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SURVIVAL OF SAITHE (*POLLACHIUS VIRENS* L) ESCAPING THROUGH TRAWL MESHES

by

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ABSTRACT

A pilot study to estimate the survival of saithe escaping from a cod-end with 145 mm diamond meshes was done in April-May 1992 north of the Faroes. Escaped fish were collected in fine meshed net cages (2x2x5m aluminium frame) mounted aft on a cod-end cover. After one hour trawling below 150m depth the cages were released by means of an acoustic release system and slowly hauled up to 40m below sea surface for UTV observations (6-7 days). The net cages were drifting freely with the current in the area north of the Faroes and located by means of radio tracked buoys. Preliminary results indicate that saithe can withstand almost the same sorting as cod with low mortality. However, more experimental work is needed to draw more firm conclusions on survival rates of saithe escaping from a cod-end.

INTRODUCTION

The basic philosophy in fishery management by mesh size regulation of trawl fisheries is to let fish under a certain minimum size escape, thereby increasing the potential future yield of the fisheries. A necessary requirement is that the escaping fish survive. But how badly damaged are the fish that manage to escape from a cod-end? Do they survive? These questions are important, and attempts to answer them were done by among others Maine and Sangster (1988), Zaferman and Serebrov (1989), and recently Soldal *et al.* (1991). The first results indicated a high mortality of young haddock in the North Sea (Maine and Sangster 1988, 1989). The survival estimates of haddock were adjusted upwards in later reports due to more refined techniques and better methodology (Maine and Sangster 1990, 1991, and Soldal *et al.* 1991). The species studied so far are haddock, cod, whiting, and to a lesser extent saithe. These studies were done in the North Sea, and in Northern Norway. Baltic herring has also been studied recently (Suuronen 1991).

The commercial trawl fishery at Faroes is mainly based on *fresh-fish* stern trawlers, traditionally aimed at cod. However, a drastic decline in the cod fishery in later years has initiated a shift of principal target species towards saithe. This change led to a conversion of most of the trawler fleet to fish on deeper water as pair trawlers to catch saithe. As the mesh size in the demersal fisheries in the Faroes EEZ is 145 mm, substantial amount of young saithe is expected to be selected out. It is therefore necessary to know if saithe escaping from cod-ends do survive. The work done so far can not be transferred to the Faroese fishery directly, as the studies have been done in shallow water less than 60 m depth, while saithe is caught at depths below 150 m, also the mesh size is different to those studied and lastly the survival data available on saithe is rather limited (Soldal *et al.* 1991). The aim of the work presented in this paper was thus to elucidate the survival rates of saithe escaping from a cod-end.

MATERIAL AND METHODS

The experiments were conducted in April-May 1992 in an area north of the Faroes (Figure 1) onboard the chartered vessel M/T *Liggjas* (21m, 370Hp) and the research vessel *Magnus Heinason* (45m, 1800Hp). Scientific personnel from Denmark, Norway and Faroes participated in the survey.

As the fishing areas for saithe are located relatively far off the coast at depths below 150m, it was considered lethal to the fish to be towed in cages 15-20 nm to an inshore area for closer observation, as used in the Norwegian method. The possibility to anchor the cages at bottom were considered. However, the current in the shelf-edge area is strong and this method provided no possibility to monitor the fish and the cages during the experimental period. Therefore the cages were hauled up to 40m for observation, where they were left drifting freely with current.

The survey started on 22 April 1992, and the first week was used to find an area north or north-west of the Faroes with suitable concentrations of saithe of a wide size range, and at the same time not too far from the isles. The residual flow north of the Faroes is going east-wards (Hansen 1979, 1991). It was therefore natural to aim at an area north-west of the isles, so the released fish cages would drift in a fairly known direction (Figure 1).

The method used in the present investigation can in short terms be considered to be an offshore version of the *Norwegian* method (Soldal *et al.* 1991) adapted to deeper water. Only the differences from the Norwegian method will be described in detail here. Trawling was performed below 150m depth with a commercial bottom trawl (Stjørnutrol) with 145 mm cod-end. The experimental set-up during trawling is shown i Figure 2. A small meshed cod-end cover kept open with aluminium rings (2m ∅) was attached to the extension-piece on the trawl and the escaping

fish were collected in a fine meshed fish cage (2x2x5m aluminium frame) mounted aft on the cod-end cover (Figure 3).

