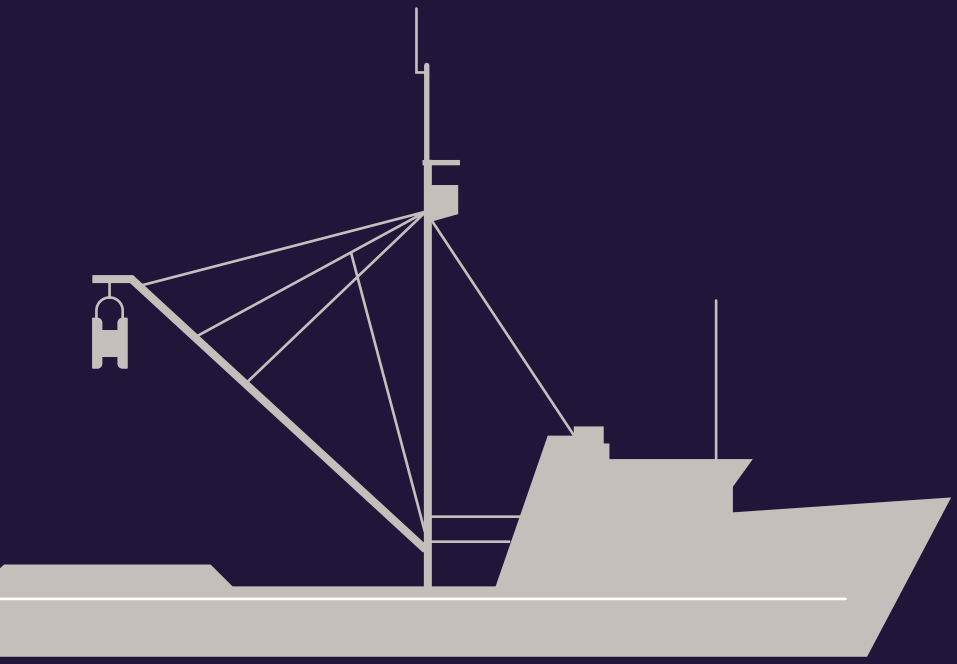
MCS PRACTIONERS INTRODUCTORY GUIDE TO:

PURSE SEINE FISHING



TRYGG MAT TRACKING

INTERNATIONAL MCS NETWORK

CONTENTS

GLOSSARY OF TERMS

AIS	Automatic Identification System
°C	Degrees Celsius
eFAD	(electronically monitored) Fish Aggregation Devices
GPS	Global Positioning System
GRT	Gross Registered Tonnes
IUU	Illegal, Unreported and Unregulated (fishing)
MCS	Monitoring, Control and Surveillance
RSW	Refrigerated Seawater
RFMO	Regional Fisheries Management Organisation
VMS	Vessel Monitoring System

This MCS Practitioners Introductory Guide has been developed by Trygg Mat Tracking (TMT) in cooperation with the International MCS Network (IMCSN). It is intended to be used as a training tool to introduce common international industrial fishing vessel and gear types, towards building knowledge in personnel working in all agencies (Fisheries, Port, Coast Guard and Navy, Maritime etc.) who may play an operational role in fisheries monitoring control and surveillance (MCS), as well as for use by broader interested stakeholders.

While this guide is a stand-alone tool focussed on purse seine fishing, it has been developed as part of series of similar introductory guides on other major industrial fishing methods and related operations, as well as complementary material on fishing vessel inspection considerations.

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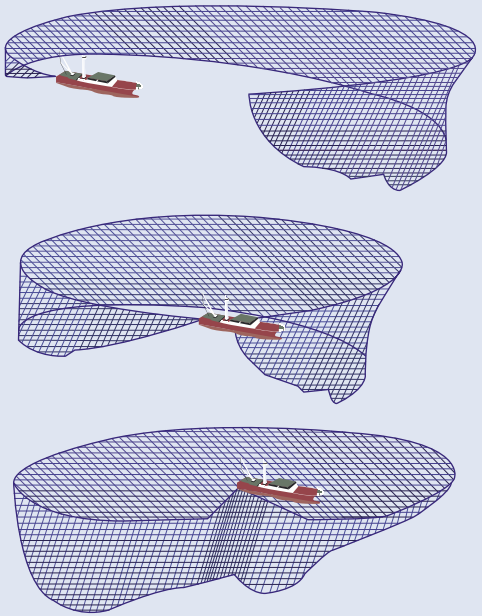
OPERATIONAL OVERVIEW: PURSE SEINERS

Purse seine fishing is a commercial fishing technique that is deployed to target a wide variety of marine species. Fishing vessels using purse seine nets appear in a variety of vessel and gear sizes. Vessels deploying purse seine nets can operate in both coastal and high seas waters.

