Purse seine volume and shape impact crowding densities

Currently, the last moment at which mackerel can be slipped from a purse seine is when 7/8 of the net has been hauled in. However, experiments show that the size of the catch, as well as the volume of the net, strongly influence when the fish are so crowded that they will no longer survive slipping.

BY MARIA TENNINGEN

Past experiments have demonstrated that fish exposed to excessive crowding in a purse seine soon die, even if they are released. This has resulted in a rule stating that a final decision on what to do with the catch must be taken before 7/8 of the net has been hauled in.

This "point of no return" rule is controversial, and there is a need for a better understanding of purse seine gear and fish school behaviour during capture. Doing so will reduce the risk of net bursts, when the catch is large, and help us estimate the true crowding density.

THE SHAPE AND VOLUME OF THE NET CAN BE RECREATED USING ACOUSTICS

As part of a two-year project funded by the Fishery and Aquaculture Industry Research Fund, scientists at the Institute of Marine Research have used fishery sonar and the HiPAP underwater positioning system to study the shape and volume of purse seines during fishing. HiPAP is a three-dimensional, acoustic positioning system that uses transponders mounted in the net walls.

HOW LATE IN A HAUL CAN SLIPPING BE ACCEPTED?

Crowding density is one of the most important factors affecting the survival rate of fish after they are slipped. If the catch size is known, the volume inside the net can indicate when fish densities are getting critically high and slipping should no longer be allowed.

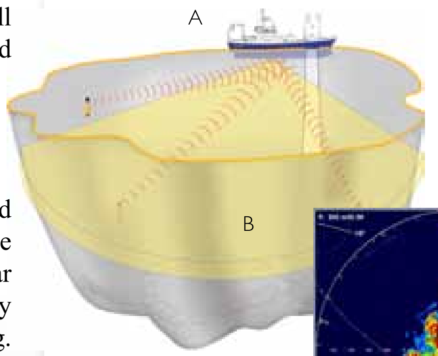

Figure 2a: The purse seine was measured using a fishing sonar and acoustic positioning system (HiPAP), with up to 6 transponders fitted to the walls of the nets (Illustration: Anne Britt Tysseland).

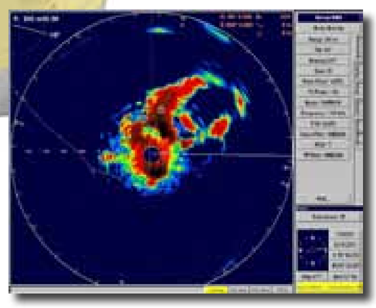

Figure 2b: Sonar image of the net with HiPAP positions marked as white circles.

Figure 1:
The "Sjarmør" during this year's Norwegian spring-spawning herring fishery (photo: Maria Tenningen).

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In our experiments, the theoretical crowding density in the purse seine was calculated by dividing the catch weight by the volume of the net. The results suggest that for catches of between 115 and 440 tonnes of mackerel, there is still plenty of space inside the net at the point of no return. A 1,000-tonne catch in the same volume, however, would have been much closer to the critical limit of approximately 30 kg of mackerel/ m^3. A mortality rate of between 10 and 30 per cent would then be expected. The crowding density in the purse seine, therefore, varies greatly from one haul to another depending on the catch size. The net size also varies, while the exact volume is affected by weather conditions and the captain's method of fishing. The behaviour of the fish and their distribution within the net is also likely to affect their survival rate after being slipped. Hence the limit at which unacceptable mortality occurs may vary from haul to haul.

WHERE DO WE GO FROM HERE?

The results show that it is possible to monitor the purse seine during fishing, and that there is the potential to develop the methodology into a real-time monitoring system. In addition to providing better control of slipping situations, real-time monitoring may increase catch efficiency and precision. If this kind of system is to be based on sonar data, the sonar must be located in a position where it is not affected by air bubble noise from the vessel.

The advantage of using sonar is that you can also get information about the fish in the net, but it can be difficult to get good sonar data during the late stages of a haul. For the purpose of studying the shape and volume of the purse seine, HiPAP may be a better option, but currently it is expensive, and the transponders are impractical due to their size. However, it is quite likely that smaller and more robust HiPAP transponders can be developed if the manufacturer sees a market for them.

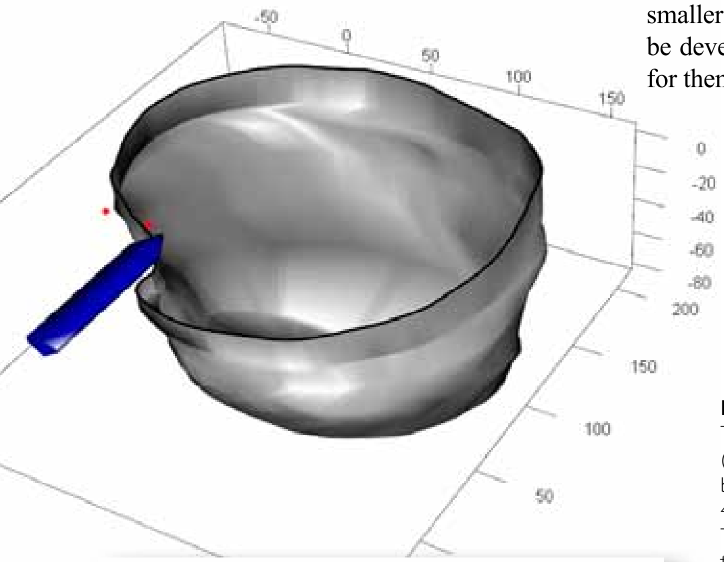

Figure 3:
3D reconstruction of the purse seine based on horizontal sonar cross sections. The red dots show the locations of the HiPAP transponders.

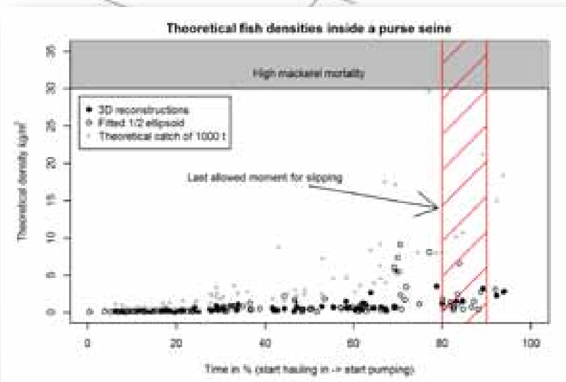

Figure 4:
Theoretical crowding density in the purse seine (catch weight/net volume). Data from a number of hauls, with catch sizes in the range 115-440 tonnes of mackerel, have been combined. Two different methods were used to calculate the volume: semi-ellipsoid (the sonar data and theoretical size of the purse seine were adjusted to the shape of a semi-ellipsoid); and 3D reconstruction (horizontal sections through the purse seine were used to reconstruct it, and the volume was calculated by triangulation). In addition, the expected crowding densities for a hypothetical 1,000-tonne catch were calculated based on the estimated volumes.

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