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Eco-Friendly Demersal Fish Trawling Systems

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Trawling has impacts on the seabed when various elements of bottom rigging, particularly the trawl boards and goundrope, skip,rub or dig into the substrate. Trawl fishermen rig their gear to efficiently sweep the seabed which results in the destruction of marine organisms or change the substrate.

In northern Australia,a fork rigged semi-pelagic trawl system has been developed which was found compatible with that of a standard similarly sized demersal trawl system. Although this system had significantly less impact on the substrate, and produced a higher quality product,fishermen found it difficult to operate.Consequently the original standard demersal trawl system was then slightly modified in order to achive similar results.The modified system has proven its commercial viability in Australia's tropical seas.The ongoing reserch is now focussing on further simplifying the standard system with a possible cross-over board to net,bridle arrangement.This paper describes the three systems,includeing the general rigging arrangements and net designs.

Key word: Trawl systems, seabed, substrate.

Bottom trawls are sometimes referred to as bulldozers mowing down fish and destroying the structure that help provide fish stocks with the necessary enviornment.

However,the impact on the seabed when various parts of the rigging of trawl skip,rub or dig the bottom is also now an important concern because of the passible negative medium and long-term effects which could result from the destruction of marine organisms or changes to the substrate.

Seabed penetration varies according to the characteristics of the trawl, floatation and weight,its rigging and the hardness of bottom.

The normal penetration depth of a bottom trawl, in normal conditions, ranges from 50 to 300 mm (Drew, 1994).

The selection of the type of groundrope (if any) fixed on a footrope depends on the fish species which are targetted their relationship with the seabed and the nature of the bottom. The groundrope can be of simple steel or combination cable for a smooth regular bottom, or a device which includes heavy chains and large rubber disks (up to 0.75 m diameter), either rolling free on the bottom or, fixed and skidding on it ("rockhoopers" type), for a rough or irregular bottom.

The otter boards normally penetrate the sediment more than the footrope but, in principle, the impact is limited to a very small bottom surface area. The otter boards are often heavy and may damage the structure of the seabed. Many types of trawl boards now in use have particular shapes for reducing the contact with the bottom while keeping

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enough spreading effect for the trawl to open horizontally.

Friction on the seabed can also be caused by steel cables between trawl boards and the net (sweeps and bridles), this depends on the arrangement of the cables according to the rigging, the length of the cable between two holding junctions, the distance between the door and the extremity of the wing of the trawl, and the weight per length unit of the cable (according to the diameter of cable used).

Whatever the type of trawl and rigging used, adjustments are possible to modulate, to a certain extent, the friction of the groundrope on the bottom. In general these are small modifications to the relative lengths of lower and upper bridles.

Normally the intention of trawl user is to have the doors and the footrope skim along in contact with the seabed without penetration it. Penetraction only causes extra resistance to towing, extra wear and potential gear damage.

On the other hand, sweeping the seabed with enough efficiency to catch bottom fish species may be profitable in the short term but should be careful that such practices are not inflicting long term environmental damage.

Between 1970 and 1990, vast areas of Australia's northern continental shelf was swept by licensed foreign demersal trawlers. Fishing effort was initially concentrated on the north - west shelf between longitudes 114-118° E. During the Eighties, the concentration of effort shifted to the Arafura Sea between longitudes 134-138°E following the decline in catches along the North - west Shelf (Mounsey & Ramm, 1991) . There was concern that the heavy ground gear used altered the morphology of the substrate and damaged sponges, sea grass and coral beds as well as other benthos. Declining catch rates were attributed to these changes and research conducted by the Common wealth Scientific Industrial Research Organisation (CSIRO) substantiated these concerns.

Two major trends evident in the catch from trawlers operaing on the North-West Shelf were reported (Sainburty, 1988). Firstly, tropical snappers which dominated the catches during the early phase of the fishery were replaced by much lower value nemipterids and lizard fish. Secondly, the quantity of benthic organisms (benthos) caught by demersal trawlers operating on the North-West shelf significantly decreased towards the end of the 1970s. The apparent changes in habitat and related species composition were becoming a national concern.

In June 1990, the Northern Territory Department of Primary Industry and Fisheries and the Australian Fisheries Service initiated a study to investigate" environmentally friendly" trawl gear for use in the norhtern finfish trawl fishery. The negative environmental implications of standard demersal trawling methods led to the development of alternative means for harvesting tropical snappers.

In 1993, a joint project commenced between the Northern Terriotory Department of Primary Industry and Fisheries (DPIF), the Australian Maritime college (AMC) and the Commonwelath

Scientific and Industrial Research Organisation (CSIRO), to further develop a semi- pelagic trawling system suitable for northern Australian conditions.

Methodology and operational details of semi-pelagic Trawling systems.

