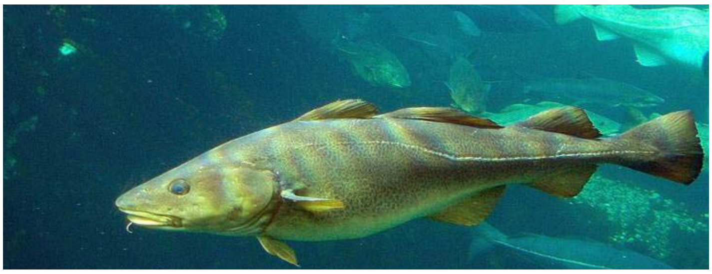
Cod avoidance techniques for the Dutch and Belgian fishing fleets

B. van Marlen, H. Polet (ILVO) and F.J. Quirijns

Report number C147/12



IMARES Wageningen UR
(IMARES - Institute for Marine Resources & Ecosystem Studies)

Client:	Ministerie van Economische Zaken t.n.v. ir. M.C. Kersbergen Directie AKV Postbus 20401 2500 EK Den Haag
	BO-12.04-001-024
Publication date:	21/12/2012

IMARES is:

- an independent, objective and authoritative institute that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the sea and coastal zones;
- an institute that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the sea and coastal zones;
- a key, proactive player in national and international marine networks (including ICES and EFARO).

P.O. Box 68
1970 AB IJmuiden
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 26
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 77
4400 AB Yerseke
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 59
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 57
1780 AB Den Helder
Phone: +31 (0)317 48 09 00
Fax: +31 (0)223 63 06 87
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 167
1790 AD Den Burg Texel
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 62
E-Mail: imares@wur.nl
www.imares.wur.nl

Contents

Nederlandse samenvatting

Visserijbeheerders zetten alles in het werk om kabeljauwvangsten in de Noordzee te verminderen, zodat het kabeljauwbestand zich kan herstellen. De Nederlandse overheid vroeg IMARES om een overzicht van maatregelen, die in verschillende landen rond de Noordzee in gebruik zijn voor het verminderen van kabeljauwvangsten. De beheerder is specifiek geïnteresseerd in tuigaanpassingen in de landen om ons heen, die ook in de Nederlandse visserij toegepast zouden kunnen worden. Met een goed overzicht van de mogelijke maatregelen kunnen overheid en visserijsector samen bespreken welke tuigaanpassingen effectief en haalbaar lijken voor de Nederlandse visserij.

Of een tuigaanpassing effectief is, hangt af van de verandering in selectiviteit vergeleken met het standaardtuig. Selectiviteit komt voort uit de relatie tussen de vorm en afmetingen van de vis en de vorm en afmetingen van de mazen in de kuil. Ook gedragsverschillen tussen verschillende (vis)soorten in het vistuig bepalen selectiviteit.

IMARES en ILVO inventariseerden bestaande tuigaanpassingen waarmee kabeljauwvangsten verminderd kunnen worden. Voor een serie van vistuigtypen en verschillende typen van aanpassingen bepaalden we hoe effectief deze was in het mijden van kabeljauw en het vangen van de doelsoorten. Tot slot gaan we in op de toepasbaarheid van de aanpassingen in Nederlandse en Belgische visserijen.

Een aantal aanpassingen heeft toepassingsmogelijkheden in de Nederlandse en Belgische visserij, zoals:

- Grotere maaswijdten (bv. Eliminator, Orkney / Shetland, 300-800mm belly panel) in TR1 vistuigen.
- Flip-Flap, Faithlie, SCIF, Ultra-V configuratie in TR2 Noorse kreeftentrawls.
- Swedish Grid, Sorting Box of SELTRA configuratie in TR2 Noorse kreeftentrawls.
- Vierkante mazen paneel in TR2 Noorse kreeftentrawls.
- Grote mazen kap panelen, T90 mazen in extensies van de kuil, een scheidingspaneel gecombineerd met een ontsnappingspaneel in de bovenkap, de pulskor in BT platvis boomkorren.
- Puls boomkor (eventueel met zeefkeel) in *Crangon* boomkorren.

Hierbij is voor deze studie niet onderzocht hoeveel kabeljauw er momenteel in elk van de genoemde visserijen gevangen wordt. Voor het wel of niet invoeren van tuigaanpassingen is het beantwoorden van die vraag wel relevant: hoeveel kabeljauw vangt een bepaald vlootsegment en hoeveel kabeljauw zou gespaard kunnen worden door het invoeren van tuigaanpassingen? De kabeljauwmonitoring die in 2012 in opdracht van het ministerie van Economische Zaken werd uitgevoerd kan waarschijnlijk voor een antwoord op de eerste vraag zorgen. Voor boomkor in het Oostelijk Kanaal, de Noordzee en het Skagerrak (80-120mm maaswijdte) werd de totale aanlanding van kabeljauw geschat op 4-5% van de aanlandingen van alle andere tuigen in hetzelfde gebied (in de jaren 2010 en 2011).

In het algemeen geldt, dat technieken die voor een specifieke visserij zijn ontwikkeld, niet zonder meer over te nemen zijn voor een visserij met andere schepen, vistuigen of in andere gebieden. Men dient er dan rekening mee te houden, dat de technieken voor iedere visserij moeten worden geoptimaliseerd. Om draagvlak te creëren is het gewenst dit in nauwe samenwerking tussen vissers en onderzoekers te doen. Ook moet er een duidelijk voordeel worden gecreëerd voor vissers om de nieuwe vistuigen te gaan gebruiken. Een definitieve keuze voor effectieve en acceptabele vistuigaanpassingen kan slechts worden gemaakt na een dergelijk ontwikkelingstraject.

Summary

Fisheries managers go to great lengths to reduce cod catches in the North Sea, aiming for recovery of the cod stock. The Dutch government asked IMARES to provide an overview of all measures that are in place in various countries around the North Sea for reducing cod catches. The Dutch fisheries managers were specifically interested in the existence of gear adjustments, which might also be applicable in Dutch fisheries. With a complete overview of possible measures, the government, fishing industry and gear scientists can decide together which gear adjustments may be effective and feasible in Dutch fisheries.

Whether a gear adjustment is effective, depends on changes in selectivity of the adjusted gear compared to the standard gear. Selectivity depends on the shape and size of fish and on the shape and size of meshes in the cod-end. Also behavioural differences between species determine selectivity.

IMARES and ILVO made an inventory of existing gear adjustments for reduction of the cod catch. For a series of gear adjustments we determined the effectiveness and applicability for the Dutch and Belgian fisheries.

A number of adjustments may be applicable in Dutch and Belgian fisheries:
- larger mesh (e.g. Eliminator, Orkney / Shetland, 300-800mm belly panel) in parts of the trawl in TR1 gears,
- Flip-Flap, Faithlie, SCIF, Ultra-V arrangement in TR2 Nephrops trawls,
- the Swedish Grid, Sorting Box of SELTRA arrangement in TR2 Nephrops trawls,
- the square mesh panel in TR2 Nephrops trawls,
- large mesh top panels, T90 mesh in the extension of the cod-end, an inclined separator panel, and the pulse trawl in BT flatfish beam trawls,
- pulse beam trawl (with sieve net) in TBS Crangon beam trawls.

In this study we did not investigate how much cod is caught in the various fisheries mentioned above. When gear adjustments are introduced, it is relevant to ask this question: how much cod is caught and how many cod can be saved thanks to the adjustment? The first question may be answered by the cod monitoring funded by the Dutch ministry of Economic Affairs in 2012. Cod landings by the beam trawl fishery (80-120mm) in the Eastern Channel, North Sea and Skagerrak are estimated to be 4-5% of total landings of all other gears (years 2010 and 2011).

Generally, it is extremely difficult to copy solutions from one metier into another, without testing and fine-tuning. It is recommended to involve the fishing industry in testing and applying different adjustments, and to create proper incentives for the use of any new gear. This process usually takes a considerable amount of time, and requires the guidance of scientific institutions.

1 Introduction

The spawning stock size of cod (*Gadus morhua* L.) in the North Sea and surrounding waters has been low since many years; since the early eighties the stock is below the precautionary level and since the late nineties it even is below the limit reference point (ICES, 2012b). For the North Sea, a cod recovery plan was put in place, which was updated in 2008 (Council Regulation (EC) 1342/2008). In several countries around the North Sea, additional measures are applied for reduction of cod catches in the fisheries. In a (Dutch) letter addressed to the Ministry of Economic Affairs, IMARES summarised the various measures that are in place (Appendix A).

After receiving the summary of measures, the ministry was interested in more details on technical gear adaptations for reductions in cod bycatch. This lead to this report, presenting an inventory of various tested gear adaptations. First, selectivity characteristics of gear are described in general. Then, an inventory of adaptations is given by gear category. At the end of the report we summarise our findings about applicability of adaptations in the Dutch and Belgian fishing fleets.

2 Assignment

The Dutch Ministry of Economic Affairs requested IMARES to explore which technical gear adaptations for reducing cod bycatch are used in Member States around the North Sea. The follow-up question was whether any of these adaptations would be applicable in parts of the Dutch fishing fleet.

This research is performed within *Beleidsondersteunend onderzoek* (BO). IMARES and ILVO carried out this study together.

3 Materials and Methods

The work is conducted by searching relevant literature and summarizing major findings. Also comments about the effectiveness of the of gear adaptations were given and the applicability of these to metiers in the Dutch demersal fisheries was appraised. International experts were contacted for additional up-to-date information on practical issues concerning gear applied to avoid bycatch of cod: Barry O'Neill and Robert Kynoch (Marine Scotland, Aberdeen, Scotland UK), Dr. Niels Madsen (DTU Aqua, Denmark), and Andrew Whyte (netmaker Scotnet International of Fraserburgh, Scotland UK).

4 Selection mechanisms

Fish that enter a net and are guided to the rear part (cod-end) can escape when their cross-section is smaller than the opening of a mesh. The cross-sectional shape in relation to the shape of the mesh opening also plays a role, and is distinctly different for roundfish than for flatfish. Square mesh offers a shape more suitable for roundfish than diamond mesh, and is thus more effective in releasing juvenile roundfish. Measurements were made on the cross-sectional shape of fish such as cod (Figure 1), and fall-through experiments to determine which shape of mesh is most suitable for which fish (Herrmann et al., 2007). The results were used in a prediction model for cod-end selectivity e.g. for cod (Herrmann et al., 2009).

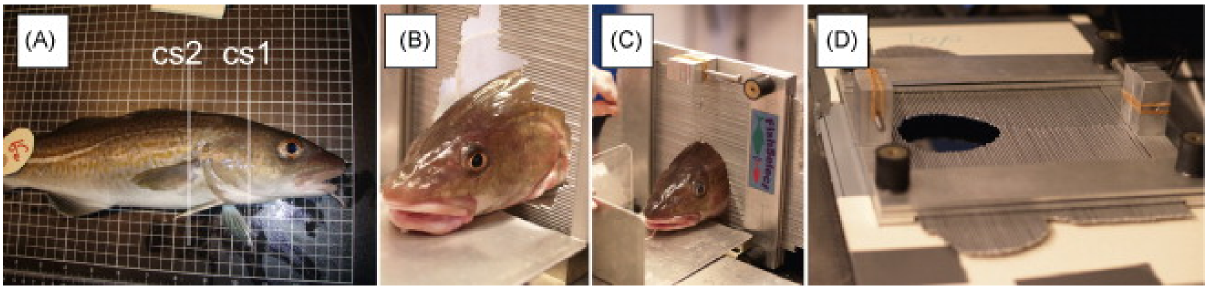


Figure 1. Morphological measurements on cod (Herrmann et al., 2007)

Another mechanism that can help to select fish out of a net is when their behaviour inside the net differs. This is the case for haddock and whiting in comparison to cod. Haddock and whiting are often found in the upper part of fishing nets, whereas cod tends to stay low (Figure 2). Such differences in behaviour can in principle be utilized to select certain species out and retain other (Engås et al., 1998; Krag et al., 2009; Main and Sangster, 1982; Main and Sangster, 1985).

All applications of selective gears use either one of these mechanisms and combinations thereof.

