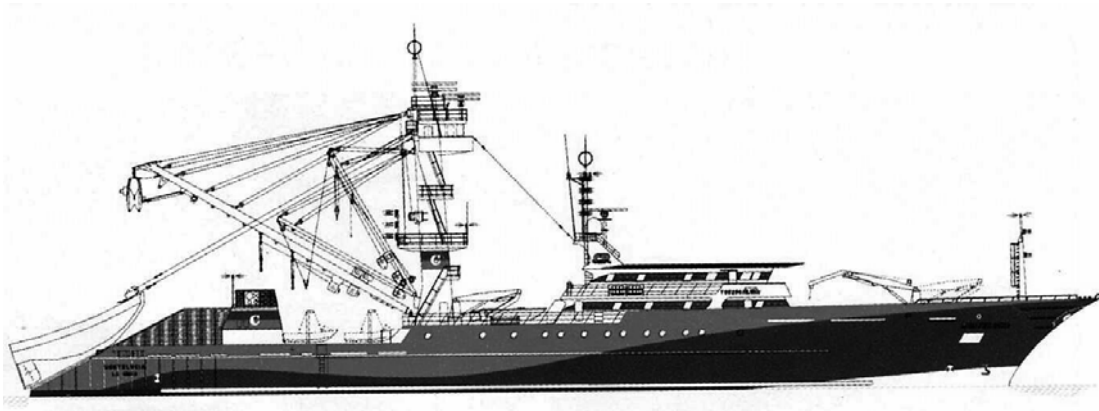




SCTB15 Working Paper

FTWG-10

Super Superseiner



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INTRODUCTION

Purse seining for tuna is one of the more technologically advanced of fishing methods, often characterized by the image of a large, sleek “superseiner”. This term, made popular in southern California during the late 60s or early 70s referred at that time to tuna vessels that could carry more than 1000 short tons of catch. A popular class of vessel having close to 1200 st capacity became the industry standard during the 1970s and formed the main component of the US fleet. Purse seine technology representative of this period spread to the Atlantic and Indian Oceans, being adopted by Asian and European fleets. A perfect example of this technology transfer were the French vessels described by Stequert and Marsac (1983) These vessels are small by present day standards, with some tuna seiners of the 21st century capable of holding three times this amount of tuna in huge brine wells. The general silhouette of a tuna seiner has changed little over time, but their size and sophistication has advanced dramatically.

During the 14th Standing Committee on Tuna and Billfish, presentations were made discussing purse seine technology and effective fishing effort during the sessions of the Fishing Technology Working Group. One suggestion during the FTWG preparatory meeting was to document a “state of the art” purse seine and longline vessel as part of a so called “frontier , or highliner analysis”. The reasoning behind this sort of exercise is to document the most technically advanced, efficient and productive fishing unit to use as a guideline for where further advances in a fishery may lead. These discussions lead to a specific task for the FTWG to: Document a “state of the art” purse seine and longline vessel as an example of where fishing technology may be headed in the future.”

This brief paper will describe a hypothetical “state of the art” tuna purse seine vessel at the time of SCTB 15 with some notes on gear and methods that were not known or widely utilized when the first “superseiners” operated in the eastern Pacific Ocean.

This attempt does not claim to be at all complete or highly detailed due to the difficulty in obtaining technical information from the commercial industry and the author’s unfamiliarity with the latest technologies that may be in development by industry. Therefore, information contained here should be viewed with caution until more directed studies have been completed. However, this account attempts to begin this task and put into print some of these technological developments that may have a significant influence on increasing effective fishing effort and the vulnerability of tropical tuna.

VESSEL CHARACTERISTICS

General vessel attributes

Length and gross registered tonnage (GRT) are poor descriptors of fishing vessel size and fishing power due to the many ways in which measurements are taken. However, overall length is usually used as one means to describe tuna seiners and can provide a useful comparison. Since 1970, large seiners have grown from around 65 m LOA to more than 100 m LOA with a beam of around 16 m.

GRT is a particularly unreliable parameter to examine as it is figured on different systems depending on country of registry. For tuna vessels, total fish hold capacity is a far better descriptor of size and potential fishing power. The early superseiners carried approximately 950 to 1150 mt of brine frozen tuna in 15-19 fish wells while the larger modern seiners can hold 2500 - 3000 mt of catch in 22 holds or more.