Trials were undertaken with the semi-pelagic trawl system for 160 days at sea over a range of trawl conditions and sites in norhtem Australia. The catching performances and by-catch reduction of each system were evaluated in relation to standard systems.

In addition to evaluation of catch and by-catch per tow, the general performance of the different systems was monitored by net-mounted underwater video equipment or professional scuba divers.

Furthermore, models of trawls and various riggings were tested in the flume tank at the Austrialian Maritime college located in Tasmania.

Trials were carried out at sea for several types of rigging arrangements. Both two and four seam trawls were used. The best results were attained when the footlines on the trawls were positioned between 0.3 and 0.6 metres above the seabed.

1) Semi-Pelagic Trawl System 1

The net of this system was a four seam box trawl based on designs of high opening trawls (Fig. 1. Julie Anne trawl) with fork rigging (Maucorps & Portier, 1971; Garner, 1978). The main objective of this trawl was to obtain the optimal vertical opening and allow the footline to position itself just above the seabed.

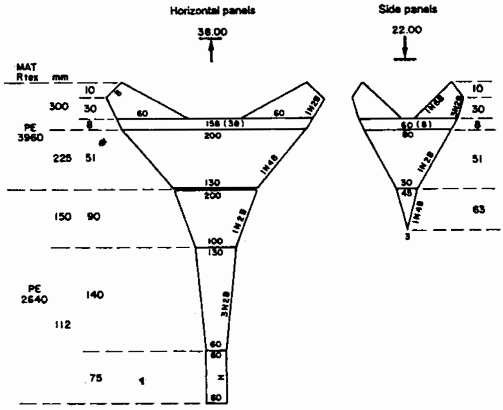

Fig. 1. Schematic diagram of the four seam trawl (JulieAnne) used in semi-pelagic trawl system 1.

The fly wires were attached to the main warp cables and helped to open and position the net between 0.3 and 0.6 m above the seabed. The lower bridles rode slightly above the seabed and connected the foot line of the net directly to the otter boards.

With several adjsutments to such a rigging, it is possible to make the trawl skim the bottom. First of all, relatively long fork have to be given preference or relatively short tatio length of warp/ depth. As can be seen from Fig. 2, viewed from above, the length of warp for the lower branch has to be slightly longer than the upper one because of the spread of the otter board. With a reduction of this difference, there will be more tension on the lower branch and, practically, the groundrope will be less able to rest on the bottom. If larger trawl boards are used. the same effect will result in increased spreading forces on the groundrope.

There are possibilities of other fork-type rigging for large opening trawl, four (and more) seams in particular. Considering

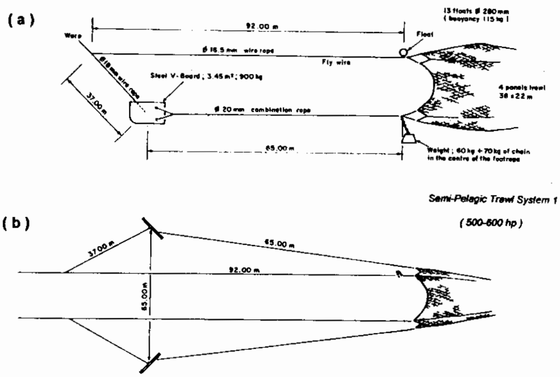

Fig. 2. Towing configuration of semi-pelagic trawl system 1 viewed from the side (a) and from above (b).

Fig. 2 there is the possibility of moving the otter board from the bottom to the junction of the fork bridles; in place of the doors heavy weights are attached where otter boards are in normal fork type rigging. The otter board, in general of pelagic type, are in mid - water (Fig. 3).

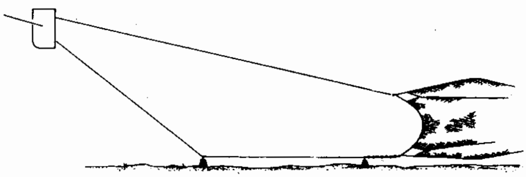

Fig. 3. 4 seam semi-pelagic trawl with fork-like rigging and trawl doors off the bottom.

It should be pointed out that with fork-type riggings in general the length of warp is very important to maintain the groundrope or the footrope in contact with the bottom.

The local finfish trawl fleet quickly adopted the new trawling system resulting in an immediate improvement in product quality and a marked reduction in by-catch (including benthos) However, the system had very limited flexibility in relation to the depth of water and types of seabed terrain it could effectively operate on.

2. Semi-pelagic Trawl System 2

The net was a simple two seam wing trawl (Fig. 4), but with the groundrope removed and the footrope set at various heights above the seabed. The bridles and sweeps were standard arrangements used on most demersal trawls. The otter boards were 50 percent larger than normally required. These were used not only to spread the net but also to keep high tension on the lower sweeps and bridles. Through this process all wire ropes were kept clear of the seabed. The heavy weights connected to the ground line in conjunction with the floats on the headline positioned the net just clear off the seabed. The main warps connect the system to the vessel.

