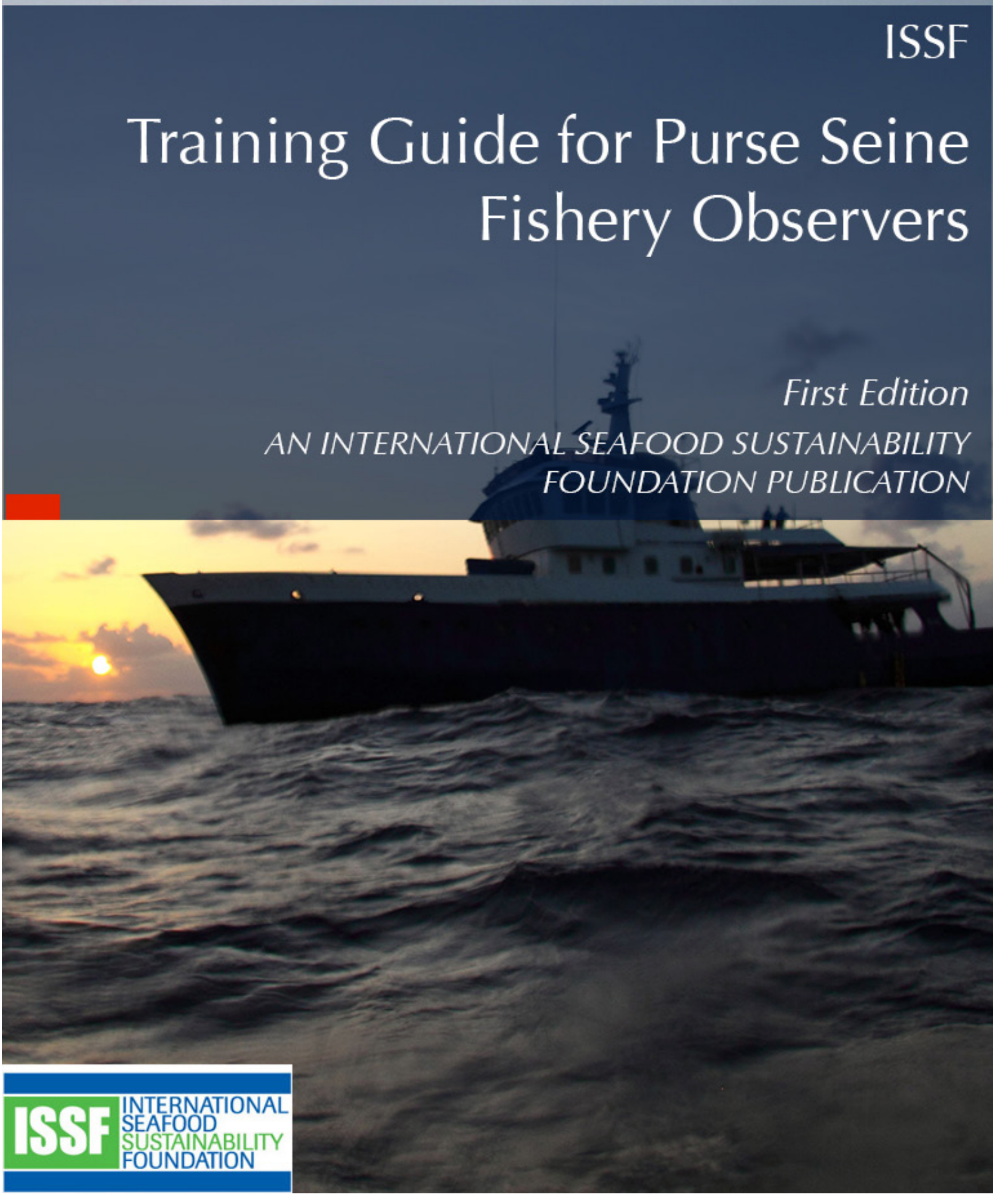
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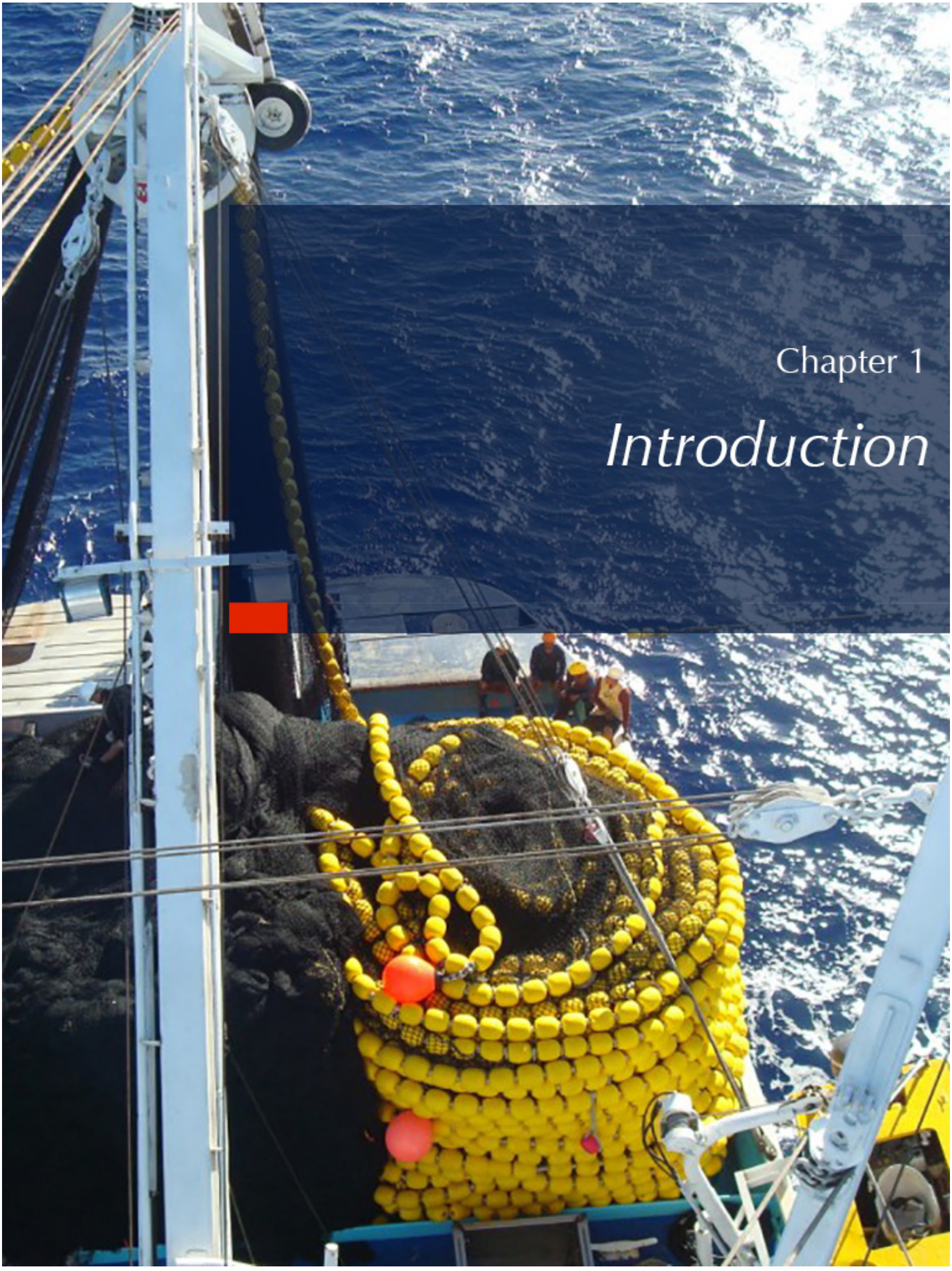
Training Guide for Purse Seine Fishery Observers

First Edition

AN INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION PUBLICATION



ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION



Chapter 1

Introduction

Chapter 1: Introduction

Welcome to the International Seafood Sustainability Foundation's sustainability review for observers on purse seine tuna vessels. Our goal is to provide an overview of the skills necessary for effective observing, particularly as they pertain to sustainable fishing practices.

Effective observer coverage is one of the ISSF Conservation Measures, which calls for 100 percent observer coverage for purse seine vessels that fish for tropical tunas. We will also summarize the rest of the related ISSF Conservation Measures for the management of tropical tuna and bycatch species that vessels are to follow if they intend to sell to ISSF Participating Companies.

Introduction

Chapter Objectives

1. Introduce ISSF's mission and approach.
2. Provide examples of ISSF's ongoing activities and outreach.
3. Provide information about ISSF's Participating Companies.
4. Highlight the importance of observers in effective fisheries management.

About ISSF

In 2008, fisheries scientists, industry leaders, and the World Wildlife Fund (WWF) founded the International Seafood Sustainability Foundation (ISSF) based on shared concerns about the future of tuna fisheries and a desire to do something about it—together. The global coalition launched publicly in March of 2009 and today has partners and supporters working in Europe, Asia, Africa, North America, South America, Australia, and Oceania.

ISSF's mission is to undertake science-based initiatives for the long-term conservation and sustainable use of tuna stocks, reducing bycatch and promoting ecosystem health.

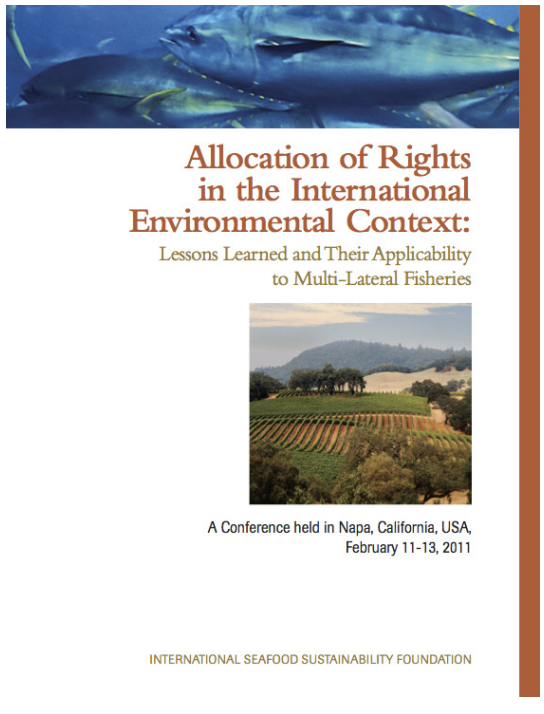
The organization's objective is to improve the sustainability of global tuna stocks by developing and implementing verifiable, science-based practices, commitments, and international management measures that result in tuna fisheries meeting the MSC certification standard without conditions, and becoming the industry standard for vessel owners, traders, processors, and marketers.

ISSF will cooperate with and support Regional Fisheries Management Organizations (RFMOs), and vigorously advocate to RFMO members for the adoption and implementation of science-based management measures so that tuna stocks and their ecosystem are managed comprehensively and sustainably.

ISSF Approaches to Improving Tuna Sustainability

- Working with RFMOs to conserve tuna stocks and their ocean ecosystems through sponsored workshops, direct advocacy, and capacity-building
- Employing sound science to attain maximum sustainable yields of targeted tuna stocks by supporting RFMO science bodies, convening leading scientists to address research challenges, and communicating results
- Striving to eliminate illegal, unregulated, and unreported (IUU) tuna fishing by implementing the use of Unique Vessel Identifiers (UVIs), mandating 100 percent observer coverage for purse seine vessels selling to ISSF Participating Companies, and testing the viability of electronic monitoring systems
- Minimizing bycatch, discards, and abandoned gear through extensive research on fishing strategies and technologies, mandating 100 percent retention of all tuna and bycatch for purse seine vessels selling to ISSF Participating Companies, and other measures
- Collecting and exchanging data to promote better scientific understanding of tuna stocks by sponsoring workshops, side events, and meetings (as well as the individual participation of participants from developing countries) regarding a variety of issues, bringing together scientists, environmentalists, vessel owners, and fishers

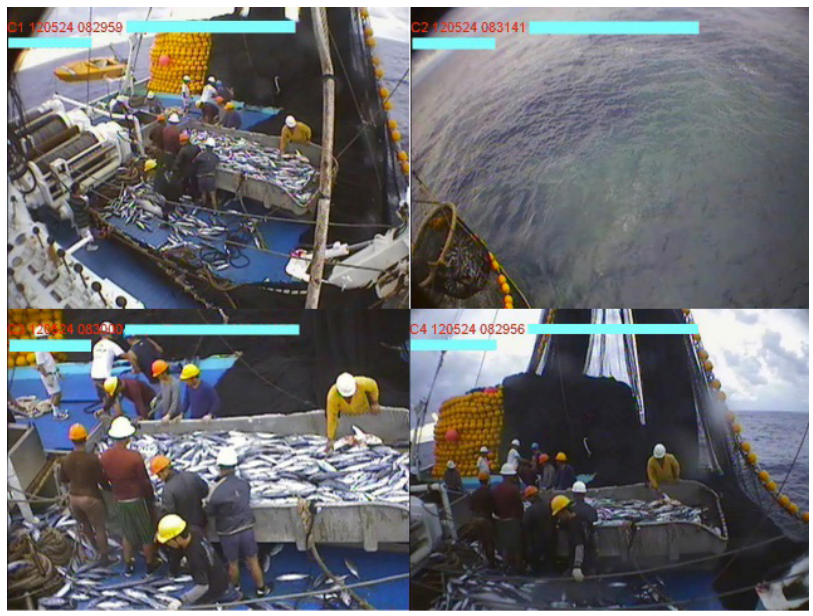
Gallery 1.1: ISSF Approaches to Improving Tuna Sustainability



Allocation of Rights Workshop Report



Online Advocacy of Key Issues



Images from ISSF-sponsored electronic monitoring trials



Shark tagging on board an ISSF bycatch research cruise



A Skipper Workshop where ideas about sustainable fishing techniques are shared

ISSF Activities

ISSF conducts educational and advocacy activities, funds major research on fisheries to reduce bycatch (the catching of nontargeted species), and uses direct-market action by its Participating Companies.

Gallery 1.2: ISSF Activities



ISSF-sponsored scientist observing fish behavior during a bycatch research cruise in the Indian Ocean



ISSF-sponsored scientist tagging a tuna during a bycatch research cruise in the Western Pacific Ocean



ISSF Skipper Workshops, where scientists and fishers share ideas to improve the sustainability of tuna purse seine fisheries



Advocating for science-based conservation and management of the tuna stocks and their ecosystems at the meetings of the tuna RFMOs



> Save the date / Call for abstracts

SCIENTIFIC SYMPOSIUM

Mitigating impacts of fishing on pelagic ecosystems: towards ecosystem-based management of tuna fisheries

15-18 October 2012 Montpellier - France

ISSF Skippers' workshop (Tuna purse seine bycatch)

19 October 2012 Montpellier - France

Approximately six million tons of tunas and tuna-like species are captured every year for human consumption. These fisheries are highly complex in nature with multiple target species and fishing gears (e.g. purse seine, longline, pole and line). As such there are several issues that scientists, policy makers and stakeholders are faced with: catches of juvenile target species, bycatch, impacts of FADs, overcapacity, interactions between fisheries, etc. A symposium will be convened to present the most recent findings and provide a platform to exchange ideas and investigate optimal approaches to mitigate impacts and ensure sustainability. We encourage participation from scientists, stakeholders and policy makers from all oceans.

The symposium (15-18 October 2012) will have four main thematic sessions:

- Ecology of target and non target species (e.g. pelagic elasmobranchs) of tuna fisheries
- Mitigation techniques
- Socio-economic challenges
- Ecological-based management of tuna fisheries in the context of global change

Deadline for abstracts is **June 1, 2012**
Registration and submission of abstracts will open soon on http://ebfmtuna-2012.sciencesconf.org/

Following the symposium, ISSF will host a workshop (19 October, 2012) where skippers and scientists can interact and discuss bycatch reduction methods in the tuna purse seine floating object fishery.

Both the symposium and skippers' workshop will be held at the Aquarium Mare Nostrum in Montpellier, located in the South of France.

Funders

The EU funded MADE project "Mitigating adverse ecological impacts of open ocean fisheries" Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 212496, www.made-project.eu

The International Seafood Sustainability Foundation, www.iss-foundation.org

Sponsoring, in addition to Skipper Workshops, symposiums for scientists and fisheries managers to share information on fisheries and bycatch research



Publishing a regularly updated "Status of the Stocks" report, with information on abundance, mortality, and related bycatch issues for every major tuna stock



Working with the tuna industry to encourage the adoption of best fishing practices by tuna fleets through the ISSF ProActive Vessel Register

ISSF ProActive Vessel Register

ISSF recently launched the ProActive Vessel Register (PVR), which is an innovative and effective way for vessel owners to identify themselves as active participants in meaningful sustainability efforts. The PVR provides third-party validated information to tuna purchasers of the positive steps each vessel is taking in implementing a series of commitments designed to bring responsible practices to tuna fishing.

Each vessel that registers on the PVR also needs to ensure that its skippers do one of the following:

1. Attend an ISSF Workshop on bycatch mitigation practices, or
2. Read the relevant ISSF Skippers' Guidebook, which contains information on bycatch handling and mitigation, RFMO requirements, and other useful information about fishing sustainably. Skippers' Guidebooks can be read online at or downloaded from http://issfguidebooks.org

If you are assigned to a vessel on the PVR, the following website will display those actions that the vessel has committed to undertaking as part of joining the PVR: http://iss-foundation.org/resources/databases/pvr/.

These actions, known as ISSF Conservation Measures, are detailed in the following section.

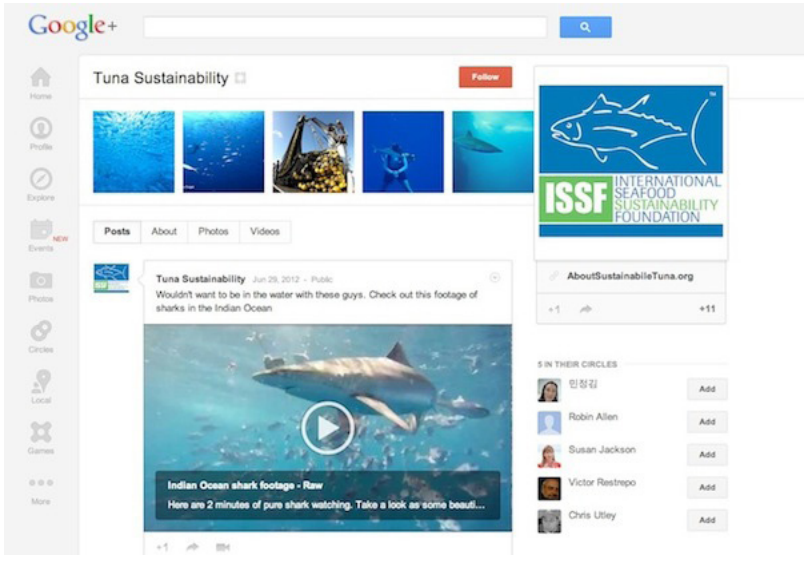
Gallery 1.3: ISSF's Interactive Tools and Online Outreach



ISSF Website: iss-foundation.org



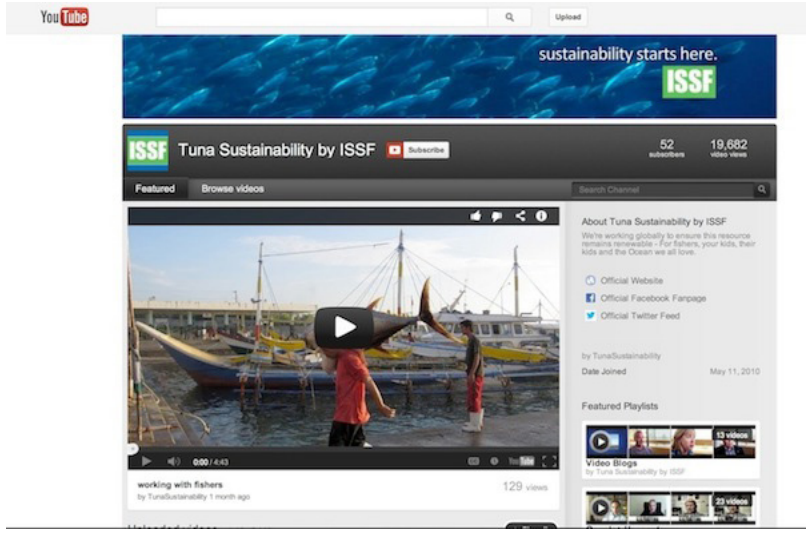
ISSF Facebook Page: facebook.com/TunaSustainability



ISSF Google+ Page: goo.gl/tgyYHO



ISSF Twitter Page: twitter.com/issf



ISSF YouTube Page: youtube.com/user/TunaSustainability

ISSF Participating Companies

ISSF Participating Companies are tuna processors or traders (primarily purchasers of raw tuna for processing, or purchasers of raw tuna or finished tuna products for resale) that are members and associate members of the International Seafood Sustainability Association (ISSA).

The Participating Companies can purchase tuna only from vessels (and vessel-owning companies) that are compliant with the relevant ISSF Conservation Measures.

Conservation Measures

To be compliant, **all vessels** must:

- Not appear on an IUU List
- Have an IMO number (when meet IMO minimum size)
- Have a company anti-fining policy
- Not have a fining finding within 2 years
- Be on a RFMO authorized record, if required
- Be flagged to a RFMO member or CNM

Conservation Measures for Purse Seine Vessels

To be compliant, **purse seine vessels** must conform to the above list for all vessels and must also:

- Have been actively fishing for tuna by December 31, 2012.
- Have a UVI, if applicable
- Be able to prove 100 percent observer coverage of large-scale vessels (human or electronic)
- Show full retention of all tunas
- Have a ISSF-trained skipper, either via an in-person Skipper Workshop or via having read the relevant Skippers' Guidebook
- Engage in no transshipment on the high seas
- Demonstrate that any observer meets baseline standards

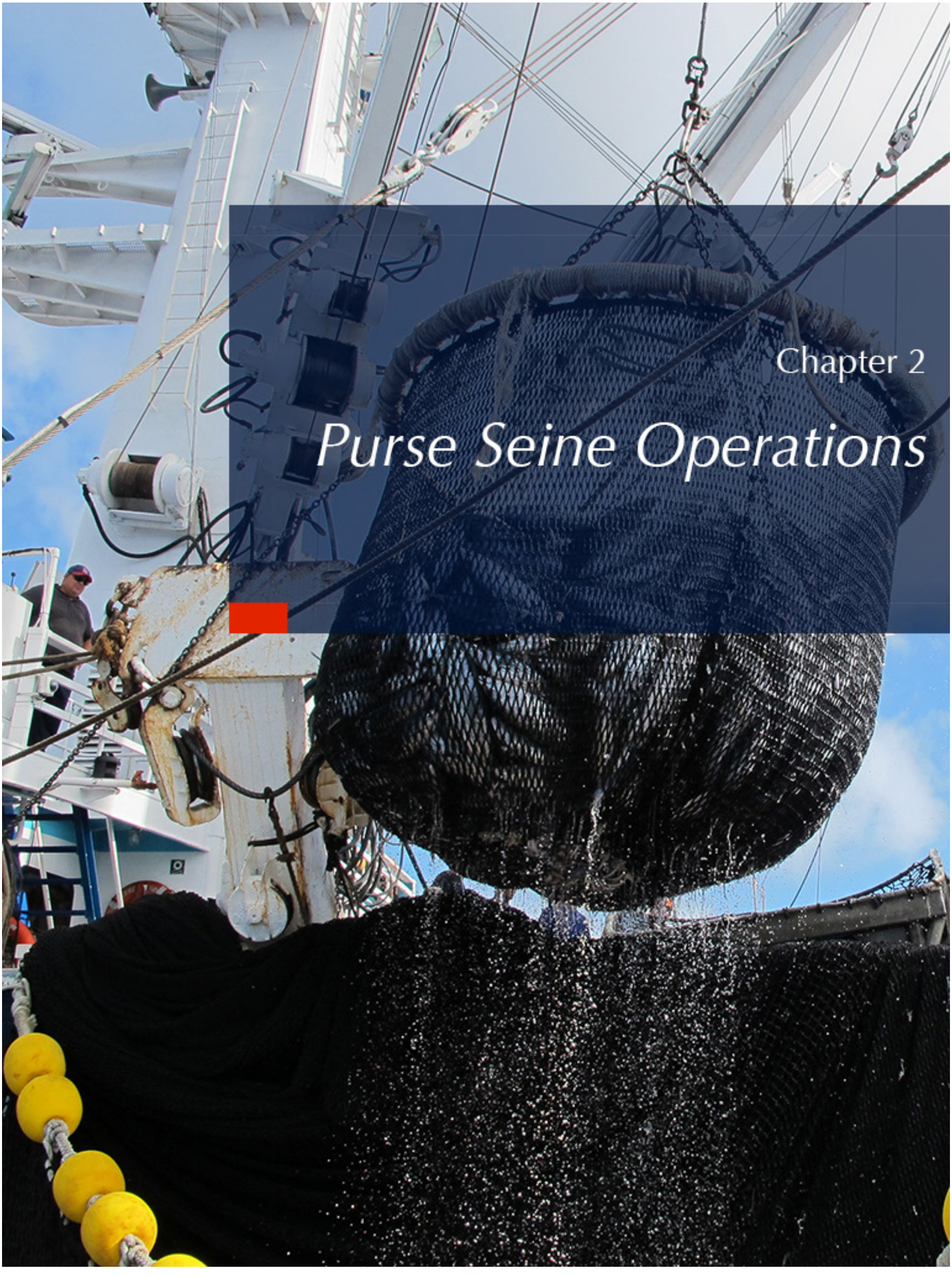
Observer Requirements

In addition, as of January 1, 2014, the vessel's observer must satisfactorily complete annual observer training. Observers sourced from established national, regional, or subregional observer programs or providers being used in RFMOs to satisfy purse seine coverage requirements must have received detailed training. This Guidebook does not supplant such training. This Guidebook reviews the skills necessary for effective observing, particularly as they pertain to sustainable fishing best practices. Further, states and RFMOs are encouraged to use these best practices in the development of or the strengthening of national, regional, or subregional human observer programs for purse seine vessels.

The Role of Observers in Sustainable Fishing

ISSF recognizes the importance of effective observing in the management of tuna stocks. Not only does observer data serve as a useful cross-check of a skipper's logbook, but it captures information that the crew does not have time to collect (e.g., discards and sensitive species interactions). Different RFMOs and regions will have their own objectives, but in general observers are tasked with scientific objectives, though sometimes compliance tasks will also need to be conducted. An observer's main role is to estimate discards and bycatch as the crews cannot devote much time to this activity. The true value of an observer lies in their independence from the commercial fishing industry. Maintaining this impartiality—thus avoiding conflicts of interest—ensures the objectivity of an observer's work.

This holds true for both scientific data collection and for any actions related to monitoring, control, and surveillance (MSC). Indeed, research has shown that the presence of observers on board commercial fishing vessels can improve the vessel's compliance with regulations, and that if possible violations do occur, they are more likely to be recorded on a vessel with an observer on board. For these reasons, ISSF believes that autonomous observer programs are a key component of effective fisheries management.



Chapter 2

Purse Seine Operations

Chapter 2: Purse Seine Operations

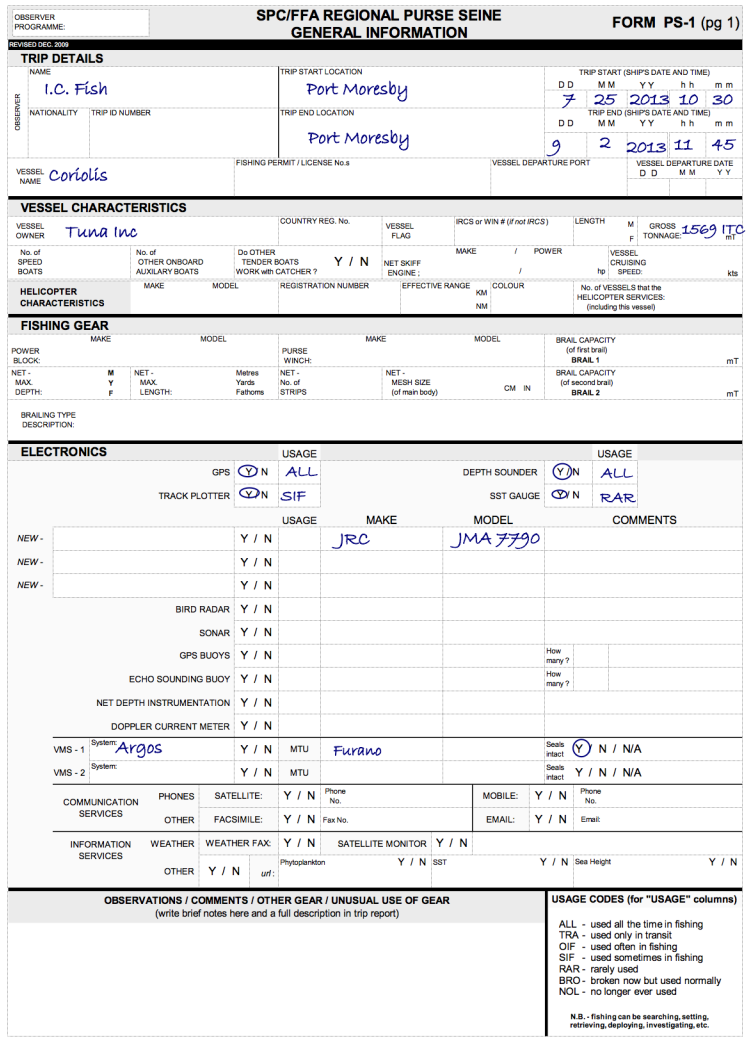
Collecting basic information about the vessel, its equipment, and its fishing strategies is a fundamental component of effective observing. Informed with this data, fisheries managers can better evaluate levels of fishing effort and efficiency, and fishing's effect on the tuna stocks' health.

Introduction

Chapter Objectives

1. Review a vessel's structural elements and identifying information.
2. Summarize purse seine fishing operations, gear, and equipment, including fish aggregating devices (FADs).
3. Review how to describe fishing effort and strategies.
4. Briefly address safety on board.

Before you collect any details about a vessel's catch, it is important to record a vessel's basic information so that it can be correctly identified by the RFMO. This information also includes details about how the vessel fishes: the size of its net, its use of electronics, and its deployment of buoys and FADs. You will record this information on the forms the RFMO will provide.



OBSERVER PROGRAMME:

SPC/FFA REGIONAL PURSE SEINE GENERAL INFORMATION — **FORM PS-1** (pg 1)

REVISED DEC. 2009

TRIP DETAILS

OBSERVER — NAME: I.C. Fish; NATIONALITY; TRIP ID NUMBER

TRIP START LOCATION: Port Moresby — TRIP START (SHIP'S DATE AND TIME) D D: 7, M M: 25, Y Y: 2013, h h: 10, m m: 30

TRIP END LOCATION: Port Moresby — TRIP END (SHIPS DATE AND TIME) D D: 9, M M: 2, Y Y: 2013, h h: 11, m m: 45

VESSEL NAME: Coriolis — FISHING PERMIT / LICENSE No.s — VESSEL DEPARTURE PORT — VESSEL DEPARTURE DATE D D / M M / Y Y

VESSEL CHARACTERISTICS

VESSEL OWNER: Tuna Inc — COUNTRY REG. No. — VESSEL FLAG — IRCS or WIN # (*if not IRCS*) — LENGTH M / F — GROSS TONNAGE: 1569 ITC mT

No. of SPEED BOATS — No. of OTHER ONBOARD AUXILARY BOATS — Do OTHER TENDER BOATS WORK with CATCHER ? Y / N — NET SKIFF ENGINE ; MAKE / POWER hp — VESSEL CRUISING SPEED: kts

HELICOPTER CHARACTERISTICS — MAKE — MODEL — REGISTRATION NUMBER — EFFECTIVE RANGE KM / NM — COLOUR — No. of VESSELS that the HELICOPTER SERVICES: (including this vessel)

FISHING GEAR

POWER BLOCK: MAKE — MODEL

PURSE WINCH: MAKE — MODEL

BRAIL CAPACITY (of first brail) **BRAIL 1** mT

NET - MAX. DEPTH: M / Y / F — NET - MAX. LENGTH: Metres / Yards / Fathoms — NET - No. of STRIPS — NET - MESH SIZE (of main body) CM / IN

BRAIL CAPACITY (of second brail) **BRAIL 2** mT

BRAILING TYPE DESCRIPTION:

ELECTRONICS

		USAGE			USAGE
GPS	(Y) N	ALL	DEPTH SOUNDER	(Y) N	ALL
TRACK PLOTTER	(Y) N	SIF	SST GAUGE	(Y) N	RAR

		USAGE	MAKE	MODEL	COMMENTS
NEW -	Y / N		JRC	JMA 7790	
NEW -	Y / N				
NEW -	Y / N				
BIRD RADAR	Y / N				
SONAR	Y / N				
GPS BUOYS	Y / N				How many ?
ECHO SOUNDING BUOY	Y / N				How many ?
NET DEPTH INSTRUMENTATION	Y / N				
DOPPLER CURRENT METER	Y / N				

VMS - 1 System: Argos — Y / N — MTU — Furano — Seals intact (Y) N / N/A

VMS - 2 System: — Y / N — MTU — Seals intact Y / N / N/A

COMMUNICATION SERVICES — PHONES — SATELLITE: Y / N Phone No. — MOBILE: Y / N Phone No.

COMMUNICATION SERVICES — OTHER — FACSIMILE: Y / N Fax No. — EMAIL: Y / N Email:

INFORMATION SERVICES — WEATHER — WEATHER FAX: Y / N — SATELLITE MONITOR Y / N

INFORMATION SERVICES — OTHER — Y / N — *url*: — Phytoplankton Y / N — SST Y / N — Sea Height Y / N

OBSERVATIONS / COMMENTS / OTHER GEAR / UNUSUAL USE OF GEAR
(write brief notes here and a full description in trip report)

USAGE CODES (for "USAGE" columns)

ALL - used all the time in fishing
TRA - used only in transit
OIF - used often in fishing
SIF - used sometimes in fishing
RAR - rarely used
BRO - broken now but used normally
NOL - no longer ever used

N.B. - fishing can be searching, setting, retrieving, deploying, investigating, etc.

General Info form from WCPFC.

We will also briefly cover in this section a vessel's compliance with the use of a Vessel Monitoring System (VMS) and standard safety at sea.

Vessel Identification and Characteristics

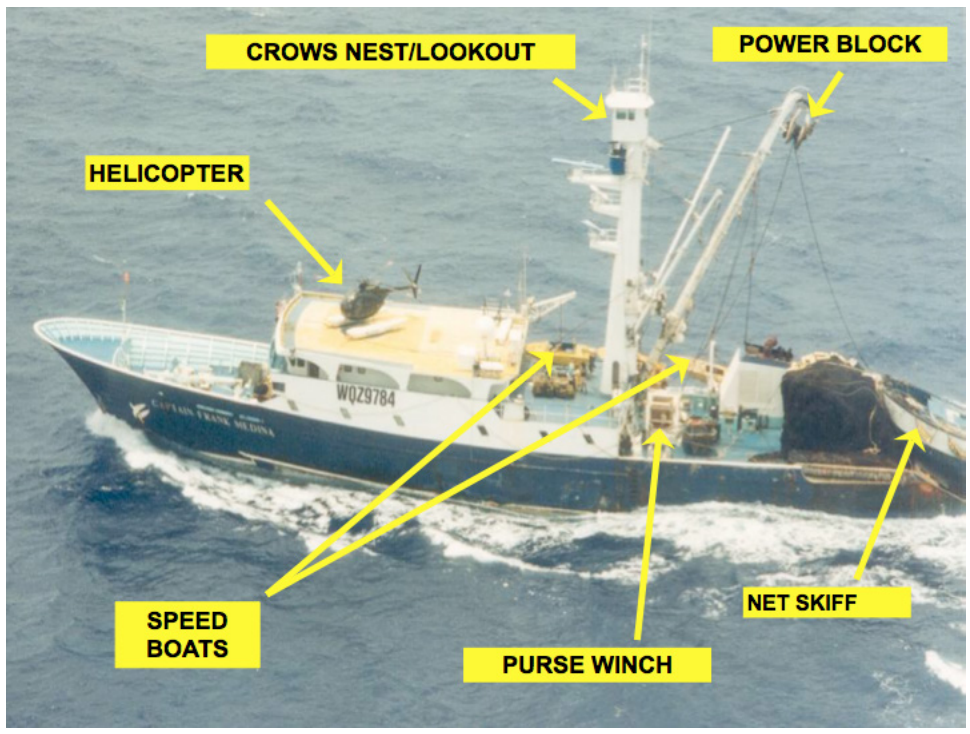
Vessels can be identified a number of ways—by its name, its International Radio Call Sign (IRCS), or its registry number for the RFMO in which it is fishing. However, while it is important to collect this information, it can change if the vessel is sold or moves to another ocean. For this reason, tuna RFMOs are now encouraging the use of a Tuna Unique Vessel Identifier (TUVI), which remains attached to a vessel for its entire life span. An example of a TUVI is a vessel's IMO number. If your observer forms provide space for such a number to be recorded, please make sure to do so, as it is the single best way to identify a vessel.

Another important feature of a vessel is its capacity, or allocated well space to hold fish. This is often recorded as metric tons, short tons, long tons, or cubic meters (the latter being the preferred unit of measurement). This capacity is divided into wells, and recording how each well is used during each trip (e.g., sealed, for non-tuna species, etc.) is also important.

Gallery 2.1: Vessel Components and Identification



Purse seine fishing vessel (Photo: SPC)



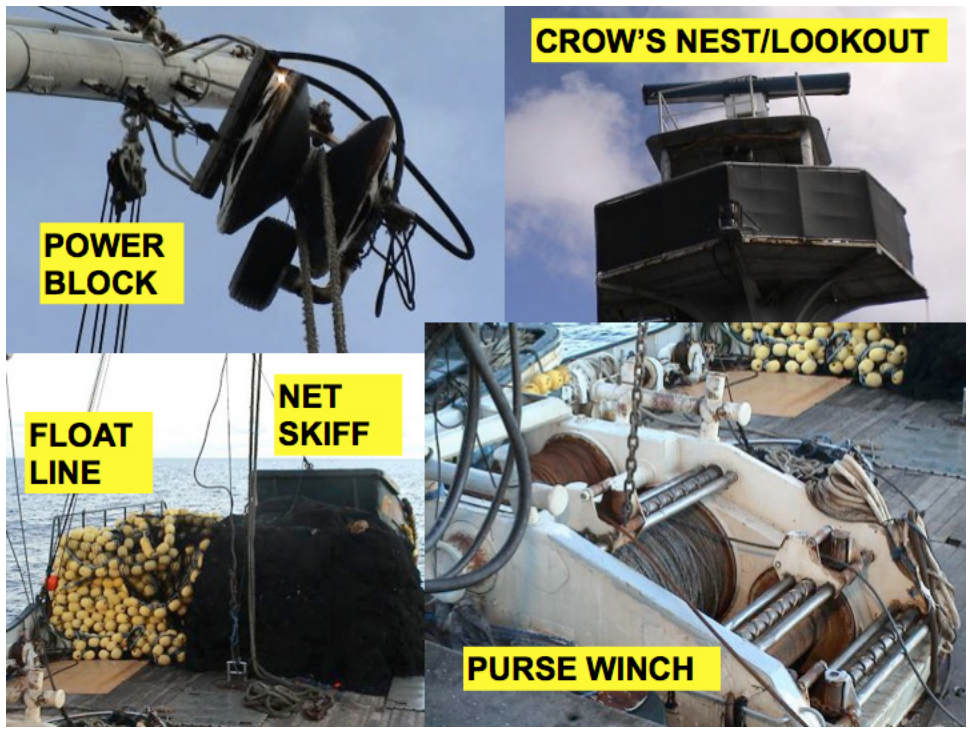
Additional components of a tuna purse seine vessel (Photo: SPC)



Additional vehicles (Photo: SPC)



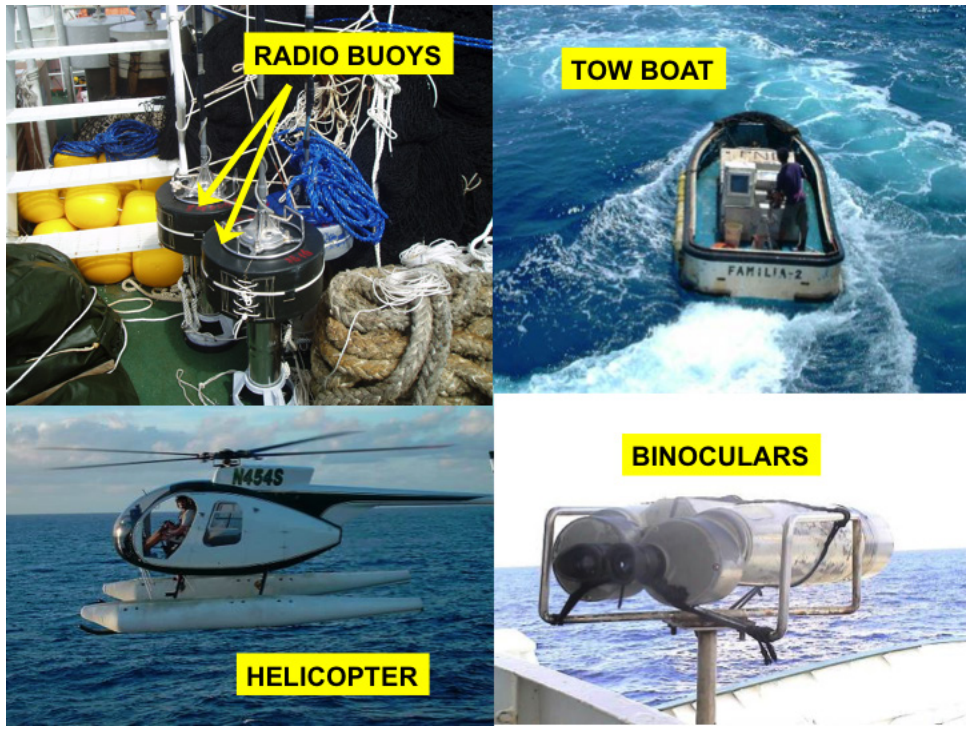
Net Skiff: This vessel anchors one end of the net while the catcher circles the school. The skiff is equipped with high-powered engines. The skiff man or engineer can provide the engine's make and horsepower. (Photo: SPC)



Fishing gear: For details about the vessel's fishing gear (e.g., the power block, purse winch), you need to ask the chief engineer or winch man, or ask for the equipment manual. (Photo: SPC)

There are many aspects of a vessel that affect how efficiently or effectively it can catch fish. A tuna vessel that has a helicopter and multiple ancillary boats is more likely to find and catch more fish than a vessel without them. Likewise, using sophisticated electronic fishing technology (e.g., radar, echosounders, sonar, etc.) will improve a vessel's chance of catching more fish. If your observer forms allow for such information to be noted, be sure to record the brand names and models of equipment used. In addition, land-based support staff who are in constant communication with the observer and the vessel-owning company can be a good resource: The staff will probably be aware of changes made to the vessel and can inform the observer before each trip. The land-based support staff can also be a source of data provision to the observer program.