After 1 hour trawling the cage was released from the cod-end cover by means of a remotely controlled acoustic release system and then taken over by the small assistant vessel, which began to haul the cage up to 40 m depth. This process was considered to be quite crucial in the whole experiment. We tried to haul the cage very slowly, and only reducing the atmospheric pressure in steps by 1/4 each 80-100 minute according to a decompression table (see Tytler and Blaxter 1973, Efanov *et al.* 1986). At the observation depth, usually 8-16 hours after release, 2x4 plastic floats (11" ∅) and two buoys (24" ∅) were attached to the line. A marker buoy with light and a radio buoy were also attached, to be able to locate the different cages drifting in the area by the assistant vessel (Figure 4). The cages were observed daily by an UTV camera lowered down the buoy line and the operator could observe the fish in the cage (Figure 5). All UTV observations were recorded on tape.

An attempt was made to analyse the scale loss and skin damage of individual fish as described in Maine and Sangster (1988, 1989). But it soon became clear that the scale loss in most fishes was more severe on one side than on the other. This phenomenon was most common among the smallest fish and especially for young haddock. Generally the scale loss on saithe was low, but no estimates were calculated. The reason will be dealt with in the discussion.

The survival of saithe escaping from a cod-end was compared to a *control* group; i.e. saithe collected in the cage from an open trawl where the cod-end was removed. The control cage and the cage with cod-end escapees were released the same day very close together (we also tried to join the two cages) to secure that both cages experienced approximately the same environmental conditions during the observation period of 6-7 days.

RESULTS

The weather conditions were poor and we experienced one severe gale in the middle of the survey. As the method is quite complex, this hampered the experiment significantly. The first successful release of an experimental cage containing adequate number of saithe was on the 28 April, one week after survey start. A control cage was also released later the same day (see 1A and 2A in Figure 1). Several cages containing cod-end escapees and control cages were released the following days. However, most of them had to be excluded from the analysis. Some cages contained no saithe and others got ruptures in the cage netting. In three cases the cage was not released properly at bottom by the acoustic release system. Two cages came to surface by themselves after release, mostly due to huge amount of small redfish (*S. viviparus*) which got positively buoyant at a certain stage of the hauling process. Cage number 4 was successfully released on the 1 May (see 4A* in Figure 1), however, during the storm that day we lost the connection with the radio buoy, it was never recovered. Four cages (no. 5,6,7 and 8) were released during the second week of the survey and the last cage was recovered on 10 May (see 8B in Figure 1) by the assistant vessel.

Saithe. Due to the development and adjustment of the experimental technique and bad weather, only two cages contained suitable number of saithe to calculate survival estimates (see cages 1 and 2 in Table 1). All saithe in the control cage survived confinement after 6 days, while only 2 out of 85 fish (2.4%) died in the cage containing cod-end escapees (Table 1). Subsequent post-mortem examination of the two fishes revealed erupted swim bladder, and no signs of external damage were evident in either fish. Some of the survived saithe had net marks around the snout region probable due to pushing its snout into the meshes in the net wall. Generally no signs of fungus development was evident on the fishes, even if scale loss and skin damage could be

observed. This might be due to the relative short observation period of 6-7 days. However, Maine and Sangster (1991) reported beginning signs of deterioration due to scale loss only after 4 days and subsequent death within the next two days, and Soldal *et al.* (1991) reported heavy infection on all damaged haddock and death within the next 5 days and practically no deaths after one week in captivity.

The length distribution of saithe escaped from the cod-end ranged from 30-65cm and the saithe retained in the ordinary cod-end ranged from 40-80cm (Figure 6).

Other species. Of other species caught was mainly redfish, and especially the small redfish (*S. viviparus*). Nearly all redfish died after 1-3 days in captivity, with only 25% survival in the control group and 0-5% survival in the experimental group (Table 2). The swim bladder was not erupted in the dead redfish. The size of the few redfish that survived was notably higher than the bulk of the dead fish, indicating size dependent survival. However this has to be verified in future work. A few halibut were caught during the survey (size ranges from 40-75cm), they all died after a couple of days in captivity. The same was true for species as ling, tusk, and monkfishes. The ling and tusk also had erupted swim bladder.

Analysis of video recordings. The UTV observations of the floating cages were done daily (Figure 5), and showed the saithe swimming calmly around the confinement of their cages. Most round fishes swam calmly around, even if the cage moved continuously with the waves and as the line up to the marker buoy was heaving in the cage. However, halibut and other bottom dwelling fish as catfish, monkfish and ling seemed to be more disturbed and excited than "normal" under this moving "bottom".

