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# SURVIVAL EXPERIMENTS WITH COD TRAWLS: SUMMER 2000

by

Aud Vold Soldal, Bjørnar Isaksen and Kjell Gamst

Institute of Marine Research, P.O. Box 1870 Nordnes,
N-5817 Bergen, Norway

## Abstract

Survival trials with gadoid fish sorted out from a demersal trawl by sorting grids and mesh selection, were carried out in August 2000 off the coast of East Finnmark. The experiments offered no evidence that the sorting grid in cod trawls results in higher mortality rates in sorted undersized gadoid species than trawls that lack a sorting grid. Indeed, the results suggest that haddock mortality rates are lower when a grid is utilised. No mortality was observed in cod or saithe in the course of these experiments. These species appear to be able to tolerate selection via both meshes and grids. A certain degree of uncertainty with regard to the experimental methods employed, however, means that the trials will be repeated in order to obtain more certain results for haddock.

## Introduction

In August 2000 the Marine Research Institute (IMR) carried out a series of survival trials on fish (cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus* and saithe (*Pollachius virens*)) that had escaped from a cod trawl either with or without a sort grid. The trials were financed by the Research Council of Norway, by the IMR itself and with significant support from the Norwegian Directorate of Fisheries through its "Fishing Trials and Guidance Scheme".

In the early nineties a number of survival trials were performed on cod, haddock and saithe escaping from a trawl via a grid or through the meshes of a cod-end. All these trials showed that the mortality in cod and saithe was virtually zero, and was low (about 5%) in haddock (Jacobsen, 1994; Main and Sangster, 1991; Suuronen et al., 1995). A further series of Norwegian survival trials led by the IMR was also carried out off the coast of Finnmark, using chartered cod trawlers and commercial trawling gear. Tests were made of both sorting grids and ordinary trawls with 135 mm meshes in the codend. The Norwegian results were in complete agreement with what had been found by other countries (Soldal and Isaksen,1993; Soldal et al., 1993; Soldal and Engås, 1997).

Following the announcement of compulsory use of sorting grids in demersal trawl in the cod fisheries north of 62°, voices were raised within the trawling industry to the effect that selection

by means of grids resulted in fatal injuries to fish. This claim was repeated during a one-day seminar on the use of sorting grids in cod trawls, organised in Bergen by the Directorate of Fisheries on November 23, 1999. It was claimed that the survival trials organised by the Marine Research Institute in 1991 had not been carried out under realistic conditions. It was claimed that during practical commercial fishing operations, the effects of grid selection on fish would be significantly greater, and would have fatal consequences.

Following this meeting it was decided that the IMR ought to carry out new survival trials. These were to be performed under as realistic conditions as possible. The Norwegian Fishing Boat Owners' Association was drawn into the planning process, in order to ensure that scientists and fishermen would be in agreement regarding the meaning of "realistic conditions" before the trials started.

## Trials: set-up and methods

The trials were carried out off the Varanger Peninsula from August 3 to 25, 2000 (Figure 1). Five days before the survival trials themselves commenced, three chartered stern trawlers began to fish within the designated test area. The boats used their own bottom trawls with sorting grids (Sort-X). The vessels' skippers themselves decided where to trawl within the trial area, towing length, etc. The only requirement on the part of the IMR was that hauls should be made within the designated area and that fishing was to be carried out under normal commercial conditions. The underlying intention was to simulate a normal fishing situation on