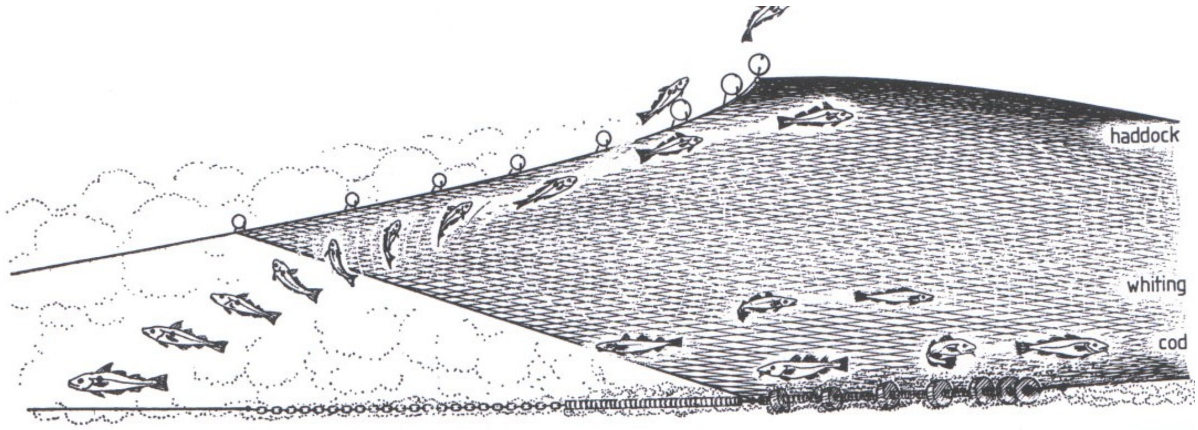


Figure 2. Differences in behaviour between haddock, whiting and cod (Main and Sangster, 1982)

Measures for selectivity used in this report are:

- L_{50}: the body length of a species at which 50% of this species are retained in the net.
- s: selection factor, which is the L_{50} divided by mesh size.

For species which should not be retained (e.g. because they do not have a high commercial value), a higher L_{50} and s is favourable. For species that are commercially valuable, the L_{50} should not be much higher than L_{50}.

5 Tested gear adaptations

This chapter describes gear adaptations and their effectiveness in reducing cod catch. The gear adaptations are sorted by gear category in which they can be used.

White fish demersal trawls (≥100mm mesh size) – TR1

Many of the gear adjustments for this gear segment are included in the Scottish Conservation Credit Scheme[1].

The Scottish Eliminator trawl

The Scottish Eliminator trawl is a design with larger mesh than usual in the front part and wings of the net (Figure 3, Figure 4). It is an effective design to reduce the bycatch of cod (Beutel et al., 2008; Holst and Revill, 2009).

The catches of cod can be affected to a considerable scale, especially for the lower length classes, making this gear suitable for reducing cod bycatch, but it is not good for catching other target species. Lemon sole is virtually lost completely in the catch (Figure 5), and reports were also given that flatfish catches were reduced by 80% (Beutel et al., 2008), which makes this gear unsuitable for flatfish fisheries.

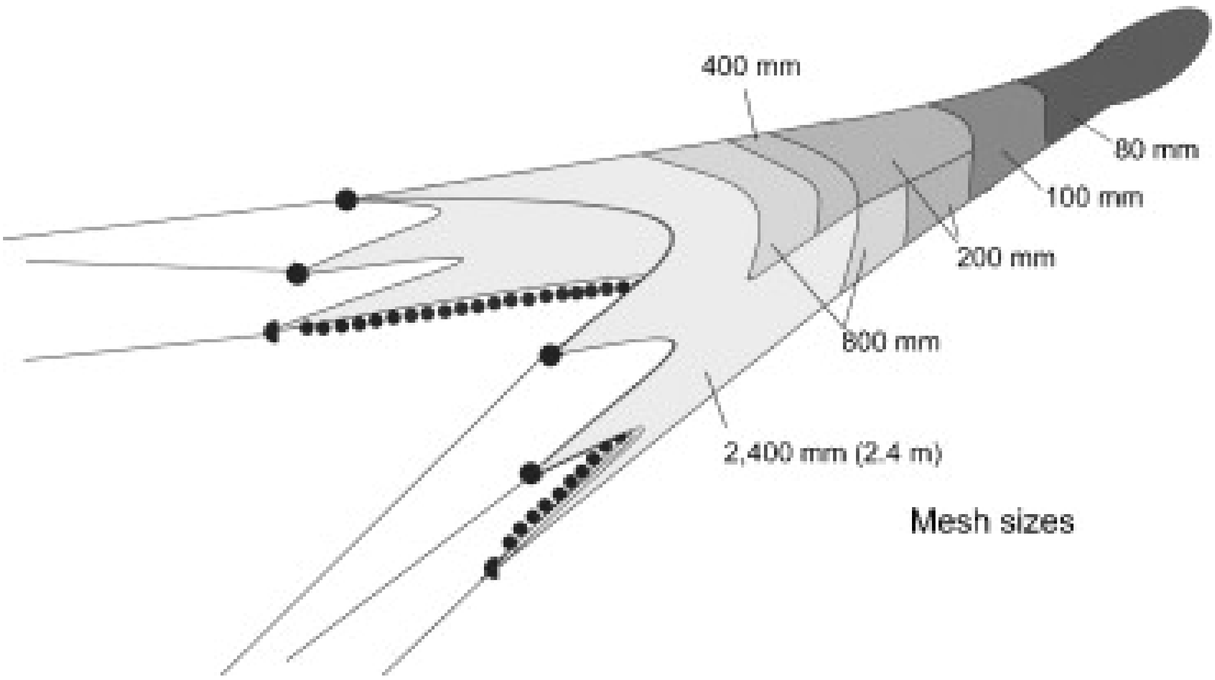


Figure 3. Diagram of a Scottish 'Eliminator' trawl (Holst and Revill, 2009)

[1] Installed in Scotland since 2008. Scottish fishermen are rewarded with extra days at sea if they adhere to certain measures (e.g. Real Time Closures, "Amber Avoidance Areas", gear adjustments, highgrading ban). The aim of this scheme was to reduce cod fishing mortality. More information:

- http://www.scotland.gov.uk/Resource/0040/00402349.doc
- http://www.marinemanagement.org.uk/fisheries/management/days_cod.htm

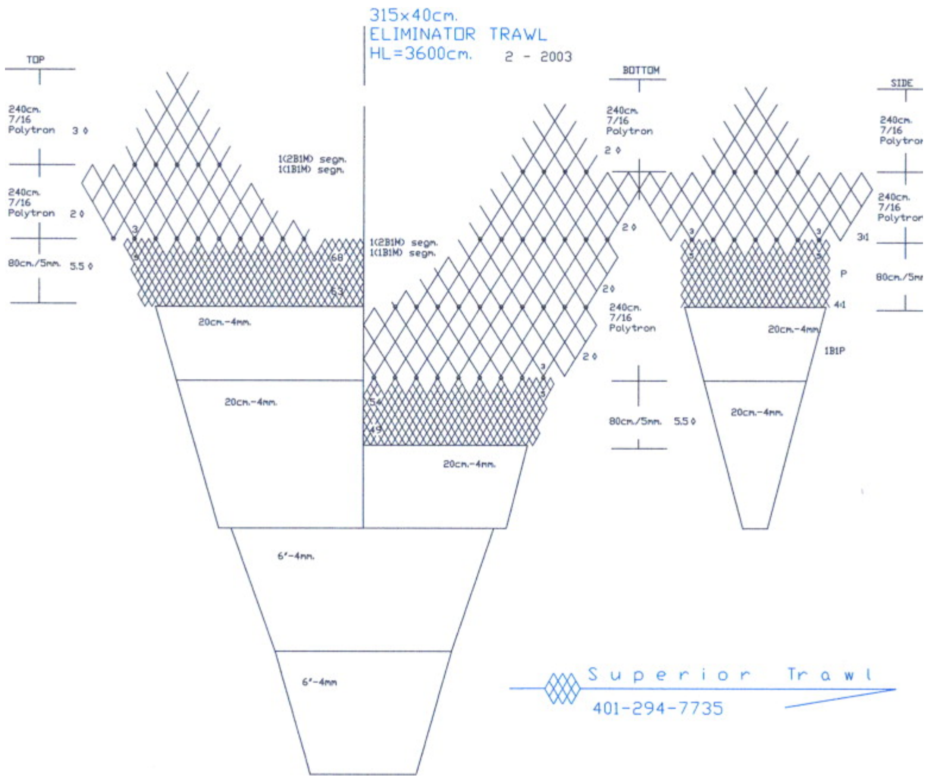


Figure 4. Net plan of an 'Eliminator' trawl (Beutel et al., 2008)

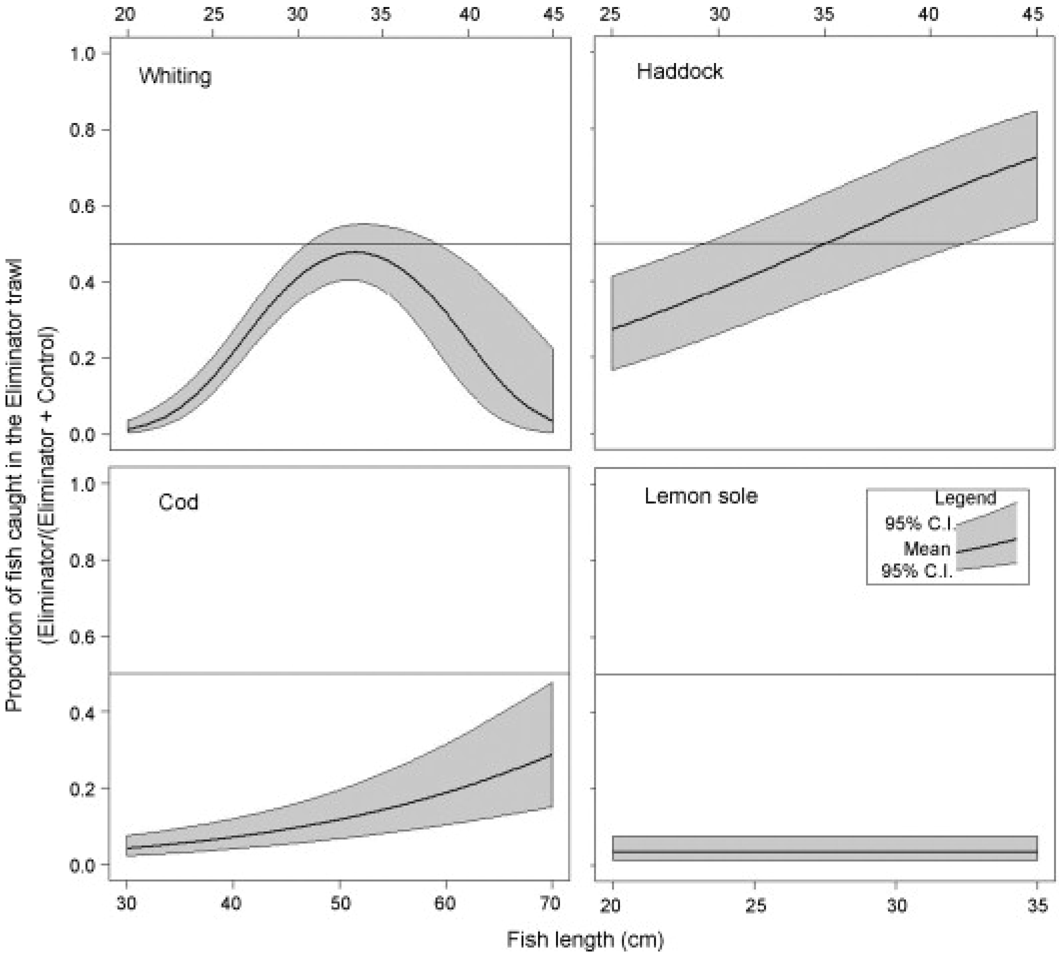


Figure 5. Results of analysis of length dependency in catches (Holst and Revill, 2009). If the proportion of the fish caught in the Eliminator Trawl (y-axis) is lower than 0.5, this means that less fish are retained in the Eliminator Trawl than in the standard trawl.

<u>The Orkney / Shetland cod avoidance trawl</u>

The Orkney / Shetland cod avoidance trawl is a trawl in which 160mm mesh is replaced by meshes of at least 300mm in the forward sections and the wings of the net (Campbell et al., 2010; Kynoch et al., 2011a). See also Figure 6. It is an effective design for releasing cod (Figure 7), but also causes considerable losses in megrim (-79...93%) and hake (-28...53%). Unfortunately the numbers of whiting, plaice and lemon sole were low and insufficient for analysis. Kynoch at al., 2011 make a plea for further research on developing gears that reduce cod catches, but retain species such as monkfish, megrim, ling, saithe and hake, as these species may contribute substantially to economic viability of this new gear.

