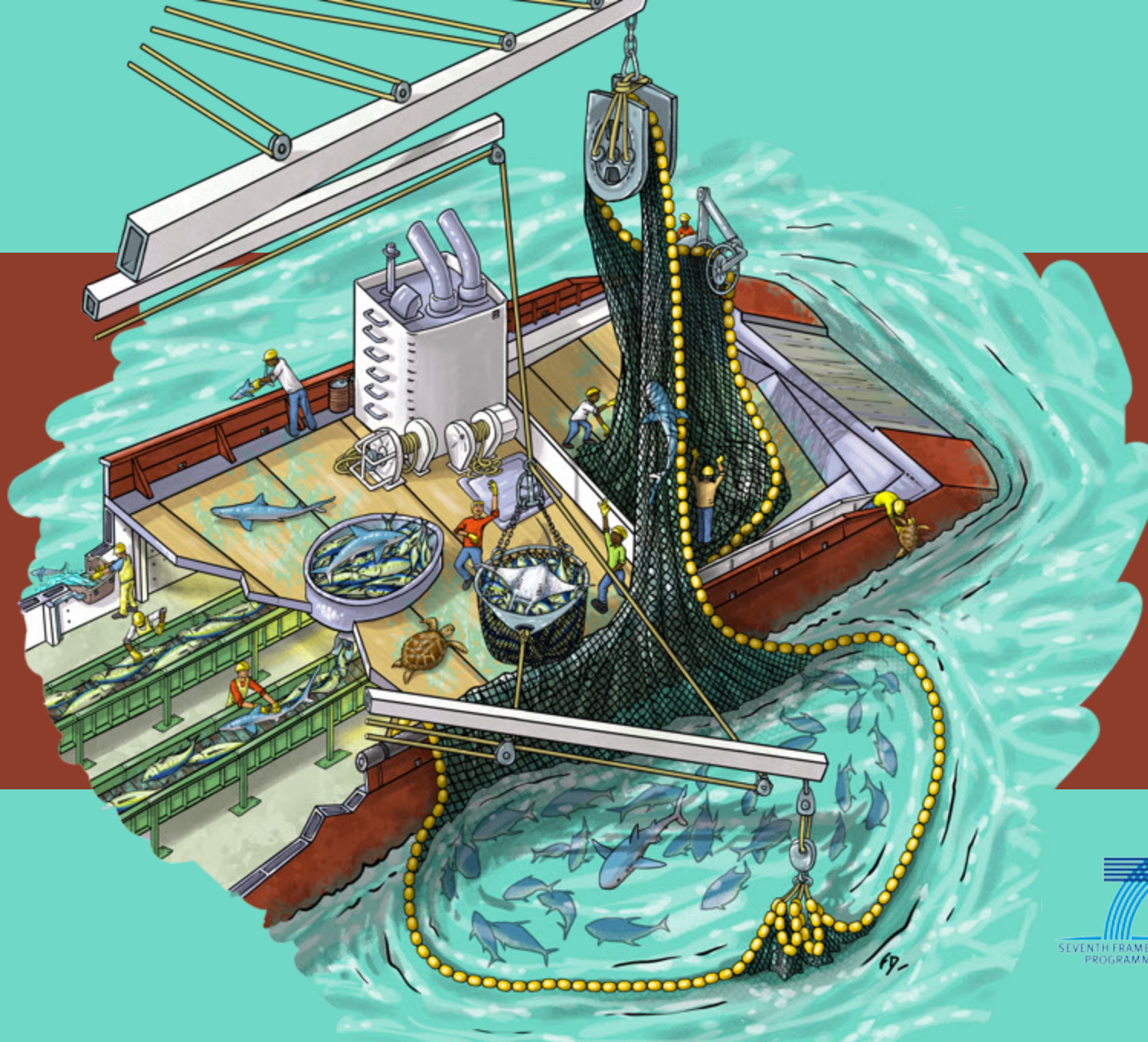




Good practices to
reduce the
mortality of sharks
and rays caught
incidentally by
tropical tuna purse
seiners.

Poisson F., Vernet A. L.,
Séret B., Dagorn L.









Acknowledgements: We are grateful to the French skippers and crews who worked voluntarily with the scientists. We would like to associate the Contrat Avenir Thonier of ORTHONGEL as the work was done jointly between MADE (mitigating adverse ecological impacts of open ocean fisheries, www.made-project.eu) and this project. We also thank Sarah Fowler for her advices and editorial comments on this document.

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Graphics and layout : Emilie Guldner

CONTENTS

➤ About this manual.....	7
➤ Various types of sharks and rays encountered.....	8
➤ Sharks and rays' weaknesses.....	12
➤ Detrimental conditions faced by the sharks and rays.....	14
➤ Risks to the crew.....	15
➤ Small pelagic sharks.....	16
➤ Medium pelagic sharks.....	18
➤ Small and medium rays.....	20
➤ Large animals.....	21
➤ Whale shark.....	22
➤ Entangled individuals.....	24
➤ Sea turtles.....	25
➤ Watch out for tags.....	26



ABOUT THIS MANUAL

During the last decade, particular attention has been paid worldwide to the problem of bycatch and discards in fisheries. The MADE* project funded by the seventh framework programme of the European Union, was set up to develop measures to mitigate the adverse impacts of fisheries targeting large pelagic fish in the open ocean: purse seiners using fish aggregating devices (FADs), and longliners.

Among the species that are accidentally caught by purse seiners, sharks and rays are particularly vulnerable. The life traits of sharks and rays (slow growth rates, late maturation, long gestation, low fecundity and long lives) make them highly susceptible to overfishing and efforts should be made to reduce their mortality. This specific issue is an objective of the ecosystem approach to fisheries and a request by consumers.

In addition, releasing bycatch alive in good conditions could facilitate the re-colonization process of the FAD after fishing. Indeed, sharks, and to a lesser extent rays, are usually considered by fishers as tough animals and they assume that they can easily survive when returned to the sea. Nevertheless some sharks that appear healthy upon release may die later because of injuries caused not only by the fishing process itself but also by handling practices. A preliminary study indicated that 50% of sharks died after release. It is therefore important to know what practices can cause a delayed mortality and which ones minimize physical trauma and stress to the animals. This manual, dedicated to skippers and crew of the tropical tuna purse seiners, shows good and bad practices when releasing sharks and rays.

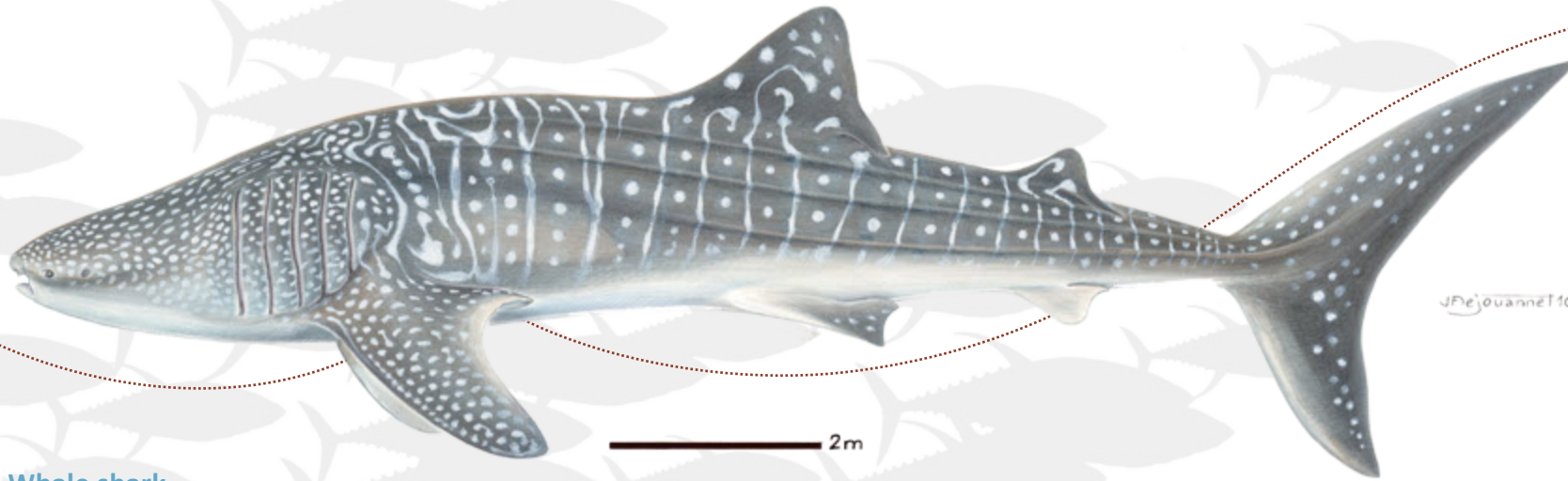
Sharks and rays are not by nature aggressive, but they can certainly cause injuries to the crew. Sharks can bite or rays can sting humans in self-defence when threatened. Massive animals like whale sharks or large manta rays are very powerful and can therefore be dangerous to handle on board. For these reasons, safety of the crew has been considered as a priority in this guide. This manual provides information on the biology of sharks and rays and also includes guidelines to release sea turtles and also provides information for reporting catches of tagged animals.

Please take time to read these pages carefully before taking any action and convey the message to those around you. The handling protocols are presented on a case-by-case basis. Start planning your release strategy, actions needed to be taken collectively onboard. Make sure that each crew member understands their role in the operation.

