MARINE RESEARCH NEWS

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Mortality of herring after being crowded in a purse seine

When purse seining for herring, catch regulation have traditionally been done by discarding all or part of the catch if it is too big, or if the size or quality of the herring does not match requirements. Net burst is also quite common. Experiments have shown that mackerel do not tolerate much crowding before mortality rates become unacceptably high. It has been speculated that this may also be the case for herring.

BY AUD VOLD, JOSTEIN SALTSKÅR AND IRENE HUSE

In the 1990s, researchers at the Institute of Marine Research performed experiments to simulate bursting of a purse seine containing herring. 70% of the herring survived for 48 hours, but after nine days only 5% were still alive. In May 2008 we performed initial experiments to see whether North Sea herring survives crowding in a purse seine prior to being discarded. Two purse seine vessels were hired for the project. One of the vessels was used to catch herring, whilst the other one acted as a support vessel for handling cages, etc. An entrance channel was attached to the bunt of the purse seine, and identical ones were attached to three large floating circular net cages (see Figure 1). The channels were sewn together when the purse seine had been hauled in approximately half way, so as to create an open channel between the purse seine and the cage. Then we continued hauling the seine very carefully until fish swam calmly into the cage.

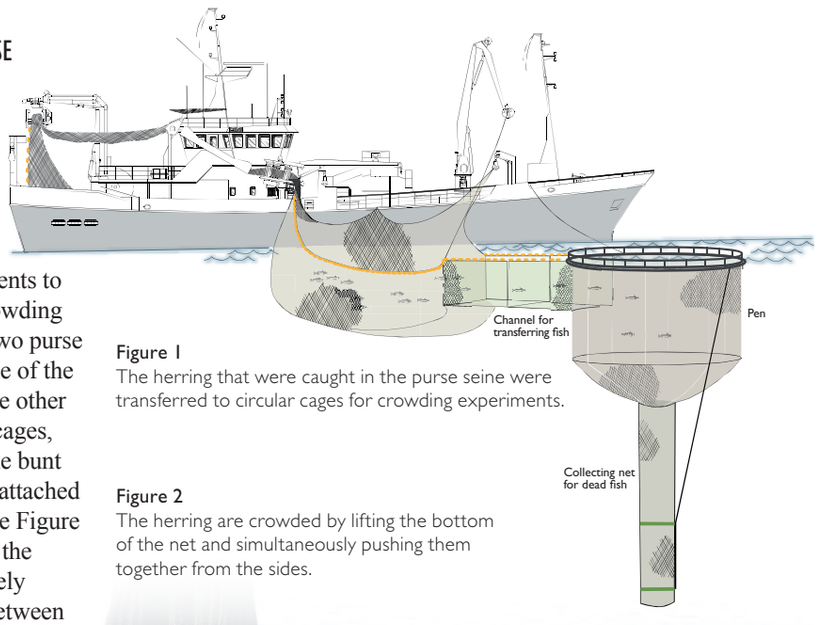

Figure 1
The herring that were caught in the purse seine were transferred to circular cages for crowding experiments.

Figure 2
The herring are crowded by lifting the bottom of the net and simultaneously pushing them together from the sides.

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OBSERVED FOR FIVE DAYS

For each haul of the seine, we filled three cages: one control cage and two test cages. The control cage were released into the sea without further action. The fish in one of the test cages were crowded until it was possible to take a fish sample for quality control purposes, and this level of crowding was maintained for ten minutes.
The fish in the second test cage were crowded more tightly. The aim was to simulate the crowding that occurs in the purse seine just before pumping starts or net burst. Thereafter the cages were allowed to drift freely in the sea for an observation period of five days. To controle the condition of the fish, the cages were equipped with cameras and video links to the support vessel. This allowed us to keep the boat 50-100 metres away from the cages while we observed the behaviour of the fish. The fish were therefore not seriously disturbed.

