10.1. Standartization of survey equipment and testing of DeepVision

Trials of inner net to reduce clogging of Harstad trawl-net by small fish.
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by
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Introduction

The DeepVision camera system has been developed by Scantrol AS to register and identify organisms that pass the system during trawling (Rosen et al., 2013). During a cruise with the R/V Johan Hjort in connection with the Joint Norwegian/Russian Ecosystem survey in the Barents Sea in 2012, the DeepVision system was installed between the extension and the codend of the Harstad trawl used for sampling in the upper pelagic zone.

The trials showed that it was possible to identify, quantify and measure the length of most of the individual fish that passed the DeepVision system during trawling (Rosen et al., 2013). When the trawl was hauled after standard trawling procedures had been completed (trawling at three depths), the observations showed that significant numbers of polar cod and Greenland halibut had passed the camera system, particularly at the surface. On the basis of these observations, we assumed that these were fish that had been snagged in the meshes ahead of DeepVision during trawling and had come loose when the net was hauled. When the trawl was brought on board, fish were found still snagged in the net, particularly in the smaller meshes (60 and 80 mm).

The reason that snagged fish come loose and pass the DeepVision system, particularly near the surface, is that the net is both slackened and tightened during this phase of hauling (for instance, when the trawl-doors reach the gallows), and this tends to release the fish. Wave motion at the surface can also affect the trawl net in ways that cause the fish to be released.

Variations in hauling procedures and weather conditions can thus influence how many fish are released from the meshes, and thus also the total catch and the index that is calculated on the basis of the catch rate. The fact that fish become snagged in the meshes also indicate that an unknown number also pass out through the meshes of the trawl and are not retained in the catch.

In the Norwegian krill fishery in the Antarctic, the problem of krill clogging the meshes during towing was solved by the addition of fine-mesh inner nets that were mounted only at the leading edge to the outer net (200 mm mesh). The inner nets are produced in 8m-long sections that overlap by about 1.5 m. Since the sections are only attached at the leading edge to the outer net, the water flow keeps them in movement, thus preventing krill clogging.

During the 2012 cruise, measurements of the geometry of the Harstad trawl showed that the vertical and horizontal dimensions of the mouth of the trawl changed with warp length and depth. For example, the vertical opening was reduced from 16 m to about 10 m when the headline was lowered from the surface to a depth of 30 m. In order to be able to trawl on the surface using current techniques and equipment, a short warp length is required, which means that the trawl doors are unable to spread the trawl sufficiently. This leads to a high vertical opening and a narrow horizontal spread at the surface. As the warp length is increased, the spread of the doors and trawl wing increases, thus reducing the vertical opening of the net. These changes in the geometry of the net probably mean that the efficiency of the trawl is not constant at different depths.

The principal aim of this cruise was to test whether an inner net similar to that used in the Antarctic could prevent clogging and the loss of small organisms during towing of the Harstad trawl. We also wished to test whether lightweight Spectra sweep instead of a wire sweep could reduce the problem of insufficient spread at the surface, such as we had observed during the cruise in 2012.

Materials and methods

The trials were carried out in September 2013 on board R/V Johan Hjort off the coast of Finnmark. A total of 13 hauls were made with a Harstad trawl. The trawls were rigged with the same combination of warps, floats and weights as for the Joint Ecosystem Survey, except for hauls 11 – 13 (see below).

Scanmar trawl instrumentation was used to measure the trawl geometry at various positions and for measurements of the speed of the trawl through the water. For measurements of water velocity in the extension, the sensor was mounted on a frame such that the distance from the sensor to the net was about 30 cm. A GoPro underwater camera without artificial lighting was used to monitor the inner nets and observe the behaviour of the fish and other organisms.

Hauls 1 – 4 and 9 – 10

A no. 36 Harstad trawl was used for these hauls. For hauls 1 – 4, the trawl was rigged with a 30 m codend with a 22 mm mesh. For the rearmost 9.8 m, netting with an 8 mm mesh was used (mounted inside the 22 mm mesh).

Four inner nets (8 mm mesh), each 6 m long, were used (Figure 1). The front part of the leading inner net was mounted about 2.5 m from the front part of the 120 mm mesh of the trawl-net itself (Figure 2). The panels overlapped by about 1.5 m, and the end of the rearmost inner net was about 1.5 m inside the codend.