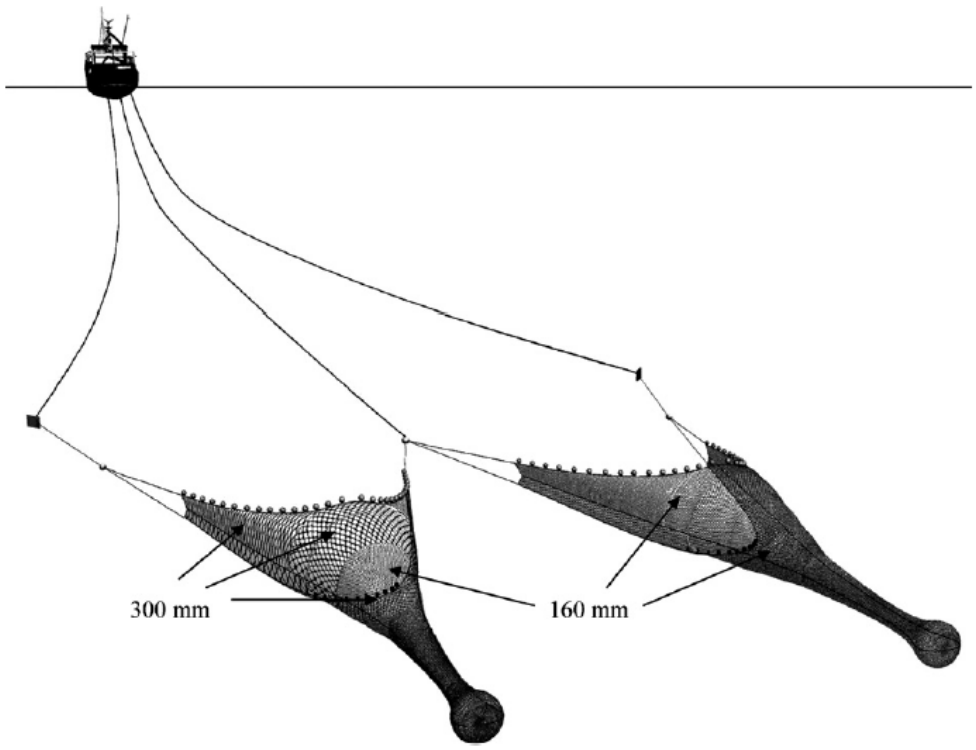


Figure 6. The Orkney / Shetland cod avoidance trawl (Campbell et al., 2010)

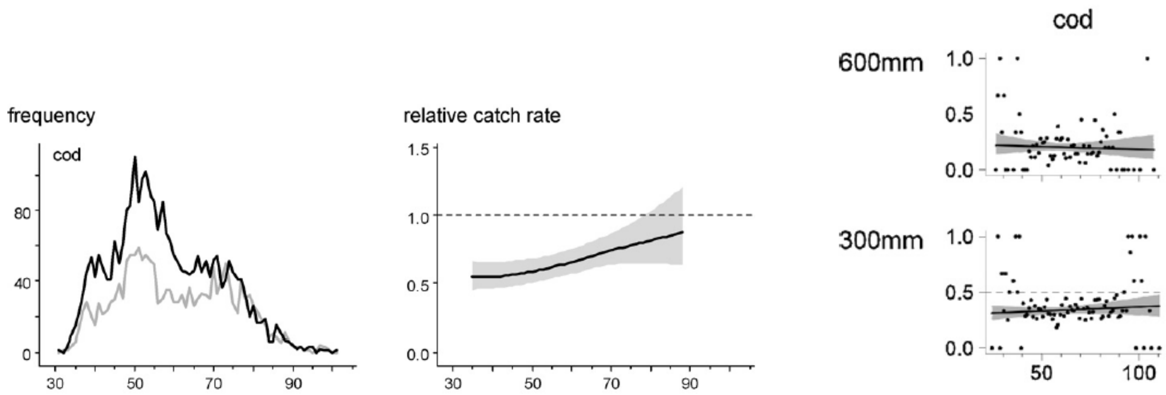


Figure 7. Effect on cod of the Orkney / Shetland cod avoidance trawl (from Campbell et al., 2010, left and (Campbell et al., 2010; Kynoch et al., 2011, right). Left: number of cod caught in the standard trawl (black) and in the adjusted trawl (grey). Middle: relative catch rate - if the proportion of the fish caught in the adjusted gear (y-axis) is lower than 1.0, this means that less fish are retained in the adjusted gear than in the standard trawl. Right: similar to the middle graph for 300 and 600mm, but here the value of 0.5 represents a similar catch.

130mm cod-end

Selectivity trials were reported by various workers. The L_{50} for cod was found to be ~35cm (Madsen and Holst, 2002) for a 120mm (nominal) diamond cod-end, but with a twine thickness of 4mm and fewer meshes in circumference (92) than used by other researchers, who found a cod L_{50} of ~45cm (Graham et al., 2004).

The 300, 600 and 800mm belly panel cod avoidance trawl

This gear has larger meshes in the belly sheet (bottom panel) ranging from 300 to 800mm (Figure 8). It is effective in releasing cod, and more so for larger mesh size. The 300mm mesh releases about 33%, the 600mm 33…57% and the 800mm 53…76%. The 300mm and 600mm test gears caught more smaller haddock (≤33cm and ≤31cm respectively), and the 300mm and 800mm fewer larger haddock (≥40cm and ≥56cm respectively). There was no significant difference in catch rates of whiting between the 300mm and 600mm test gears and the control, but there was evidence that the 800mm gear caught fewer larger whiting (≥ 36cm). For saithe there were no significant differences between any of the test gears and the control (Kynoch et al., 2011b).

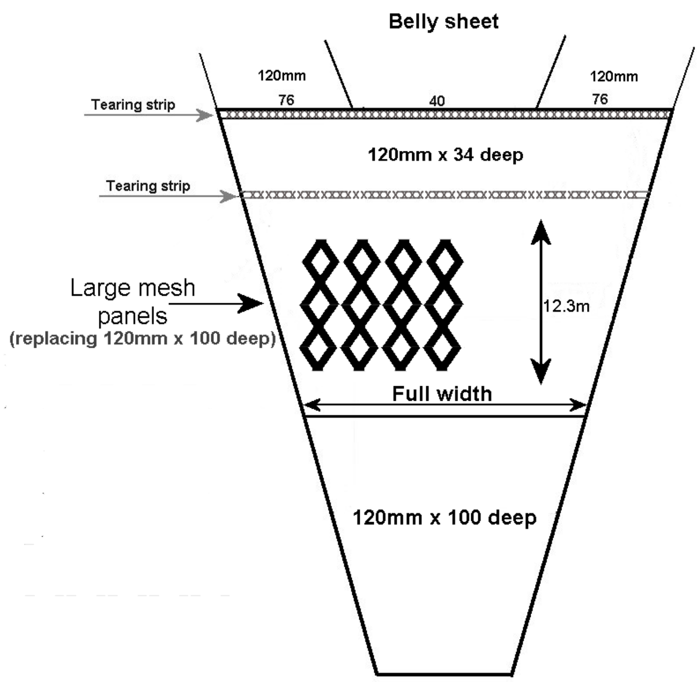


Figure 8. The 300mm belly panel cod avoidance trawl

The (200mm) Square Mesh Panel

Square mesh panels (SMP) or windows inserted in the top sheet of a trawl net (e.g.) can be effective in releasing roundfish species such as whiting, but are often not effective on cod (Frandsen et al., 2009; Graham and Kynoch, 2001; Graham et al., 2003; Graham et al., 2004; Madsen et al., 1999; O'Neill et al., 2006).

Further proof was given by a year-long trial on a commercial boat using a 90mm, and 3m long square mesh panel with a 100mm cod-end, which had no significant effect on the catches of haddock, cod or monkfish (Bullough et al., 2007). See Figure 9.

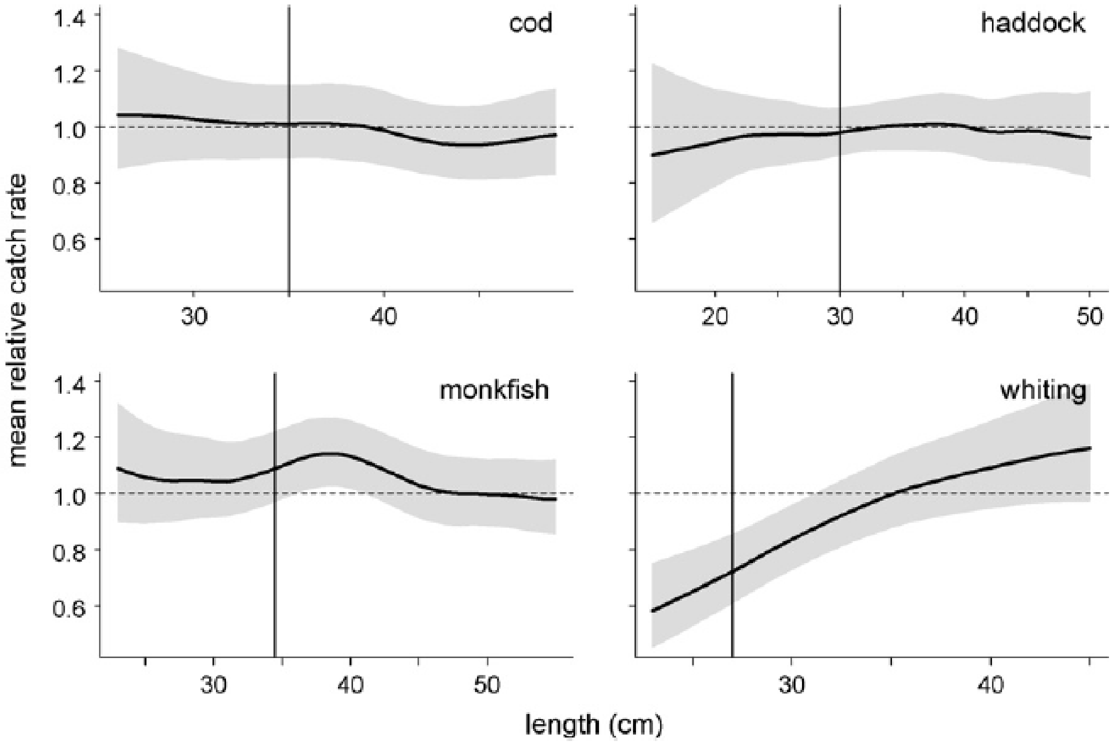


Figure 9. Mean relative catch rate for 4 species, based on results of a year-long trial on a commercial boat with a 3m long 90mm mesh SMP. If the proportion of the fish caught in SMP (y-axis) is lower than 1.0, this means that less fish are retained in the SMP than in the standard trawl. Minimum landing size is indicated with the vertical line.

Nephrops demersal trawls (70-99mm mesh size) – TR2

Nephrops Flip Flap 'netting' grid trawl

This is a design of a *Nephrops* trawl in which an actual blockage is offered to incoming fish thus stimulating them to leave the net through a triangular release hole in the top panel. A 200mm SMP (8 bars wide and 10 bars deep) is attached across the aft part of the net with a lower section hanging loose pressed down by weighted selvedges. In addition there is a 200mm (12 bars across) SMP in the top sheet just before the fish outlet (Figure 10).

Faithlie Cod Avoidance Panel

This is a design of a *Nephrops* trawl in which also an actual blockage is offered to incoming fish guiding them to two triangular release holes in the top panel. A 300mm SMP (14 meshes wide and 8 meshes deep) is attached across the aft part of the net. To allow the passage of benthos and ground fish species, it is permitted to create a hole at the bottom of the panel, by cutting out the mesh bars. The reductions by weight of cod, haddock and whiting are 62, 74 and 66% respectively (Kynoch et al., 2012). See Figure 11 and Figure 12.

