Protecting Spawning Cod in the Irish Sea through the use of Inclined Separator Panels in Nephrops Trawls

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Abstract

As a result of serious concerns over the state of cod stocks in the Irish Sea, the EU introduced closed areas and seasons in the Irish Sea for the first time in 2000. During this first closure period, trials on board the twin-rig vessel “Northern Dawn” were carried out to assess the effectiveness of an experimental separator panel fitted to a Nephrops trawl at facilitating the release of cod. Results revealed that the panel proved effective, with a significantly reduced number of cod being retained by the experimental net compared to a standard Nephrops trawl. Good separation of other whitefish species such as haddock and whiting from Nephrops was also observed. Owing to the effectiveness of the separator panel tested in 2000, under EU Regulation 300/2000, fishing with Nephrops trawls with separator panels fitted was permitted within a defined part of the closure area in 2001. Observations on three vessels over the duration of the closure during 2001 indicated results very similar to those attained in 2000 with release rates of cod for all size classes of 68%. Since these trials, experimentation has been carried out with the inclined separator panel in other Nephrops fisheries and again the results have shown the potential advantages as a technical conservation measure compared to rigid grids and horizontal separator panels which are more complex to handle and expensive to install. This work has clearly demonstrated that the use of the panel provides a relatively straightforward and inexpensive way to allow vessels to continue to fish for Nephrops within otherwise closed areas with minimal impact on stocks of other species.

Introduction

In the Irish Sea (ICES Division VIIa), the cod stock is exploited by vessels from Northern Ireland fishing with semi-pelagic trawls and an Irish mixed whitefish species demersal trawl fleet. In addition, vessels from Northern Ireland and Ireland targeting Nephrops norvegicus, as well as beam trawlers from Belgium and Holland also catch quantities of cod. The profile of Irish Sea landings has shown that over 70% of the catch in 1998 was made up of mostly immature two-year old fish. This narrow range of age groups together with recent poor recruitment, increased fishing mortality and low spawning stock biomass have resulted in cod stocks declining...
dramatically. As a result of these serious concerns, the EU introduced closed areas and seasons in the Irish Sea for the first time in 2000\textsuperscript{1}. The spawning areas initially defined were to the east of the Isle of Man and between the Isle of Man and the coast of Ireland, with the closure effectual from 14\textsuperscript{th} February to 30\textsuperscript{th} April 2000. See Figure 1. This action, in conjunction with the development of technical conservation measures aimed to restore the Irish Sea cod stock above the precautionary biomass reference point ($B_{pa} = 10,000$ tonnes) and below the precautionary fishing mortality reference point ($F_{pa} = 0.72$) over a three to five year period.

During 2000, data was gathered from surveys aboard commercial vessels to quantify the amount of cod by-catch taken in the Irish Nephrops and whitefish fisheries within the closed area. In addition trials with a standard Nephrops trawl fitted with an experimental inclined separator panel were undertaken. This net was specifically designed to facilitate the release of cod, especially spawning cod. As the Nephrops fleet may also discard large amounts of whiting and haddock on the grounds of the Western Irish Sea it was hoped that this net would allow for high rates of escape for juvenile whiting and haddock. In addition, it was anticipated that this net would help increase the quality of Nephrops landed and lessen the sorting work on deck for the crew.

This paper summarises the findings from these trials carried out in 2000 and further work in 2001 and comments on the perceived effectiveness of the Irish Sea closure, the use of the Separator Panel during the closure and the future management of Irish Sea cod stocks.

**Inclined Separator Panel**

The modified inclined separator trawl used during all experiments was designed and constructed by James McDonnell of Gear Tech in conjunction with the Fishing Technology Section of BIM. The separator panel is fitted into the trawl in such a manner as to divert cod and other whitefish species coming down the trawl towards an escape hole of 2.4m on top of the trawl located in a modified extension piece. The 3m separator panel starts 50 meshes above the codend with the leading edge of the panel horseshoe shaped and 0.5m into the bottom sheet below the selvedge at an angle of approximately 30º to the selvedge. The leading edge of the panel is 0.3m above the bottom sheet, and at its widest point the panel is one third of the total width of the net from selvedge to selvedge. (See Figure 2).