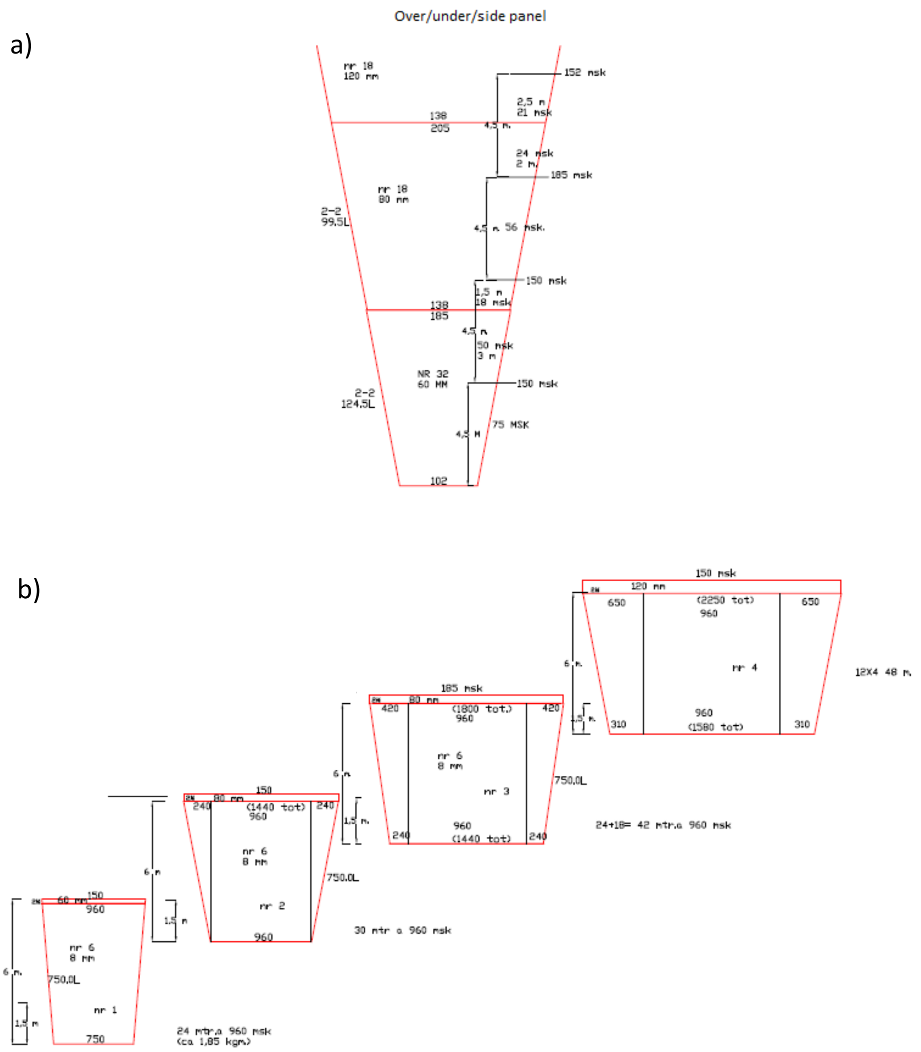

Figure 1. Drawing of extension of the a) Harstad trawl and b) the four inner nets. Mounting positions of inner nets in extension of the trawl are indicated in black in the upper drawing (a).

Figure 2. Front part of the inner net mounted to the 120 mm mesh of the trawl net itself.

For hauls 9 and 10, the trawl was rigged in the same way as for hauls 1 - 4, except that the codend was constructed of 8 mm mesh netting (a protective cover was mounted outside the net).

Hauls 5 – 8 and 11 – 13

A no. 32 Harstad trawl was used for these hauls. For hauls 5 - 8 and 11 - 13, the trawl was rigged in the same way as for hauls 1 - 4, except that inner nets were not rigged in the panels from 120 mm mesh and further back to the codend. The aims of hauls 5 – 8 was to observe whether the inner nets ahead of the codend affected trawl geometry and water flow in that area.

During haul no. 13, tests were carried out to map the effects on the geometry and position of the trawl in the water column when 80 m Spectra sweeps were rigged.

Results and discussion

The underwater observations showed that the inner nets functioned as intended (Figure 3). The inner nets, particularly their rear parts, were in continuous motion, which meant that small organisms did not become snagged during towing. The mesh size of only 8 mm also prevented small fish from escaping from the net.

