

## A Long-Term Trial of the Effects of a Square-Mesh Panel on Commercial Fish Catches

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Fisheries Development Note

No. 9

July 2001

### Summary

A series of trials were carried out from November 1999 to October 2000 to assess the effect of fitting a square-mesh panel (9.3 m from the cod-line) on the catches of a demersal whitefish trawler. A total of 192 hauls, totalling over 784 hours of fishing time, were made, and a total of 75,500 kg of fish were caught. No significant differences were found between the catches of cod, haddock and monkfish taken with the cod-end fitted with the panel, and an unmodified control cod-end. The panel did reduce the catches of both undersized and marketable whiting were (by 33% and 15%, respectively).



The fishing vessel *Guiding Light* (LK 84) used in these trials.

### Introduction

The large bycatch of undersized (immature) fish in demersal trawls, the vast majority of which are subsequently discarded dead, is arguably one of the most serious issues currently facing commercial fishermen and fisheries managers. This mortality of immature fish results in smaller future stock sizes and reduced earnings for fishermen. Considerable interest has been focussed in recent years on the potential of 'square-mesh panels' as a means of improving the selectivity of demersal trawl nets.

A substantial amount of research has been carried out in recent years on the effectiveness of square-mesh panels, but although the basic principals have been demonstrated the results of experiments have sometimes been inconclusive and difficult to interpret, often due to

the relatively small numbers of tows usually achieved during previous trials (typically less than 2 weeks). In addition, the fishing gear used in previous trials has sometimes differed significantly from normal commercial fishing gear, or has been operated in different ways, which can make it difficult to apply the results to the commercial fishing industry.

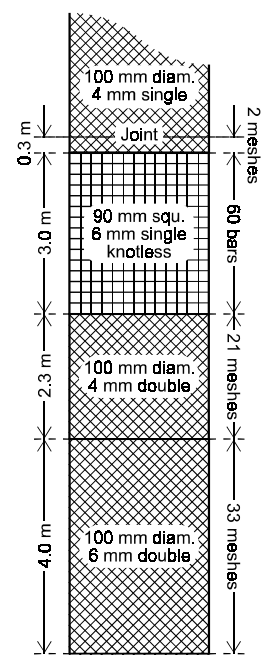
To address some of these problems the North Atlantic Fisheries College, in association with the Marine Laboratory in Aberdeen, undertook a long-duration trial to assess the effects of a square-mesh panel on bycatch levels during normal fishing operations.

### Methods

The trials were carried out onboard the Shetland fishing vessel *Guiding Light* (LK 84), a 23 m, 485 kW demersal whitefish trawler. Trials were carried out for one week each month over one year, from November 1999 to October 2000.

For the trials two identical new cod-ends were manufactured for the *Guiding Light's* normal trawl net (to the same design as her usual cod-end). One of these (the 'experimental' cod-end) was fitted with a square-mesh panel (right), while the other (the 'control' cod-end) was left unmodified. The square-mesh panel was constructed of 90 mm knotless netting, was 3 m long and was fitted 9.3 m from the cod-line. Both cod-ends had a 235 mm lifing bag fitted (52 open meshes).

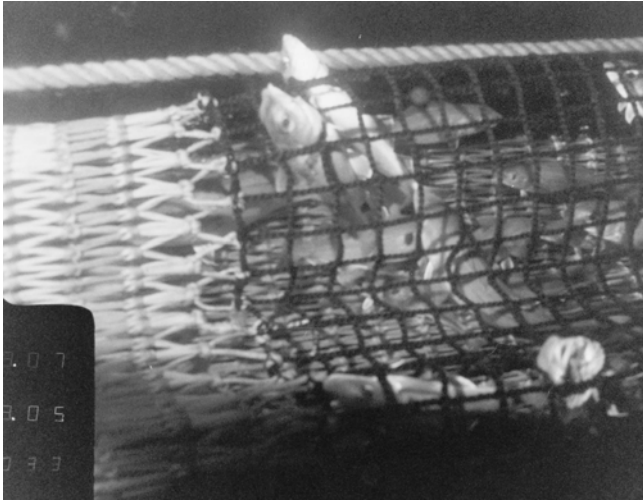
Preliminary trials with the experimental cod-end were carried out during July 1999, during which a remotely controlled underwater vehicle equipped with television and still cameras was



Schematic diagram of the experimental cod-end used in these trials.

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used to observe the net and the square-mesh panel. This



*Photo of the square-mesh panel in the experimental cod-end during the preliminary trials.*

demonstrated that the square-mesh panel was correctly rigged and operating as expected, with fish observed escaping through it.