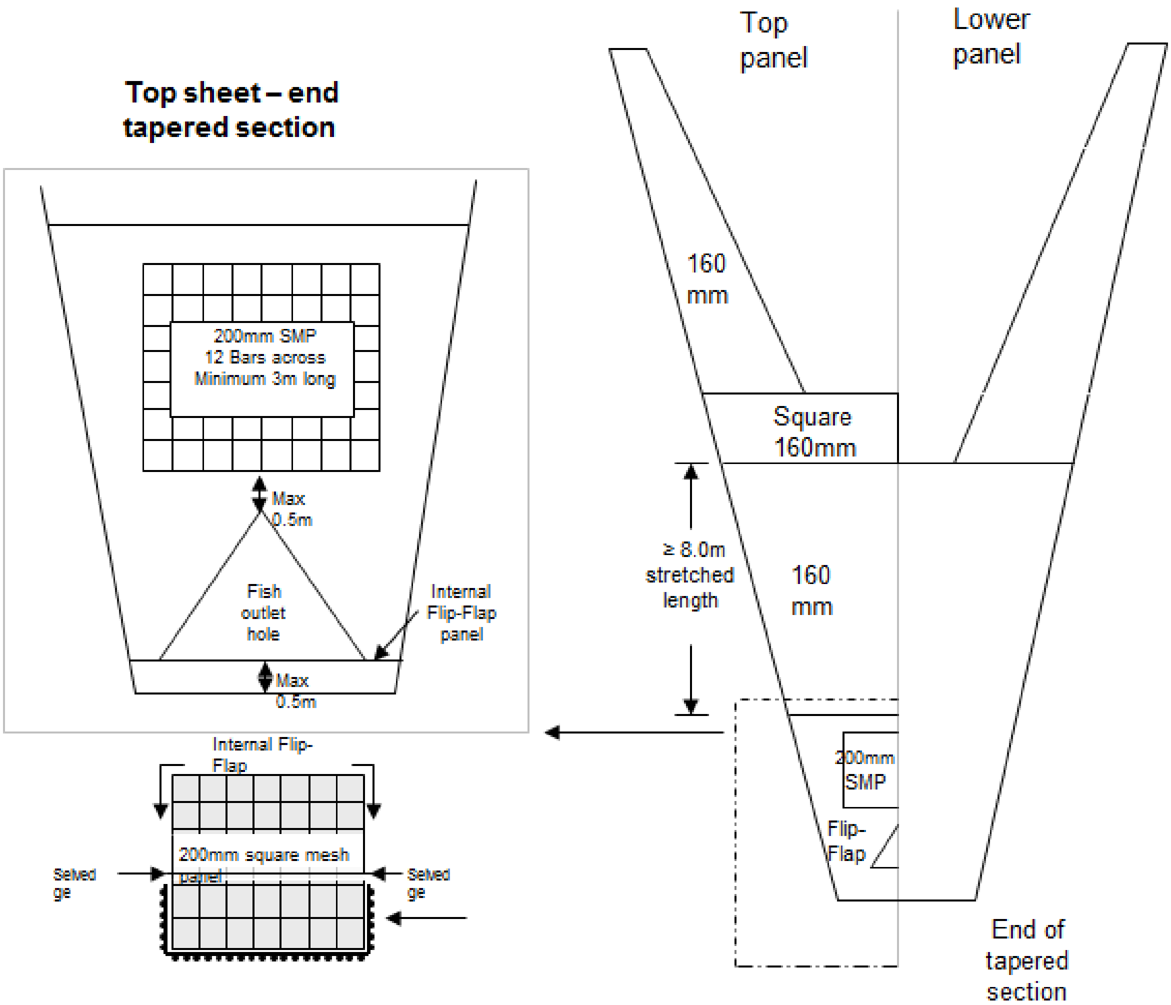


Figure 10. *Nephrops* Flip Flap 'netting' grid trawl

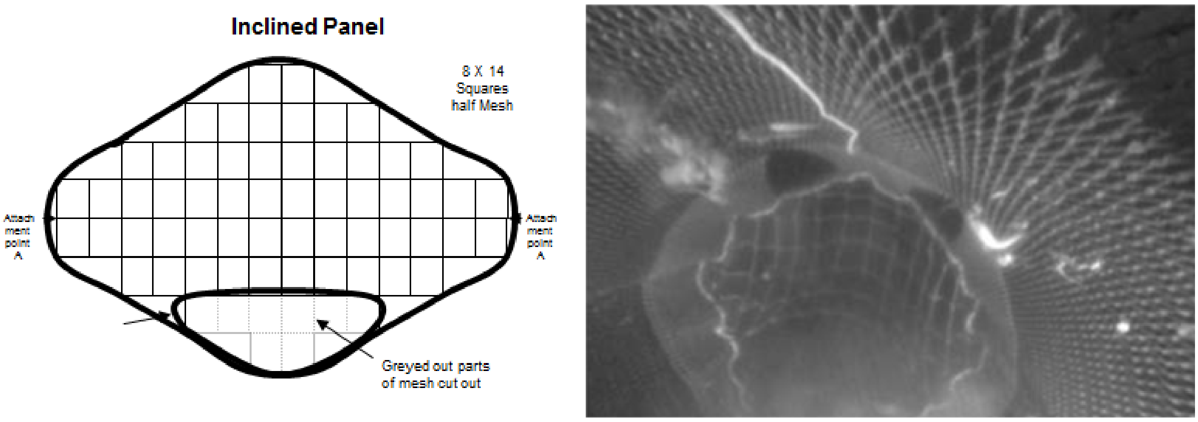


Figure 11. Faithlie Cod Avoidance Panel – diagram (left), direct observation (right) (Kynoch et al., 2012)

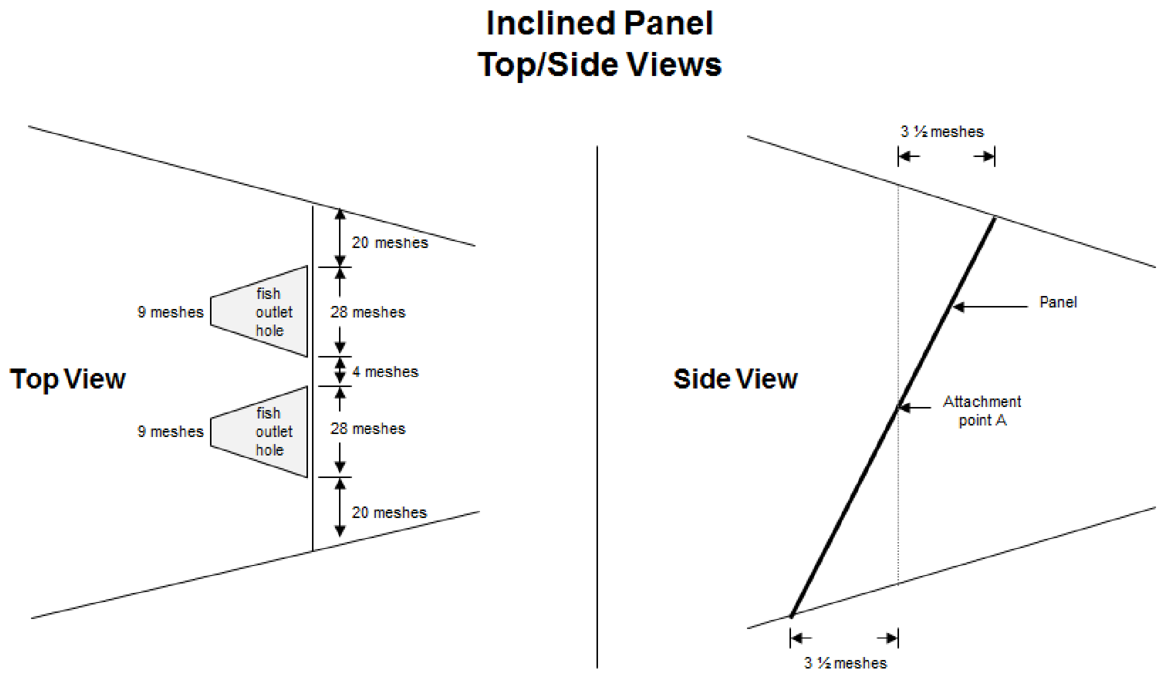


Figure 12. Faithlie Cod Avoidance Panel – top and side views (Kynoch et al., 2012)

<u>The Scotnet Internal Cod Flap (SCIF) with 120mm SMP</u>

A design has been made and tested recently based on the ideas in the *Nephrops* Flip Flap 'netting' grid trawl and the Faithlie Cod Avoidance Panel, called the Scotnet Internal Cod Flap (SCIF) (Figure 13). It is a 21 bars wide and 10 bars deep square mesh panel laced to the top sheet of the trawl, with 200mm mesh size, positioned 20m from the cod-end at the junction of 100 meshes clear. This panel is considerably cheaper (around £200) than the Flip-Flap and Faithlie designs. The flap has a 2m long 4 kg leadline to keep it down. The material used is 5mm bonded treated nylon, and it is very stiff. It has a fish outlet in the 90mm top sheet of 50 meshes down, 30 meshes top, and 10 meshes in depth in front of the flap.

It has been tested very recently (November 2012) and filmed by Marine Scotland Aberdeen. It also has the important advantage that there were no seals in the cod-end, they recognise the panel and turn out.

The original Flip-flap does not seem very suitable for vessels with a length over all < 10m, and the Faithlie is also not suitable for smaller boats (personal communication, Andrew Whyte, Scotnet International, Fraserburgh, Scotland UK). This flap allows *Nephrops* to pass through the 200mm mesh or underneath. It was also reported that debris such as oil drums pass the flap without problem. The SCIF together with a 120mm SMP reduced cod bycatch by some 66% (in weight, 68% in numbers), haddock was reduced by 51% (in weight) and whiting by 58% (in weight) without loss of target species, as was shown by a twin-trawl commercial trial with 20 hauls (*Personal communication*, Andrew Whyte Scotnet International Fraserburgh, Scotland UK).

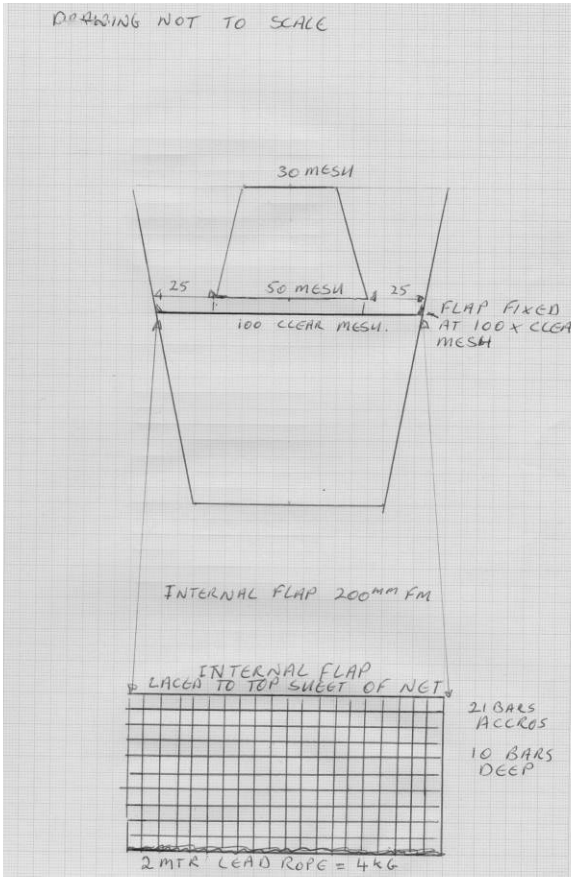


Figure 13. Scotnet Panel – info: Andrew Whyte Scotnet International Fraserburgh, Scotland UK

The Scotnet Ultra V-trawl with 160-200mm SMP

In this design the square of the net was also completely taken out. In addition a SMP was used in the aft part of 160mm or 200mm mesh size. The design enabled a 70% (160mm SMP) and 80% (200mm SMP) reduction in cod catches (Figure 14 and Figure 15).

