Trials of a Net Grid for the UK Nephrops trawl fisheries

Cefas

Tom Catchpole, Frank Armstrong, Stuart Masson, Dave Price, Mark O'Brien & John Hingley

June 2012

This work was funded by Defra

Executive Summary

Gear trials were performed on the Net Grid by Cefas and the crew of the MFV Avocet in May and June 2012; 30 hauls were completed.

The Net Grid is comprised of a four panel box section inserted into a standard two-panel trawl into which an inclined sheet of 80mm netting is laced.

The Net Grid is positioned between the codend and the square mesh panel.

On the top of the box section in front of netting grid is a fish escape hole.

The netting grid acts as a physical barrier and guides fish out of the escape hole while Nephrops pass through the netting to the codend.

Cod catches were reduced by 91% by number with the Net Grid compared to a standard trawl

During Nephrops targeted fishing, cod catches made up 1.5% of the total catch weight with the Net Grid.

Catches of haddock, whiting and monkfish across all lengths were significantly less with the Net Grid.

Catches of Nephrops were unaffected by the Net Grid.

Discards were reduced by 57% by weight with the Net Grid compared with a standard trawl

Introduction

The concept for the Net Grid was developed by Stuart Masson, owner of the MFV Avocet, with the intention to minimise cod catches, and catches of other fish by UK *Nephrops* trawlers operating in the North Sea.

Following commitments to implement more selective gears in the Nephrops trawl fisheries made by the UK in 2011, the Net Grid design was selected during discussions with Cefas scientists, Defra and fishermen to be tested in comparative gear trials. The objective was to assess whether it could deliver a catch weight for cod of 1.5% of the total catch weight and be applicable to Articles 11 and 13 Council Regulation (EC) No 1342/2008.

The Regulation, under Article 13, permits the allocation of additional effort for highly selective gear and cod avoiding fishing trips. Under Article 11 of the EU Regulation, there exists the possibility of the EU Commission granting an exemption for vessels provided that the percentage of cod catches as assessed by the EU Scientific, Technical and Economic Committee (STECF) does not exceed 1.5% of total catches on average. To date, only the Swedish grid (and variants of this design) has received approval under Article 11.

Here we report on trials carried out by Cefas onboard the MFV Avocet to evaluate the performance of a trawl with the new Net Grid design in comparison with a standard gear used by the UK Nephrops fleet in the North Sea.

Materials and Methods

Vessel:

The vessel used for the trials was the MFV Avocet, a wooden built 17.3m Scottish registered twin-rig trawler (335kw engine). Vessel owner and designer of the modification to the net is Stuart Masson and the skipper during the trials was David Price.

Gear:

The Avocet fishes with matching twin-rig standard fishtail trawls:

- 440x80mm mesh fishing circle of 2.5mm high tenacity compact braided twine
- 37m ground gear with 12m of 150mm discs 200mm apart in centre and 500mm in wings
- 70m of 22mm combination sweep
- 65mm wire attached to 2m Dan-Green ‘V’ doors, 460kg each, chain mat clump 520kg
- 120mm square mesh panel at end of tapered section of net at 15-18m from codline
- Codends of double 4mm twine 100mm round of 96-99mm diamond mesh
- Lifting bags of 240mm double 4mm twine

The two trawls of the twin-rig were the same other than the Net Grid modification. A standard trawl was towed simultaneously alongside the modified trawl to enable a direct comparison in catches.

Modification -The Net Grid:

One of the two rigs was modified to include the Net Grid. The modified trawl was operated as the port net of the pair. The Net Grid design (Figure 1) is a relatively simple modification to a conventional Nephrops trawl. A wall of netting is attached within the trawl to act as a physical barrier to fish, but allow the passage of Nephrops through to the codend. Results from the Swedish grid and other designs indicate that a physical barrier to separate out the fish is the most effective approach to deliver cod catches at 1.5%.

