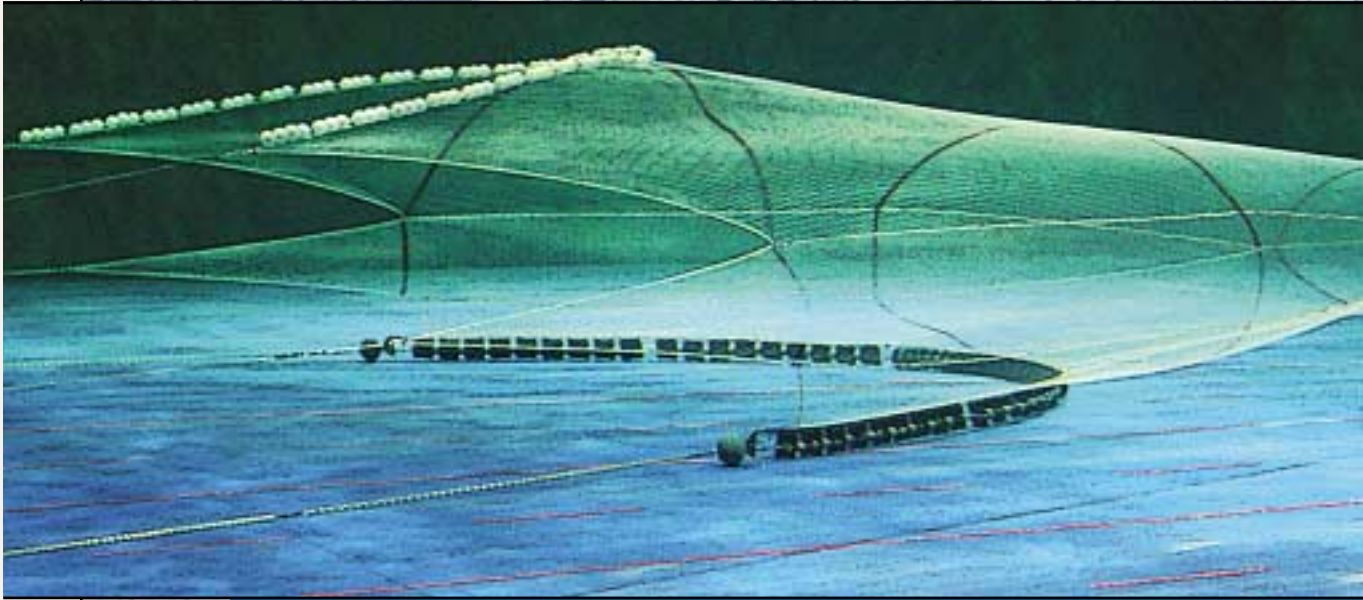


4-2004



A NEW GROUND GEAR
*for bottom-trawls, incorporating
spreading features*



INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET



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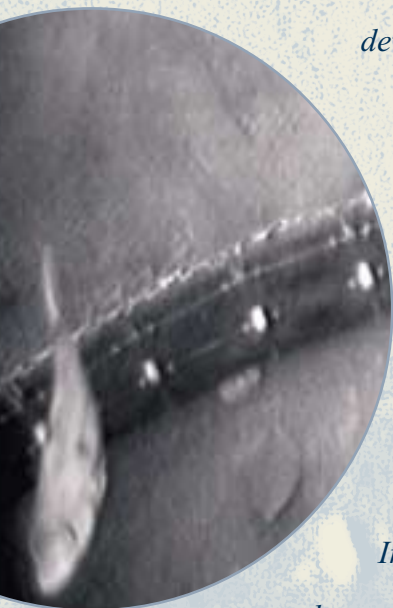
A NEW GROUND GEAR *for bottom-trawls, incorporating*

WHY USE GROUND GEAR ON BOTTOM-TRAWLS?

A trawl net needs to be protected while fishing on rough seabeds, otherwise it will rapidly be filled up with stones or be snagged. In both cases a common outcome is lost catch and damaged trawl net.

