REAL RISK OF EXTINCTION.



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THE IMPORTANCE OF BETTER HANDLING AND AVOIDING CRITICAL AREAS FOR SHARKS AND RAYS IN THE MEDITERRANEAN

More than half the shark and ray species (53%) found in the Mediterranean are threatened with steep population declines and the risk of extinction.^{1,2} The leading driver for this is fisheries mortality, even though they are rarely the direct or main targets of the fleet.³



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Elasmobranchs can end up as bycatch in almost all fishing gears, most commonly in longlines, gillnets and trawls depending on the region.⁴ Whether they live through these encounters is an increasingly important factor in fisheries management,^{5,6} since individuals that get released and survive can keep contributing to their populations. This is particularly relevant for sharks and rays because their 'K-selected' life history – slow growth, late maturity, long gestations, few young, long lives – means overfishing can quickly decimate stocks, which fail to regenerate. This can cause a real risk of extinction. In other words, what happens to individual elasmobranchs can affect entire populations over time – and this is why a GFCM Recommendation requires that 24 elasmobranch species listed in the Barcelona Convention must be released unharmed and alive as far as possible.

But for catch-and-release to be a dependable management strategy, there must be a high likelihood of post-release survival^{7,8,9} – and knowledge in this area is currently lacking. Research is increasing on the effects of bycatch and discards on elasmobranch species,¹⁰ but there is still only limited and fragmented work¹¹ on at-vessel mortality (AVM – when the animals are dead in the gear) and post-release mortality

(PRM – when they are released but die later): to date, only two studies have been carried out in the Mediterranean.^{12,13}

It's impossible to define a single survival rate after release for elasmobranchs:¹⁴ instead, this is influenced by a range of factors – environmental, biological and operational. These include depth of capture, gear type, sea conditions, sea temperature, air exposure, light conditions, and size and species. But in any case, crucially, **bycaught individuals' survival chances are directly related to the fishers' handling and releasing skills and equipment:** some shark species that may appear healthy on release may die later not just because of the fishing process, but as a result of how they have been handled.^{15,16,17}

This brief considers two key questions. First, how can we improve our understanding of PRM for elasmobranch species, in order to incorporate this knowledge into fisheries management strategies? Second, what can be done to improve the likelihood of post-release survival for individual animals caught as bycatch and released?

The second of these questions is also relevant for other vulnerable Mediterranean species including turtles, cetaceans and seabirds.

THE IMPORTANCE OF BETTER DATA

Data on elasmobranch stocks are often limited, and information on catches and discards is important to improve the assessment and management of these stocks.¹⁸

So far, though, none of the red-listed elasmobranch species in the Mediterranean have assessments of how bycatch is affecting their population development, or their levels of PRM from different fishing gears and in different regions. This means that current information on population status may be misleading: PRM estimation is vital for future conservation efforts.

At the very least, appropriate data collection on bycatch paired with standardized survival rate estimates are needed so findings can be replicated across temporal and spatial scales, and meaningfully compared. With this in mind, the new GFCM protocol '[Monitoring the incidental catch](#)

[of vulnerable species in the Mediterranean and Black Sea fisheries: methodology for data collection](#)' aims to provide a framework for the development and implementation of an efficient, standardized data collection and monitoring system for all vulnerable species encountered in the region, and it should now be used throughout the Mediterranean.

The methodology proposed aims to ensure minimum common standards for the collection of data on these species and facilitate replicability and comparisons among fisheries across the region, offering a harmonized basis of knowledge, information and evidence for decision-making.



PREGNANT INDIVIDUALS



50%

**PREMATURE BIRTH
IN BYCAUGHT
SHARKS AND RAYS**

More than half the fishers interviewed in a survey carried out in Turkey, Morocco and Italy stated that they had witnessed premature birth in bycaught sharks and/or rays. When a pregnant female gives birth on board it is a sign of high stress, and it is highly doubtful the individual will survive. There is a clear need for measures to mitigate bycatch of pregnant individuals – such as **spatial and temporal closures of known pupping and nursing grounds** – as well as better handling procedures.