HOW PURSE SEINERS CATCH FISH

The purse seine is an effective fishing method used to capture aggregations of fish and squid that group together ('school') near the surface. Once a school of fish is located, the fishing vessel quickly surrounds it using a long and deep net (the seine) that encircles the school. The seine is set with floats attached to the top of the net, and weights and heavy rings attached to the bottom to ensure that it hangs straight down in the water column. A cable (purse line) is threaded through the rings at the bottom of the net.

The net is then 'pursed' under the school by winching in the purseline, closing or 'pursing' the net so the fish can no longer escape. The net is then hauled lengthwise using a power block until the fish are packed tightly in the end of the net ('bunt'). The catch is then removed from the net with a large dipnet, braille or suction pump, so it can then be chilled or frozen.



TYPES OF PURSE SEINER VESSEL

TUNA PURSE SEINERS

These are large purse seiners which typically have a bridge at the front of the vessel, a large mast in the middle, a heavy boom that can carry the power block and a working deck at the backend of the boat. There are refrigerated storage wells for the catch. Their equipment consists of a three-drum purse seine winch and a power block, with topping, vang, cork and other specific winches to handle the heavy boom and net.

OTHER PELAGIC SEINERS

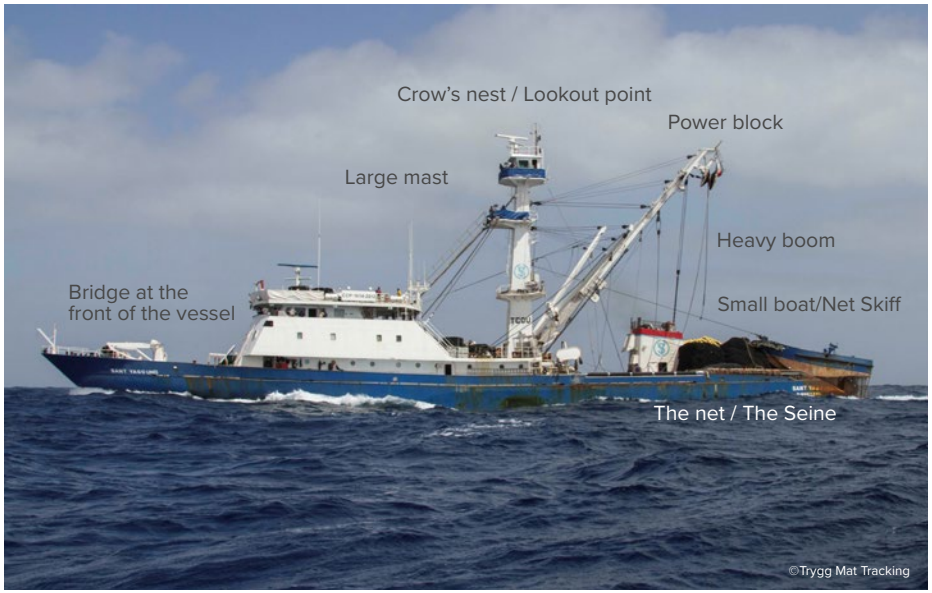
Purse seiners are also the gear of choice for smaller pelagic species used either for direct human consumption or the production of by-products such as fishmeal. These vessels comprise a large group appearing in all sizes ranging from small boat to large open ocean-going vessels. An example of a drum seiner is provided.

This briefing focuses on the operations of tuna purse seine vessels, although many of the principles are the same across all varieties.

HOW TO RECOGNISE A TUNA PURSE SEINER

In general, modern tuna purse seine vessels have a characteristic silhouette. The front of the vessel is raised high and the stern low. There is a distinctive bridge and often a raised crows nest for sighting schools of fish. At the rear of the vessel, there is usually a main deck, two thirds of which is used for stowing the net and for handling the catch. There is a hatch and a chute running down from this deck to the lower deck for the catch. The lower deck, known as the fish depot/deck, contains the holds (or 'wells') where the fish is stored, and the conveyor belts or channels that collect the fish dropped down the chute and distributes it to the different holds.