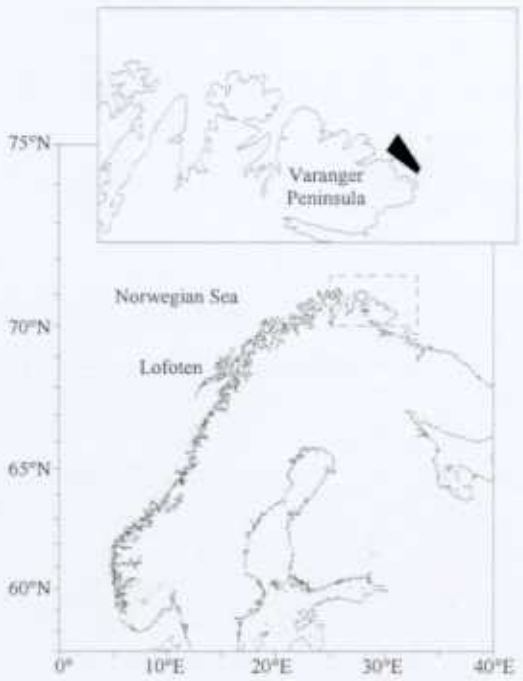


Figure 1. The trial area off the Varanger Peninsula

a fishing ground with several boats fishing at the same time. This was done in order to ensure that the fish in the area would experience the same level of "stress" as on a normal fishing ground where several boats are fishing, and in order to ensure that a certain proportion of the fish would pass through the sorting grids several times before the start of the survival trials.

The trials as such started on August 8 on board "Myrefisk II". The rigging of the trawl with its cover net and collection cages is shown in Figures 2, 3 and 4. Fish that passed through the sorting grid or the meshes of the cod-end were collected by a fine-meshed cover net stretched over the grid or around the cod-end. At the end of the cover net was fastened a cage of fine-meshed netting stretched over metal rings. Fish for a control group were also collected by a collection cage mounted directly on an extension of the trawl. These fish had passed through neither meshes nor grid. Hauls were made at depths of 60 - 90 m.

At the beginning of each trawl haul, the collection cage was left open at each end so that the fish that escaped from the trawl could pass out freely. After towing for about one hour the cages was closed at one end by means of an acoustic release unit, and escaped fish began to be collected. The trawl hauls were thus as long as they would have been during normal commercial fishing operations. During the whole process, the underwater vehicle FOCUS (Figure 9) was used to study the configuration of the trawl, the quantity of the catch and how the cover net and the cage behaved in the sea. After the cage had been closed, the quantity of fish entering the cage was checked. When the number of fish was regarded as sufficient (usually after five to ten minutes), the cage was released from the trawl and its front end was closed. An acoustic release was also employed here to release and close the cages (Figures 2 and 7). The cages were raised to depths of 40 - 50 m and anchored on the fishing grounds (Figure 5). An active radar sonde was mounted on the marking buoy in order to track the cages during the next few days.

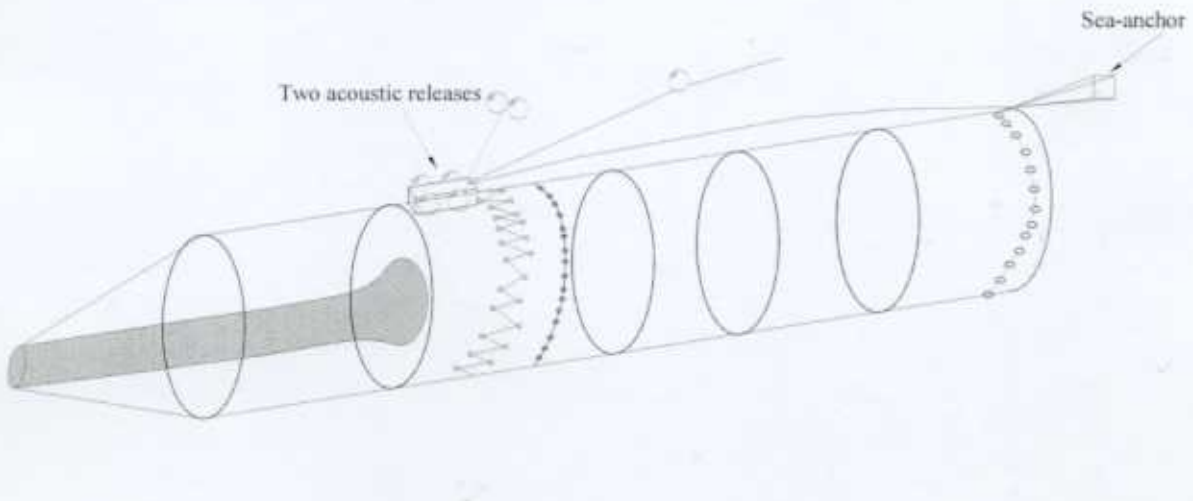


Figure 2. Arrangement of the cover net and collection cage for collecting fish that had escaped through the meshes of the cod-end.

