



Purse Seine and its operation

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Purse seining is one of the most aggressive, efficient and advanced fishing methods. It is aimed mainly at catching dense, mobile schools of pelagic fish and includes all the elements of searching, hunting and capture. The schools of fish are surrounded and impounded by means of large surrounding net. A purse seine is made of a long wall of netting framed with float line and lead line (usually, of equal or longer length than the former) and having purse rings hanging from the lower edge of the gear, through which runs a purse line made from steel wire or rope which allow the pursing of the net. Thus a bowl like space is created in which the fishes are enclosed and prevented from escaping. It is the most efficient gear for catching large and small pelagic shoaling species. Purse seines were used as early as 200 years ago and the modern purse seine started evolving about 100 years ago.

Small purse seines are operated entirely by hand in small scale fisheries. In artisanal or semi-industrial fisheries, the purse seine handling equipment may include: a purse seine winch or a capstan, a purse line reel, a brailer and a power block and in some fisheries, a net drum. In industrial purse seine fishery, the basic equipments include, in general: a hydraulic power block or Triplex roller, a powerful purse seine winch, a number of derricks, including a brailer or a fish pump, a skiff and sometimes, an helicopter.

The purse seine can be used by a large range of vessel sizes, ranging from open boats and canoes up to large ocean going vessels. The purse seines can be operated by one or two boats. Most common ones are those operated by a single boat, with or without an auxiliary skiff.

History

The purse seines have developed from two different fishing methods – beach seine and lampara. Beach seines have been used through the ages almost all over the world. They are usually deeper than the depth of the water. The top edge is framed with a float line and lower edge with a lead line. It is set in a semi-circle at some distance from the shore and then hauled ashore onto the beach using long ropes. During hauling, the beach seine filters the whole depth of the water from the surface to the bottom. As soon as the wing tips come within the reach of the fishermen they bring the lead line of both wings together in order to gather the fish towards the centre. The bunt part with the catch inside is the last part to be brought ashore. Purse seines evolved from beach seines in 1920s with the incorporation of a pursing arrangement in order to close the net at the bottom after surrounding the shoal of fish. This facilitated operation of net in deeper waters. Lampara – The term lampara stems from the Greek and Latin roots of the word lamp (Lampas, lampa), as this fishing method must have been associated with lights. In contrast to beach seines, lampara are true surround nets.

They have rather short wings, a deep central bunt, and a lead line substantially shorter than the float line. It form a scoop shape during hauling.

As early as 1863 Chinese fishermen were known to be using them for catching squid. In 1893 the first purse seiner Alpha started fishing sardine and mackerel in California. Purse seining fishing continued only for large fish like barracuda, yellowtail and white sea bass. Since 1914 it has been also used for tuna. In 1940 purse seines for sardine fishery were introduced. In India only after 1977 purse seines were introduced and now have become a very important fishing gear for harvesting mackerel and sardines in the south west coast.

Purse seining in the world

In some parts of the world, purse seining produces the largest single catches of all fishing methods. A good example is the Chilean fishery, where a fleet of about 300 purse seiners harvest a catch of about 6 million t of clupeids – an average of around 18000 t. The other major purse seine fishery is the tuna fishery which is carried out over a far greater geographical area. Purse seines are also used to catch the demersal fish such as cod by modifying its design to operate close to the bottom. However, the major contributor to the purse seine fisheries of the world is the vast number of smaller vessels landing small quantities of all species of fish. The percentage of the world catch caught by surrounding nets fisheries is 25 % to 30 % of the total world catch.

Sardine and mackerel purse seines are generally 200 – 300 m long, where as the tuna purse seines are longer and range in length from 350 –1000 m and are usually deeper in proportion. Japanese two-boat purse seines are the largest in the world with 2300 x 300m. The American and other tuna purse seines are of one-boat type for catching skipjack, yellow fin, blue fin and Albacore. Norwegian and Icelandic purse seines for herring and mackerel are shorter but deeper with 500m x 200m.

Common sizes of famous purse seines in the world

- i. Modern Peruvian Anchovieta purse seines : 585m x 52m
- ii. California Tuna purse seines : 900m x 81m
- iii. Norwegian Tuna purse seines : 1440 x162 m
- iv. South African Pilchard purse seines : 668 x 72 m
- v. Anchovy purse seines : 477 x 63 m
- vi. Icelandic purse seines : 414-252M x (Deeper seines) 162 - 252M

Fish landings by major fishing gears

- i. Trawls : 40%
- ii. Purse seines : 20%
- iii. Gill nets : 20%
- iv. Lines : 10%
- v. Others : 10%

Main species fished by purse seines

The fish groups are the clupeids which provide the largest total landings of any category of pelagic fishes. The individual stocks are subjected to substantial annual fluctuations, which are thought to be influenced by both excessive industrial fishing and changing environmental conditions. Examples are the Californian sardine, South African pilchard and the Peruvian anchovies.

European pilchard – (*Sardina pilchardus*) Over a million tonnes of European pilchard are caught annually along the western coast of Africa and Europe and in the Mediterranean and Black seas.

Sardinellas - *Sardinella* spp. About 10 species of the genus *Sardinella* contribute to the annual world yield over 1.2 million tonne. The most important species are the round or Spanish sardinella (*S. aurita*) caught off W Africa, Central America, north eastern coast of South America and the Mediterranean, and the Indian oil sardine (*S. longiceps*) major catches of which are from India and Philippines.

Menhaden (*Brevoortia* spp) About one million tonnes off south east coast of US are landed annually.