The sloping stern of the vessel is also used to store and launch a powerful tow boat, known as a skiff, panga or punt. This is used to tow the net and purse wire when the net is launched from the back of the purse seine vessel. There may also be other smaller tow boats to help manouver the main vessel as well as small fast skiffs or speedboats which are used to assist the fishing operations for example by supporting fishing manoeuvres, grouping schools of fish, preventing the school from escaping before the net is closed, and retrieving monitored fish aggregating devices (FADs).



GEAR ON BOARD

While the shape of a vessel gives a good clue in regards to the type of gear a vessel operates, it is the actual fishing gear on board that defines the type of fishing done and this should be reflected on the fishing licence. The key type of gear and machinery on board a purse seine vessel are those needed to both capture and preserve the catch.

PURSE SEINE FISHING GEAR AND RELATED EQUIPMENT

NET

Purse seine nets are the biggest nets used in fishing. Therefore, purse seine vessels are carefully designed to carry large and heavy nets. In a big tuna purse seiner, nets can be up to 3000 meters long, 300 meters depth and weigh an estimated 6 tons.

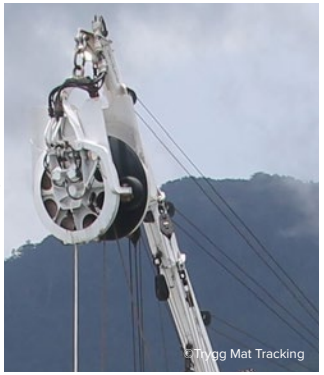
The net has chain and rings on the bottom side to hold the purse wire and floats on the top side to hold up the net on the surface. The net is stacked on the stern deck in a big pile up to 6 meters high.

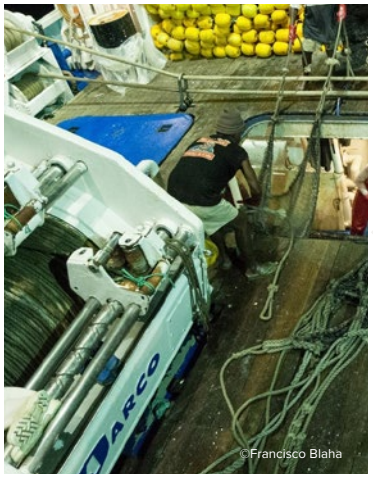
MAST AND BOOMS

Purse seiners have a very characteristic mast and a boom (or booms) linked to it towards the stern. The most important and largest boom has the power block on it, used for hauling the net. Smaller side booms can play a support role in hauling the gear, retrieving fish from the net etc.

POWER BLOCK

There are several types of power blocks that are used in tuna purse seine fisheries. Most vessels use some form of a boom-suspended hydraulic power block. The entire seine passes through the power block, descending to deck level for manual stacking by the crew. Correct positioning of the net is assisted by vertical and lateral movements of the main boom to which the block is attached.





PURSE WINCH

The basic form of the tuna purse winch is seen in the picture, consisting of a hydraulically driven purse wire drum, stern drum and bow drum. The stern drum holds all of the purse cable during the beginning of the set, paying out cable through the purse rings as the net is set in a circle. At the completion of the encirclement phase, the cable is connected to the bow drum and pursing begins on both bow and stern drums simultaneously. There may be more winches for setting and hauling operations.

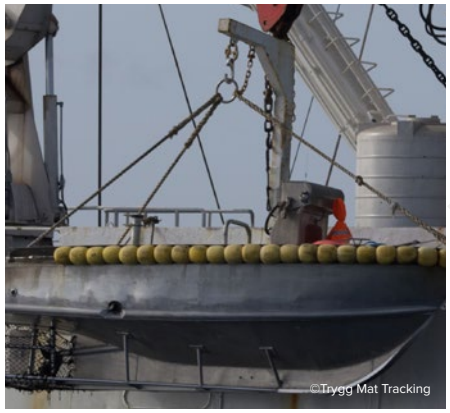
BRAILER

Rapid loading of the catch is critical, particularly where sea surface temperatures are high. A large dip net or 'brailer' that can load catch at a very high rate is generally stowed on deck. It is lowered (using the booms and cables from auxiliary winches) into the net when hauled on the side of the vessel and 'scoops' the catch and deposits it on deck where the catch is sent by chutes to the storage holds.