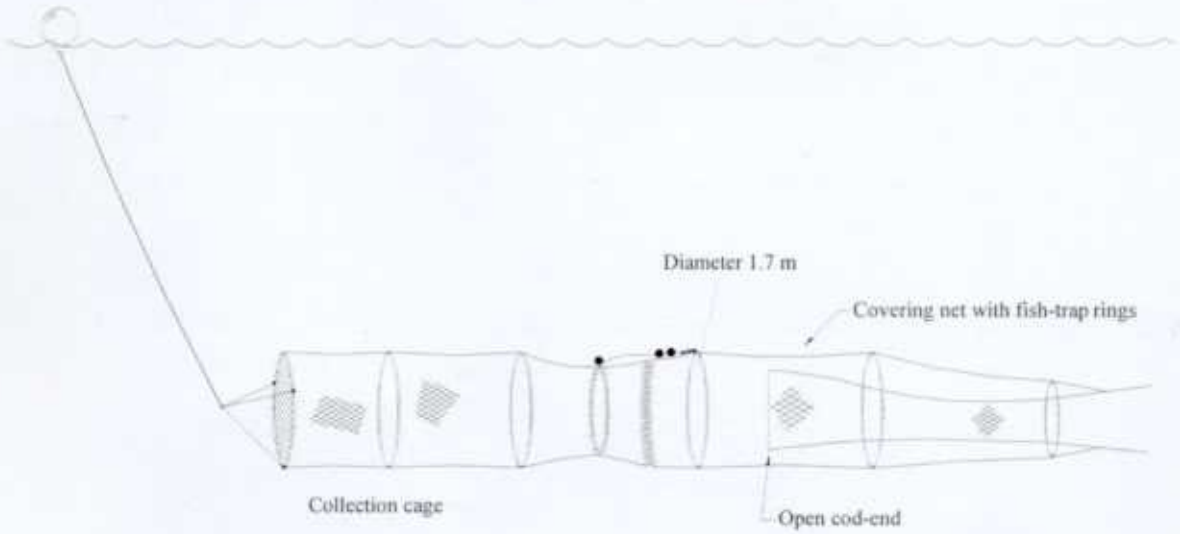


Figure 3. Arrangement of the cage for collecting the control group. The cage is secured to the extension, and is towed with the cod-end open.