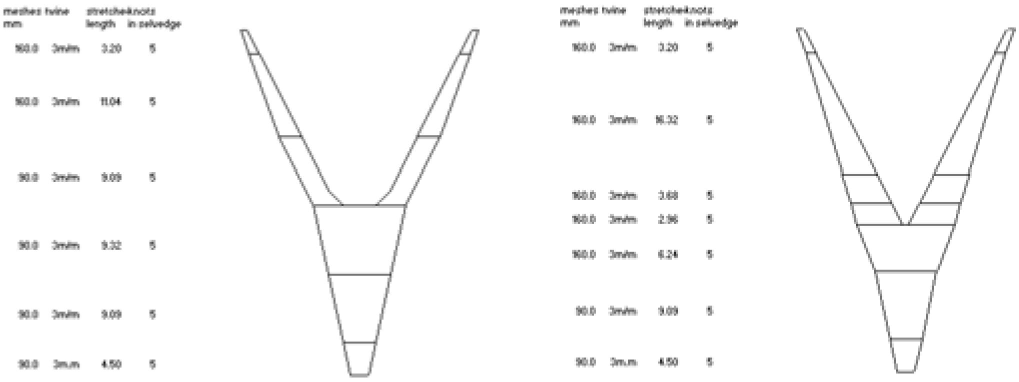


Figure 14. Scotnet Ultra-V trawl net plan – info: Andrew Whyte Scotnet International Fraserburgh, Scotland UK

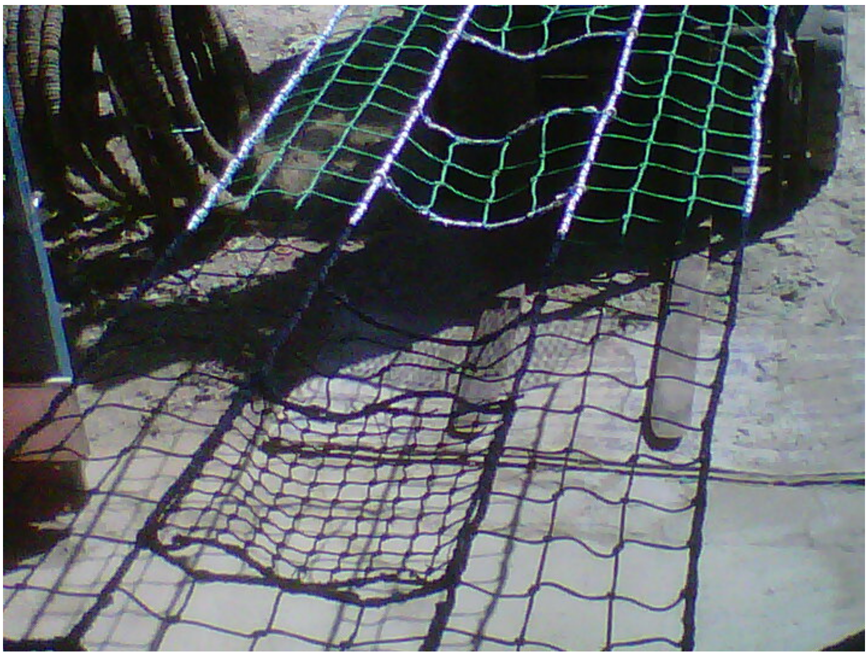


Figure 15. Scotnet Ultra-V trawl SMP – info: Andrew Whyte Scotnet International Fraserburgh, Scotland UK

<u>Square mesh cod-ends or panels</u>

Decades of R&D have been devoted to improving the selectivity in *Nephrops* trawls resulting in many designs, tests and publications (Armstrong et al., 1998; Briggs, 1983; Briggs, 1986; Briggs, 1992; Briggs, 2010; Catchpole et al., 2006; Catchpole et al., 2007; Frandsen et al., 2009; Madsen et al., 2010; Madsen et al., 1999; Revill et al., 2007; Robertson, 1993; van Marlen et al., 2007). Such cod-ends and panels are effective in releasing particularly whiting and haddock.

An excellent review has recently been made summarizing all the work focusing on the Kattegat and Skagerak area on improving selectivity on cod in *Nephrops* trawls, with comments on practicality and creating proper incentives in the industry (Madsen and Valentinsson, 2010). In addition to cod bycatch reduction they mention effects on flatfish species such as plaice and sole. They reported reductions in undersized cod bycatch ranging from 48-77%.

Swedish grid

The Swedish grid forms a combination of a guiding funnel and square mesh panels (Figure 16). It has a bar spacing of 35mm and is made of two hinged sections to enable easy winding on a net drum. It is quite effective in releasing cod (-30…60%). Small fish pass the grid, but cod larger than 34cm, haddock larger than 35cm, whiting larger than 38cm and hake larger than 41cm were released. *Nephrops* catches were good, but -10...25% were caught of smaller (41–58mm) individuals. A downside is that a grid is sensitive to blocking by weed, etc., and fishermen often see objections in having a rigid structure in the net.

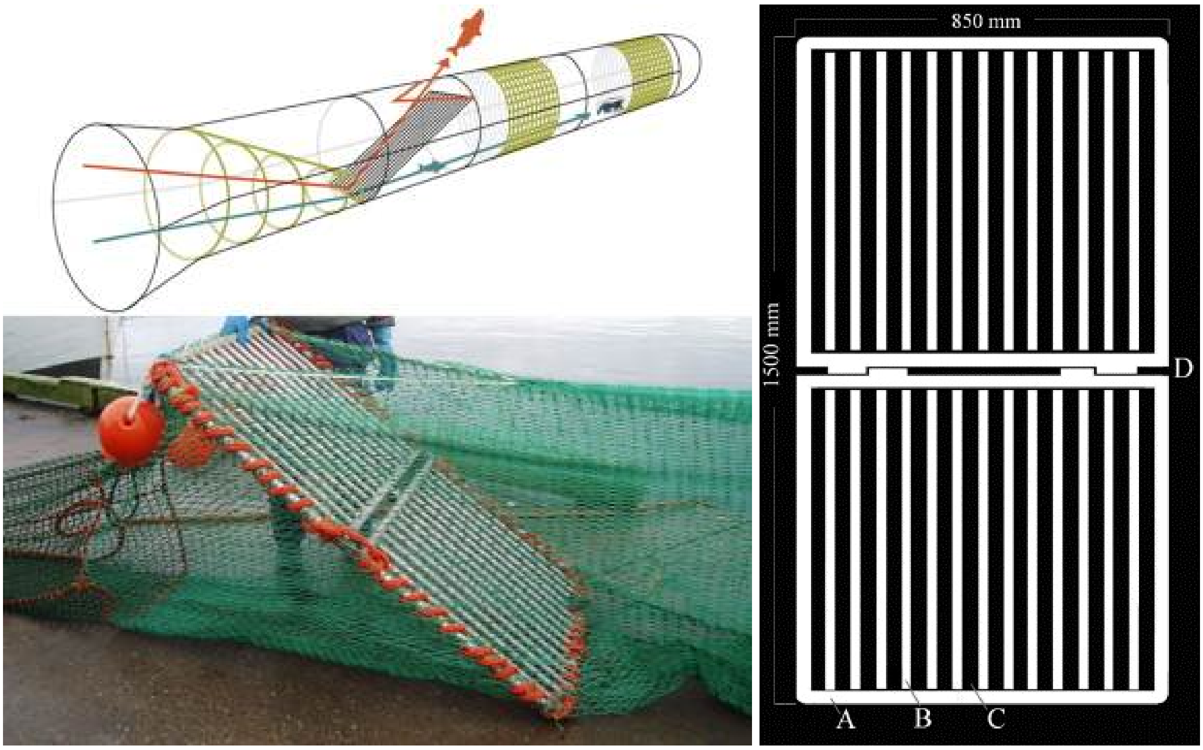


Figure 16. The Swedish grid – working principle and dimensions

The Sorting Box and SELTRA trawl

The Sorting Box is a recent Danish design of a four-panel sorting section in which a 300mm window is placed at the top at about 3-6m from the cod-line meant for the Kattegat and Skagerrak *Nephrops* fish-ery. It has a considerably larger mesh size than earlier versions of escape windows (Figure 17).

It is a very effective gear in releasing cod (-92%), haddock (-80%), and hake (-90%), but also releases a considerable number of flatfish (plaice: -84%, lemon sole: -75%, and dab: -100%). In addition some 30% of *Nephrops* was lost (Madsen et al., 2010).

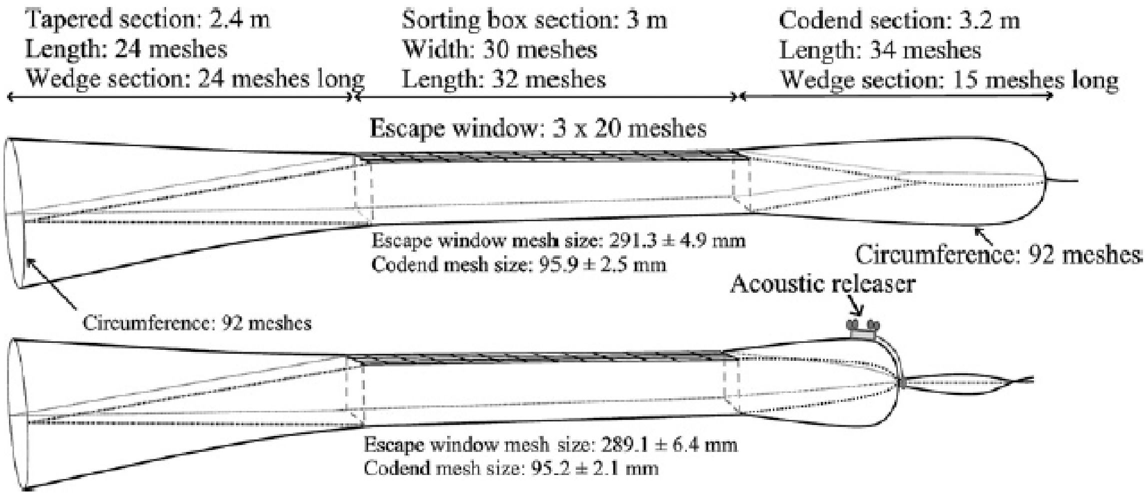


Figure 17. The Sorting Box (Madsen et al., 2010)

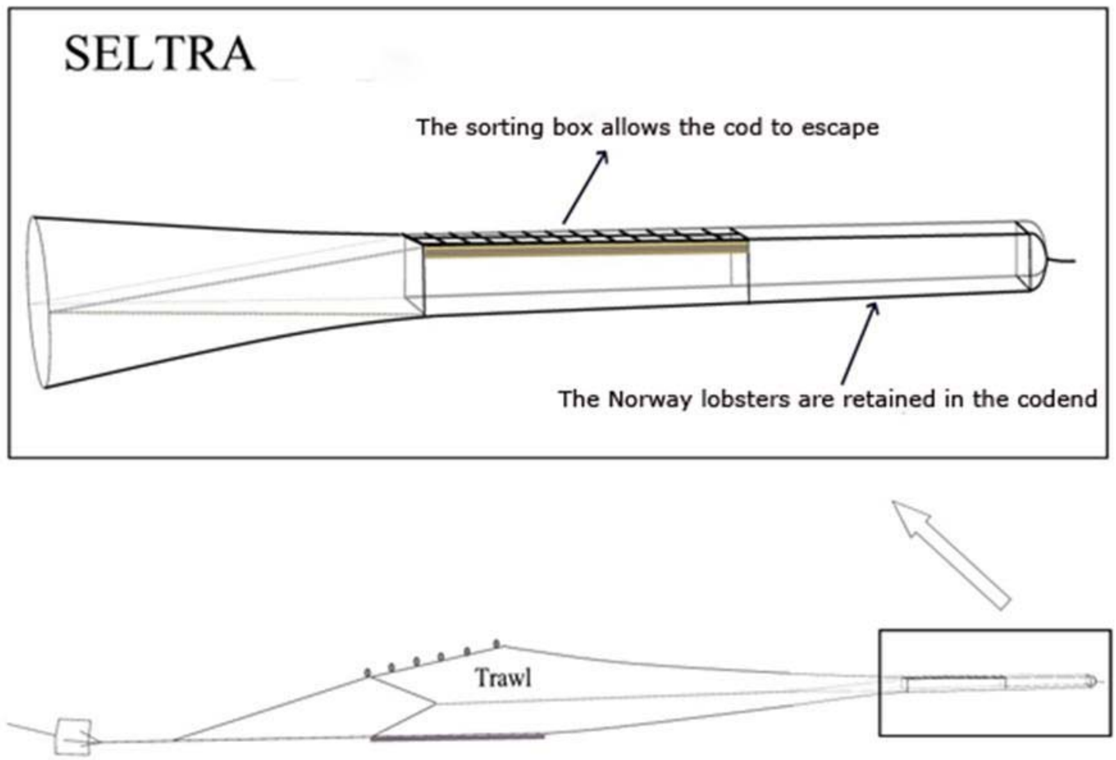


Figure 18. The Danish SELTRA trawl, a variant of the Sorting Box

A variant of the Sorting Box is the so-called 'SELTRA' trawl based on wishes from the fishing industry (Figure 18). The differences concern the following points:

- Number of meshes is allowed to be more than 100. A total of 140 were used in the Sorting Box originally.
- Some weight was used in the Sorting Box.
- The netting is now single (and not double).

- It can be made in a 2 or 4 panel section (most fishermen use 4-panels).
- The window was moved a little forward ending 4m from the lifting strop.
- Both square and diamond meshes (2 x larger) can be used.
- Different mesh sizes were applied.