Japanese pilchard or sardine (*Sardinops melanostica*). This is one of the major surround net fisheries of the world, producing an annual catch of over 5 million tonne.caught mainly by Japanese, Korean and Russian fishermen.

Chilean pilchard or sardine (*Sardinops sagax*) Annual landings between 4 to 5 million tonne. Mainly caught by the Chilean and Peruvian purse seine fishermen.

South African Pilchard (*Sardinops ocellata*) This species is seen along the coast of southern Angola, Namibia and republic of South Africa.

Anchovies (*Engraulidae*) Highly fluctuating fishery due to environmental and excessive fishing effort. The most outstanding collapse was Peruvian anchovieta fishery which was caused by the invasion of warm El nino waters displacing the cold and nutrient rich waters of the Peruvian upwelling.

Scombrids (tunas, bonitos, mackerels and bill fishes) Scombrids are one of the commercially most important fisheries. The world annual tunas, bonitos and bill fishes reaches 50 % of the total scombrid fish landings. More than half of the tuna landings is made by US and Japanese fisheries.

Mackerels – Around 4 million tonnes of mackerel are caught annually, mostly with purse seines.

Other fishes

Salmon- Substantial purse seine fishery of salmon is that of the USA and Canada on the north west coast of north America. Around 3-4 million tonnes of mackerel are caught annually.

Capelin (*Mallotus villosus*)- It is one of the most important commercial species of Northern Atlantic Ocean. The bulk of the catches were taken by Icelanding and Norwegian purse seine fishermen.

Squid – Of the 2 million t of squid landed annually only a fraction of this amount is caught in surround nets.

Crustaceans – *Metapenaeus dobsoni* are sporadically landed by purse seiners usually in Karnataka and Kerala in India.

Structure of purse seine.

The structure of purse seines vary widely depending on the method of operation, gear handling, depth of operation, target species and vessel characteristics. Brief description of a typical purse seine net is given below.

Bunt: The region in the purse seine net where the catch is accumulated before brailing is called the bunt because of the excess strain it has to withstand. It is made up of heavier netting. The bunt is placed in the centre or at the end of the wall of the netting depending on the type of operation. The bunt should be at least as long and deep as the length of the boat.

Main body: It extends from one end to the other end of the net except the bunt region. It is the largest part of the net and facilitates surrounding of the fish shoal during operations. It is made by joining together large sections of netting of appropriate mesh sizes to catch the target fish. The material used should have high specific gravity to increase the sinking speed during setting. Twisted knotless netting and Raschel braided netting are lighter and are widely used for purse seines. But, of late knotted webbing is preferred over knotless webbing, because of the difficulty to repair knotless webbing when damaged.

Selvages: Selvages or guarding are strips of strong netting and are used for strengthening the main webbing and to protect it from damage during operations. It is provided in the upper, lower and side edges of the main body of the net. It consists of few rows of large meshes of thicker twine. The upper selvedge is attached to the float line also called the head rope and the lower selvedge to the lead line or foot rope. It is also attached to the side ropes or gavel lines. Lead line is usually longer than float line by 10 %.

Floats: Best floats for purse seines are plastic. Shape of floats can be cylindrical or spindle. Total buoyancy of float is maintained at 1.5 to 3.5 times the total under water weight of the purse seine net and its appurtenances. Higher buoyancy is provided in the bunt area in order to counteract the sinking force due to weight of heavier netting in this area and the weight of fish while concentrating the catch. Usual extra buoyancy of floats is 2 to 4 times the weight of foot rope with sinkers. Usually double float lines, one rope with right hand twist and the other with a left hand twist is rigged, which prevents it from twisting. Braided rope is very good for float line because once stretched it does not kink twist (turn around itself) or twist.

Sinkers: Spindle shaped sinkers are attached to the lead line to attain 1-3 kg.m-1 for small purse seines and up to 8 kg. m-1 for large tuna purse seines. Lead of approximate weight of 50-65 g are used as sinkers. size 15 - 20 No per kg. Usually 180 to 220kg of sinkers are used for a sardine purse seine of 250m. with the distribution of 0.5kg to 2 kg per metre of lead line

Bridles and tow line: Bridles are ropes attached to float line and lead line on either side and are connected to a tow line of sufficient length to facilitate setting and hauling operations.

Lines and ropes Twisting of fibre ropes may cause considerable problems hence braided ropes are preferable to twisted one. It is recommended to pre-stretch new ropes before the netting is stapled to them. This can be done putting the rope under load and using swivels to rake out extra twist. In case multiple head lines and float lines are used it is advisable to use ropes with opposite twist directions so that the twisting forces of each rope counteract one another.

Float lines - Floats are threaded to the float lines and to which the netting is hung directly. Single rope float line is disadvantageous due to distortion of the meshes of the guarding strip which occurs around the floats if the hanging is tight and with loose hanging the distortion is less, but spaces are created between the float line and the netting where small fish may escape

or large fish or porpoises may get jammed during hauling. Both the distorted net edge and the loose hanging create weak spots along the float line which may give way when under load. It is advisable to have float lines made up of two or more ropes. While rigging the net, it is more convenient to hang the netting from the hanging line and then to seize it together with another rope carrying the floats.

Lead lines- Lead lines as a rule are made of ropes of the same size as that of the float lines. Single rope lead line are used more often than that of single rope float lines. It could be mainly due to the size of the sinkers which are smaller than the size of the floats and hanging netting directly on the lead line does not cause problems. Chain lead lines and lead lines without sinkers are also used.