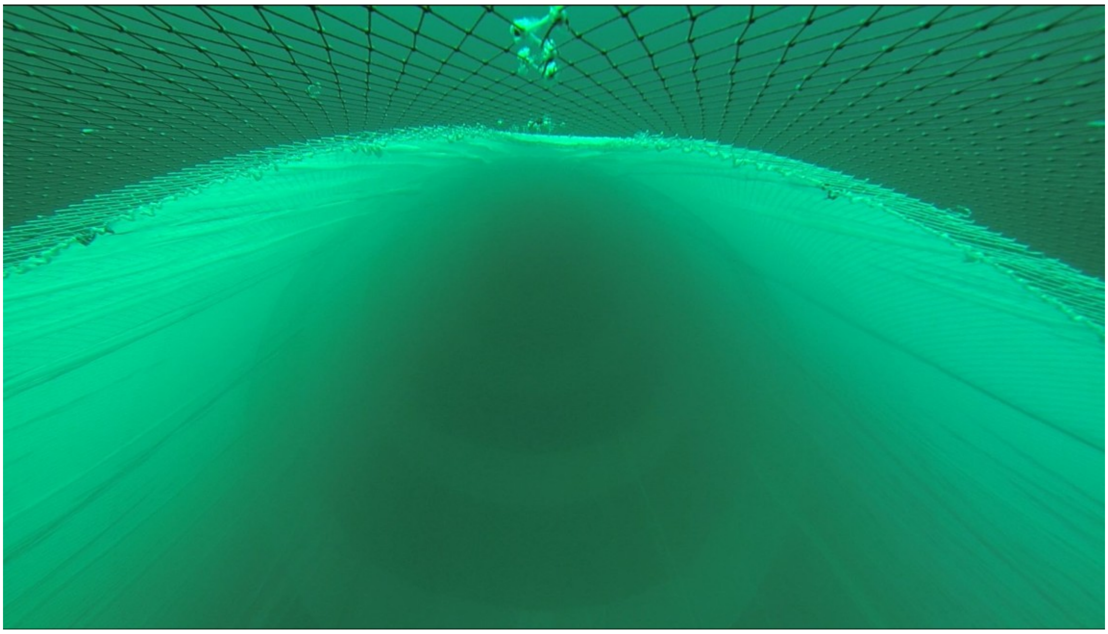

Figure 3. Observation of the front part of the inner net mounted to the 120 mm mesh of the trawl net itself (looking towards the codend).

Measurements of the geometry of the two trawls, both with and without the inner nets mounted, showed that it was very similar when the leading inner net was mounted on the trawl itself (about 2.5 m in front of the rear end of the 120 mm mesh panel).

With a warp length of 150 m, the vertical opening was about 6 m in this area, while the horizontal opening was around 5 m. At the entrance to the codend, the geometry changed; with the inner nets installed, the vertical and horizontal openings of the entrance were about 3.6 m and 3.4 m respectively, while without the nets they were 1.5 m and 1.4 m respectively. The difference in the dimensions of the opening at the entrance to the codend was also observed via the video camera.

These measurements and observations show that the fine-mesh inner net helps to increase entrance diameter of the codend (Figure 4). In the area where the inner nets are mounted, the trawl is cut at a high angle, and we believe that the increased dimensions are due to a combination of the high angle and the fine mesh, which balloons out as it is drawn through the water.