The SELTRA-trawl is still being studied. It is expected to have a somewhat lower selectivity, but still high. The probability that fish encounter the panels is estimated to be around 73%, which is very high, but lower than the probability in some of the original experiments. The height under the window determines the effect on cod. The lower the more cod go out, but the higher the chance of losses in target species (*personal communication* Dr. Niels Madsen, DTU Aqua).

Beam trawl (>70mm) - BT

In Belgium, research was carried out to determine the selectivity of beam trawls with 80mm and 100mm for several species including cod (non-published data, information available with Hans Polet, ILVO). The higher L_{50} and the selection factor, the bigger cod can escape from the net. E.g. the body length at which 50% of the cod are retained in the net (L_{50}) in the standard 80mm beam trawl with diamond mesh is 14.7cm (Table 1). The results can be used to compare selectivity of gear adjustments.

Selection ogives can be calculated from the selection factor (Figure 19). The ogives show that roughly all cod above the minimum landing size is retained in the 80mm and 100mm nets.

Table 1. Selectivity parameters of beam trawls for cod. All polyethylene netting with 4mm twine thickness. T90 means that the original netting is rotated 90 degrees. The selection factor is the L_{50} divided by mesh size. The standard gear at the time was the beam trawl with diamond mesh, presented in the grey coloured row. (Depestele et al., 2008)

Type of mesh	Mesh size (actual size)	Braided	Half number of meshes in circumference x meshes deep	L_{50}	Selection Factor
Diamond	80 (80.0)	Double	50x50	14.7	0.18
T90	80 (81.2)	Double	25x100	22.5	0.28
T90	80 (81.2)	Double	35x100	20.3	0.25
T90	100 (96.6)	Double	25x100	24.9	0.25
T90	100 (102.0)	Single	25x100	26.6	0.26

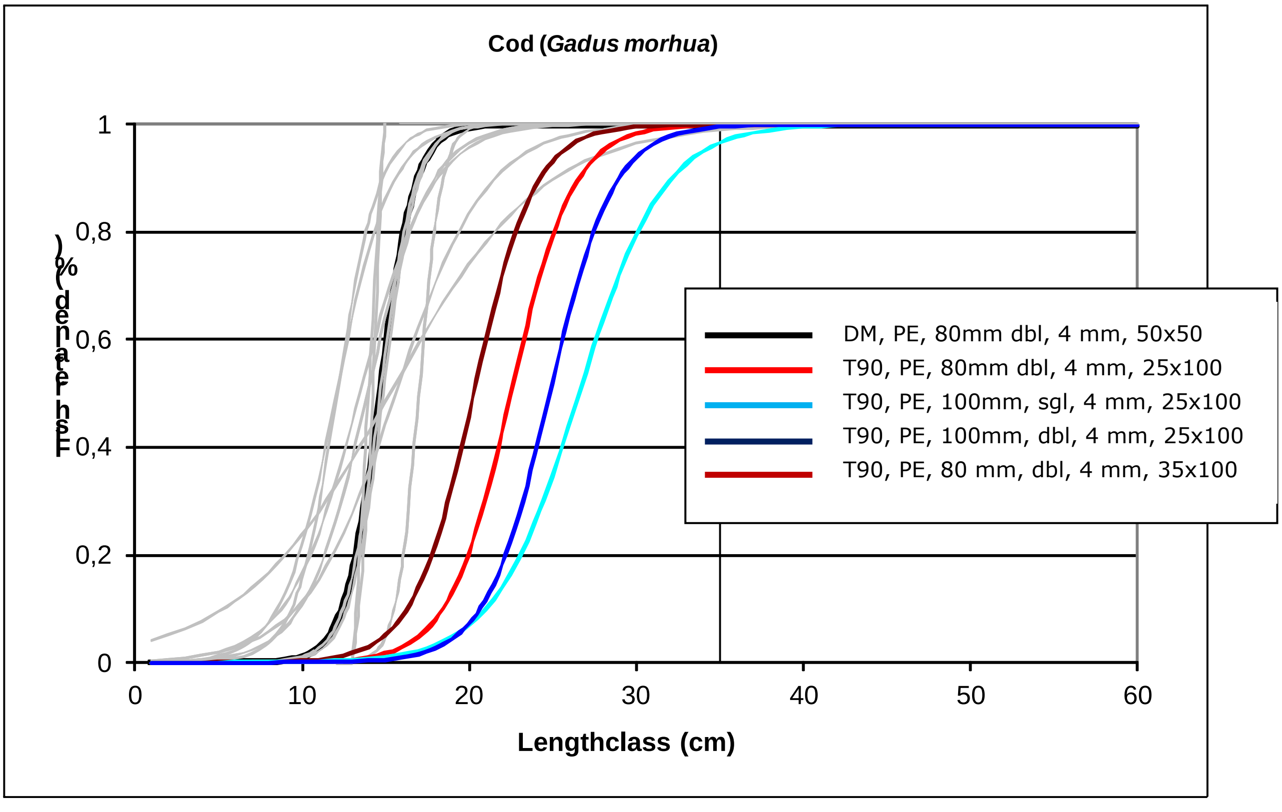


Figure 20. Selectivity ogives for cod, dbl = double twine, sgl = single twine. The grey curves represent the selection ogives of the individual hauls done with the DM 80 mm cod-end. The vertical line represents the minimum landing size of cod: 35cm.

Large diamond mesh top panel

Large diamond mesh top panels were investigated between 1990-1997 in several large EU-projects resulting in a release rate for cod and whiting of about 30-40% (van Marlen, 2003) in the tickler chain type of V-net (Figure 21, Figure 22), whereas in the round R-net with chain mat (Figure 23) the panel was less effective (van Marlen and van Duijn, 2005). The designs were not applied in the commercial fishery because fishermen feared loss of sole and plaice. However such losses can be kept relatively small at 0-5%. As the trawl has no square and misses out the lifting effect of this netting it presses harder on the bottom. Also claims were given that fish become more abraised by passing sediment due to a higher flow velocity through the net. The design may be improved by adding some sort of extra stimulation inside the net to force roundfish to move upward to the large mesh panel, such as guiding ropes or an inclined panel.

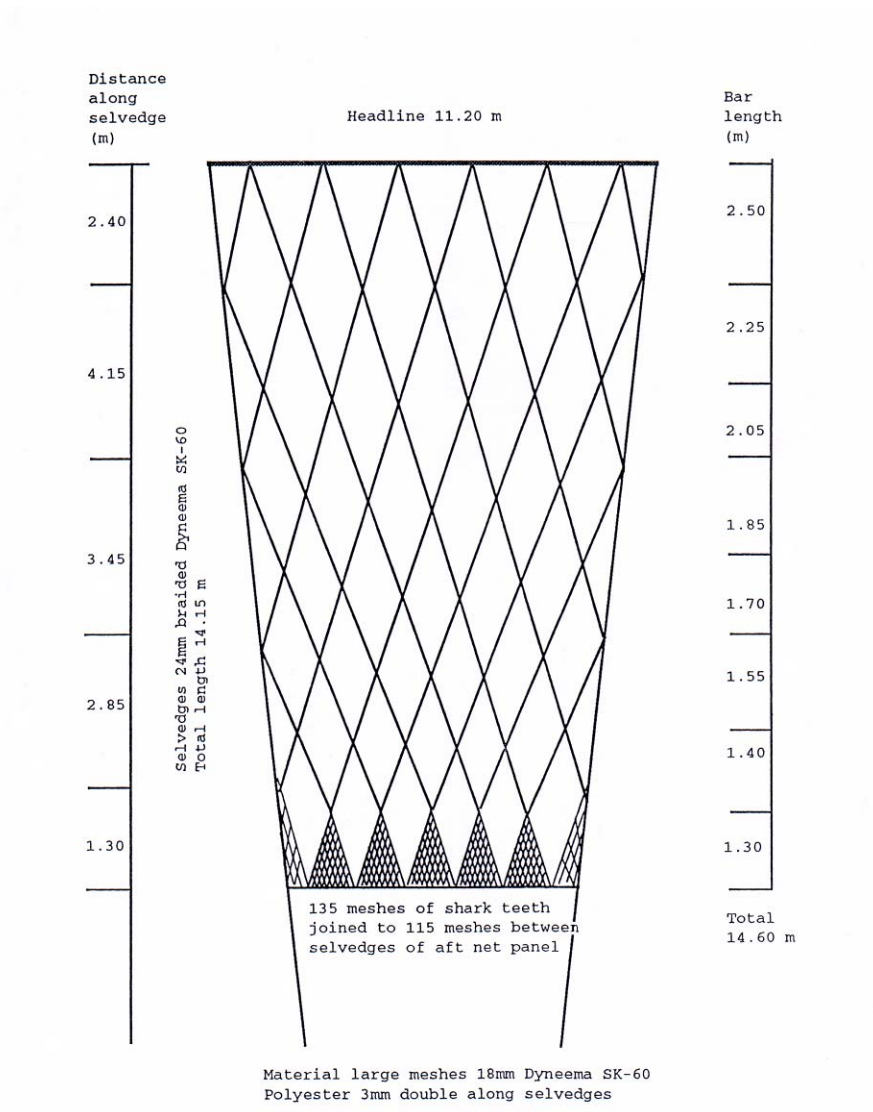


Figure 21. Large mesh top panel design for a 12m V-net (van Marlen, 2003)

Figure 22. Large mesh (2.6-5.0m) top panel in a tickler chain V-net

Figure 23. Large mesh (1.20m) top panel in a chain-mat round net

Square mesh cod-end

Square mesh has been tried in trawl cod-ends for many decades as a solution to enhance the selectivity on particularly roundfish (Bahamon et al., 2006; Catchpole et al., 2006; Halliday et al., 1999; He, 2007; Robertson, 1986; Robertson and Stewart, 1986; Robertson and Stewart, 1988; Sala et al., 2008; Walsh et al., 1992). The principle does not work well on flatfish having a distinct non-circular cross-sectional shape (Fonteyne and M'Rabet, 1992; Walsh et al., 1989), see Figure 24.

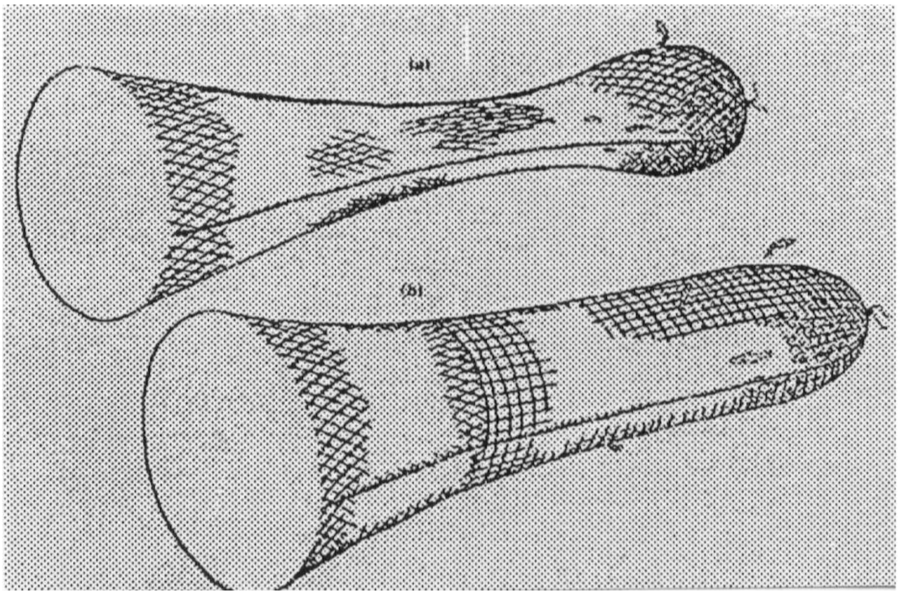


Figure 24. Square mesh cod-end – working principle

<u>'T90', or meshes rotated 90°, in the cod-end</u>

Another way to create better mesh openings than hanging meshes on the square is turning meshes 90° (Figure 25). Meshes are pulled more open across the netting, than in the conventional hanging length-wise. The technique originated from Poland as an alternative to the BACOMA cod-end and has been investigated over several decades (Wienbeck et al., 2011).