Gavels and other vertical ropes – Gavels (breast lines) are made of similar ropes to the lead lines or float lines. Their length depends on the net.

Purse lines : Fibre ropes and steel wire ropes are used for purse lines. Fibre ropes are used when the pursing is manual. Most seiners have purse lines at least 10 – 20 % longer than the total length of their seines. If the purse lines are very long then swivels are used to connect one or two purse lines to prevent twisting and kinking. Purse lines are subjected to considerable frictional wear in the purse rings and abrasion on the winch barrel and in the purse blocks. Steel wire, polyamide and PES are considered good for purse lines. It must be about 100 to 150 times longer than the joint length of the lead line and the gavels. Purse lines are made of synthetic rope for small and light purse seines or of steel wire rope of 5/8" or 3/8" for heavier purse seines.

Hanging coefficient: The most common horizontal hanging coefficient on float line is 0.7 and for body and bunt is 0.65. Lead line : 0.75 for body and 0.7 for bunt

Tow lines: It is usually made of rope or steel wire and is the last part of the seine that is paid out from the purse seiner. The end of the tow line remains attached to the seiner and it can be used to allow a greater circumference of set to be made by using the tow line as an extension of the net.

Tow ropes: It is about $\frac{2}{3}$ rd of the float line length. The tow rope or lazy line is paid away at the same time as the bunt.

Purse rings: must be strong – steel or brass rings are used with snap type or closed. The size of purse rings depends on the size and weight of the net. These in turn depend on the size of the boat. For small and light purse seines, purse rings of 100 mm to 150 mm across and made of steel 10 mm in diameter and weighting 1 to 1.5 kg each can be used. For bigger nets rings of 120 mm to 180 mm across of steel 12 mm in diameter and weighing 2 kg to 3 kg each can be used. Number of purse rings may vary from 20 to 60.

Design

Before designing a purse seine gear, the following factors will have to be taken into consideration. The area to be fished, the size of the vessel; the biological characteristics of the target species (such as shoal size, swimming speed, swimming layer, size composition and behaviour of fish during approach of the craft and during surrounding, and pursing of the gear). Determination of length, depth and shape of the net; depending on the target species. Selection of materials; mesh size and twine thickness for the bunt and the body netting, hanging coefficient, and determination of weight and number of sinkers and floats required for the net.

The size of purse seine varies in different region in different conditions and the mode of operations also may differ. However, it is common in design and construction. The webbing surrounded by selvages on all its four sides is of uniform mesh size depending on the type of fishery. It is formed by lacing a number of vertical pieces of webbing one after another. The depth of which increases systematically from both wing ends and reaches at the maximum at the central strips. The mesh sizes are usually the same throughout but the twine size will be generally thicker at the bunt end and the wing region.

The length and depth of the seine must be determined by the size of the vessel, the species, behaviour of fish, fishing method and condition. It is easiest for operation when the depth is between 10-15 % of the length. However, in certain cases the depth goes upto 30 – 50 % of the length for inshore purse seines for sardines, anchovies, pilchard where the shoal depth will be more. On the contrary deep sea purse seines for fast swimming fishes like tuna, skipjack etc long and relatively shallow seine is most suitable. A rough rule of thumb is that depth of the purse seine is one-tenth of the float line. Most purse seines are 1/7-10 depth length ratio or $L = 10H$. varies to $\frac{1}{4}$ to $\frac{1}{3}$ for deep swimming and quick diving shoals. The lead line is usually shorter than the float line by 5 to 12 percent.

Mesh size : The mesh and twine size is directly related to the size of fish and the quantity of fish caught. Choice of too small mesh size increases the cost and results in slow sinking. Too large a mesh size results in loss of catch as well as gilling. The mesh size of purse seines must be small enough not to gill the fish in any part of the seine. A common practice is to select a mesh size considerably smaller in the bunt, but a larger mesh is enough in the other parts of the seine.

Choice of mesh size is a function of the target species. It is necessary to avoid enmeshing or gilling the fish (with respect for regulations on minimum mesh size)

$OM = \frac{2}{3} \times \frac{L}{K}$ (Fridman formula)

Where

- OM = mesh opening (mm) in the bunt
- L = length (mm) of target fish
- K = Coefficient, a function of the target species
- K = 5 for fish that are long and narrow
- K = 3.5 for average shaped fish
- K = 2.5 for flat, deep bodied or wide fish

Twine Size: The main criterion for determining the twine thickness for netting in a purse seine is to provide sufficient strength for pursing and hauling when the load due to the fish is maximum. The wing ends and the lower and upper selvages of the seine are subjected to the greatest stresses. Therefore twines of greater thickness are used in these parts. Minimal loads are imposed on the central sections of the seine.

Floats and sinkers – Sinking speed is found to be proportional to the square root of the apparent lead line weight. Excessive weights results in damage, strain on hauling equipments and handling problem. The normal requirement is 0.5 top 2.0 kg.m^{-1} of foot rope. The buoyancy requirement is 2-4 times of the weight of the foot rope.

Ratio of ballast to weight of netting (in air) The weight (in air) of the ballast normally ranges between $\frac{1}{3}$ and $\frac{2}{3}$ the weight of the netting in air. The weight in air of the ballast per metre of seine foot rope is often between 1 and 3 kg (although more is used for small mesh purse seines used to catch deep swimming small pelagic fish and upto 8 kg/m is used in large tuna seines).