*mitigating adverse ecological impacts of open ocean fisheries, www.made-project.eu

VARIOUS TYPES OF SHARKS AND RAYS ENCOUNTERED

During the fishing process, fishers interact with various types of sharks and rays that range widely in size, weight and shape. Certain interactions are sought-after (i.e. whale sharks, for their potential as 'living' FADs), while others are undesirable as they can cause time wastage (sorting the animals from the catch) and potentially endanger the crew. This manual presents information about the habitat, migration pattern, status and conservation of the more common species encountered.



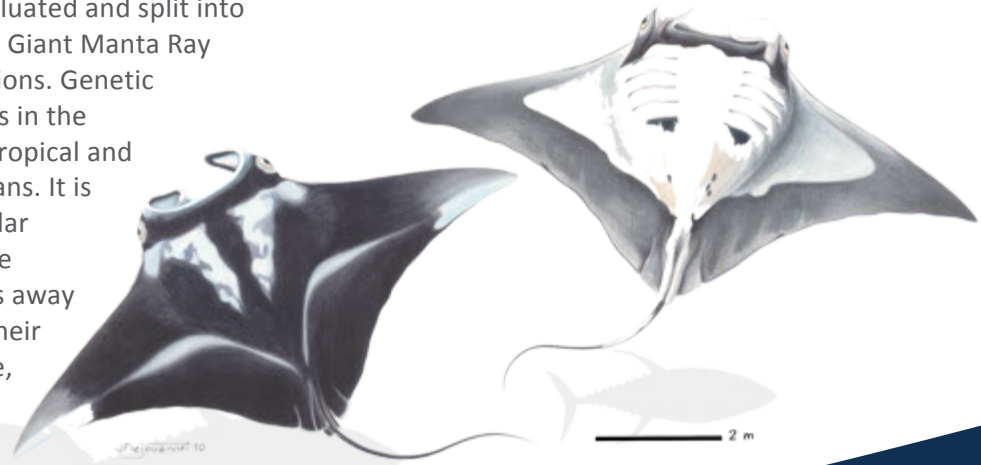
Whale shark

Habitat and migration: Whale sharks (*Rhincodon typus*) is found in all tropical and warm temperate seas except the Mediterranean. Studies using satellite tags technology have demonstrated that these animals undertake multi-annual and very long-distance migrations.

Status and conservation: This species is assessed as Vulnerable by IUCN. Whale Sharks are legally protected in many countries. Some Regional Fisheries Management Organisations (RFMOs) have discussed adopting measures to prevent their use as FADs and to release accidental bycatch unharmed.

Giant Manta Ray

Habitat and migration: The genus was recently re-evaluated and split into two species, the Reef Manta Ray (*Manta alfredi*) and the Giant Manta Ray (*Manta birostris*). Both species have worldwide distributions. Genetic evidence further confirms the existence of a third species in the Caribbean. The Giant Manta Ray occurs in tropical, sub-tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. It is commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts. These mantas make migrations away from these areas during parts of the year but return to their birthplace. In other areas, such as southern Mozambique, the Giant Manta Ray is seen sporadically throughout the year although individuals are not commonly re-sighted over time.

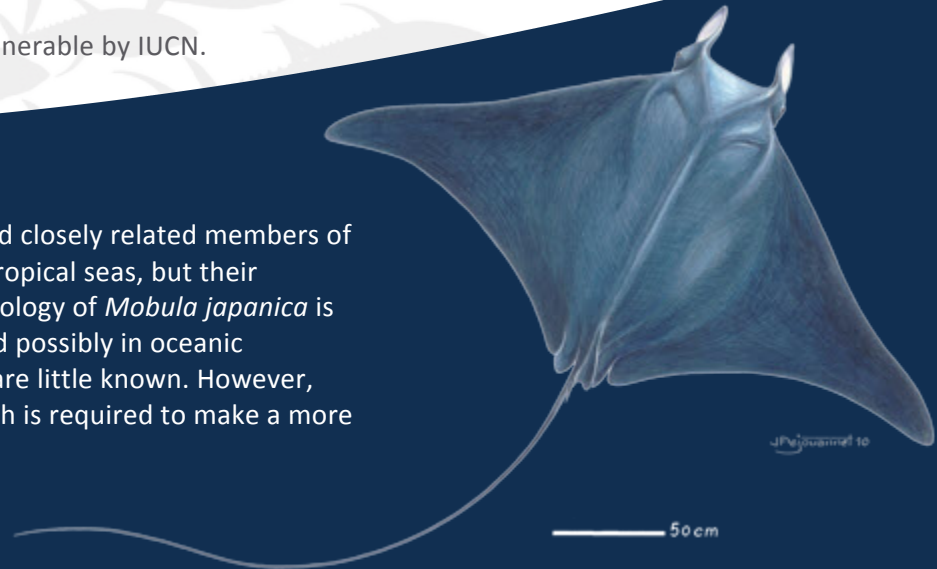


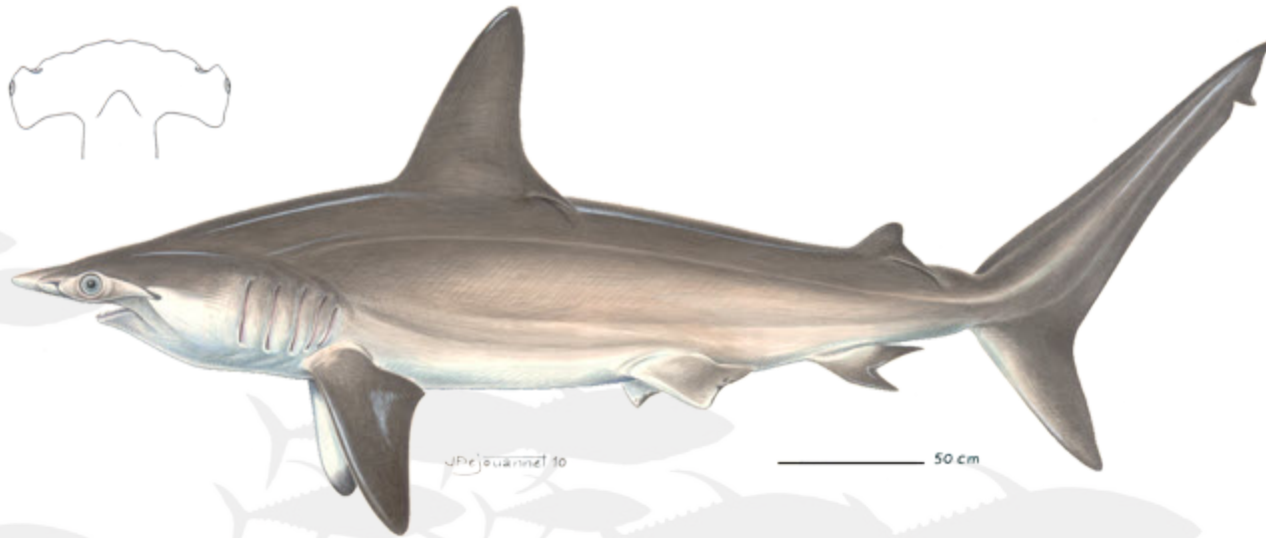
Status and conservation: Both species are assessed as Vulnerable by IUCN.

Devil Ray

Habitat and migration: The devilrays (*Mobula japonica* and closely related members of this genus) are probably circumglobal in all temperate and tropical seas, but their distribution is not completely defined. Information on the biology of *Mobula japonica* is extremely limited. The species is found inshore, offshore and possibly in oceanic environments, but the movement patterns within its range are little known. However, available life history information is limited and more research is required to make a more accurate assessment of the threat posed by fisheries.

Status and conservation: *Mobula japonica* is assessed as Near Threatened globally by IUCN.





Scalloped Hammerhead shark

Habitat and migration: The Scalloped Hammerhead (*Sphyrna lewini*) has a circumglobal distribution in coastal warm temperate and tropical seas.

Status and conservation: All large species of hammerhead are assessed as Endangered globally by IUCN.

Silky shark

Habitat and migration: The Silky Shark (*Carcharhinus falciformis*) is essentially pelagic and is often found near the edge of continental and insular shelves.