**Methodology**

A similar methodology has been employed for all of the trials carried out to date with the inclined separator panel. All fishing operations have been conducted under the direct supervision of appropriate scientific staff from Bord Iascaigh Mhara and carried out under normal commercial fishing operations. To allow direct comparison between fishing gears, standard trawls were compared against an experimental net fitted with an inclined separator panel, either in a twin-rig arrangement or through alternate hauls with identical gear. In order to maximise the effectiveness of the

\textsuperscript{1} Commission Regulation (EC) No. 304/2000 of 9 February 2000 establishing measures for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa)
separator panel and also to directly assess fish escapement, in a number of the trials the experimental trawl had a second or top codend fitted to it, constructed in 80mm x 3.5mm P.E. On board the trial vessels the contents of each codend were emptied into separate fish pounds and a standardised stratified sampling protocol applied to the catch from each codend.

**Results**

**Trial 1**

Trials were carried out on board the 20m/425hp Howth based twin-rig vessel mfv “Northern Dawn” using standard 25fm *Nephrops* trawls. A total of 42 valid hauls were completed over the period March-April 2000. For the purposes of the trials, the survey area was split into Zone Ia and Iiia as indicated in Figure 1 based on information from local fishermen who identified these two areas as distinct fishing grounds within the closed area.

When cod by-catch is taken as a percentage of *Nephrops* catch using the standard gear in Zone Ia and Zone Iiia compared to the lower codend (B) of the modified inclined separator trawl the reduction in cod by-catch using the modified inclined separator trawl is clearly evident (Figure 3). The ratio of cod by-catch to *Nephrops* catch in the lower codend (B) of the modified inclined separator trawl (see Table 1) was 8.0% in Zone Ia and 3.2% in Zone Iiia compared to 23.3% and 18.4% recorded with standard trawls.

**Table 1. Cod by-catch as a percentage of *Nephrops* catch (landed kg) using the modified inclined separator trawl and with standard trawls.**

<table>
<thead>
<tr>
<th>Area</th>
<th>No. Hauls</th>
<th>Sample</th>
<th>Cod (kg)</th>
<th>Nephrops (kg)</th>
<th>By-catch ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone Iiia</td>
<td>20</td>
<td>Total</td>
<td>97</td>
<td>2970</td>
<td>3.20% 0.60%</td>
</tr>
<tr>
<td>Zone Ia</td>
<td>22</td>
<td>Total</td>
<td>141</td>
<td>1760</td>
<td>8.00% 1.30%</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone Iiia</td>
<td>64</td>
<td>Total</td>
<td>2,092</td>
<td>8,982</td>
<td>23.3% 0.90%</td>
</tr>
<tr>
<td>Zone Ia</td>
<td>22</td>
<td>Total</td>
<td>403</td>
<td>2,191</td>
<td>18.4% 1.6%</td>
</tr>
</tbody>
</table>

The relative proportions of cod and *Nephrops* in the catch were also compared for each Zone using each gear. The level of by-catch in the lower codend (B) of the modified inclined separator trawl was significantly lower at the 95% level than in the control codend (C).

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Examining the ratio of catches (by haul) between the traditional and the separator (B) trawl showed that the cod by-catch in the separator trawl was $35\% \pm 4.7\%$ of that in the traditional in Zone Ia and $15\% \pm 2.8\%$ in Zone IIa. This represents cod separation to the upper codend (A) of $65\%$ in Zone Ia and $85\%$ in Zone IIa. There is good, though not statistically significant, separation of cod in the $40+\ cm$ size range (Figure 4). The separation of haddock is particularly successful with almost all the fish ($98\%$) going into the upper codend where they would escape in the commercial situation (Figure 5). Good separation of whiting was found with $68\%$ of fish retained in the top codend with this spread evenly over all size classes (Figure 6). Escapement of *Nephrops* into the top codend was found to be insignificant and there was no difference between catches of *Nephrops* between the control and experimental trawls.

**Trial 2**

Under Council Regulation 300/2001 the measures put in place for 2001 were amended. Figure 7 illustrates the closed areas as defined in this Regulation. Owing to the effectiveness of the separator panel tested in 2000, under Article 2(b) fishing with *Nephrops* trawls with a separator panel fitted was permitted within a defined area (see Fig. 7), provided observers were present on board vessels for at least 50 fishing voyages (Article 3) and the by-catch of cod did not exceed 18%.

**Single-rig trawlers**

Two single-rig *Nephrops* trawlers mfv’s “Ave Maria” (19m/380hp) and “Kestrel” (16m/240hp) from the Irish Sea port of Skerries were involved in a total of 58 sea trips (14th March to 3rd May 2001) lasting 58 days. These vessels had the inclined separator panel fitted described previously to standard *Nephrops* trawls.

A total of 118 valid tows were conducted using the modified inclined separator panel. Preliminary analysis of the size distribution data collected for cod, haddock and whiting for each vessel for the duration of the survey revealed a similar shaped size distribution for each species, indicating that the nets from both vessels were fishing similarly (Figure 8 a-c).