Ratio of buoyancy to total weight of the seine - The rigging of floats on a purse seine must take into account not only the buoyancy needed to balance the total weight of the gear in water, but also additional buoyancy. This additional buoyancy should be of the order of 30 % for calm waters and upto 50-60 % in areas of strong currents, to compensate for rough sea conditions and other factors related to handling of the gear. Buoyancy should be greater in the area of the bunt (which has heavier twine) and mid way along the seine (where pulling forces are greater during pursing).

In practical terms the buoyancy of the floats should be equal to about 1.5 to 2 times the weight of the ballast along the bottom of the seine. Lead line of the purse seine is usually longer than the float line upto 10 %. However, in some types the two lines are equal in length.

The hanging ratio (E), is usually greater on the lead line than on the float line. Hanging ratios generally range from 0.50 to 0.90, depending on the type of the net. The hanging ratio may also vary along the float line or lead line, usually being lower in the bunt.

The tow line is normally about 25 % of the length of the purse seine.

The purse line is generally 1.1 – 1.75 times the length of the head line, usually about 1.5 time the length of the purse seine. The purse seine must have good resistance to abrasion and good breaking strength. As a general guideline the breaking strength (R) of the purse line should be as follows:

$R > 3 \times (\text{combined wt of the netting, lead line, leads and purse rings})$

$R = (\text{tons}) = \sqrt{\text{tonnage of vessel}}$

Volume occupied by the seine when rigged.

$V(\text{m}^3) = 5 \times \text{weight (tons) of the seine (in air)}$

Depth in water: As an approximation the actual depth or height (AD) can be considered equal to roughly 50 % of the stretched depth. (SD, or stretched mesh size x No. of meshes) of the seine at its extremities and 60 % near the center of the net.

$AD = SD \times 0.5 = SD/2$ extremities

$AD = SD \times 0.6$ centre of net

Sinking speed of a purse seine for different seines - sinking speed has been measured in a range from 2.4 – 16.0 m/min, with an average of 9.0 m/min.

The overall size of purse seine is best expressed as length of float line. A purse seine in water is not a truly vertical wall of webbing but the net is hung so that it is roughly cup-shaped when laid out in a circle. This is accomplished by making the lead line shorter than the float line.

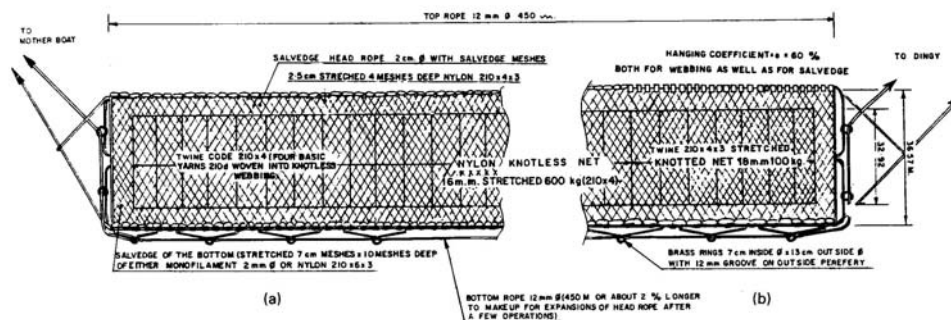
Selection of materials

Properties of the netting materials exert profound influences on the fishing net. Based on the requirements of the fishing gear the materials are selected. The choice of material for the construction of purse seines is very important. The following properties are to be considered before selecting the material for purse seine.

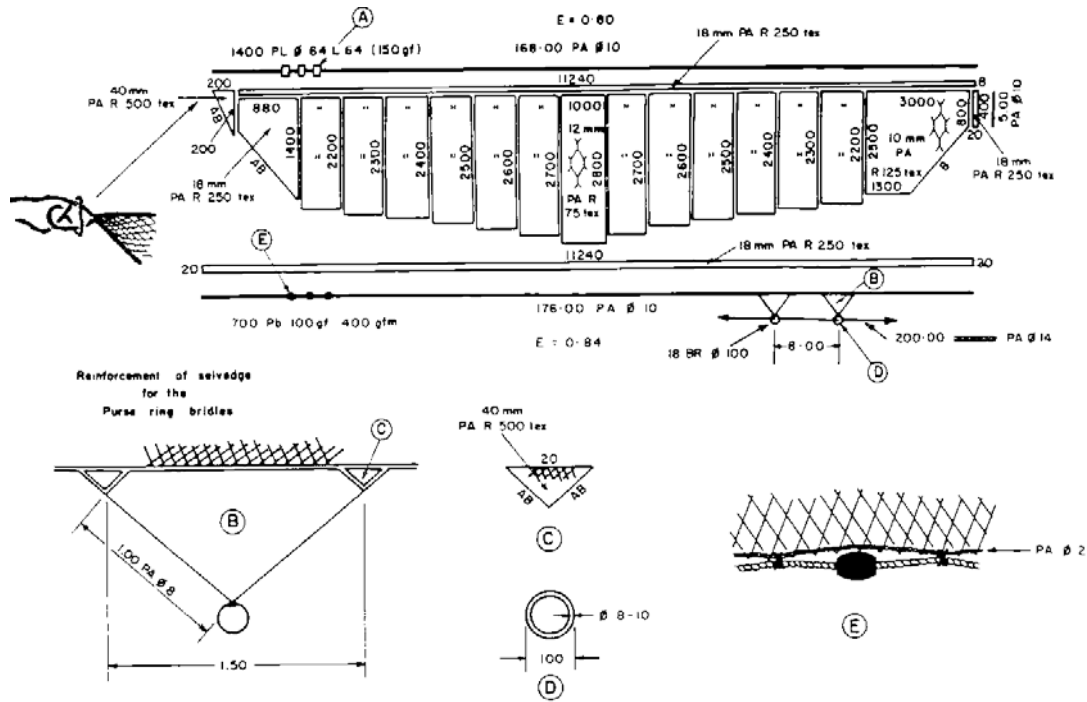
High breaking strength, excellent elastic properties, high specific gravity, low resistance against current, good water shedding capacity and type of knot.