Gallery 2.2: Vessel Electronics



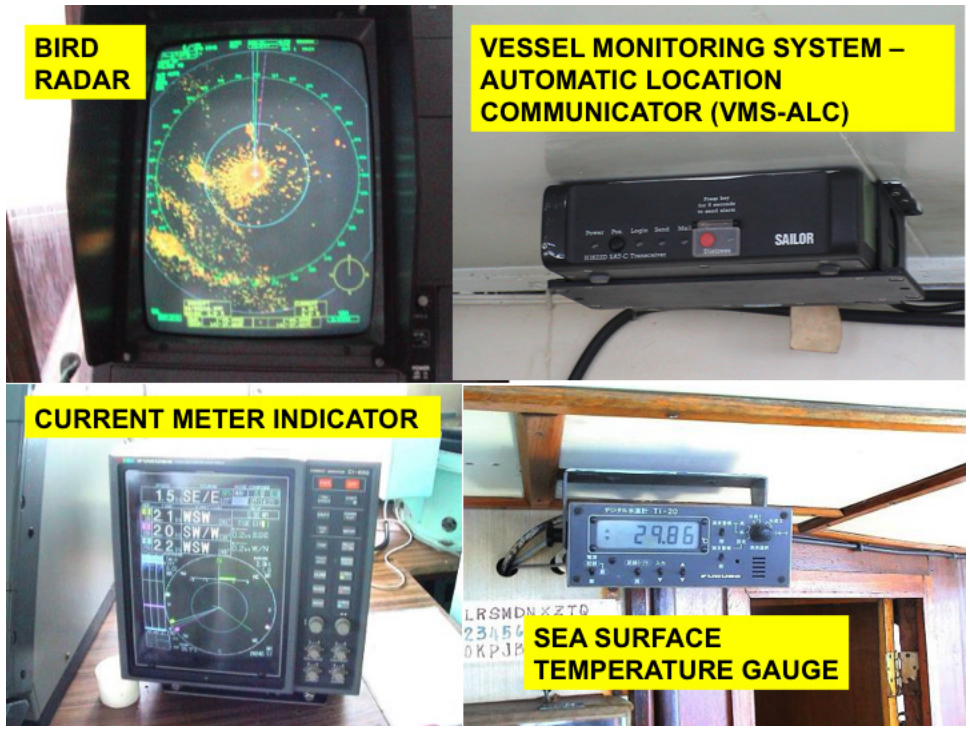
Fishers use many strategies to identify schools of fish: some visual, some electronic. (Photo: SPC)



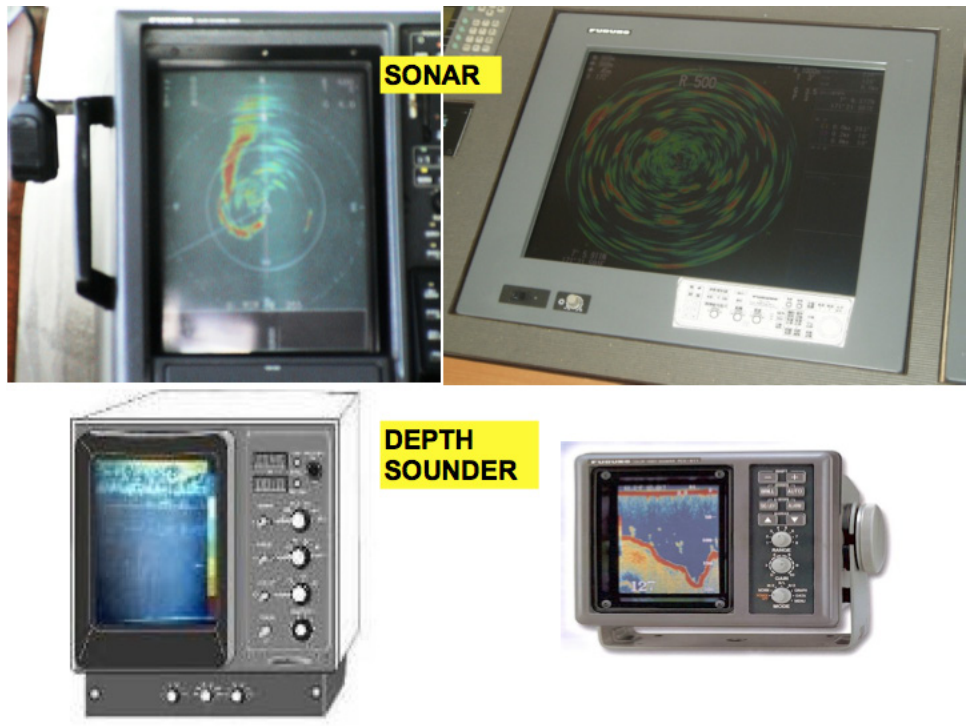
Looking for fish (Photo: Jeff Muir)



Many of the electronics used to find fish are located on the bridge. (Photo: SPC)



Examples of electronics found that can be found on the bridge (Photo: SPC)



Examples of sonar and depth sounder equipment (Photo: SPC)



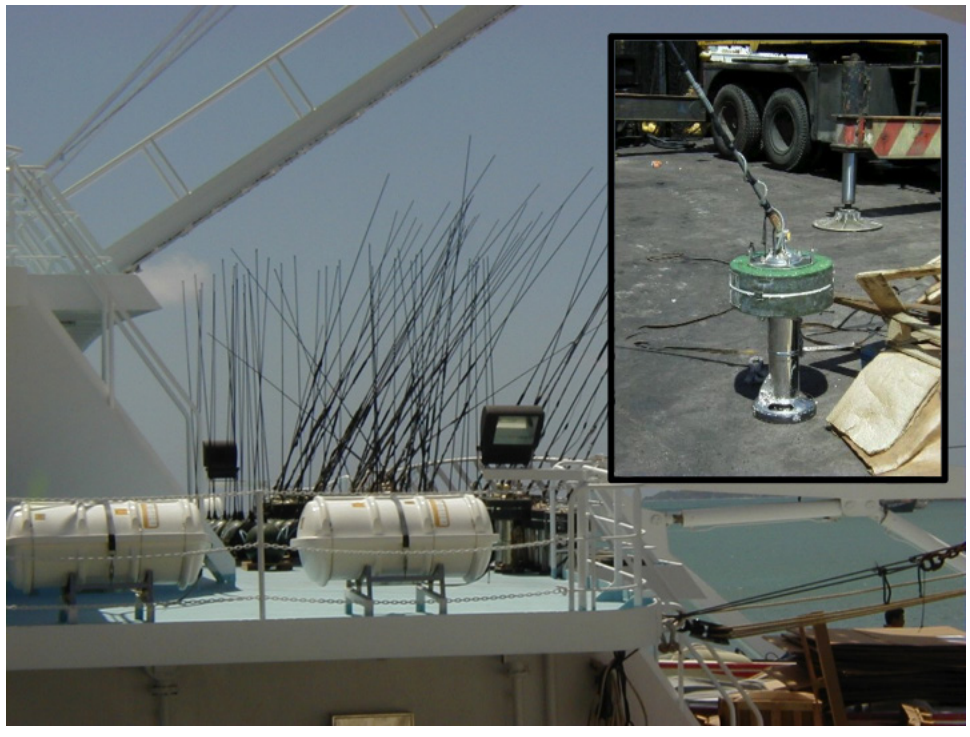
Examples of Global Positioning System (GPS) units (Photo: SPC)



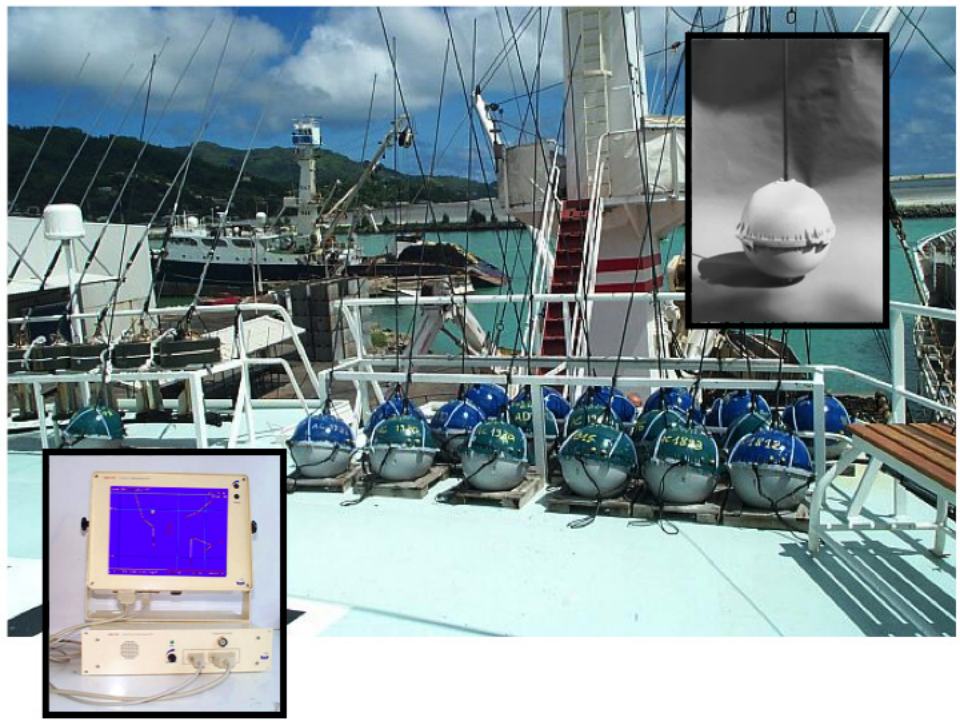
Examples of Track Plotter units (Photo: SPC)



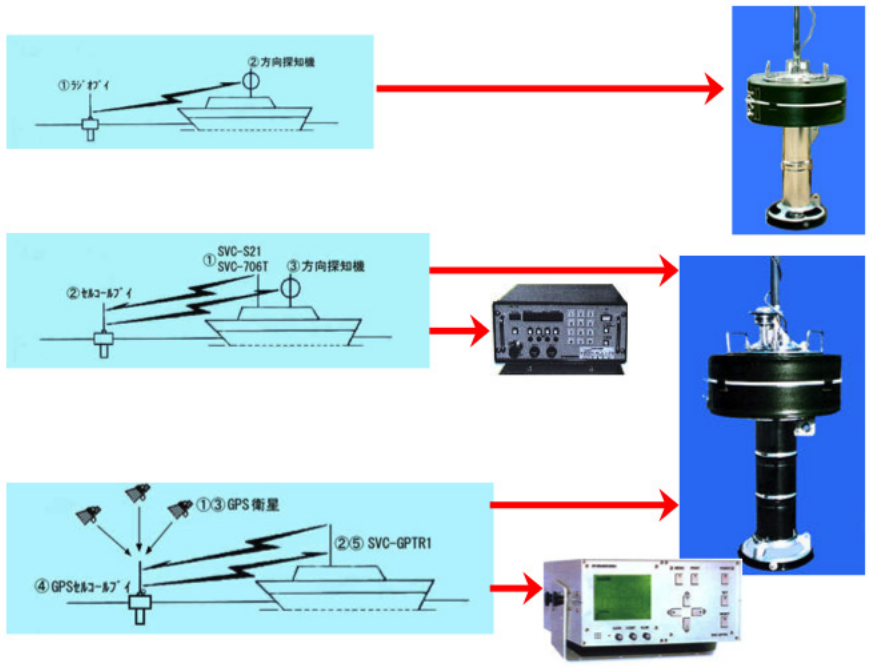
Radio buoys (Photo: SPC)



Radio buoys with inclined antennae (which can reduce their detection by other vessels) (Photo: SPC)



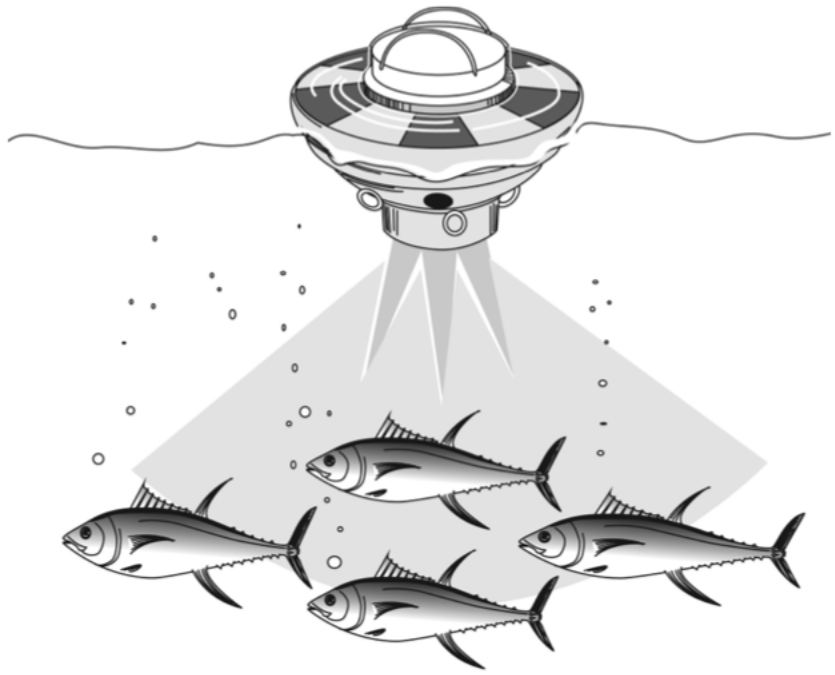
Serpe-type, GPS-tracking radio buoys (Photo: SPC)



The general characteristics and gear involved with constant transmit (top), select call (middle, with select-call transmitter) and GPS-positioning (bottom, with GPS transceiver) radio buoys (Photo: SPC)



New generation, low-profile GPS (upper left) and solar-power sonar (lower right) buoys (Photo: SPC)



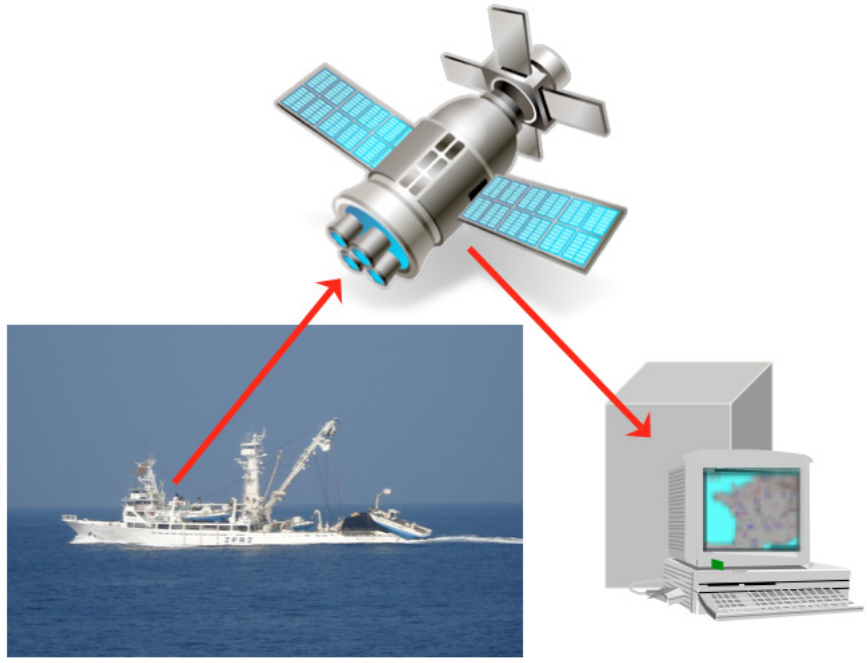
Sonar buoys can detect the quantity of fish present and transmit that information to the vessel. (Photo: SPC)



Solar-powered sonar buoys ready for deployment (Photo: SPC)

All purse seine vessels fishing for tuna are required to use a Vessel Monitoring System (VMS) as directed by the RFMO in which they are operating. These units, at a minimum, transmit a vessel's position at regular intervals to a central agency. This vessel surveillance can be used to identify illegal fishing in closed areas or during closed periods. It is important that the VMS units are operational and transmitting at all times during the trip. Observers should note the unit's make, model, and operability. If the unit has tamper-proof seals, ensure that they are intact.

Gallery 2.3: Vessel Monitoring System



Vessel Monitoring Systems (VMS) transmit the location of a vessel to a central recording site on a regular basis. (Photo: SPC)



The VMS has two components onboard: the transceiver box (two examples on right) and the antenna (left). (Photo: SPC)



The organization that administers the VMS program will often seal the transceiver box with special stickers to prevent tampering with the unit. (Photo: SPC)



It is important to note any evidence of tampering with the VMS unit. (Photo: Joshua Sione, JCS)

The size and construction characteristics of the purse seine net influence the catch of both tuna and nontarget species. Recording an estimation of the net size and depth will allow RFMO scientists to track the relationship between net characteristics and catch. In general, the net measures 1,500 to 2,000 m long and 120 to 250 m deep. The size of the mesh in the main part of the net is usually around 120 mm when stretched. The top of the net is mounted on a floatline and the bottom on a leadline. The leadline generally consists of a steel chain with steel rings, known as "purse rings," attached below the chain. The purse line, which runs through the purse rings, is made of steel and allows the pursing of the net. The deckboss, navigator, or chief engineer may have access to the vessel's net diagram, and this will help you record accurate specifications of the net. Presence of any size-sorting net component or any other experimental gear designed to modify the size of the catch and bycatch should also be described and recorded for future reference.

Purse Seine Fishing Operations

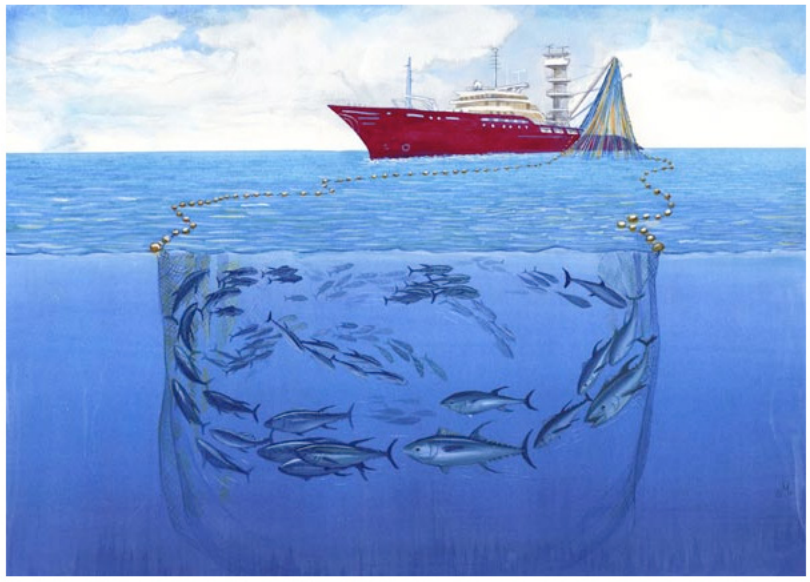
Once the vessel has identified a fish aggregation, the skipper will evaluate the species composition, school size, and chances of capturing the aggregation. Often electronic devices like the echosounder and sonar are used to make these determinations. If the aggregation is at a FAD, these tools are critical because most FAD fishing is initiated before daylight so other visual cues, such as fish on the surface or birdlife, cannot be used to evaluate the aggregation. If the decision is made to make a set, the vessel is positioned by the skipper and then the skiff is released, towing the end of the net. The purse seine vessel tows the purse seine net around the aggregation to encircle them within the net. Most often, the corkline will be in a circular or oblong shape when the purse seine vessel and skiff come back together. At this point, cables and towlines are exchanged between the two vessels, and the skiff commences towing the purse seine vessel in order to maneuver it away from the net. The net is then closed underneath the school by hauling the purse line running through the rings at the bottom of the net. This process is called "pursing." Once pursing is completed, the net hauling (commonly referred to as "net rolling") process begins. The net is stacked back on the back deck of the vessel with the aid of the power block and the crew. As the volume of the net becomes smaller, the fish become more concentrated. At the end of net rolling, the "sacking up" point is reached, where the final slack in the net is removed and the catch is concentrated and scooped out using a brailer.

A sorting bin, commonly known as a hopper, is often used to sort the catch before it is directed into wells for storage. The hopper typically holds the capacity of the vessel's brail of fish, which are loaded in the hopper one by one as the crew sorts through the catch. The crew can remove unwanted bycatch, mutilated or damaged catch, and other bycatch at this stage. A door or hatch is actuated with a hydraulic control and allows the catch to be dumped into the loading hatch of the vessel in a controlled manner. Since the hopper stalls the loading of the catch into the wells, this is a good point for observers to evaluate catch composition for their reporting.

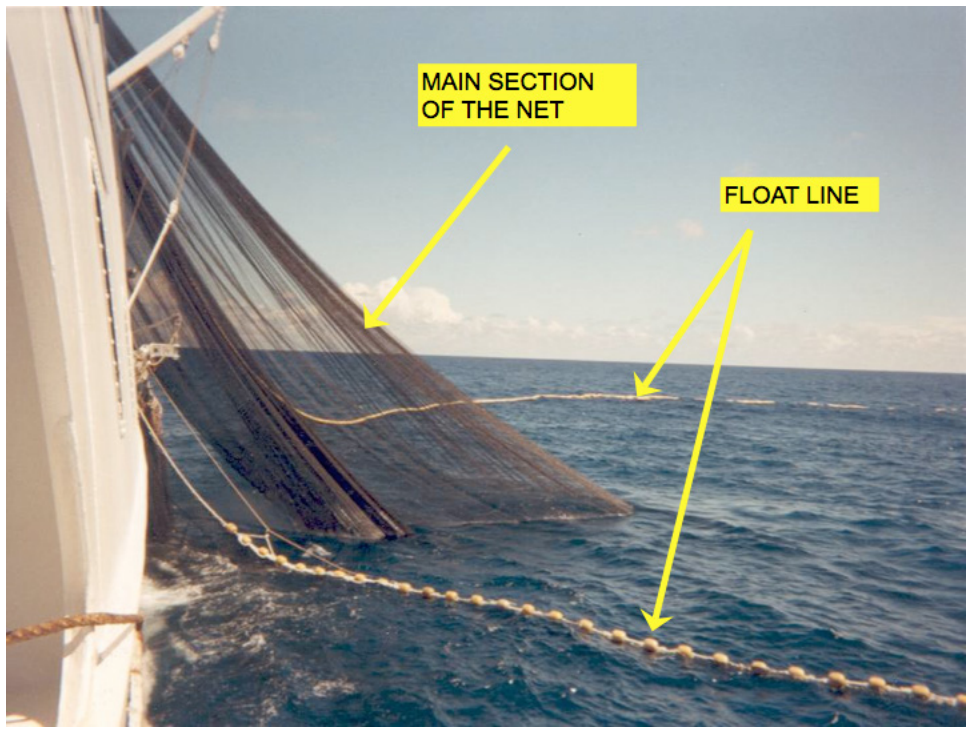
If a hopper is not used, brails are emptied directly into the loading hatch of the wet deck. This makes it difficult to assess the type and amount of bycatch species in each brail.

Once on board, the fish pass below deck to be loaded into wells. While most vessels employ conveyor belt systems to direct catch into desired wells, some use chute systems that also quickly deliver catch to wells. Some vessels are equipped to bulk-freeze the catch, but most keep the fish in refrigerated brine tanks (brine at 0° C), which occupy much of the lower part of the hull and are equipped with batteries of seawater pumps for circulation. In the larger vessels, the tunas are preserved in wells of 20 to 120 metric tons each, (vessel total 800 to 2,000 metric tons) with brine freezing at -20° C. In the more artisanal purse seiners, tuna are generally kept in iced seawater.

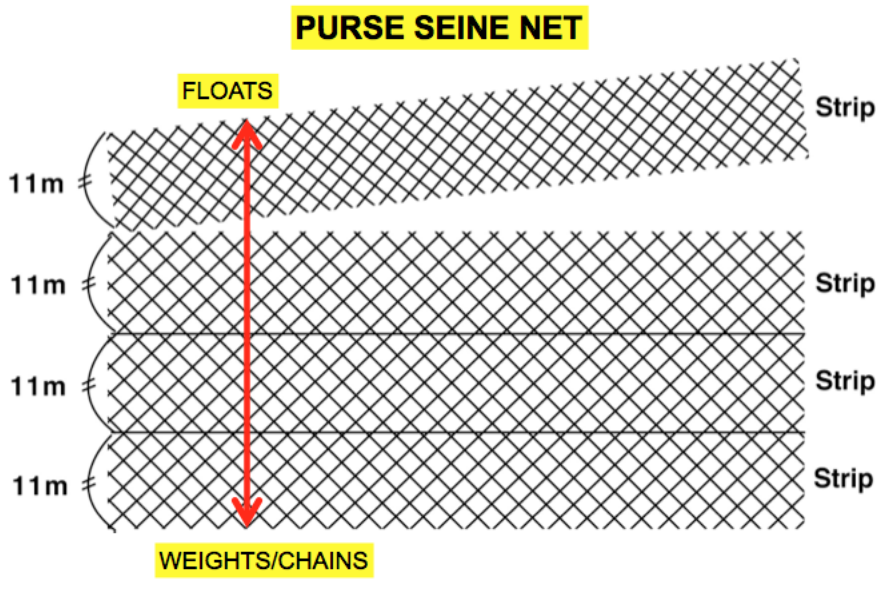
Gallery 2.4: Purse Seine Net and Setting



Purse seine net set around a tuna school (Photo: FAO)



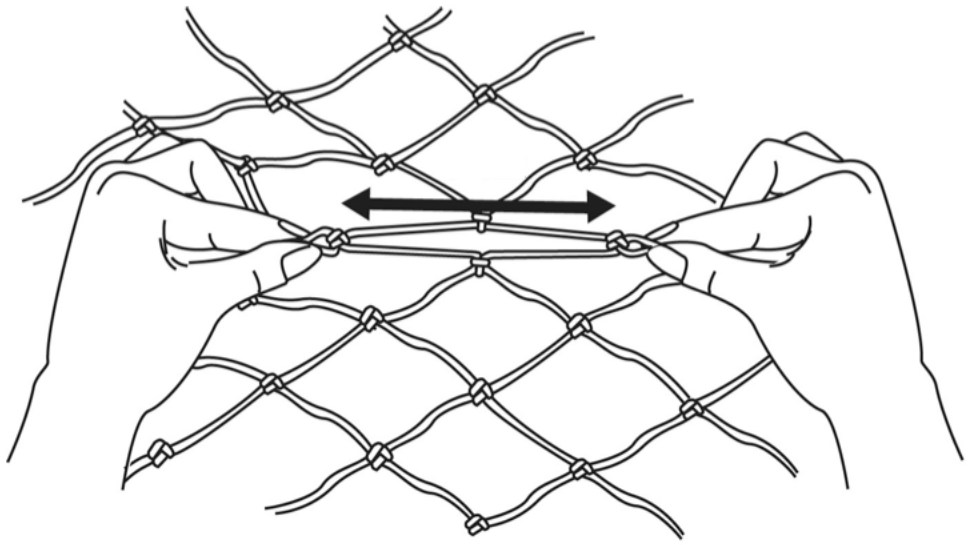
The purse seine net (Photo: SPC)



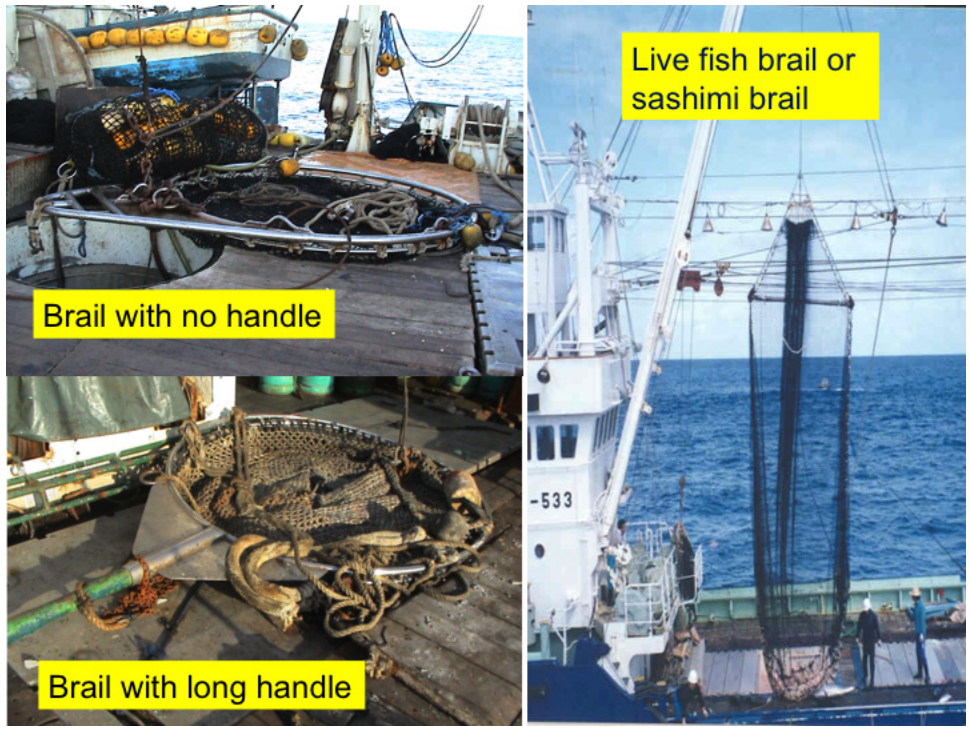
The purse seine net is made up of strips of net. By adding more strips, the net becomes deeper. Similarly, by removing strips, the net can be made shallower. Chains and/or weights are added to the bottom of the net to allow it to sink. Floats are used at the top of net. (Photo: SPC)



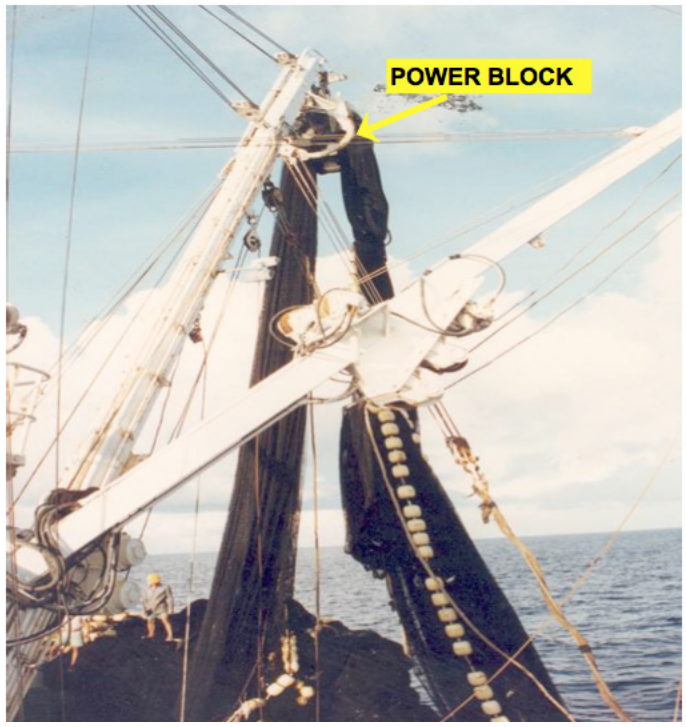
Here, the main net is covered under the orange tarp, with the bottom of the net (with the associated chains and purse rings/sinkers) visible. The skiff can be seen in the upper right section of the photograph. (Photo: SPC)



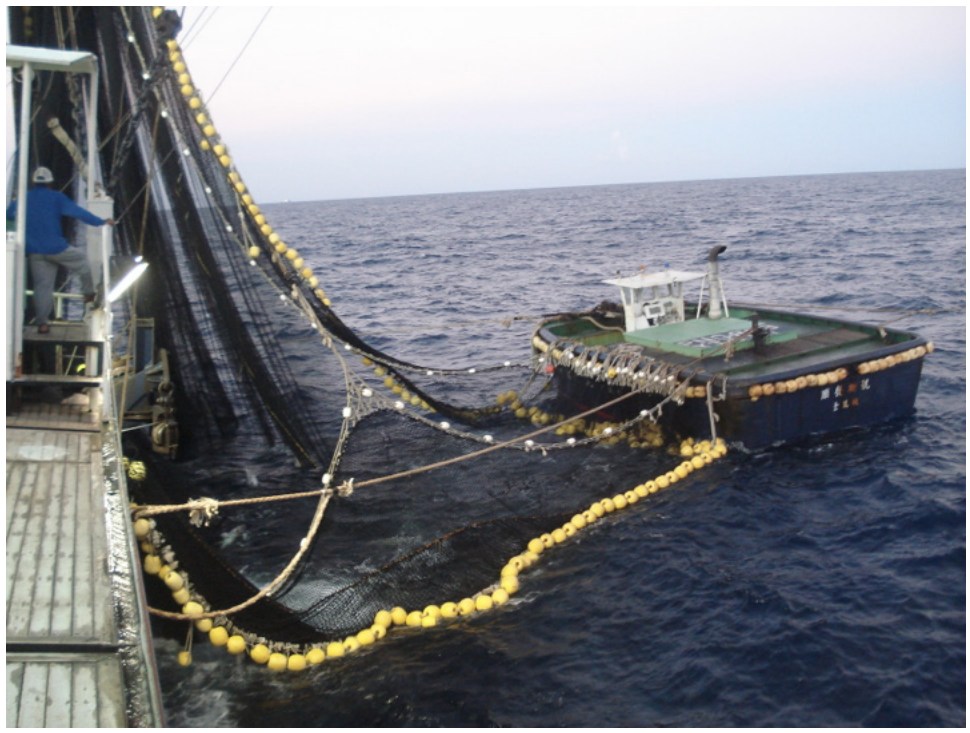
To measure the mesh size of the purse seine net, pull the net taut and measure the distance between knots, as shown above. (Photo: SPC)



Once the net has been set, the fish are harvested from the purse seine using a large scoop net called the "brailer"; several tons of fish are taken on board each time. There are several types of brailers, and some are shown above. Where possible, it is important to note the brailer type and capacity. (Photo: SPC)



Here, the power block is hauling the net. (Photo: SPC)



Ready for brailing (Photo: SPC)



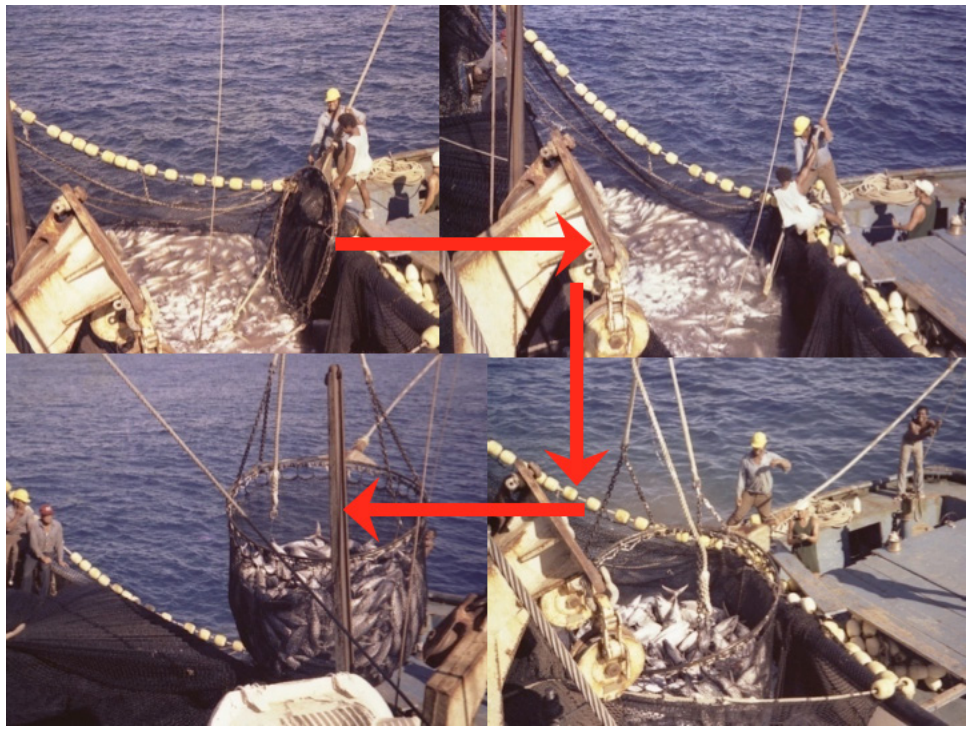
Brailing process (Photo: SPC)



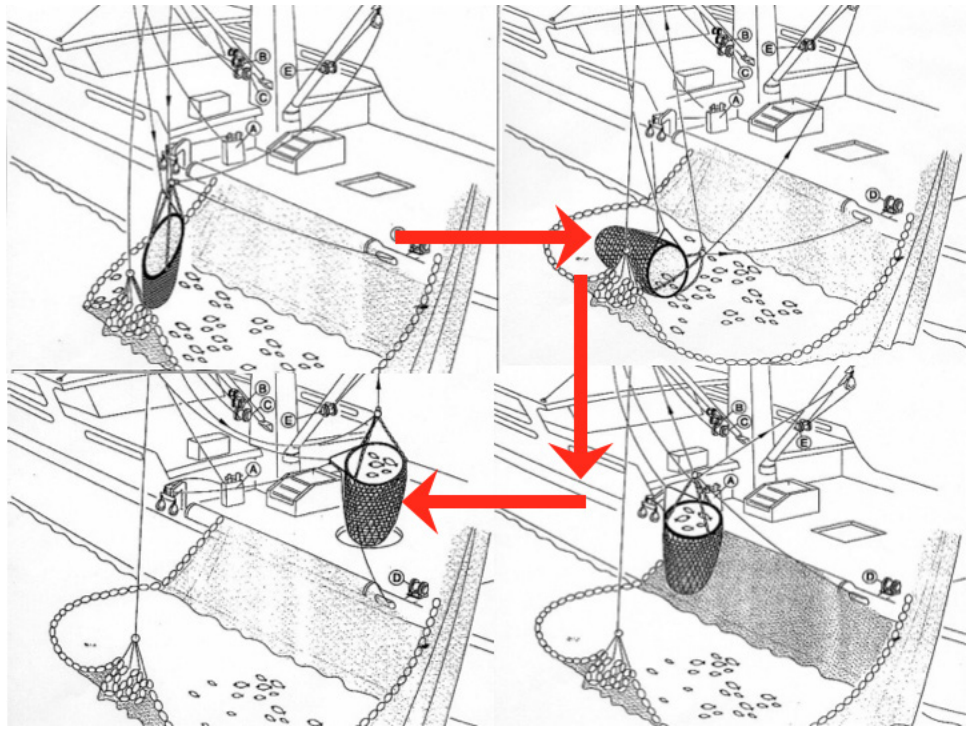
Brailing process (Photo: Jeff Muir)



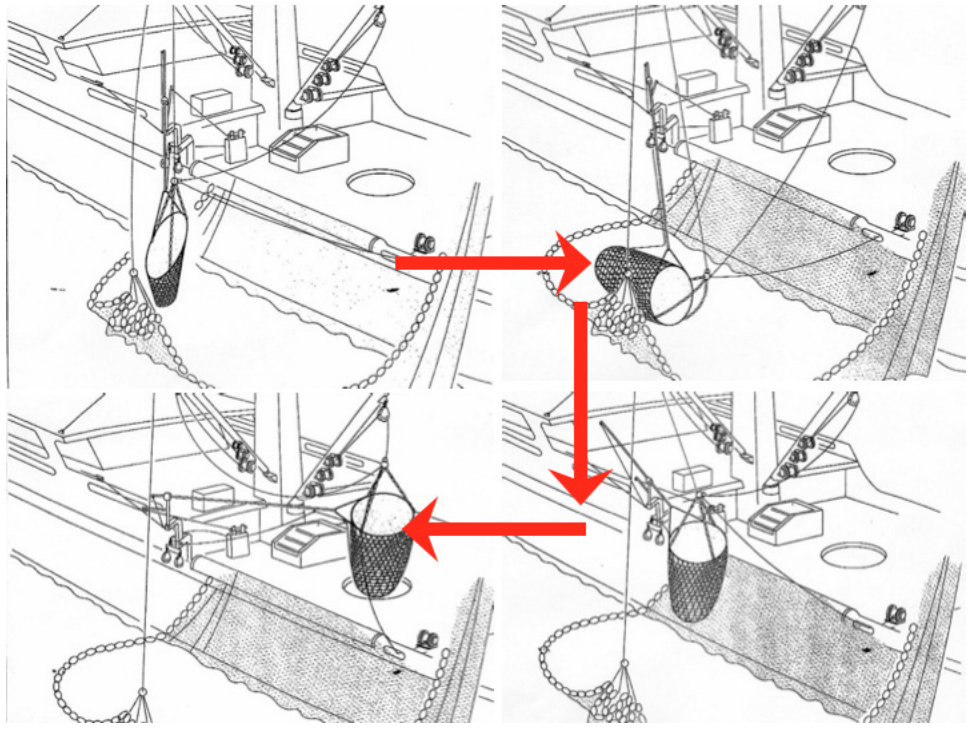
Brailing process (Photo: SPC)



Old-style brailing (Photo: SPC)



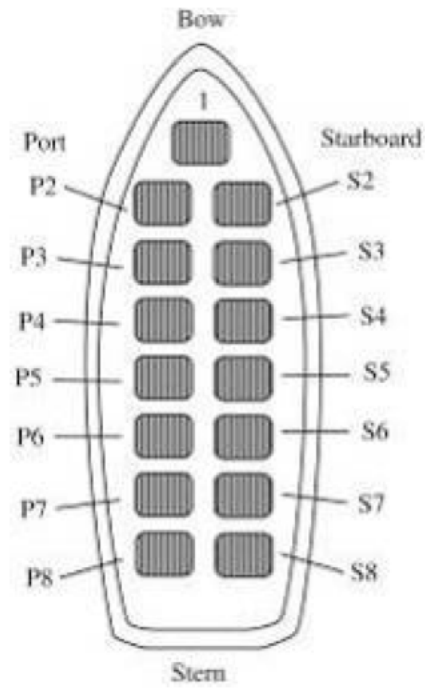
Spanish-style brailing (Photo: SPC)



Modified Spanish brailing (Photo: SPC)



Below the deck, the fish are sorted into wells. (Photo: SPC)



A typical map of wells in a tuna purse seine vessel (Photo: SPC)

Gallery 2.5: Purse Seine Fishing Stages



Various stages of net setting: surrounding the school, skiff meeting the purse seine vessel with end of net, navigator driving purse seine vessel during set from port station, and exchanging cables and tow ropes between skiff and purse seine vessel (Photo: Jeff Muir)



Net rolling as seen from the speed boat deck and work boat (Photo: Jeff Muir)



Show here (clockwise from top left): the pursing process at start, the pursing winch retrieving cable, and the purse cables coming through blocks on purse boom. (Photo: David Itano)



Sacking up. A crew working with net to make sack as small as possible (top left), two shots of the sack of fish ready to be brailed (top middle and right), brailing (bottom left), and view from underwater of fish being "sacked up" (bottom right). (Photo: Jeff Muir)



Use of a hopper. An empty hopper being readied for use (top left), hopper being filled with one 7 mt brail of catch (top right), crew sorting catch in hopper (bottom left), crew removing a blue marlin from hopper (bottom right). (Photo: Jeff Muir and Fabien Forget)

Fish Aggregating Devices

Many fish species, including tuna, naturally associate with objects floating at the surface of the ocean. There are two types of floating objects: natural and man-made. Man-made floating objects specifically constructed to attract fish (and also natural objects such as logs that are found by fishermen, then modified and redeployed) are called fish aggregating devices (FADs). They can be anchored to the ocean floor or set to drift in the open ocean. Drifting FADs are often equipped with a radio or satellite transmitter to aid in their relocation. Anchored FADs (called "payaos" in some regions) are commonly used by artisanal and sport fishing fleets but also by industrial pole-and-line and tuna purse seine vessels in some regions, such as the western Pacific Ocean and Maldives in the Indian Ocean. However, the mainstay of the world's industrial purse seine fleets is drifting FADs.