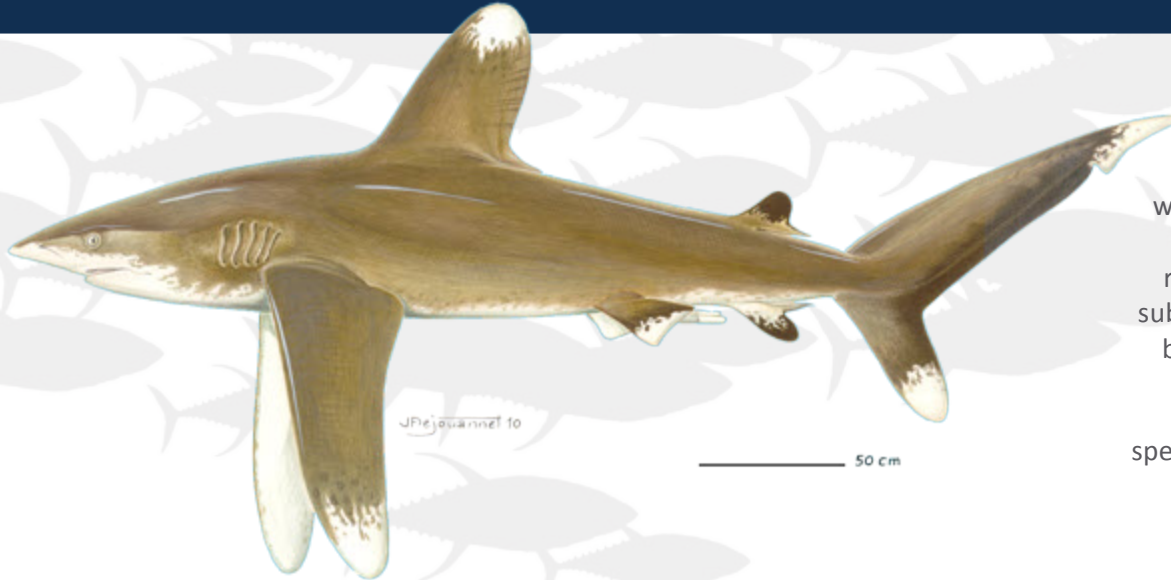
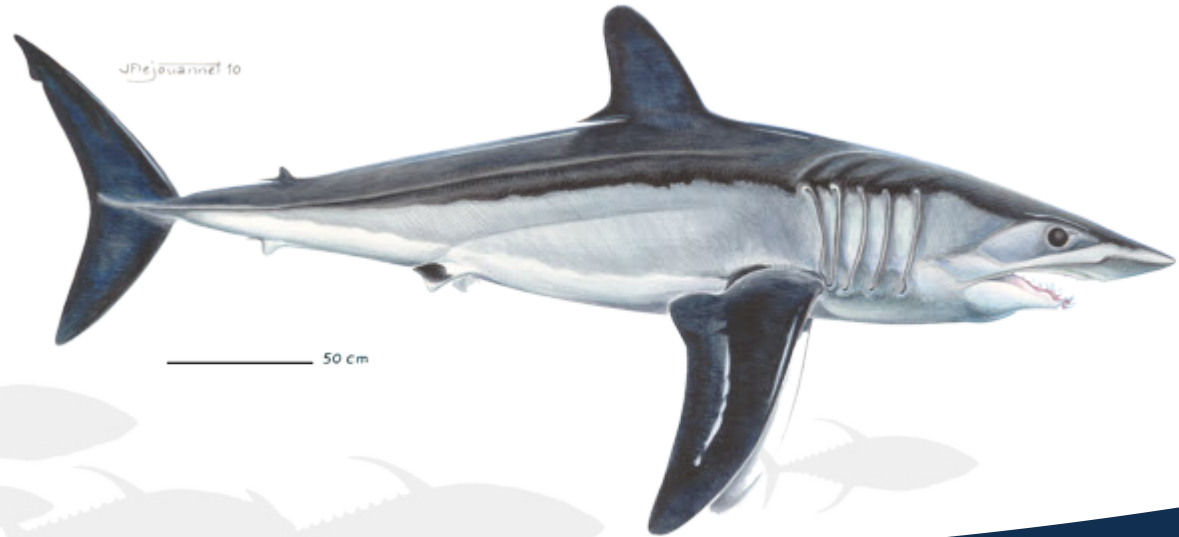
Status and conservation: Globally this species is assessed as Near Threatened.



Shortfin Mako shark

Habitat and migration: Shortfin Mako (*Isurus oxyrinchus*) is a coastal, oceanic species occurring from the surface to at least 500 m depth and is widespread in temperate and tropical waters of all oceans from about 50°N to 50°S. Shortfin Makos can make extensive migrations.

Status and conservation: This species is assessed as vulnerable by IUCN.



Oceanic whitetip shark

Habitat and migration: The oceanic whitetip shark (*Carcharhinus longimanus*) is one of the most widespread shark species, ranging across entire oceans in tropical and subtropical waters, usually found far offshore between about 30°N and 35°S in all oceans.

Status and conservation: Globally this species is assessed as Vulnerable by IUCN, but it is assessed in particular as Critically Endangered in the Northwest and in the Western Central Atlantic.

SHARKS AND RAYS' WEAKNESSES

Internal organs: Sharks and rays are very fragile because their internal organs are not protected by a rigid skeleton, but loosely held in place by connective tissue. More than any other fish, they suffer damage to internal organs when removed from the water. In their environment, water supports their organs; out of the water, the connective tissue can easily tear and their organs are easily crushed because of the weight of gravity.

Spinal cord: Injury to the spinal cord and internal organs is particularly likely to occur if the animals are lifted by their head or tail. Pressures on the spine can inflict irreversible damage. The weight of gravity can also damage tendons that hold vertebrae in place.

Gills and blood circulation: In the water, sharks and rays can suffocate if they are restrained; their blood circulation can be reduced when they are not moving. The gills and other internal organs are very easily damaged once they are removed from the water. They enable them to breathe and any damage to the gill slits may result in a slow death by suffocation when released.

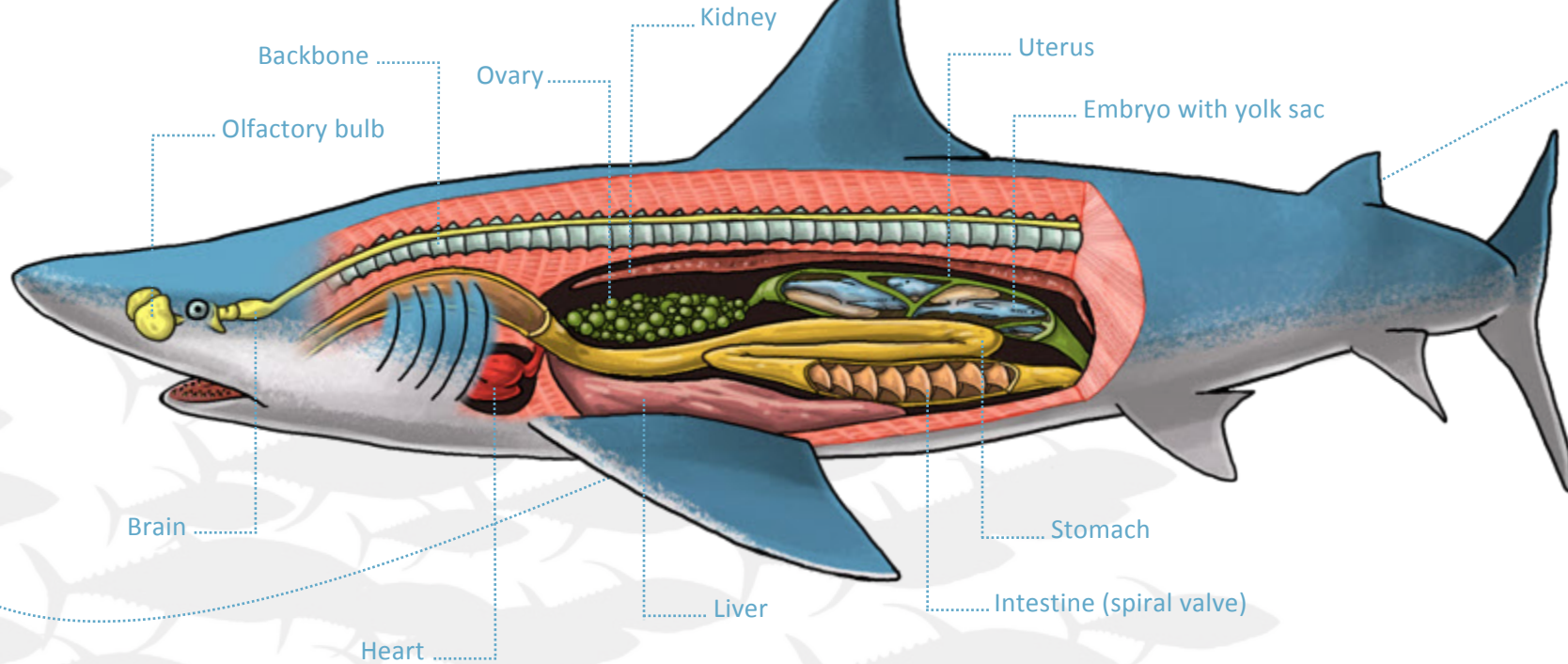
Snout: Several sensory organs are situated in the snout of the shark: the nostrils (olfaction), the Lorenzini ampullae (electroreceptors), the anterior branches of the lateral line system (detection of movements and vibrations in the surrounding waters) and sensory crypts (chemoreceptors). This means that shark snouts are very sensitive and fragile. It is strongly advised not to hurt it, because damage caused to these sensory organs can seriously handicap shark by reducing its ability to detect and capture its prey.

Particular life history traits: It is well known that sharks and rays have life history traits that make them vulnerable to fishing, and very slow to recover once depleted. The silky shark^{*} is now the most common species of sharks in the bycatch of the purse seiner, followed far behind by the formerly abundant oceanic whitetip, the hammerhead and mako sharks. The catch trends suggest that all of these species have been declining in abundance in recent years. This is why many of the RFMOs and biodiversity conventions have begun to adopt special conservation and management measures for several oceanic shark species.

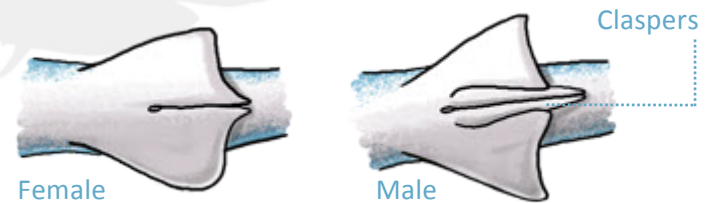
* Example of the silky shark:

- Slow growth rates: it averages 20 cm growth after the first year of life, with a growth rate of 16 cm per year between the 2nd and 4th year, and only 3 cm per year or less after age 11.
- Late maturation: silky shark reach reproductive maturity at a late age, varying depending upon geographic region (5 to 12 years).
- Long gestation period: it takes from 12 months for embryos to develop inside the females which give birth possibly every 2 years.
- Low fecundity: a female shark produces few young per litter (2-14 per litter).
- Long lifespan: more than 22 years.