As it is a huge net, the material used for purse seine should be thinner (preferably knotless) to reduce the bulkiness of the net. It should have high breaking strength. As the net has to withstand enough energy against impact forces due to accumulation of fishes and during hauling the netting material should have high elastic property. For better performance of the net the material used should sink fast and the net has to be pursed as quickly as possible to evade escape of fish shoals. The sinking speed depends on the sp gravity, degree of twist and the smoothness of the twine. This also can be increased by increasing the amount of weight in the foot rope.

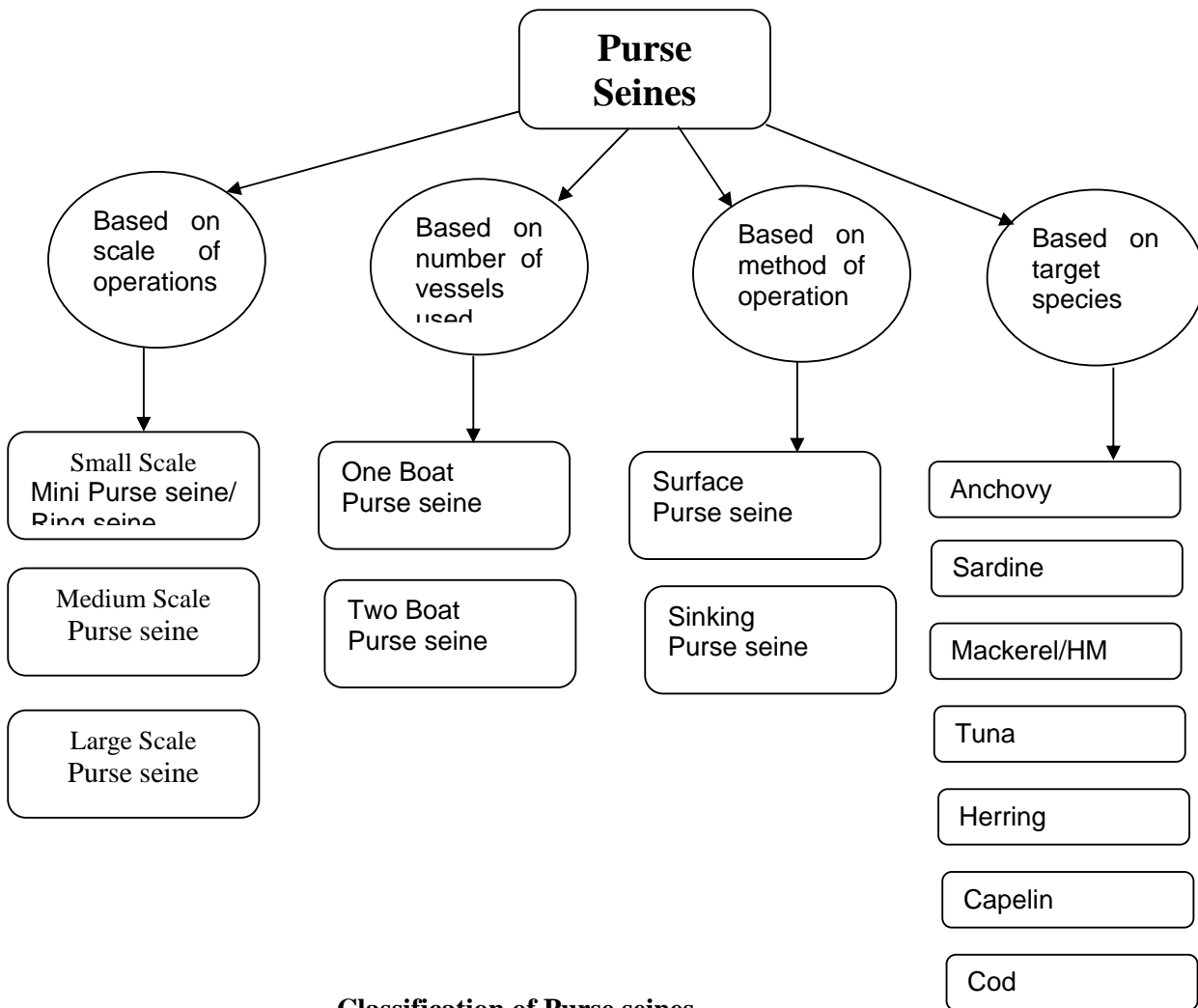
To avoid the distortion of the net due to strong under water current, which sometimes could be from two different directions, the material selected should have less resistance against current. Knotless netting is preferred to knotted netting because the resistance will be less than the knotted netting. Hence large parts of the netting in purse seines use knotless webbing. Recently hexagonal meshes netting has been introduced due to the advantages of comparatively low hydrodynamic resistance and saving in the total material required for the net. Only the bunt and selvedge are constructed using knotted net for the required strength in these parts of the net. Among synthetic materials terylene and nylon are preferred as they are having high breaking strength. Recent trends is to make combination twines like PA and PVC so as to combine the strength of the former and the high sp gravity of the latter material.