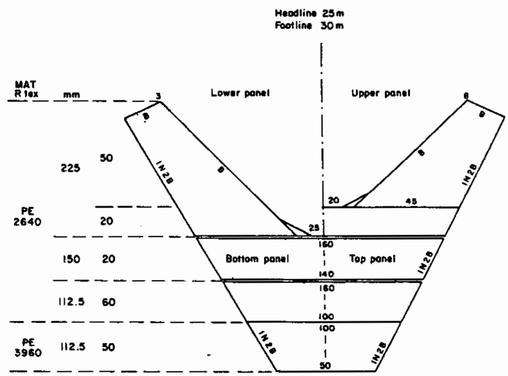

Fig. 4. Schematic diagram of the two seam trawl (14 fathom frank and bryce) used in semi-pelagic trawl system 2.

The results supported earlier evidence that semi - pelagic trawls can be environmentally friendly and that they can be operated in a similar manner to standard demersal fish trawls (Brewer *et al.*, 1995, in press).

The performance of this sytem was not only compared with that of an identical trawl, rigged ot operate in the normal demersal fishing, but also against the same rig operating at 0.8-0.9 m above the seabed. The results were encouraging in that no target species were lost and by-catch (including benthos) was significantly reduced.

3. Semi-pelagic Trawl System 3

This last system is now under development.

The net is the same as system 2, the headline is connected to the heel of the ottter board while the footrope to the rear upper section of the otter board. This rigging is presently refferred to as the "cross-over semi-pelagic trawl system". The floats and weights are to be used in the same fashion as with system 2 and the main warps will connect the system to the vessel.

Initial flume tank trials indicate this trawl system will be stable and effective in keeping the wire ropes clear off the seabed.

This system is still being developed using flume tank models,small prototype gear,then full scale trials. If is planned to use the same net with similar float and weight arrangements as used in system 2. Anticipated rigging arrangement are shown in Fig. 5. The system

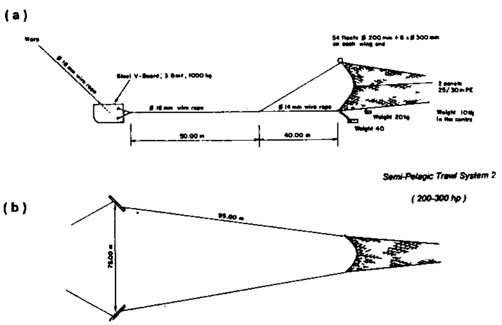

Fig. 5. Towing configuration of semi-pelagic trawl system 2 viewed from the side (a) and from above (b).

will be incorporated with standard size otter boards suited to the trawl net developed.

The performance of the system will be compared with that of a similar size standard demersal rig.

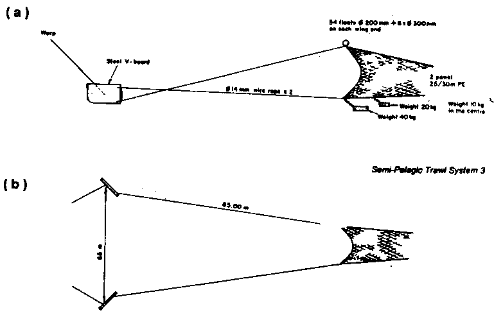

Fig. 6. Anticipated towing configuration of semi-pelagic trawl system 3 viewed from the side (a) and from above (b)

The two semi-pelagic trawl system tested to date have proven commercially viable for relative high value demersal species in the Gulf of Carpentaria and the Arafura Sea. Gear trials and evaluation indicated that the semi-pelagic trawl systems are enviromentally friendly, catching signifficantly less benthos and unwanted species than conventional demersal trawling systems. The largest living bottom structures encountered during the trials were sponges up to 0.5 m in diameter,but most were less than 0.25 m in diameter. The semi-pelagic system on an average made 95 per cent less bottom contact than a conventional trawl. Only the otter boards and the footrope weights were in contact with the seabed.

By raising the ground gear to 0.6 m above the seabed no significant losses of target species (tropical snappers) were encountered; however,at 0.8 m or more above the seabed, a large percentage of these species were able to escape the trawl.

Less enviromental degradation of the seabed and an increase in the product quality are plus features of the semi-pelagic trawl systems. Less sorting of the catch and minimal wear and tear on the fishing gear also highlight the adavantages of these systems. Yet, disadvantages like, major adjustments required to the flywire rig on system 1 when changing depths or the larger than normal otter boards required for system 2, are still causing concern to researchers and fishers alike.

The new cross-over wire arrangement is showing promise, at least on the prototype rigs, and may become the next semi- pelagic trawling system for northen Australia.

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