The main trials consisted of a series of pairs of hauls; one with the experimental cod-end and one with the control cod-end. Both hauls in each pair were made in the same area and they were of the same duration so that the catches could be directly compared. Apart from alternating the cod-end on the net between hauls, and some modification of haul durations, the skipper's normal commercial practices were followed as closely as possible (e.g. fishing pattern, choice of grounds, etc.). Between 6 and eight pairs of hauls were made during each trial week, with each haul lasting about 4½ hours, on average. Additional hauls were made with a small-mesh (40 mm) cod-end to provide information on the full range of size of fish present on the grounds being fished.

One problem with this method of comparing cod-ends is that because fish are not evenly distributed two successive hauls in the same area may catch different quantities of fish, even if the same cod-end is used. By carrying out a large number of hauls over a long time period in this study it was hoped that these natural variations would average out, making it easier to compare the two cod-ends.

Each haul was sorted and the total quantities of each species retained and discarded were recorded. Representative samples of the four main species caught; (cod, haddock, monkfish and whiting) were measured to provide length-frequency distributions. Gutted weights of the fish caught were calculated from their lengths using published length-weight relationships.

## Results

During the period from November 1999 to October 2000 the *Guiding Light* carried out a total of 60 days of fishing trials with the experimental and control cod-ends in 12 separate trips at approximately monthly intervals. The

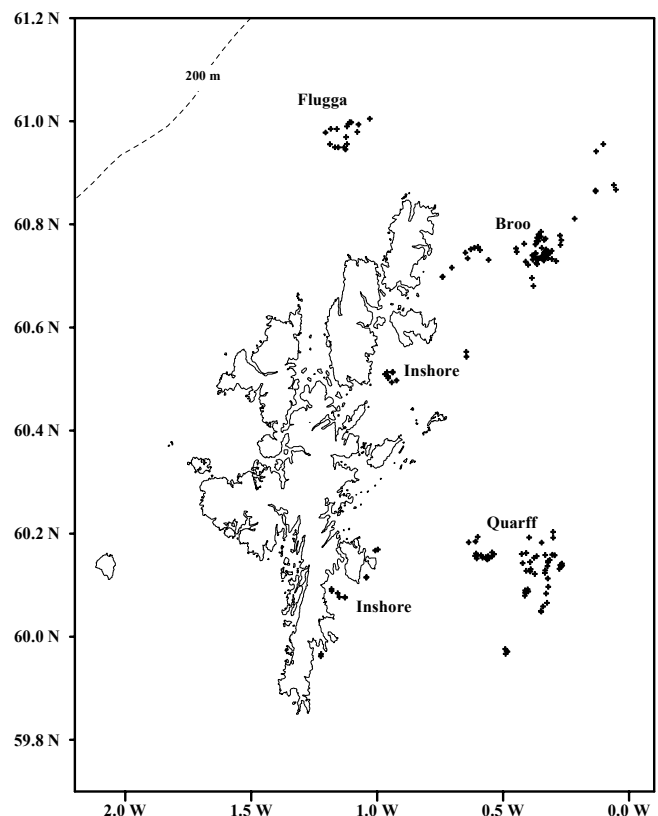
trials were carried out on fishing grounds to the North and East of Shetland, as shown on the map below.

A total of 215 trial hauls were made, of which 195 were valid; 86 pairs of hauls with the experimental and control cod-ends (i.e. 192 in total), and 23 with the 40 mm cod-end. The remaining 20 hauls were rejected as foul, because the net was either damaged, badly fouled, or otherwise judged not to have been performing correctly.

The average haul duration was 4 hours 34 minutes. The fishing time with the two cod-ends was closely matched with a total of 391 hours 54 minutes with the experimental cod-end and 392 hours 25 minutes with the control cod-end; a difference of only 31 minutes over the course of the trials.

The *Guiding Light's* total catch during the trials was some 75,500 kg, of which 51,500 kg (68%) was classed as marketable and retained for landing and sale. The remaining 24,000 kg (32%) comprised either unmarketable species or fish below minimum landing sizes and was discarded. Haddock, whiting, cod and monkfish predominated in catches with a total of 189,620 individual fish caught. With a total gutted weight (retained and discarded) of 57,600 kg these species accounted for 76% by weight of the total catch, and 86% (44,900 kg gutted weight) of the marketable catch.