Figure 25. T90 or meshes turned 90° in the cod-end (Wienbeck et al., 2011)

Another study showed that the L_{50} increased even more substantial than in the Wienbeck et al. study (2011). It increased from 14.7cm in diamond mesh netting to 22.6cm in T90 netting (Table 1, Depestele et al., 2008). The T90 cod-end has interesting selective properties for the most important commercial species for the beam trawl, i.e. sole. It allows more undersized fish to escape and more marketable fish to be caught. Roundfish species, such as cod, and non-commercial fish and invertebrates escape much more easily from a T90 mesh than from a diamond mesh in a typical beam trawl cod-end. It can thus be expected that the application of a T90 cod-end will result in less discards and cleaner catches.

Square mesh panel

Square meshes were shown to be less selective for flatfish compared to diamond meshes (Fonteyne and M'Rabet, 1992; Walsh et al., 1992). The rationale behind it was that diamond meshes have a shape similar to the body shape of flatfish. For roundfish on the other hand, the selective properties of square meshes are better than those of diamond meshes.

Square mesh cod-ends may suffer from mesh distortion, as in each mesh one of the mesh bars does not carry tension. Knotless netting might solve this problem, but is more difficult to mend. For such practical reasons the square mesh window offers a solution, leaving the cod-end as it is. Unless fish are guided to or forced to hit the panel, escape depends on fish recognizing the opportunity of the open meshes to go through.

Trials with a 160mm panel in the top sheet of a beam trawl placed before the cod-end revealed that catches of marketable sole (-0…13%) may be reduced and plaice (-5…+7%) remains about the same (van Marlen et al., 2009), and Figure 26.

Trials with a square mesh cod-end showed that the selectivity for roundfish improved compared to diamond mesh (Depestele et al., 2008). For example, the L_{50} for poor cod (*Dutch: dwergbolk*) increased from 12.9cm in diamond mesh to 18-19cm in square mesh (compared to T90 mesh: 19.6cm). It can be expected that this increase would also be seen for cod. The selective properties for sole appear to be comparable to those of the T90 cod-end, slightly better than those of traditional diamond mesh.

Figure 26. Square mesh window in the top sheet of a 12m beam trawl

Narrow cod-end

Diamond meshes have the tendency to close when they are stretched. Stewart and Robinson (1985) showed during underwater observations of trawls that diamond mesh cod-ends get a bulbous shape by the drag force of the accumulated catch in the cod-end. The consequence is that only a few mesh rows in front of the bulge are open and unobstructed. All meshes in front of this zone are stretched and have a reduced mesh opening. The number of meshes through which fish can escape is thus seriously reduced (Wileman et al., 1996). By reducing the number of meshes in the circumference of the cod-end, it is expected that the meshes in front of the accumulated catch will remain more opened.

A trial was carried out with a narrow diamond mesh cod-end (80mm nominal mesh size) having a circumference of only 40 meshes in comparison to the standard 50 meshes. For roundfish, the selective properties appeared to be slightly better than those obtained with the traditional diamond mesh cod-end. But in general, the performance of the narrow cod-end was less promising and worse than the performance of the T90 and square mesh cod-end.

T90 combined with a benthos release panel

First, a benthos release panel (BRP) was developed with the goal of reducing bycatch of benthic invertebrates (Figure 26). Trials with some variants of BRP showed that a square mesh window in the aft of the belly (in front of the cod-end) resulted in drastic reduction of bycatch of inert material and benthic invertebrates. Mesh sizes of 150mm in this BRP resulted in the lowest loss of commercial species. (Fonteyne and Polet, 2002)

A second step was to combine the BRP with T90 mesh, in order to have a reduced fish bycatch. A BRP (1.8m x 1.2m, 120mm mesh size) was combined with 80mm meshes in the cod-end that were rotated 90° (T90) (Fonteyne and Polet, 2002). For cod, the abundances per tow were very low (<10 individuals), which resulted in discontinuous data across the length range. Data were pooled over all trips per treatment, but no significant effects were observed. There is a trend towards loss of marketable cod with the BRP and an increase of all lengths of cod with the T90 cod-end, but further research is needed to confirm these observations.

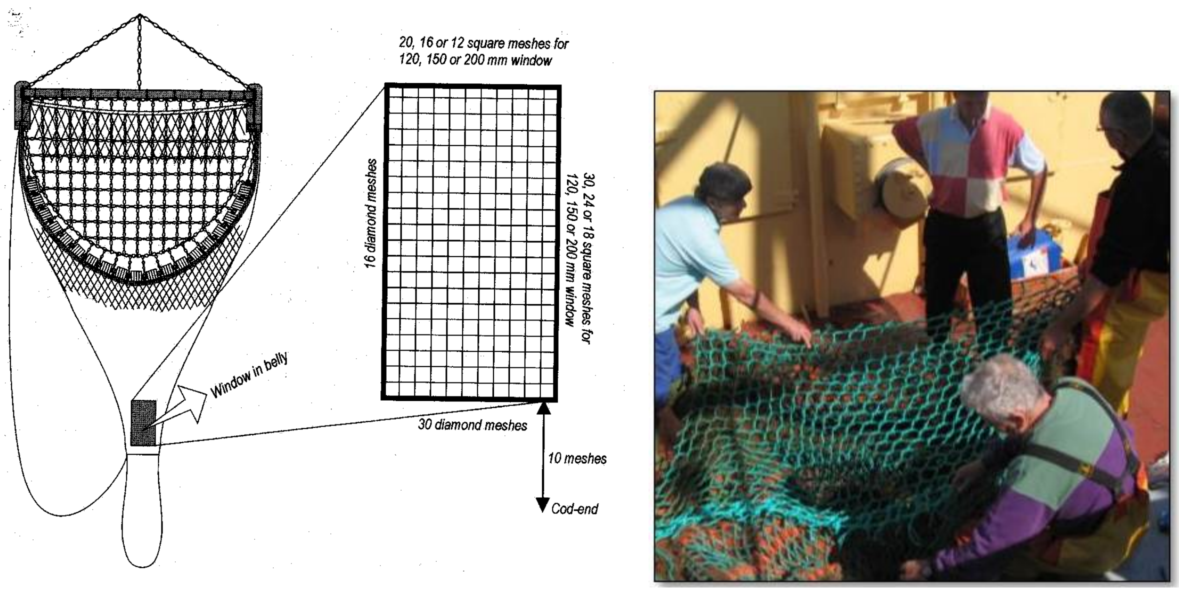


Figure 27 The benthos release panel

Alterations to the top panel

Two types of escape openings in the top panel were tested: square mesh top panels and cutaway covers (Fonteyne, 1997). See Figure 27. The idea was that these openings would be escape zones for roundfish without affecting the catch of flatfish.

Figure 28 Square mesh top panels (left) and Cutaway covers (right)

Roundfish species like haddock and whiting, which stay in the middle or upper part of a trawl when they are caught can escape through escape openings in the top panel of a beam trawl. The efficiency depends on the size of the escape opening and consequently they are only efficient when inserted in the larger beam trawls. Cod, however, a species remaining close to the belly of the trawl when caught, takes no or little advantage of these escape openings.

Inclined Separator panels

As the cutaway cover (see previous paragraph) was not effective for reduction of cod catch, it was combined with an inclined separator panel. This panel was tested in a beamtrawl with a chain matrix. It was rigged from the chain matrix to the cover (Figure 29). The separator panel should guide the cod to the opening in the top of the trawl. (Depestele et al., 2008)

Trials with this adjustment were carried out with commercial vessels. The conclusion was that application of an inclined separator panel in a beam trawl can significantly reduce unwanted bycatch of cod (-39%). The limited data available on other species showed no significant catch reduction. In a similar previous experiment carried out in 2005 within the framework of the REDUCE project (Anon. 2002), a 20% catch reduction was observed for cod. Catch reductions were also observed for whiting (20%) and haddock (30%). The differences observed may be explained by differences in rigging.

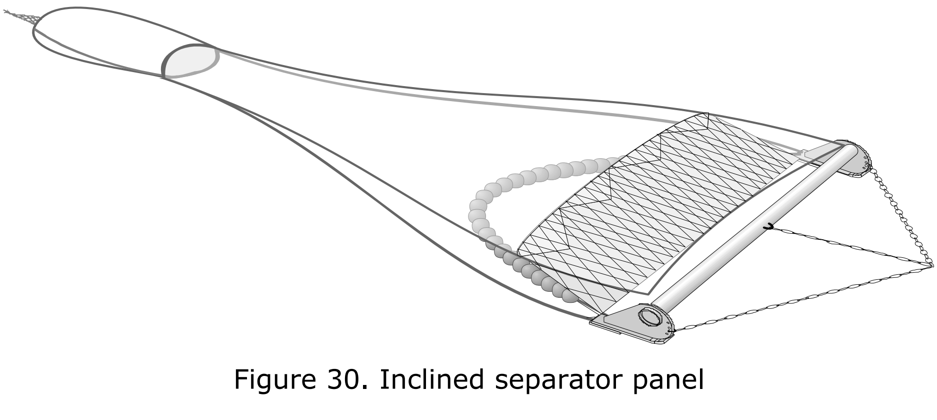


Figure 30. Inclined separator panel

T90 extension

The T90 extension was originally developed to reduce the bycatch of sand in the beam trawl fishery, in order to reduce fuel consumption and enhance fish quality. An additional result might be a reduced catch of benthic invertebrates. In flume tank studies, it has been observed that T90 netting allows an enhanced water flow through the net and wider opening of the meshes than traditional diamond meshes.

Fishermen experienced that the T90 extension succeeded in reducing bycatch of sand and benthic invertebrates without grave losses of commercial catches. At the same time, 36% less cod was caught.

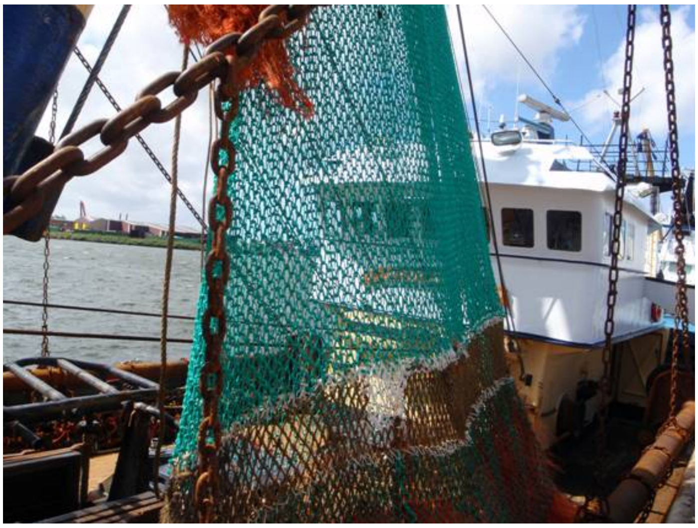


Figure 31. T90 extension rigged on board Z 98

Pulse stimulation

Pulse stimulation in flatfish beam trawling has been developed from the early 1970s, with recent commercial applications (Agricola, 1985; de Groot and Boonstra, 1970; ICES, 2010; ICES, 2011; ICES, 2012a; Kurc, 1971; Lamarque, 1976; Stewart, 1975; Stewart, 1977; Stewart, 1978; van Marlen et al., 2000; van Marlen et al., 1997a; van Marlen et al., 1999; Vanden Broucke, 1973). It is a good technique to save energy and reduce fuel costs. Also discards can be substantially reduced at 60-65%, but catches of sole and plaice can be somewhat lower (-20…25%). Cod catches are also lower (-80%), but there may be some occurrence of broken spines in cod.

Figure 32. Flatfish pulse beam trawls, left DELMECO 2005; right HFK 2011.

Shrimp trawls (16-31mm) - TBS

Sieve or veil nets

It was shown in earlier research that bycatches in the North Sea brown shrimp (*Crangon crangon* L.) beam trawling can be substantial (Table 1) and avoiding discards can have a positive effect on the spawning stock biomass of particularly plaice (+16%) and sole (+8%), but also to a lesser extent on cod (Revill et al., 1999; van Marlen et al., 1997b).

This led to studies in technology to reduce such bycatches. The sieve (or veil) net and sorting grid came out as possible solutions. The sieve net is an inner cone of netting of larger mesh size (60 – 70mm) than the surrounding net (20mm) guiding larger biota to an outlet, whilst shrimp can pass through (van Marlen et al., 2001a; van Marlen et al., 2001b), see Figure 33. It is taken up in European legislation since 2003. A drawback is that it can get clogged with jellyfish or sea weed rendering its effect nil.

Further studies were done on sieve nets over the years (Polet et al., 2004; Revill and Holst, 2004a; Revill and Holst, 2004b; van Marlen et al., 2009; Wienbeck, 1998a). It was concluded that they are effective, but not for the very small length classes below 10cm.