Throughout the history of trawling, various types of ground gear have been developed, gradually extending the range of trawlable bottoms. Until 1985, the predominant type of ground gear mounted on bottom trawls consisted of rolling bobbins, threaded on a chain that ran through holes in their centres. These bobbins were either air-filled steel spheres or were made of solid rubber. On large trawlers, the bobbins could be as much as 24" (60 cm) in diameter.

In the mid-80s, Rockhopper ground gear was developed and adopted by a number of major trawl fisheries, and nowadays this type of gear is virtually exclusively used by fisheries all over the world. What is unique about Rockhopper gear is that the discs are usually made of cast-off tyres, which means that much of the gear consists of relatively inexpensive materials. This gear has also been given a very descriptive name, in that "hopping over" rocks is extremely characteristic of this type of gear. As well as being better than the earlier bobbin gear at protecting the trawl net and preventing it from snagging, there are also clear indications that catch efficiency for cod has improved with the use of Rockhopper ground gear.





WHY DO WE NEED NEW TYPES OF GROUND GEAR?

Although Rockhopper gear has been a success in trawl fisheries, it also has a number of negative characteristics. The rubber discs that are its most important components have a density that makes them almost neutral buoyant in seawater. In air, however, Rockhopper gear can be extremely heavy, weighing up to 250 kg/m. This means that handling Rockhopper gear on deck is a heavy task. The cross-wise mounting of the Rockhopper gear discs also means that hauling the gear on board involves a lot of friction. Powerful outhaul winches are needed to set out a trawl with Rockhopper gear. The gear also takes up a great deal of space when it is handled on a net drum.

During towing, the Rockhopper gear discs on the trawl wings are oriented virtually at right angles to the direction of towing. This produces a considerable amount of resistance in the form of both bottom friction and water resistance. Since the Rockhopper ground gear was adopted about 15–20 years ago, trawlers have had to increase the size of their trawl doors (both weight and area), with the result that they are now at least twice as big as they were ten or fifteen years ago. The greater resistance of Rockhopper gear is not the only reason for the increase in the size of trawl doors – the trawls themselves have also become bigger and stronger, and towing speeds are often higher than they used to be.



Fullscale sheering ground gear.

DEVELOPMENT OF NEW GROUND GEAR

A new ground gear concept has been developed as part of the process of development of a new generation of cod trawl, which is a joint project between the Institute of Marine Research and the Hirtshals Department of SINTEF Fisheries and Aquaculture, partially funded by the Fishery and Aquaculture Industries' Research Fund (FHF). On the basis of the experience described above, the aim of this research is to reduce resistance during towing, make the gear easier to handle, cause less damage to the seabed environment and not least, reduce escapes of cod from under the trawl, in comparison with normal Rockhopper gear.

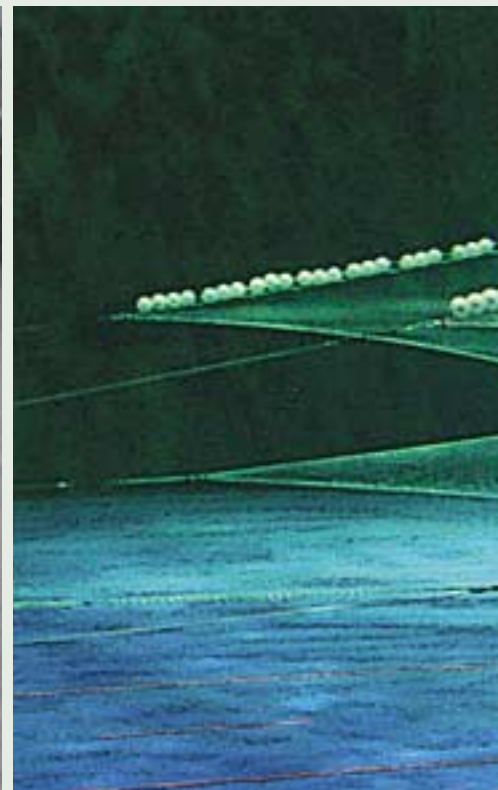
The new ground gear concept is still in the developmental phase, but model trials and preliminary full-scale trials have shown that the new concept has the potential to win widespread practical and commercial acceptance. This is the background for our wish to present the concept at this stage of development, focusing on the development efforts that have already been carried

out, the experience that these have given us and, not least, to say something of the applications that we believe the new gear could have in the future trawl fisheries.