The catches of cod, haddock, monkfish and whiting with the experimental and control cod-ends are summarised in more detail in the table below, and in the graph on the last page, which shows the catches per unit effort of



*Location of hauls made by the Guiding Light with the experimental and control cod-ends. Crosses indicate the mid-point of each haul.*

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these species.

Detailed analysis of the data showed that there were no significant differences between the catches of cod, haddock or monkfish taken with the experimental and control cod-ends. Apparently large numbers of undersized haddock were caught with both cod-ends; almost half of the haddock caught being undersized. However, much larger quantities of undersized haddock were caught with the small-mesh cod-end, 4,589 per hour on average, compared to about 78 per hour with the experimental and control cod-ends.

The only species which showed strong evidence of a reduction in catches with the experimental cod-end (with the square-mesh panel) was whiting. The catch rate for undersized whiting with the experimental cod-end was about 33% less than that with the control cod-end. The catch of Grade IV whiting was also reduced by 22% and of Grade III by 8%. Overall the square-mesh panel reduced the catch rate of whiting by about 17%, and by 15% for marketable size grades.

## Discussion

The trials undertaken on the *Guiding Light* during this study represent one of the longest and most comprehensive comparative trials of square-mesh panels yet undertaken and have generated a large set of data.

Detailed analysis of the data collected during these trials found that the square-mesh panel had a significant effect

on the catch of only one species - whiting. There was no evidence of a panel effect for cod, haddock or monkfish. A panel effect was not really anticipated for monkfish, as their shape makes it unlikely that they would escape through a square-mesh panel, but the lack of an effect for cod and (particularly) haddock was surprising.

There is no evidence that the lack of a panel effect was due to any fault with the design or rigging of the panel; the TV observations made during the preliminary trials showed that the panel was properly rigged and that fish were escaping through it. The duration of the trials and the amount of data collected means that there should have been a good probability of detecting a panel effect if it was present.

There is no doubt that square-mesh panels fitted in demersal trawl nets can reduce catches of undersized fish of various species, as has been demonstrated in previous trials. Some previous trials by the Marine Laboratory in Aberdeen of similar cod-end designs to that used in these trials have found more significant effects on catches, particularly of haddock.

The very large catches of undersized haddock taken with the small-mesh cod-end suggests that although the square-mesh panel had little apparent effect on haddock discards, the vast majority of undersized haddock (>98%) may have been escaping from the *Guiding Light's* cod-end, whether or not it had a square-mesh panel fitted.

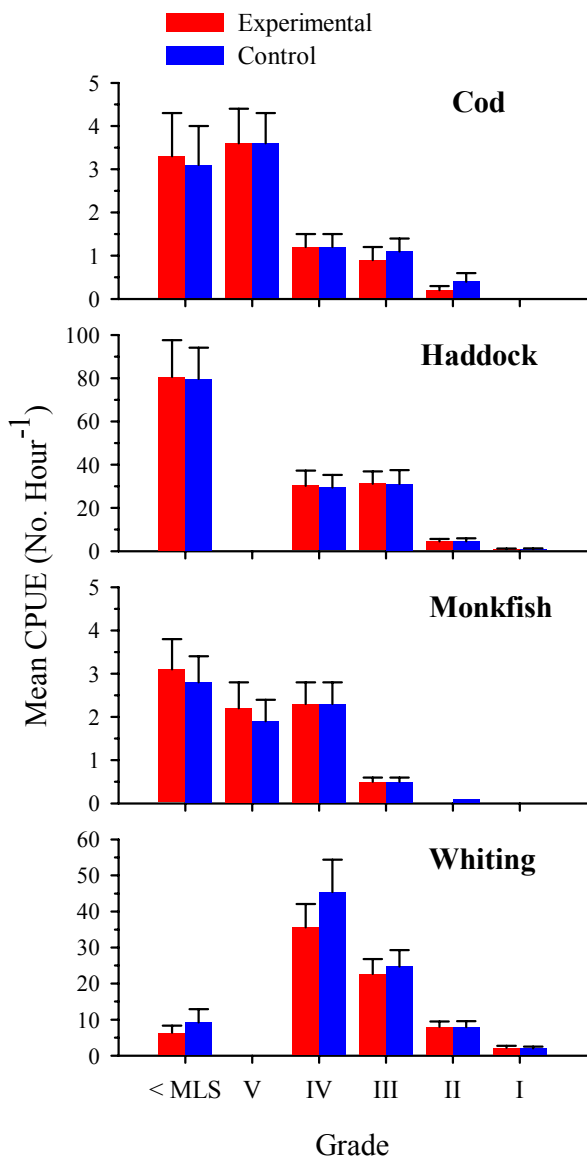
*Summary of the numbers and gutted weight (kg) of cod, haddock, monkfish and whiting caught with the experimental (with square-mesh panel) and control cod-ends, by size grade and marketable (retained) and undersized (discarded) components.*