DISCUSSION

The method. The present work must be considered as a pilot study to modify and develop an experimental technique on survival of cod-end escapees in the open sea and at depths below 150m. The depth, the offshore location of saithe, and the strong current along the shelf edge were all factors that made the experiment challenging, but at the same time they limited the experiment in several ways. Too few cages were released successfully containing adequate number of saithe, to draw any firm conclusions on survival rates. Also the fast drifting of the floating cages east-wards (up to 75 nm in 6 days, cage 1 in Figure 1) and the problem to observe all released cages daily by one assistant vessel, as they in many cases were to far apart (Figure 1), limited the area where the experiment could be done. In fact we had to move the experimental area east-wards following the drifting cages, to secure that additional released cages were within the operating radius of the assistant vessel. Improvement of the weather conditions might be obtained, simply by conducting the survey later in May or in early June.

The technical equipment, the trawl, the cod-end cover (kept open by 2m ∅ hoops), and the cages (Figure 3) worked exceptionally well during the survey. Video recordings within the cage during trawling showed clear space between the cod-end cover and the cod-end due to the aluminium rings. No masking is considered to have occurred.

Survival. The two dead saithe had both erupted swim bladders. No superficial signs of scale loss or skin damage were evident that could have caused their death. A possible death cause could have been a to rapid decompression, when the cages were hauled up to observation depth of 40m. If depth sensors had been on the cages, a more careful decompression regime could have been managed. Generally the scale loss was low, and in the few cases where it could be observed, an uneven damage on each side was noted, indicating that exhausted fish might have laid back and rubbing one side against the small meshed netting in the bottom of the cage during trawling

lasting one 1 hour. Soldal *et al.* (1991) mentioned this phenomenon in small haddock after only 10 min. trawling. Therefore no scale loss estimates were calculated.

Beside the possible death cause by the to rapid decompression of fish, one additional cause of death among halibut, ling and catfish, could have been the continuos movement of the cages with the waves, thereby stressing the fish usually adapted to rest on bottom. Indeed the dead halibut had clear signs of damaged blind side.

One unexpected result was the high mortality of redfish, and particularly of small redfish (*S. viviparus*), whether it had escaped the cod-end or not (Table 2). One plausible explanation might be that redfish, usually considered a deep water species, is neutrally buoyant at depth thereby experiencing greater problems during depression, while roundfish might be negative buoyant at sea bed and neutrally buoyant in midwater, as suggested by Arnold (1991), and therefore better can withstand the hauling process.

To conclude: The present study has revealed and clarified some of the experimental deficiency encountered during this survey, the technique has been tested and adjusted to work offshore on deep waters, and a few results have emerged. The method is now considered ready to give reliable survival estimates on saithe and other species in future work.

Norwegian investigations on the mortality rate of fish escaping through trawl meshes indicated no mortality for cod and a mortality less than 10% for haddock (Soldal *et al.* 1991). The data on saithe were insufficient to give reliable estimates of mortality, although they stated that the mortality rate was lower than for haddock and probably higher than for cod. The preliminary results from our first experiment indicate that saithe can withstand almost the same sorting in a cod-end as cod with low mortality. However due to data deficiency more experimental work is needed to draw more firm conclusions on survival of saithe escaping from a cod-end.