The modification was made to a standard Nephrops trawl (Figure 1,2,3). The net grid was situated between the codend and the existing square mesh panel. The trawls used by the fleet are generally constructed of two-panel trawls; the net grid is fixed within a four-panel box section, which is inserted into the two panel trawl. The wall of netting is positioned at an incline, in front of which, on the top of the box section, is a fish escape hole. The netting barrier is laced to the top and both sides, but not to the bottom of the box section.

In these trials the net grid was constructed of 80mm braided twine and was attached in a square mesh orientation in parallel with the box section. Two rigid pipes were attached vertically, either side of the net grid on the outside of the box section. These were to keep the box section rigid and maintain the maximum vertical height to enable consistency in fish escapement. These pipes could be unclipped to hang free on the trawl so that they could be wound onto the net drum during hauling.

Figure 1 The Net Grid (turned on its side) positioned between the square mesh panel and the codend; floats and poles are used to maintain the height in the Net Grid and openness of the escape hole

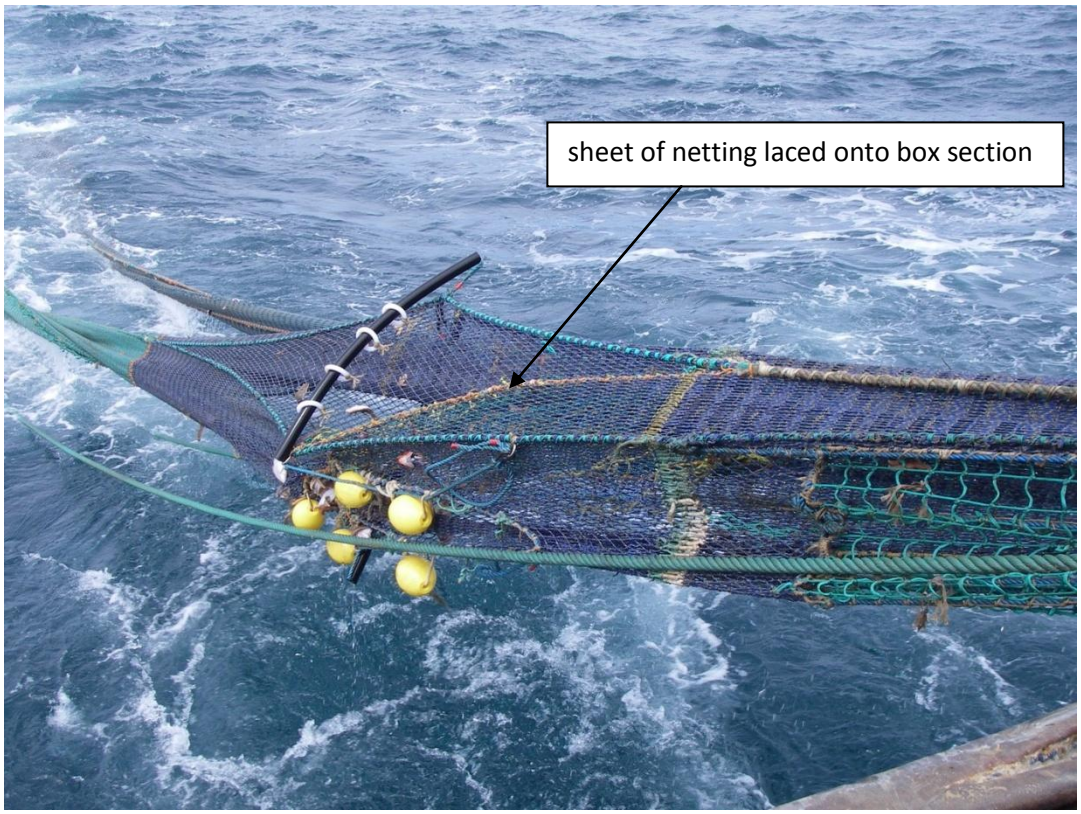


Figure 2 Conceptual diagram of the Net Grid, Nephrops pass through a sheet of netting which is laced into a four panel box section to the codend, while cod and other fish are guided to the escape hole.