Most drifting FADs have two main components: a floating structure and an underwater feature. The floating component is generally constructed of bamboo canes laced together and/or other buoyant materials such as cork floats or sealed PVC piping. Often called rafts, the floating structures are usually wrapped in purse seine netting to keep materials together and also to serve as a camouflage for the FAD. The surface structure is often rectangular (4 to 6 square meters), but other shapes (e.g., cylinders) are also used. Shapes, construction style, and choice of materials vary greatly by region.

Hanging from the floating raft, the underwater feature, also known as a tail, commonly consists of a panel of purse seine netting weighted at the bottom in order to remain submerged and nearly vertical as the FAD drifts. The tail is thought to serve two purposes: to attract fish, and to act as a sea anchor to slow the drift of the FAD. These net panels can hang from a few meters deep to over a hundred meters, depending on the ocean and the fleet. A radio or satellite buoy is usually attached to the FAD so its position can be remotely monitored. Sometimes the buoys are equipped with echosounders with data transmission capabilities that allow skippers to monitor the FAD for the presence of fish.

FADS and Bycatch

FADs attract more sea life than just tuna. In addition to other species of bony fish, sharks and turtles are known to visit FADs. In some instances, those animals become entangled in the netting on the raft (turtles) or in the netting suspended under the raft (turtles, sharks and other fishes). The main shark species that often associate with floating objects are the silky shark and, to a lesser extent, the oceanic whitetip shark. Several turtle species can be found around floating objects, depending on area, the most common being the olive ridley turtle. While turtles can get trapped in the submerged netting, they can also become entangled when they climb on the floating structure. The turtle's claws can easily become entangled in the mesh panels covering the raft. The proportion of turtles that come into contact with FADs and are able to swim away to those that become permanently entangled is currently unknown. Entanglement issues vary greatly by region, though, and are influenced by the mesh size of FAD materials.

FAD Construction

To address the problem of animal entanglement in FADs, ISSF has developed a guide to assist fishers in constructing more environmentally friendly FADs. Some fleets have already begun deploying such FADs, and RFMOs are beginning to consider adopting similar guidelines. Since observers are often required to describe the FADs constructed and/or deployed by the vessel, it is possible to compare those FADs against the guidelines presented below, and to offer advice on best practices in non-entangling FAD construction.

Though specific design is the decision of the fishers, the following points should be considered:

- To reduce entanglement of turtles on the FAD itself, the surface structure should not be covered or covered only with non-mesh material.
- If a subsurface component (apron or tail) is used, it should not be made from netting, but rather from non-mesh materials such as ropes or canvas sheets.
- To reduce the amount of synthetic marine debris, and to promote environmentally friendly FADs, the use of natural or biodegradable materials should be promoted.

Understanding that the transition from traditionally constructed FADs to non-entangling FADs may take time, the following guidelines—while not eliminating the risk of entanglement—would significantly reduce the potential for unintentional shark and turtle mortality:

- For the surface structure, only smaller mesh netting of 7 cm (2.5 inch) stretched or less should be used for wrapping it up tight. Log-shaped (i.e., cylindrical) or spherical floats naturally deter turtles from climbing onto the device, and should be used instead of flat rafts when possible.
- For the underwater tail, the netting should be rolled up and securely tied into "sausages." These sausages should be constructed from netting of 7 cm (2.5 in) stretched mesh or less, so that, if the sausages unwind, the netting will not entangle marine life. If panels are preferred, only a single panel should be used and the panel should be heavily weighted to keep it taut. The panel should consist of either a solid sheet (e.g., canvas) or netting with a stretched mesh of 7 cm (2.5 in) or less

Gallery 2.6: FADs



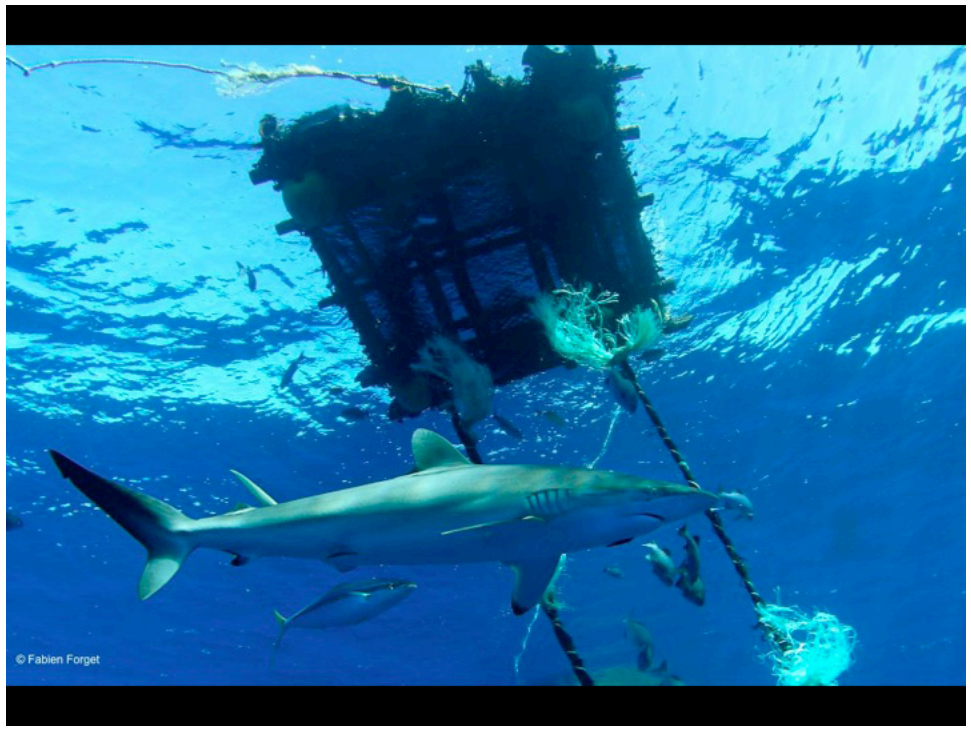
Towing a FAD (Photo: Fabien Forget)



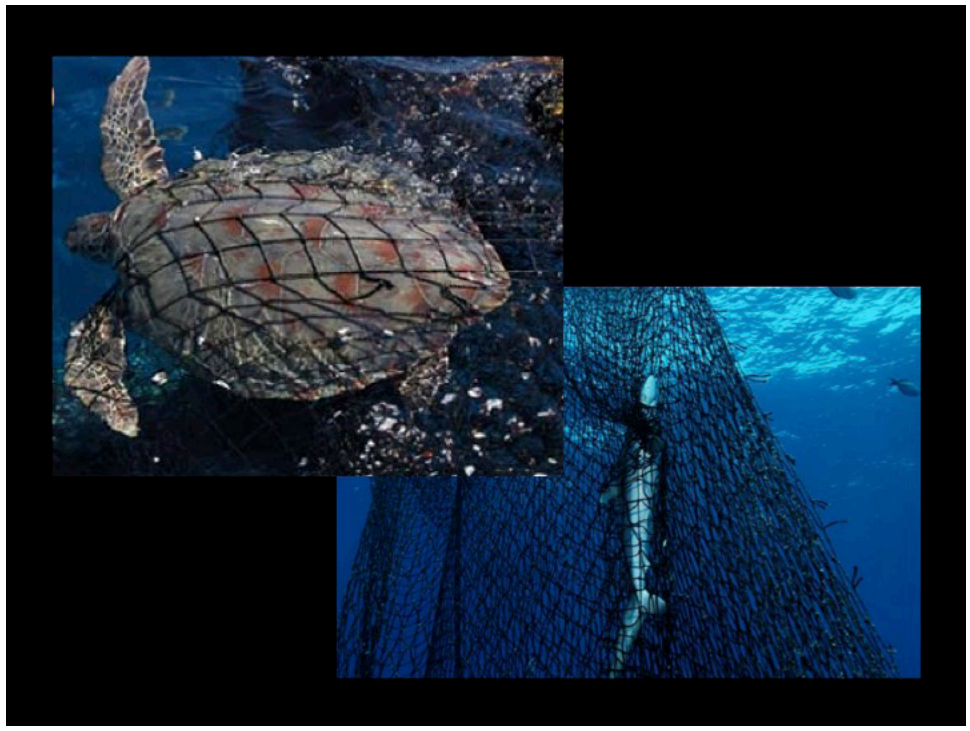
Shark entangled in a FAD (Photo: Fabien Forget)



Sea life around a FAD (Photo: SPC)



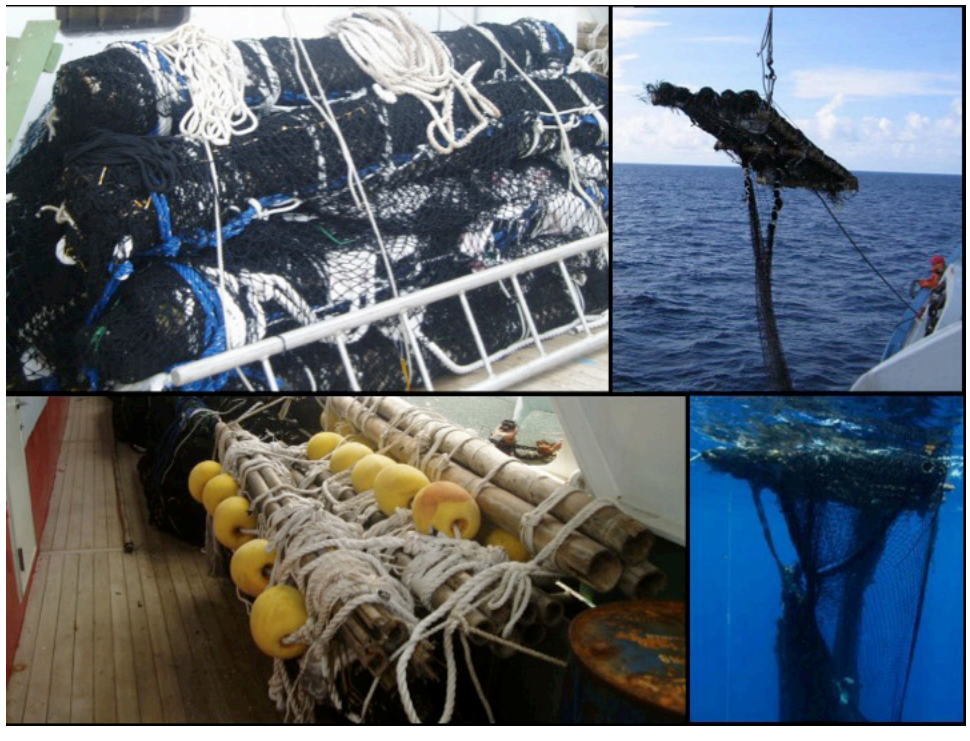
This FAD does not have the hanging net panels seen in most traditional FADs. (Photo: Fabian Forget)



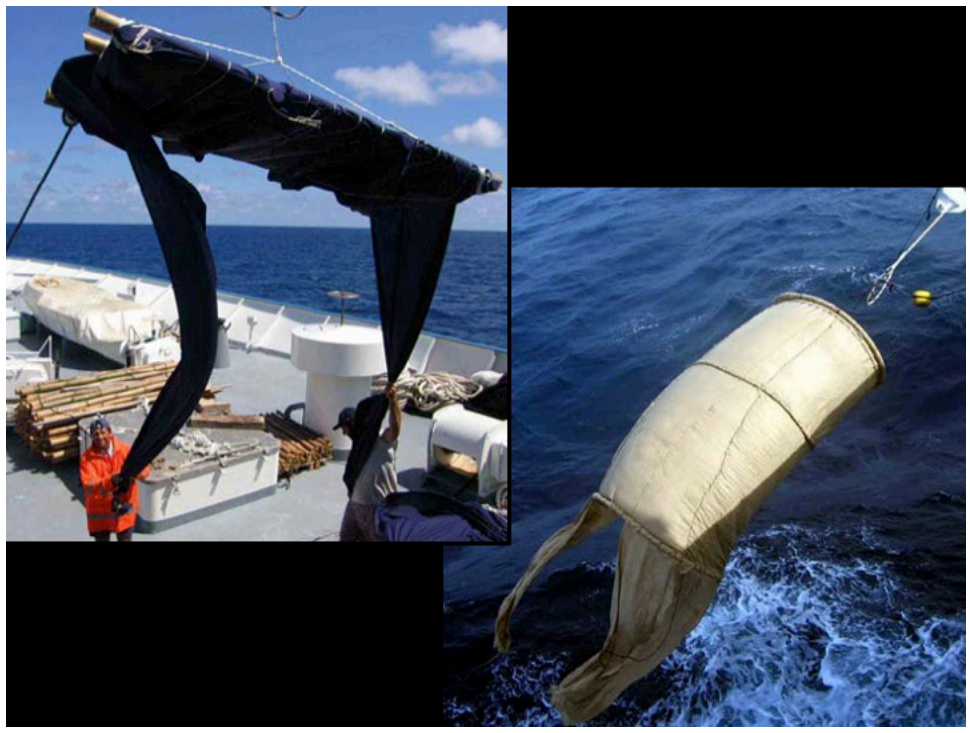
The netting used in traditionally constructed FADs can entangle animals, notably sensitive species such as turtles and sharks.



Construction of traditional FADs on deck using bamboo, floats, and purse seine netting



FAD rafts stored on deck



Alternative, non-entangling FAD designs substituting net with fabric (left) or biodegradable sheets (right) (Photo: IEO)



Capt. Dick Stephenson's FAD design using ropes to replace net



FAD constructed with biodegradable materials including palm leaf cover and small mesh jute netting commencing 10 m below the raft (Photo: AZTI-Tecnalia)



Tightly fitted small-mesh netting on raft



Underwater netting held into bundles ("sausages" or "chorizos") with ropes (Photo: IRD)



Commercially used FAD with raft underwater and net replaced by plastic sheets (Photo: Inpesca)



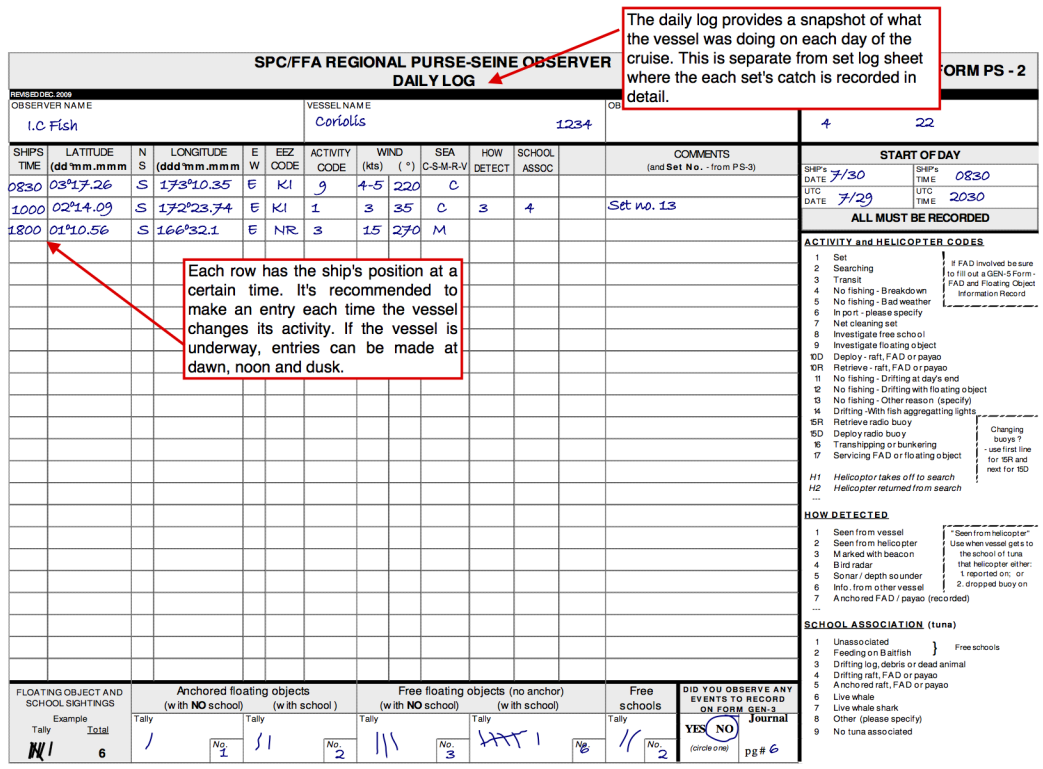
A narrow "log style" surface instead of a traditional wide-raft FAD discourages turtles from climbing. (Photo: ISSF)

Fishing Activity

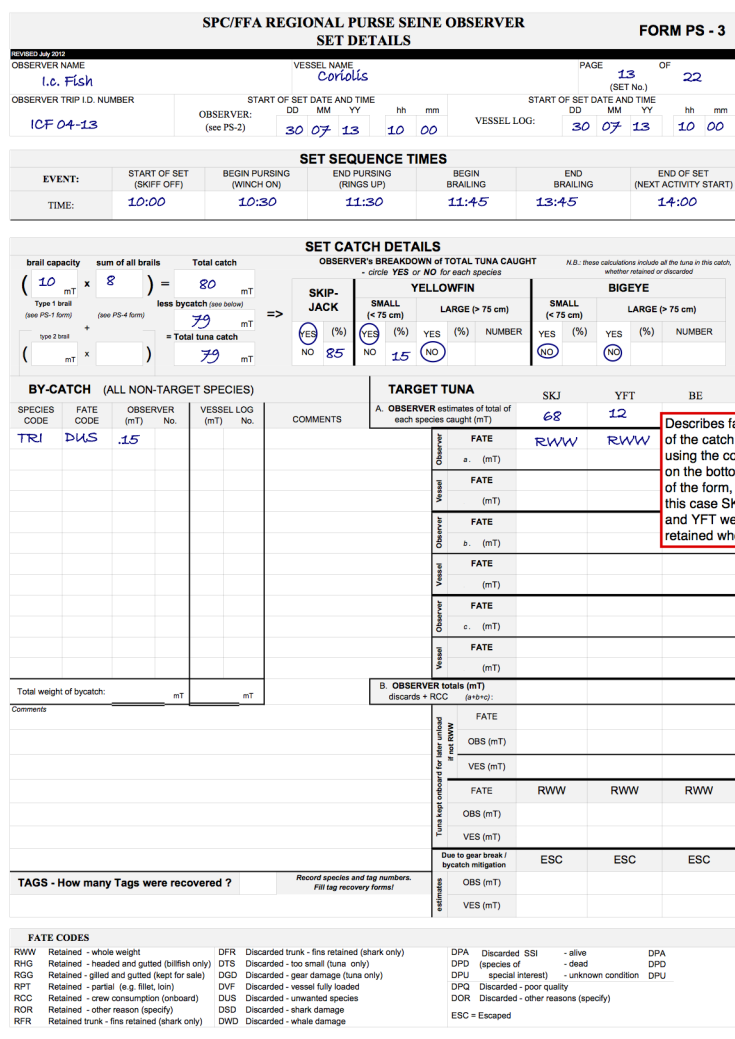
An important observer activity is documenting how a fishing vessel spends its time. This information helps fisheries scientists and managers understand how much effort a vessel exerts relative to how much fish it catches (catch per unit effort, or CPUE), which can be used to make estimates about the tuna stock's abundance (decreasing CPUE indicates overexploitation). Observer forms generally have "activity codes" that allow an observer to note what the vessel is doing, such as searching for fish, returning to port, traveling to a FAD, setting, etc.

Of particular importance regarding catch is how the vessel encountered the fish. Was it a free school unassociated with a floating object? If so, what type of cue helped detect it (foam or movement in the water, jumping fish, or seabirds over the school)? Did the helicopter find a school of fish and then direct the vessel to it? Did the skipper check the data from the echosounder buoys on his deployed FADs and then decide to visit the one with the most fish? This information is also useful to scientists as they attempt to quantify the amounts of fish caught using different fishing strategies, and to understand the impacts of technology on fishing efficiency.

Gallery 2.7: Observer Documentation



Sample Daily Log Form



Sample Set Details Form

Safety At Sea

The first priority for any seafaring vessel should be crew safety. Observer program managers should determine the seaworthiness of the vessel through contact with the competent authority and refuse to deploy observers if minimum standards are not met.

Observers should be given specific at-sea safety training performed by a professional safety trainer and if possible with the support/input from observer managers. Many nations follow the guidelines of the International Maritime Organization (IMO) on training for safety at sea and they implement these courses through their national authorities. If available, observer program managers must require the observers to comply with this training either before or after observer training.

Observers are generally required to take note of the safety equipment on board, including life rings, life preservers, life rafts, Emergency Position Indicating Radio Beacons (EPIRBs), fire safety, and first aid kits. In addition, observers should feel—at all times—confident in their personal safety while on board. If the observer ever feels threatened or intimidated, or is otherwise treated improperly (e.g., access to food or first aid denied), the observer must be allowed to contact their Observer Coordinator immediately. Some observer programs are taking steps to provide their employees with satellite phones or other independent means of communication. At the very least, the observer program should have a procedure to report these incidents at the end of the trip so the data can be made available to the national authority.

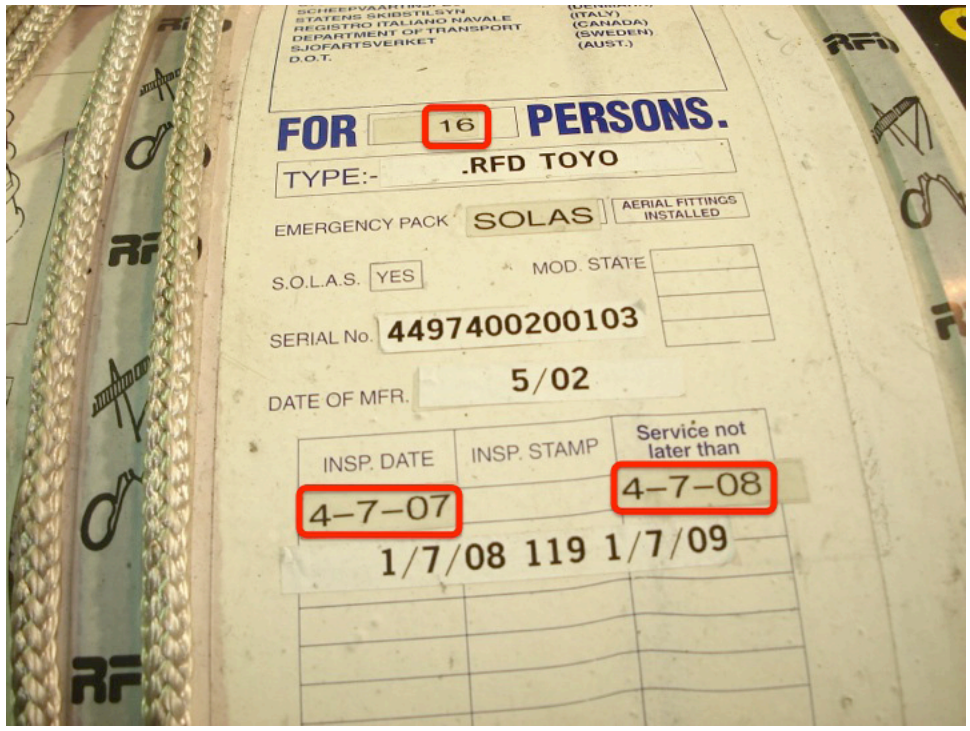
Gallery 2.8: Safety Equipment



Some observer forms require noting the number of life jackets and/or life rings.



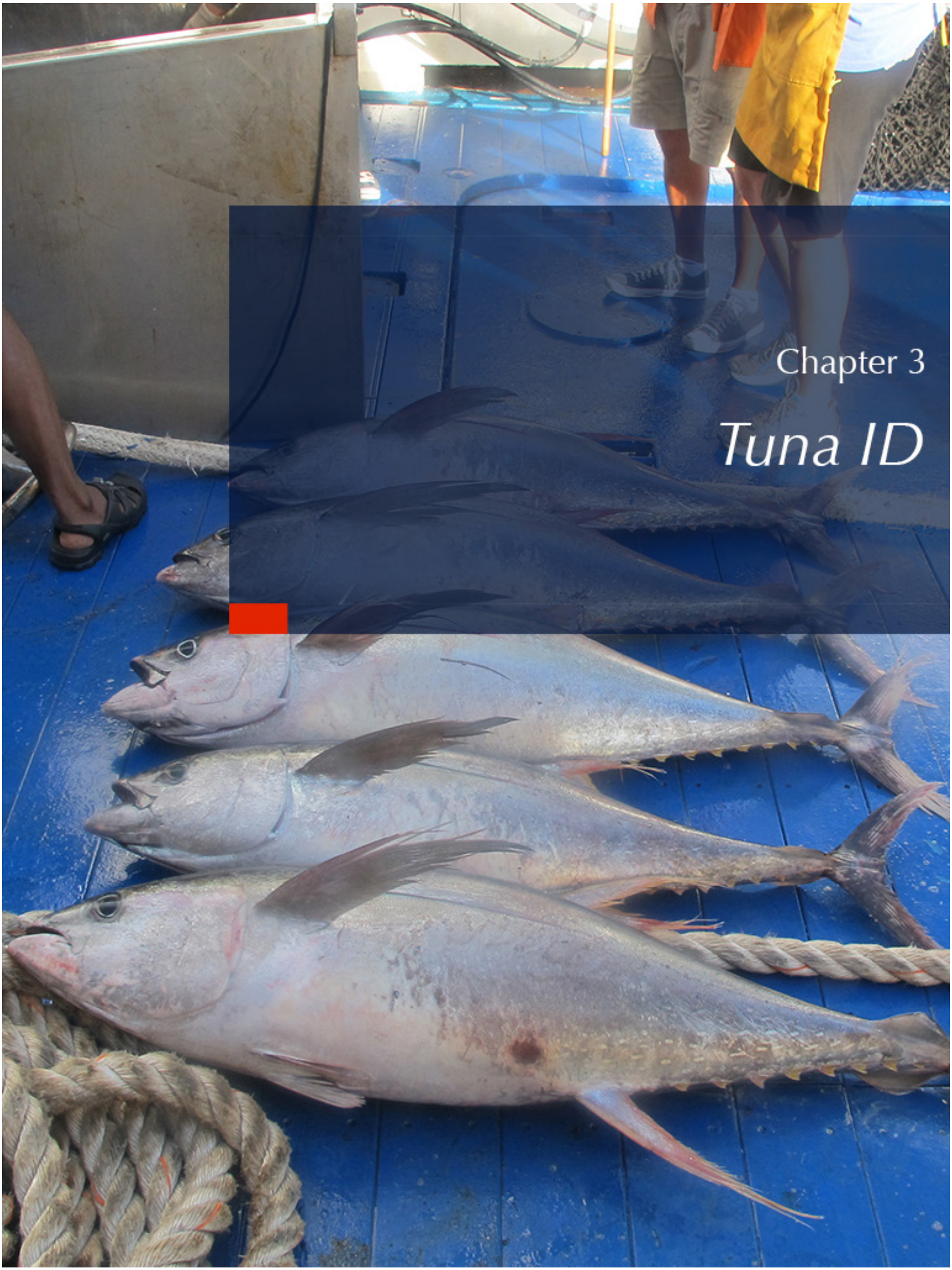
Life rafts are often packaged in white plastic barrels and inflate when deployed (see inset image).



Life rafts should have their capacity listed, and should be inspected regularly, with the dates recorded on the outside of the raft's container.



All vessels should have an Emergency Position Indicating Radio Beacon (EPIRB) on board.



Chapter 3

Tuna ID

Chapter 3: Tuna ID

Accurately measuring the catch of specific tuna species is critical to our understanding of the health of the fisheries. However, distinguishing between the tuna species caught during fishing, particularly small yellowfin and bigeye, can be challenging. Observers provide a valuable contribution to fisheries management with their skilled species estimates.

Introduction

Chapter Objectives

1. Review briefly the primary tuna species caught in the tropical tuna purse seine fishery.
2. Learn to distinguish small yellowfin from small bigeye tuna.
3. Practice tuna species identification on non-ideal specimens.

Once details on a vessel's identifying information and fishing operations have been recorded by the observer, attention can be turned to recording the results of the catch. During tropical tuna purse seine fishing, the species that makes up the bulk of the catch depends on a number of things, such as the type of set, the area, the time of the year, etc. Generally, skipjack tuna is targeted on FAD sets and free school sets, while yellowfin is targeted in free school sets or in association with dolphin schools (in the eastern Pacific Ocean). Bigeye and yellowfin, usually of small sizes, are often caught in association with skipjack in FAD sets.

Observers are charged with recording both a set's catch amount and its species composition. This is almost always challenging, given the speed and scope of work during the brailing and sorting process. While working experience is the best means of developing quick and accurate species ID skills, at the end of this chapter are some images that illustrate typical non-ideal and "spill" samples to help observers learn. Additional information on sampling strategies is covered in a later chapter.

Tuna Species

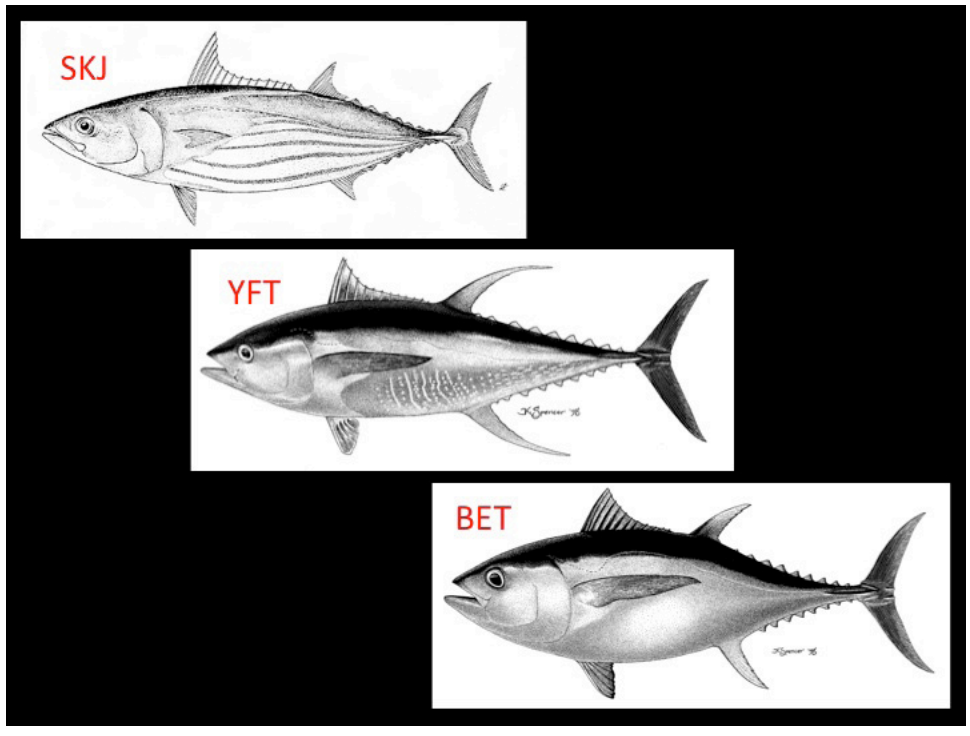
Seven species of tunas are of major commercial importance on a global scale: three species of bluefin tuna, albacore, bigeye, yellowfin, and skipjack. Due to differences in their distributions and the different fisheries that exploit them, the species are classified as "temperate" or "tropical." The temperate tunas are the bluefins, plus albacore; they are found in waters as cold as 10° C, but can also be found in tropical waters. Skipjack and yellowfin are classified as tropical and are found in waters with temperatures greater than 18° C (although they can dive in colder waters). Bigeye could be classified as intermediate, but is often treated as a tropical species in fishery statistics. For the purposes of this review, further discussion is limited to skipjack, yellowfin, and bigeye because these are the three tuna species encountered during tropical tuna purse seine fishing.

Skipjack (*Katsuwonus pelamis*) are found mainly in the tropical areas of the Atlantic, Indian, and Pacific Oceans. Their geographic limits are 55° – 60° N and 45° – 50° S, with their greatest abundance in equatorial waters. Skipjack form both free schools and schools associated with floating objects. They are the principal species associated with FADs and are caught in conjunction with juvenile yellowfin and bigeye tunas. Skipjack are the smallest of the major commercial tuna species, with a common size range of 40 to 80 cm, except when occasionally caught in association with dolphin schools, in the eastern Pacific Ocean, where they reach larger sizes.

Bigeye (*Thunnus obesus*) are found in the subtropical and tropical areas of the Atlantic (but not the Mediterranean), Indian, and Pacific Oceans. Their geographical limits range from 55° – 60° N to 45° – 50° S. Juveniles and reproductively active adults are found in equatorial waters as well as at higher latitudes. Bigeye rarely form free schools, and usually are caught in the purse seine fishery while associated with floating objects. Small bigeye will form schools with juvenile yellowfin and skipjack tunas while associated at FADs. Bigeye reach similar maximum sizes to those of yellowfin (over 200 cm). Individuals as large as 150 cm occur in some fisheries, but it is common to find the size range down to 40 cm. Bigeye does not associate with dolphin schools in the eastern Pacific Ocean.

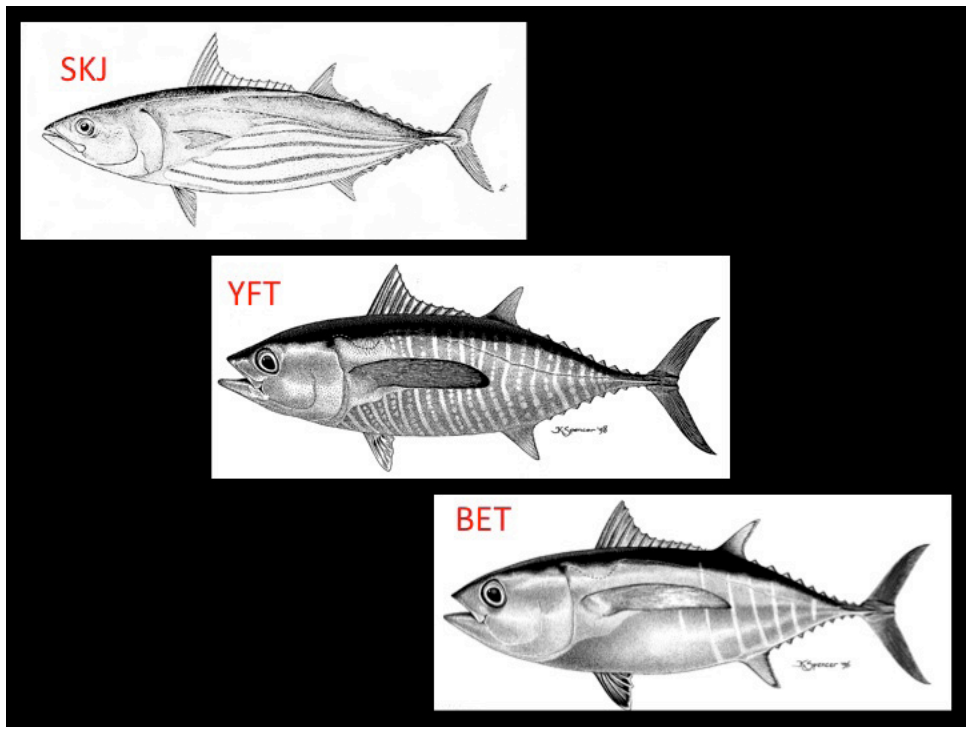
Yellowfin (*Thunnus albacares*) are found in the subtropical and tropical areas of the Atlantic, Indian, and Pacific Oceans. The yellowfin's geographic limits are from 45°– 50° N and S, although in the Pacific they occur mainly within 20° of the equator. Yellowfin form both free and associated schools, with adults generally forming schools of similarly sized individuals. The free-swimming schools tend to contain large individuals and comprise yellowfin only. In the eastern Pacific, schools are often associated with dolphin pods, an association not common elsewhere. Yellowfin tuna generally reach sizes approaching those of bigeye, with a common range of 40 to 150 cm (or even larger when found in association with dolphins).

Gallery 3.1: Tuna Species



The three tuna species (adult forms) most likely to be encountered during tropical tuna purse seine fishing: skipjack (SKJ, top), yellowfin (YFT, middle), and bigeye (BET, bot-

tom). The skipjack is easy to distinguish by the horizontal stripes that run down its body. (Photos, top to bottom: FAO, K. Schaefer, K. Schaefer)



The same three species, but showing the small (juvenile) forms of yellowfin and bigeye more commonly occurring with the mature skipjack (Photos, top to bottom: FAO, K. Schaefer, K. Schaefer)



Schooling tuna: note the uniformity of fish size (Photo: Jeff Muir)



Mixed tuna (Photo: FADIO/IRD-Ifremer/M. Taquet)



Schooling yellowfin (Photo: Jeff Muir)



With their characteristic horizontal stripes and fusiform shape (wide in the middle and evenly tapered at both ends), skipjack are relatively easy to identify. Distinguishing between small bigeye and yellowfin is more challenging and will be reviewed in detail in the next gallery. (Photo: David Itano)

Small Bigeye and Yellowfin

Though small bigeye and yellowfin are easy to confuse, they are important to identify! In some oceans, one of these stocks may be experiencing overfishing while the other is healthy—and without accurate catch data, scientists cannot produce effective stock assessments and managers cannot make informed decisions about conservation measures. In the majority of cases, the observer is the most skilled and best-positioned person on the vessel to carry out a realistic estimate of the bigeye and yellowfin brought on board.

Though large adult bigeye and yellowfin are characterized by dissimilar body and fin shapes, these differences are less noticeable when they are young. However, the small tunas do have somewhat different markings and—to a lesser extent—colors. The following photo gallery will illustrate the typical characteristics of small bigeye and yellowfin, and provide some side-by-side comparisons.