SHARK ANATOMY



This drawing shows the internal organs of a gravid female. The liver has two large lobes (one has been removed to show the other organs); the digestive tract includes a U-shaped stomach and very short and compact intestine, named the spiral valve as its internal wall is twisted as a spiral staircase. Most sharks are viviparous : embryos develop inside the maternal uterus.



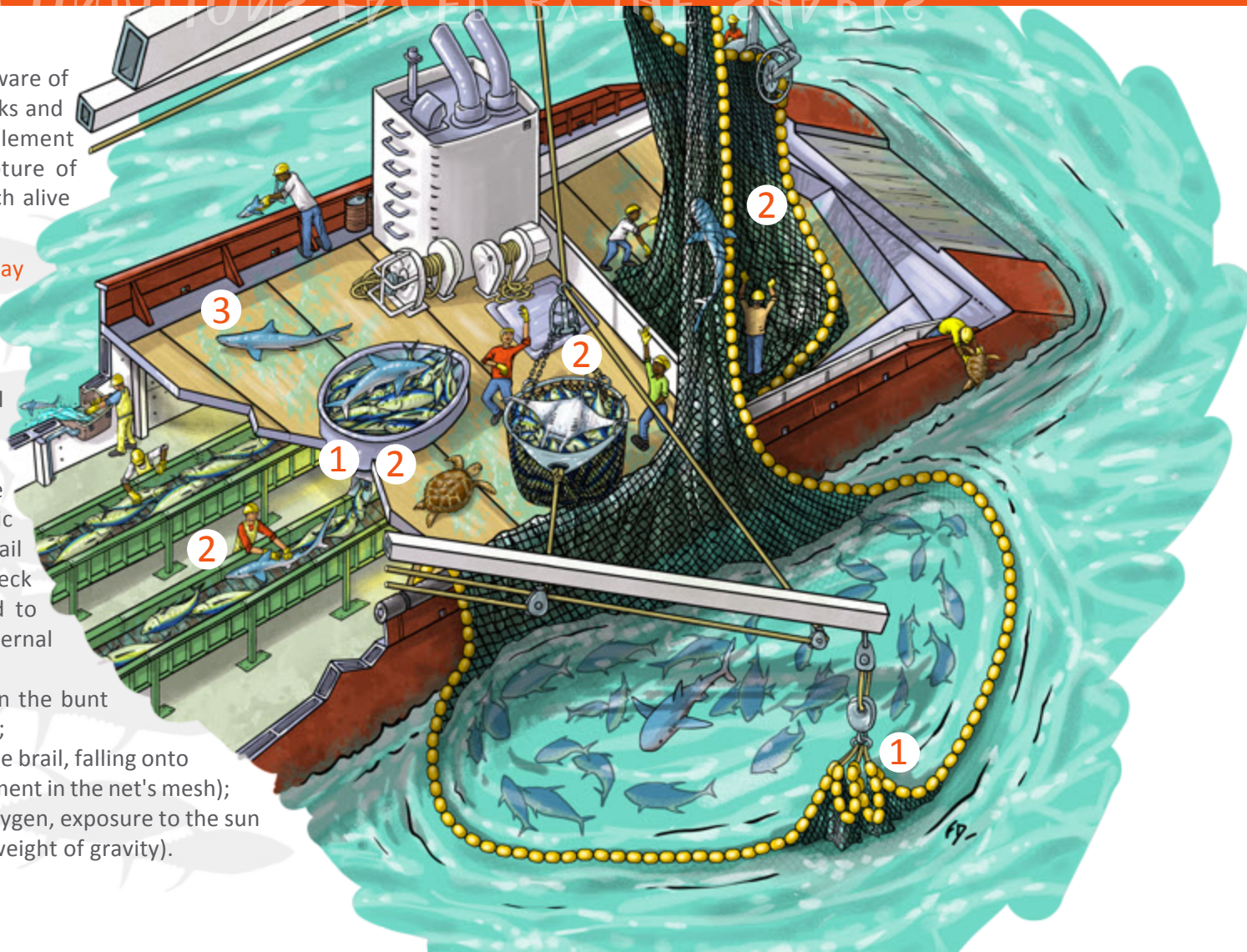
DETRIMENTAL CONDITIONS FACED BY THE SHARKS

RFMOs are becoming increasingly aware of the threatened nature of some sharks and rays and requiring vessels to implement special measures to avoid the capture of certain species and to return bycatch alive to the sea.

Fish that are caught and released may die for several reasons, but the two primary causes are wounding and stress.

The conditions faced by sharks and rays during the different phases of the fishing operations and catch processing are summarized in the drawing below. Apart traumatic handling practices (lifting up by the tail or mechanically dragging on the deck and/or towing), fishes are exposed to detrimental conditions including external and internal damages due to:

1. physical contact with other fish in the bunt and with hard objects surrounding it;
2. the rough harvesting process (in the brail, falling onto the upper and lower decks, entanglement in the net's mesh);
3. removal from the water (lack of oxygen, exposure to the sun and organs crushed because of the weight of gravity).



RISKS TO THE CREW

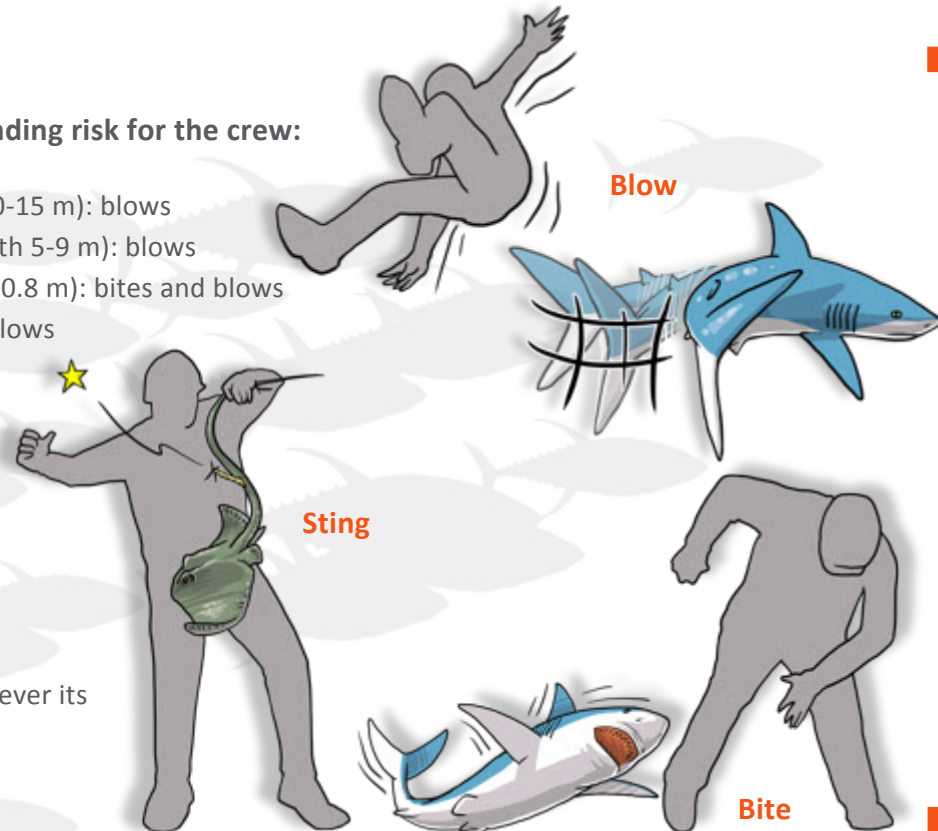
The several types of sharks and rays encountered during the fishing process pose various degrees of danger to the crew. These ones may suffer injuries by being struck or bitten by large fish and sharks or stung by stingrays. Obviously, differences in procedures are expected according to the size and the shape of the individuals, and solutions will be considered carefully in this manual, on a case-by-case basis.

Categories of sharks and rays with corresponding risk for the crew:

- › Large whale sharks (4 to 14 tons, total length 10-15 m): blows
- › Medium whale sharks (500 kg-3 tons, total length 5-9 m): blows
- › Medium and large sharks (>10 kg, total length > 0.8 m): bites and blows
- › Small sharks (<10 kg, width <0.8 m): bites and blows
- › Large rays (about 1 ton, width > 2 m): blows
- › Medium rays (30-70 kg, width < 2m): none
- › Small rays (stingray, about 2 kg): sting

FOR YOUR SAFETY

- › Always be cautious when you handle a shark, whatever its physical condition may be (alive or moribund).
- › Avoid the jaws for safety reasons.
- › Return the fish back to the sea as soon as possible.