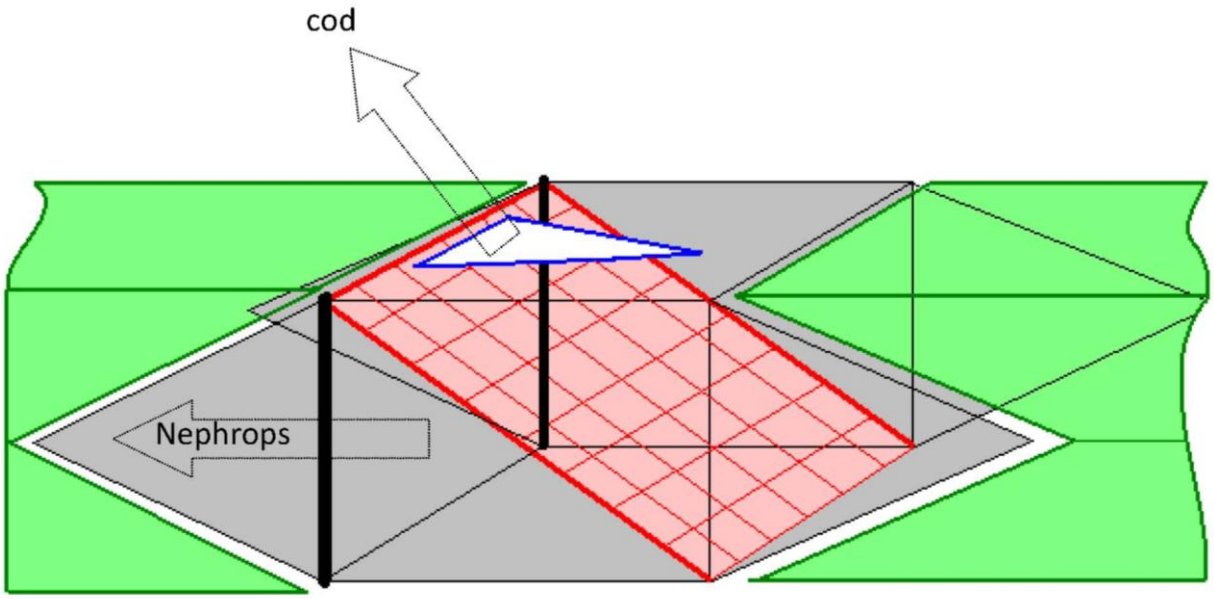
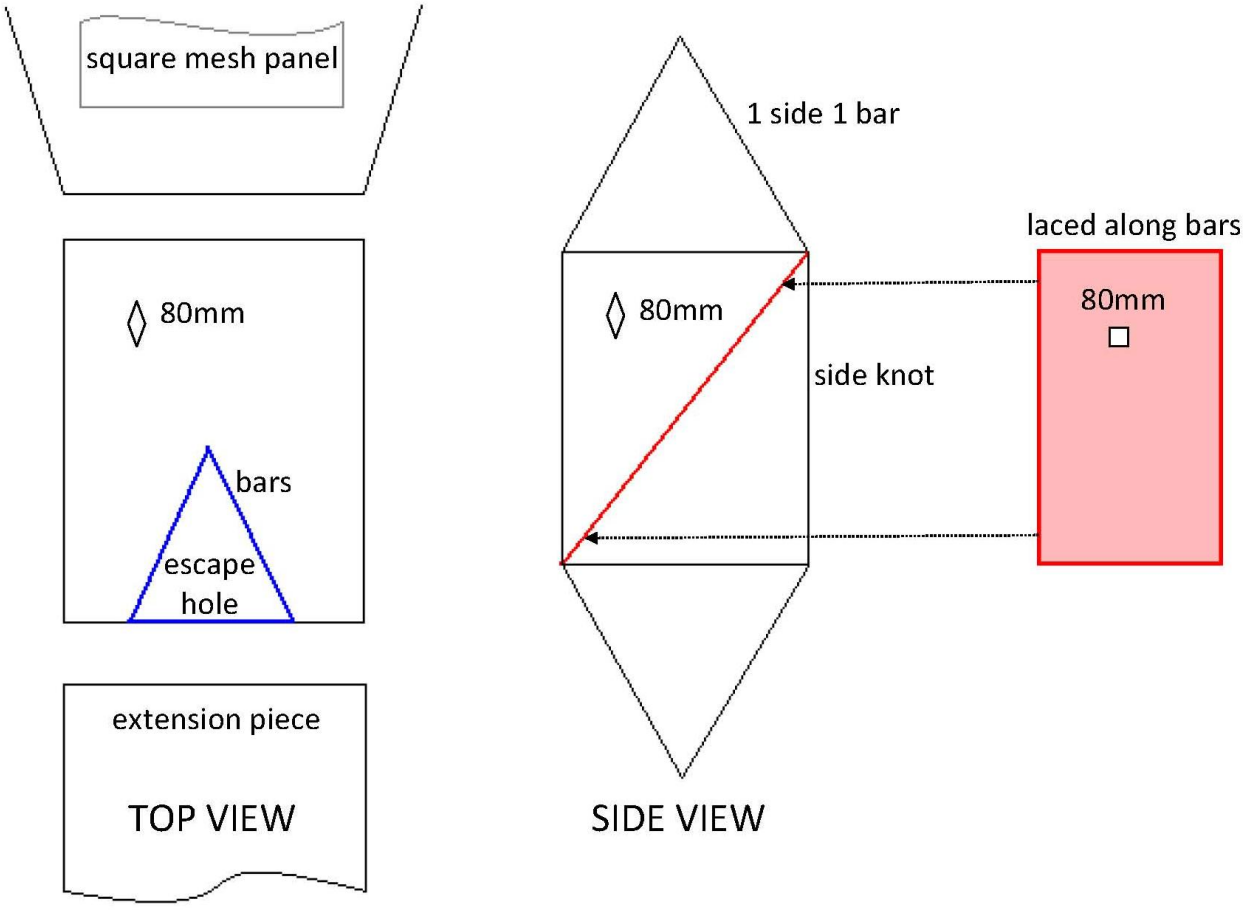


