

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

Figure 2
Transferring the herring from the net to the cage. The channel between the net and the cage is connected and kept open.

Crowding in purse seine can kill half the catch of North Sea herring

Catch regulation in purse seining for herring has 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 during certain seasons. Our experiments showed that if tightly crowded, herring will, just like mackerel, experience unacceptably high mortality rates. However, whereas mackerel experienced massive mortality shortly after being crowded, it took longer for the herring to die.

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The Norwegian herring and mackerel fisheries in the North Sea and Norwegian Sea were recently certified as sustainable by the Marine Stewardship Council. However, various conditions are attached to the certification, one of which is that purse seiners must implement measures to reduce discard mortality rates for certification to be extended beyond five years.

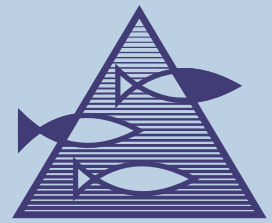
TWO YEARS OF EXPERIMENTS

In May 2008 and 2009, The Institute of Marine Research carried out experiments to see whether North Sea herring survive crowding in a purse seine prior to being discarded. Two purse seiners 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 cages (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 the fish swam calmly into the cage (Figure 2).

For each haul of the seine, we filled three cages: a control cage and two test cages. The fish in the control cage were released into the sea without further action. The test cages





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Figure 3: The herring are crowded by lifting the bottom of the net and simultaneously pushing them together from the sides.

were crowded to varying degrees (Figure 3). The aim was to simulate the crowding that occurs in the purse seine during sampling and pumping. Subsequently the cages were allowed to drift freely in the sea for an observation period of roughly five days. To monitor the condition of the fish, the cages were equipped with cameras and video links to the support vessel.

50 PERCENT MORTALITY

Our experiments showed that very few herring died in the control cages where there was no crowding (1-2 %), whereas mortality rates in the test cages depended on the degree of crowding (see Figure 4). With very slight crowding, no more fish died than in the control groups, whereas the mortality rate was a massive 50 percent in the most tightly crowded groups.

The degree of crowding used for the experiments was decided in consultation with the fishermen on board. However, there were as many opinions as to what level of crowding was normal during purse seining as there were fishermen, and it proved to be very difficult to estimate the fish densities during the crowding process. Calculations that we have performed based on photos and measurements taken during the experiments show that the fish density varied greatly between the experiments (see Figure 4). A major problem we face when evaluating the relevance of the experiments is that we have no method for measuring fish density in real time.

TIME-CONSUMING PROCESS

Our experiments showed that if tightly crowded, herring will, just like mackerel, experience unacceptably high mortality rates. However, whereas

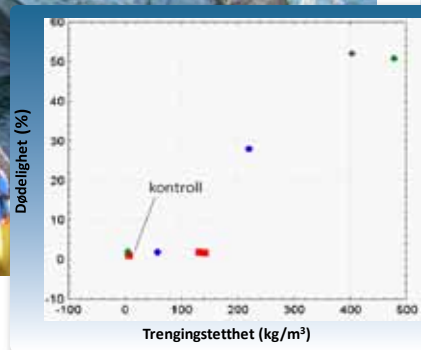


Figure 4: Mortality of North Sea herring as a function of fish density in the cages. The red and blue dots relate to experiments in 2008, whilst the green ones are from 2009.

the mackerel experienced massive mortality shortly after being crowded, it took longer for the herring to die. Mortality rates only started to rise after 2-3 days, and when the experiments finished after five days we could see that many of the surviving herring were suffering from scale loss and/or skin damage. Observed mortality would probably have been higher had the experiment continued longer. Research into herring physiology and stress responses performed during the experiments support that assumption. After crowding, herring had unusually high levels of stress hormones in their blood, and blood parameters showed that the fish were in a state of osmotic imbalance.

All of the Institute of Marine Research's experiments looking at the survival rates of pelagic fish that have been crowded in purse seines show that these species do not cope well with that kind of treatment. Crowding and discarding will result in undesirable and unnecessary mortality. Fishing methods must be changed in order to reduce the number of fish that are crowded and subsequently discarded. Current purse seines and catch methods have been developed to maximise catch volumes. Significant research should now be done to develop methods for sampling fish prior to hauling the seine or at an early stage of the catch process, in order to avoid tight crowding. Seines must also be designed in such a way as to allow any fish to be discarded as quickly, easily and gently as possible. This requires innovation and development both by fishing fleets and fishing gear manufacturers.

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