Design details of a purse seine used by small-scale fishermen of the west coast of India



A modern, FAO purse seine for small scale fishery using boats 10-12 m (Pajot 1978)



Fishing Operations

Fish detection and scouting are the most important aspects in purse seining. Searching for fish aggregation, then identifying wherever possible the fish species and evaluating school sizes and its catchability, prior to surrounding is the major part of a purse seine operation. Purse seining operations involves location of fishing grounds, scouting, setting, pursing and hauling.

Location of fishing grounds

Location of fishing grounds is very much necessary to reduce expensive searching time, which will also save fuel costs. Satellite imagery, aerial spotting, and general hydrographical information are very helpful in locating fishing grounds. Information on position and extent of fish concentrations, average size of shoal and depth and general movement of schools are very vital for increased efficiency of purse seine operations.

Fish behaviour and schooling patterns

Many types of schools can be distinguished in the sea. The fishermen are well experienced and are able to identify the shoals. The most important and commonly encountered ones are :

Breezing school (Breezers) – Fish swimming very close to the surface of the water, usually in a single direction, creating ripples which resemble those created by a light breeze

Boiling school (Boilers) – Fish feeding intensively and often in conjunction with marine birds, crowding upon the prey and creating an impression of the top of the boiling pot.

Jumpers – Schools moving with some members breaking the surface showing all or most of their bodies.

Black spots – Surface schools appearing to the ship borne observer as black or dark spots.

Spinners – Fish swimming very close to the surface which shine from time to time, probably by deflecting light from their bodies as they twist and turn in pursuit of prey.

Fire balls – Surface schools which can be spotted during night time owing to the bioluminescence they generate in water

Different species and sizes of the fishes have different schooling characteristics and this makes it possible to identify different school types from the air and sometimes at night due to bioluminescence. In fact, experienced fishermen are able to identify the species and also are able to roughly estimate the size of the shoal.

Attraction to FAD and flotsam

The attraction of fish to floating objects has been observed and utilized by the fishermen in many parts of the world. FAD attraction enabled the development of the traditional dolphin fishing in Malta because dolphin fish do not naturally occur in the Mediterranean in fishable schools. Sophisticated FAD systems may comprise sonars, and FAD – Ship automatic radio communication and supply information on the occurrence of fish concentrations in the neighborhood of the FAD.

Scouting for fish

Visual spotting- They can be spotted from high places out at sea or from the crows nest placed on the main mast. Scouting is also done using powerful binoculars which are generally mounted on the bridge. A constant look out is maintained for fish schools.

Fish location using hydroacoustic equipment – Echosounders is one of the most practical and effective fishing tools and can be used even by the smallest of seiners. Sonars are also used for searching the fish school.

Preparing a purse seine for setting

For a smooth operation the seine must be properly stacked. The net will have to be arranged properly before the commencement of the voyage so as to enable the crew to release the net from its bunt end and skiff end simultaneously. To facilitate this, the head rope with floats is stacked at the port side stern, keeping the skiff end at the top with the skiff line and the haul line at the bottom.

Operation

Purse seines can be set in one of the following four ways.

- (a) with a skiff
- (b) using a buoy with or without sea anchor
- (c) using an anchor with or without skiff
- (d) using a tow rope

The traditional method is the side method. The purse seine can be operated either with the aid of purse boat, with the help of the drive line and without purse boat or drive line.

It is not enough a shoal is located. Its movement is another factor to be encountered, to determine the position of the boat to be taken before spotting. After locating and scouting the fish shoal to determine its movement and ascertaining the direction and velocity of wind and current, encircling is done generally in a clock wise direction.

Setting operation

The main factors are the type of bottom, distance from shore, state of the sea, wind and current. Strong under currents having a direction and velocity different from the surface current may deform and entangle the net. The purse seine is set around a detected school of fish. After that, the net is closed underneath the school by hauling the purse line running through the rings (pursing). Hydroacoustic instruments, like sonars are important tools to locate fish aggregations. Also common is the use of "natural" signs of fish aggregations (often observed with binoculars) to start with the fishing operation, like concentration of sea birds, ruffling of the water surface and presence of groups of dolphins. Artificial " Fish Aggregating Devices" (FAD's) and light attractions are used in some fisheries to concentrate the fish.

Direction of wind and current

A fair knowledge of direction and speed of wind and current are the pre requisites of successful purse seining. As the layout of the net is in the proper direction and if the current is feeble and the wind strong, paying of the net should begin in such a way that if the boat is drifted towards the net it should be taken away from the net. In case when both the current and the wind are strong, it is not advisable to operate the gear.

Light attraction can be useful for successful purse seining where one or more of the following conditions occur

- i. Fish do not create schools to justify purse seining operations
- ii. Fish swim too fast
- iii. Fish prefer to stay in shallow and rocky areas
- iv. Fish swim to deep

Light attraction is unsuccessful in the following conditions.

- i. Visibility in water is poor
- ii. Current is strong
- iii. Strong moonlight

Chumming

It is often used to slow down fast swimming fish. It enables the aggregation of dispersed and loosely associated fish.

At just the right moment, the tow boat is dropped over the stern with the end of the seine tied to it. Running in reverse, the towboat holds the end while the seiner quickly circles the fish paying the seine overboard as she goes, coming around to pick up the end from the tow boat again.