SMALL PELAGIC SHARKS

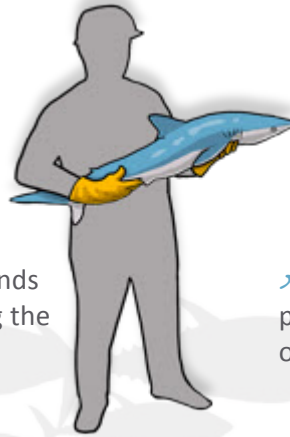
HOW TO HANDLE SHARKS

Small sharks are best handled using both hands:

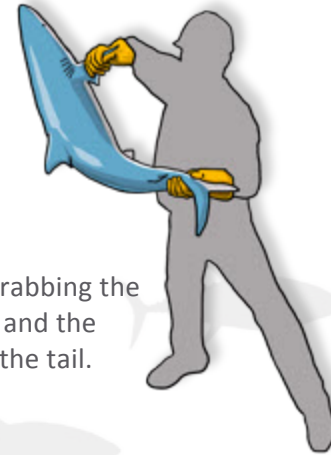
› one holding the dorsal fin and the other supporting the body.



› both hands sustaining the body.

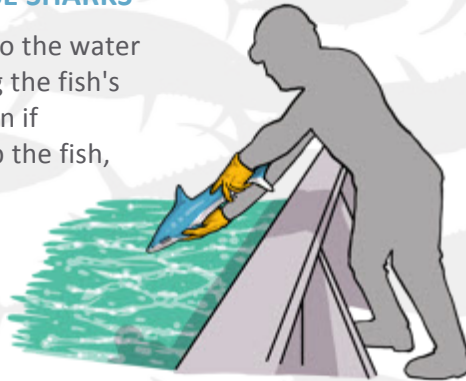


› one hand grabbing the pectoral fin and the other hand the tail.



HOW TO RELEASE SHARKS

› Return the fish to the water headfirst, pointing the fish's head straight down if possible. Just drop the fish, do not throw it!



› **If the shark is found in the lower deck:**

If the boat is equipped with a bycatch conveyor belt and a waste chute, ensure that the flow of water is strong enough to evacuate it through the drain pipe.



› **If the animal is too big for the waste chute or if there is not such equipment onboard**, carry the animal as soon as possible on the upper deck and release it back to the water as described above.

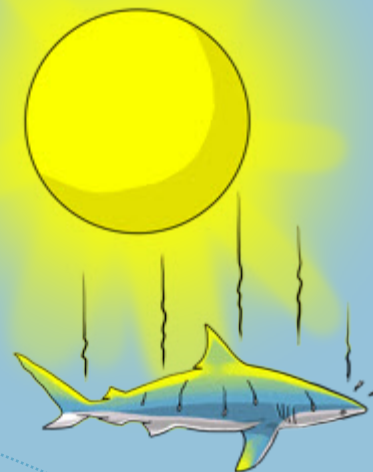
DO NOT:



› Under no circumstances should a shark be lifted by its tail or head.

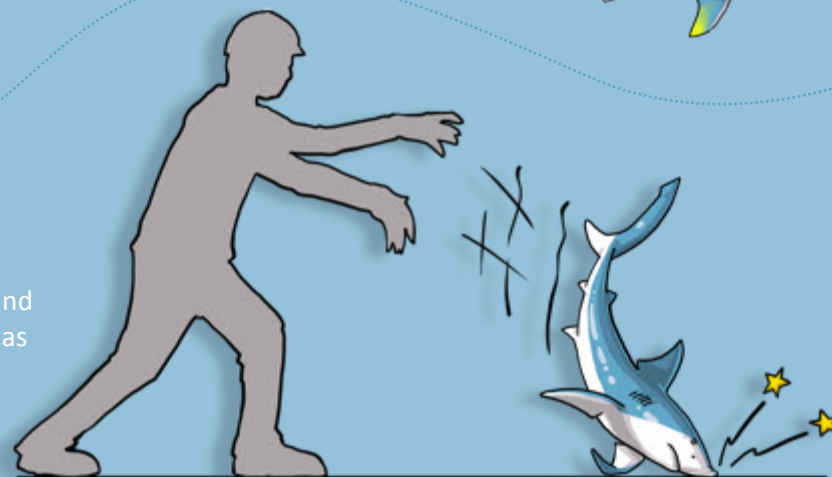


› Do not carry or drag the shark by inserting your hands in its gill slits.



› Do not expose the animals to the sun.

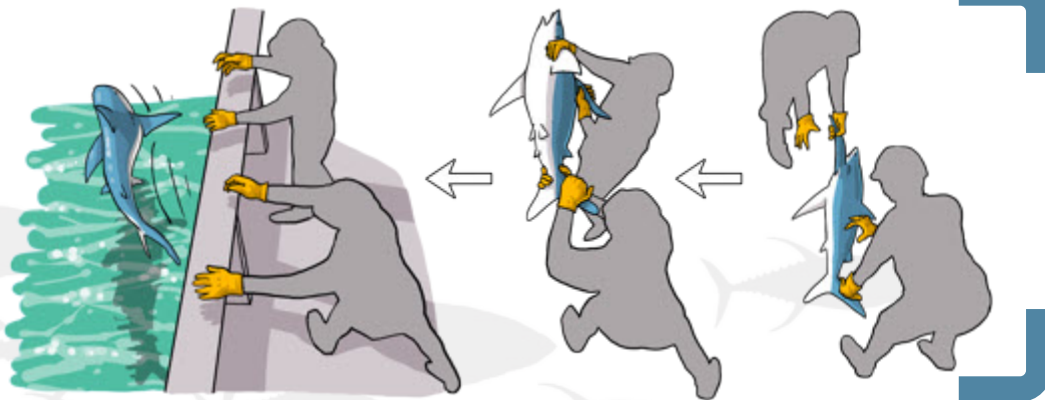
› Don't expose animals to physical trauma (do not throw it, whatever the distance; do not push it too harshly; and avoid squeezing fish around the belly, as this can damage internal organs, etc.).



MEDIUM PELAGIC SHARKS

HOW TO HANDLE AND RELEASE SHARKS

- Medium sized fish can be handled by two persons : one crew member holds the dorsal fin and the pectoral fin, keeping well away from the head, and the second crew grabs the tail.



If you are obliged to delay its release:

- prevent the animal from battering itself on the deck and surrounding hard objects,
- place the animal in the shade and water regularly it,
- use a hose placed in the jaw with a moderate flow of water if you want to delay its release.



HOW TO CALM DOWN A VIGOUROUS SHARK

- Cover the shark's eyes with a piece of smooth, wet and dark cloth. Never press this against the eyes.



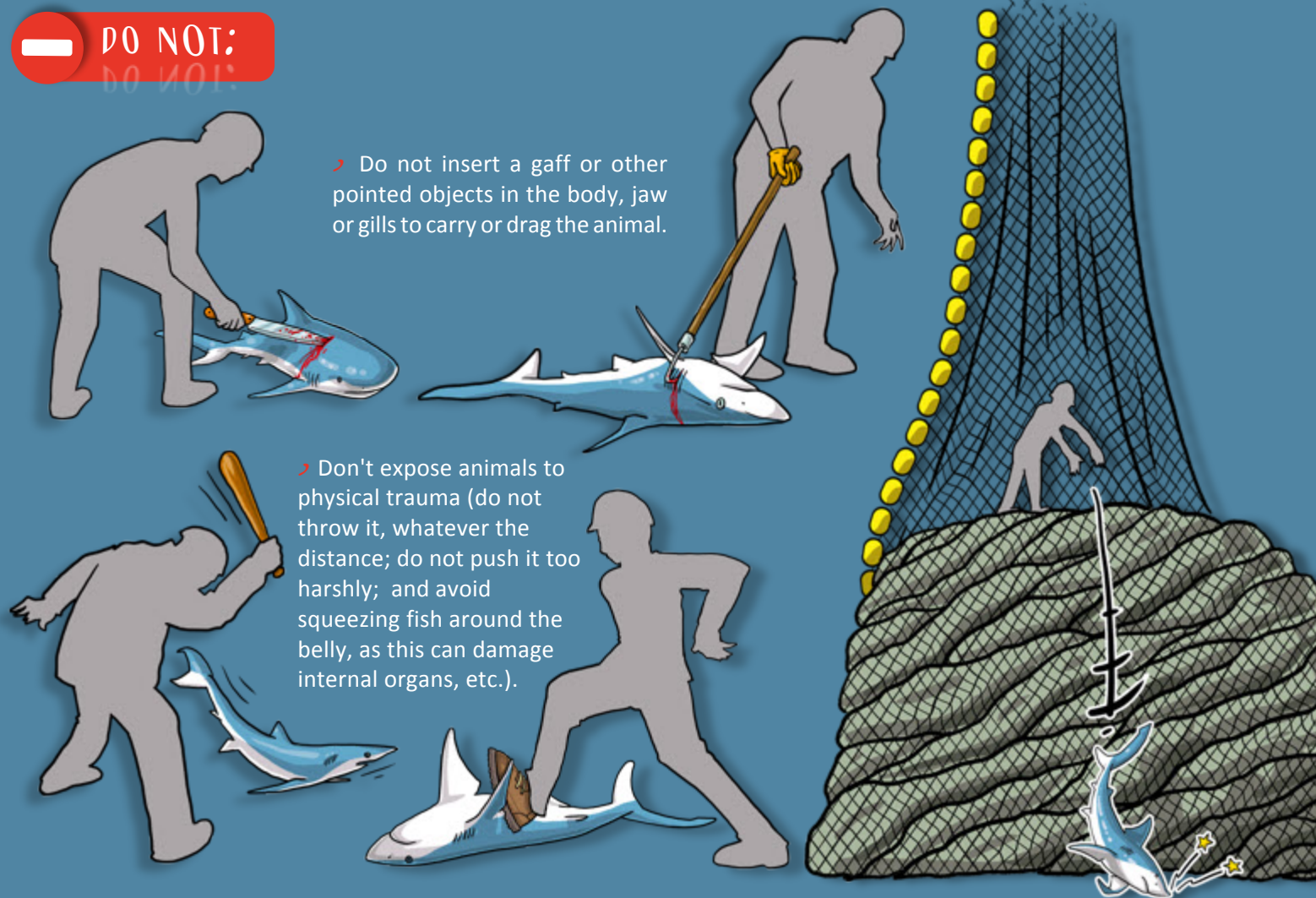
HOW TO PREVENT SHARK BITES

- A dead fish (skipjack) or a big stick placed between the jaws prevents it from biting and will allow it to be handled safely.