SCORING CONDITION, ASSESSING POST-RELEASE MORTALITY

A variety of different scales are used to assess animals' condition after catch and at release. These can then be combined with other data (e.g. satellite tagging, blood samples) to assess PRM for different species; the latter data helps evaluate the accuracy of the scale applied.

Health condition scales are often used. Some assess condition only once on board, others at release, while some assess both. The scales may offer just two options (dead/alive), include a third (good/fair/poor), or in some cases use up to five (excellent/good/fair/poor/moribund/dead).

The most common at-release evaluation uses what's known as a behavioural release condition score (BRCS) where the animal is rated on a qualitative scale progressing down from 'swims off with vigour' and 'slowly swims away', to 'no swimming and sinks' and 'non-responsive or dead in boat'.¹⁹

The GFCM protocol mentioned above uses a range of data including an onboard observation general form (see Annex 3.c) where information on the vulnerable species at capture

and release is required. This uses a four-point scale: alive/dead/almost dead/state unknown.

However, despite the fact that the categories on this scale may appear to be clearly distinct and keep bias low, inclusion of information on mobility and the presence of injuries could help a better categorisation of the state of the animal. More species-specific detail should be circulated, and specific observer training – which has been started in 2022 – could improve data collection to support a better estimate of true bycatch mortality rates.

To enable accurate assessment of the condition at capture of elasmobranch species, the researchers propose this table to support categorization.

TABLE 1: ASSESSING SURVIVAL CATEGORIES^{20,21}

SURVIVAL CATEGORY	ACTIVITY AND STIMULI	PRESENCE OF INJURIES	SEA LICE (IF APPLICABLE)	SKIN DAMAGE
HIGH (ALIVE) 	- Flopping and curling strong - Opening mouth/ clenching jaws - No stiffness	- No cuts or bleeding observed - No bashed parts - Hooked in lip/mouth	No scavengers in body openings	0% of body damage, bruises or redness - Vivid coloration
MODERATE - LOW (ALIVE) 	- Weaker movement or little movement limited to ripples and twitches - Little response to stimuli - Opening mouth slowly - Some stiffness	- Small cuts or scars not deep - Little bleeding - Small vital organs exposure	Presence of scavengers in body and cloaca	- Up to 40% of body with bruises or redness - Discoloration partially
BAD (MORIBUND) 	- No physical activity or response to stimuli - Jaws open (for sharks) - Rigor mortis	- Very severe wounds or body parts missing - Excessive bleeding - Vital organs protruding/ - Damaged	Scavengers in cloaca and eyes and gills tissue consumed	>40% of bruises and redness, skin, and body damage - Colour alternation

* At least **one of the bullet points from each category** must prevail for the assessor to decide Survival category

TABLE 2: ASSESSING CONDITION AT RELEASE

When it comes to assessing condition at release, they propose the following:

HEALTH INDEX	ACTIVITY AND OVERALL MOVEMENT	PRESENCE OF INJURIES	SEA LICE (IF APPLICABLE)	SKIN DAMAGE
GOOD (ALIVE) 	■ No revival time required when the shark was returned to the water, rapid swimming upon release, usually with a vigorous splash ■ Maintain depth almost directly	■ No cuts or bleeding observed ■ No bashed parts ■ Hooked in lip/ mouth (not ingested) ■ Vital organs intact (no stomach or intestines everted)	■ No scavengers in body openings	■ 0% of body damaged, bruises or redness ■ Vivid coloration
FAIR (ALIVE) 	■ Long revival time required; once revived, limited (sharks) or no swimming (rays) observed upon release but respiration functional (i.e. incapable of directed swimming but still alive) ■ Sinks at the bottom with ventral size respiration functional (rays) ■ Little response to stimuli – opening mouth/rippling of fins ■ Nictating membrane responsive (sharks)	■ Small cuts or scars not deep ■ Little bleeding ■ Spiracles and gills intact	■ Presence of scavengers in body and cloaca	■ Up to 40% of body with bruises or redness ■ Vivid coloration
BAD (MORIBUND) 	■ Dead upon removal from gear or moribund and unable to move even after a long submergence time (i.e. sank at the bottom with dorsal side) ■ No physical activity or response to stimuli (i.e. no clenching jaws, or nictating membrane for sharks, some tickling muscles for batoids) ■ Limited respiration from spiracles ■ Rigor mortis	■ Very severe wounds or body parts missing ■ Excessive bleeding ■ Spiracles and gills bashed or bleeding ■ Vital organs protruding	■ Scavengers in cloaca and eyes and gills tissue consumed	■ >40% of bruises and redness, skin, and body damage ■ Colour alternation