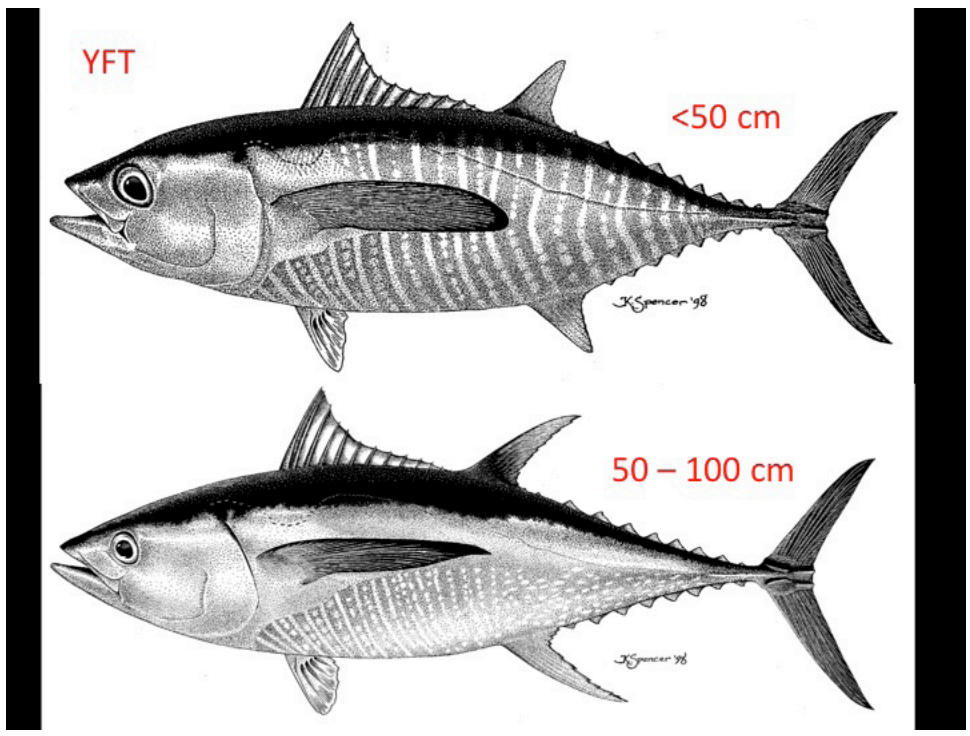
Gallery 3.2: Bigeye and Yellowfin Tuna



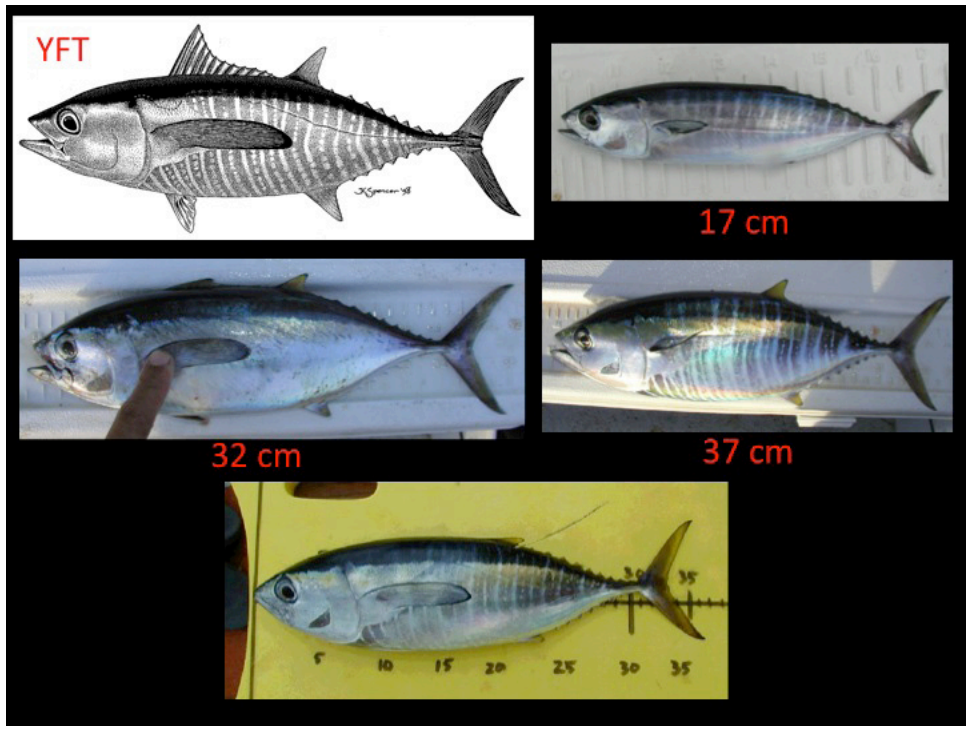
Yellowfin and bigeye tuna can be hard to distinguish, especially when they are not yet mature. Of the nine juvenile tuna in this photo, three are yellowfin, and six are bigeye. The following photographs will illustrate the differences between the two species, and provide some comparative examples. (Photo: David Itano)



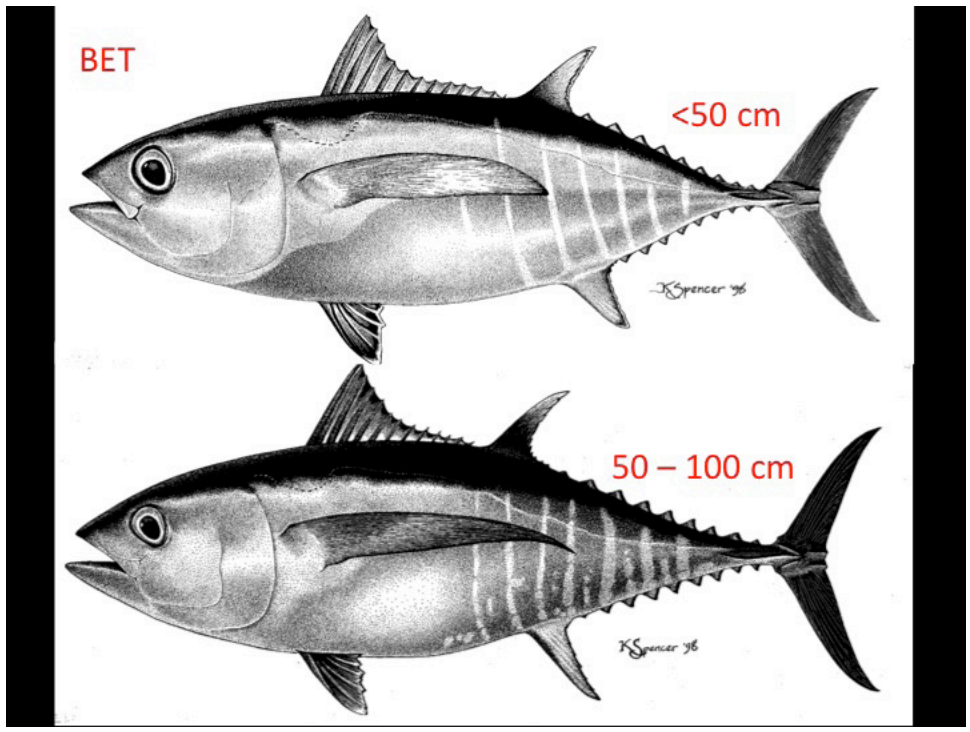
At the same length, juvenile yellowfin (top) and bigeye (bottom) look similar but not identical. (Photo: David Itano)



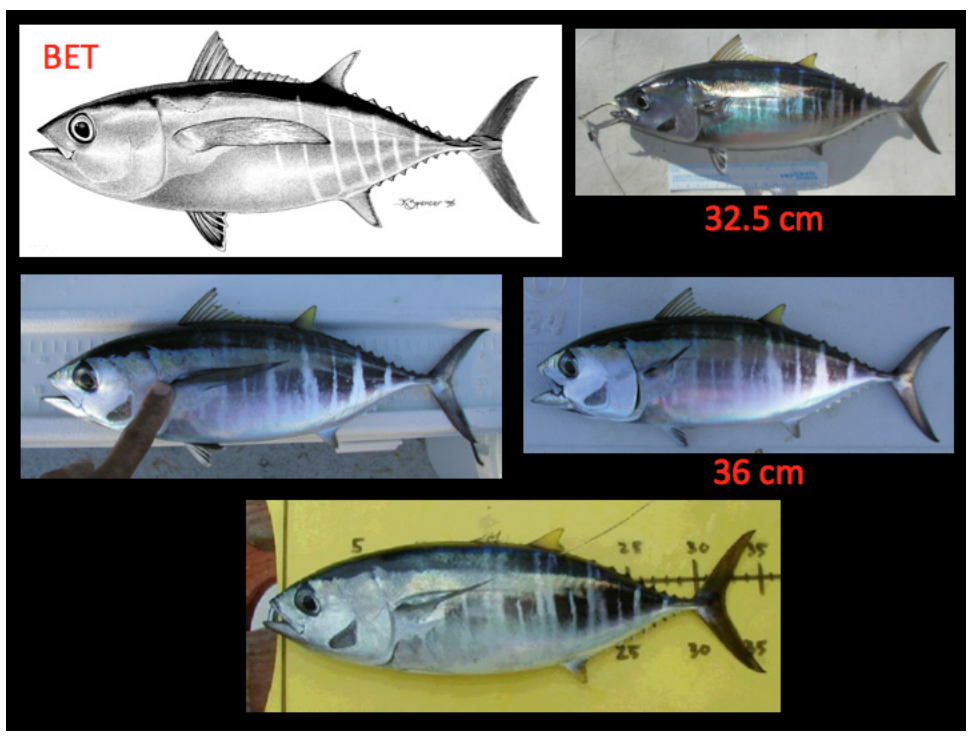
Yellowfin tuna shorter than 50 cm (top) and between 50 and 100 cm (bottom) (Photo: K. Schaefer)



Examples of yellowfin tuna under 50 cm. Note the closely spaced, alternating pattern of lines and dots that extends from the tail to beneath the pectoral fin and to above the midlateral body line, with clear demarcation between the marked and unmarked regions. (Photo: David Itano)



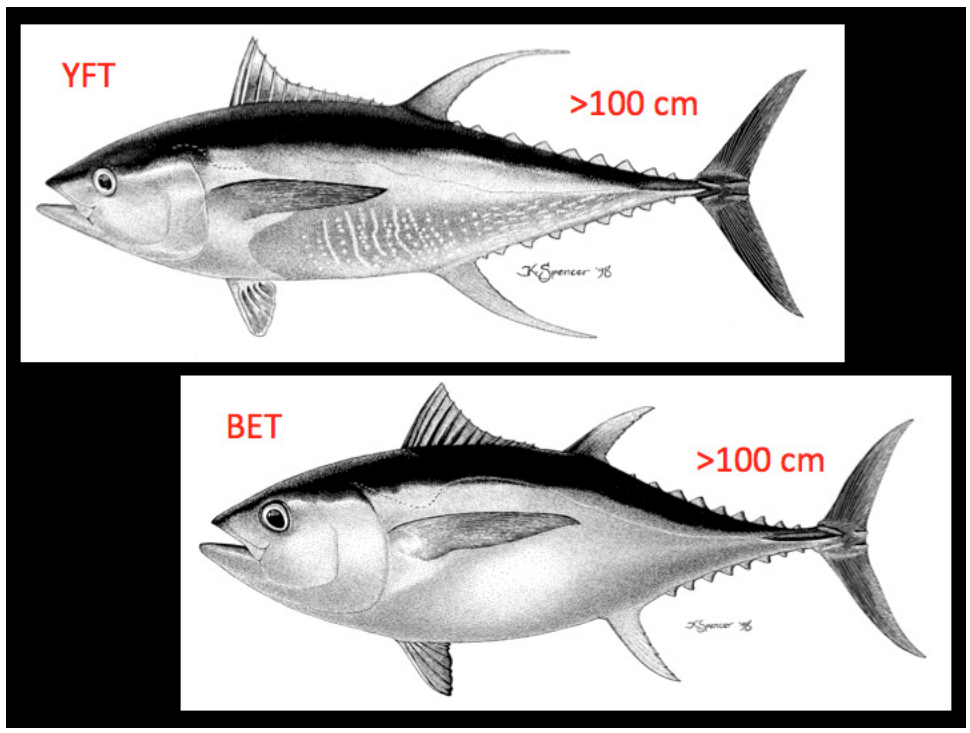
Bigeye tuna at shorter than 50 cm (top) and between 50 and 100 cm (bottom) (Photo: K. Schaefer)



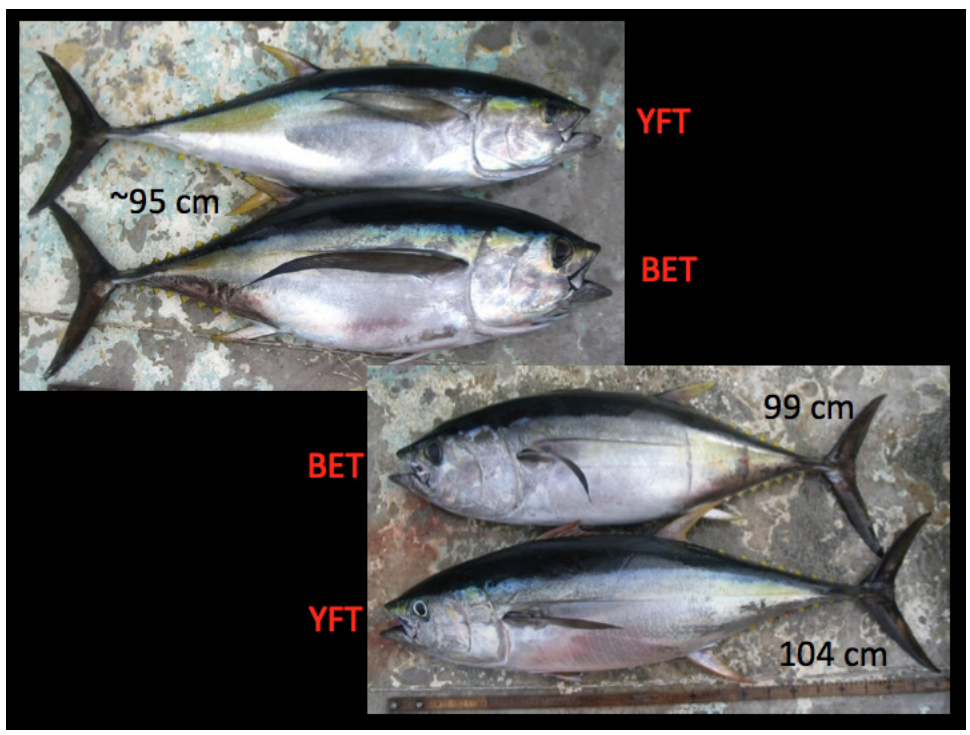
Examples of bigeye tuna under 50 cm. Note that the white lines that are both irregularly spaced and sized, with few to no rows of dots present, and the demarcation between the marked and unmarked region is generally not clear. (Photo: David Itano)



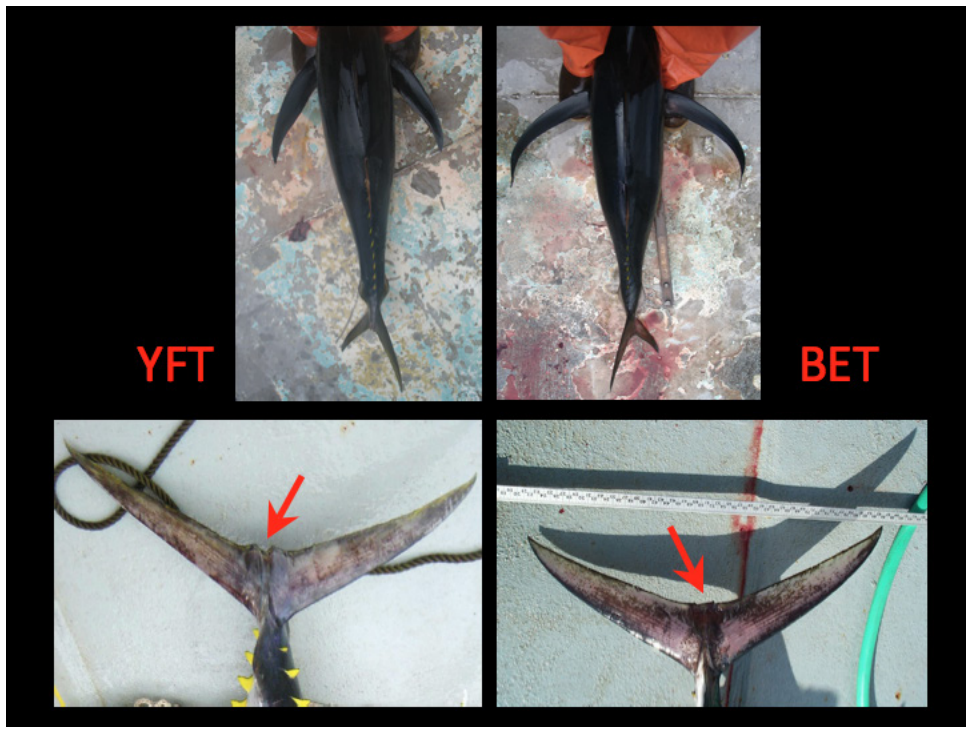
Comparison of small yellowfin (top and bottommost fish) and small bigeye (second and third fish from the top). Though there are characteristics of coloration that can distinguish bigeye from yellowfin, the colors fade very quickly after death and therefore are not a reliable means when identifying species during a purse seine fishing operation. Note that the pink color is a reflection in the photo and not a color of the fish. (Photo: David Itano)



Large adult yellowfin have a streamlined, elongated body shape (above left), while large bigeye have a more rounded and deep body shape (lower right). (Photo: K. Schaefer)



Examples of larger yellowfin (top and bottommost fish) and bigeye (second and third fish from the top). In the top photo, note the yellowfin's smaller head and eye size. When undamaged, the pectoral fin for fish under 150 cm can be a useful secondary diagnostic, since the bigeye's is longer, more flexible, and tapers to a thin point. (Photo: David Itano)

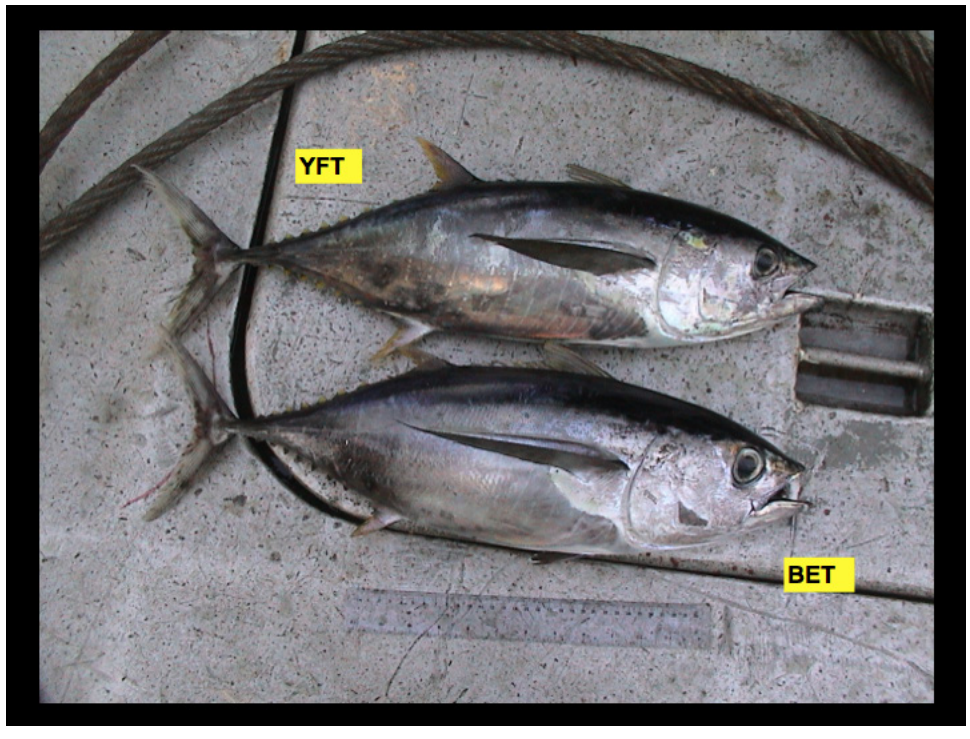


Yellowfin pectoral fins (top left) are straight and stiff, while bigeye pectoral fins (top right) make a smooth arc and have flexible tips. The caudal fin in a yellowfin has two ridges that make a distinctive V-shaped notch at the center of the fin, while the same area on the bigeye's caudal fin is relatively flat. (Photo: David Itano)

Damaged, Frozen, or Non-Ideal Conditions

Tuna identification is made more difficult when the fish are damaged or frozen, since that can result in changes to fin shape, body proportion, and coloration. Remember, do not rely on a single distinguishing feature, but instead look at multiple features for identification. Correctly identifying these species, especially when the individuals are in less than ideal condition, is difficult and requires practice.

Gallery 3.3: Identifying Damaged or Frozen Fish



Faded markings: sometimes the lines and other markings on the sides of the fish can fade, preventing species identification using that characteristic. Here the yellowfin (top) retains some of its vertical markings below the lateral line, however the bigeye's (bottom) marks have almost entirely faded. (Photo: David Itano)



Faded colors: sometimes the fish's coloring can be faded, preventing species identification using that characteristic (yellowfin top, bigeye bottom). The colors can fade entirely to silver/white and blue/black, but body shapes should still allow identification. (Photo: David Itano)



Predation (e.g., shark bites), net damage, or other handling damage can also make species identification difficult. In this case, the intact pectoral fin (long, with a thin and flexible tip) suggests bigeye as the species. (Photo: David Itano)



Deck spill on a purse seine vessel. The observer must be aware of general species and size composition as the tuna come on board—and to note changes in those variables as the catch is brailed. (Photo: David Itano)



Brine-frozen tunas will likely be entirely absent of distinguishing color characteristics, and distortion of body shape is more likely. (Photo: David Itano)

Gallery 3.4: Testing Tuna Identification Quiz



Top: Yellowfin Tuna
Bottom: Bigeye Tuna
(Photo: David Itano)



Top: Bigeye Tuna
Bottom: Yellowfin Tuna
(Photo: David Itano)



Top: Bigeye Tuna
Bottom: Yellowfin Tuna
(Photo: David Itano)



From top, the first three are "False Tunas" (see Chapter 4).

Bottom three are: Yellowfin tuna, Bigeye tuna, and Skipjack.
(Photo: David Itano)



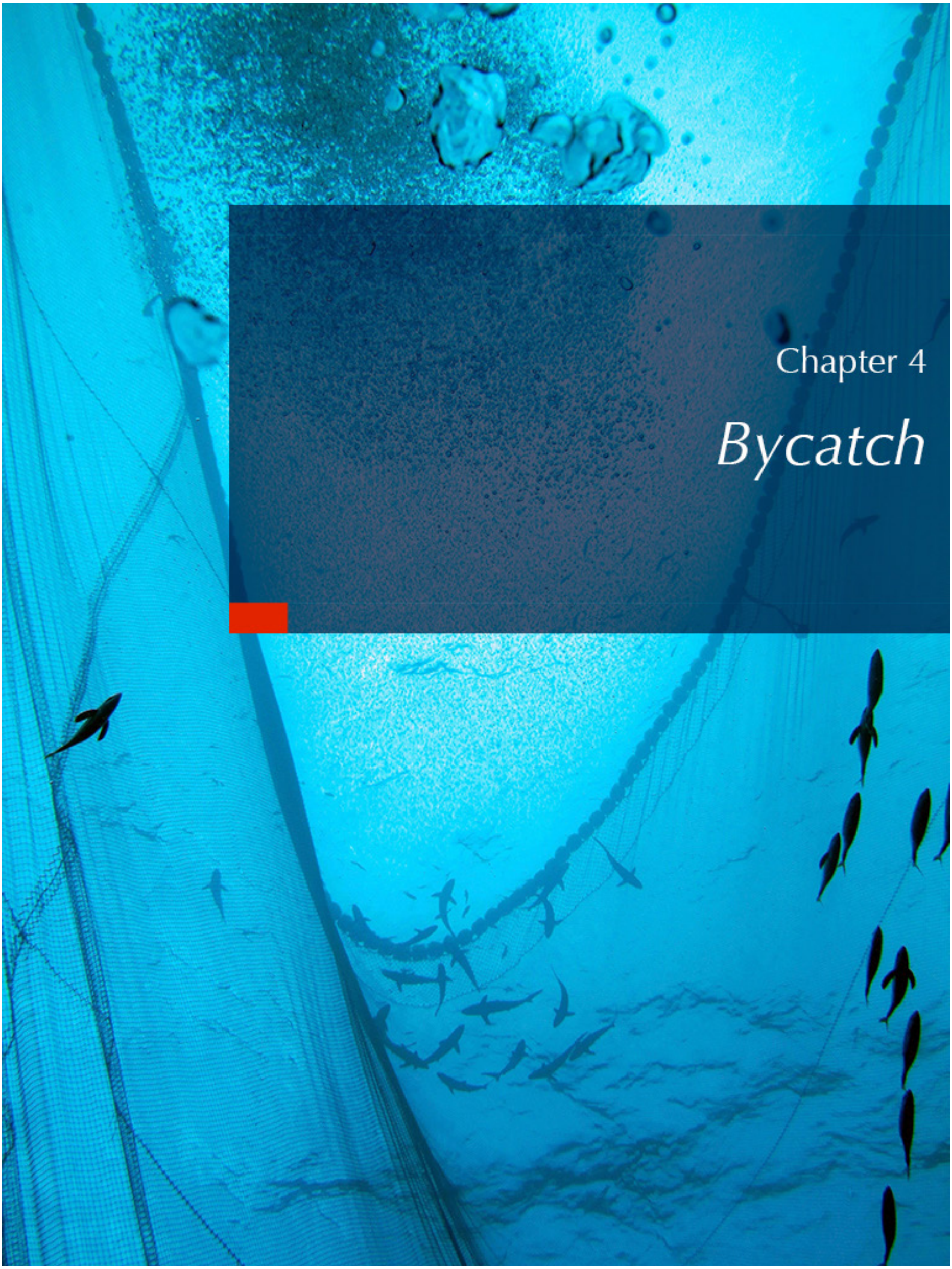
Answer: best estimates are:
YFT: close regular line pattern, long body, caudal notch
BET: large head and eye, irregular line pattern
YFT: Thick, short pectoral fin, possible regular marking pattern
BET: long pectoral fin, no sharp caudal notch
BET: long pectoral fin, deep body
YFT: close regular line pattern, short pectoral fin, small eye
BET: long pectoral fin, widely spaced line pattern
YFT: short pectoral, close, regular line pattern, caudal notch possible
YFT, possibly: short head, close line-and-dot pattern, but long pectoral fin (needs closer look)
BET: long pectoral fin pointing down, vertical white lines, deep body
YFT: close line-and-dot pattern
BET: long pectoral fin with thin tip, widely spaced vertical white lines
(Photo: David Itano)



Yellowfin Tuna
(Photo: David Itano)

Conclusion

This chapter provides just a brief review of how to identify the three primary tuna species encountered during tropical tuna purse seining. Not reviewed were details about internal identification mechanisms, such as descriptions of liver shape and swim bladders. There are comprehensive guidebooks available online, which can be used to further enhance one's identification skills, including the excellent guidebooks produced by David Itano for the Secretariat of the Pacific Community, which formed the basis for the information presented here.



Chapter 4

Bycatch

Chapter 4: Bycatch

Observers are the single best source of information about the species and amounts of bycatch in the tuna purse seine fishery. These critical data shape debate and guide decision making in all RFMOs.

Introduction

Chapter Objectives

1. Review the commonly encountered bony fish species.
2. Highlight the sharks, rays, and turtles that might interact with the purse seine gear.
3. Provide species identification tips.
4. Provide best practices for bycatch handling and release.
5. Address fishing strategies that can reduce bycatch.

Bycatch Introduction

The non-tuna catch of purse seine sets is, by weight, very low compared to other fishing techniques, such as longlining, although different purse seine fishing strategies have different levels of bycatch. The majority of bycatch is generally other bony fishes, with a small fraction of bycatch being environmentally sensitive species of sharks and turtles. The non-tuna or incidental catch is also often termed bycatch or discards. Bycatch is anything that is not the actual target of the fishing operation. Some of these nontarget species are discarded or can be kept onboard for consumption by the crew, or retained to be landed and sold. **Recording bycatch or discarded species is the most important role of the observer.** There are other methods to determine the total catch, however, as bycatch is often discarded at sea, the only possible way to know how much and what has been caught is through the observer.

The priority of observers for recording bycatch should be as follows:

1. Tuna discards
2. Catch and discards of sharks and billfish
3. Catch and discards of other species

Observer recording of bycatch species and amounts is important for a number of reasons, as the data are crucial to assessing the ecosystem impacts of tuna fishing on the larger marine environment.

Indeed, the impact of such catches on stocks has to be carefully evaluated. For example, the landing of frigate tuna may have no impact on that resource as the stock size is large and the species not fully commercially utilized. Alternatively, high catch and discards of small bigeye tuna could have a significant impact on stocks that are heavily exploited. An observer must be able to distinguish between these species to ensure that the fishery scientists receive the best data to produce the most accurate stock assessments.

In addition to identification, the best practices for the handling and release of sensitive species is reviewed here. **Remember that handling of the catch and bycatch is the responsibility of the crew.** However, observers can be a resource for the skipper and crew by providing information on national or international requirements for the handling of sharks and turtles.

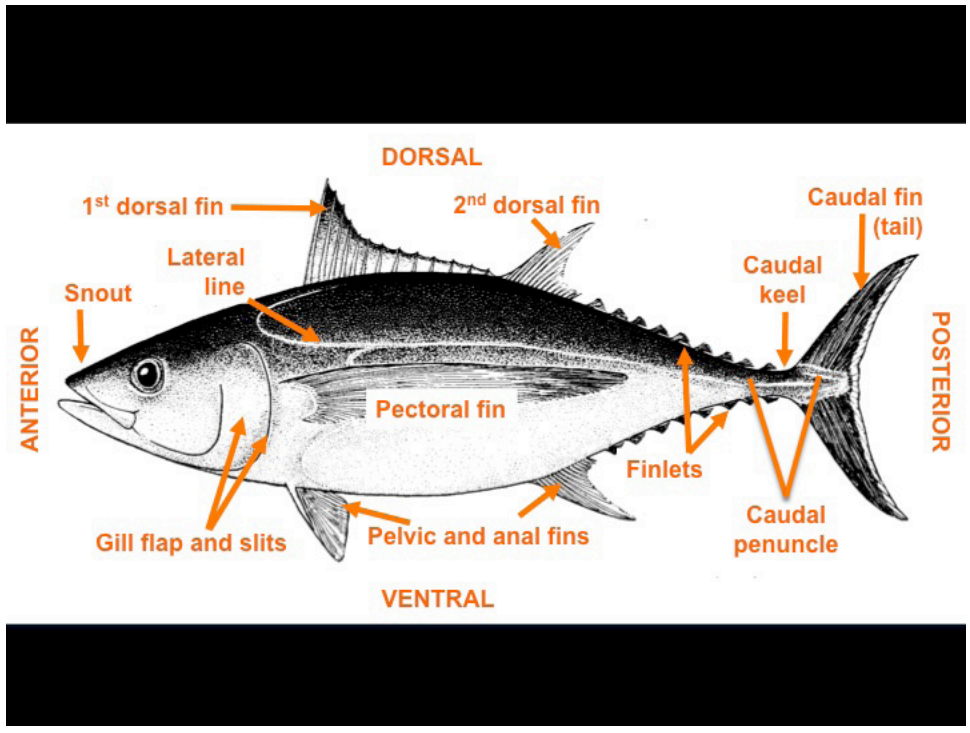
Bony Fishes

The following gallery presents the bony fish that are commonly caught in association with tuna schools. Each species' common name and FAO code are given. The FAO identification code is a universal three-letter abbreviation that is often used by observer programs. Generally, these species' stocks are considered to be healthy and they do not require special handling or extra record-keeping. In addition to these, other species may be encountered, and it is recommended that a more comprehensive guide is kept for reference while on board.

Gallery 4.1: Bony Fish Identification



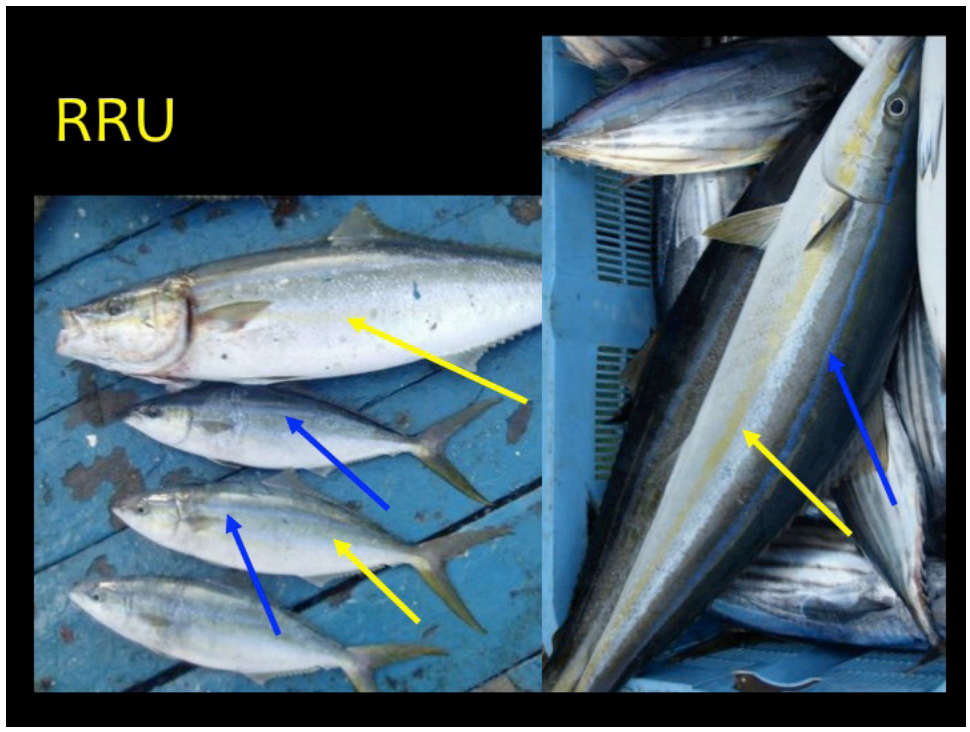
An observer will encounter many fish species during the course of their duties. This gallery will review some of the more common fish and point out their identifying characteristics. (Photo: Fukofuka & Itano, 2007)



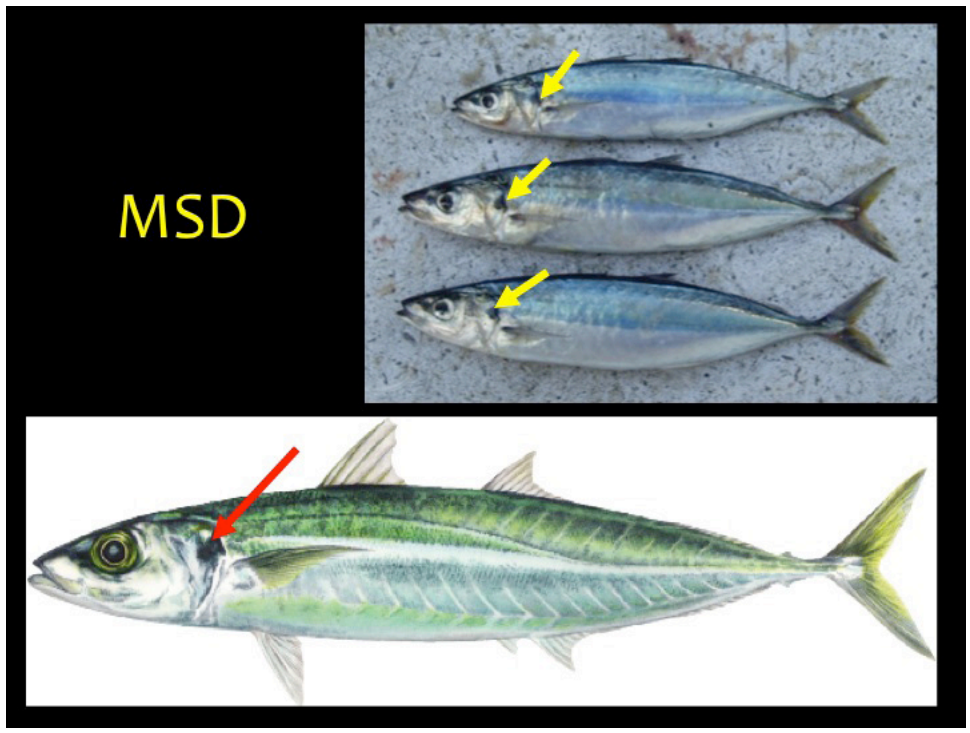
Parts of a fish (Photo: Fukofuka & Itano, 2007)



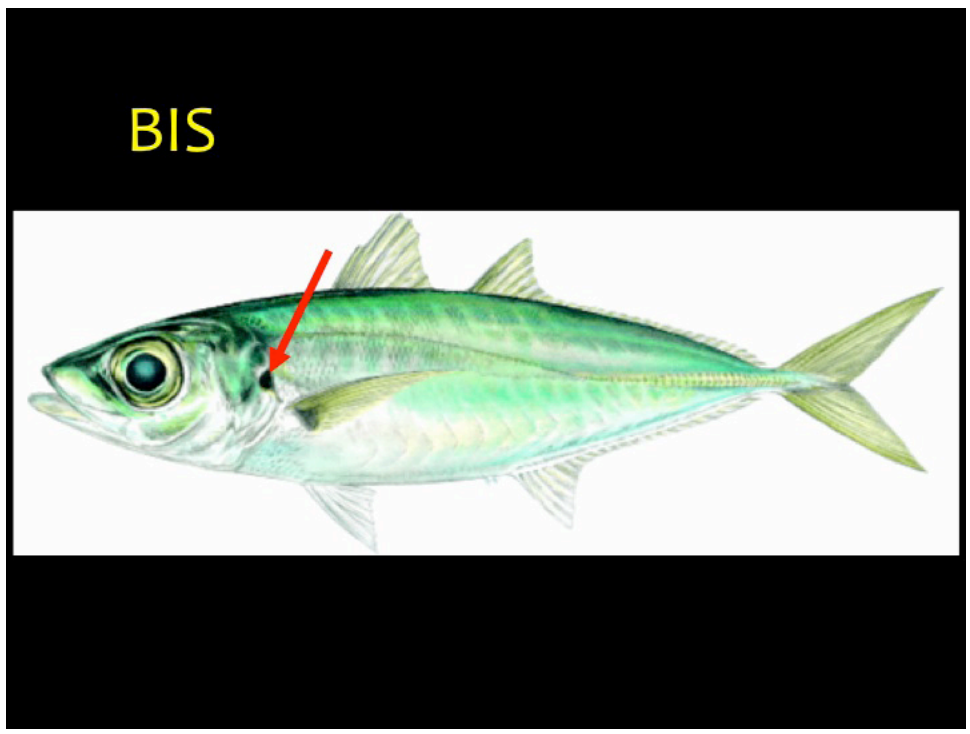
Spotted Oceanic Triggerfish (TRI): white spots (red arrows), one or more spines above the head (yellow arrows), body turns solid black when brine frozen (bottom left photo). (Photo: Fukofuka & Itano, 2007)



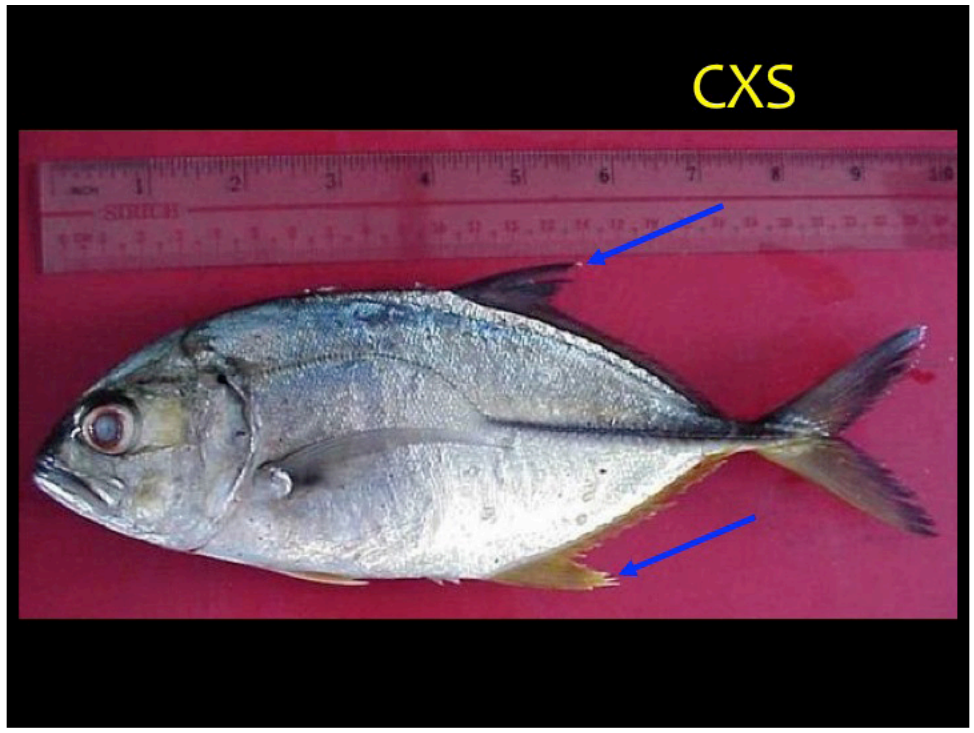
Rainbow Runner (RRU): Long, thin fish with blue and yellow stripes along the body. (Photo: Fukofuka & Itano, 2007)



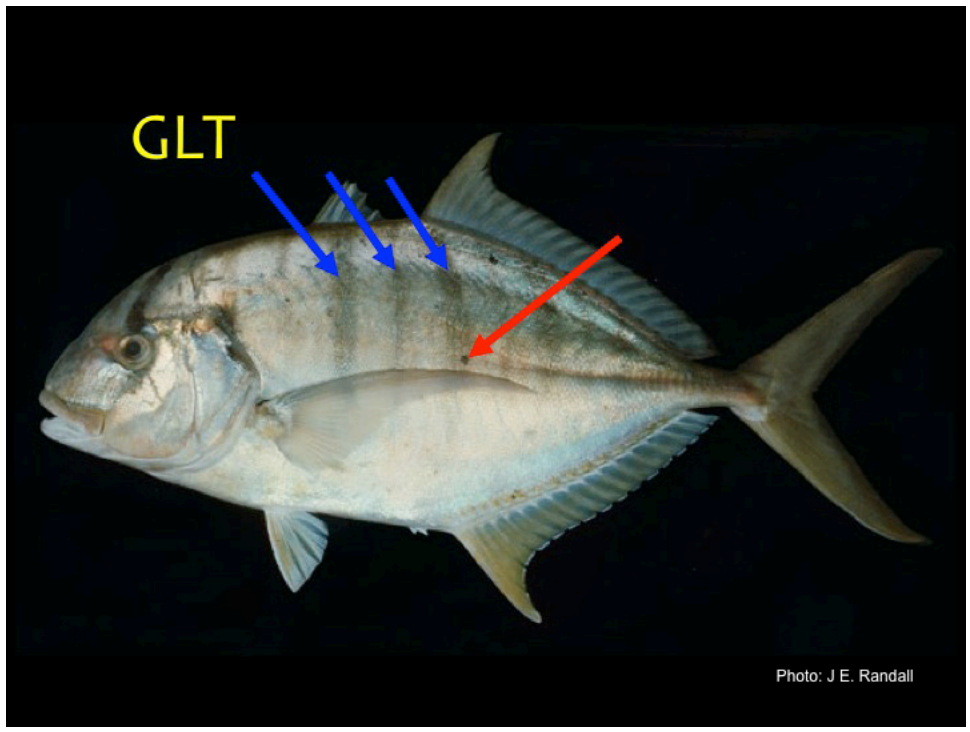
Mackerel Scad (MSD): Skinny shape, metallic black upper body and silver/white lower body, with a black mark on the upper gill flap (arrows) (Photo: Fukofuka & Itano, 2007)



