Design Concept, Rigging and Operation of Pelagic and Semi-pelagic trawls

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Technological advances are essential part of any industry for furtherance and development and fishing can be no exception. If we look back at the development track of fishing industry for the past 30 years, we can easily enumerate the differences in many aspects. Global fish production has increased to 100 million tons from 20 million tons in 1950. The increase in production in capture fisheries was 6.0 to 6.5% per year. Large distance water fleet operating under the principle of open access expanded and penetrated all rich areas of ocean until the extension of national jurisdiction at the end of 1970. This was followed by periods of relative stagnation and reduced growth in production in early 1980 as the capture fishery resources in many fishing areas approached or exceeded sustainable limits. Increasing scarcity of fish was met with new technology to improve the performance of the gear, fleet and vessels. Diversification of fishing methods has contributed to this development and semipelagic trawling is one among diversified trawling methods. In addition, declaration of Indian EZ in 1976 brought to focus the need for developing the fishery of 2 million Sq. Km. area ~~million~~ and exploiting the same in a responsible manner. Target specific trawls were to meet this requirement and pelagic and semipelagic trawls contribute enormously in this direction.

Mid-water Trawling Techniques:

Since world war II, mid-water trawls also known as floating trawls or pelagic trawls have been introduced in the commercial fisheries to exploit concentration of fish in water layers away from the sea-bed.

First designed by Robert Larssen of Denmark in 1948, the net was four equal paneled operated by two boats. Later considerable success was achieved in W. Germany with one boat Mid-water trawl of rectangular shape which had unequal side panels. Great progress took place since 1963 with the advent of stern trawling.

While bottom trawls are often towed for several hours together at a time and fish a large area, so capturing loosely distributed fish, the midwater trawl is towed for a relatively shorter period inorder to pass through and catch a particular shoal of fish successful, mid water trawling required the effective use of various electronic aids, to find fish and manpower the vessel while catching them, the net must be set at the correct depth and the vessel proceed in a course that will ensure the net passing through the school of fish [illegible] in the process of catching them. Due to density of fish shoal through which the net passes, the catch per tow is much greater than the bottom trawl with an estimated ratio of 10:1.

Both single or stern trawling and pair trawling are of importance in midwater trawling. Pair trawling is particularly useful in 3 ways.

1. It is more appropriate in smaller low powered vessels and is especially applicable in shallow water, where a single vessel passing over a shoal tends to scare the fish school downwards.

2. Two boat trawling appears to be advantageous in that the towing warps do not pass through and frighten the school of fish before the net reaches them.

There may also be some changes made in the rigging of the gear, depending on the depth of operation and whether the net is fishing near the bottom or surface. The towing speed depends on the species of fishes and is an important operating parameter.

For sluggish and slow swimming fishes 2 to 3 km is sufficient while 4.0 to 5.0 knots is essential for fast swimmers. It is important that the size of the net is suitable for a particular application and matched to the vessel's power. It is important in mid-water trawling, to have a means of determining the position of net between bottom and surface. The net sonde, an acoustic instrument is used for purpose. It has got a transducer unit fixed on the centre of the headline which transmits the required information back to the vessel through signals transmitted by special towing warps with conductor cables built into them and the recording unit either separately or connected to the display unit of sonar in the bridge. The skipper by using them can adjust his trawling speed and warp length to ensure that the gear passes through the depth of the intended fish school. It is also common for vessels undertaking mid-water trawling to be fitted with SONA (Sound for Navigation and Ranging) for detecting fish school and manoeuvering the vessel.

Mid-water trawl nets resembles more of a cone than the flat bag of the bottom trawl, the mouth taking up an eliptical circular shape depending on the design. Normally, the net does not come into contact with the seabed except in shallow water where the headrope is on the surface while the foot rope scraps the bottom. The net is of a relatively lighter construction enabling the vessel to tow a larger mid water trawl net.

Mid-water trawl is made lighter with thinner material used for gear fabrication. The foot cope is lighter compared to the bobbins and discs of bottom trawl. In cosmos trawl, the upper belly made of bigger mesh size than the corresponding pieces of lower belly. In some, fore part is made of large meshes or only with ropes. In some other trawls like what was operated in Indo-polish survey, jet bellies are used to get a maximum head rope lift.

Two boat or pair Mid-water trawl

Each vessel tows one side of the net using twin warps attached to the upper and lower bridle legs. Horizontal opening of the mouth is maintained by the correct spacing of the vessels while in tow. Vertical opening of the gear is obtained by

correct floatation and weighting. A iron weight of approximately 20 kg is attached to the lower bridles. The sinkers are usually chain weight. distributed uniformly along the foot rope.