Figure 3 Plan of Net Grid with cutting ratios for the insertion of the box section and fish escape hole



Trials:

The first of two trials was conducted between 29th May and 4th June 2012 and the second between 11th June and 16th June 2012. In total, 30 hauls were conducted and 28 sampled by two Cefas scientists.

The first trial (17 hauls) focussed on the ability of the modified trawl to avoid catching cod. It was recognised that sufficient data were needed on the difference in cod catches between the modified and standard trawl to determine genuine differences in selectivity. The first trial took place in the area known as 'The Holes' (ICES area IVa) where cod were present but Nephrops were not. The second trial (13 hauls) focussed on the ability of the Net Grid trawl to deliver 1.5% cod catches during commercial Nephrops targeting fishing. This trial took place in the area known as 'Silver Pits' (ICES area IVb). The haul duration was three hours in the first trial and 5 hours in the second trial, and the vessel towed at its normal fishing speed of 2.5 kts.

Sampling:

The entire catches from the standard and modified trawls were sorted separately into landed and discarded categories. Fish were measured to the cm below; all fish were measured when possible, sub-sampling for some species was necessary on some hauls. Length-weight relationships were applied to generate estimates of the catch weight of each species and therefore in the total catch. In the second trial, an estimate of the weight of cod as a percentage of the total catch was made in real time for each haul.