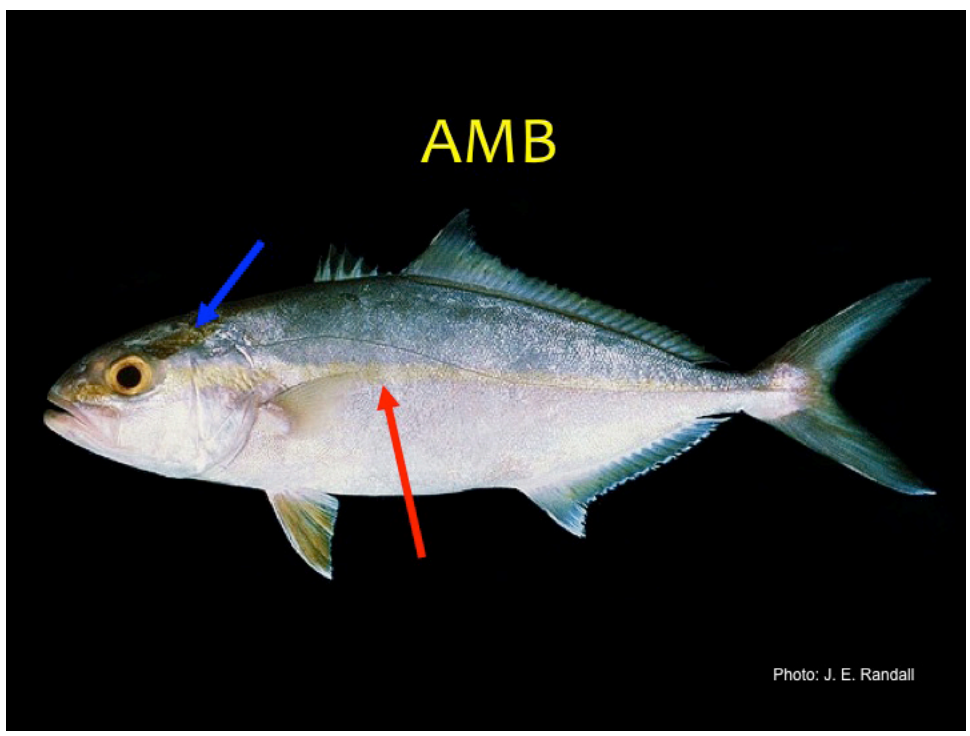
Bigeye Scad (BIS): Long metallic blue-green body, large eyes, black spot on gill flap (arrow) (Photo: Fukofuka & Itano, 2007)



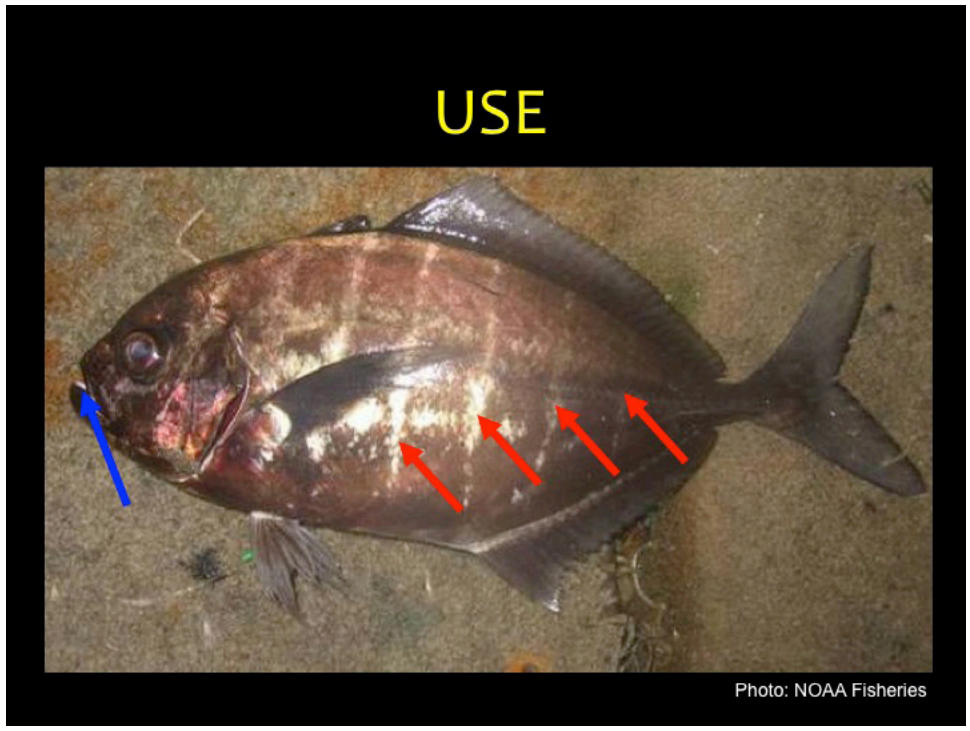
Bigeye Trevally (CXS): Distinct shape with blue/green upper body and silver/white lower body, large eyes, white-tipped dorsal and ventral fins (arrows), yellowish-black caudal fin (Photo: Fukofuka & Itano, 2007)



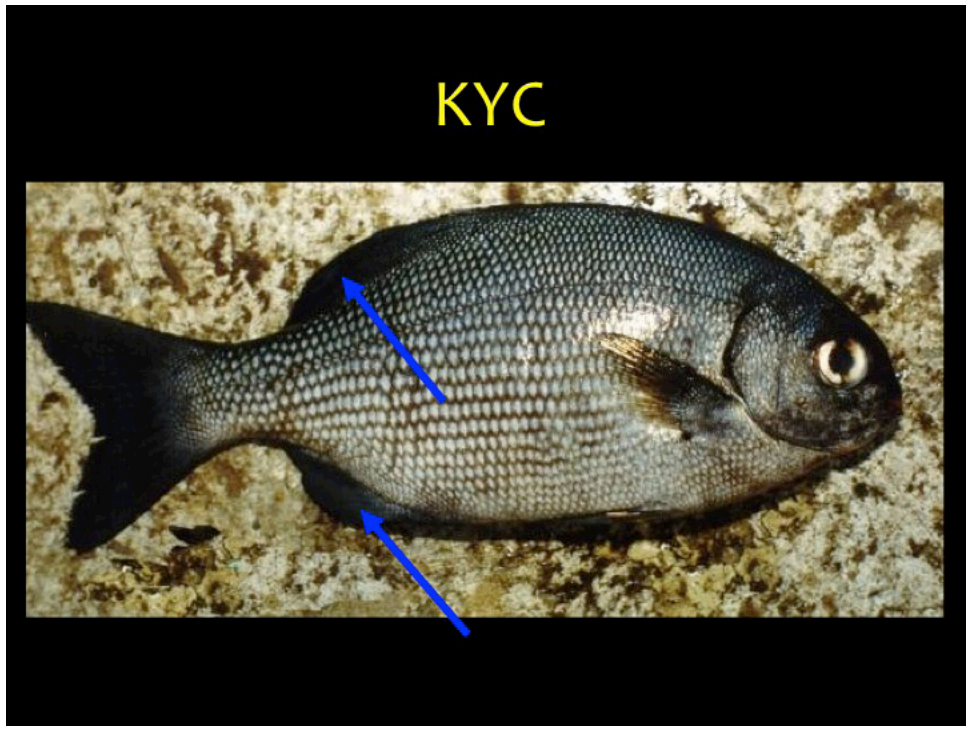
Golden Trevally (GLT): Yellow/silvery body, yellow fins, pattern of broad and narrow black bars (blue arrows), black spots on sides in adults (red arrow) (Photo: J.E. Randall)



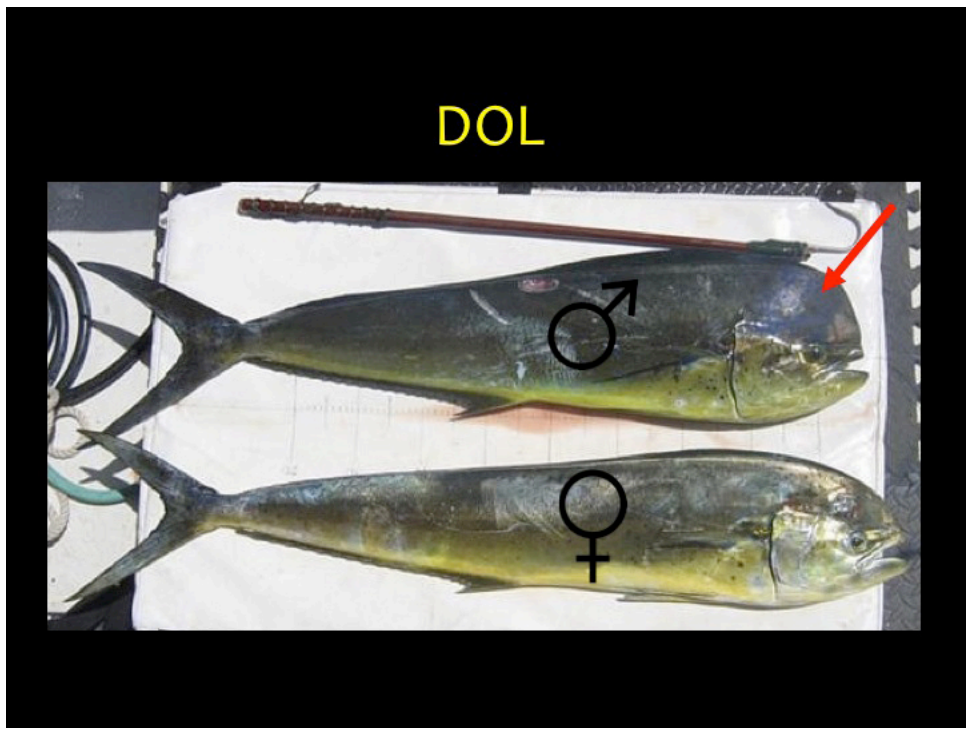
Greater Amberjack (AMB): Green/gray upper body and silver/white lower body, faint stripe along middle side (red arrow), dark strip over the eye (in the young especially, blue arrow) (Photo: J.E. Randall)



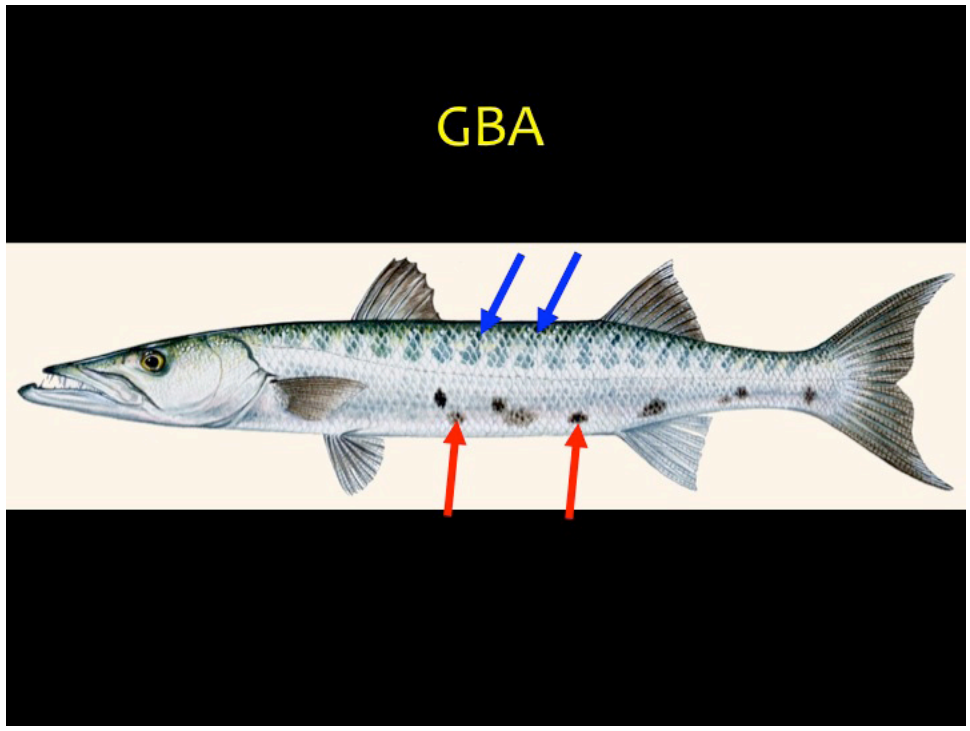
Cottonmouth Jack (USE): Dark gray body with lighter vertical bars (red arrows), dark fins, and the tongue and inside of mouth are pure white (blue arrow) (Photo: NOAA Fisheries)



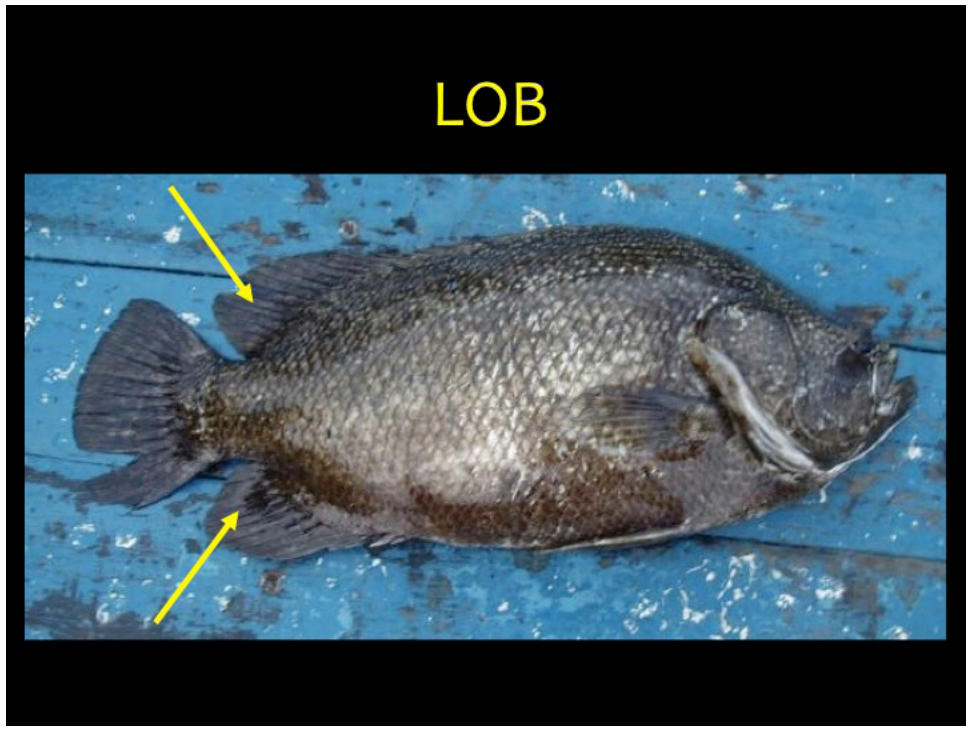
Blue Sea Chub (KYC): Allover dot pattern, dusky fins, elongated dorsal and anal fins (blue arrows). Very common, particularly under FADs and logs (Photo: Fukofuka & Itano, 2007)



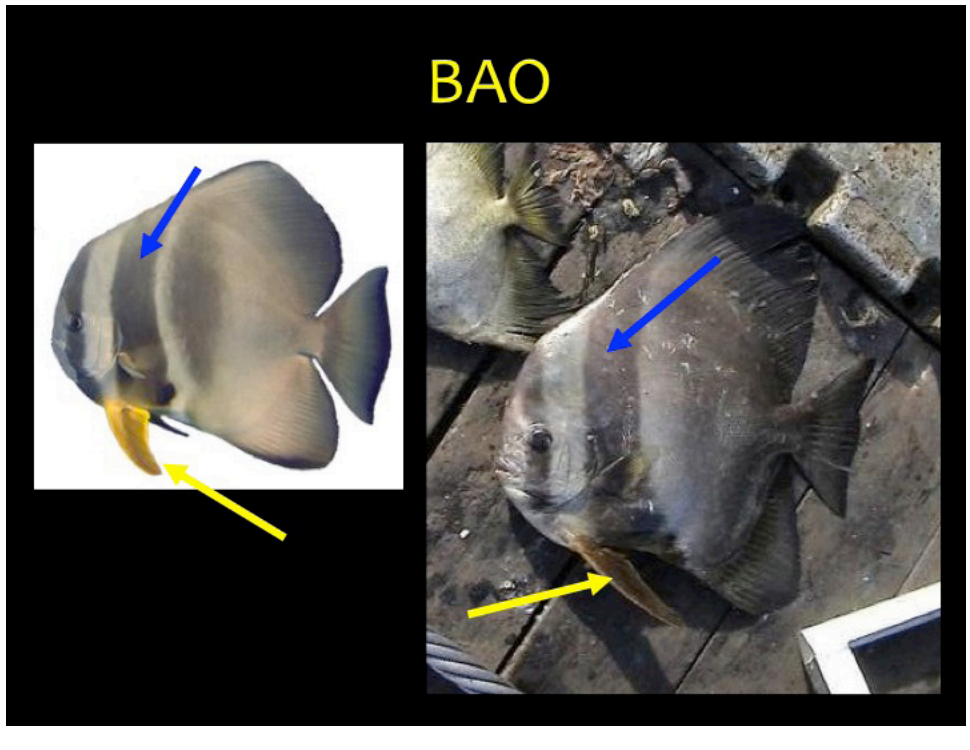
Dolphin Fish/Mahi Mahi (DOL): Distinct body shape, blue-green upper body, yellow lower body, males have a high forehead (red arrow) (Photo: Fukofuka & Itano, 2007)



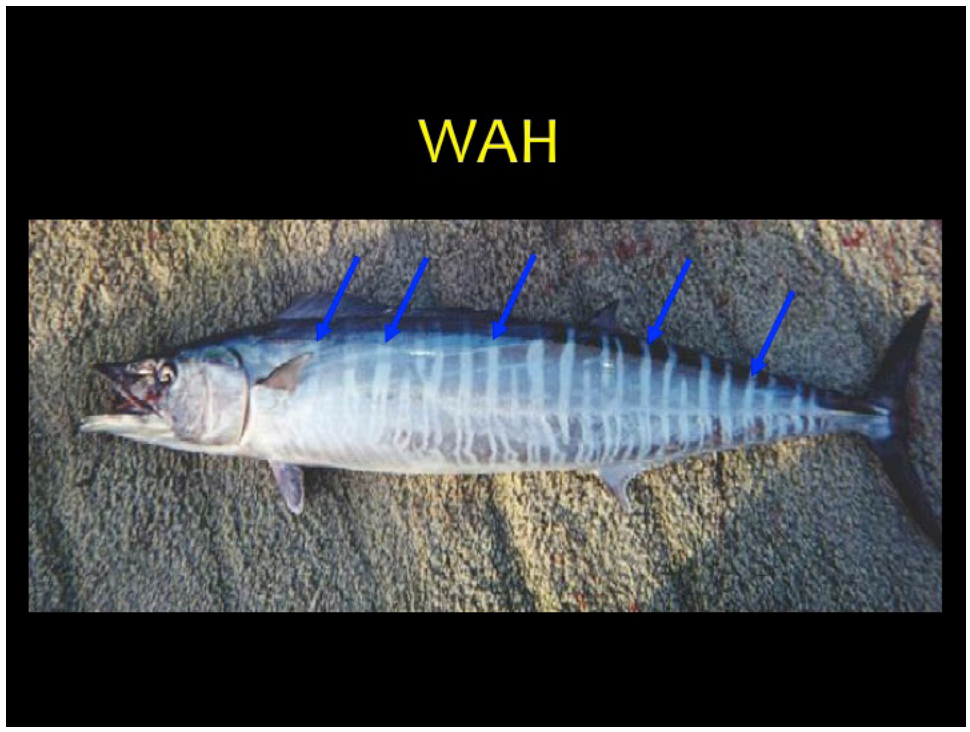
Great Barracuda (GBA): Long, thin fish with short, dark bars on silver sides (blue arrows), irregular dark sport on underside (red arrows), lower jaw sticks out (Photo: Fukofuka & Itano, 2007)



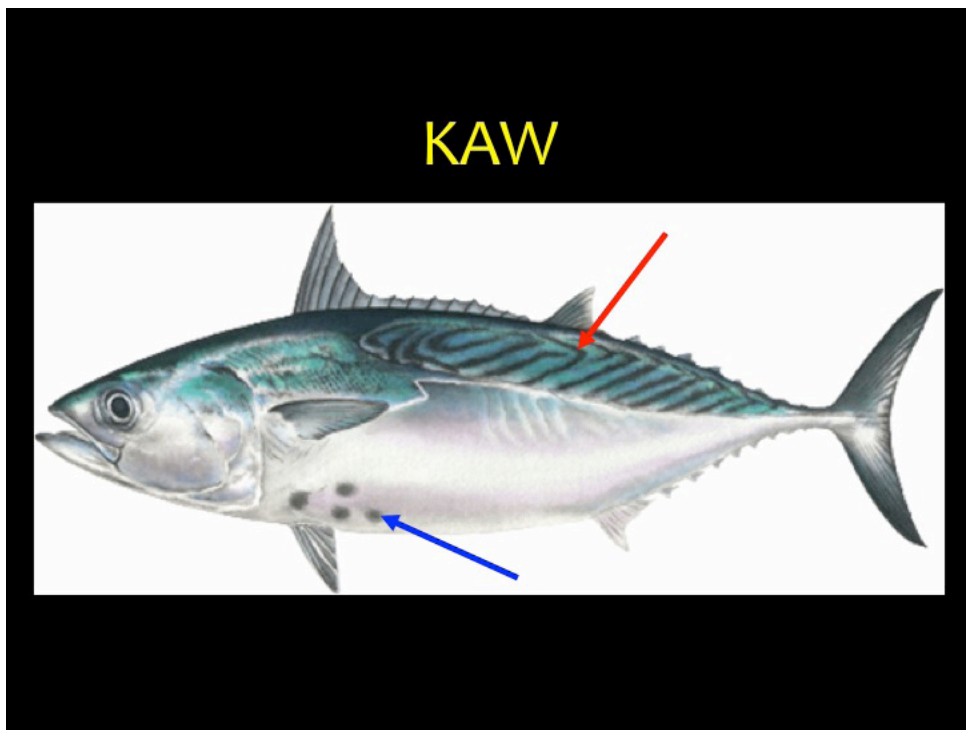
Tripletail (LOB): Dark brown or black upper body with a bronze/gray lower body, small eyes near mouth, extended round dorsal and anal fins (yellow arrows) (Photo: Fukofuka & Itano, 2007)



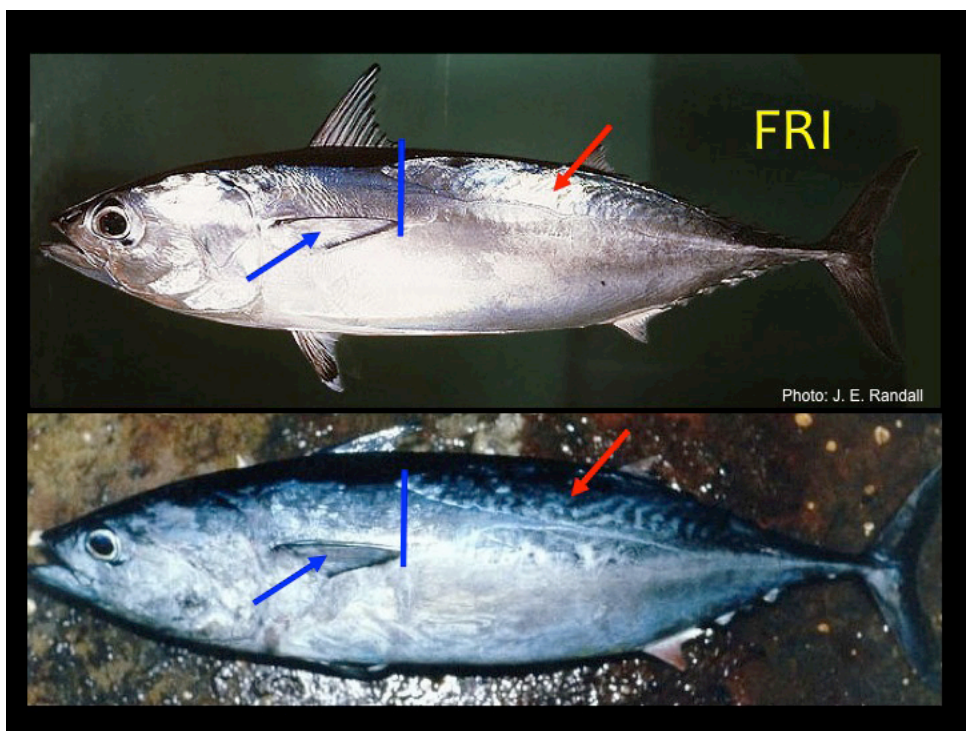
Longfin Batfish (BAO): distinctive shape with black bars (blue arrows) and yellow pelvic fins (yellow arrows) (Photo: Fukofuka & Itano, 2007)



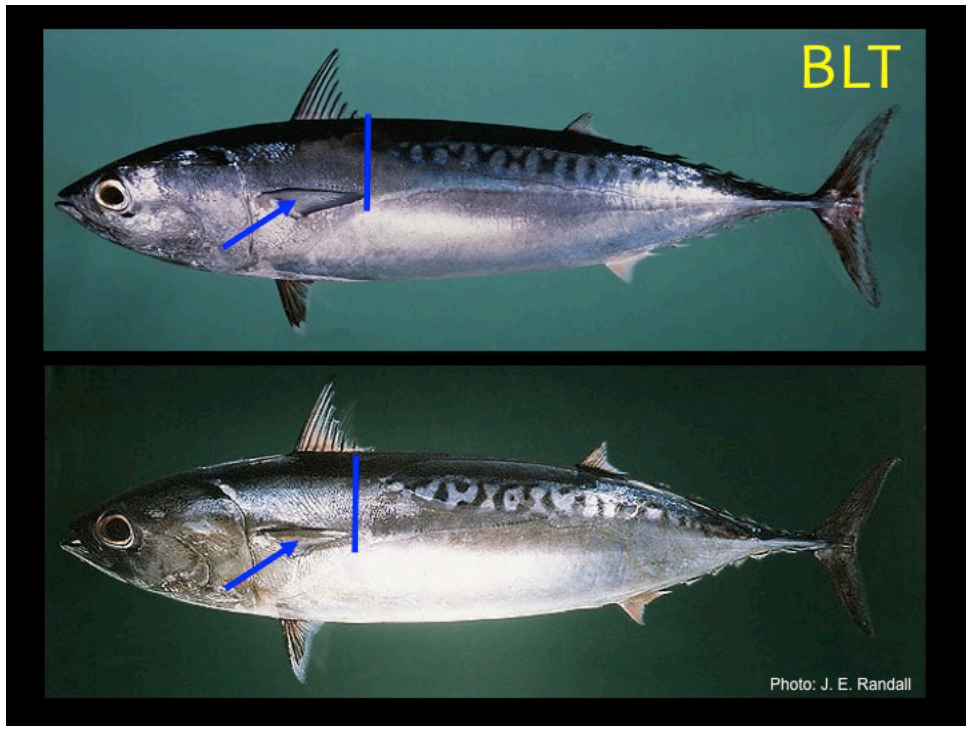
Wahoo (WAH): A long body shape with vertical bars across most of the body (blue arrows) (Photo: Fukofuka & Itano, 2007)



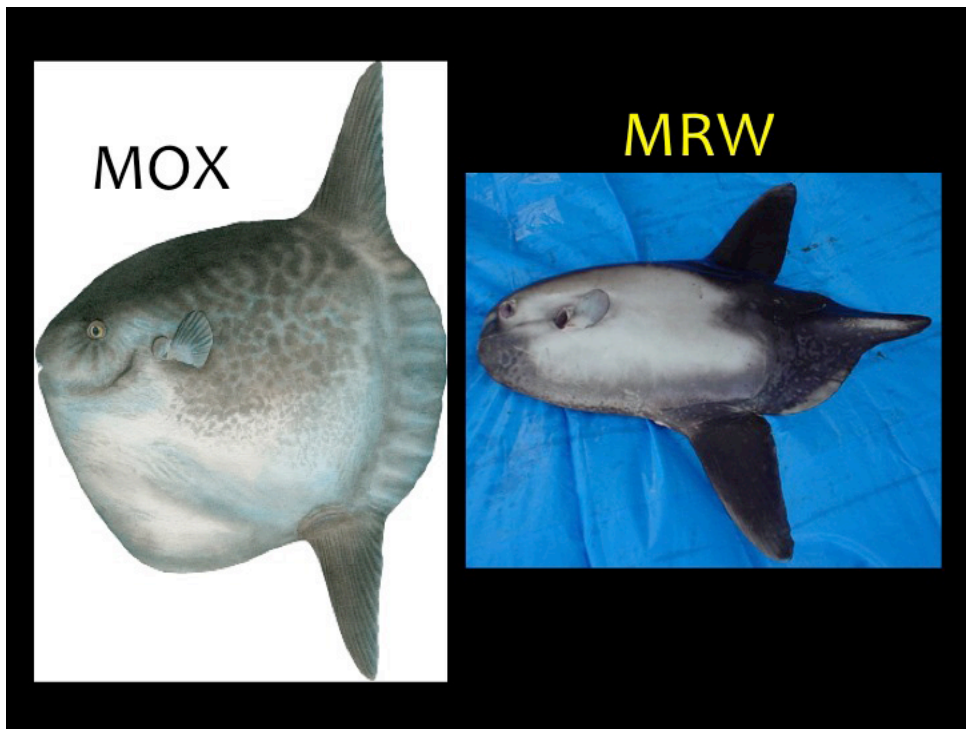
Kawakawa (KAW): The body shape is similar to tuna, however there are characteristic black spots on the belly, close to the pelvic fin (blue arrow), and broken diagonal stripes on its back (red arrow) (Photo: Fukofuka & Itano, 2007)



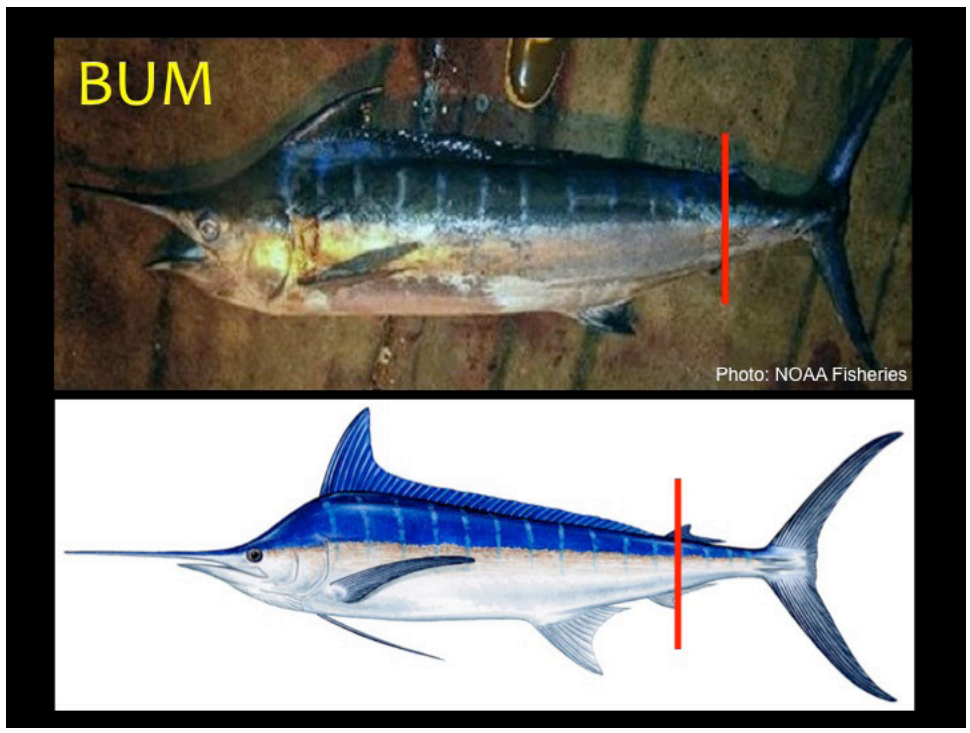
Frigate Tuna (FRI): Scaleless area on the dorsal posterior (top rear) area (red arrow), short pectoral fin that reaches just past the start of the scaleless area (blue bars and arrows) (Photo: J.E. Randall)



Bullet Tuna (BLT): Similar to the frigate tuna, except that the pectoral fin does NOT reach past the start of the scaleless area (Photo: Fukofuka & Itano, 2007)



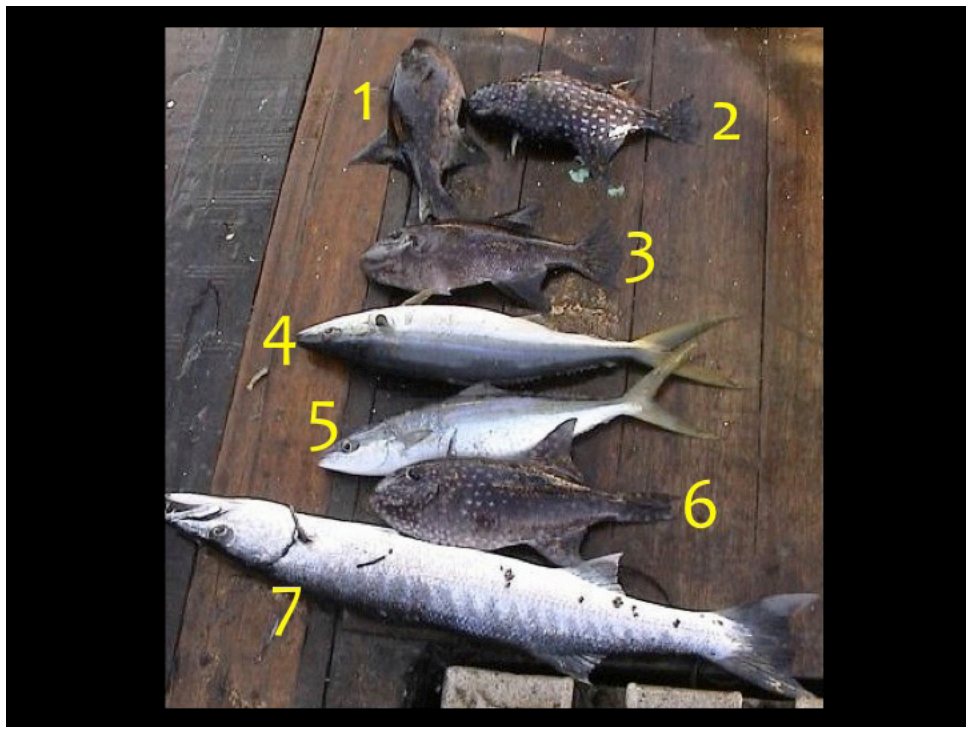
Ocean Sunfish (MOX) and Sharptail Sunfish (MRW). (Photo: Fukofuka & Itano, 2007)



Blue Marlin (BUM): First dorsal fin height is ½ to ¾ of body depth, pectoral fins are nearly straight (not curved), blue-black color on upper half of body with white/silver below, second dorsal fin slightly behind the second anal fin (red bar) (Photo: Fukofuka & Itano, 2007)



Black Marlin (BLM): First dorsal fin height is ½ or less body depth, pectoral fins are curved and stick out from the body, blue-black color on upper half of body with white/silver below, second dorsal fin slightly in front the second anal fin (red bar) (Photo: Fukofuka & Itano, 2007)



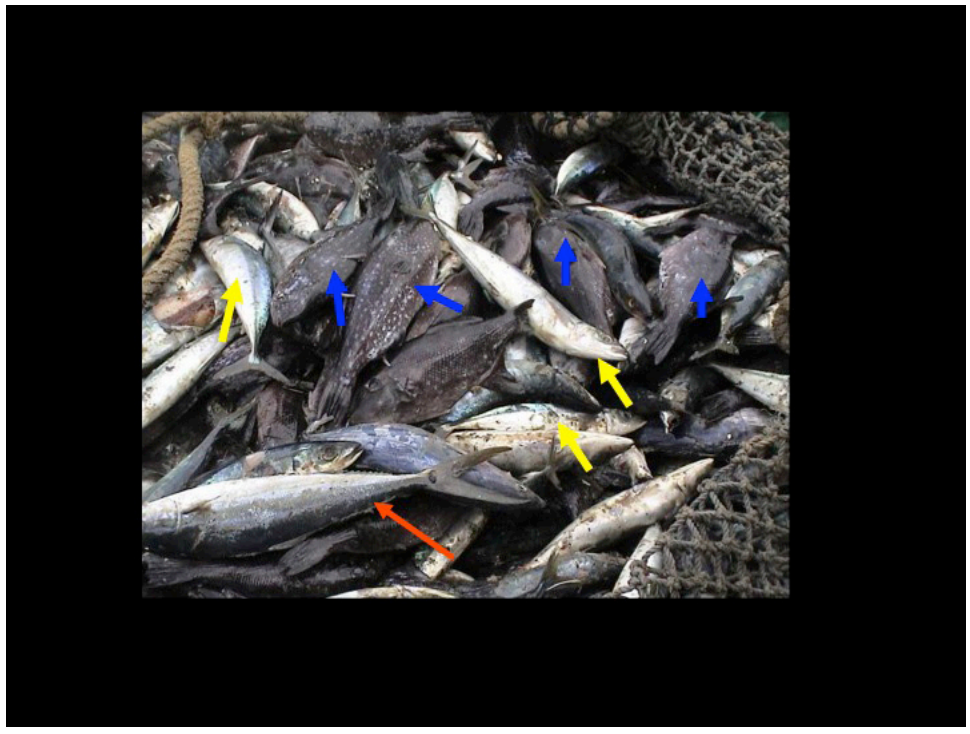
1, 2, 3, 6 = Spotted Oceanic Triggerfish (TRI)
4, 5 = Rainbow Runner (RRU)
7 = Great Barracuda (GBA)
(Photo: Fukofuka & Itano, 2007)



From top: spotted oceanic triggerfish (TRI), mackerel scad (MSD) and blue sea chub (KYC) (Photo: Fukofuka & Itano, 2007)



From top: BLT, FRI, KAW, YFT, BET, SKJ. (Photo: Fukofuka & Itano, 2007)



All frozen specimens:
Mackerel scads (yellow arrow)
Oceanic triggerfish (blue arrow)
Rainbow runner (red arrow)
(Photo: Fukofuka & Itano, 2007)



Mackerel scads (yellow arrow)

Oceanic triggerfish (blue arrow)
Rainbow runner (red arrow)
(Photo: Fukofuka & Itano, 2007)

Sharks and Rays

While not the most common bycatch in tuna purse seine fishing, sharks and rays are the most vulnerable to its effects. Several aspects of their biology make them highly susceptible to overfishing, including:

1. slow growth rates,
2. late maturation,
3. long pregnancies,
4. low fertility, and
5. long life spans.

Contrary to the belief that sharks (and to a lesser extent rays) are hardy and that they can sustain rough handling or extensive exposure and still survive when returned to the sea, initial studies suggest a survivability rate of only 50 percent, even if they appear healthy upon release, most probably due to severe stress and/or injury sustained during the fishing and handling process.

This high mortality rate is surely influenced by a number of biological "weaknesses" in sharks and rays. Unlike other fish, these animals do not have a hard skeleton of bone to protect their internal organs. When out of water, the tissue that holds organs in place can tear and the weight of gravity can result in crushed or damaged organs. This same connective tissue holds the spinal cord and vertebrae in place, and for this reason, animals handled from the head or tail can suffer irreversible damage as a result. A shark's head also holds a number of sensitive and fragile organs used to detect prey, and if handling damages these, then the shark – once released—could be unable to locate prey and starve.

So for these reasons, it is important that an observer can quickly identify the animal's species and ensure its rapid—and safe—return to the sea. The following galleries will review the most common shark and ray species encountered, and methods used by crews for their handling and release.

Commonly Encountered Sharks and Rays

Though the species of sharks that are encountered during tuna purse seine fishing can depend on your location and the time of year, here we describe some of the most commonly seen sharks and rays.

Silky Shark: A smooth brownish body, with a white underside. The pectoral (side) fins are much closer to the head than the dorsal (top) fin, which has a spine at its base. A ridge runs from the dorsal fin to the tail. The underside of the otherwise white pectoral fins has a dark gray tip.

Oceanic Whitetip Shark: Large and rounded dorsal (top) and pectoral (side) fins that are white at the tips. It can have black marks on the ends of its other fins. Its head looks flattened, with a rounded snout. The body is mostly brown with a white underbelly.

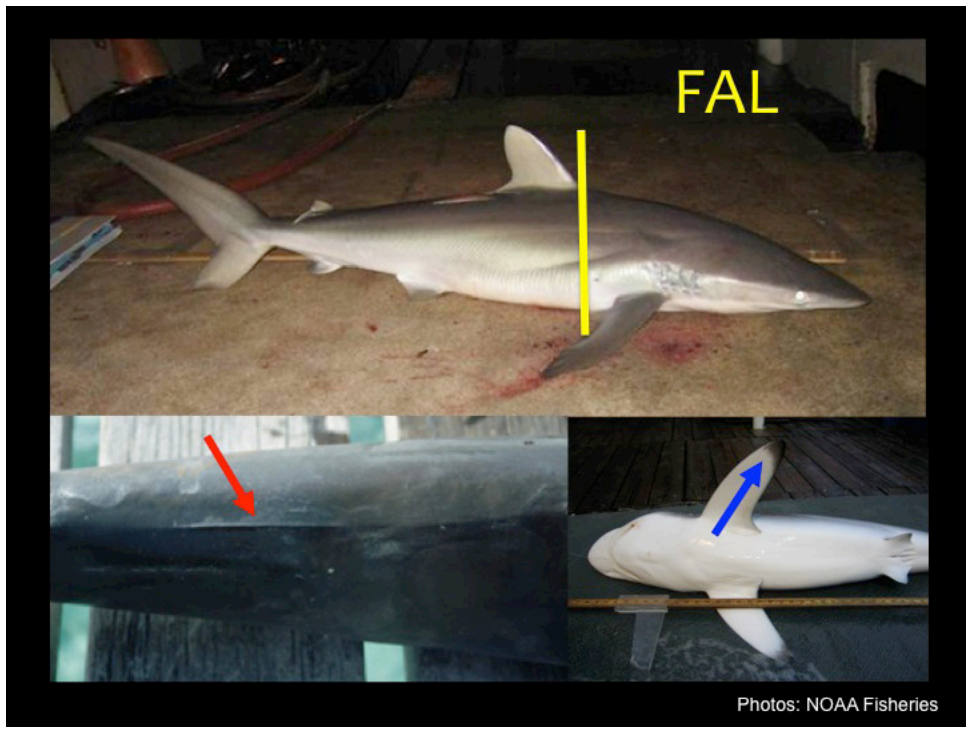
Shortfin Mako Shark: A pointed, cone-shaped snout with long gill slits behind the head. The teeth are long and exposed, without serrations. The body is a dark, deep blue on the back, with a white belly. The pectoral fins are shorter than the head is long. There is also a longfin mako, and its pectoral fins are as long or longer than the length of its head.