AUXILIARY VESSELS

SKIFF (TOWBOAT, PANGA OR PUNT)

The net skiff is a substantially sized auxiallary boat with a powerful engine that is stored at the stern of tuna purse seiners. Once a decision is made to make a set, the skiff is released, towing the end of the net, while the purse seine vessel deploys around the fish school to encircle them within the net. They are also used as tenders to transport crew and goods when anchored in port, and can support other fishing operations.



FAST SKIFFS

Deployed from the side of the purse seiner, these small, fast vessels serve multiple functions, including supporting fishing manoeuvres and net deployment, grouping schools of fish, preventing the school from escaping before the net is closed, and retrieving monitored fish aggregating devices (FADs).

SUPPORT VESSELS

Tuna purse seine operations are frequently aided by smaller support (or supply) vessels that operate independently from the main purse seine vessel. These vessels work in conjunction with one or a group of large purse seine vessels and primarily collaborate to deploy, monitor, and retrieve the drifting FADs. The support vessels also look for and evaluate other vessel's FADs and safeguard aggregations of tuna on their own FADs from theft by other vessels. One supply vessel may support several purse seiners or, less commonly, several supply vessels may support one purse seiner. The support vessels may also assist the purse seiner in its fishing operations by locating naturally floating objects and checking and evaluating them for fish aggregations; building and repairing FADs; adding/replacing FAD transponders; exchanging crew from and to port; supplying food, goods, bait etc.; serving as a platform for at-sea repairs, and more. This assistance is aimed to improve the fishing efficiency of purse seiners, increasing their catch rate and reducing costs, specifically those expended in searching.

A tuna support vessel involved in FAD deployment and retreival.

FINDING THE TUNA

The world's largest purse seiners are dedicated to catching various tuna species, primarily for the global canned tuna market. Tuna purse seine vessels find these highly mobile species either by spotting free-swimming schools of tuna, or by targeting schools of tuna that have aggregated around natural or artificial floating objects.

Free-swimming schools of tuna are spotted from an elevated platform such as a crows nest, with spotters looking for telltale signs such as flocks of birds, dolphins, and the tell tale signs of a 'feeding frenzy' of fish breaking the surface of the sea. Some larger industrial vessels may use the aid of a helicopter (or if close to shore a spotter plane); drones are also increasingly being used. Usually stored above the bridge and away from collision hazards, helicopters are commonly compact single rotor two seater designs, with perspex cockpits that allow observers a good field of vision when searching for tuna.

Catching schools of tuna using natural or manmade floating objects takes advantage of the natural tendency of fish to aggregate around such objects in the open ocean. Man-made floating objects are called fish aggregation devices (FADs). FADs are constructed out of a variety of materials, but have similar characteristics. They normally consist of a floating raft (made of bamboo poles or large buoys), subsurface aggregating materials such as palm fronds or netting, and a satellite tracking device that signals its location to the vessel. The use of netting is generally discouraged due to the risk of bycatch entanglement, but does occur in some fisheries.

An example of a Fish Aggregating Device (FAD)

Some FADs have echo sounders that detect the amount of fish underneath them and transmit this information back to the fishing vessel. These technologically advanced devices allow vessels to determine when to return to a FAD to maximise their catch and efficiency. Migrating tuna and other species gather under the FADs, making schools easier to find. Tuna purse seiners use drifting FADs, which drift with currents in the open ocean. FADs can also be anchored to the seabed in coastal waters, however these are generally not used by tuna purse seine vessels. The use of FADs significantly increases the catching capacity of a tuna purse seiner, and as a result most tuna RFMOs now restrict the number of FADs that can be used by a vessel, and/or are introducing FAD closed seasons.

Schools of tuna will also aggregate around logs and other large natural objects floating in the water, so vessels may also set their nets around these. Large marine animals such as whales and whale sharks can have a similar effect on smaller fish species, which has historically led some tuna purse seine vessels to deliberately set their nets on these animals; this practice is now banned by most RFMOs. Fish will also aggregate around data buoys and purse seiners have been known to set around these; as this practise frequently damages the data buoy, some RFMOs have introduced measures banning this practise.