The most favourable condition of mid-water trawling are those in which

i) fish concentration are farely large and remaining stationary
ii) the fish are relatively inactive either by virtue of low water temperature or their physiological state (spent and spawning fish are generally inactive).
iii) The fish do not undergo rapid depth migration and their depth distribution is fairly constant over the fishing locality.
iv) the water is shallow and turbid or if clear contain low concentration of phosphorescent organisms.
v) the light intensity is low.

Mid-water trawl is not to replace demersal trawl but are considered an additional fishing method as circumstances demand and is supposed to fill the gap between the working range of conventional near sea bottom fishing gear for exploiting the known fish stocks and opening up so far untapped resources.

The following three aspects determine the effectiveness of mid-water trawl

i) Shape
ii) Twine thickness
iii) Towing speed.

If the net mouth is not opened vertically high enough, the net may catch only a part of the fish school or may even be trawled below the school. A very high vertical opening can be achieved by sacrificing to some extent the width and for this purpose, square mid-water trawls are designed.

This method can be adopted without much capital investment and can be carried out even if the ground is rough as the boards do not touch bottom.

Designing a mid-water trawl is done for catching some particular fish by some particular trawls. The problem is to use the restricted trawler power to best advantage either by increasing the size of the trawl, decreasing the speed or vice versa. It is always better to construct a bigger mid-water trawl than a smaller one dragged in good speed.

Mid-water trawl gear improvements are aimed at the attainment of minimum vertical opening which facilitates better guiding of fish into trawl with a smooth flow of water. For some time, there had been a requirement put forward by the fishing industry for a high headline trawl gear capable of being used off-bottom with increased fishing capacity from the improved mouth opening. With gear and fuel prices constantly increasing it is imperative that manufacturing and operating costs should be competitive and that the net should be capable of operation by existing vessels employing conventional gear, handling systems. Therefore, the principle design objectives for the proposed trawl should have:

i) increased headline height while maintaining wing end spread
ii) no undue increase in drag
iii) reduction in vulnerability to ground damage
iv) to be easy to handle with minimum modification to existing system
v) competitive manufacturing costs.

Fishing Accessories for Mid-water trawl

1. Otterboards

For all trawling operations, except for pair trawling\otter boards are essential for spreading the gear horizontally. It is also called the shearing force of the otterboards. The otterboards are designed on hydrodynamic principles and are specially suitable for achieving that force. The basic idea of otter board design is to shape them in such a way that their shearing power is as great as possible but at the same time their resistance to motion is as little as possible. Bent or moulded boards meet these requirements better than conventional boards. Hydrofoil type, vertically curved otterboards are mainly used for mid-water

trawls and have efficiency for opening the net at low drag. They are also called suberkrub boards named after the inventor. The shearing force of otterboards for mid-water trawls should not be directed slightly downward by horizontally or even slightly upward unlike boards for demersal trawl. The lower width to weight ratio is also advantageous in these type of boards for suberkrub doors, the aspect ratio is 2:1. These doors are used in many parts of the world for midwater or near seabed fishing. Polyvalent doors are introduced and found suitable for near seabed fishing with their high hydrodynamic efficiency and has much greater spreading power than a traditional flat trawl board of the same area.

2. Front weights

To keep the opening of mid water trawls in most effective form not only the doors but also floats on head rope, weights on the foot rope and front weights at the lower wing tips are needed. They are also called depressors and are intended to keep the gear open down wards.

3. Bridles

Increasing the vertical height of a midwater trawl is effected by adding light double bridles or by keeping the otterboards as remote as possible by long sweeps. They concentrate the fish shoal into the path of the mid water trawl. 50 M length of bridles has been found optimum for medium sized trawlers to obtain unrestricted vertical opening and to give a satisfactory gape.

4. Detecting devices

Fish detecting devices like Echo sounder and sonar are essential prerequisites for effective mid-water trawling practices. As long as they did not exist, it could never be ascertained at what depth the fish sought were to be found. Many mid-water trawls designed earlier failed because of this uncertainty.

The invention of net sonde in 1958 was an important step towards effective mid-water trawling. This is an echo sounder oscillator which propagates and receives impulses through a cable transmitting the same to the recording unit on the bridge. It is thus possible to continuously monitor the trawl performances.