The average by-catch of cod expressed as a percentage of the total commercial catch was low and not significantly different between vessels ($4.59\%$ for vessel A and $7.44\%$ for vessel B (Table 2a). As *Nephrops* constitute the majority of the total commercial catch ($>80\%$) for these vessels the cod as a percentage of *Nephrops* catch is not significantly different ($5.03\%$ Vessel A, $8.80\%$ Vessel B) from cod as a percentage of the total commercial catch as shown in Table 2b.

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4 Council Regulation (EC) No. 300/2001 of 14 February 2001 establishing measures to be applied in 2001 for the recovery of the stock of cod in the Irish Sea (ICES division VIIa)
**Table 2a** Cod by-catch as a percentage of the commercial catch using the modified inclined separator trawl on single-rig vessels.

<table>
<thead>
<tr>
<th>Vessel</th>
<th>No. Hauls</th>
<th>Sample</th>
<th>Cod (kg)</th>
<th>Commercial catch (kg)</th>
<th>By-catch ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>54</td>
<td>Total</td>
<td>349</td>
<td>7604</td>
<td>4.59%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.16%</td>
</tr>
<tr>
<td>B</td>
<td>66</td>
<td>Total</td>
<td>860</td>
<td>11553</td>
<td>7.44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.27%</td>
</tr>
</tbody>
</table>

**Table 2b** Cod by-catch as a percentage of *Nephrops* catch using the modified inclined separator trawl on single-rig vessels.

<table>
<thead>
<tr>
<th>Vessel</th>
<th>No. Hauls</th>
<th>Sample</th>
<th>Cod (kg)</th>
<th>Nephrops (kg)</th>
<th>By-catch ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>54</td>
<td>Total</td>
<td>349</td>
<td>6959</td>
<td>5.03%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.14%</td>
</tr>
<tr>
<td>B</td>
<td>66</td>
<td>Total</td>
<td>860</td>
<td>9771</td>
<td>8.80%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.73%</td>
</tr>
</tbody>
</table>

**Twin-rig trawlers**

One twin-rig *Nephrops* trawler mfv “Sancta Maria” (18m/456hp) from Skerries was involved in a total of 8 sea trips (20th April to 4th May 2001) lasting a total of 11 days. To allow direct comparison between traditional fishing methods a standard net (without separator panel) was towed simultaneously with a net fitted with an inclined separator panel. In addition, a top retainers codend arrangement was employed to assess the level of fish escapement as previously described.

A total of 26 valid tows were conducted using twin-rig fishing gear. The percentage of cod retained in the lower cod-end of the trawl with the inclined separator fitted was significantly lower than that of the control (Inclined separator panel = 3.12%, Control = 10.89%). The percentage of cod was also lower than either of the single-rig trawlers (Table 3a).

**Table 3a** Cod by-catch as a percentage of the commercial catch using the modified inclined separator trawl on a twin-rig vessel.

<table>
<thead>
<tr>
<th>Net</th>
<th>No. Hauls</th>
<th>Sample</th>
<th>Cod (kg)</th>
<th>Commercial catch (kg)</th>
<th>By-catch ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>26</td>
<td>Total</td>
<td>172</td>
<td>5523</td>
<td>3.12%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.67%</td>
</tr>
<tr>
<td>Control</td>
<td>26</td>
<td>Total</td>
<td>480</td>
<td>4409</td>
<td>10.89%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.25%</td>
</tr>
</tbody>
</table>

As with the single rig trawlers cod as percentage of *Nephrops* catch is not significantly different than cod as a proportion of total commercial catch for each gear type of the twin-rig vessel (Table 3b) and is well below the 18% cod by-catch allowed for under the EU Regulation.

**Table 3b** Cod by-catch as a percentage of the *Nephrops* catch using the modified inclined separator trawl on a twin-rig vessel.

<table>
<thead>
<tr>
<th>Net</th>
<th>No. Hauls</th>
<th>Sample</th>
<th>Cod (kg)</th>
<th>Nephrops (kg)</th>
<th>By-catch ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>26</td>
<td>Total</td>
<td>172</td>
<td>5176</td>
<td>3.33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.76%</td>
</tr>
<tr>
<td>Control</td>
<td>26</td>
<td>Total</td>
<td>480</td>
<td>3501</td>
<td>13.71%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.68%</td>
</tr>
</tbody>
</table>
Cod separation into the upper cod end is readily apparent (Figure 9), averaging 69.87% ± 5.72% per cm size class, with no size related separation evident. This is consistent with the level of separation achieved during the trials in 2000, which was around 75%. Due to the low numbers of haddock and whiting no assessment of the level of separation was made. Again escapement of Nephrops was not found to be a problem, with little or Nephrops being retained in the top codend. As Table 3b shows there is no difference in commercial catches between the control and experimental trawls.