The fishing operations realized by a purse seiner to catch fish, from the beginning of the shooting of the net up to the end of the hauling, back on board of the seine (ready for a new shooting), are called a "set".

Surrounding the fish

Normally the starting point of the set should be such that at the end of the shooting the working side of the seiner faces the wind so that the wind pushes the vessel away from the net.

Setting speed

The vessel speed is reduced due to the resistance of the seine descending from the seiners deck or net bin. It is estimated that a seiner loses about 20 % of her free running speed while setting a seine on a straight course. The seiner loses additional speed owing to the curvature of the set as a function of the radius of the set to the vessel length. Normally the net is set at the maximum possible speed. However excessive setting speed may delay the sinking of the lead line.

As soon as the shoal is located, the skiff with the skiff line and portion of the net is towed and paid in the form of a circle surrounding the shoal. For the correct positioning of the vessel versus the fish school, the direct observation from the crow's nest, at the top of the mast, is essential (as it was also before for the detection/location of fish from signs at or over the surface of the sea, including seabirds). The vessel then encircles the school at maximum speed. Usually, the purse seine is set and the circle is closed within 4 to 8 minutes. In the Mediterranean Sea, purse seiners fishing northern blue fin tuna often do not shoot all the length of the seine and close the circle with only a portion of the net. At this time, tunas can change their direction and escape before the circle is closed. In the eastern Pacific Ocean, purse seiners often set on tuna school associated with dolphins. 3 to 5 speedboats are then used to maintain the tuna school within the area expected to be closed by the purse seine and to push away the dolphins. By the time, the vessel completes the circling, the skiff transfers the line to the vessel and recovers the breast line selvage portion of the bunt end thus forming a circle, the circumference of which is thus completed by the seiner with the shoaling fish in it.

With the completion of the layout and recovery of the skiff wing, the rear end of the cable is fixed and purse winch commences (this is called "pursing" because it is similar to pulling the drawstring of an old-fashioned purse). Pursing is an important stage of the fishing operation. It has to be done carefully and swiftly. Any minor error of judgment or delay in executing may lead to fouling the net in the propeller, loss of catch, or accidents. The maximum pursing speed depends on the power and rpm of the winch. It can reach upto 2m/s. A purse line is used to close the bottom of the purse seine net after surrounding the shoal. The purse line passes through the purse rings attached to the lead line. The length of the purse line is roughly 1.5 times the length of the pure seine.

As the cable reels over the drum, the purse rings with bridles come up one after another closing the bottom of the net and when all the rings are up, they are hoisted and the net is completely closed. It is worth observing that, until the purse seine is not closed, the fish can still dive below the net or the purse seine vessel and escape. During the pursing, and especially when there is current, in order to prevent the purse seiner from drifting over the net, the skiff is attached to the starboard side of the vessel and pulls it away from the net. In the Eastern Central Pacific area, a special operation, known as the "backdown operation" is realized at this time in order to release dolphins having been trapped in the purse seine. The pursing may take for large purse seines around 15 to 20 minutes. Side by side with pursing,

hauling also starts from the wing end by manual labour or power block. The fishes are concentrated at the bunt region and brailed out mechanically or by manual labour.

Hauling

Purse seines are hauled manually or by using power blocks aboard the purse seiner with a hydraulic power block which is, on board industrial purse seiners, attached to the end of the boom and hanging above the deck, on medium size vessels operated at the extremity of a crane fixed on the deck at the aft part. Under the power block, the net is stacked on the stern of the boat by fishermen in such a way that it will come smoothly off the stern at the beginning of the next set. As a whole, this operation will, if there is no incident, take around one hour.

When most of the purse seine has been retrieved, the fishes have been gathered within a restricted area along the portside of the vessel. Then the fish are harvested from the purse seine using a large scoop net called the "brailer". Several tonnes of fish are taken on board each time. The duration of this operation will depend upon the quantity of fish in the net.

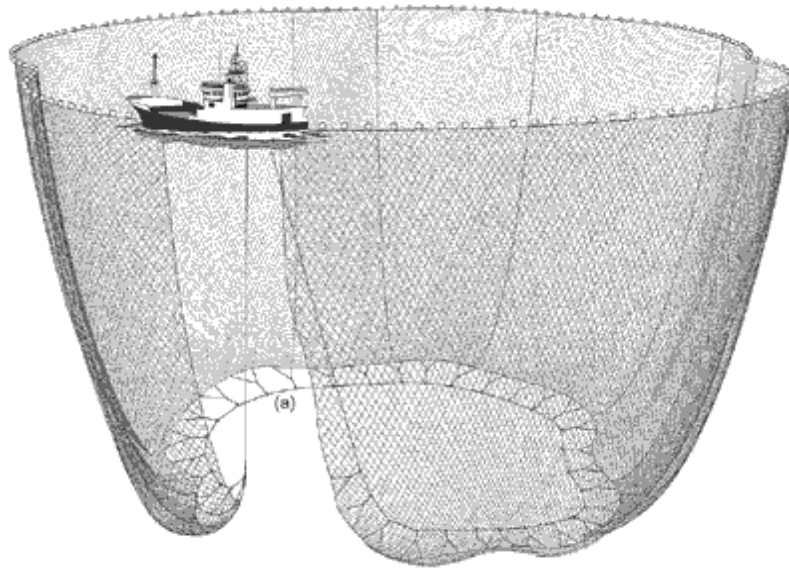
Aggregated resources in the upper levels are most common, but fish at depths up to 300 m can also be targeted. The purse seines are also used in inland areas when there is enough room for the operation of a large net. Because of its characteristics there is no impact on the bottom habitat (except when the water depth is less than the height of the seine during the fishing operations and that the lower edge of the gear wipes the sea bottom). The main negative impact is the incidental capture of dolphins in certain fishing areas. Special techniques have been developed to reduce by catch of dolphins; the Medina panel and "back down" operation, which allow encircled dolphins to escape alive. When small pelagic purse seines are used with light attraction, there may be incidental catch/by catch (including too small fish, juveniles or endangered species).