FAD transponders. Each will be attached to a FAD and transmit information about the fish that are present under the FAD, as well as positional location.

A spotter helicopter on a purse seiner

PRESERVING FISH

Once on board, the fish pass below deck to be loaded into fish holds (also known as 'wells'). In smaller purse seiners, fish are delivered straight into holds filled with iced seawater. Bigger vessels employ chute or conveyor belt systems to quickly deliver catch into the desired holds. Most tuna landed by purse seiners are chilled whole in refrigerated seawater (RSW) without bleeding, removing the gills, or gutting (i.e. as whole fish). This technique involves storing fish in brine (made by adding salt to sea water) and reducing the temperature of the brine until the fish (but not the brine) are frozen.

Freezing large amounts of fish requires very large powerful freezing equipment and high-volume wells. These occupy much of the lower part of the vessel and are equipped with pumps for brine and RSW circulation. In the larger vessels, there are also "dry lockers" that work as "traditional freezers" where already brine frozen fish is stored 'dry' (without brine). Newer vessels also have specially adapted "dry lockers" that act as blast freezers for higher value species (similar to those in Longliners) that can freeze and maintain temperatures to -35°C.

In some regions, groups of smaller purse seine vessels may operate together along with a 'mothership'. The catch vessels themselves may not have storage wells, but will instead bring the fish to the mothership that will then take the catch on board and store in its own holds.

Once in port, the catch is offloaded using the booms or alternatively external cranes either onto refrigerated cargo vessels, into refrigerated containers for onward transport, or into local coldstore or canning plants for processing.

Tuna frozen in refridgerated sea water (RSW) being lifted out of the fish hold for offload

DESCRIPTION OF THE FISHING OPERATION

Once a fish school is sighted, the vessel captain will evaluate the potential species, school size, and chances of capturing the aggregation. Often electronic devices like the echosounder and sonar are used to assist this process. If the school 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 school.

If the decision is made to set the purse seine net, the vessel is positioned near the school of fish. The skiff is released, maintaining the tension on the seine with its powerful engine while the seiner encircles the school with the net. Most often, the floatline (the floating part of the gear) will be in a circular or oblong shape when the purse seine vessel and net 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 manoeuvre 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 process begins. The net is hauled with the aid of the power block at the end of the main boom and stacked back on the stern deck of the vessel with help of the crew. As the volume of the net in the water becomes smaller, the fish become more concentrated. At the end of hauling, the “sacking up” point is reached, where the final slack in the net is removed, the catch is concentrated and then “scooped” out of the net and onto the deck using a brailer or pump.

The length of the whole shooting and hauling process will depend on the amount of fish in the school and the size of the brailer as well as varying factors such as sea conditions, mechanical issues etc. During the manoeuvres the purse seine vessel will likely drift at low speeds with the wind and current.

A purse seiner in the process of hauling the net after it has been ‘pursed’ around a school of tuna.

DISTANT WATER TROPICAL TUNA PURSE SEINERS - OTHER CONSIDERATIONS

TARGET SPECIES

Tuna purse seiners primarily target schooling pelagic tuna species such as skipjack and yellowfin, generally for use in canned tuna. The targeted tuna stocks are found mainly in tropical waters, although their range can extend up to 40 degrees north and south of the equator. Since skipjack tuna often swim with juvenile bigeye and yellowfin tuna, these other tuna species often end up as a bycatch of the fishery. Albacore tuna are targeted in more temperate waters. In general, tuna purse seiners typically catch large quantities of lower value young or small-sized tuna (versus longline vessels for example which catch fewer but higher-quality, larger and higher value tuna).

In recent years the purse-seine catch of bigeye tuna has been increasing rapidly, mostly due to the increased use of FADs. It is estimated that more than 60% of total tuna catch is caught by purse seiners, and up to 90% of global landings of skipjack, yellowfin and bigeye tuna.

In other fisheries, purse seines are also used to target smaller schooling pelagic fish such as herring and mackerel.

Catch being offloaded from a purse seiner in West Africa, showing a mix of tropical tuna species.

BYCATCH

Tuna purse seine vessels are associated with the ‘bycatch’ of many other species. This includes sharks, swordfish, sea turtles, and occasionally whales or dolphins. In addition, the bycatch of juvenile tuna can be of concern. While bycatch may occur anytime a purse seine is operated, sets on free-swimming tuna schools is likely to have significantly lower bycatch rates than sets on FADs, which attract species other than tuna.