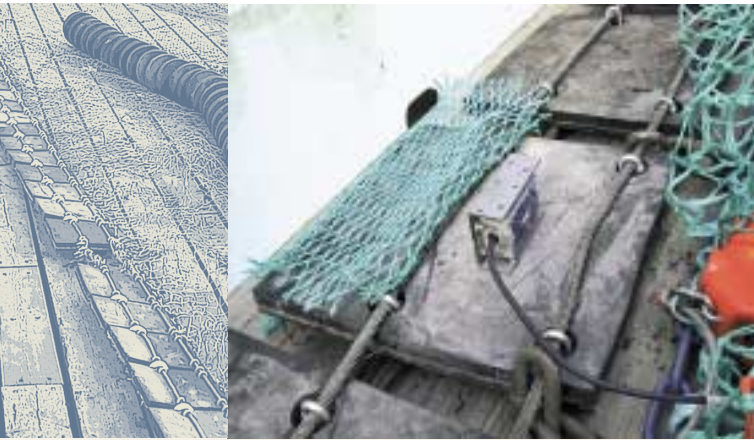
THE NEW GROUND GEAR

The new gear concept consists of rectangular plates of rubber or plastic that are mounted in such a way that their surfaces are vertical and in line with the fishing line. All earlier types of trawl gear have been based on wheels or discs that have been threaded on a line or chain, which has been oriented parallel to the fishing line. However, the new plate gear has something in common with the "skirt" used on the Danish seine-net. In the course of developing this "plate ground" gear we have also found that a combination of plates along the wings of the trawl and Rockhopper discs mounted as mid-gear has the potential to be a successful concept.

The plates that have been used so far in the development of this concept have been rubber plates cut to size from discarded conveyer belts.



Center gear made from rubber plates.