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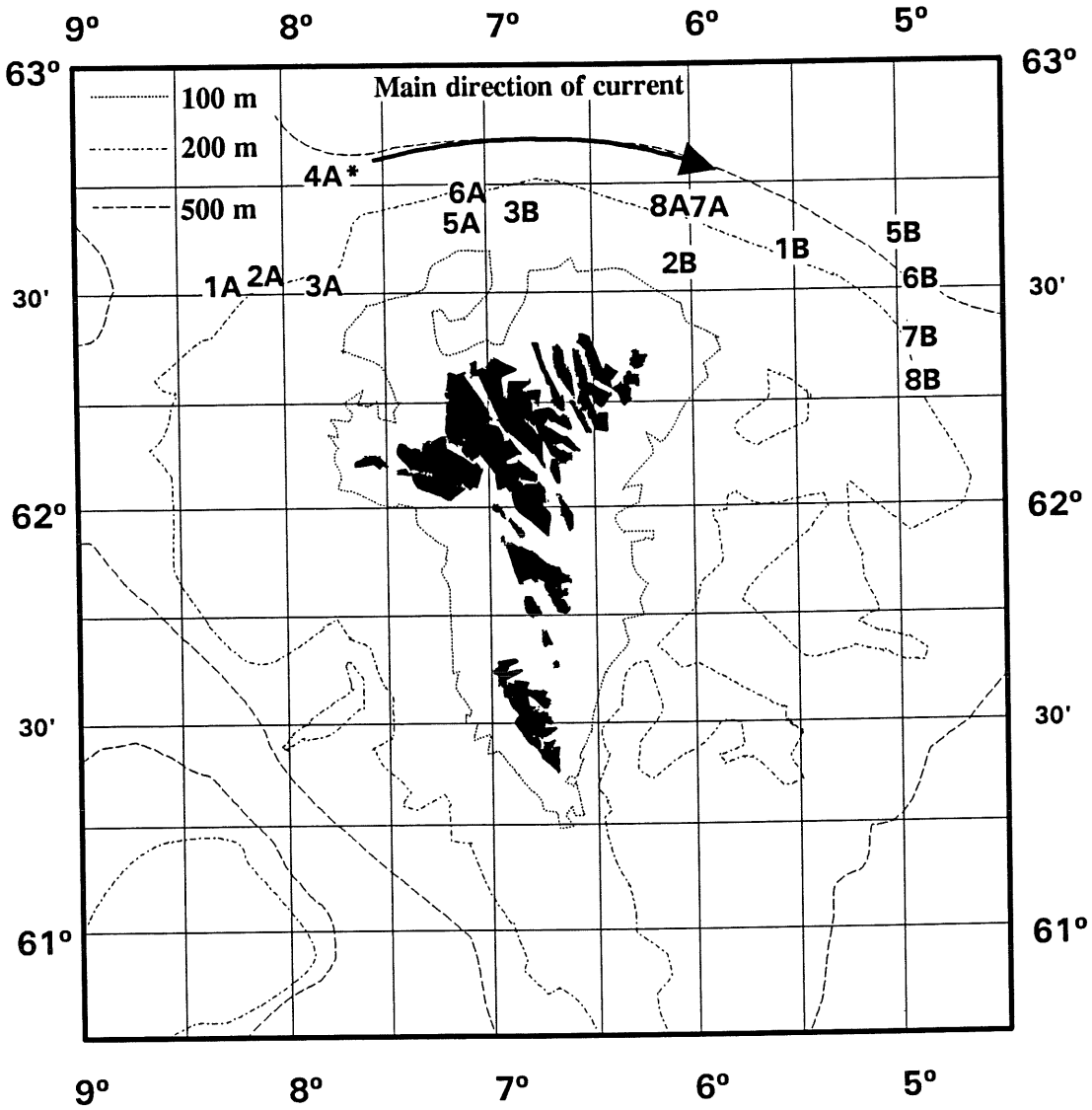

Figure 1. Survey area. The numbered markers labelled **A** show release positions of the cages, while the numbers labelled **B** show the recovery positions. As can be seen, cage number 1 drifted over 75 nm eastward during 6 days! Cage number 4 was never recovered, and is probably drifting towards the northern Norwegian coast by now.