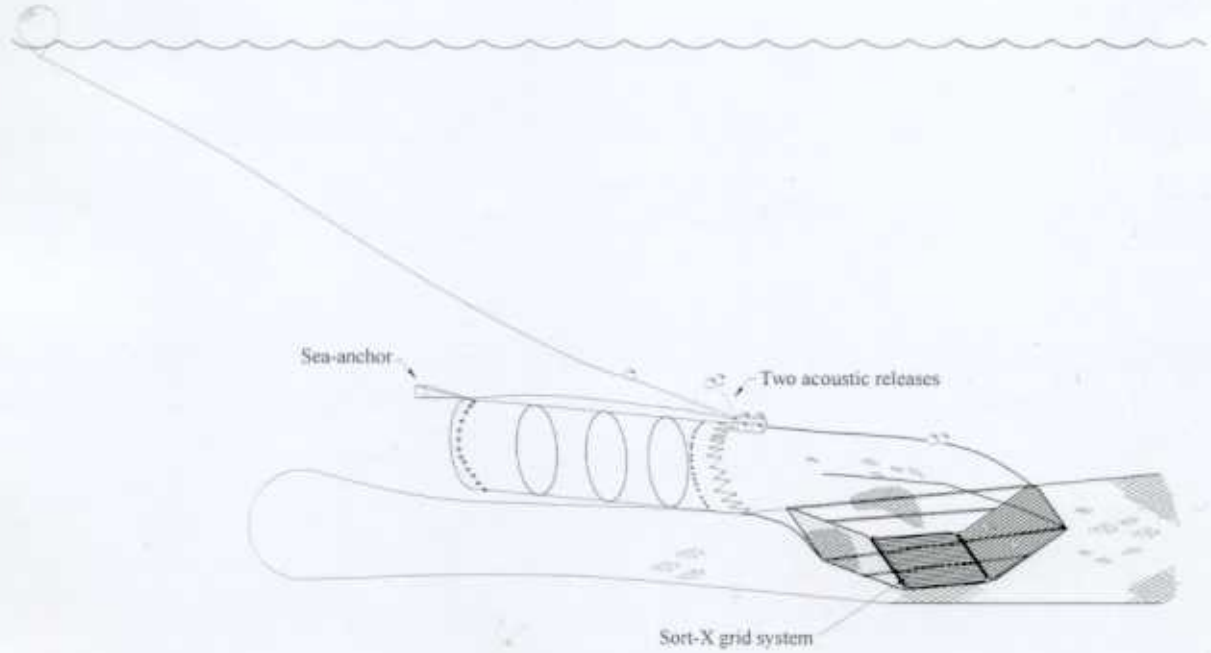


Figure 4. Fish that were sorted out through the grid were collected with the aid of the cover net over the grid. The collection cage was secured to the covering net.

Immediately after the cages had been anchored they were inspected by underwater camera in order to check that they contained sufficient fish, and that they were closed at both ends. The cages were subsequently inspected every second day until they were recovered after seven days in the sea, when the number of live and dead fish of each species, the size of the fish and the degree of injuries suffered were registered.