Whale Shark: The world's largest fish (generally 4–12 m long) is a filter feeder with a broad, flat head, and a unique color pattern of light spots and vertical and horizontal stripes. Schools of tuna can congregate around a whale shark (i.e., the animal acts as a FAD), however deliberate setting around a whale shark is forbidden by a number of RFMOs and national governments.

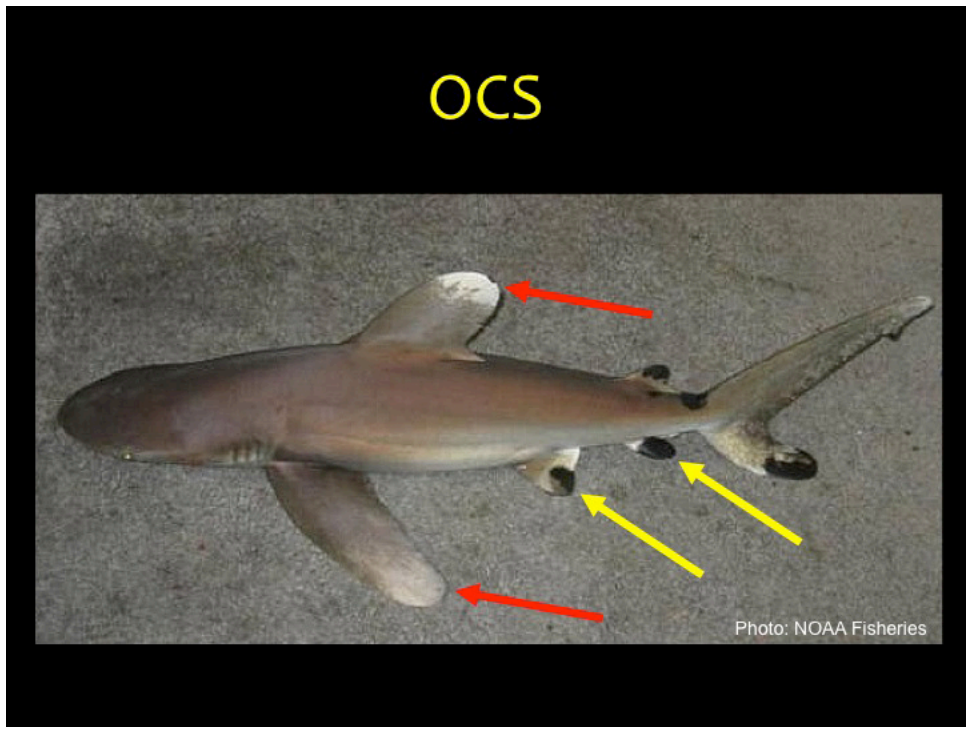
Giant Manta Ray: A very large body (up to 9 m across) with broad head and projections on either side of mouth. The animal is near-black to black on top and whitish on the underside, with a short and thin tail, which may lack a spine depending on the species.

Pelagic Sting Ray: A wedge-shaped body much wider than it is long, with non-protruding eyes and dark purple coloration. The animal should be handled with caution due to its robust spine located on its tail. They generally grow to about 60 cm across.

Gallery 4.2: Shark and Ray Identification



Silky Shark (FAL): Narrow, pointed snout with dorsal fin beginning behind pectoral fin (yellow bar), low ridge running between dorsal fins (red arrow), and black marks on the underside of the pectoral fins (blue arrow). Silky sharks are the most commonly encountered shark in tuna purse seine fishing. (Photo: NOAA Fisheries)

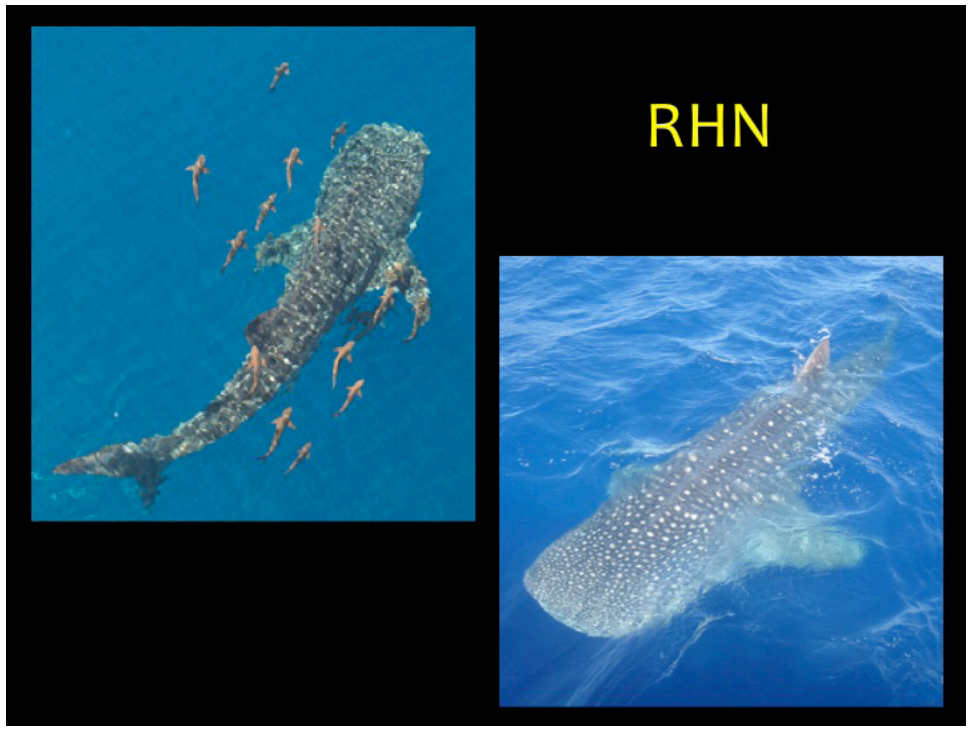


Oceanic Whitetip Shark (OCS): large rounded first dorsal and pectoral fins with white or mottled tips (red arrows), flattened head and curved snout, small fins may have black tips (yellow arrows). (Photo: NOAA Fisheries)

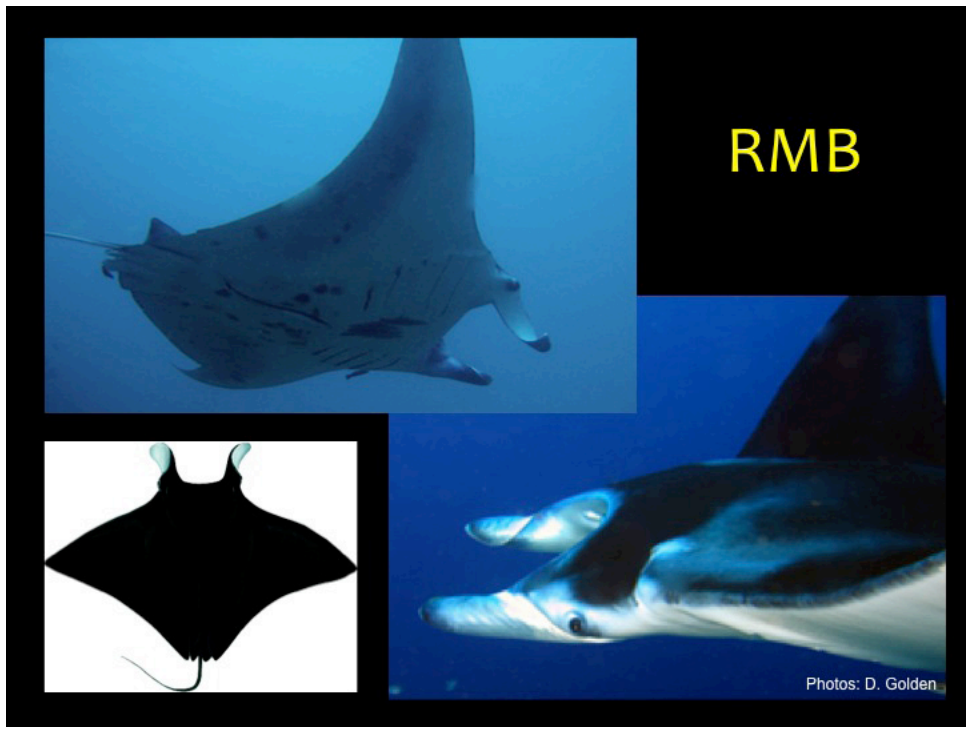


Shortfin Mako Shark (SMA): A pointed, cone-shaped snout, long gill slits behind the head, long and exposed teeth, and a dark, deep blue back, with a white belly (Photo: Jeremy

Stafford-Deitsch_IUCN)



Whale Shark (RHN): The world's largest fish (generally 4–12 m long), a filter feeder with a broad, flat head, and a unique color pattern of light spots and vertical and horizontal stripes



Giant Manta Ray (RMB): Very large body (up to 9 m across) with broad head and projections on either side of the mouth, near-black to black on top and whitish on the underside, short and thin tail usually without a spine (Photo: D. Golden)



Pelagic Stingray (PLS): A wedge-shaped body much wider than it is long, non-protruding eyes, dark purple coloration, and a robust spine (red arrows) (Photo: NOAA Fisheries)

Shark and Ray Handling and Release

Sometimes sharks will spin and roll themselves in the net, though they can otherwise still be in good condition. As the net is reeled in, the crew should look ahead to try to spot **entangled sharks** as early as possible. If a shark is lifted up in the net toward the power block, this becomes a dangerous situation for both the shark and the crew. If an entangled shark is seen, the crew should reduce the speed of the net reel (thus reducing tension in the net), and then attempt to carefully remove the animal, using knives or clippers if necessary to cut the net.

Observer programs should have a clear specific policy regarding the handling of bycatch, particularly for those species that can pose a danger to the integrity of an observer. Some general guidance is given in the following paragraphs. **Note that handling of the catch and bycatch is the responsibility of the crew and not the observer. Nevertheless, it is a good idea for the observer to understand the handling techniques used by the crew.**

There are three good ways to handle a **small shark**:

1. One hand on the dorsal (top) fin and the other holding the body from below
2. Both hands holding the body
3. One hand on the pectoral (side) fin and the other holding the tail

To release the shark, the crew should point the head down toward the water and then drop it in.

For a **medium-sized shark**, one or two people should hold the dorsal and pectoral fins, with the other person holding the tail. To release the animal, the crew should drop (not throw) the shark over the side.

Because a **stingray**'s spine is located at the base of its tail, it is best to avoid the rear of the animal and grasp it near the head. The sting is not very harmful, though it is painful.

For **large sharks, rays, and other large fish** (e.g., moonfish), the crew can attempt to release them directly from the brailer, if feasible, by tipping one edge of it into the ocean. Alternatively, the animal can be returned to the sea using a piece of net, plastic tarp, or canvas that can be lifted by the vessel's crane. The material should be ready on deck before brailing, and when a large animal is encountered, it can be placed on the material, which is then hooked up to the crane and lifted over board.

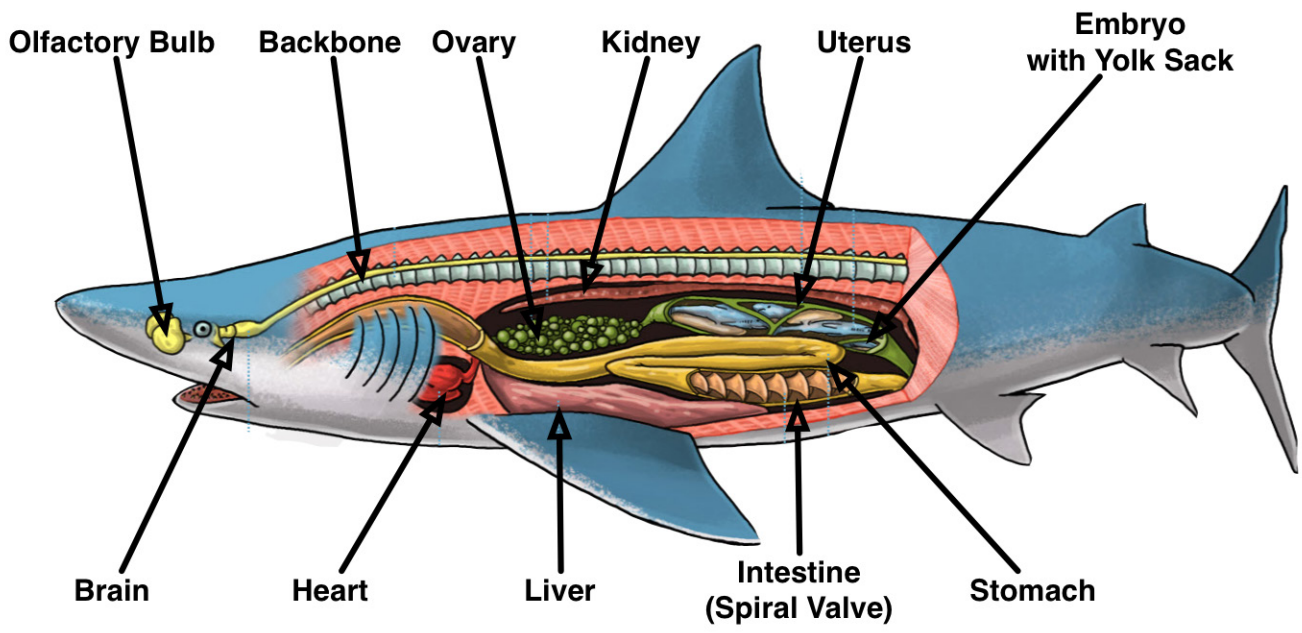
The release of encircled **whale sharks** is required by regulation in most regions, however caution must be taken by the crew to ensure that the animal is not further harmed during the release process. As illustrated in the gallery, there are two safe release methods and their application depends on the position of the whale and tunas in the net. If the whale shark is at the surface and separated from the tunas, the animal can tear the net (or a crew member can cut a few meters of net in front of the animal's head), and then swim freely out of the net. An alternative technique requires the crew in charge of the net hauling operation to use the winch and the capstan to bring the whale shark close to the hull, onto the floatline, and then roll it outside the sack. In this case, a rope placed under the animal and attached to the floatline could help roll the whale shark out of the net. **At no time should the animal be pulled by the tail**, towed by a speedboat, or hauled up with the vessel's crane because this can cause severe injury to the animal.

The two most important things to remember about shark and ray handling by the crew are:

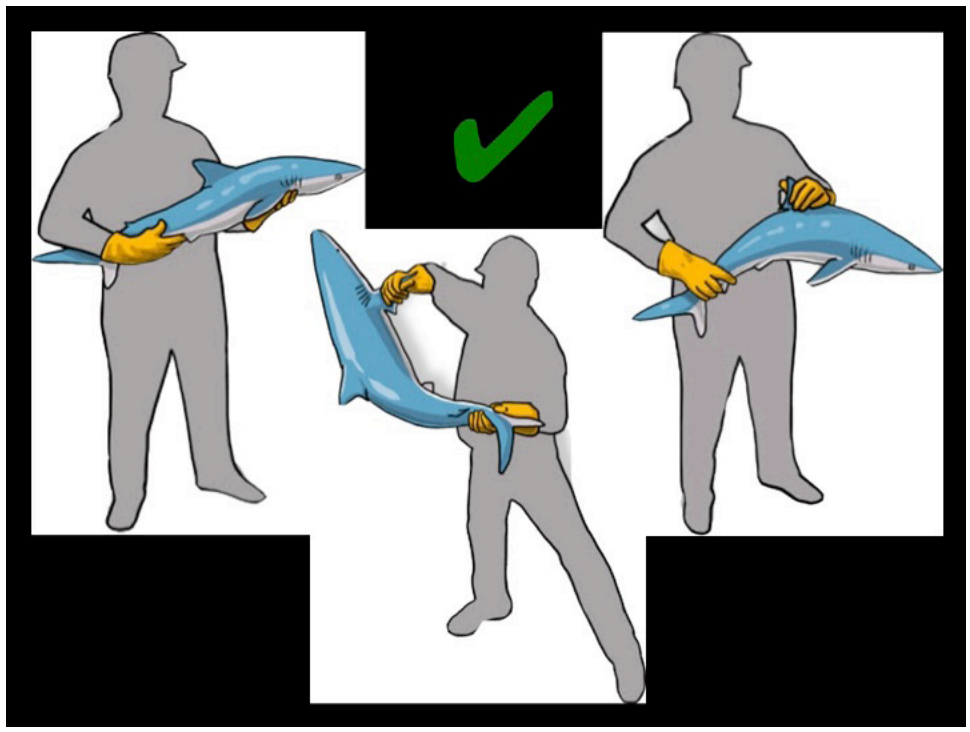
1. Personal safety comes first, and
2. Proper handling combined with a speedy release dramatically improves the likelihood of the animal's survival.

ISSF endeavors to share this same information with the vessel's skipper in the hope that his crew is prepared for safe handling PRIOR to net hauling—this includes instructing them on correct handling techniques ahead of time, and ensuring they have the right tools at hand on deck.

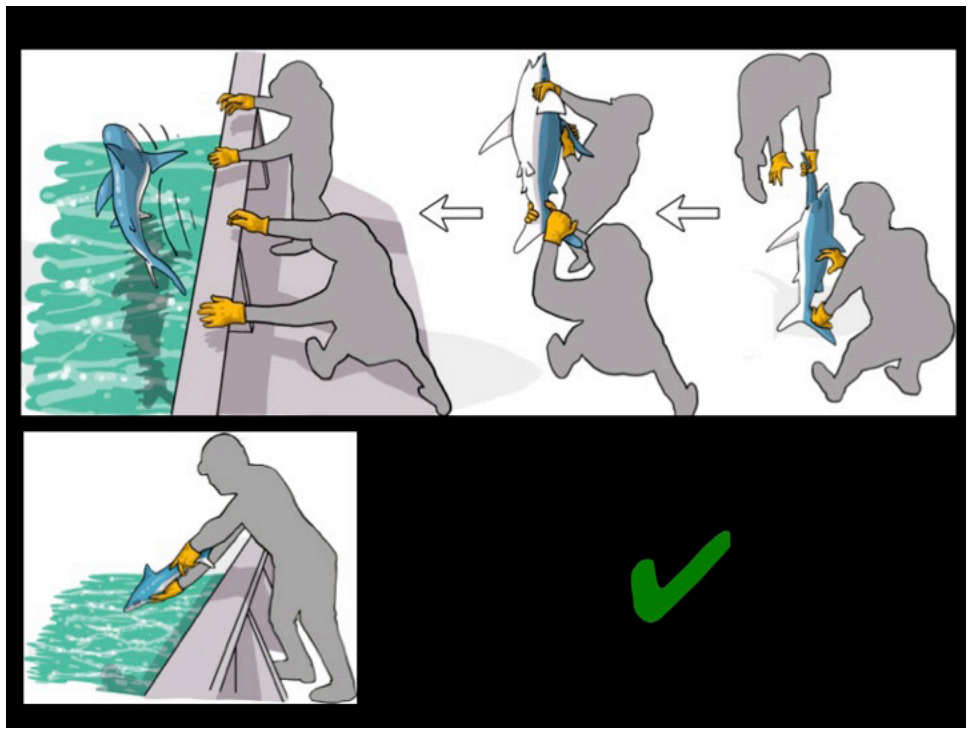
Gallery 4.3: Shark and Ray Handling and Release



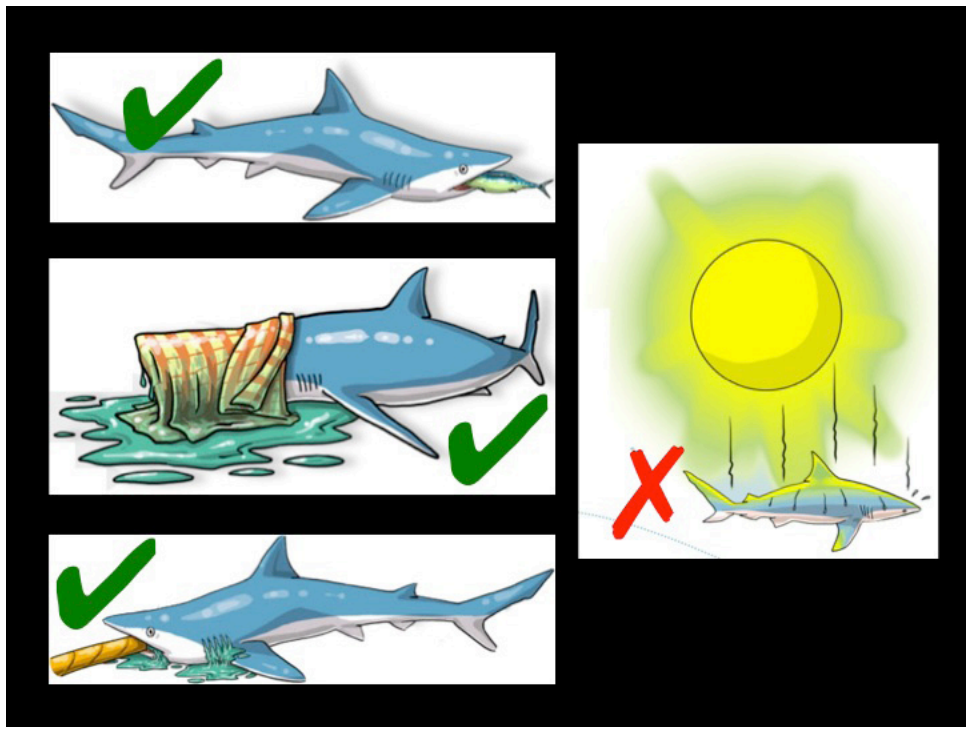
Shark anatomy



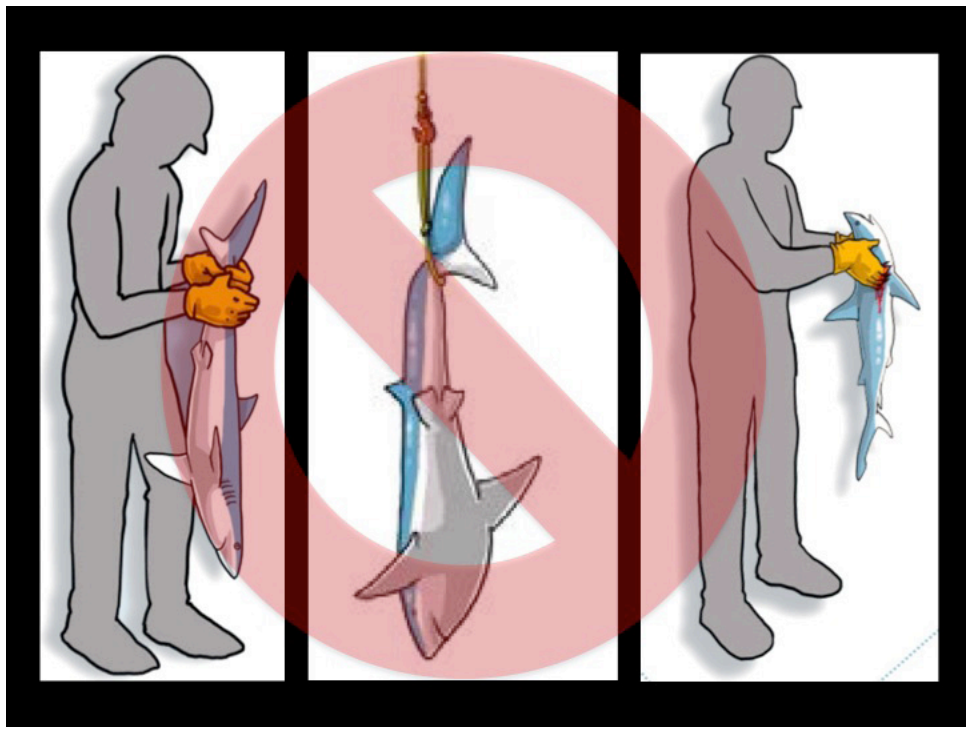
Proper handling positions for small sharks (Photo: Poisson et al 2012)



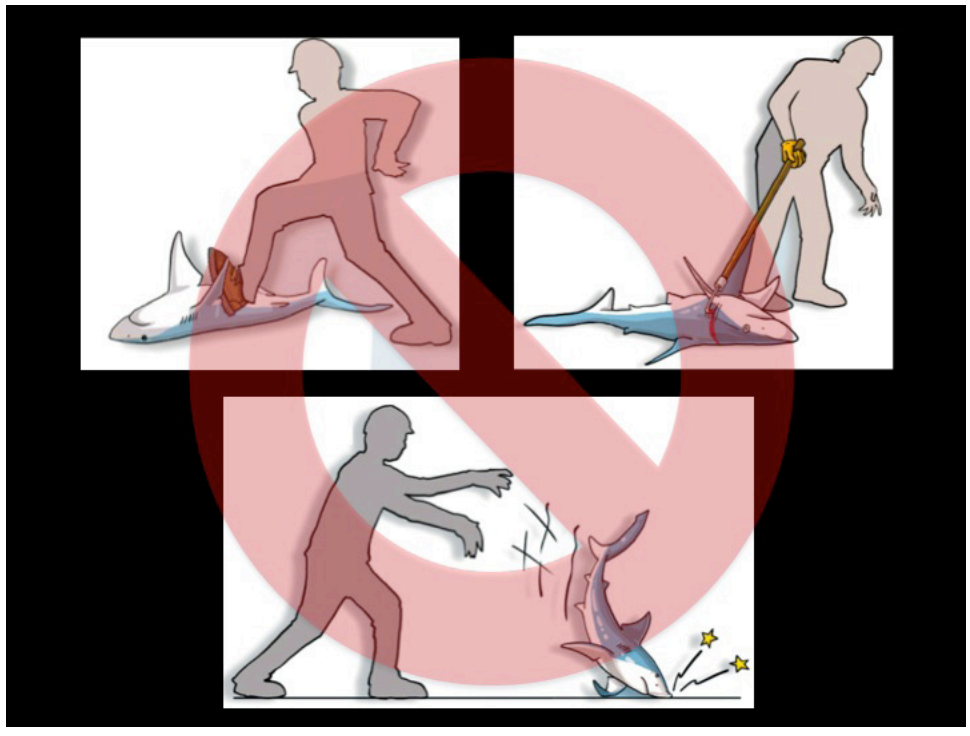
Proper and handling of medium-sized sharks, and correct release positions (Photo: Poisson et al 2012)



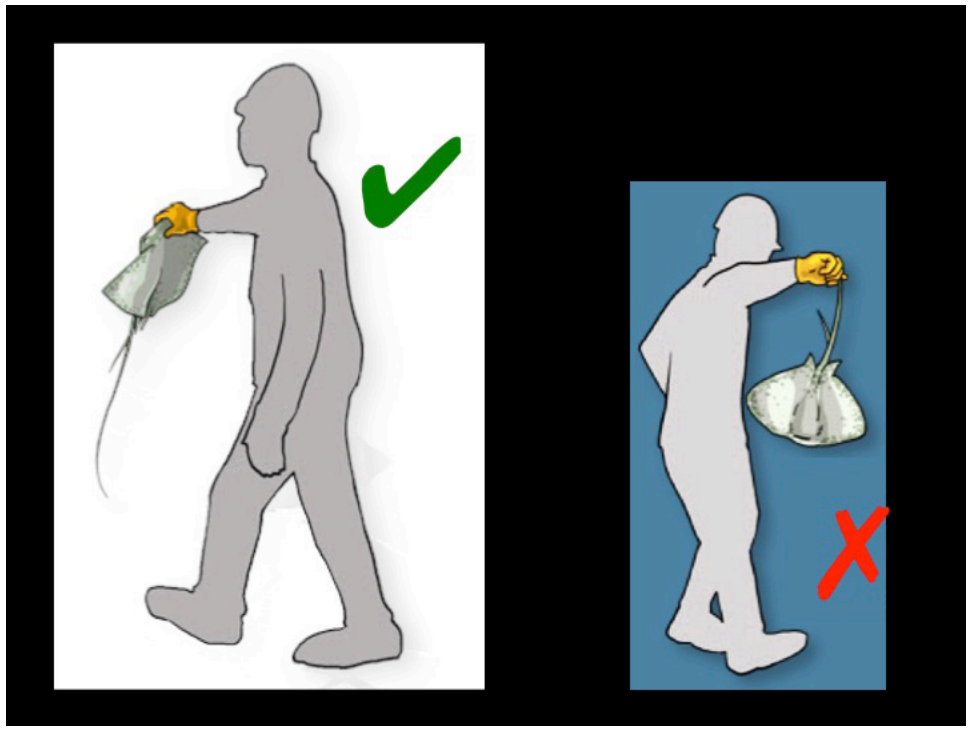
For a shark that cannot be released immediately, keep it cool (out of the sun, with a wet towel draped lightly over its head), and with a fish in its mouth to prevent bites or a hose to allow it to breathe (Photo: Poisson et al 2012)



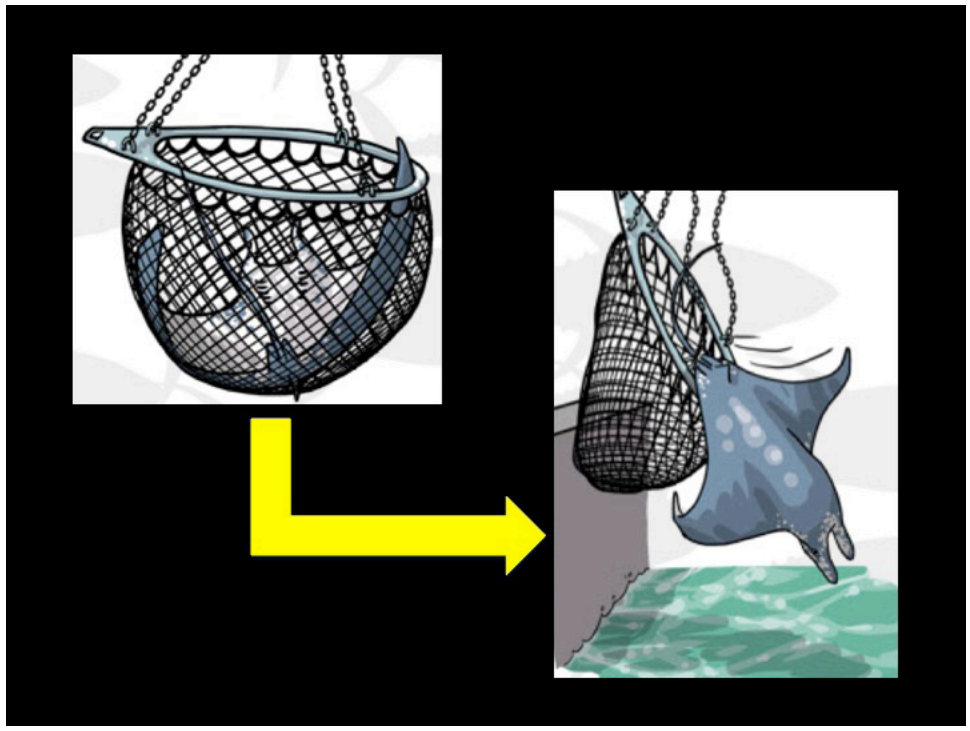
Do NOT hold a shark by its tail, or from its gills (Photo: Poisson et al 2012)



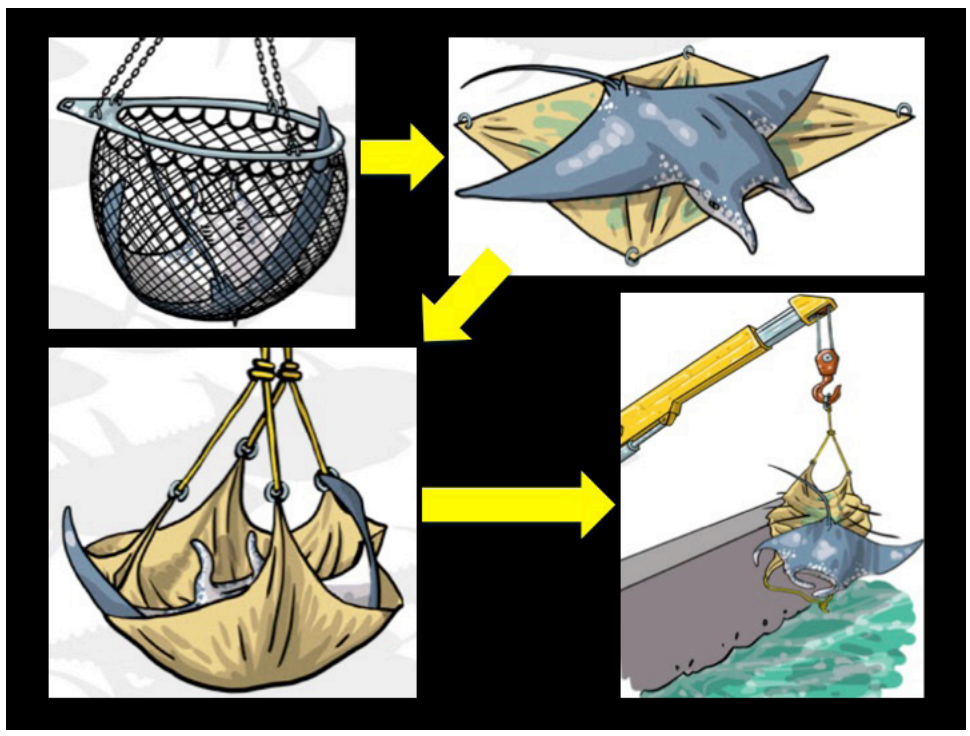
Do NOT step on a shark, handle it with a gaff or other sharp object, or throw it on the ground, as all of these actions can severely damage its internal organs (Photo: Poisson et al 2012)



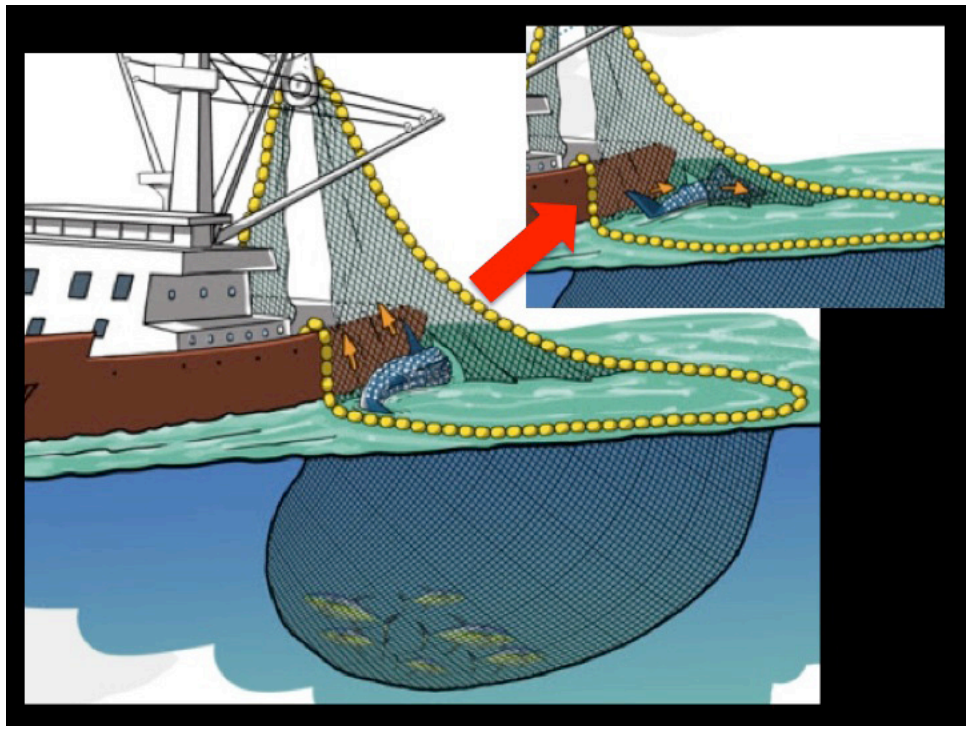
When handling a sting ray, hold it by its body and away from your body to avoid injury from its spine. Do NOT carry it by its tail. These instructions also apply to small manta rays, which can be safely carried with a person holding each wing. (Photo: Poisson et al 2012)



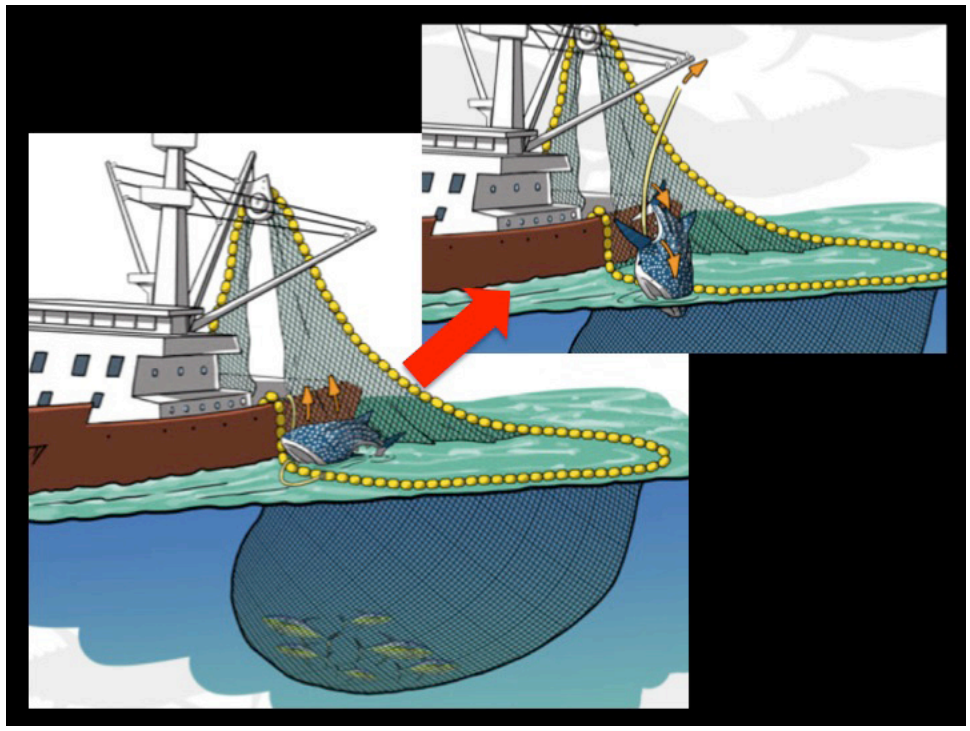
Manta rays can be released directly from the brailer. (Photo: Poisson et al 2012)



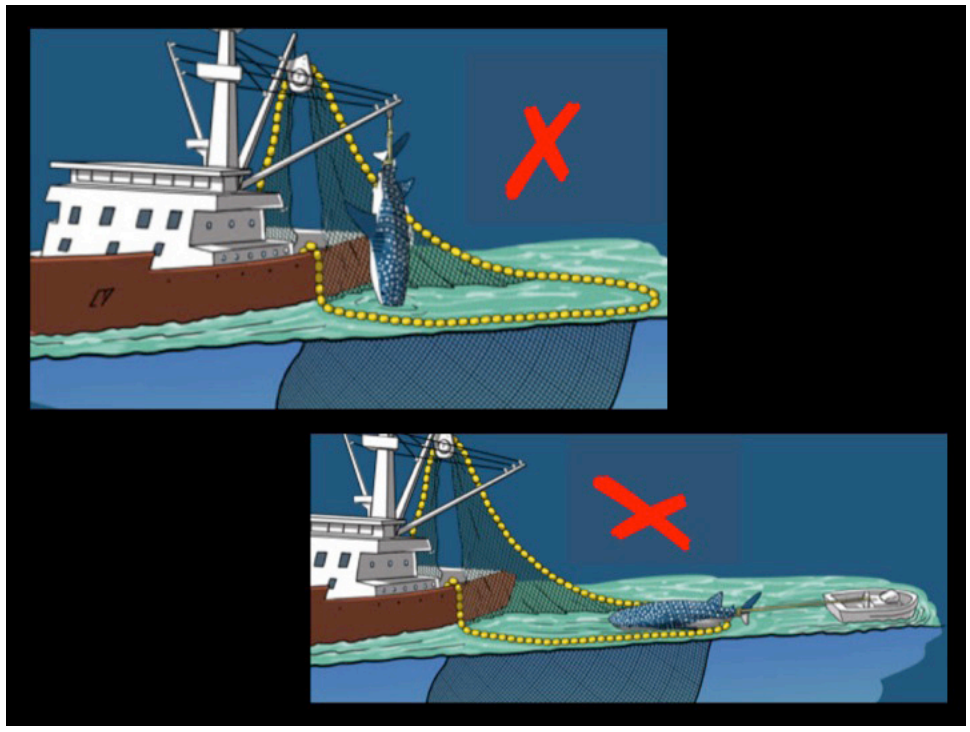
Alternatively, the manta ray can be brailed onto a tarp on deck that is then lifted by the crane and released over the side. (Photo: Poisson et al 2012)



If the whale shark is at the surface and separated from the tunas, the animal can tear the net (or a crew member can cut a few meters of net in front of the animal's head), and then swim freely out of the net. (Photo: Poisson et al 2012)



An alternative technique requires the crew in charge of the net hauling operation to use the winch and the capstan to bring the whale shark close to the hull, onto the floatline, and then roll it outside the bunt. In this case, a rope placed under the animal and attached to the floatline could help roll the whale shark out of the net. (Photo: Poisson et al 2012)



A whale shark should NEVER be pulled by its tail. (Photo: Poisson et al 2012)

Sea Turtles

Sea turtles can occasionally be found entangled in the nets of FADs or associated with the tuna school in the bunt.

All sea turtles are protected internationally, as these long-lived animals face a number of environmental challenges (breeding ground destruction, boat collisions, ingestion of marine debris, disease linked to ocean pollution), including interactions with fishers. There are seven species of sea turtle, with five commonly encountered during tuna fishing.

Commonly Encountered Sea Turtles

Each species of sea turtle has a few distinguishing features that will help you identify it. Different species have different numbers of prefrontal scales—the small, paired scale found behind a turtle's nostrils and between its eyes. A turtle's top shell (or carapace) can also have a different number of plates (or scutes) arranged in a unique pattern.

Leatherback turtles are the easiest to identify, as they are the only sea turtle that does not have a hard shell. The shell is black with white spotting, and has 5 to 7 ridges that run down its back. They can grow quite large – up to 1.8 m (6 ft) long and 680 kg (1,500 lbs).

The **loggerhead** turtle has a wide, blocklike head, and four prefrontal scales (two pairs) between its eyes. Its top shell has 5 central plates going down its back, with 5 lateral plates on each side. They tend to be found in more temperate (subtropical) waters.