DO NOT:

➤ Do not insert a gaff or other pointed objects in the body, jaw or gills to carry or drag the animal.



➤ Don't expose animals to physical trauma (do not throw it, whatever the distance; do not push it too harshly; and avoid squeezing fish around the belly, as this can damage internal organs, etc.).

SMALL AND MEDIUM RAYS

HOW TO HANDLE RAYS



➤ In the case of a small manta ray, which can be handled by 2 or 3 people, it is recommended to carry it by the side of the wings.

➤ Hold the ray far away from you in order to avoid lashes of the tail and the contact with the barbs.

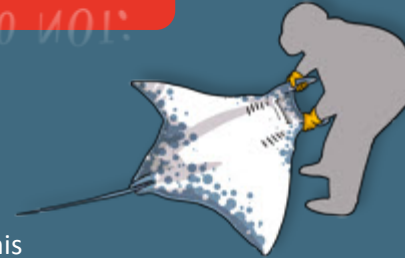
* The 'stinger' of the stingray is a barbed spine that is located at the base of its tail. Stingrays use their barbs as defensive weapons to protect themselves from sharks and other predators. The Stingray's barb is covered in a mildly venomous sheath of skin. When the barb is pushed into a foreign body the venom is dispersed. A sting from a stingray is painful regardless its size, but not very harmful. It is better to avoid the rear part of this fish and handle it by the head.



DO NOT:

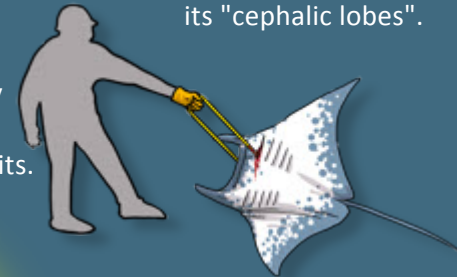


➤ Do not carry a ray by its tail: this is dangerous!

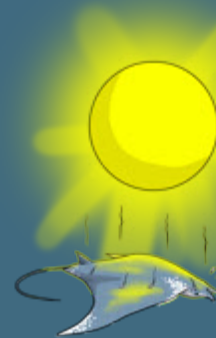


➤ Do not drag, carry or hold a ray only by its "cephalic lobes".

➤ Do not carry or drag the shark by inserting your hands in its gill slits.



➤ Do not insert a gaff or other pointed objects in the body.



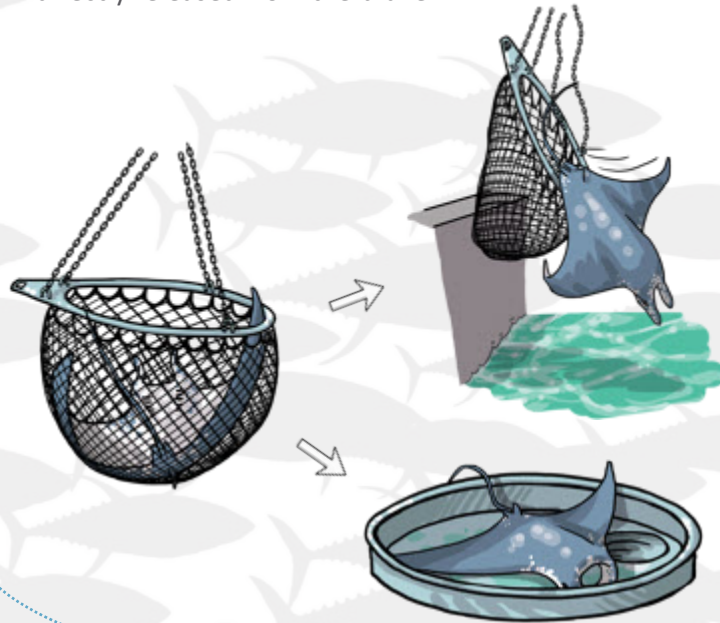
➤ Do not expose the ray to the sun.



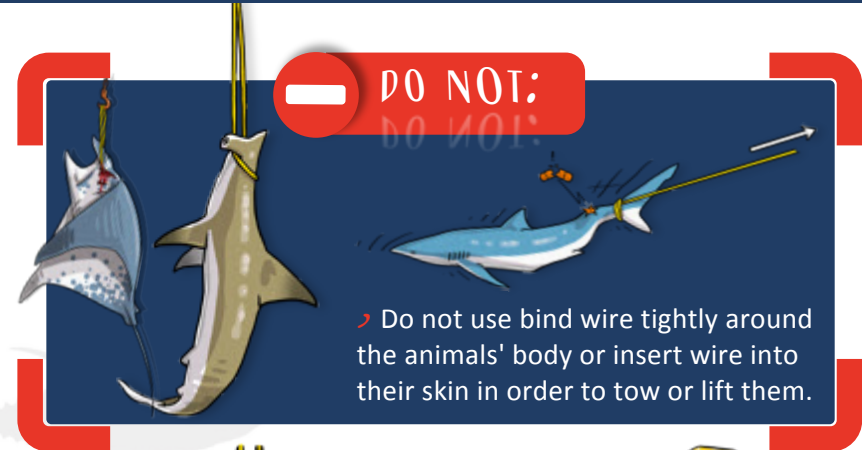
LARGE ANIMALS

HOW TO RELEASE A LARGE ANIMAL

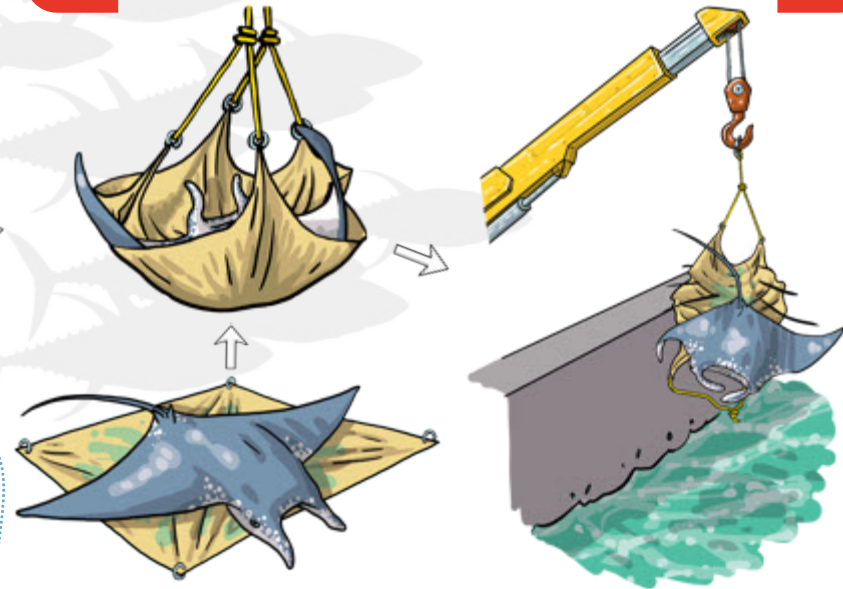
Very large fish, like large sharks, mantas or moonfish, can be directly released from the brailer.



Alternatively, they can be returned to the sea using a piece of net or a piece of plastic canvas that can be lifted by the crane. Before each set, the crew must prepare a piece of net (or a piece of canvas) on the deck to be ready to release large animals.



Do not use bind wire tightly around the animals' body or insert wire into their skin in order to tow or lift them.