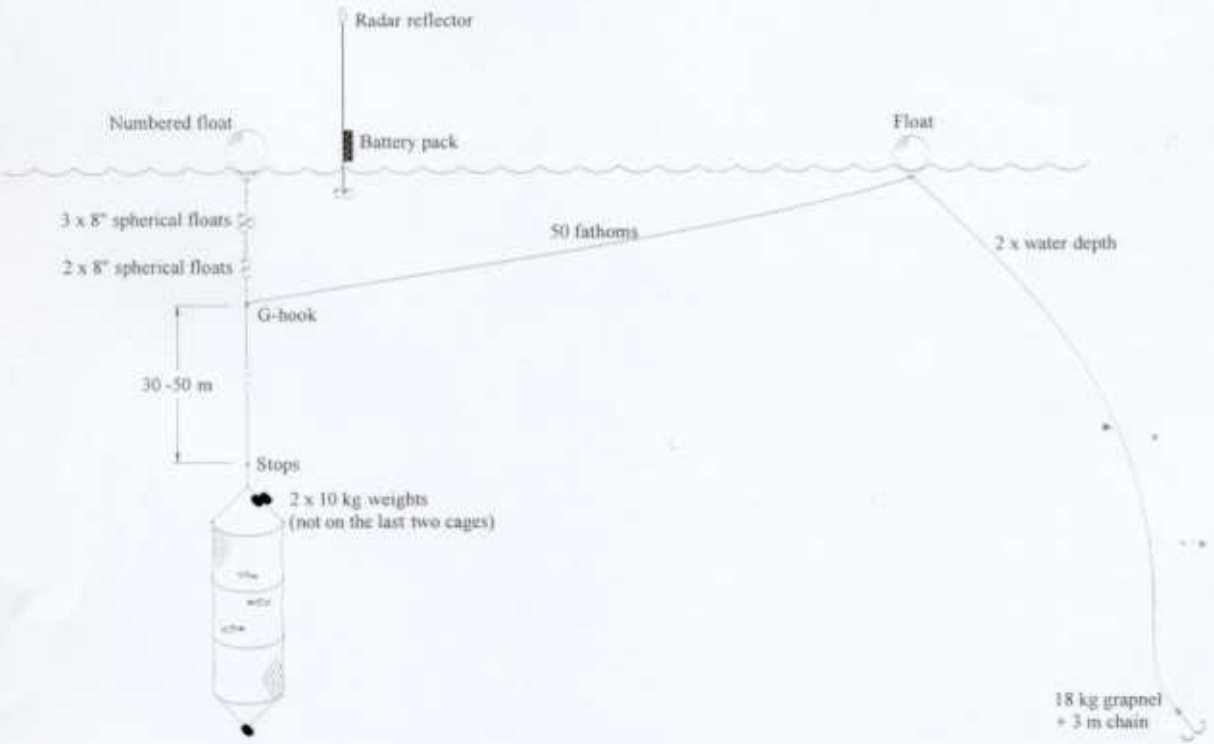


Figure 5. The cages were anchored on the fishing ground at depths of 40 - 50 m. The fish were observed by means of an underwater video camera every second day for a week.

## Results

There was no mortality in cod or saithe during the trials. Haddock mortality was higher, and varied widely from cage to cage within the same category of trials (Table 1). Rates of morta-lity in the control and grid-selected group were virtually identical, with means rates of 8 and 10% respectively, while mortality in the mesh-selected group was considerably higher (28%).

Visual observations of the fish in the cages at the end of the trials showed major injuries on the skin of haddock (Figure 11). The scale layer was partly worn off in large areas, particularly along the lateral line organs and at the tail. There were also major wear injuries on

Table 1. Mortality rates in haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*) and saithe (*Pollachius virens*) in the observation cages.

| | **Control** | | | **Grid selection** | | | **Mesh selection** | | |
|---|---|---|---|---|---|---|---|---|---|
| Cage no. | Total no. of fish in cage | No. of dead fish | Mortality (%) | Total no. of fish in cage | No. of dead fish | Mortality (%) | Total no. of fish in cage | No. of dead fish | Mortality (%) |
| **Haddock** | | | | | | | | | |
| 1 | 194 | 23 | **11,9** | 64 | 1 | **1,6** | 45 | 4 | **8,9** |
| 2 | 74 | 3 | **4,1** | 85 | 17 | **20,0** | 139 | 70 | **50,4** |
| 3 | 133 | | **0,0** | 40 | 4 | **10,0** | 33 | 8 | **24,2** |
| Mean | 133,7 | 13,0 | **5,3** | 63,0 | 7,3 | **10,5** | 72,3 | 27,3 | **27,8** |
| **Cod** | | | | | | | | | |
| 1 | 20 | 0 | **0** | 4 | 0 | **0** | 15 | 0 | **0** |
| 2 | 3 | 0 | **0** | 16 | 0 | **0** | 15 | 0 | **0** |
| 3 | 3 | 0 | **0** | 16 | 0 | **0** | 2 | 0 | **0** |
| Mean | 8,7 | 0 | **0** | 12,0 | 0 | **0** | 10,7 | 0 | **0** |
| **Saithe** | | | | | | | | | |
| 1 | 2 | 0 | **0** | 8 | 0 | **0** | 10 | 0 | **0** |
| 2 | 0 | 0 | **0** | 36 | 0 | **0** | 4 | 0 | **0** |
| 3 | 3 | 0 | **0** | 0 | 0 | **0** | 19 | 0 | **0** |
| Mean | 1,7 | 0 | **0** | 14,7 | 0 | **0** | 11,0 | 0 | **0** |

the fins. Some of these injuries may have been acquired in the trawl during towing and the passage through the grid or meshes, but since the majority of the injuries were found on the tail and fins, is seems likely that the haddock had problems in avoiding the walls of the net during the observation period. It appears likely that the swimming capacity of the haddock was insufficient to enable them to avoid the walls during periods when current speeds were high.

Neither cod nor saithe displayed equivalent skin injuries.