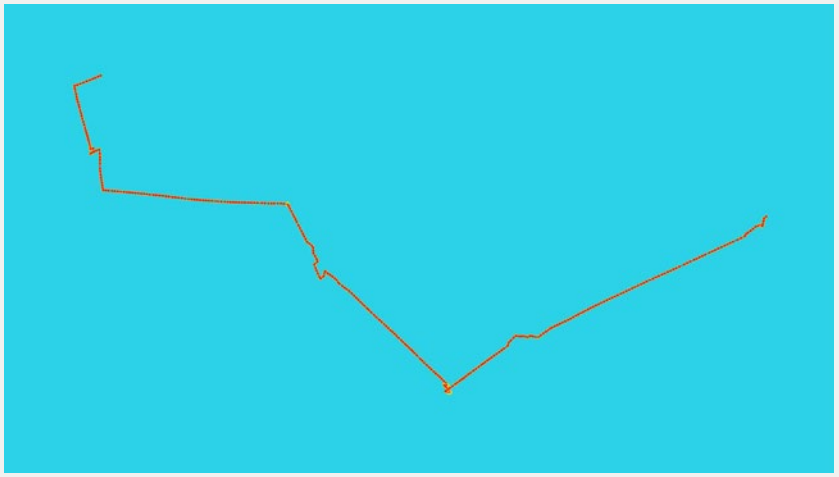
PURSE SEINE VESSEL TRACKING

The ability to get a clear indication of what gear type is being used by an individual fishing vessel, based on vessel movement patterns from remote monitoring sources such as AIS and VMS varies considerably across gear types, the length of the fishing operation, and the frequency and availability (temporal/spatial resolution) of the position signals. However, in general it is important to understand that vessels that use different gear types do generally have distinctive positional patterns. The longer that fishing operations go on, the more likely the vessel can be identifiable by fishing method due to the likelihood of an increased number of vessel positions being received. One characteristic that is common to all fishing operations is that there is always a stop or drop in speed at some point in the fishing operation.

Industrial Tuna Purse Seine operations leave a distinctive pattern on AIS and VMS. Shorter and longer periods of searching for schools of fish, or transit to and from FADs, leaves a track pattern of stable speed and course. In between these stable tracks periods of drifts at low speeds, generally representing the set of net and hauling of the catch, may be seen.

While general operations and drift events do leave a distinct pattern, the actual setting of the gear is normally over within minutes. Therefore it may not be visible in tracks, particularly in VMS, due to the gaps in between positional transmission (e.g. low resolution). AIS does however on occasion provide high enough resolution to also establish clear indications of the sets and encircling activity.

It is important to be aware that while in most cases a drift event by a purse seine vessel is likely to be fishing activity, it could also be an indicator of a number of other activities, including maintenance stops, transhipment or rest periods.



AIS positions showing a distinct pattern for a purse seine vessel, where longer search and transit patterns can be seen in between breaks with low speed patterns, indicative of sets and hauls.

A) AIS positions showing a pattern indicative of a purse seine set and haul, where a) shows a track with HIGH temporal resolution with positions every minute. The half circle (with a length of 1500 meters, performed in 8 minutes) indicates the encircling a school of fish. This is followed by a drift pattern.

B) Shows the same event with a LOW resolution of one position per 30 minutes, where only the break in course and following drift pattern can be seen.