Data Analysis

Catch composition analysis
The percentage contribution of cod in the total catch was estimated for hauls in the second trial in which catches were representative of Nephrops targeted fishing (n=9). Mean numbers and weights caught per haul were generated for the main commercial species. The percentage difference in catches between the standard and Net Grid trawl for the main commercial species are given for all sampled hauls, and for those fish above and below the legal minimum landing size (MLS).

Catch comparison model
For each of the main commercial species, the catches from the standard and modified trawl were compared using a catch comparison statistical analysis method (Holst et al, 2009[1]). This analysis used a generalised linear mixed model (glmm) which provides comparisons of fish catch at length by the two gears through a continuous curve with a realistic confidence band. The analysis was applied to the catch data from all sampled hauls from both trials.

Results

[1] Holst R., Revill A. A simple statistical method for catch comparison studies. Fisheries Research 95 (2009), 254–259

Catch composition

During targeted Nephrops fishing, the weight of cod caught by the modified trawl with the Net Grid was 1.5% (st dev 0.01) of the total catch weight (Table 1). This figure was supported by the real time estimates of cod in the catches with the Net Grid (mean 1.3%). In comparison the catches of cod in the standard trawl contributed 9.9% (st dev 0.05) of the total catch weight. The result represents an 85% reduction in the contribution of cod in the catch.

Table 1 Percentage of cod in the catch during Nephrops targeted fishing.

% cod catch		
haul	Net Grid trawl	standard trawl
21	2.0%	12.2%
22	1.8%	15.7%
23	0.8%	7.7%
24	0.3%	4.1%
25	1.2%	18.8%
27	0.0%	8.0%
28	1.2%	12.5%
29	3.4%	9.1%
30	3.0%	4.9%
mean	**1.5%**	**10.3%**

The overall reduction in the weight of cod when using the Net Grid was 81% (Table 2). Haddock and whiting catches were reduced by 37% and 80% respectively. The reductions in catches of these fish above and below the MLS were comparable. Catches of Nephrops above the MLS were 25% higher and catches below the MLS were 36% lower when using the Net Grid.

Table 2

	COD	HAD	NEP	PLE	WHG
overall % difference (wt)	-81%	-37%	25%	16%	-80%
% difference >MLS (wt)	-81%	-38%	25%	8%	-74%
% difference <MLS (wt)	-71%	-33%	-36%	62%	-84%

In terms of numbers of fish, during Nephrops targeted fishing, a mean 2.5 cod were caught per haul with the Net Grid (range 0-6). In comparison the standard trawl caught a mean 32 cod (range 11-63). The trawl with the Net Grid caught on average 91% fewer cod. During Nephrops targeted fishing, the standard grid caught 340 cod and the trawl with the Net Grid caught 38 cod. In all hauls discard weight was reduced by 57%.