* At least **two of the bullet points from the first and the second category** must prevail for the assessor to decide Health category

TABLE 3: INDICATIONS OF POOR HEALTH IN COMMONLY CAUGHT MEDITERRANEAN ELASMOBRANCH SPECIES

Further detail is species-specific. While the signs of a healthy animal are similar across the board and usually involve vigorous movements, the table below shows how indications of bad health can vary across a range of commonly caught Mediterranean elasmobranch species.

SPECIES	INDICATION	SPECIES	INDICATION
CATSHARKS (<i>Scyliorhinus</i> spp., <i>Galeus melastomus</i>) 	■ Opening mouth like yawning ■ Turns on ventral side slowly (If observer tries to touch the animal it may react but still the chances of survival are extremely low)	STING RAYS, EAGLE RAY (<i>Dasyatis</i> spp., <i>Myliobatis aquila</i>) 	■ Excess mucus on spiracles ■ Slowly dries on ventral side (centrally on disc)
DOGFISH (<i>Squalus</i> spp.) 	■ Coloration towards darker colours ■ Fins appear dry ■ Mouth open is not a good sign even if the animal moves	LONGNOSE SKATE (<i>Dipturus oxyrinchus</i>) 	■ White spots and patches disappear or fade
BLUNTNOSE SIXGILL SHARK (<i>Hexanchus griseus</i>) 	■ Discoloration from grey-brown to red brown	SKATE (<i>Rajidae</i>) 	■ Expands dorsal side on deck or while hooked and lifts the tail to the side if on deck with partial stiffness ■ Mucus on body openings it is not a good sign especially when on spiracles ■ Mature Rajidae males open one of their claspers before dying ■ Pregnant females give birth prematurely and die due to stress
SMOOTH-HOUNDS (<i>Mustelus</i> spp.) 	■ Tail loosens ■ Mouth opens slowly	BULL RAY (<i>Aetomylaeus bovinus</i>) 	■ Vivid colours fade (from bright yellow to grey)
MARbled ELECTRIC RAY (<i>Torpedo marmorata</i>) 	■ Bends upwards (ventral side) as if receiving an electric shock, but then shortly it slowly returns to horizontal position on deck and dies	BLUE SHARK AND MAKO SHARK (<i>Prionacea glauca</i> and <i>Isurus oxyrinchus</i>) 	■ Vivid colours fade (from bright blue to grey)

THE IMPORTANCE OF BETTER HANDLING

When a bycaught animal is brought on board, the path it takes after removal from the gear through the vessel infrastructure can have a major effect on its chances of survival.²² From the speed of handling to the means of release and the equipment used to achieve it, everything the crew does will influence the health of the bycaught individual.²³

The skills of the crew in release techniques are of primary importance – and generally speaking, fishers are more confident about releasing species that have been completely protected for years, like turtles and dolphins. Sharks sometimes have their jaws detached when hooks are cut out by inexperienced crew, and they can be severely injured when they are body-gaffed prior to being discarded.^{24,25}

Basic training is needed to ensure such events are minimized as far as possible. An obvious place to start is with FAO's [Good practice guide for the handling of sharks and rays caught incidentally in Mediterranean pelagic longline fisheries](#), although a recent survey we carried out among fishers in Morocco, Turkey and Italy suggests that regional awareness of this particular resource is still limited – lack of wide-scale accessibility, particularly for small scale fishers, is clearly an issue. There is also a need for handling guidelines dedicated to all other key gears. Recent initiatives – like regional training on vulnerable species bycatch organized through the [MedBycatch project](#), as well as the [SSF Forum](#) – will be crucial platforms to improve SSF **access to capacity-building for more responsible practice**.