Discussion

The results from these two fairly extensive studies along with similar work in other Irish Nephrops fisheries have shown the use of the inclined separator panel allows up to 75% of cod of all size ranges to be potentially released from standard Nephrops trawls. Definitive selectivity parameters, however, have not been established for the device as yet, although two research programmes recently funded by EU and Member States (RECOVERY, QLRT-2001-00935 and NECESSITY) aim to assess the selectivity and effectiveness of various gears including large mesh panels, a reduced headline trawl and indeed inclined separator panels5. The success of the panel is attributed to it’s design and it’s positioning within the trawl. It has been suggested that the good separation of cod may be because of their observed behaviour of staying close to the seabed after encountering the footrope becomes less pronounced further back in the trawl, and therefore a higher proportion would swim above the panel, which is positioned in front of the codend. It has the advantages of square mesh panels, being inexpensive (€250-300) and relatively easy to install and maintain. The initial rationale behind it’s development was that Nephrops fishermen would gain access to fishing grounds otherwise closed, without catching quantities of spawning cod, i.e. an incentive to fish more responsibly instead of total exclusion. This is similar to the use of sorting grids in Norwegian shrimp fisheries6.

The data from the trials with the separator panel have demonstrated that the use of the panel meets these requirements, and thus the main aim of releasing spawning cod in this case has been achieved. Problems have arisen, however, because the closure itself has proved difficult to monitor and also it has become diluted with a number of derogations for different types of vessels including the use of semi-pelagic trawls in one particular area and the opening of the entire area to beam trawls. These gears unquestionably have an adverse impact on cod stocks. The defined area in which the separator panel can be used is so small as to be meaningless and around it fishermen can fish as normal with standard Nephrops trawls as long as they stay within catch composition regulations. Fishermen have therefore simply fished on the periphery of the “separator zone” or waited until the Naval patrol ships have not been present and slipped in and out of the area without being detected. If the use of the panel had been made mandatory within the whole closure zone then it would have been far more effective. As with any conservation measures fishermen using the panel have also already found ways of circumventing it by lashing the opening closed. In reality a

combination of these factors meant that uptake of the panel in 2001 was relatively low restricted to around 5 vessels fishing in the area. This increased to 7 vessels in 2002 and 14 vessels in 2003 out of a total of 36-40 vessels fishing in the area.

The Irish Sea cod closure has now been in place for four years, three of which the use of the inclined separator panel has been permitted. According to the EU, the technical measures are not sufficient to tackle the depleted state of the stock and that long term recovery measures including the use of the blunt management tool of days at sea limitations will have to be introduced to improve stock levels instead of the closed area. Given that the closure was originally designed to protect spawning cod at a specific time, it is very unlikely that the effort limitation regime envisaged by the EU Commission will do much to protect fish stocks. As vessels will be allowed to aggregate their days under the EU proposals, they will merely concentrate their efforts when cod are spawning and in the Irish Sea these times and areas are well documented. Other demersal species such as whiting and haddock will be targeted in a similar manner and this is a serious drawback of the proposed effort limitation scheme in that it inadvertently encourages intensified fishing effort when fish are plentiful or easy to catch i.e. when spawning.

On the basis of anecdotal evidence, fishermen from Northern Ireland and Ireland have consistently claimed that the closure, even in its diluted format, has worked to some degree and that stocks of cod in the Irish Sea have improved dramatically since the first closure in 2000 despite the derogations, widespread misreporting and limited uptake of the panel. Due to the short time series and lack of proper monitoring, however, there would appear to be little scientific evidence either way to categorically prove that the measures have or have not worked as highlighted by ICES and ACFM. In 2002 ICES considered the stock to be outside safe biological limits and based on the most recent estimates of the biomass ICES still classifies the stock as being outside safe biological limits. Recent stock assessments have indicated, though an increase in SSB in the Irish Sea cod stock. The estimate at the start of 2003 for the stock was 6,400 tonnes compared to the estimated/forecast SSB at the start of 2003 made in 2002 of 4,600 tonnes. This would at least suggest an improvement in the stock since the introduction of the measures and a more stringent closure coupled with sensible technical measures including mandatory use of the panel in the closure area would certainly be more favourable to Irish fishermen. It is apparent, however, that dilution of the measures has been detrimental to the chances of success and also undermined a potential technical solution to the problem in the inclined separator panel.