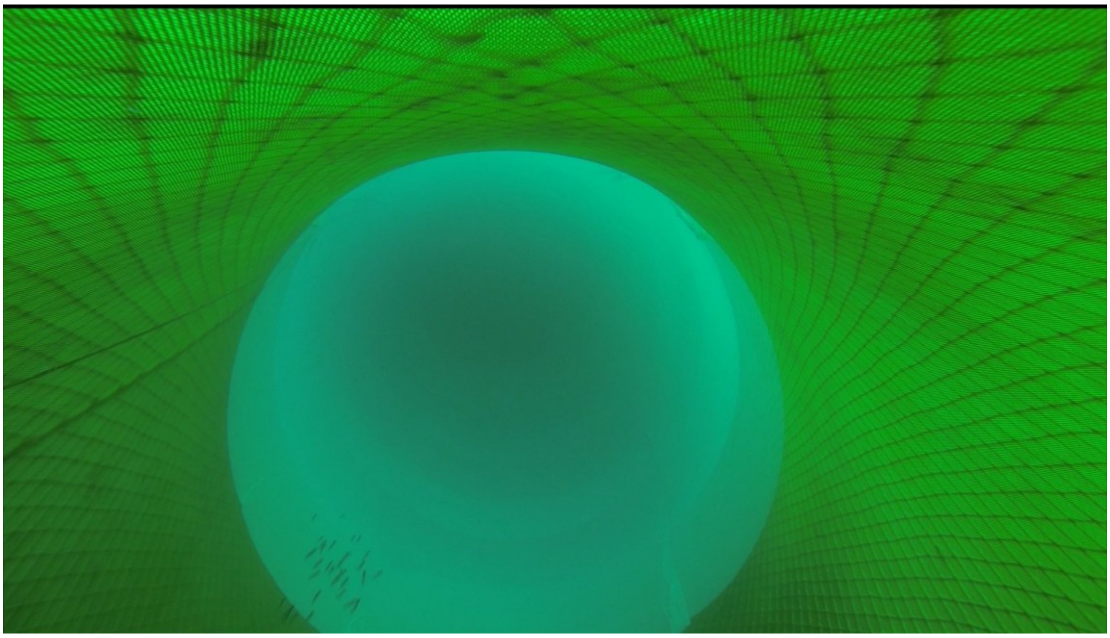

Figure 4. Observation of the aft part of the last inner net (front entrance of the codend, looking towards the trawl opening). Small herring observed in the lower left part of the picture.

Water flow sensors mounted at the headline and the rear of the trawl (in the areas of 120 mm mesh where the inner net was mounted and the entrance of the codend) showed that there was no difference in flow by position on with and without the inner nets.

Catch rates were low in these trials. The underwater observations made during hauls 1 – 4, in which the inner nets were deployed, showed that capelin fry were carried by the flow when they passed the end of the last inner net (about 1.5 m inside the codend) and through the 22 mm meshes in the codend at the end of the final inner net. Clogging by capelin fry was also demonstrated in this area, when the trawl was brought on deck. In order to prevent this from happening, a codend with a mesh of only 8 mm was successfully deployed in the remaining hauls.

The trials using the Spectra (light synthetic) bridles (length: 80 m) showed that it was possible to trawl with the headline at the surface with a warp length of up to 170 m. Using wire bridles (standard length: 120 m) the headline could only be kept at the surface with warp length of approximately 80 m. Due to problems with the trawl instrumentation, the vertical and horizontal openings of the trawl were not measured during the trials with Spectra sweeps.

The way ahead

The trials using inner nets attached to the leading edge of the actual trawl functioned according to expectations. The fine-meshed inner nets were in continuous motion during towing, and prevented the trawl from becoming clogged by fish and other organisms, and also hindered fish losses through the meshes.

In further efforts to develop a representative sampling trawl for the upper pelagic zone, the following objectives should be achieved: the trawl must maintain a constant geometry at all depths sampled and should have a well-defined catch area that does not become clogged or lose organisms.

The trawls used in the Antarctic krill fisheries used a large-meshed (200 mm) outer net as a framework to attach the leading edge of the inner nets. By using a similar outer net with large (200 mm or more) square meshes in a four-panel trawl, two objectives can be achieved: a) the trawl's maximum horizontal spread will be limited by the bar length of the meshes in the mouth area. By using trawl doors with a high spread capability in combination with short Spectra sweeps, this can be obtained during surface trawling and the net geometry will not change when either depth or warp length increase. If Spectra sweeps are used in place of wire sweeps, trawling just behind the vessel in the propeller wake can be avoided; b) the narrow-mesh inner nets used in the above-mentioned trials were mounted on the outer net from an area that covers a given height and width, which thus constitutes the catch area for small fish, within which losses through the meshes and clogging fish are minimised.

In order for the new trawl design to efficiently also capture large fish the size of the trawl mouth must be found. Due to towing resistance, it will not be possible to deploy inner nets to cover an similar area to that in the Harstad trawl. If the trawl mouth needs to be similar in size to the Harstad trawl it would be possible to use square meshes ahead of the inner nets in order to obtain an effective trawl opening for large fish. With square meshes, the chances of fish clogging the net will be reduced to a minimum (based on previous trials)

References

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