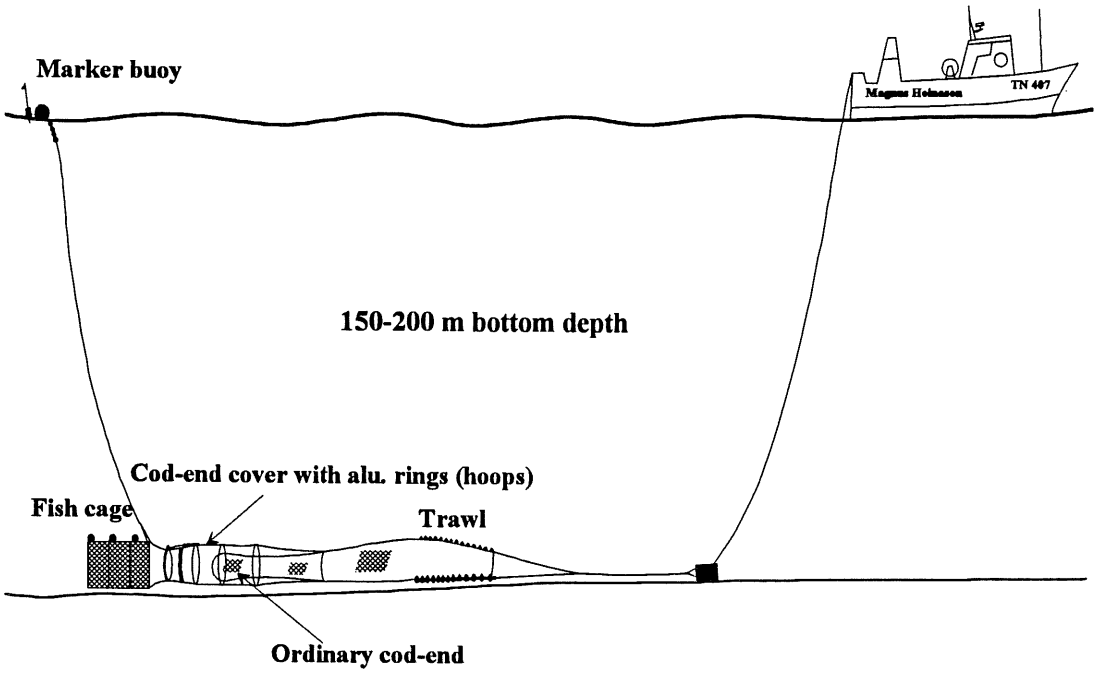

Figure 2. Experimental set-up during demersal trawling with the cage attached to aft end of cod-end cover (see details in Figure 3).

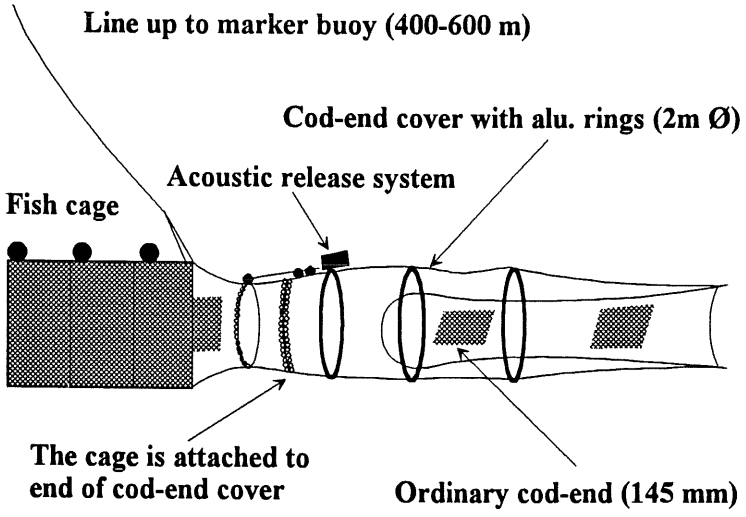

Figure 3. Details of the attachment of the fish cage to the small meshed cod-end cover and the remotely operated acoustic release system. Fish escaping through the cod-end meshes is caught in the fine meshed net cage (2x2x5m aluminium frame).

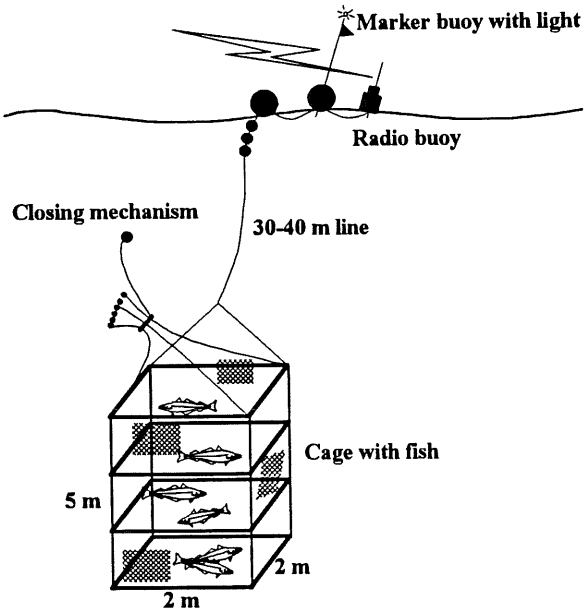

Figure 4. Fish cage drifting freely with the current at 40 m depth during the observation period (4-7 days).