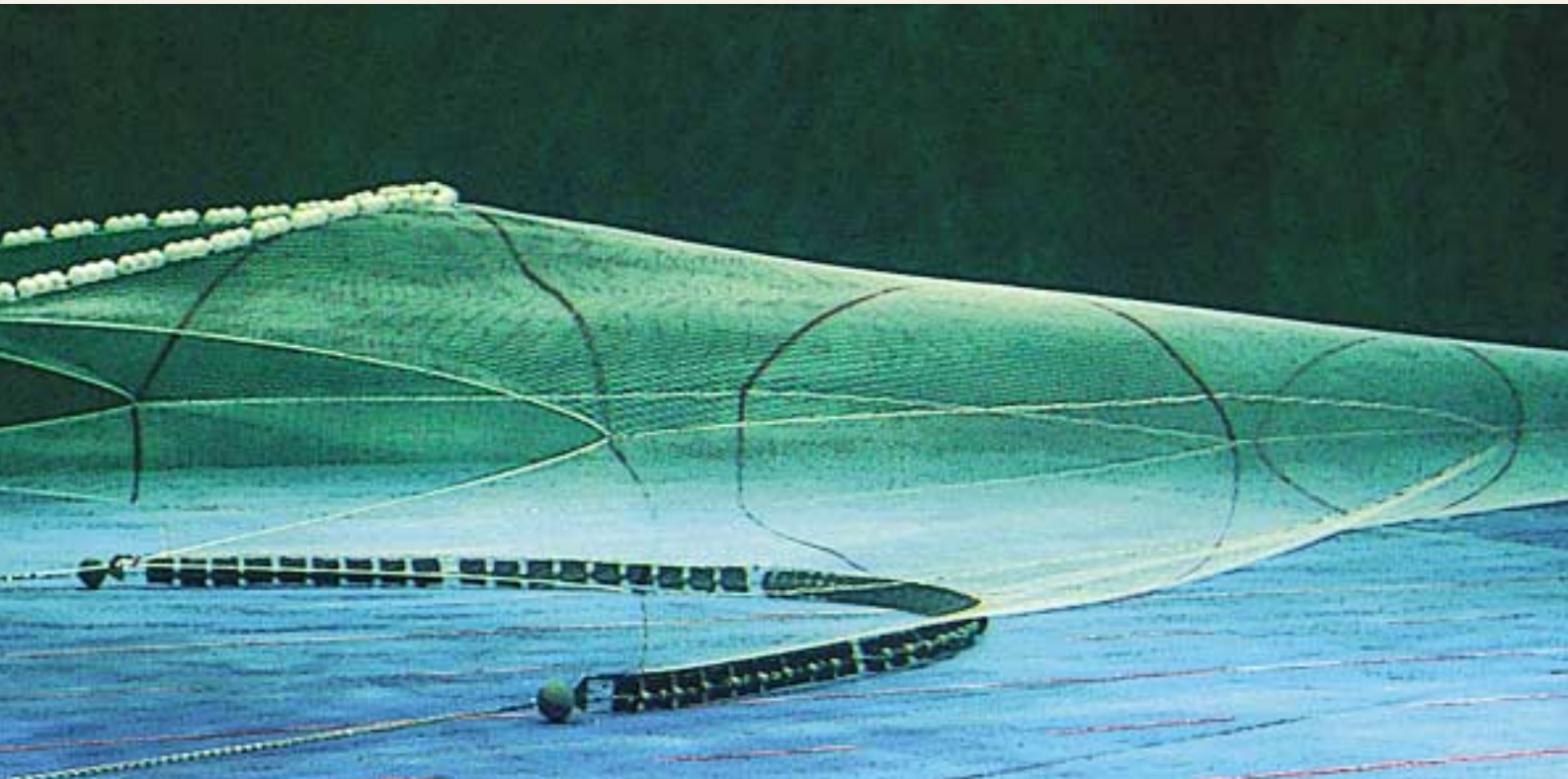
Full-scale plates made of plastic (PEHD 1000) has also been used in the development phase. The plates are locked into position between two rows of wires or chains, where one row passes along the top edge while the other passes 60 % below the top of the plate.

In the course of development of the gear concept, which until now has aimed at adapting it to the new type of cod trawl, we have concentrated on full-scale gear with 50 x 50 cm (20" x 20") plates, although the size of the plates that can be used in this gear concept is virtually unlimited.

WHAT DEVELOPMENT HAS BEEN MADE AND HOW WELL DOES THE GEAR WORK?

Model tests performed in the tank at Hirtshals (1:10 scale) and with F/V "Fangst" in the Varanger Fjord (1:2 scale) have involved three gear set-ups employing plates and discs. The tank trials demonstrated that with plates mounted as side gear and Rockhopper discs in the centre, resistance was about 4 % lower than with complete Rockhopper gear, while a gear consisting only of plates was about 2.5 % heavier to tow than a pure Rockhopper gear. It was found during the flume tank tests that the horizontal spread of the trawl increased by 13 % measured at the danleno, when the shearing plate gear was mounted on a trawl compared to a situation where a normal Rockhopper gear was used.

The 1:2 model was tested on board F/V "Fangst" on several different seabeds in the Varanger Fjord in September 2003. Measurements made using Scanmar gear sensors and underwater video observations showed that wing spread increased



Model test in the Hirtshals flume tank.

with the use of the plate gear mounted on the wings and that the trawl with the plate gear passed over rocks at least as easily as the same trawl with Rockhopper gear. The observations also suggested that fewer fish escaped beneath the trawl when plate ground gear was mounted in its centre section. The impact on the seabed also seemed to be reduced when the plate gear was used.