The main benefits of having net sonde in mid water trawling are:

a. The depth at which the trawl is functioning is known.
b. The vertical opening of the gear under tow is also known.
c. The behaviour of fish in the trawl path can be monitored.
d. To some extent the quantity of fish caught can be observed with the aid of net sonde. This is an advanced technique better than depth telemeter, since they enumerate the relation between the trawl net and bottom. The relation between trawl net and the fish shoal can be easily understood.

Fish finding can be described as a prerequisite for all rational fishing efforts and one of the determinates of economic efficiency. Even in highly developed trawling about 50% of the time available for fishing is expended for fish searching. Progress in instrumentation and fishing technique of fish detection is bound to have significant effects in this context (in reducing the time utilized for searching). In short mid water trawling involves dragging the trawl with 1 or 2 vessels in the area between ocean bottom and its surface to catch pelagic fish. Depth of trawl is regulated by towing speed and length of warp laid out.

a. With lower warp and lower speed the trawl sinks.
b. it rises with shorter warp and higher speed..

Vertical adjustment of mid water trawl net to the position of fish school is accomplished by 3 methods.

a. by varying the length of warp paid out.
b. by varying the towing speed and
c. by varying both.

The first method is employed when the net is far above or below the fish school. The second one when the net is relatively close to the fish school and the third one when the fine adjustment of the net is necessary.

An important development that is called semi-pelagic trawling, is a technique developed in the later part of 1980s. The otter boards remain in touch with the bottom but the trawl floats at some distance about it. Semi-pelagic trawls were constructed because fish concentrate at a a short distance from the bottom

outside the range of the usual bottom trawl with a low vertical opening. Some modern bottom trawl with more than 6 seams and specially constructed trawl for high opening are intended to achieve, more vertical opening to exploit fishes which aggregate just above bottom and which are not exploitable by conventional bottom trawls, with less vertical opening.

A mid-water trawl with its typical rigging can be used as a semi-pelagic trawl with some alteration in the rigging of sweep lines and by using heavy otterboard.

For catching a semipelagic fish, the efficiency of a trawl can be expressed as the product of towing speed, wing spread and opening height. For catching semi-pelagic species, the square and the upper part of the net together with the opening height play an important role. To get the optimal functional efficiency, the strain paths of the trawl net should follow the framing lines and selvedges, thus allowing unrestricted opening of the netting panels.

Trawling Speed

If a trawl speed is less than the cruising speed of the fish, efficiency of capture is low. If the trawl speed is some what above the cruising speed, the fish in front of the foot rope will eventually tire and drop back to be caught in the net. It is quite clear that most of the fish caught by trawl could quite easily escape by using their 'panic speed'. The swimming ability of fish depends largely on their size and species. Understanding how a net works and of the underlying biological principles, is of interest to both fishermen and designer of fishing gear. It is generally accepted that the net mouth, the nature and thickness of material used as well as the towing speed influence the efficiency of variable depth trawls.

Mid-Water Trawling

There are 4 distinct areas for different fish reactions to the trawl in day light. The first area extends from otter boards to wing tips. The second lies between wing tip and back part of the belly. The fish (thus observed in west African

grounds in general) made few attempts to escape through meshes of this area unless the netting actually touched the tail in which case it was trapped in it swimming and passed out through large meshes. In general, fish in this area, seek for a big opening and finding none, pass back into the bag. The third area includes the last part of the belly and the conical section of the trawl bag. In this critical area, the fish become concentrated, rush about and seek escape through the meshes. Fourth area is the cod end. The critical area in which fish, when there is a concentration of them, get panic and seek escape through the meshes and thus relatively further forward in the net where the net is smaller or more rapidly tapered.

A trawl net is designed according to the type of fish sought for their behaviour as well as the mode of operation of the gear. This explain the necessity for different designs as the type of behaviour of fish vary considerably. In short, a trawl gear is designed as per the type of fish intended to be caught. When the net is correctly designed and constructed, it is an efficient device and the efficiency fo the gear depends primarily on the precision and symmetry in construction of the webbing and the body of the net.

The net has to be designed and shaped so as to offer minimum resistance to motion and give optimum mouth opening, offer least hindrance to the movement of fish towards cod end and it should be carefully matched to the available thrust developed by the propeller. A constant relationship exists between the development of a trawl net and that of a fishing vessel and her propulsive power and deck equipment. In smaller trawlers, thrust developed is comparatively low. The thrust is only about 7% of the rated shaft horse power while big trawlers develop as much as 25% thrust of the available shaft horse power , but of this nearly 50% of energy is required for towing the gear system.