Top speed is not especially relevant to tuna seiners, as they normally cruise much slower for fuel savings, and rated speeds of seiners have not appeared to change a great over the years. What has

changed is the addition of bulbous bows on all large seiners to achieve greater fuel efficiency and performance. Typical top rated speeds are approximately 16 knots, but the vessels normally cruise at lower speeds.

Although this comparison examines vessels built thirty years apart, US seiners were not operating in the western Pacific in 1972. Therefore, the information in this report and contained in the following table will compare vessel and gear attributes for a vessel operating in 1982 and a hypothetical vessel that could be equipped today.

Table 1. Vessel specifications of a hypothetical tuna seiner operating in 1982 and one operating in 2002.

Characteristic	1982	2002	Comments
length overall	~ 65 m	~ 105 m	
beam	~ 12.5 m	~ 16.0 m	
draft	~ 4.5 m	~ 7.0 m	
bulbous bow	No	Yes	2002 – fuel efficient hull
number of fish wells	15 – 19	19 – 22	
fish well capacity	950-1150 mt	2500 – 3000 mt	
catch storage temp	-9 to -12 C	-20 C	1982 – catch maintained in brine 2002 – catch brine frozen and held dry
maximum speed	15 kts	19 kts	
propeller	fixed blade	variable pitch	variable pitch – greater control, less main engine wear
bow thruster	Yes	Yes	
stern thruster	No	Yes	stern thruster provides greater control in pursuing and net hauling stages
power block size	~ 140 cm	~ 230 cm	
side roller	No	Yes	side roller necessary for “Spanish style” brailing
seine skiff	12.2 m	11.5 m	large skiff not needed for “Spanish style” bailing
crew	18 – 20	27 – 29	1972 needed helicopter pilot, 2002 needs electronics tech, sonar specialist, etc.

Notable improvements over the years include the addition of side rollers, stern thrusters, variable pitch propeller and improved refrigeration systems.

Auxiliary Vessels Small boats

Many of the US vessels that moved to the western Pacific came from active participation in the ETP fishery for tuna found in association with dolphins, and were equipped with several light, fast speedboats. These vessels were used to herd dolphins and associated tuna during fishing operations, but found little use in other oceans, where tuna are not seined in association with dolphin.

Auxiliary vessels used by modern purse seiners are often associated with setting on drifting objects. Therefore, heavier, powerful work boats are needed to tow logs and FADs out of the net. These vessels may also be equipped with high quality echo sounders and radios to relay additional data to the main vessel on school size, location and species composition.

Some fleets believe in the power of artificial light to enhance the aggregative effect of a FAD or log, and make use of lighted auxiliary boats. The smaller ones will be equipped with portable generators to power the underwater and surface lighted devices. This has been a common practice with Philippine seiners for many years when operating on anchored FADs. Large, lighted tender vessels have also been utilized. Itano (1991) describes the use of a 35 m search boat with underwater and surface lights that were used to increase aggregation in log sets for a Japanese group seiner in 1990. The EU project ESTHER has also documented the use of lighted tender vessels used by their fleet.

Supply vessels

These supply vessels used by large EU seiners are described in Arrizabalaga et al (2001) and in the ESTHER Scientific Report of Project (Gaertner and Pallares, 2002). Two general types of supply vessels are in use: anchored and navigating vessels. Anchored vessels act as FADs and use large light arrays to increase aggregation, and are usually located on a seamount. These vessels are fully equipped with sonar and sounders used to assess the size of the aggregation. Navigating supply vessels operate on the high seas as support vessels for purse seiners, engaged in activities that include: building and seeding of FADs, location of floating objects, recovery of FADs, assessment of school size and species, facilitating crew changes at sea, provisioning, movement of injured crewmen and serving as a repair facility for the fishing vessels (Arrizabalaga et al, 2001). Another important duty of supply vessels is to guard their drifting FADs belonging to their company from setting by other vessels.