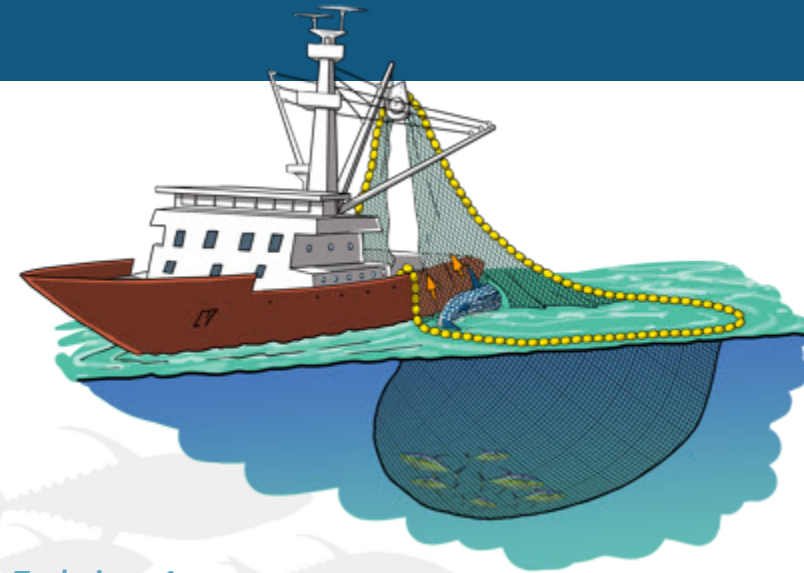
WHALE SHARK

HOW TO RELEASE WHALE SHARKS

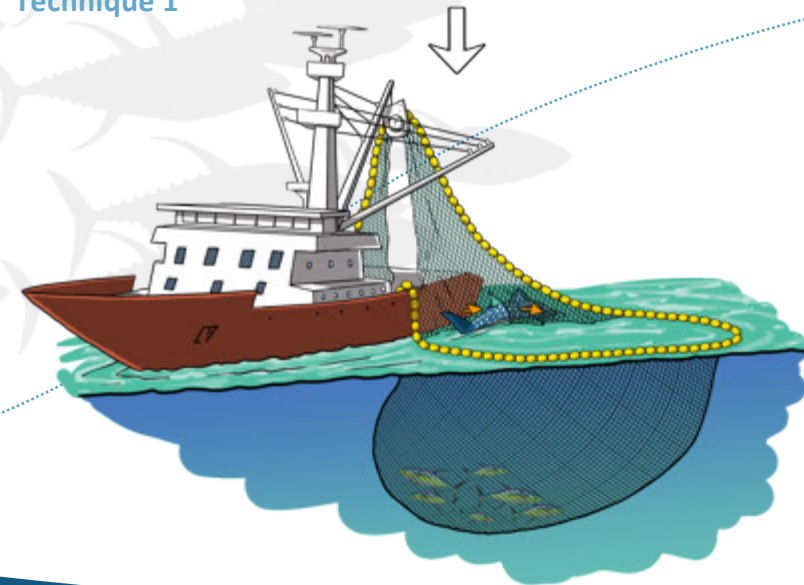
Some skippers experienced years of operation to release whale sharks from the net and sack without harming them. This way, they developed non-lethal techniques. The ones already in place are presented below.

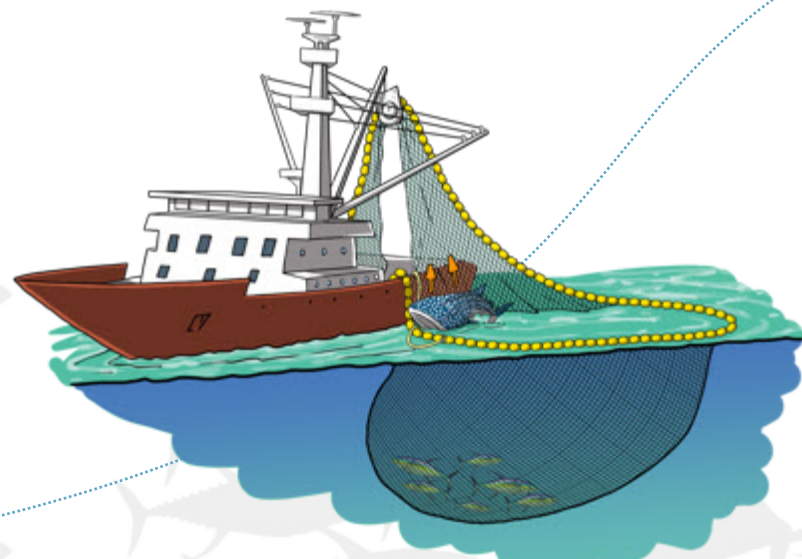
The first technique is applied if the whale shark is at the surface and separated from the tunas. Either the shark tears the net by its weight and passes outside or, if the operation presents no danger, a crew member cuts a few meters of the net in front of the mouth of the shark to release it.

For the second technique, the crew in charge of the net hauling operation manages with the winch and the capstan to bring the whale shark close to the hull, to stand the animal on the net and to roll it outside the bunt. A rope placed under the animal and attached to the float line could help rolling the whale shark out of the net.

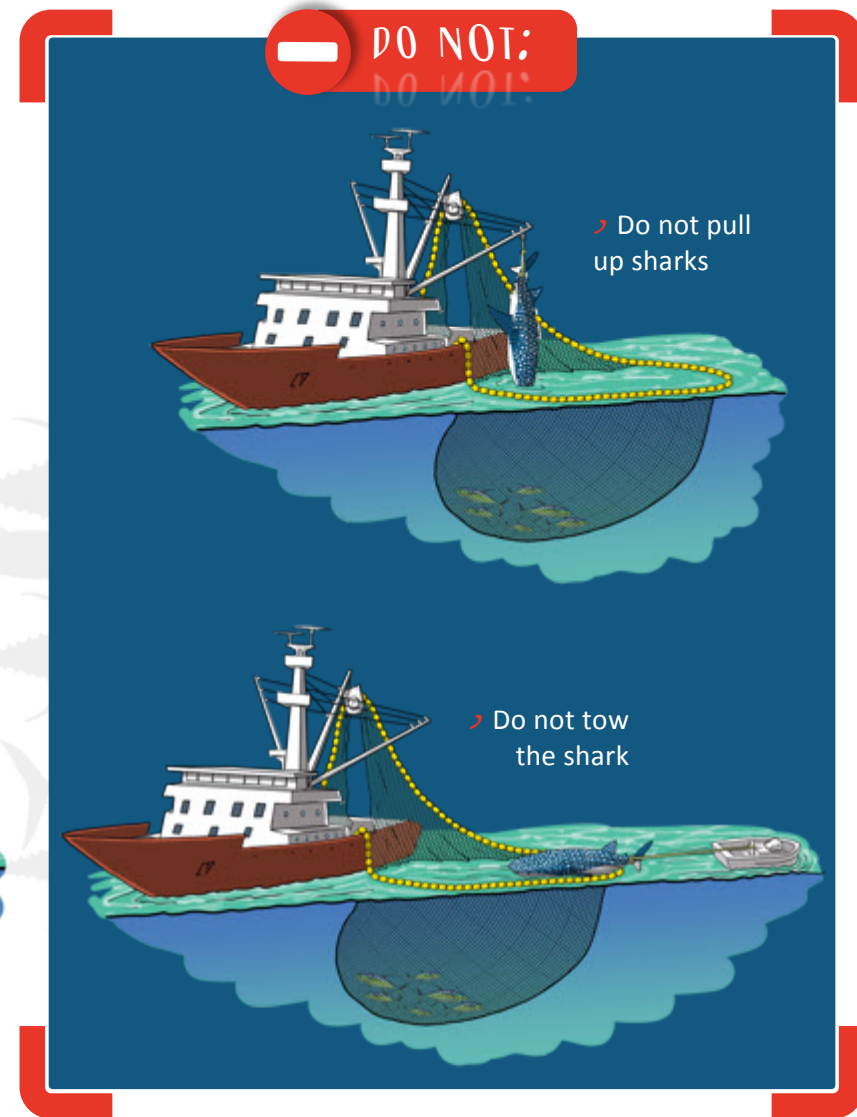
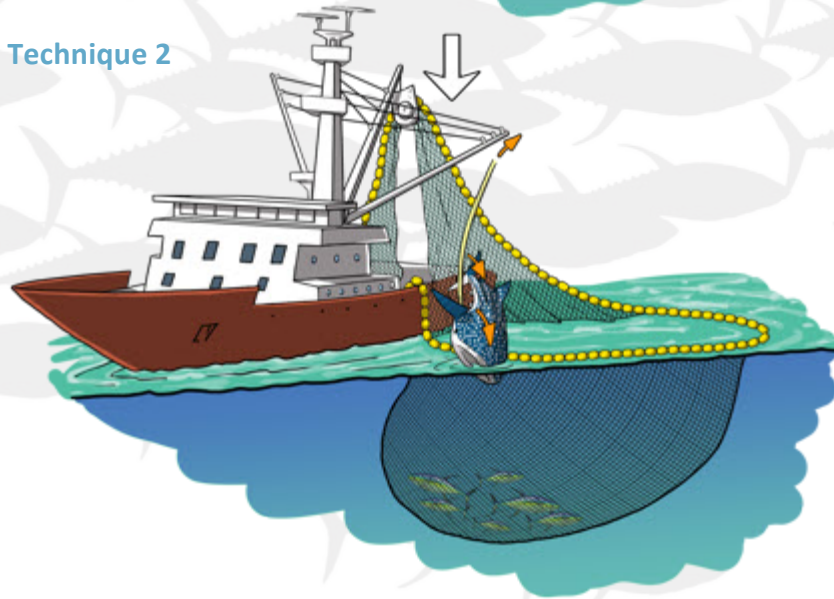


Technique 1





Technique 2



DO NOT:

Do not pull up sharks

Do not tow the shark

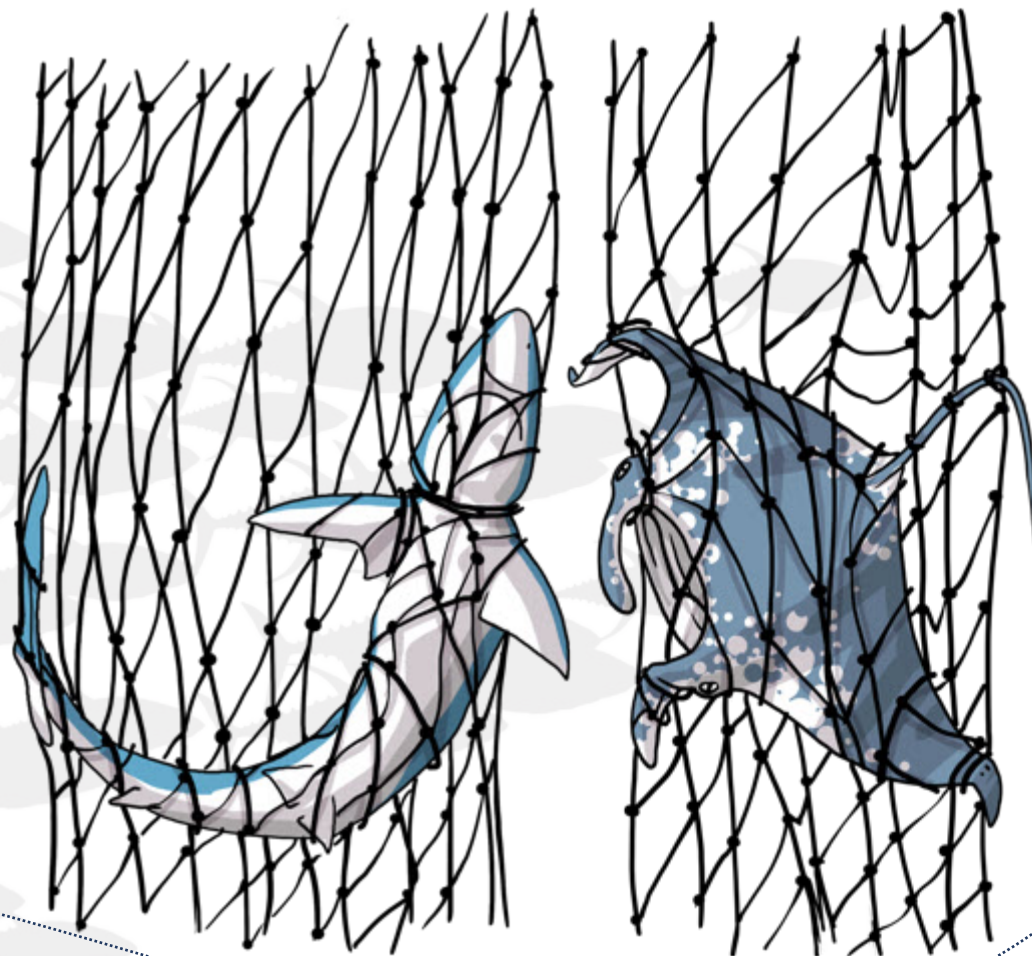
ENTANGLED INDIVIDUALS

Some sharks tend to spin and roll themselves in the net, these entangled sharks are in most cases still in good condition. If entangled sharks are lifted up with the net towards the power block, this is dangerous to both the sharks and the crew.

➤ Scan the net as far ahead as possible to spot the sharks as early as possible. It is important to react quickly upon sighting in order to release the animal before it is lifted with the net.

➤ Ask for the speed of the net reel to be reduced. This will slacken the tension of the net and allow the entangled animal to be carefully removed from the net.

➤ Avoid tugging or yanking net strongly and, if necessary, use clippers to cut the net.



SEA TURTLES

Sea turtles can be caught when entangled in the net of the FAD structure or associated with the tuna school in the bunt. So:

- scan the FAD,
- scan the net as far ahead as possible during the net hauling to spot the sea turtles as early as possible,
- minimise the tension of the net (if necessary, use clippers to cut the net),
- separate the turtle from the rest of the catch and bycatch.

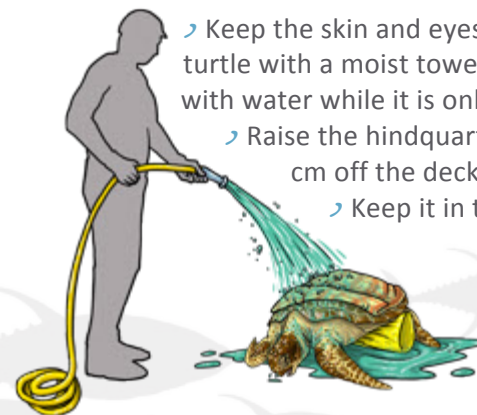
HOW TO HANDLE AND RELEASE A SEA TURTLE



- Hold the turtle by the side of the shell.



- Return the turtle gently to the sea.



- Keep the skin and eyes moist by covering the turtle with a moist towel or periodically spraying it with water while it is onboard.
- Raise the hindquarters of the turtle about 20 cm off the deck.
- Keep it in the shade

Did you know that all the sea turtle species are internationally protected?

DO NOT:



- Do not place the turtle upside down. Turtles cannot breathe in this position.



- Do not expose the turtle to the sun.



- Do not lift them by the flippers.

WATCH OUT FOR TAGS

Worldwide, several tagging programmes are being conducted to study the migration behaviour of large migratory fish and sea turtles. Numerous types of tags have been deployed from "spaghetti" tags affixed onto the fish to complex electronic tags inserted into the body of the fish or attached externally to fish (and turtles).

Accurate data reporting can provide valuable and useful information about animal populations. In most cases, instructions on how and where to report recaptures appear on the tag. Generally, the date, geographical location, the length (and sex of the animal when it is noticeable) and fishing conditions should be reported. We recommend that if the animal can be returned alive to the water, the tag should be left attached to the animal and information reported only if you have enough time.

In case you find the animal dead, don't lose the tag-it's the proof you'll need to get your reward, and report it directly through a local fisheries agency.

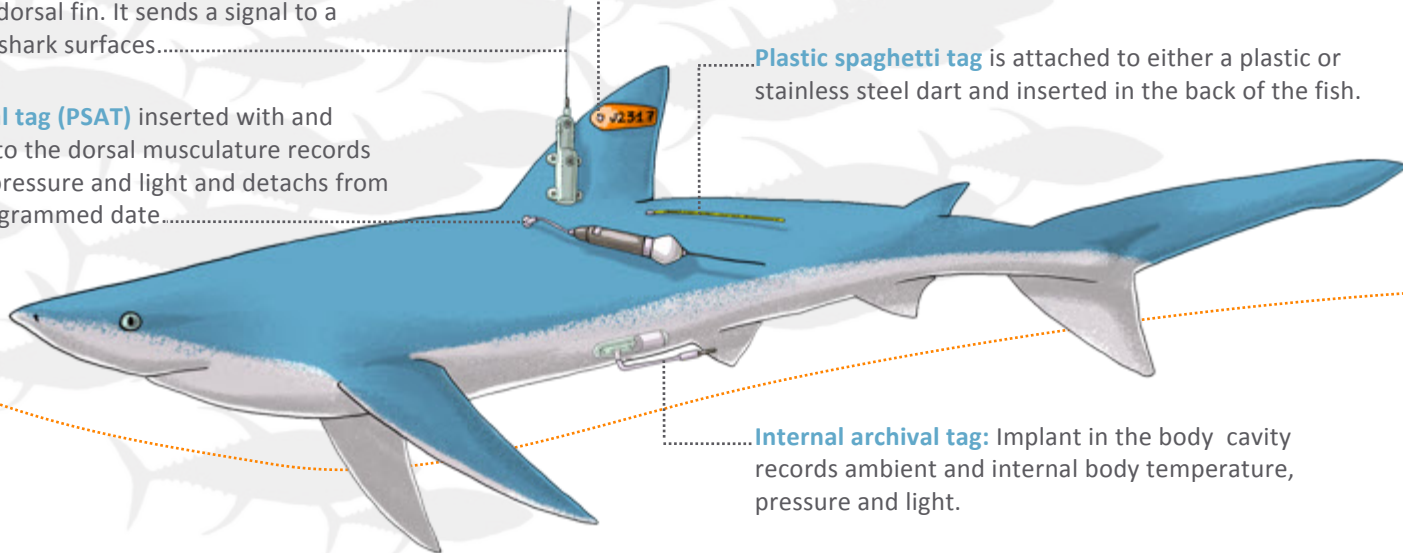
Smart Position or Temperature Transmitting (SPOT) tag attached to the shark's dorsal fin. It sends a signal to a satellite every time the shark surfaces.....

Pop-up satellite archival tag (PSAT) inserted with an anchor and a tether into the dorsal musculature records ambient temperature, pressure and light and detaches from the animal on a pre-programmed date.....

Rototag is a two piece, plastic cattle ear tag which is inserted through the first dorsal fin.

Plastic spaghetti tag is attached to either a plastic or stainless steel dart and inserted in the back of the fish.

Internal archival tag: Implant in the body cavity records ambient and internal body temperature, pressure and light.









Did you know that sharks, rays and other unwanted species in the catch will die if they are not handled carefully before being returned to the sea?

This manual is dedicated to the skippers and crew of tropical tuna purse seiners. It was developed following observations by scientists during commercial fishing trips and discussions with fishermen.

These handling/release guidelines, voluntary and nonbinding, are intended to promote good handling practices to avoid injuries to the crew when handling sharks and rays (sea turtles and large fish) and to minimize physical trauma and stress of animals in order to improve their post-release survival. It provides "Dos" and "Don'ts" in order to show in an easy way the practices that should be avoided and practices that should be encouraged. This manual also provides basic information on the biology of sharks and rays and a description of the most common species encountered by the crews.

Here we only present some guidelines and suggest some methods that can certainly be adapted by crew. There is no panacea for the problem of bycatch and no single mitigation method was found to be effective at reducing the mortality of sharks and rays. Mitigation research is by definition an iterative process and complementary actions can be carried out at the different steps of the fishing process (e.g. Attract sharks away from the FAD before or after setting) to reduce the mortality of these animals.