Conclusions

- Due to the serious state of cod stocks the EU introduced a cod closure in the Irish Sea in 2000, which has been in place for three years and prohibits fishing with all gears for the period mid-February to the end of April.
- Trials in 2000 in the Irish Sea indicated a significant reduction in cod by-catch in a *Nephrops* trawl fitted with an experimental inclined separator panel to around 5% compared to 20% with standard trawls.

• Separation rates of between 65-85% to a top retainer codend were recorded with the separator panel fitted with no size related separation.
• Separation rates of 98% for haddock and 68% for whiting were also attained.
• As a result of these trials the EU allowed the use of separator panels within a defined area and on the basis of certain criteria.
• Repeat trials in 2001 on two single-rig vessels and one twin-rig vessel gave similar findings to 2000 in terms of cod by-catch, indicating cod by-catch of 5% compared to 15-18% in standard trawls.
• Results from trials on a twin-rig vessel gave a by-catch of cod of 3% with the experimental trawl fitted with the separator compared to 11% with the control trawl.
• Cod separation into an upper retainer codend of approximately 70% with no significant size related separation was recorded.
• Uptake of the separator panel has increased since 2001 when only 5 vessels used the panel to around 35% of vessels fishing in the area.
• There is some evidence that SSB for cod in the Irish Sea has increased since the closure has been enforced based on recent ICES assessments but there has been no scientific evaluation of the effects of gear-related regulatory measures on the Irish Sea cod stock including the use of the inclined separator panel.
• Irish fishermen favour a more stringent closure coupled with sensible technical measures, including the mandatory use of the separator panel.
Figure 1. Closed areas in the Irish Sea 2000

Closed to all fishing with any demersal trawl, seine or similar towed net, any gill net, trammel net or similar static net or any fishing gear incorporating hooks from 14th February to 30th April 2000.

Fishing is permitted with a prawn net in the areas of the closed boxes coloured green provided:
1. A minimum of 35% live weight of prawns (Nephrops) is on board.
2. Only one mesh size range is carried on board, 70-79mm OR 89-99mm.
3. No other type of gear may be carried on board.
4. No mesh in any part of the net is greater than 300mm.

The use of beam trawls within the closed area is allowed during the closed period but only to the east of 5°30’W as shown on the map above.
Figure 2. Design and Positioning of Inclined Separator Panel
Figure 3. By-catch of cod in the Nephrops fishery using traditional & modified trawls – Mfv “Northern Dawn”

Figure 4. The effect of the separator panel on cod retention in the Nephrops trawl – mfv “Northern Dawn”
**Figure 5.** The effect of the separator panel on haddock retention in the *Nephrops* trawl – mfv “Northern Dawn”

**Figure 6.** The effect of the separator panel on whiting retention in the *Nephrops* trawl
Closed to all fishing with any demersal trawl, seine or similar towed net, any gill net, trammel net or similar static net or any fishing gear incorporating hooks from the 14th of February to 30th April 2001.

Fishing is permitted with a prawn net in the areas of the closed boxes coloured green provided:
A minimum of 35% live weight of prawns is on board.
Only one mesh size range is carried on board, 70-79mm or 80-99mm.
No other type of gear is carried on board.
No mesh in any part of the net is greater than 300mm.

Fishing is permitted with a prawn net in this area provided that in addition to the above:
It complies with the provisions made for the green zone.
It includes an inclined separator panel.
If the total weight of cod retained on board is greater than 18% of the total catch, the vessel must stop fishing in this area for at least 24 hours.

Fishing is permitted with Semi-pelagic trawls in this area from the 14th February to 22nd March provided:
The nets used are 100mm diamond mesh size as a minimum.
Incorporate at least 500 individual meshes of mesh size at least 300mm.
If the total weight of cod retained on board is greater than 15% of the weight of the total catch, the vessel must stop fishing in this area for at least 24 hours.

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Figure 7. Closed areas in the Irish Sea 2001
Figure 8a. Length frequency distribution of haddock sampled from each single-rig trawlers - Irish Sea 2001.

Figure 8b. Length frequency distribution of cod sampled from each single-rig trawlers - Irish Sea 2001.

Figure 8c. Length frequency distribution of whiting sampled from each single-rig trawlers - Irish Sea 2001.
Figure 9. Cod separation into the upper cod-end of the experimental trawl in the twin-rig vessel – mfv “Sancta Maria”