FULL-SCALE TESTS

A full-scale trawl with sheering plate-gear mounted on the wings and Rockhopper discs in the centre was tested in three trawl hauls by the R/V “G.O. Sars” in April 2004. The trawl and gear

were observed by TV from a towed underwater vehicle and measured using Scanmar instruments. These trials confirmed earlier model experience, that when they are installed as side-gear, plates have improved spreading ability and that they pass well over stony ground. It was also documented that the way in which the gear is rigged is critical for good contact with the bottom. The gear can be rigged in such a way that the plates either tend to lift or dive. The angle of the plates can in this way be used to control bottom contact. An inclinometer on the plates and a Scanmar sensor that indicates the distance to the bottom both turned out to be useful instrumentation for monitoring bottom contact during towing.



Bottom trawl with sheering ground gear.

APPLICATIONS OF THE NEW GROUND GEAR

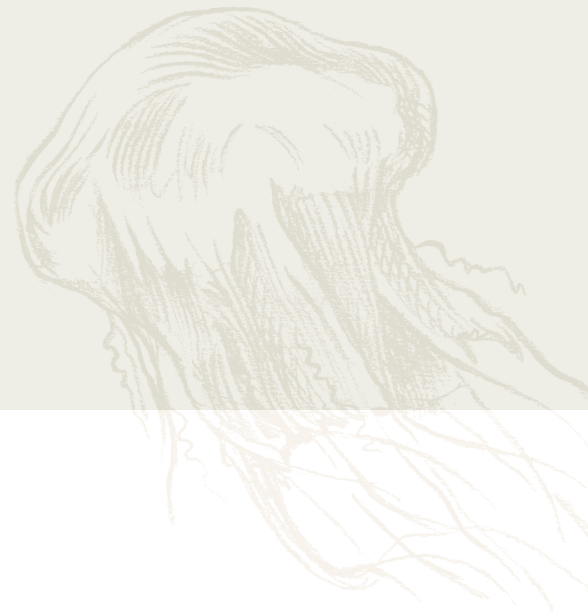
The new shearing plate gear, possibly in combination with Rockhopper discs, will undoubtedly find applications in a number of trawl fisheries. The extent to which it is adopted in cod trawling will depend on its ability to offer similar protection of the trawl as to today's Rockhopper ground gear. It will also need to be reliable in operation, which means that the plates must always remain vertical during fishing. A sensor to monitor the orientation of the plates would be helpful to ensure operational reliability. Scanmar A/S has already developed a sensor that appears to hold promise for this purpose. The adoption of plate ground gear by the cod trawler fleet would mean that handling on deck would require less room and less power. Just as important, it would be easier to handle trawls with this type of gear on a trawl-drum. In vessels with trawl chutes more room can mean less wear on bobbins and nets than when complete Rockhopper gear is in use. The potential gain in resistance means reduced fuel costs for a fleet for which these costs are critical for the "bottom line".

The shearing plate ground gear probably has most potential as a shrimp trawl ground gear. Shrimp trawling gear is much longer than fish trawling gear, being 60–70 m long as opposed to 20–30 m. This means that the reduction in resistance is potentially greater than the approximately four percent demonstrated for fish trawling gear. The most important benefit, however, may lie in the greater catch opening width that a plate side-gear would provide. A 15 % increase in gear spread would roughly speaking mean a 15 % increase in catches of shrimp. Another potential advantage of the plate gear is that the spreading effect offered by this gear, in conjunction with other means of spreading a gear in a horizontal direction, could spread the trawl sufficiently to eliminate the need for large, heavy trawl doors. Our vision for the future is that the warps ahead of the trawl doors will lie parallel to each other and that rolling weights with some degree of shearing force will be capable of replacing trawl doors. This would probably be much better for the seabed environment than heavy trawl doors.

A trawl concept in which the warps are parallel ahead of the trawl would also be extremely interesting when we consider a survey trawl designed for making more accurate biomass measurements of demersal fish stocks. This possibility, which is due not least to the development of the new bottom trawl-gear concept, is already internationally recognised.



Wing gear of rubber plates.





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