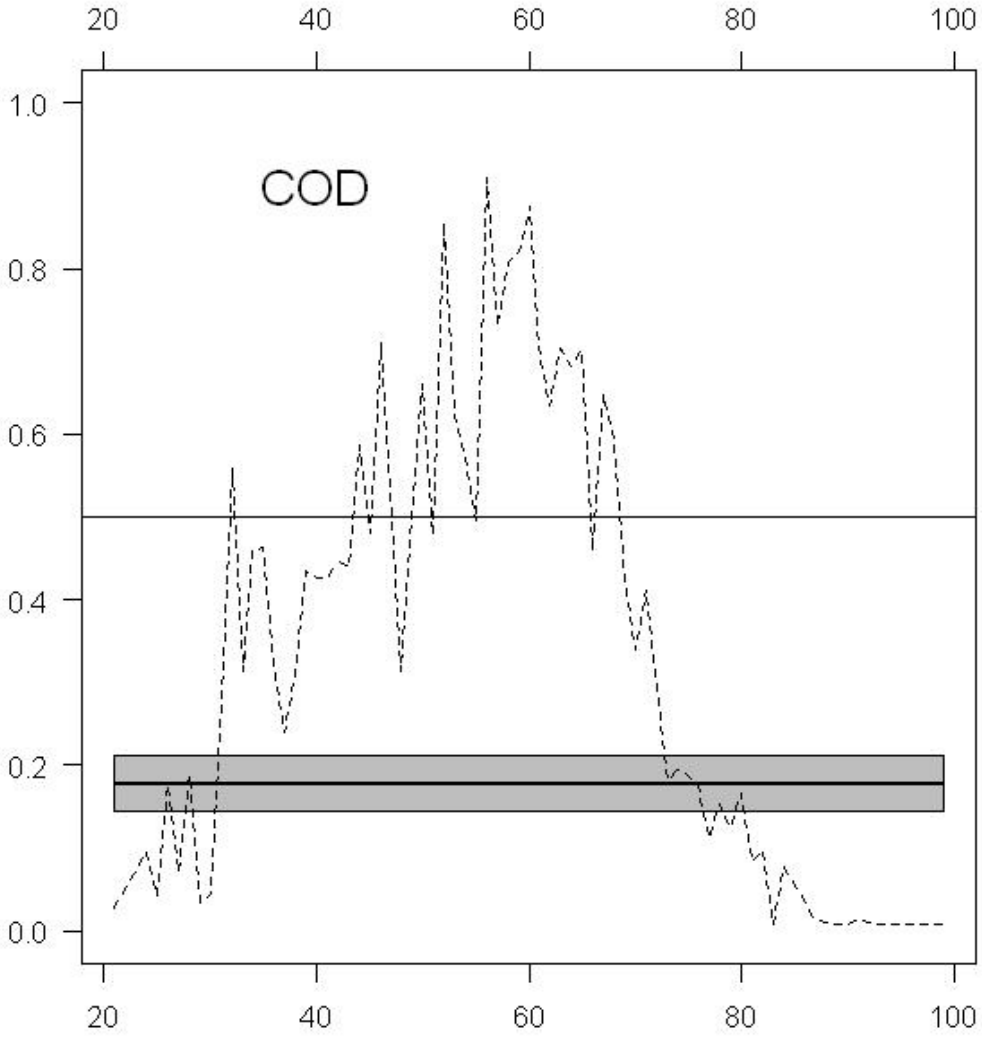
Catch comparison model

The glmm catch comparison model was fitted to data from all hauls for the main commercial species.

Cod

The most significant fit was a constant relationship ($p<0.001$), whereby cod catches were consistently lower with the Net Grid across all lengths (Figure XX, Annex XX). The length frequency of the cod caught in the standard trawl is shown in Figure XX.

Figure 4 Modelled proportion of the number of cod by length caught with the Net Grid relative to the total caught in both Net Grid trawl and the standard trawl; the line at 0.5 indicates an equal number caught in both trawls. Grey areas depict 95% CIs around the modelled fit (bold solid line); the dashed line is the pooled length frequency of cod caught in the standard trawl.



Other species
Haddock, Nephrops, monkfish and whiting also demonstrated significant ($p<0.001$) constant relationships. Haddock, monkfish and whiting demonstrated significant reduction in catches with the Net Grid across all lengths; Nephrops catches were not significantly different between the standard trawl and trawl with the Net Grid (Annex 1). Plaice illustrated a significant linear relationship ($p<0.001$) but the model indicated that catches were not significantly different between the standard and modified trawls.

Discussion
The results demonstrate a large and significant decrease in the number and weight of cod caught when using the Net Grid. A 91% reduction in cod by number (81% by weight) delivered a contribution of cod in the total catch weight at 1.5% on average.