		Cod				Monkfish			
		Experimental		Control		Experimental		Control	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
<b>Grade</b>	<b>I</b>	15	144	19	170	4	70	4	61
	<b>II</b>	96	535	159	897	19	136	23	161
	<b>III</b>	347	1,100	421	1,341	184	713	199	747
	<b>IV</b>	461	731	453	726	911	1,498	936	1,545
	<b>V</b>	1,406	1,018	1,433	1,054	882	603	763	522
<b>Total Marketable</b>		2,324	3,528	2,484	4,188	2,000	3,020	1,925	3,035
<b>Undersized</b>		1,319	375	1,251	353	1,183	324	1,106	308
<b>Total</b>		3,643	3,902	3,735	4,541	3,183	3,344	3,030	3,343

		Haddock				Whiting			
		Experimental		Control		Experimental		Control	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
<b>Grade</b>	<b>I</b>	339	398	367	437	866	502	790	458
	<b>II</b>	1,686	1,144	1,806	1,229	3,073	1,192	3,101	1,197
	<b>III</b>	11,954	4,635	12,361	4,785	8,630	2,411	9,535	2,650
	<b>IV</b>	11,883	3,109	11,667	3,046	13,553	2,617	17,366	3,331
<b>Total Marketable</b>		25,861	9,285	26,202	9,498	26,122	6,721	30,792	7,636
<b>Undersized</b>		30,976	4,448	30,551	4,380	2,416	296	3,624	432
<b>Total</b>		56,837	13,733	56,753	13,877	28,538	7,018	34,416	8,068

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The overall average catch per unit effort (mean number of fish caught per hour) of cod, haddock, monkfish and whiting with the experimental and control cod-ends, by size grade and below the minimum landing size (<MLS). Error bars show 95% confidence limits

One aspect of square-mesh panel design that has been demonstrated previously is that the effectiveness of the panel increases if it is moved closer to the cod-line. Although the position selected for the panel in these trials was selected as one that it was thought would prove effective in the light of results from previous trials it is possible that its effectiveness would have been increased if it had been positioned closer to the cod-line. It was not, however, the purpose of these trials to compare different panel positions and any attempt to move the panel during

these trials would have substantially reduced the value of the data collected by introducing a confounding factor.

The fact that the square-mesh panel had a significant effect on catches of whiting but not on catches of haddock highlights the difficulty of designing effective technical conservation measures in a multi-species fishery. Changing the design of the panel to increase its effect on haddock would likely allow even more marketable whiting to escape, while trying to retain the marketable whiting would reduce its effect on haddock.

## Square-Mesh Panel Legislation

During the course of these trials square-mesh panels became a legal requirement for all UK fishing vessels using demersal trawl or seine nets as part of a package of conservation measures designed to help protect juvenile haddock. The size and mesh-size of the required panel matched that tested in these trials, but fishermen were allowed to fit it up to 12 m from the cod-line (and many apparently fitted it at this distance).

Anecdotal information indicates that there was a fairly widespread perception amongst fishermen that the square-mesh panel had little effect on catches taken with demersal trawls, although those using seine nets felt that if anything the panel was too effective.

## Conclusions

These trials found no evidence that the experimental cod-end used in these trials (with a square-mesh panel) had any significant effect on catches of cod, monkfish or haddock, although there was a significant reduction in catches of whiting. Previous trials have demonstrated that square-mesh panels can effectively reduce catches of undersized haddock. The failure of the panel tested to do so may be a result of its position; it is possible that moving the panel closer to the cod-line would reduce the catch of undersized haddock.

If the cod-end tested in these trials is representative of those being used by Scottish fishing vessels, the current legislation which allows square-mesh panels to be fitted up to 12 m from the cod-line may not be as effective at reducing catches of juvenile haddock as had been hoped. However, the catches with the small-mesh cod-end also suggest that during the trials the majority of juvenile haddock may have been escaping anyway, regardless of whether or not a square-mesh panel was used.

## Acknowledgements

The cooperation and assistance of the skipper and crew of the *Guiding Light*, without which these trials could not have been conducted, is gratefully acknowledged, as is the assistance of the Marine Laboratory Aberdeen.

This project was partly funded by the European Commission DG-FISH (Study No. 98/020).