Many species suffer from exposure to air, light and exposure to sea birds. The shorter the exposure, the higher the chances for survival.²⁶ A **quick sorting** of the catch by a skilled crew is beneficial to the health of bycaught animals. Discards can be temporarily stored on deck, or released through a tube above or subsurface. This affects the exposure time to air.²⁷

There are also a range of vessel modifications which can considerably improve post-release survival rates, and fortunately they are simple and inexpensive: cost is a critical factor for small-scale fishers. **Shades** can be placed over the sorting area to reduce exposure to the sun, which can otherwise cause skin dehydration equivalent to injuries; this is particularly important for smaller elasmobranchs which may not be treated separately and immediately. It can also help other vulnerable species: for sea turtles and dolphins, covering them in wet blankets or towels while in the sorting area can increase their chance of survival.^{28,29}

Hoses that suck in seawater for cleaning the decks can be used to keep sensitive species alive while untangling them: water can be directed through a shark's gills, or used to keep the skin of a dolphin wet.

When it comes to the moment of release, **side doors** can be helpful for removing larger animals safely. Lifting them up and over the side with a rope can apply huge pressure which damages their internal organs, whereas an opening in the side means they can slide straight into the sea.

Crew safety must of course be of paramount importance during all handling procedures.



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FAO recommends that all vessels should carry the following gear to aid in handling and release:



TOWEL

to prevent animal from dehydration, cover eyes to prevent shock



KNIFE

to untangle animal



BOX/TRAY WITH LID

to provide a secure/ calm environment for seabirds



LONG PLIERS/ BOLT CUTTERS

to unhook animal



LONG PRUNING SHEARS

to unhook animal from a distance



LANDING NET

to safely move animal



WORK GLOVES

to prevent injuries and enable secure hold on animal



SPARE ROPE

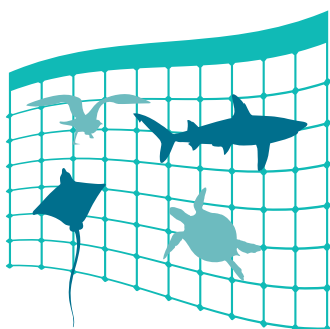
to secure animal while untangling



PIECE OF WOOD

to prevent bites

MINIMIZING BYCATCH: GFCM RECOMMENDATIONS AND OTHER BEST PRACTICES



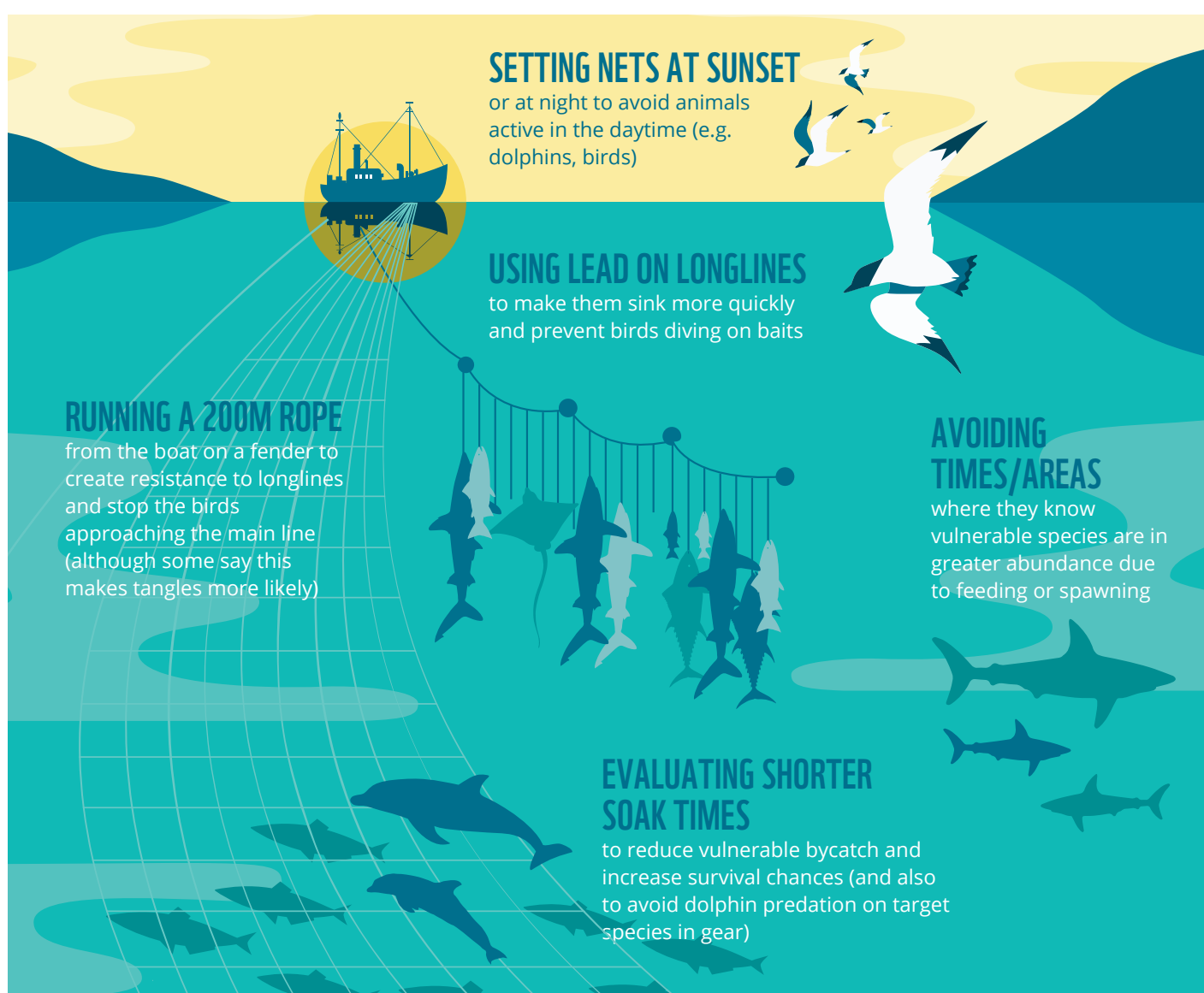
Of course, the best strategy of all for reducing PRM in vulnerable species is not to catch them in the first place. Following its [44th session](#) in 2021, the GFCM released a series of four binding Recommendations on mitigating fisheries impacts on seabirds, sea turtles, cetaceans and elasmobranchs. As well as calling on member nations to increase monitoring and data collection in line with GFCM protocols, the Recommendations contain various mitigation measures aimed at limiting or eliminating bycatch across all four species groups.

MITIGATION IN PRACTICE: FISHER RESPONSES

It's important to note that fishers themselves try to avoid bycatch, except in cases where vulnerable shark and ray species might be marketable.

As the 71 fishers who responded to the survey in Morocco, Turkey and Italy told researchers, dealing with bycatch takes time and resources and gear can be damaged, while some believe an absence of incidental bycatch would lead to higher catches of target species – although opinion is divided over

whether measures to reduce bycatch will reduce overall catches, and over which measures are the most effective. Respondents interviewed in this local ecological knowledge survey mentioned a number of simple mitigation measures which are currently used in the Mediterranean. These include:



Fishers mentioned that they have heard of other mitigation measures (e.g. acoustic devices, circle hooks, hook pods, turtle exclusion devices), but they are mostly viewed as measures that would complicate their daily work and reduce their catches, so in practice they're rarely used. Collaboration with the fleets to roll out effective mitigation measures, and to monitor the effects of the measures applied through proper research, is therefore crucial in order both to reduce bycatch and to increase the chances of survival for affected animals.

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