Olive ridley turtles are the smallest and one of the most commonly encountered sea turtles in pelagic, deep-set tuna longline fisheries. Its shell is gray-green, with 5 central plates, and 5 to 9 pairs of lateral plates (the other turtles will never have more than 5). They are more common in tropical waters.

The **hawksbill** turtle is the most endangered species of sea turtle. It has a sharp, hawklike beak. This is the only turtle whose plates on its top shell overlap, like shingles on a roof. There are 5 central plates, and 4 side pairs.

Green sea turtles have just two prefrontal scales between their eyes, unlike the other turtles that have 4 or 5. Despite their name, green sea turtles' smooth oval shells are a mix of colors (brown and yellow-green in younger individuals, and darker green in adults). They have 4 lateral plates on their shell. They are usually found in warmer waters.

Gallery 4.4: Sea Turtle Identification



Leatherback Turtle (DKK): The only sea turtle with a soft shell, which is black with white spotting, and has five to seven ridges that run down its back



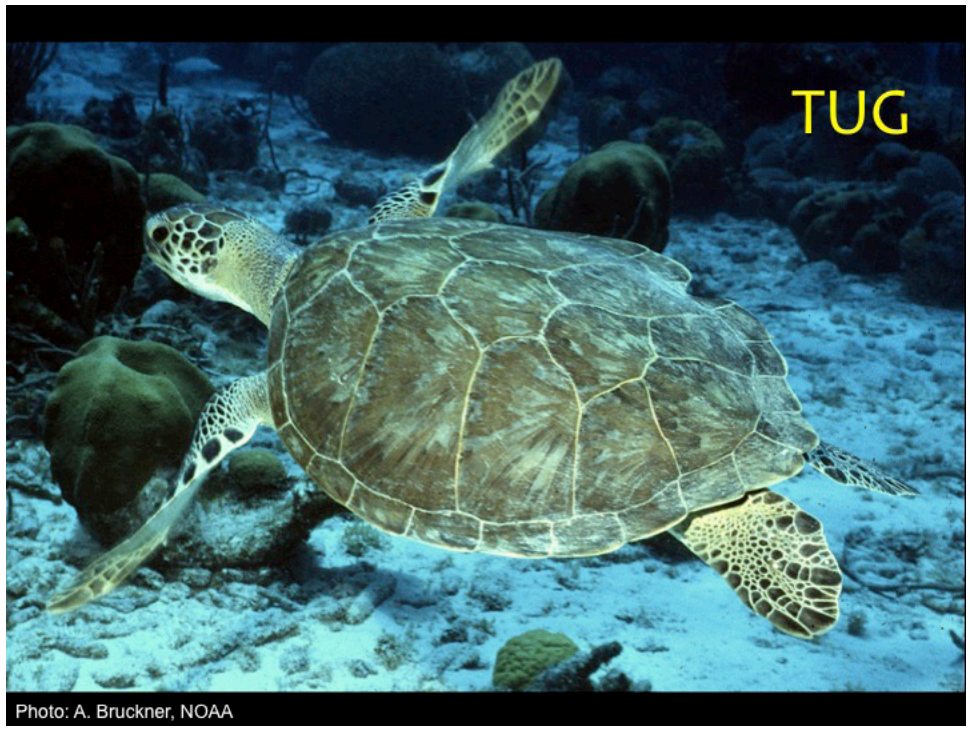
Loggerhead (TTL): A wide, blocklike head, four prefrontal scales (two pairs) between its eyes, with five central plates going down its back and five lateral plates on each side (Photo: NOAA Fisheries)



Olive Ridley Turtle (LKV): A small species with a gray-green shell, with five central plates, and five to nine pairs of lateral plates (the other turtles will never have more than five)



Hawksbill (TTH): A sharp, hawklike beak, and the only turtle whose plates on its top shell overlap, like shingles on a roof (Photo: C. Rogers, USGS)



Green Turtle (TUG): Just two prefrontal scales between the eyes (unlike the other turtles with four or five), and a smooth oval shells that is brown and yellow-green in younger individuals, and darker green in adults (Photo: A. Bruckner, NOAA)

Sea Turtle Handling and Release

The current, and best, practice for crew to avoid turtle mortality once entangled in a purse seine net is the use of speedboats or an inflatable raft to release the turtles unharmed from the net before passing through the power block. The best time for this action is when the entangled turtle and net leaves the water on the way to the power block (at this point, the hauling should be paused). If necessary, knives or clippers can be used to cut the net. **Disentanglement at the earliest possible stage maximizes survival.** Speedboats or rafts can also be used to remove any free-swimming encircled turtles.

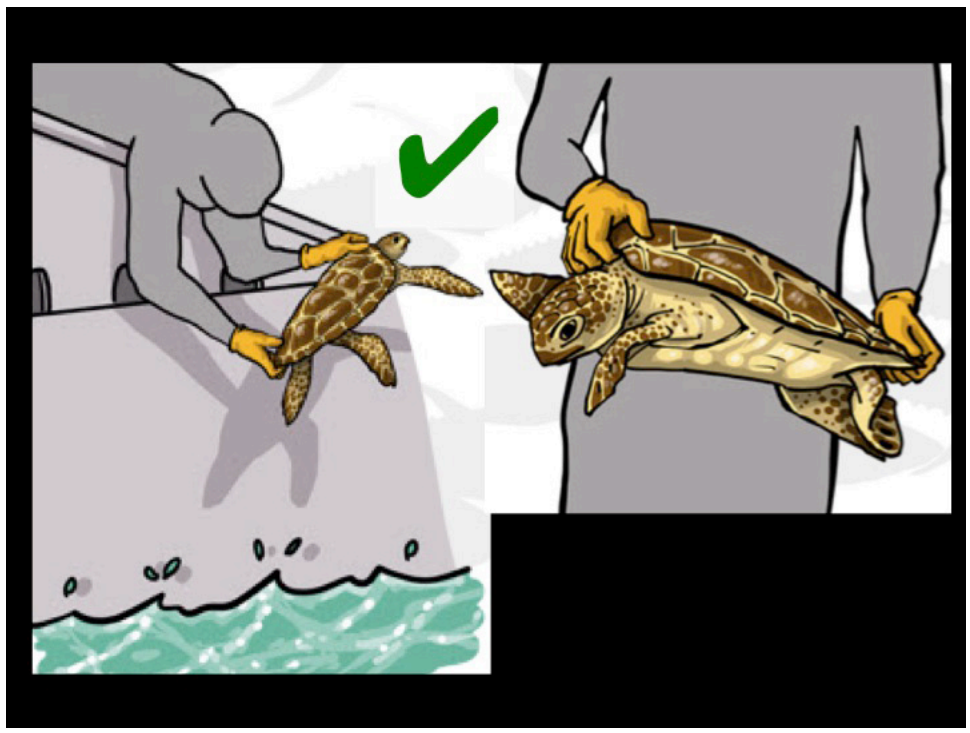
When handling a turtle, lift the turtle by grabbing the sides of its shell. Do not lift the turtle by its flippers or use sharp objects (e.g., gaffs) to retrieve them. Release the turtle gently into the water. Do not drop or throw the turtle from a great height. Make sure the turtle is a safe distance from the speedboat before the propeller is reengaged.

A newly disentangled turtle may be stressed or exhausted by its ordeal. If possible, the crew should allow it to rest (for example, on a tire) for a few hours before releasing it. If the turtle is turned, it should not be turned in a complete circle as this can cause their intestines to twist. The animal should be kept moist (the body can be covered—but not nose and mouth—with a wet towel, or sprayed periodically with water) and at a temperature above 15° C (60° F). When the turtle is ready to return to the sea, the crew should take the following steps:

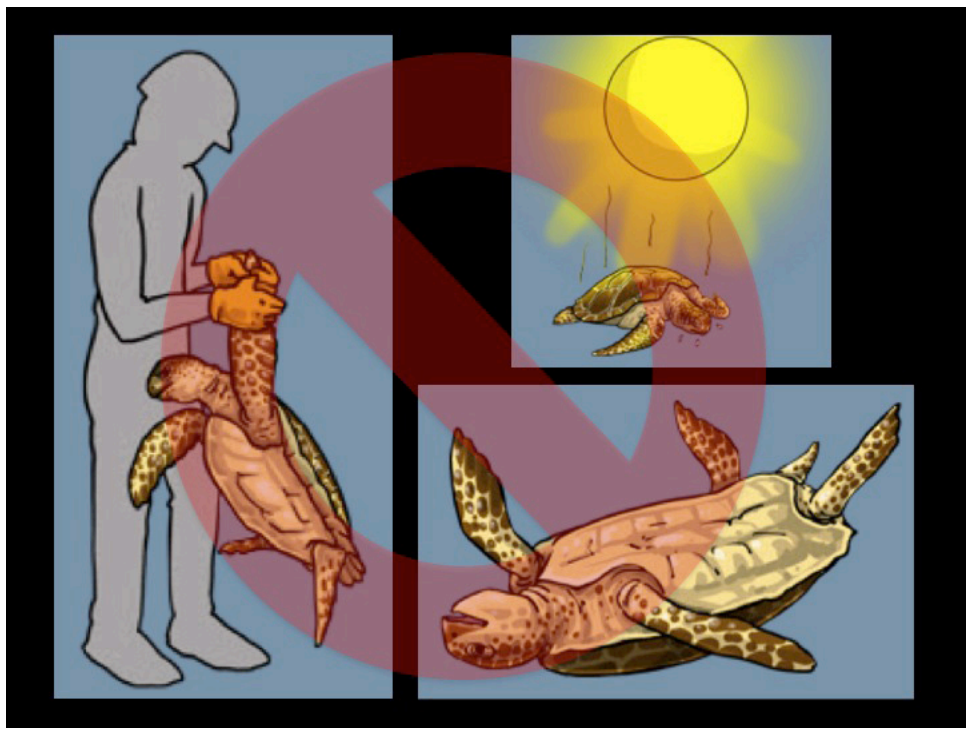
1. Check that there is no fishing gear in the water
2. Disengage the propeller
3. Ease the turtle into the water head first while holding it by the sides of its shell. If the vessel has a side door, releasing the turtle from the open door is a good option

If the turtle appears unconscious (possibly due to entanglement underwater), place the turtle on a tilted surface so that its hindquarters are approximately 15 cm (6 in) higher than its head. This allows water to drain out of its lungs. Again, keep the animal moist (with a damp towel over its shell) and at a temperature above 15° C (60° F). Check the turtle's reflexes by touching its tail or eyelid every three hours. An unconscious, but live, turtle may not react. If, after 24 hours, the turtle still shows no reflex reaction, it is likely dead. However if it does recover, release it gently into the water.

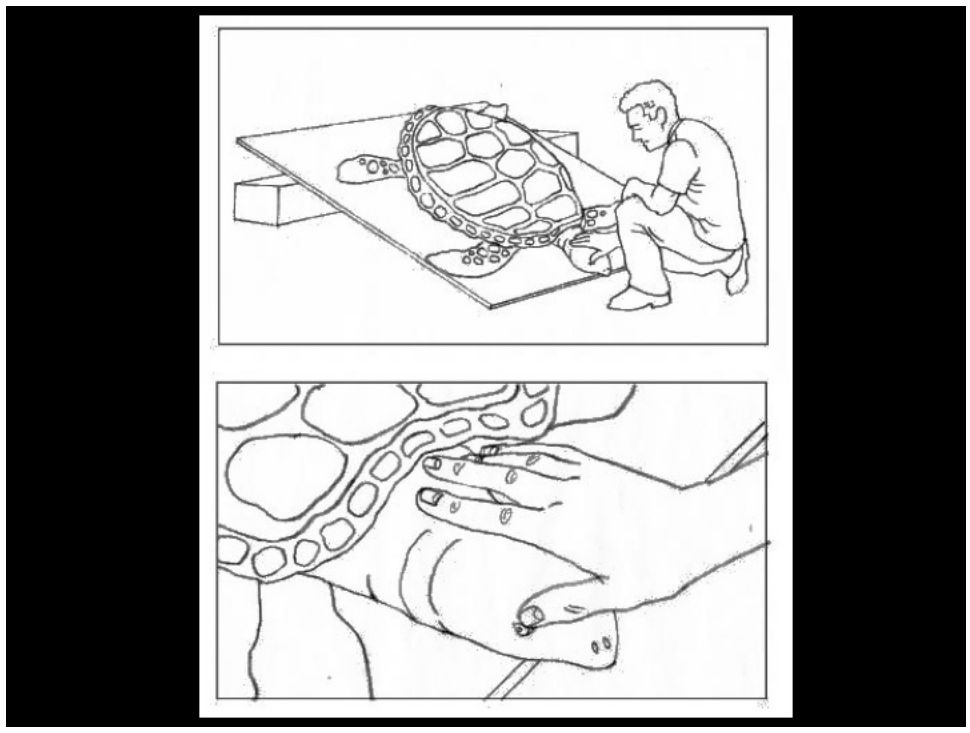
Gallery 4.5: Sea Turtle Handling and Release



When handling, lift the turtle by grabbing the sides of its shell. Release the turtle gently into the water head first. (Photo: Poisson et al 2012)



Do not lift the turtle by its flippers or use sharp objects (e.g., gaffs) to retrieve them. Do not leave turtles in the sun or lying on their backs. (Photo: Poisson et al 2012)



Recovery of an unconscious turtle: place the turtle on a tilted surface with its hindquarters approximately 15 cm higher than its head, and check the turtle's reflexes by touching its tail or eyelid every three hours.

Reducing Bycatch

Reducing the catch of sensitive nontarget species is a top priority for all organizations interested in improving the environmental sustainability of tuna purse seine fishing, including ISSF. Here, we briefly outline a few simple things that can be done by the crew to reduce bycatch.

Improved FAD construction. As discussed in an earlier chapter, non-entangling FADs will reduce the incidental capture of turtles and sharks. The "ghost fishing" of certain FAD types seems to be a significant contributor to shark mortality in some regions—that is, even when the purse seiner is nowhere in sight, the FAD could continue to entangle and kill. By ensuring that the FAD is composed of non-entangling materials, this ghost fishing can be minimized or completely eliminated. Additionally, the vessel should consider altering the shape of the FADs' rafts so that turtles cannot climb them on to rest (i.e., swapping a flat surface for a curved one).

Avoiding small sets. A recent study of bycatch amounts compared to total FAD set sizes (Dagorn et al., 2012) found that small sets had a higher percentage of bycatch than larger sets. For very small sets (less than 10 tons), the effect is most pronounced—in other words, small sets make the least significant contribution to tuna catch, but the most significant contribution to bycatch totals. Averaged globally, sets under 10 tons comprise 3 to10 percent of total catch, but 23 to 43 percent of all bycatch. If a skipper avoids making small sets, he can dramatically reduce his bycatch "footprint" with only a minimal impact on his tuna catch.

Future work. While there are several strategies currently being tested, there are no proven techniques for completely avoiding the bycatch of sharks in purse seine fishing. However, ISSF continues to sponsor bycatch research cruises to study the most promising strategies, including the use of chum to lure sharks away from the tuna aggregation. Further developments in this field will be included in future versions of this training.

Movie 4.1: ISSF Shark Research: Testing Chum Lure

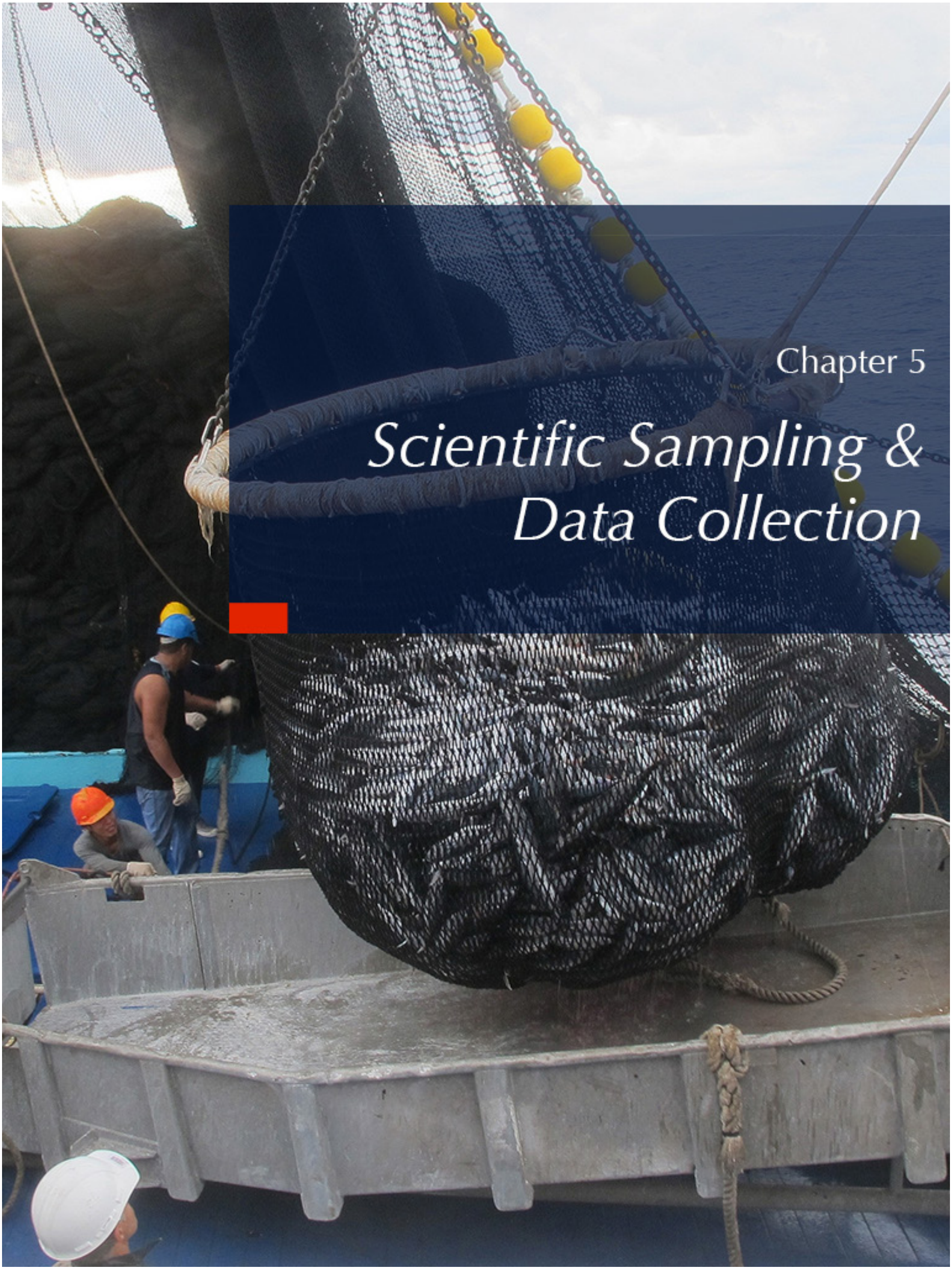


A video about testing a chum lure Available online at http://youtu.be/ap8aYwDEcqA

Final Notes

These bycatch mitigation and handling guidelines were developed with the input of scientists, skippers, crew, and fisheries managers. However best practices are always evolving, and if new information becomes available, ISSF will update this guidance. Also, if your experience as an observer suggests alternative methods of successful bycatch

mitigation and handling, we are always eager to test such techniques during our research cruises. There will be a place to share such information at the end of this module, and ISSF encourages you to do so as long as it does not violate any rules of confidentiality.



Chapter 5

Scientific Sampling & Data Collection

Chapter 5: Scientific Sampling and Data Collection

The primary scientific occupation of an observer at sea is to gather data on discards: tuna discards and the catch and discards of sharks, billfish, and other species. Other duties include collecting fish measurement data, collecting biological samples, and carrying out other research-related activities. Without these data, scientists would be unable to accurately monitor the health of the tuna stocks and other species encountered during fishing.

Introduction

Chapter Objectives

1. Address sampling techniques and fish measurements.
2. Provide guidance on estimating catch amount and other recording.
3. Review scientific tag types and retrieval protocol.

Though observer duties are similar across the tuna RFMOs, the various national and regional observer programs can have different nomenclature, data fields, and reporting methods. It is the observers' responsibility to ensure that they understand which specific data they need to collect and how it should be logged. This chapter will briefly review the primary sampling tasks of an observer, which are a universal component of any tuna purse seine observer program.

Sampling Strategy

This section will be most helpful to those observers that sample onboard. Depending on the RFMO, the catch can be sampled either onboard by observers or by port samplers when the vessel returns to port.

The ideal goal of catch sampling is to determine the age of every fish caught. This information forms the basis of the common stock assessment tools used today. When combined with other stock abundance estimates, such as catch per unit effort (CPUE) and research vessel surveys, various aspects of the population dynamics and life histories of the species can be determined. This enables biologists to assess the size of the fish stocks and make recommendations on how the resource may be harvested without endangering the stocks.

But, of course, there is no readily available technique to make such a direct determination of age, and there is certainly not the time to do so for every fish landed. Instead, the observer must use fish length as a proxy for age (length is well correlated to age and weight of a fish), and collect that data from a random sample of the fish that are brought on board.

One technique for random sampling is to begin with the total number of brails the crew estimates is in the net. A good goal is to sample 10 percent of that total. For example, if there are an estimated 30 brails of fish in the net, the observer would want to sample three brails. Next, select a random number (or have someone else pick a number for you) between 1 and 10. That tells you which brail to begin with. If the random number was 4, for example, you would sample the 4th, 14th, and 24th brails to come on board. If 30 brails was an underestimate and there were really 35 in total, then you would sample the 34th brail as well. If your random number had been 7, then you would sample only the 7th, 17th, and 27th brailer.

For any selected brailer, it is not possible to identify and count all fish. Each brailer can be 3 or 5 tons in capacity, which means 500 fish or more, depending on their sizes. You may need to take a subsample in order keep up with the fish coming on board and ensure an even sampling through the haul. Subsamples can be done via "grab" or "spill" sampling.

Grab vs. Spill Sampling. "Grab sampling" is when an observer pulls by hand fish from a pile. Because of the subconscious human tendency to select larger individuals, many programs are moving away from using grab sampling to "spill sampling" in their sampling strategy. Spill sampling is when the fish are sampled from a receptacle that has been filled directly from a single brail. If this technique is used, the observer is often asked to also note the brail number sampled and the total number of fish measured. Be sure to follow your regional observer training protocols on how to obtain a grab or spill sample.

Fish Length Measurements

The following six metrics are the most commonly used for measuring the length of tunas, billfish, other bony fish, sharks, rays, and turtles. Ideally, the observer has a set of calipers and a slate, waterproof paper, or other writing options for wet work.

Fork Length ("FL")

- Measurement: The length from the snout to the fork in the tail.
- Uses: For all tunas and other fish with a fork in the tail (including sharks).

Lower Jaw to Fork ("LF")

- Measurement: The length from the lower jaw to the fork in the tail.
- Uses: For billfish.

Total Length ("TL")

- Measurement: The total length of the fish.
- Uses: For all species with no fork in the tail.

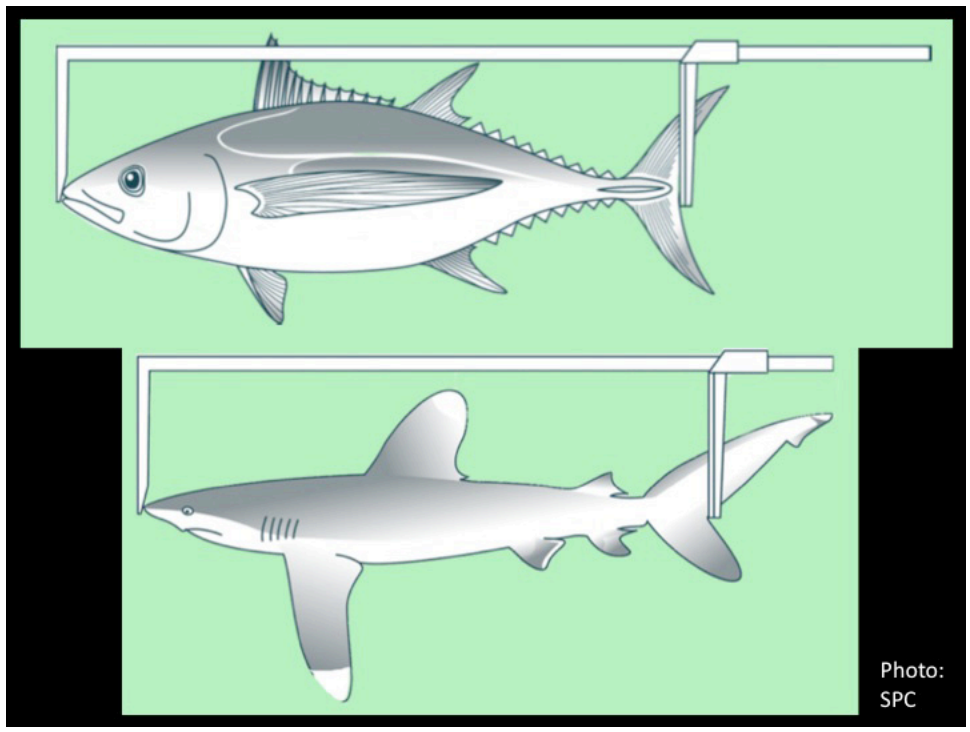
Total Width ("TW")

- Measurement: Total width of fish.
- Uses: For rays.

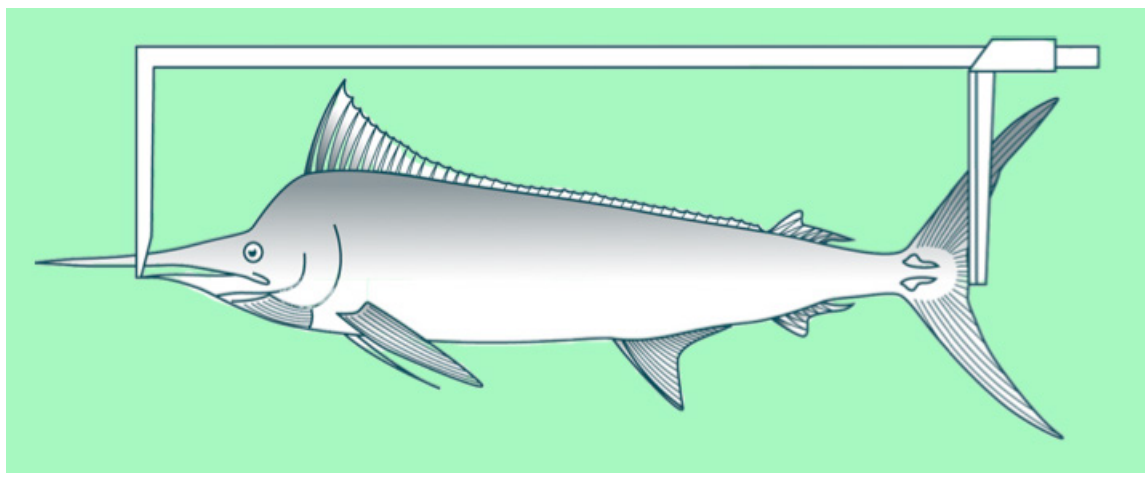
Carapace Length (“CL”)

- Measurement: Length of animal’s carapace.
- Uses: For turtles.

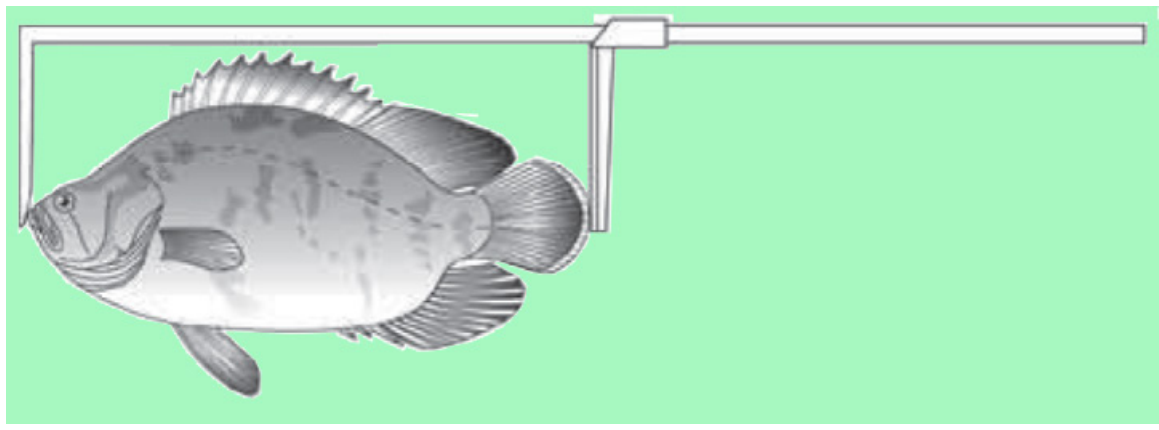
Gallery 5.1: Fish Length Sampling



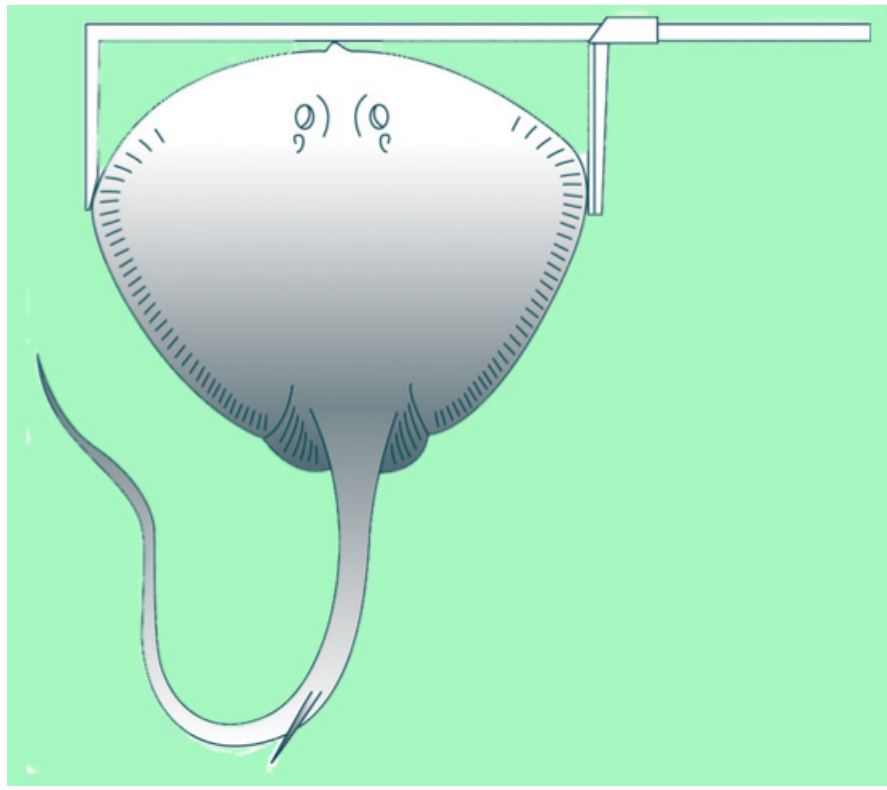
FL (upper jaw/snout to fork in tail): for tuna and all other fish with a fork in the tail (including sharks) (Photo: SPC)



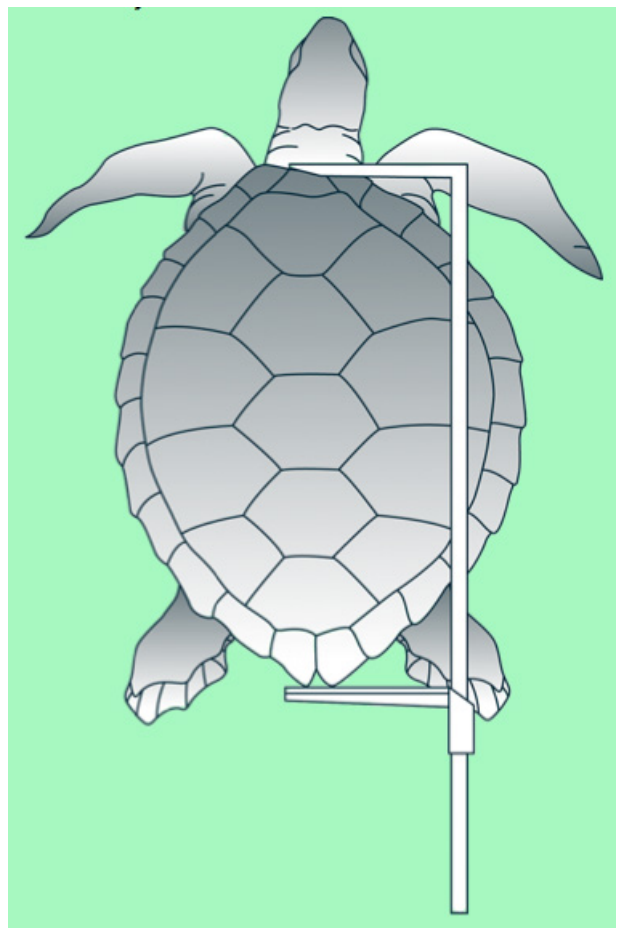
LF (lower jaw to fork in tail): for billfish (Photo: SPC)



TL (total length): for all species with no fork in tail (Photo: SPC)



TW (total width): for rays (Photo: SPC)



CL (carapace length): for turtles (Photo: SPC)



Sampling tuna lengths (Photo: David Itano)



Sampling tuna lengths (Photo: ISSF)



Sampling tuna lengths (Photo: SPC)



Sampling tuna lengths (Photo: NOAA)

Biological Sampling

Sometimes observers are charged with taking biological samples, such as otoliths (fish ear bones) and stomach contents. During dissection, other useful information can also be gathered, such as the animal's sex. Your observer program will provide further instruction for this sampling if it is required.

Otoliths. One of the most important parameters of interest to a fisheries biologist in the study of a sample or catch of fish is the age of the fish taken. Again, observer samples provide this information through the collection of otoliths, or fish ear bones. These bony structures, generally located beneath the brain, show growth rings in a distinct pattern when cut and placed beneath a microscope, which allows the scientist to count the fish's age, in much the same way as a cross section of a tree trunk can reveal a tree's age.

Stomach contents. Understanding a species' food source allows its location in the greater marine ecosystem's food web to be identified. When stomach contents are sampled, the tissue is generally preserved in formalin for later analysis in a laboratory.

Estimating Catch

To be successful as an observer, you must quickly learn to accurately estimate sizeable quantities of fish. There are three ways to estimate a set's total catch:

1. Weigh the entire catch (feasible if the catch is small and there is a brailer scale)
2. Use the vessel's estimate
3. Record the brail tally (brail tally × number of brails = total catch weight)

The first option is generally unavailable, and the second option introduces the possibility of bias, given the data's source. The third option is independent, but requires careful observation. You will find that with experience your ability to accurately estimate catch size becomes better. A brail tally is a record of how full each brail was, which can be added up to give the number of 100 percent full brails. When you multiply that number by the capacity of the brailer (ask the skipper or mate, if you do not know), you have an estimate of the total catch weight. However, the total weight within the brailer can vary with the species and their sizes.

Example: Catch Estimation

Example: It took 6 scoops of the brailer to bring the catch on board. The first two brails were full. The second two were 75% full. The last two were 50% full.

The brail tally in this case would be:

1 + 1 + 0.75 + 0.75 + 0.5 + 0.5 = 4.5 full brails

The brailer capacity is 800 kg:

4.5 × 800 kg = 3,600 kg = 3.6 mT

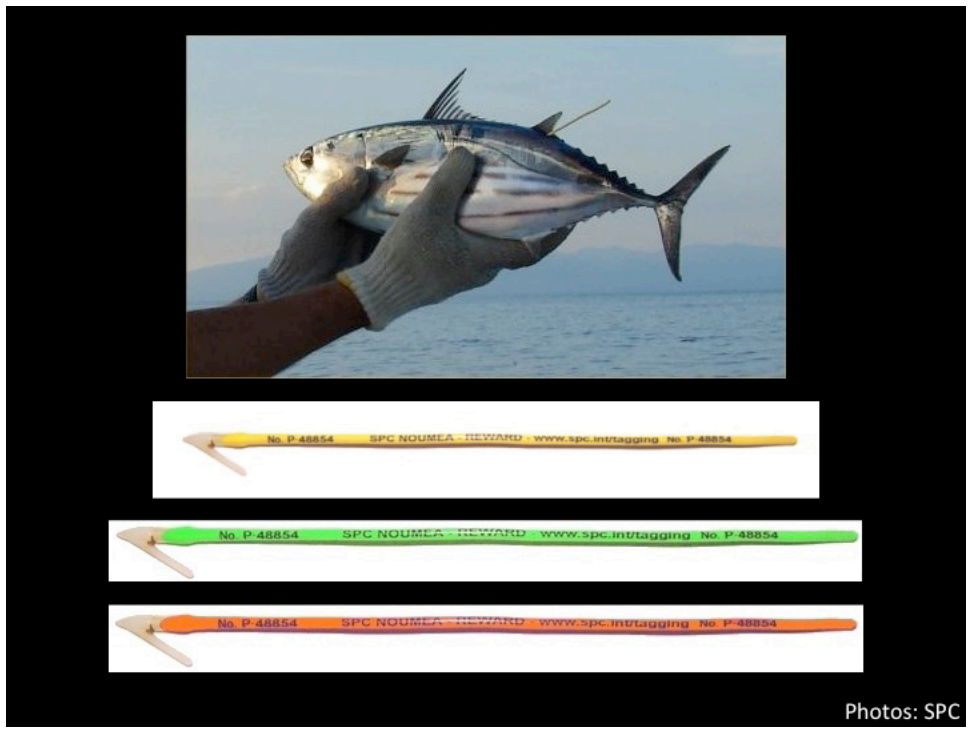
Tagged Animals

If your vessel encounters a tagged fish, marine mammal, or sea turtle, please make every effort to recover the tag (if the fish is dead) or record the information in it (e.g., for a tagged turtle that will be released). In most cases, instructions on where to report recaptures appear on the tag. With these types of tags, there is often a reward associated with the returning the tag to the researchers who deployed it. Generally, the date, location, animal's length (and sex when it is noticeable), and fishing conditions should be reported. Your observer program can provide specific recovery information for the tags likely to be encountered in your region. This is valuable data used in fisheries management decisions, stock assessments, and other biological research.

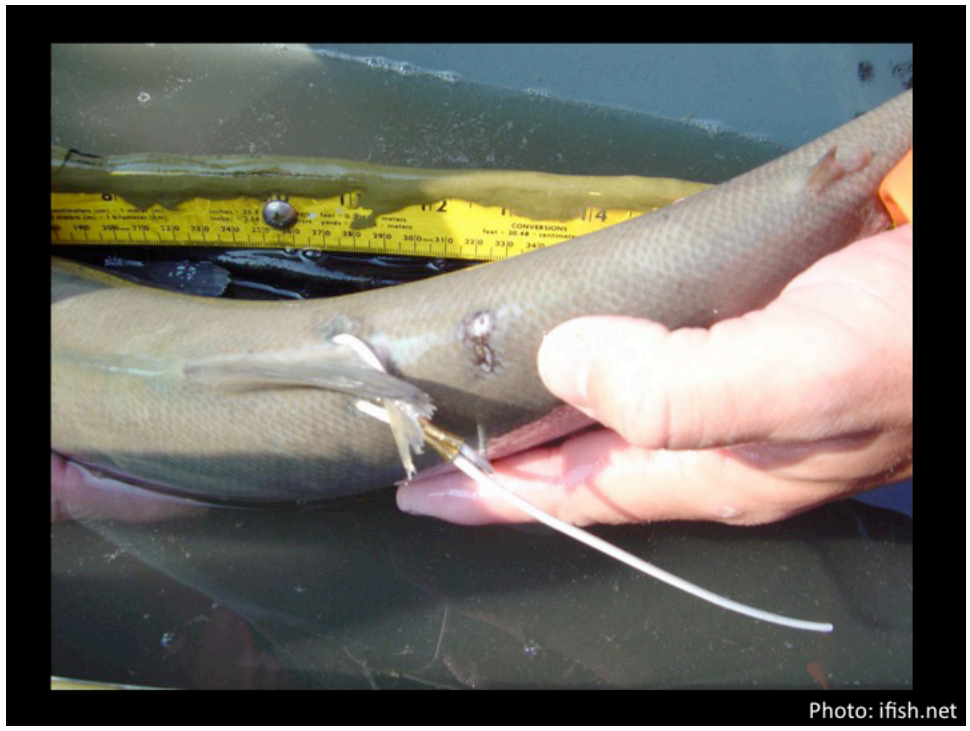
Tag types. There are a variety of tag types in use, from simple numbered plastic tags to complex electronic tags. Plastic spaghetti or dart tags are attached on the back of the fish. Rototags are a two-piece, plastic cattle ear tag, which is inserted through the first dorsal fin. Sonic tags are miniature radio transmitting devices that are surgically implanted inside the tuna. Since sonic tags are not visible externally, a conventional tag of a certain color will be visible on the outside. Internal archival tags, implanted in the body cavity, record the internal body temperature and the environment's temperature, pressure, and light. Smart Position or Temperature Transmitting (SPOT) tags are attached to

the animal's dorsal fin and this tag sends a signal to a satellite every time the animal surfaces. Pop-up Satellite Archival Tags (PSAT) are inserted with an anchor and a tether into the dorsal musculature, recording temperature, pressure, and light, and they detach from the animal on a preprogrammed date.