Net skiff

The primary auxiliary vessel of a purse seiner is the purse seine net skiff, which anchors the bow end of the net during the setting process. The net skiff was an integral part of the fishing process during the earlier period as it was used to tow the stern end of the catcher vessel out of the encircling net during pursing and supported the stern bunt of the net during drying up and brailing (Itano, 1990). However, with Spanish style brailing and stern thrusters, the importance of the net skiff has greatly diminished. There may even be a reduction in the size and power of net skiffs on modern seiners, but this requires further investigation.

Helicopter

Helicopters can also be considered a form of “auxiliary craft” associated with the catcher vessel. The use of helicopters for searching and setting operations has greatly diminished in recent years due to the success of “bird radar” for locating surface schools and increases in remotely sensed, artificial drifting object sets that take place before dawn.

GEAR ATTRIBUTES

Net

The purse seine net is the main gear item on a seiner. Information on tuna purse seine nets published in observer reports is summarized in Itano (1998). In general, knotless nets used by the Japanese have tended to be longer and deeper compared to knotted netting popular with US and EU fleets. Knotless netting stacks in a smaller volume, sinks faster and purses more easily requiring less power to purse and haul. Disadvantages of the twisted strand knotless netting include: slippage at the crosses and much weaker than knotted netting, requiring greater care in setting and hauling in current.

A newer form of knotless netting (Ultra Cross) is formed by four braided strands that eliminate the slippage problem and form a much stronger mesh with the advantages of old style, twisted knotless webbing. Ultra Cross netting is also available in materials much stronger than traditional nylon, such as Spectra, polyethylene and polyester blends. Additional advantages of Ultra Cross are claims of longer service life compared to knotted nylon and the material does not abrade fish as badly during the brailing process. Disadvantages include high initial cost and more difficult to mend. However, rips in the net will not “run” as was the case with twisted, knotless netting.

Improved sinking and pursing characteristics of purse seines have also been realized by lightening of twine diameter and enlarging mesh sizes in the main body of the net.

Electronics

Improvements in marine electronics is a well known factor in the increase in effective fishing effort and efficiency of tuna purse seiners. This section will concentrate on categories of marine electronics

that have improved significantly in recent years, or whose use has expanded into new areas of development.

Improvements in radio buoy technology have lead the way toward the successful development of drifting FAD technology. The technology has also been driven by a need to reduce the the ft of radio buoys and the tuna associated with attached FADs. Morón et al. (2001) provides a detailed timeline of developments in radio buoy technology adopted by EU tuna purse seine vessels for fishing on drifting FADs In the Indian Ocean. Information from this report is summarized in Table 2. Some of this information, particularly on the earlier models was obtained by interviews and should be treated with caution until more research can be carried out. However, information on the recent, high tech models is considered quite reliable.

Basically, constantly transmitting radio buoys, which are still used in some fisheries are unsuitable for modern seining as they are too easy to locate by other vessels and can be easily stolen and the signaling frequency re-set. Range and battery life are poor.

Sel-call buoys eliminated other boats tuning in the buoy, since it will only signal when the mother ship sends a signal to begin a short transmission During this brief period, the vessel would establish a most probable course toward the buoy by radio detection finder. The problem was that the loading coil of the buoys could be detected by high resolution radar. To foil this method of locating and stealing radio buoys, the manufactures began to install inclined antennae on radio buoys around 1995.

The introduction of GPS buoys really revolutionized fisheries, as they allowed the vessel to plot real-time positions of their FADs and plan the most efficient fishing strategy.

In recent years, most vessels have adopted the use of long-range GPS tracking buoys that have battery life of almost one year and send GPS, SST and battery condition by HF radio signals. These units have an antennae protruding from the top. One disadvantage of this antennae is that other vessels can detect the buoys at ranges up to around 14 miles. However, this is a plus for the vessel as well.

A further development has produced GPS buoys that can send position, track, SST, battery condition and sonar information through the INMARSAT satellite array. Sonar data can be set to scan different depths and send data to the ship. However, these buoys are expensive and sonar data can be misleading if foreign material or undesirable sizes or species of fish are recorded.

Table 2. Evolution of radio buoy technology (Morón et al. 2001).