## Discussion

The fact that no mortality was found in cod and saithe confirms the results of earlier experiments (Soldal et al, 1993; Jacobsen 1994; Suuronen et al, 1995). The higher mortality in haddock than in cod or saithe also confirms earlier findings (Main and Sangster, 1991; Soldal et al, 1993). However, the haddock mortality observed in these trials was higher than expected. In the trials carried out on the coast of Finnmark in the early 90s, the mean mortality rates of the grid-selected and mesh-selected groups were 7.9% and 3.7% respectively. The mortality of the control group was as high as 20% in these trials, a result due to cannibalism following the entry of a number of large cod into the cages.

In theory, mortality in the control group should have been virtually zero if the cause of death was injuries suffered in the course of passing through the grid or mesh. In our experiments, we observed a mean mortality of 8% in this group. This must be due to injuries that the fish suffered in the trawling process before the fish were sorted out through the grid or meshes, or which we caused them as a result of the experimental methods we utilised.

The experimental methods used in survival trials are extremely complex and critical. Handling and storage of the sorted fish after capture can easily cause them further injury and stress, thus raising mortality above that caused by the trawl itself. Last year's trials were planned in collaboration with the Fishing Boat Owners' Association, in order to ensure that the experimental methods would be acceptable to the fleet. Important industry requirements were that the trials should be carried out under normal commercial fishing conditions, i.e. by commercial vessels using standard trawling gear and on fishing grounds where active fishing takes place. This meant that the trials were carried out in the open sea off the coast of East Finnmark. The cages in which the undersize fish were collected were anchored floating at a depth of 40 - 50 m on the fishing grounds. Previous trials have shown that towing the cages into sheltered waters causes more injuries to the fish and raises mortality rates significantly (Breen et al., 1998).

Examination of external injuries demonstrated that haddock suffered wear damage to their skin and fins after a week in the cages (Figure 11). This was probably due to the fish finding it difficult to avoid the walls of the net cages in the strong currents that they experienced in this area. Saithe and cod seemed to be better able to deal with this situation, and did not suffer from such injuries. Nor was there any mortality in these species.

However, Table 1 indicates that there was a tendency towards higher mortality in the mesh-selected group than in the grid-selected or control groups. If the experimental method had functioned satisfactorily we would have expected mortality in the control group to be virtually zero. Variations between individual cages within the same group should also have been small.

The high mortality in the control group, in combination with the wide variation in rates between cages, means that we cannot have complete confidence in the results of these trials. However, the trend does show that mortality is greater in haddock escaping through the meshes of a cod-end than haddock escaping via a sorting grid. These trials offer no suggestion that the sorting grid itself is the cause of high mortality rates in cod, haddock or saithe, as has been claimed by the trawling fleet.

However, the trials will be repeated in the summer of 2001, using improved techniques based on the experience gained in summer 2000, in order to remove all sources of uncertainty regarding the results.

## Conclusions

These survival trials, which were carried out in August 2000 off the coast of East Finnmark, offered no evidence that the sorting grid in cod trawls results in higher mortality rates in sorted undersized gadoid species than trawls that lack a sorting grid. Indeed, the results suggest that haddock mortality rates are lower when a grid is utilised. No mortality was observed in cod or saithe in the course of these experiments. These species appear to be able to tolerate selection via both meshes and grids. A certain degree of uncertainty with regard to the experimental methods employed, however, means that the trials will be repeated in order to obtain more certain results for haddock.

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Figure 6. The survival experiments were carried out on board the stern trawler "Myrefisk II"

Figure 7. Cod-end with cover cage and acoustic releases on the deck of Myrefisk II

Figure 8. The collection cage floating at the surface as the trawl is set

Figure 9. The underwater vehicle FOCUS being steered during trawling

Figure 10. The observation cages, in which the fish sorted out from the trawl remained for a week after being caught, were 8 m long, with a diameter of 2 m

Figure 11. Typical fin and tail injuries in haddock that had been in the observation cages for a week