DIFFERING OPINIONS

We only had time to perform two parallel experiments during the 14 day-long expedition. In both of the experiments, very low mortality rates were observed in the control group (0.9 and 1.0%). This was also true for the herring that were slightly crowded (1.8 and 1.6%), whereas the results from the two cages with "tightly crowded" fish were widely divergent. In the first experiment 27.9% of the fish died, whilst only 1.8% died in the second one. In the first experiment, we observed that many fish were suffering from scale loss, injuries and bleeding along their sides.
The levels of crowding used for the experiments were based on discussions with the fishermen on board regarding the normal levels of crowding during commercial purse seining. However, there were as many opinions as to what level of crowding was normal as there were fishermen, and it proved to be very difficult to estimate the fish densities during the crowding process. Calculations of the volume in the cages using photographs taken during crowding, together with the number of fish obtained at termination of the experiment, showed that the crowding density in the second experiment had been significantly less than the equivalent group in the first experiment (see Figure 3). This discrepancy arose because we had no way of measuring how tightly the herring were crowded. During the earlier crowding experiments with mackerel, the fish were crowded until they showed panic behaviour ("boiling"). Herring do not display a similar panic response, which means that we had no reference point for the level of crowding.

SUITABLE METHODOLOGY NEEDS TO BE FOUND

For future experiments it will be very important to develop a method or an instrument to measure the fish density during crowding.We are currently working on solutions in this area. It may appear that North Sea herring in May are somewhat less affected by crowding than mackerel proved to be in similar experiments in the autumn. However, if tightly crowded, herring will also experience unacceptably high mortality rates. Whereas the mackerel experienced massive mortality shortly after being crowded, it took longer for the herring to die. We can only assume that the mortality rate would have been higher if the observation period had been longer than five days.
As the results of these two experiments were so divergent, it is very important to perform further experiments. It would also be dangerous to extrapolate the results of these experiments to other situations, for example different times of year when the condition and biological status of the fish are different. Further experiments are therefore vital.

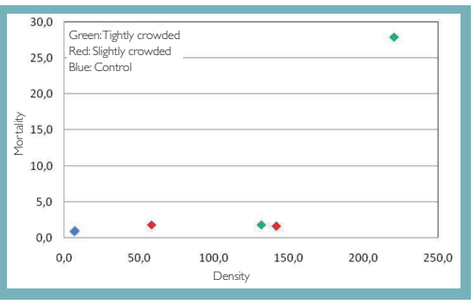

Figure 3
Mortality as a function of fish density in the cages. In one of the cages that was supposed to be tightly crowded, the fish were in fact not crowded any more closely than in the cages that were supposed to be slightly crowded.

INSTITUTE OF MARINE RESEARCH
Nordnesgaten 50
P.O. Box 1870 Nordnes
NO-5817 Bergen – Norway
Tel.: +47 55 23 85 00
Fax: +47 55 23 85 31

www.imr.no

TROMSØ DEPARTMENT
Sykehusveien 23
P.O. Box 6404
NO-9294 Tromsø – Norway
Tel.: +47 55 23 85 00
Fax: +47 77 60 97 01

FLØDEVIGEN RESEARCH STATION
NO-4817 His – Norway
Tel.: +47 55 23 85 00
Fax: +47 37 05 90 01

AUSTEVOLL RESEARCH STATION
NO-5392 Storebø – Norway
Tel.: +47 55 23 85 00
Fax: +47 56 18 22 22

MATRE RESEARCH STATION
NO-5984 Matredal – Norway
Tel.: +47 55 23 85 00
Fax: +47 56 36 75 85

PUBLIC RELATIONS AND COMMUNICATION
Tel.: +47 55 23 85 38
Fax: +47 55 23 85 55
E-mail: informasjonen@imr.no

CONTACTS
Aud Vold
E-mail: aud.vold@imr.no
Tlf: +47 55 23 84 41
Research group: Fish capture

Jostein Saltskår
E-mail: jostein.saltskaar@imr.no
Tlf: +47 55 23 68 05
Research group: Fish capture

Irene Huse
E-mail: irene.huse@imr.no
Tlf: +47 55 23 68 22
Research group: Demersal fish