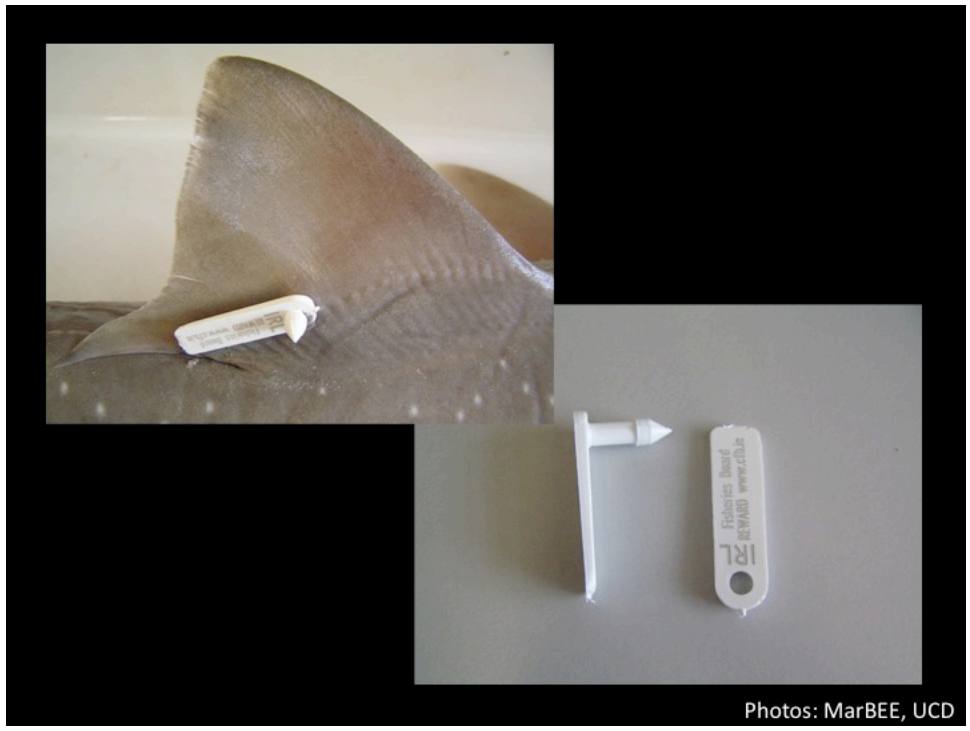
Gallery 5.2: Scientific Tag Types



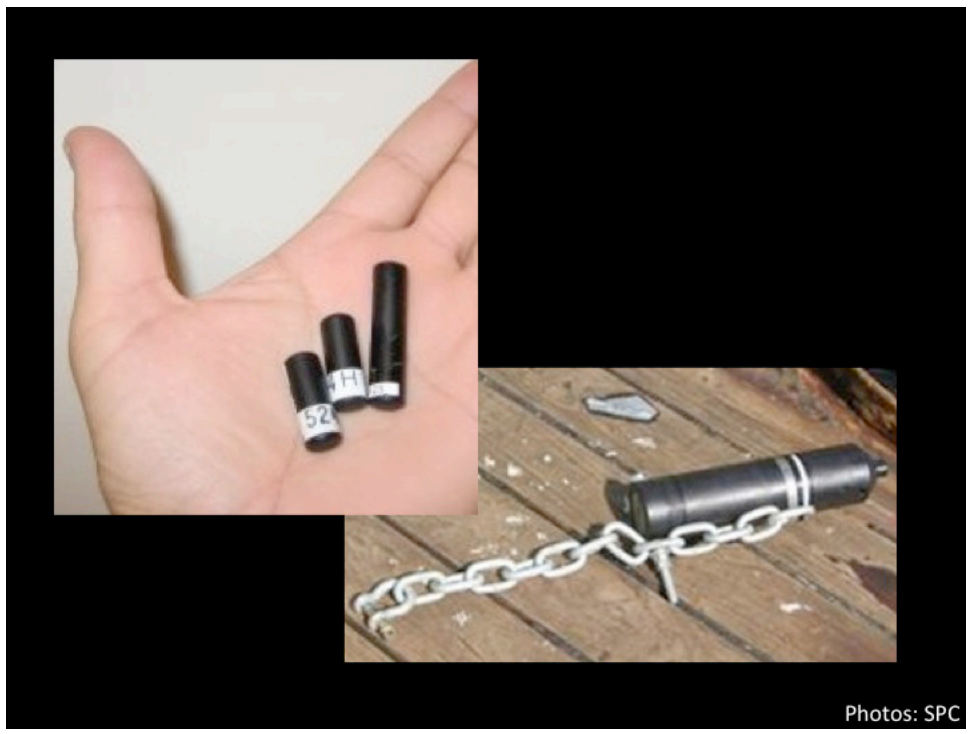
Conventional dart tags are composed of a composite plastic barbed head with a polyvinyl plastic streamer/shaft. Different colors can indicate the presence of additional, internal tags. (Photo: SPC)



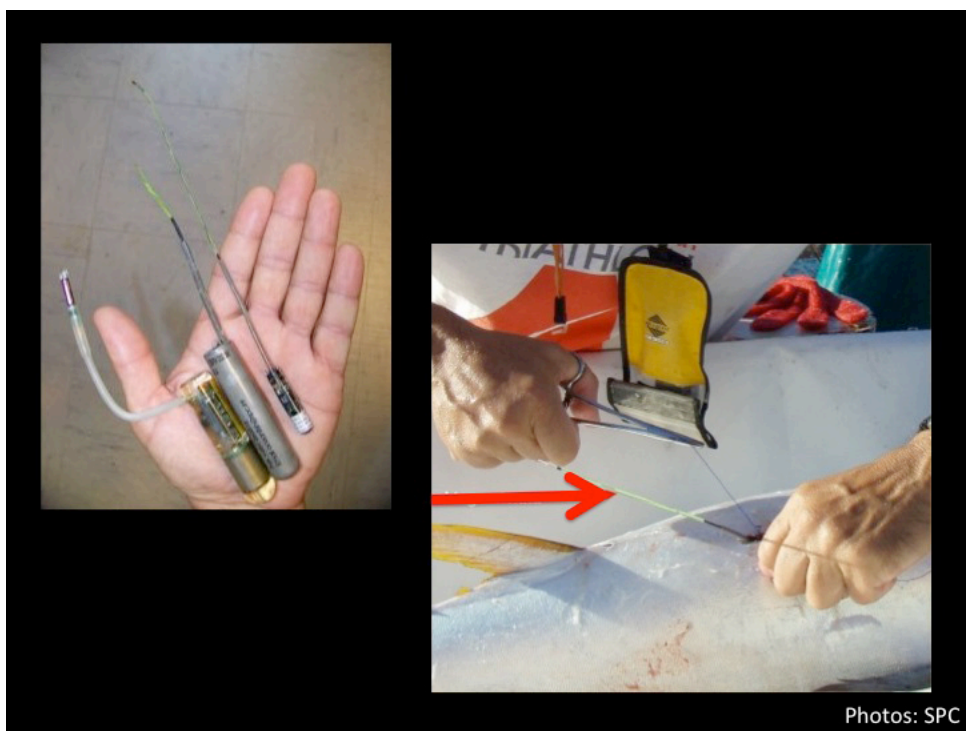
Plastic "spaghetti" tag. (Photo: ifish.net)



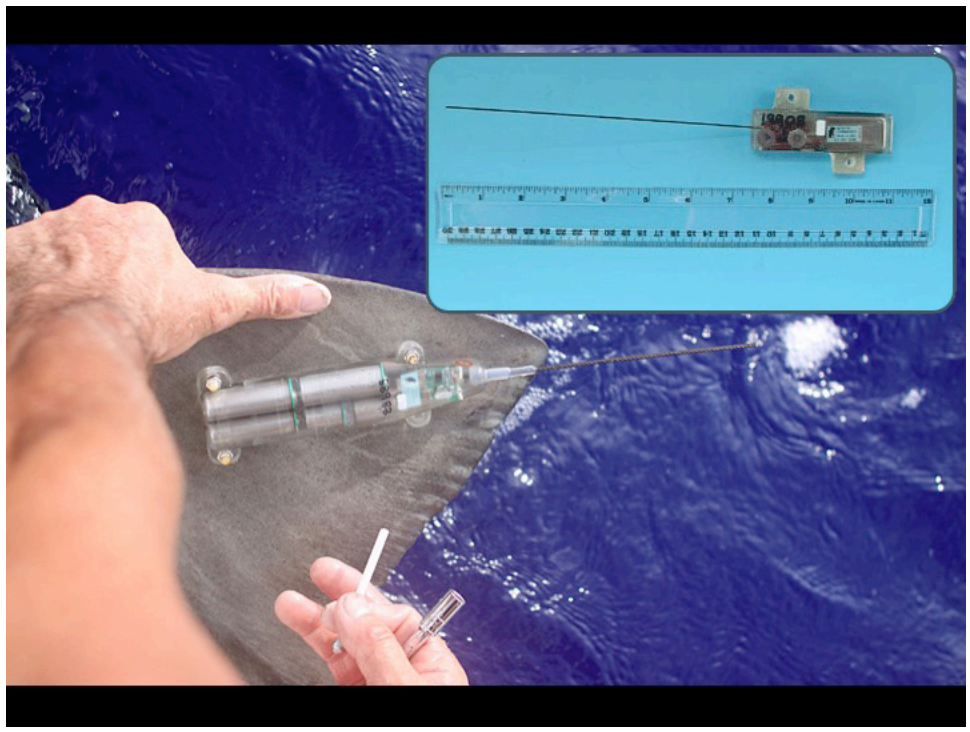
Rototags are a two-piece, plastic cattle ear tag, which is inserted through the first dorsal fin. (Photo: MarBEE, UCD)



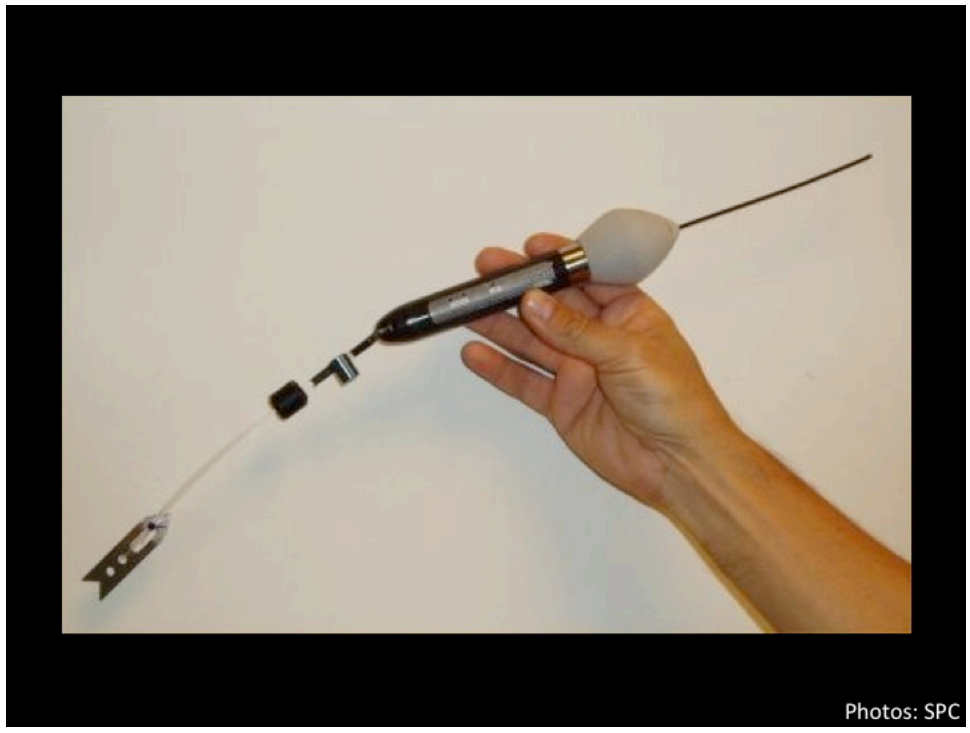
Example of sonic tags (left) and of a sonic receiver on a FAD (right). Sonic tags are miniature radio transmitting devices that are surgically implanted inside the tuna. Since sonic tags are not visible externally, a conventional tag of a certain color will be visible on the outside of the fish. (Photo: SPC)



Archival tags are miniature computerized data recorders that are surgically implanted into the tuna's body (antenna, red arrow). (Photo: SPC)



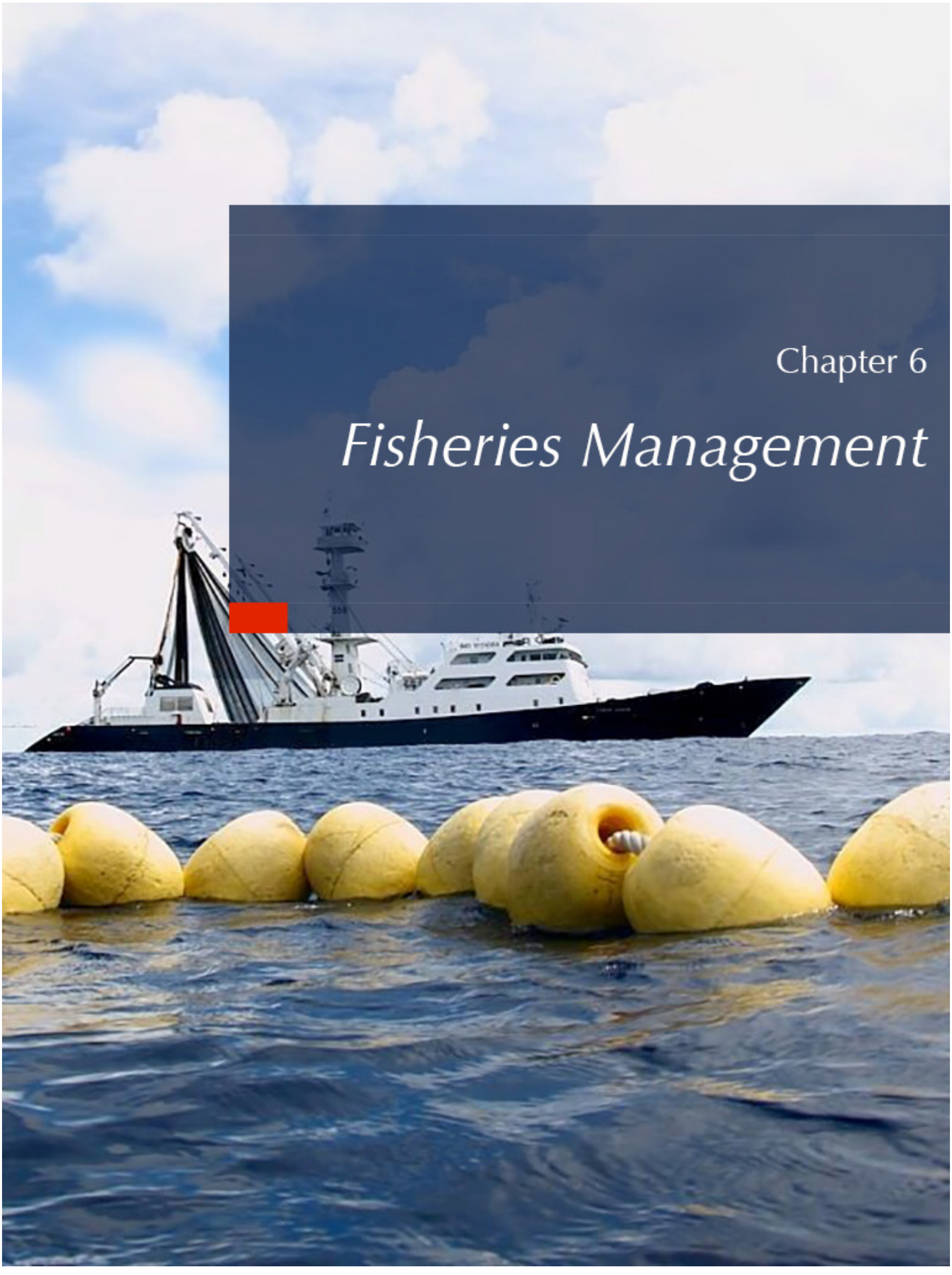
Smart Position or Temperature Transmitting (SPOT) tags are attached to a fish's dorsal fin; the tag sends a signal to a satellite every time the fish surfaces. (Photo: SPC)



Satellite tags record the same information as archival tags but they do not need to be recovered. They are fixed on the back of the fish and after a predetermined time, they will detach from the fish, float to the surface, and transmit the recorded information to a satellite. (Photo: SPC)

Final Notes

Sampling activities can vary from one RFMO to another. This section covered the basic steps to accurately sample fish on board the vessel. Depending on your location, sampling of the catch will or can be conducted by port samplers when the catch is brought to port.



Chapter 6

Fisheries Management

Chapter 6: Fisheries Management

The ability of Regional Fisheries Management Organizations (RFMOs) to manage tuna stocks is only as good as the quality of compliance by its many members. When vessels do their part to meet the RFMO obligations, they make a vital, fundamental contribution to the success and sustainability of the fishery.

Chapter Objectives

1. Summarize the major organizations and instruments responsible for tuna fisheries management at the global, regional, and national levels.
2. Outline the vessel-level actions necessary for compliance with RFMO obligations, including:
    1. Fishing Measures
    2. Data Reporting
    3. Observers
    4. Tag Recovery
3. Identify the ISSF Commitments.

International Organizations and Instruments



Tuna is an international resource: it can be caught in one country by a vessel flagged to another, processed in a third country, and consumed in a fourth. As a result, there are a great variety of organizations that shape the fishing process, from global (the United Nations), to regional (RFMOs), subregional (the parties to the Nauru Agreement in the western Pacific), and national (coastal and flag state) levels.

The United Nations Convention on the Law of the Sea (UNCLOS) established rules for the use of, and operation on, the world's oceans. It governs all aspects of ocean space, such as demarcation, environmental control, marine research, commercial activities, and the settlement of disputes relating to ocean matters.

Here are the aspects of UNCLOS most relevant to tuna fishers:

- Coastal states have sovereign rights to their territorial sea (12 nautical miles), and to the resources in their exclusive economic zone or EEZ (200 nm).
- All states are allowed the traditional freedom of navigation, research, and fishing on the high seas, as well as "innocent passage" of their vessels through other Coastal states' waters.
- All states undertaking activities that affect living marine resources on the high seas are obligated to adopt, or cooperate with other states in adopting measures to manage and conserve those resources.

In order to implement this last point, the United Nations Fish Stocks Agreement (UNFSA) was conceived. Specifically, UNFSA does the following:

- Establishes principles for the conservation and management of highly migratory fish stocks that must be based on the precautionary approach and the best available scientific information
- Requires the management of those other species in the same ecosystem that are affected by fishing activities (i.e., bycatch)
- Requires both coastal and distant water fishing States to ensure compatible conservation measures between EEZs and the high seas
- Specifies the duties of flag States to exert control over their fishing vessels
- Contains rules on the establishment of RFMOs, including the obligation of fishing states to become members and comply with all measures

There is some variation among the RFMOs' conservation and management measures, but the primary mechanisms used are these:

- Catch and/or effort limits
- Catch and/or effort reporting
- Spatial and/or temporal closures, and gear restrictions
- Controls on at-sea transshipments
- Observer and Vessel Monitoring System (VMS) requirements
- Scientific data provisioning, reporting, and handling

Each RFMO has different ways of tackling these subjects, but in all cases, high levels of monitoring and compliance are key to successful management. Without compliance, excess catch drives down fish stocks, poor reporting and data provisioning prevents accurate assessment, and violating closures or observing requirements weakens necessary protections. Decisions about stock assessments, catch limits, and management strategies are only as good as the quality of data received by the RFMOs' scientists, and vessels play a critical role in this process.

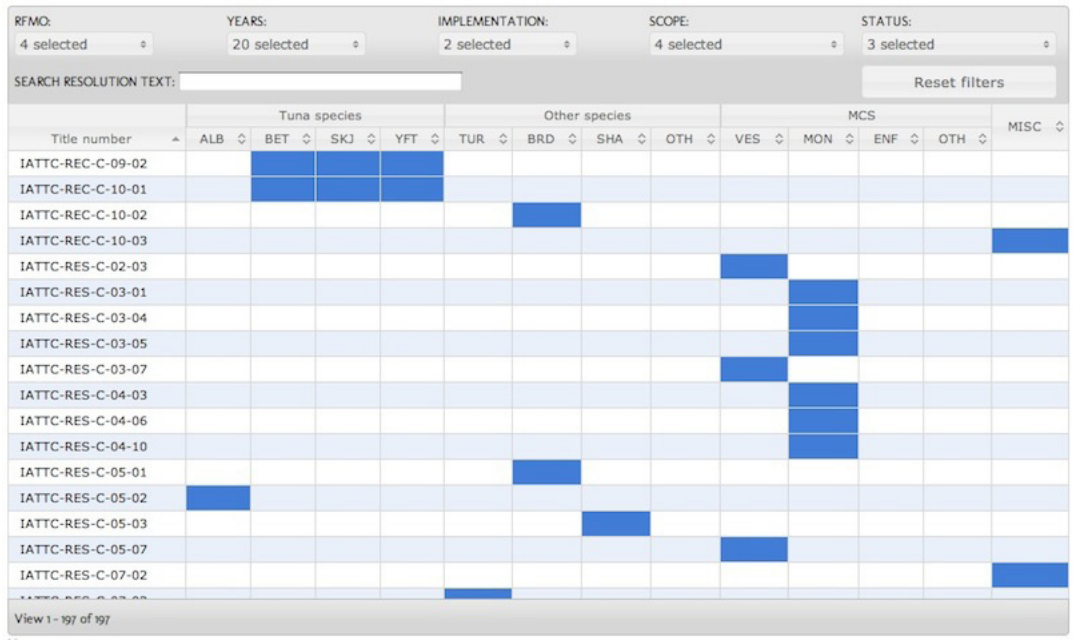
ISSF has compiled an online database that lists all measures for each tuna RFMO. Measures can be sorted by RFMO, keyword, year, or other parameters. Given the dozens of requirements active in any given region, this database is a useful tool for identifying those measures that apply to the vessel's gear type.

For example, longline at-sea transshipment is generally permitted only for large-scale longliners with carrier vessels that participate in a regional observer program. To determine the particular requirements of the RFMO in which the vessel fishes, you can search for the term "transshipment" in the ISSF RFMO database to find the applicable measure. An example for purse seine fishing would be to search the database for RFMO data collection requirements for FADs (fish aggregating devices), which now exist in

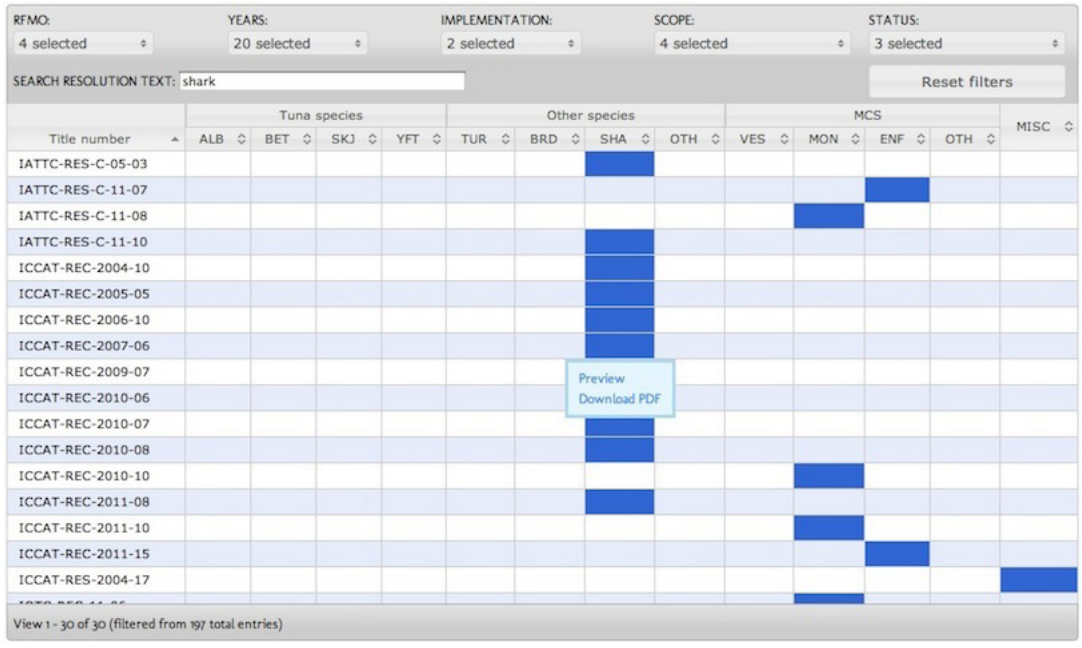
the IOTC, IATTC and ICCAT.

These conservation and management measures are then implemented in the various flag and coastal states' laws and regulations. Fishers must be familiar with both the vessel's flag state's laws and the laws of the coastal state in which they are fishing. Each tuna RFMO's major conservation and managements measures relevant to both purse seine and longlining are noted below. However, the descriptions below are not exhaustive and should be used only as supplemental summary information to the detailed requirements contained in the RFMO conservation and management measures. For instance, some RFMOs require the completion of statistical or catch documentation forms, transshipment declarations, or other kinds of certificates for landing, import and/or re-export of certain tuna species. Fishers are encouraged to contact their flag state for more information on the applicable requirements for the RFMO in which they are fishing, and consult the ISSF RFMO database for the full text of the measures.

ISSF RFMO Database



ISSF has compiled a database that lists all measures for each tuna RFMO. http://iss-foundation.org/knowledge-tools/databases/rfmo-management-database/.



In this example, shark is in the search field. http://iss-foundation.org/knowledge-tools/databases/rfmo-management-database/.

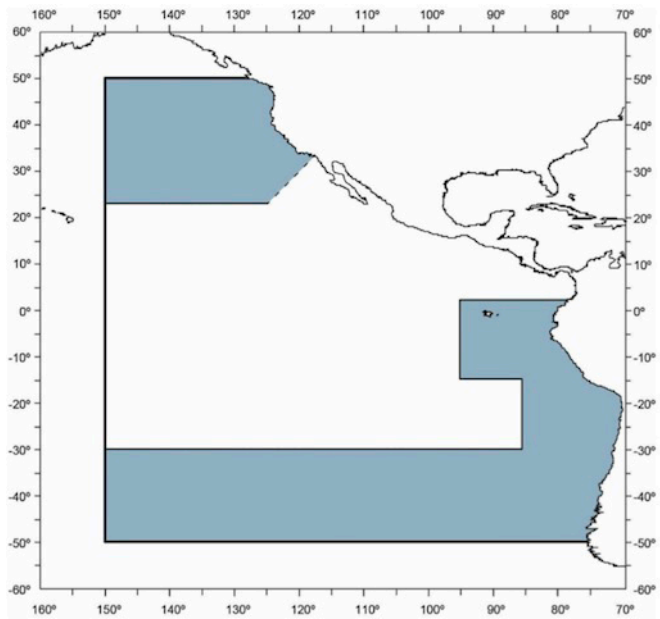
Inter-American Tropical Tuna Commission (www.iattc.org)

There is one main binding, multiyear conservation measure covering tropical tuna stocks (bigeye, skipjack, and yellowfin) that currently includes, among other things, provisions for a 62-day full closure for purse seine fishing, a two-month closure in a specific area of the Convention Area for purse seine fishing, and bigeye catch limits for longline vessels.

The IATTC has also adopted conservation measures for specific tuna species, including North Pacific albacore and Pacific bluefin tuna. The requirements of these measures vary from limits on increasing fishing effort from current levels to limits on total commercial catches for a set period. If fishing for these species, fishers must become aware of the specific requirements.

Regarding seabirds, IATTC requires the use of two different seabird bycatch mitigation measures, and fishers should also make efforts to ensure that any birds captured are released alive and in the best condition possible. This applies to longline vessels in the shaded area in the following map.

For sea turtles, longline skippers must ensure that their vessel has on board the right equipment to promptly release any incidentally caught animals (e.g., dehookers, line cutters, and scoop nets). Fishermen must also bring aboard, if practicable, any comatose or inactive turtle as soon as possible and foster recovery, including resuscitation, before returning it to the water.



Area Requiring Seabird Bycatch Mitigation Measures. When fishing in the shaded area, IATTC requires vessels to use two different seabird bycatch mitigation measures.

IATTC also discourages shark retention (oceanic whitetip retention is prohibited), while requiring "full utilization" of those sharks that are retained (keeping onboard all parts except the head, guts, and skins to the point of first landing). In addition, no more than 5 percent of total landed shark weight can be composed of fins.

IATTC also requires full retention of bigeye, yellowfin, and skipjack tunas caught by purse seine vessels.

Western and Central Pacific Fisheries Commission (www.wcpfc.int)

There is one main binding conservation measure covering tropical tuna stocks (bigeye, yellowfin, and skipjack) that currently includes, among other things, provisions for FAD closures and FAD set limits, purse seine effort limits, longline catch limits for bigeye tuna, capacity limits for developed nations' large-scale purse seine and longline vessels, and the prospect of a FAD set prohibition on the high seas in 2017 unless the Commission agrees to alternative measures.

The WCPFC has also adopted conservation measures for specific tuna species, including North Pacific albacore, South Pacific Albacore and Pacific bluefin tuna. The requirements of these measures vary from limits on increasing fishing effort from current levels, limits on the number of vessels targeting the species, or a combination of limits on total effort and catches of juveniles. If fishing for these species, fishers must become aware of the specific requirements.

Regarding bycatch, the WCPFC:

- Requires implementation of the FAO guidelines for reducing sea turtle mortality and to disentangle/release them when caught alive
- Caps (by country) the catch of striped marlin
- Requires specified seabird bycatch mitigation measures depending on gear and location (like ICCAT and IOTC, south of 30° S fishers must use two of the following three measures: night setting, weighted branchlines, and tori lines)
- Mandates reporting of shark catches and discards by gear type and species
- Prohibits retention of oceanic white tip sharks and silky sharks
- Prohibits intentional purse seine setting on whale sharks and cetaceans
- Enforces a 5 percent limit on the ratio of shark fins to total shark weight that can be retained onboard fishing vessels, and encourages the release of live sharks

The WCPFC also requires full retention of bigeye, yellowfin, and skipjack tunas caught by purse seine vessels.

International Commission for the Conservation of Atlantic Tunas (www.iccat.int)

There is one main binding conservation measure covering tropical tuna stocks (bigeye, yellowfin) that amends previous recommendations, and sets out a multiyear management plan. The main provisions are summarized below.

Bigeye:

- Total allowable catch (TAC) with catch limits given to members. The measure includes detailed provisions for countries to be penalized with lower quotas if their limits are exceeded
- A capacity limitation (country-specific) for the number of longline and purse seine vessels over 20 m in length
- The establishment of a record of vessels actively fishing for bigeye

Yellowfin:

- An overall yellowfin TAC (not allocated by country)
- The establishment of a record of vessels actively fishing for yellowfin

ICCAT has also adopted conservation measures for specific albacore tuna species, including North Atlantic, South Atlantic, and Mediterranean. The requirements of the measures for the northern and southern stocks include an established TAC, catch reporting, and placing a cap on vessel numbers by country. There are also applicable fishing capacity limits for some of these stocks. If fishing for these species, fishers must become aware of the specific requirements.

The Atlantic bluefin tuna is found in the north Atlantic and the Mediterranean Sea, and is composed of two stocks: western Atlantic, and eastern Atlantic and Mediterranean (these stocks do mix as well). Because of past overexploitation, the stocks—particularly the eastern stock—are highly managed, with many regulations in place. For the western stock, the primary conservation measures are a TAC, a minimum size requirement, and a prohibition on directed fishing in the Gulf of Mexico and transshipment at sea.

The eastern stock has a TAC and other measures to ensure that this rebuilding stock continues to improve, such as:

- Management of fishing fleet capacity
- Seasonal closures (6 months for longliners)
- Minimum sizes (8 and 30 kg, depending on the fishery)
- A record of authorized fishing vessels
- Weekly catch reporting by ICCAT members
- Vessel Monitoring Systems (VMS) for all vessels over 15 m
- Required catch documents
- Boarding and inspection activities

Bycatch Measures:

- No more than 5 percent of total shark weight can be shark fins
- Encourages the release of live sharks in fisheries that do not target sharks
- Limits mortality on porbeagle and North Atlantic shortfin mako
- Prohibits the retention of bigeye thresher, oceanic whitetip, several species of hammerhead sharks, and silky sharks. All of these measures have a reporting requirement associated with them
- Prohibits the retention of shortfin mako on board vessels flagged to countries that do not report catches for this species
- Requires the use of safe-handling practices, such as the use of line cutters and dehooking devices for sea turtles
- Specific reporting requirements for sharks, sea turtles and seabirds
- Catch limits (by country) on blue and white marlin
- Requires longline vessels fishing south of 25° S to use two measures from a choice of bird-scaring line, night setting, and line weighting. Between 20°– 25° S, vessels are required to use a bird-scaring line.

ICCAT has also established penalties for Members that do not report annual catch data (including zero catches) by prohibiting them from retaining such species in the following year.

Indian Ocean Tuna Commission (www.iotc.org)

For tropical tunas, there is one main binding conservation measure that covers vessels greater than 24 m as well as smaller vessels fishing on the high seas. This measure calls for a one-month closure for longliners and purse seiners in a specified area.

IOTC has also adopted conservation measures for albacore tuna. The requirements include limiting fishing vessel capacity to the amount that existed in 2007 for all vessels greater than 24 m, and those under 24 m that fish outside their EEZ. If fishing for this species, fishers must become aware of the specific requirements.

IOTC also requires full retention of bigeye, yellowfin, and skipjack tunas caught by purse seine vessels.

Bycatch Measures:

- No more than 5 percent of total shark weight can be shark fin
- Encourages the release of live sharks in fisheries that do not target sharks
- Prohibits retention of all species of thresher sharks and oceanic whitetip sharks
- Requires shark data reporting, especially in fisheries that target sharks
- Requires longline vessels fishing south of 25° S to use two seabird bycatch mitigation measures from a choice of bird-scaring lines, night setting, and line weighting
- Requires members to mitigate sea turtle mortality and to provide data on turtle bycatch to the IOTC
- Prohibits intentional purse seine setting on whale sharks and cetaceans

Further Notes on Data Reporting and Compliance

Observers and Port Samplers

Longline Observer Requirements:

For longline vessels, though the details of the programs vary, most tuna RFMOs require an observer coverage level of at least 5 percent for longline vessels over 24 meters, and, in some cases, for smaller vessels operating in the high seas or in EEZs other than their flag state EEZ.

Purse Seine Observer Requirements:

For purse seine vessels, though the details of the programs vary, in the WCPFC, IATTC, and ICCAT there are a 100 percent coverage requirements (at least for certain geographical areas and/or times of the year and certain vessel sizes). In the IOTC, there is a 5 percent observer coverage requirement for vessels 24 m and greater in length overall operating on the high seas and for vessel less than 24 m if they fish in EEZs and on the high seas. Fishers operating purse seine vessels in these RFMO Convention Areas must become aware of the specific applicable observer requirements.

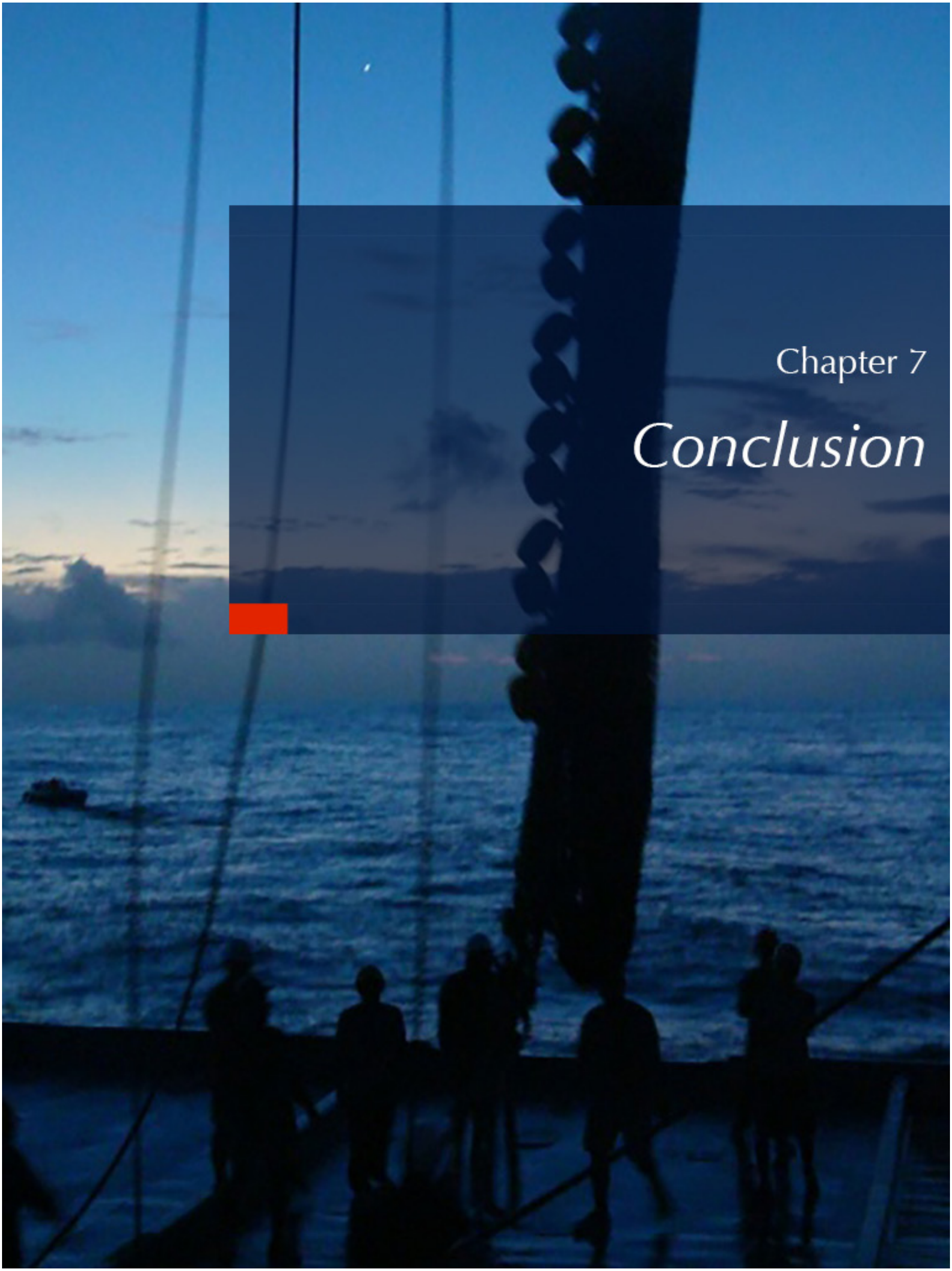
Observers collect and report data on tuna catch, bycatch, and discards, among other things, through observer program worksheets and/or logbooks. In addition, some regions have port samplers that collect catch data as well. These data are an essential part of the scientific evaluation of the tuna fisheries and the ecosystem in which they live. Skippers should ensure that observers and port samplers are given the access necessary to carry out these important duties.

Please note these are brief summaries. For full text of the gear-specific observer requirements in force in each RFMO, visit ISSF's RFMO database.

Tag Recovery and Reporting

Tuna (and other fish) tagging programs have a number of uses, but almost all tagging programs share a common goal: gathering data about fish. Most tagging programs seek information on fish movements, growth, behavior, and mortality. This data is critical to our understanding of fish biology and for the creation of accurate models for stock assessments. You might also encounter tagged seabirds, with small bands on their legs.

Simple tags have printed information and instructions on how to return the tag. These tags remain attached to the fish until it is landed. Some high-tech tags monitor and record data. Some fish tags even pop off the fish at an appointed time, float to the surface, and transmit information via satellite. If the vessel's crew lands a tagged animal, please take the time to remove the tag, note the time and location of the landing and ensure that the tag is returned to its owner. Often there are rewards for the return of tags—another reason to help contribute to the good management of your fishery. Fishermen must not remove the tags from live birds.



Chapter 7

Conclusion

Chapter 7: Conclusion

This conclusion covers an overview of an observer's recording and reporting responsibilities, including timing and forms for filings, a review of content required, and how to register your completion of this module with ISSF.

We have now reviewed most of the major elements of an observer's responsibilities, which include:

- Describing fishing gear, technology, and operations (including FADs)
- Identifying all commonly encountered tunas, other bony fish, sharks, rays, and turtles
- Understanding best practices for the handling and release of sensitive species
- Recording catch estimates, fish lengths, and other biological data
- Recording data on nontarget species, such as :
    1. Tuna discards
    2. shark and billfish catch and discards, and
    3. other species catch and discards
- Reporting all information completely and accurately

Considering all the effort put into fulfilling these duties, it should not be forgotten that the reporting of this work, completely and accurately, is the linchpin of an effective observer trip.

Recording and Reporting

Your observer program will supply you with the required forms to enter the data you collect on your trip. In some cases, these may be forms from the RFMO, in others they may be from a regional or national authority. As many of the fields in region-specific forms are tied to that RFMO's conservation measures, it is a good idea to familiarize yourself with them. These measures can be found on the RFMO's website, however ISSF has an easy-to-use database of all RFMO measures that are searchable by term. (A description of this database appears in the previous chapter and the database itself can be found at http://iss-foundation.org/knowledge-tools/databases/rfmo-management-database/).

Given the observer's long days and hard work, it is best to not trust anything to memory. For this reason, another recommended recording technique is daily journaling, where the observer—in narrative—can note events of the day, unusual behaviors or activities, questions to ask once in port, and other thoughts.

At the End of the Trip

An observer's duties do not end when the vessel reaches port. Some observer programs require the collection of landing data. A port sampler may be present. If you must travel by air before returning the forms, be sure to hand-carry all important information and documentation.

Most programs aim for some manner of debriefing—a review of the trip with a debriefer from the observer program. These subjects generally include:

1. General description of the trip (duration, weather, catch)
2. Errors (intentional or otherwise) made by the crew in reporting location, catch, FAD sets, etc., on their log forms
3. Recorded cases of noncompliance, and other observed violations of RFMO measures or national laws
4. Relations with crew
5. Success of fish sampling
6. Any unusual events or encounters

As debriefers are generally very experienced observers in their own right, this meeting is a good opportunity for the observers to ask for clarification about their duties, improvement on the instructions (such as the observer manual, if there is one), or advice about managing relationships or conflicts on board. In some regions, the observer programs have grown faster than their ability to recruit and train debriefers, in which case, not all observers may be debriefed after a trip. But it is expected that debriefer training will catch up, so that all observers can expect debriefing in the future.

In Conclusion

This module has described some of the duties an observer will be called upon to perform while at sea. Depending on the observer program, additional scientific sampling or MCS (monitoring, control, and surveillance) activities may also be required. This information is only a guide or refresher and should not be considered a substitute for robust, in-person training. Indeed, increasing attention is being paid to the role of observers in fisheries management because RFMOs are realizing that quality observing is a critical component of scientific assessments and effective MCS.

By completing this online module, you are ensuring that the vessels on which you act as an observer are compliant with the ISSF observer training measure.[1] This allows those vessels to do business with the ISSF Participating Companies, which are interested in sourcing from environmentally responsible practitioners.

This guidebook for observers is a living document that will continue to be updated to reflect the state of the art. ISSF welcomes suggestions to improve the guidebook or ideas for further

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1 The ISSF measure can be achieved by being trained in one of the RFMO or national observer programs. However, in that case, this training module can also be helpful as a refresher.

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