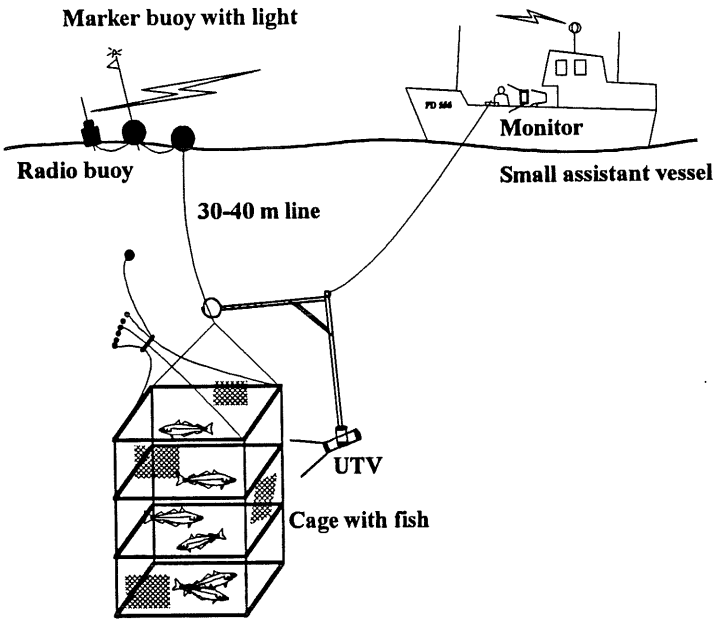

Figure 5. Daily observation of the fish in the cage by a remotely operated UTV.

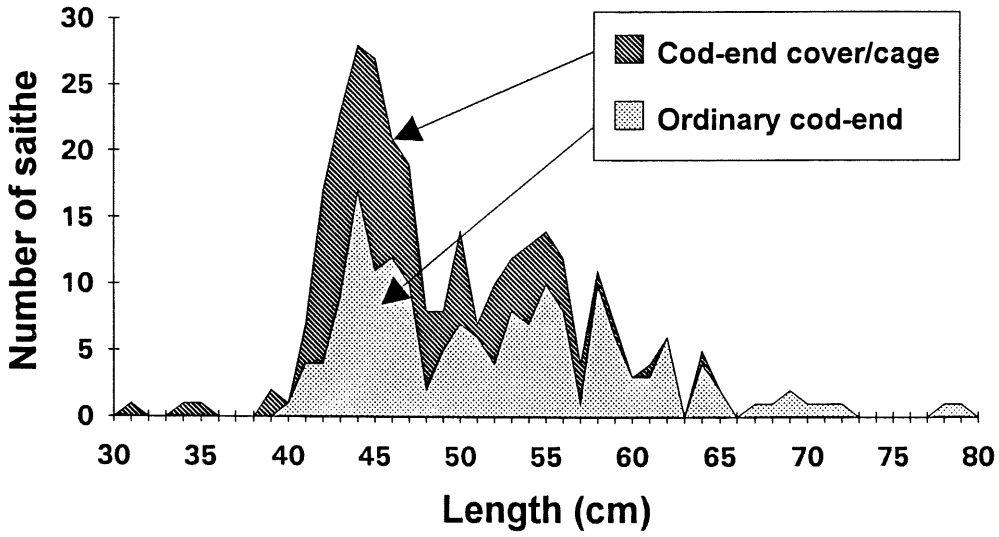

Figure 6. Length distribution of saithe from all trawl hauls during the survey; the dark area is the fish escaped from the cod-end and withheld in the cod-end cover or the cages. The light area is fish retained in the ordinary 145 mm cod-end.

Table 1. Mortality results for saithe during the observation period (6-7 days). Only cage 1 (mesh selection) and cage 2 (control) contained suitable number of saithe to calculate survival estimates.

Experimental group	Cage no.	Obs. period	No. of saithe	No. of deaths	**Survival (%)**
Mesh selection	**1**	**6**	**85**	**2**	**97.6**
Mesh selection	6	6	2	1	-
Mesh selection	7	7	2	0	-
Mesh selection	8	7	3	0	-
Control	**2**	**6**	**15**	**0**	**100.0**

Table 2. Mortality results for redfish (*S. viviparus*) during the observation period (6-7 days).

Experimental group	Cage no.	Obs. period	No. of saithe	No. of deaths	**Survival (%)**
Mesh selection	1	6	17	16	5.9
Mesh selection	6	6	900	896	0.4
Mesh selection	7	7	85	85	0.0
Control	2	6	24	18	25.0