The contribution of cod to the catch is calculated from relatively few hauls during Nephrops targeted fishing. It is recognised that the ability of a gear to demonstrate 1.5% catch of cod is dependent on the selectivity of the trawl in combination with the abundance and population structure of cod as well as the abundance of other species. When substantial numbers of fish are escaping a selective trawl, fewer cod can make up a higher percentage contribution of the total catch. In these trials, despite higher Nephrops catches when using the Net Grid, delivering 1.5% cod in several hauls was dependent on whether 1 cod were caught or more. The trials demonstrated that the Net Grid was consistent across the length range of cod and would therefore, be expected to deliver consistent results when encountering different population structures.

A lower percentage contribution of cod in the catch does not necessarily indicate any reduction in cod fishing mortality. In this instance, catches of cod were reduced by 91%. By contrast in 2006, when Cefas trialled the Swedish grid design in the English Nephrops fishery the Swedish grid was effective at avoiding the retention of large cod, but more small cod were retained. The trawl with the Swedish grid caught more than twice as many '0' group cod than the standard trawl (Catchpole et al, 2006[2]). In these trials, the Swedish grid did not deliver 1.5% in cod catches or a reduction in numbers of cod caught.

For other species, catches across the length range of whiting, haddock and monkfish were significantly reduced. Catches of plaice and Nephrops not significantly affected. Discards were reduced by 57%.

There were no handling problems with the modified trawl, the Net grid pass through power blocks (Figure 5) and wound on to net drums.

[2] Catchpole, T.L., Revill, A.S., Dunlin, G., 2006. An assessment of the Swedish grid and square mesh codend in the English (Farn Deeps) *Nephrops* fishery. Fisheries Research, 81, 118-125.

Figure 5 The Net Grid passing through a power block with pole unclipped.

Key features of the NET GRID

A four-panel box constructed of 80mm diamond mesh is inserted within a standard trawl between the existing square mesh panel and the codend

Netting is laced along the top edge of the box section and along the full length of each side of the box section at an incline along the side knots; the panel is not attached along the bottom edge

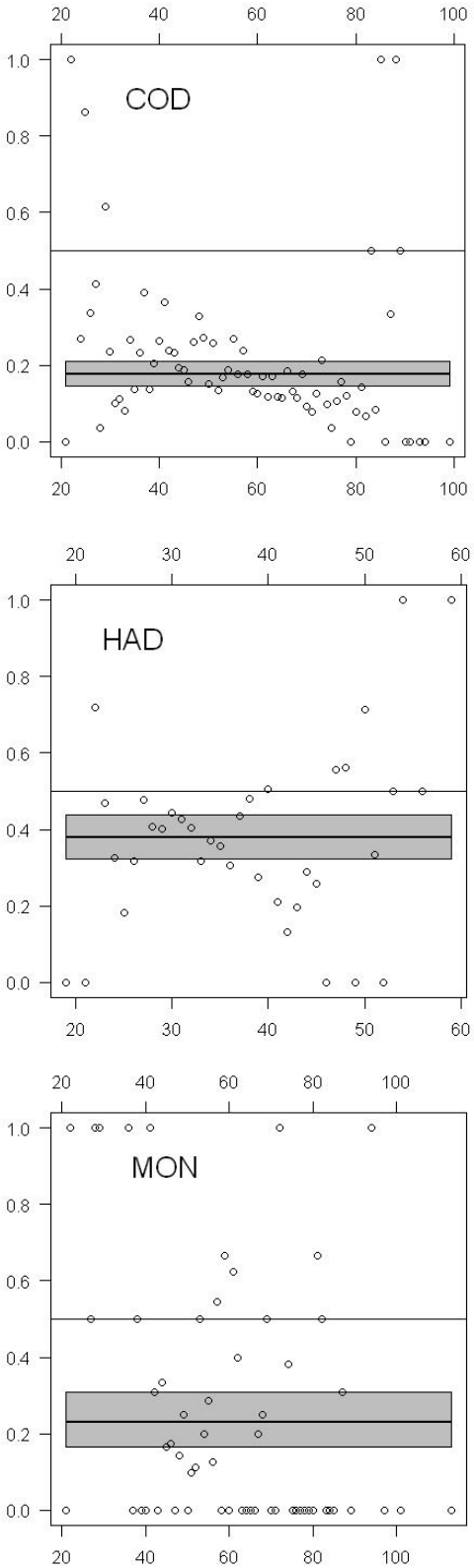
The inclined netting section is of 80mm (stretched mesh) single braided twine and is orientated in a square mesh configuration (delivering ~40mm bar length)