Purse seining with FAD and floatsam

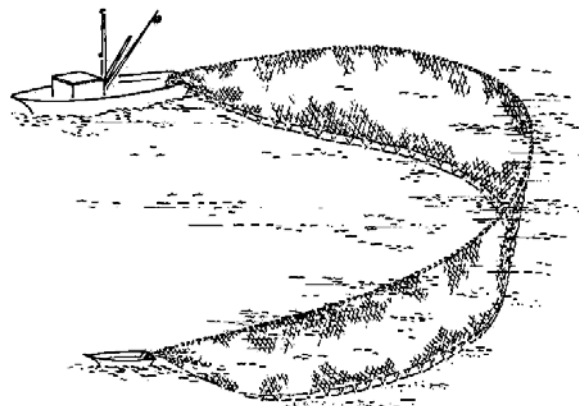
The fishing operation is same as above, but due attention is to be given so that the net does not foul on to the FAD. There are three main methods of making a set around the FAD. In the first method the FAD is hauled in along with float, cable and anchor towards the end of pursing on the deck of the seiner. The second method consists in pushing the FAD float under the lead line just before the end of pursing. In the third method the FAD is rigged with two floats, one at the end of the anchor cable, and the other, the FAD with its lures. The FAD can drift or can be slowly towed away from the anchor buoy and the set can be made around the drifting part of the FAD. The FAD remains safely inside the net throughout the operation and is not hauled onboard until the seine has been fully pursed. FADs in association with lights are also used to see that the school of fish remain with the FAD during the pursing operation. A scout boat with echosounder is associated with the FAD to identify a commercial fish concentration at FAD and to communicate with the seiner. This increasingly used practice of encircling floating objects, including man-made FADs increase the capture of small sized and immature fishes aggregating around such devices.

Foul gear formation

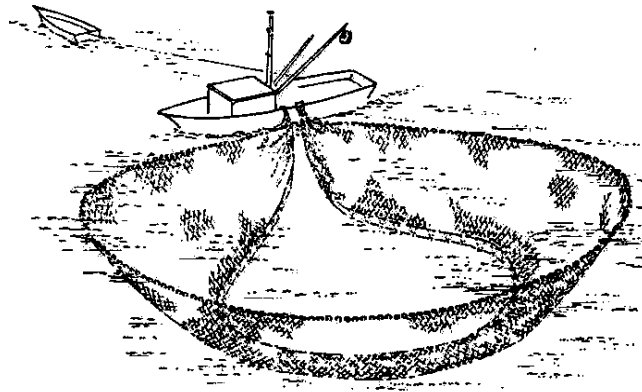
Fouling of gear is caused by coiling of the wing with the purse cable, which to a great extent is due to pursing prior to the fixing of foot and head rope of bag end. When the skiff end foot rope is free during purse seine, the purse wire as it rolls over the winch, drags the free foot rope and entangles it with a cable resulting in incomplete pursing. Yet another type of foul gear can occur if no proper care of the direction of the wind and current is taken. In this case the boat will be over the net and while pursing, the cable will come in contact with the webbing below the boat resulting in falling of the webbing over the cable.



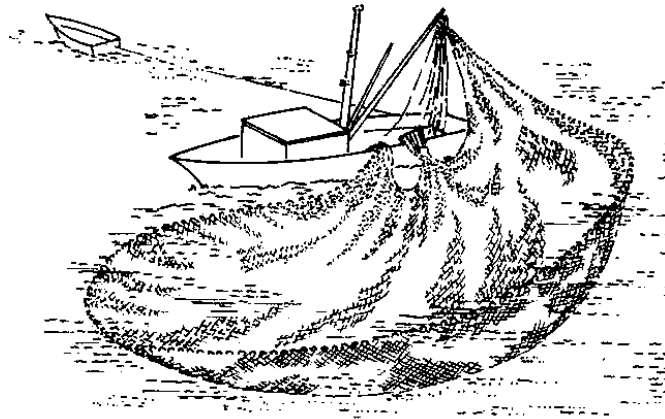
A diagrammatic representation of purse seining



Setting the seine



Pursing the seine



Hauling the seine

Three main stages of purse seining operations

Preventing fish escaping during purse seining and hauling

Preventing the escape of fish from a purse seine as it is being pursed has been tackled in many way. The most common, and simplest method is by making noises in the water by banging on the hull of the seiner and skiff. Some fishermen use explosives. Special dyes are also used which form an opaque curtain in the sea through which the fish will not pass. Fish scaring lamps are used during night.

‘Tom weights’ are used over the side by means of a rope running through a separate sheave at the purse davit to reduce the gap between the wings during hauling operations. A submersible hydraulic winch is also used in some of the sophisticated vessels.

Sometimes fishes tend to escape between the floatline and the netting if the staplings are not tight and close to each other. Fish jumping over the float line is also common and could lead to major losses of the catch. To prevent this, the float lines are tied together and also suspended by booms and lifting it over the gunwale. This operation can also be done by auxillary skiffs