The effect on haddock selectivity of varying cod-end circumference, inserting a ‘flexi-grid’ or inserting a Bacoma type panel

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ABSTRACT
A comprehensive set of experiments using the twin trawl technique was conducted in the North Sea to assess the selectivity of haddock (Melanogrammus aeglefinus), cod (Gadus morhua) and saithe (Pollachius virens) in 120mm mesh cod-ends with (i) 100, 80 and 60 meshes in circumference; (ii) a 35mm ‘flexi-grid’ mounted in the extension and, (iii) a 110mm ‘Bacoma’ style square mesh panel.

INTRODUCTION
The scientific advice from the International Council for the Exploration of the Seas (ICES) has consistently recommended a large reduction in the discarding of juvenile North Sea cod and haddock and an overall reduction in fishing mortality on cod of all ages. In 2001, due to low cod spawning stock biomass, and high levels of haddock discarding, the regulatory authorities in the EU and Norway initiated a series of technical measures under the auspices of a ‘cod recovery plan’. The minimum mesh size in the North Sea was increased from 100 to 120 mm in January 2002 in Norwegian waters and in 2003 in EU waters. As part of the agreed record between the EU and Norway, it was decided to conduct a series of collaborative selectivity experiments to identify possible mechanisms for improvements in exploitation patterns of relevant species.

METHODS
The trials were carried out in August 2002 on fishing grounds, west and south west of Bergen in the Norwegian North Sea, using MV Fertile II (BF 740), a 610 kW, 22.6 m, twin rig demersal trawler, typical of the Scottish boats that operate in Norwegian waters. The vessel’s own twin trawls were towed using a three-wire system with a 1500 kg Morgére centre clamp weight with Morgére size 8, 1040 kg otterboards to spread the gear. The twin trawl technique (Wileman et al., 1996) was used to estimate the selectivity of each net.

For each haul, logistic curves were fitted to the measured numbers at length, rather than the ranked numbers at length, using the SELECT statistical model where the sub-sampling fractions are incorporated through an offset variable (Millar and Walsh, 1992; Millar and Fryer, 1999). The individual-haul selection curves were combined using the between-haul selection model of Fryer (1991).

The modelling process estimated and compared the selectivity of each gear variant where the sub-sampling fractions are incorporated through an offset variable (Millar and Walsh, 1992; Millar and Fryer, 1999). The individual-haul selection curves were combined using the between-haul selection model of Fryer (1991).

RESULTS
It was possible to estimate the haddock selectivity of thirty two hails and the between haul analysis of these data found that the 50% retention length of haddock depended on log-catch and on gear type and that selection range depended on gear type.

The fitted relationships of 50% retention length and log catch are displayed, by gear, in figure 1. Further investigation of the selectivity of the gears demonstrated that there was no difference between the standard cod-end with 100 meshes in circumference and the gear with a flexi-grid inserted ($p > 0.24$) and that the cod-ends with 60 and 80 meshes in circumference and the cod-end with the Bacoma panel were significantly more selective than the other two ($p < 0.002$). Of these there was no difference between the cod-end with 60 meshes in circumference and that with the Bacoma panel ($p = 0.7$) and only marginal evidence of a difference between the cod-ends with 60 and 80 meshes around ($p < 0.1$).

STOCK PREDICTIONS
Using the selectivity estimates we assess the effect on haddock stock size, landings and discards of reducing the number of meshes in circumference from 100 to 80 of the 120mm mesh cod-ends of the Scottish whitefish fleet. Two other fleets are also considered: the Scottish Nephrops fleet using mesh sizes below 100mm which catch small but economically important quantities of haddock, and an international fleet which includes all other fisheries catching haddock in the North Sea – including beam trawls, static gear, industrial trawls, etc. It is assumed that the fishing mortality and effort exerted by these two fleets do not change throughout the period.

Data from the 2004 ICES stock assessment Working Groups are used as a baseline, and recruitment, growth and natural and fishing mortality at age are taken into account for the succeeding 11 years. Estimates of haddock selectivity in Nephrops gears are obtained from STECF model (Anon, 2003).

The comparisons presented in the table below suggest that a major improvement in the selectivity of the Scottish whitefish fleet for haddock will have a considerable benefit to the stock by reducing discards for that fleet (row 1) but there will be short-term losses in landings and only a 2% long-term gain. The Nephrops fleet, using unchanged gear, will experience a much greater increase in landings (54%) than the fleet making the change.

A more equitable solution may be achieved by changing the selectivity of both fleets. Hence, we also consider what happens if the haddock selectivity of the Scottish whitefish fleet is improved by increasing cod-end mesh size to 95mm and by fitting a 120mm square mesh panel and the selectivity of the Scottish whitefish fleet also increases, but not by as much as above.

In the example presented here, a modest improvement in gear selectivity – for both Scottish fleets – can be chosen to ensure long-term benefits to the stocks and the fleets concerned (row 2). The effect on the catch of other species (e.g. Nephrops) and the short and medium–term effects are not shown here but would also need to be considered in the management process.

<table>
<thead>
<tr>
<th>Changes in technical measures for Scottish fleet (haddock selectivity parameters)</th>
<th>% change in long term (11 years) for haddock</th>
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</thead>
<tbody>
<tr>
<td>95mm codend</td>
<td>No change</td>
</tr>
<tr>
<td>120mm square panel</td>
<td>+22</td>
</tr>
<tr>
<td>60 meshes around</td>
<td>+26</td>
</tr>
<tr>
<td>80 meshes around</td>
<td>+27</td>
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REFERENCES