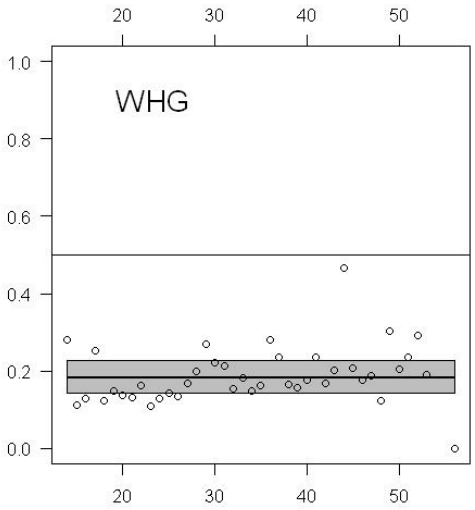
Forward of the top edge of the inclined netting section is a fish escape hole cut along the bars of the 80mm diamond mesh in the centre of the top panel of the box section

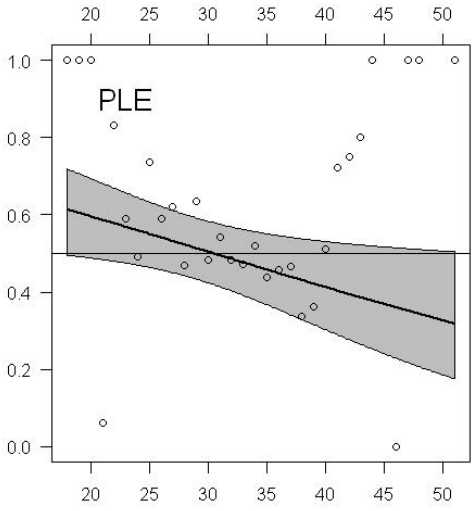
Two pipes are attached vertically to either side of the box section adjacent to the top edge of the inclined netting section

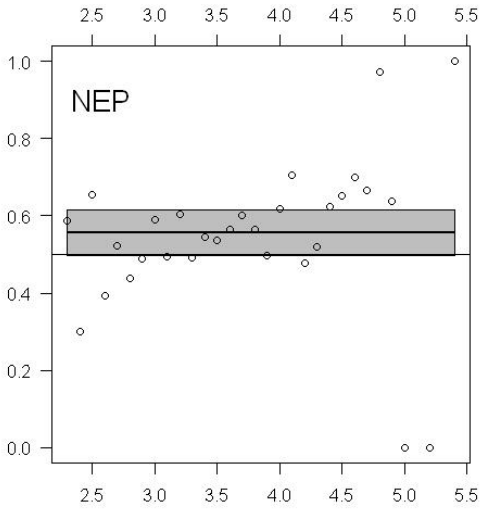
Floats are attached around the fish escape hole to retain full opening

Annex 1 Modelled proportion of the number of six species by length caught with the Net Grid relative to the total caught in both the Net Grid trawl and the standard trawl; the line at 0.5 indicates an equal number caught in both trawls. Grey areas depict 95% CIs around the modelled fit (bold solid line); the dots are the pooled proportion at each length from all hauls.




WHG
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0


PLE
20
25
30
35
40
45
50
1.0
0.8
0.6
0.4
0.2
0.0


NEP
2.5
3.0
3.5
4.0
4.5
5.0
5.5
1.0
0.8
0.6
0.4
0.2
0.0