PURSE SEINER INSPECTIONS - WHAT TO LOOK FOR

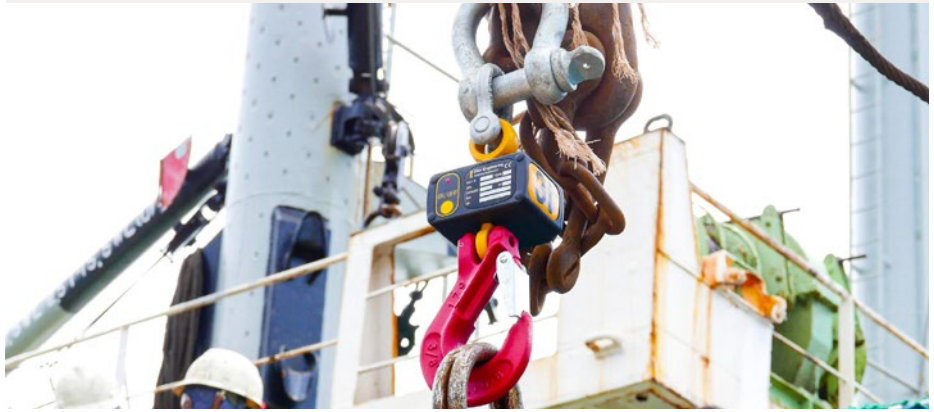
For an overview of the general needs and considerations for the inspection of all fishing vessels, please refer to the brief MCS Practitioners Introductory Guide to Industrial Fishing Vessel Inspections. Specific considerations for in port and at sea inspections of purse seine fishing vessels include the following:

CATCH RELATED

Most licensing conditions specify the target species, the bycatch able to be retained on board, and in some case total allowable catch volumes. It is well known that one of the critical illegal, unreported and unregulated (IUU) fishing issues relates to underreporting and misreporting of catches. Transhipments or offloads in port by purse seiners is one of the last opportunities for port inspectors to measure the level of a vessel's reporting of catch before the fish is transported further for processing. Inspection should evaluate if the volumes found in fish holds are in a similar ratio as in the logbooks / catch declarations, etc. When fish are offloaded they can be inspected for species composition to ensure that these meet requirements.

UTILISING NEW TECHNOLOGY TO ADDRESS CATCH REPORTING RISKS

New technological advances offer port inspectors an opportunity to substantively improve this monitoring process and record accurate weight data for an entire transhipment or offload based on the use of hanging crane type scales (called dynamometers) with a wireless remote weight display attached to the hooks of the cranes used during the operation. This provides port inspectors an opportunity to record accurate transhipment or offload weight data and helps eliminate the challenges and issues relating to the use of catch "estimates". Initial use of these hanging crane type scales by port inspectors in several port inspection programs has shown that the accuracy of weights were significantly increased and provided a means of independent verification of weight of catch transshipped or offloaded in port. Port inspection programs should consider the use of this emerging technology as a component of their own port inspection processes that involve purse seiners.



TRANSHIPMENT

No tuna RFMO permits the transhipment of fish at sea from a tuna purse seiner to a carrier vessel[1]. While it is considered that the overall risk of transhipment by purse seine vessels at sea is low, it is certainly possible and cases are documented.

If analysis of VMS/AIS is conducted as part of the Advance Request for Entry to Port (AREP) assessment indicates that the vessel has spent time at sea in close proximity to another vessel (generally 4+ hours) at the low speed required for transhipment (generally less than 2 knots), then the possibility of an illegal transhipment should be investigated as part of an inspection. In this case, logbooks, temperature variations on the cargo hold, and estimates of volumes and catch composition in the fish holds in comparison to those recorded in documents can be used to determine if a non-authorised transhipment

1. In some regions this was temporarily suspended during the global COVID-19 pandemic.

took place. However, it needs to be considered that operationally there are many other valid reasons for which two vessels manoeuvre alongside one another that do not imply transhipment, for example provision of food, new gear, crew, parts, oil, etc.

Transhipment in port between tuna purse seine vessels and carrier vessels occurs in many ports not at dockside, but at anchor in the port. As a result many such transhipments may not have adequate levels of inspection. An in-port transhipment that is not observed however can hold the same risks as an at-sea transhipment, namely the under-reporting of catch, possible illegal catch not being identified, the presence of regulated bycatch species, and issues such as incorrect or forged paperwork.

In-port transhipments that take place at anchor frequently have low inspection levels, yet present many of the same risks as at-sea transhipment and require good oversight.

FADS

Both purse seine vessels and their support vessels should be inspected to ensure that they are meeting any FAD management measures that may be in place, whether limits on numbers per vessel or closed seasons and areas. This can be done by inspecting log books, as well as the eFAD monitoring system onboard the vessel. Key areas to look at include the number of FADs that are deployed and being monitored; these should be within the required limits and there should be none in closed seasons for example. FAD locations, particularly regarding closed areas, can also be examined.

It is also important to inspect logs to ensure no sets on NOAA data buoys or tsunami buoys have taken place, particularly where these are RFMO prohibited activities.

NOTES

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