Device	Features	Detection range	Date of introduction	Comments
constant transmit	sending signal every few minutes	~ 90 nmi	pre-1980	Limited range, short battery life, easily located and re-programmed
sel-call radio buoy	remained inactive until signaled from vessel	~ 150 nmi direction, ~ 400 nmi audible	1986	Increased battery life
high frequency sel-call radio buoy	increased range due to higher frequency transmission	~ 200 nmi direction, ~700 nmi audible		
bent-antennae sel-call radio buoys	inclined antennae	reduced	1995	bent antennae made detection by radar difficult
GPS sel-call radio buoys	receives GPS position from satellite and transmits position by radio signal	700 – 900 nmi	1996	revolutionary, allowed real time position data
“Serpe” type GPS tracking buoy	sends GPS, SST, battery state by HF radio signals	700 – 1400 nmi	1998/1999	sends track data to computer screen, very long battery life
Satellite transmitting GPS / remote sonar transmitting buoy	sends GPS, SST, sonar data, battery state via INMARSAT	essentially unlimited	1998/1999	uses solar panels to extend battery life, sonar data can be set to different depths

The hypothetical super superseiner of 2002 might be equipped with marine electronics as described in Table 3. Some items simply did not exist or were not commonly used in 1982, while other items simply became more powerful and full featured, such as radar and depth sounders. Recent GPS tracking systems are capable of tracking up to 170 different radio buoys.

Table 3. Marine electronics on a hypothetical tuna seiner operating in 1982 and one operating in 2002.

Item	1982	2002	Comments
Doppler current meter	No	Yes	
Navigational radar	Yes	Yes	2002: very high resolution, used to detect buoy antennae
S band Bird radar	No	Yes	
Sat Nav	Yes	No	Sat Nav currently obsolete
GPS	No	Yes	
Sounder	Yes	Yes	2002: scientific grade, computer integrated units
Sonar	Yes (one unit)	Yes (four units)	2002: low frequency unit for long range detection, higher frequency unit for medium and short range, species discrimination
Radio buoys	constant transmit	sel call, bent antennae sel call, GPS sel call, GPS radio transmitted, satellite linked GPS and sounding buoy	2002: Serpe type radio transmitted GPS buoys and satellite GPS/sounder buoys most popular and advanced

IMPROVEMENTS TO FISHING OPERATIONS

The adoption of some form of the so called “Spanish style” brailing has had the greatest impact on overall vessel efficiency to purse seine fishing power. Traditional brailing requires that the net skiff be used to support the corkline of the net sack while bights of webbing are slung and hauled up in the long process of drying, or “sacking up” the net. Brailing was accomplished by manually pushing the brailer hoop into the sack full of fish, perpendicular to the axis of the vessel, which was hauled up to the boat using hydraulic unloading boom and main boom winches.

With Spanish style brailing, no net skiff is necessary as the corkline and sack are supported by a reinforced unloading boom. A much heavier brailer ring is drawn through the sack in a bow to stern motion by a deck mounted winch. No people are needed and the total automation allowed brailer capacity to increase to approximately 4 – 5 mt.

Integral to the full use of this system is the installation of rubberized rail rollers that speed up drying of the net and can easily dry the net after each brailing operation.

An adaptation of this system uses a stick mounted brailer ring that slides through a ring on the top of the purse davit. With this system, popular with the US fleet, the pole provides some stability and guidance, resulting in fast and safer brailing operations.

IMPROVEMENTS TO FISH STORAGE AND UNLOADING

Increased loading speeds requires faster chilling and freezing times which has been maintained by more powerful ammonia compressors, brine chillers and improved refrigeration technology.

The final bottleneck in production is related to the time each vessel loses in port unloading the catch. Unloading brine frozen tuna can be a long, difficult task as each fish is pulled free from a frozen mass of fish and thrown into a steel unloading bucket.

Modern tuna seiners float the catch out rather than dry the well and pull each fish out by hand. A raised stainless steel combing is bolted onto the regular combing and a chute connected from the well to a conveyor belt that runs the length of the wet deck. Frozen fish are simply floated out on chilled brine, spill out the chute and are carried out to the stern unloading hatches by the conveyor belt.

SUMMARY

The modern super superseiner of 2002 bears many superficial similarities to tuna seiners of 1982, but are much more efficient and productive. The simple proof of increased fishing power is that modern seine vessels are capable of landing more than twice as much tuna per year. These considerations stress the importance of adjusting for increases in effective fishing effort and the dangers of regulating by unadjusted vessel numbers or vessel days.

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