Table 1. Estimated discards in North Sea *Crangon* beam trawling (1996-1997)

Species	No of fish discarded per year (1996-1997)
Plaice	928 million fish
Whiting	55 million fish
Cod	42 million fish
Sole	16 million fish

Source: Van Marlen *et al.* (1998)

NB: All fish were aged 0, 1 and 2 years old

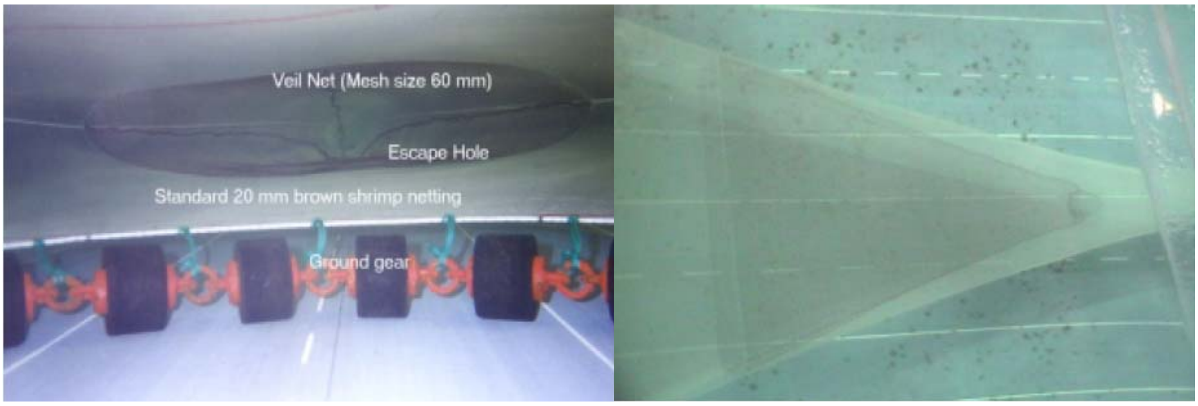


Figure 33. Sieve or veil net developed for the *Crangon* fishery.

Sorting grids

The idea of rigid sorting grids developed in the Norwegian shrimp (*Pandalus*) fishery has been tried also in *Crangon* beam trawling. Shrimp can pass through the bars (spaced 20mm apart), while larger biota are guided to an outlet hole. This device is also sensitive to clogging as is the sieve net. Further studies were done on sieve nets and sorting grids over the years (Graham and Radcliffe, 1998; Madsen and Hansen, 2001; Polet, 2002; Wienbeck, 1995; Wienbeck, 1998b; Wienbeck, 1999). See Figure 34.

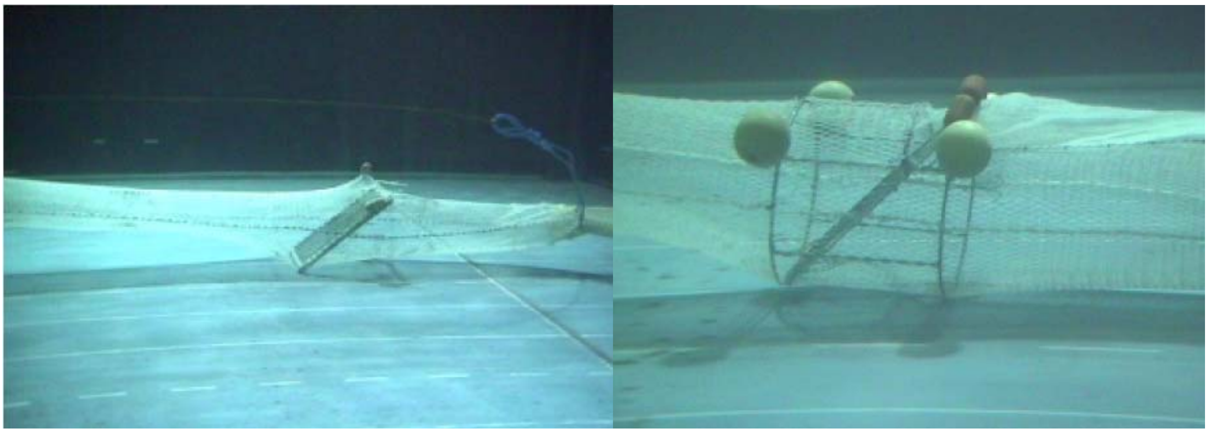


Figure 35. Sorting grids developed for the *Crangon* fishery.

Release hole ('Letterbox')

Recently a new technique was developed called the 'Letterbox', which is a sort of release hole in the lower panel of the net with two guiding panels at both sides running in a V-shape. It is a narrow slit to which parts of the catch are guided, but not shrimps that can go through the guiding panels. Fishermen believe this is a good alternative in times a sieve net becomes clogged. It was tested in 2011 and found as effective in reducing bycatches as a sieve net (Steenbergen et al., 2011).

Pulse stimulation

Apart from mechanical devices another way to decrease discards is to use electrical or pulse stimulation (Boonstra and de Groot, 1974; ICES, 2010; ICES, 2011; ICES, 2012a; Polet et al., 2005a; Polet et al., 2005b). Recently developments in pulse shrimp trawling show a clear potential in reducing discards (Verschueren et al., 2012), see Figure 36.

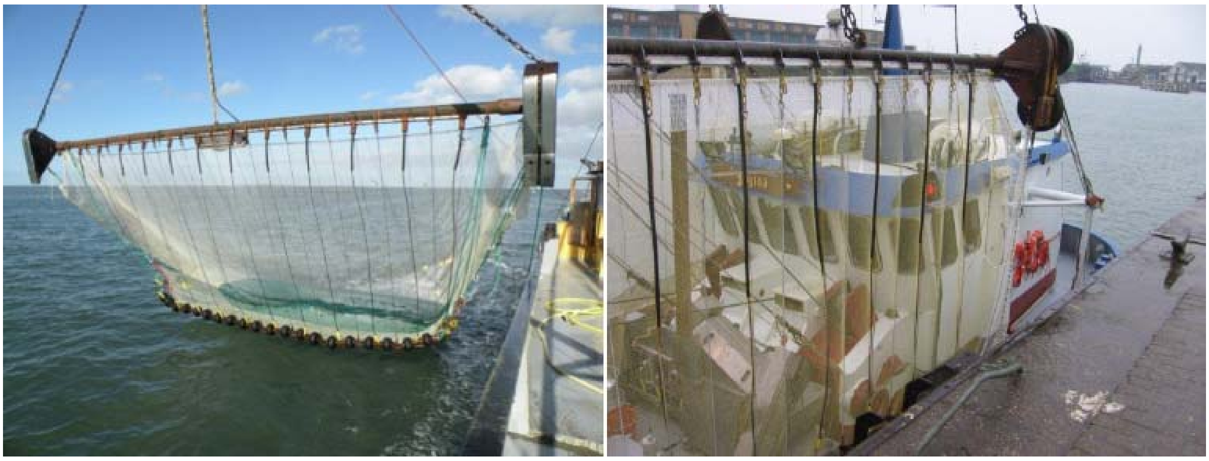


Figure 36. "Hovercran" on HA-31 (left) and WR-40 (right)

Summary of results by gear adaptation

The results of the gear adaptations as described in the previous sections, are summarised in table 3. It should be noted that the results presented in the table are achieved with different types of beam trawl, in varying seasons and on different fishing grounds. This means, that the results should merely be seen as indicative instead of being matter-of-fact.

Table 2. Summary of findings. TR1=Whitefish demersal trawls, equal to or greater than 100mm; TR2=Nephrops demersal trawls, 70-99mm mesh size; BT=beam trawl; TBS=shrimp trawl. Effectiveness expressed in percentage reduction or increase in catch or in L50. Species abbreviations: COD=cod, MEG=megrim, HKE=hake, HAD=haddock, WHG=whiting, NEP=nephrops, PLE=plaice, LEM=lemon sole, DAB=dab, SOL=sole, BIB=bib, BLL=brill. Applicability to Dutch or Belgian fisheries: Y=yes, N=no.

Gear Group	Technique	Effectiveness	Applicability	Comments
TR1	Scottish Eliminator trawl	-81% COD	Y	Worth to be tested, for otter trawlers only. Unsuitable for flatfish fisheries (-80%).
TR1	Orkney / Shetland cod avoidance trawl	-49...75% COD -79...93% MEG -28...53% HKE	Y	Worth to be tested, for otter trawlers only.
TR1	130mm cod-end	L_{50} = 34 ... 45cm	N	For otter trawlers only.
TR1	300-800mm belly panel cod avoidance trawl	-~30% COD (300mm) -33...57% COD (600mm) -53...76% COD (800mm)	Y	Worth to be tested, for otter trawlers only.
TR1	200mm Square Mesh Panel	Not very effective on cod	?	Mesh distortion might be a problem. Knotless netting more difficult to mend. Works better on haddock and whiting.
TR2	*Nephrops* Flip Flap 'netting' grid trawl	-73% COD -67% HAD -82% WHG NEP similar	Y	Flap is obstruction to pass, physical barrier. Worth to be tested.
TR2	Faithlie Cod Avoidance Panel	-62% COD	Y	Flap is obstruction to pass, physical barrier.

Gear Group	Technique	Effectiveness	Applicability	Comments
		-74% HAD -66% WHG		Worth to be tested. Effect on *Nephrops* still to be determined. Two fish outlets needed in top sheet.
TR2	Scotnet Internal Cod Flap + 120mm SMP	-66% COD -50% HAD -58% WHG NEP similar	Y	Debris passed flap without problem. Worth to be tested. Cheaper solution. One fish outlet needed in top sheet.
TR2	Scotnet Ultra-V trawl + 160-200mm SMP	-70% COD (160mm) -80% COD (200mm)	Y	Worth to be tested.
TR2	Square Mesh cod-end or Panel (SMP)	-48...77% COD (dis-cards)	Y	Often applied in combination with other tech-niques.
TR2	Swedish grid	-30...60% COD -10...25% NEP 41–58mm	Y	Worth to be tested, used by 109 DK and SE vessels. Losses reported in PLE, and large NEP. Grid may be sensitive to blocking by weed etc. Handling and safety issues.
TR2	Sorting Box & SELTRA trawl	-92% COD -80% HAD -90% HKE -84% PLE -75% LEM -100% DAB -33% NEP	Y	Worth to be tested, but flatfish loss might be too large. *Nephrops* losses can be kept at reasonable level, but flatfish losses still high.
BT	Large diamond mesh top panel	-30...40% COD -40% WHG -0...5% SOL & PLE	Y	Net harder on the ground, less lift. Thoroughly tested. Panel needs certain length, not very suitable for shorter R-nets. COD not forced out, less effective. Add more effective stimulators?
BT	Square mesh cod-end	-51%COD (80mm) -78%COD discards (100mm)	Y	Large cod observed to swim along in the cod-end and feed on incoming fish, no escape at-tempts. Better escape for small cod.

Gear Group	Technique	Effectiveness	Applicability	Comments
				A Belgian study showed slightly improved selective properties for sole compared to diamond mesh (80mm). Selective properties for plaice are worse and better for roundfish.
BT	Square mesh panel or window in top sheet	-?COD -8...27% discard fish -0...13% SOL -5...+7% PLE	Y	Very low cod catches, difficult to prove effect. SMP 160mm square meshes in top sheet. Technically feasible. More data needed on cod.
BT	Narrow cod-end	L_{50} for sole above minimum landing size (25cm) L_{50} for roundfish increases, e.g. poor cod (*dwergbolk*) from 12.9 to 20-21cm	Y	Results are not as promising as those of the T90 and square mesh cod-end.
BT	T90 meshes in cod-end	Two studies showed an increase in L_{50} for COD: one showed +7.3% and another showed an increase from 15cm for diamond mesh to 22mm for T90 mesh. T90 more selective for flatfish (sharper selection curve)	Y	T90 results in an increased L_{50} for cod. The results may vary greatly, due to characteristics of the cod-end and the way the gear is operated. Simple and cheap construction. Fewer meshes round give higher L_{50}. Meshes more open over entire cod-end length. Single twine gives higher L_{50} than double twine. L_{50} drops with twine thickness. Higher escape rate due to haul-back possible. New T90 cod-ends are not easy to handle due to asymmetric shape. Possible slip-ping of the knots
BT	Benthos Release Panel (150mm)	-18% COD	Y	Possible loss of sole

Gear Group	Technique	Effectiveness	Applicability	Comments
BT	T90 + benthos release panel	-?COD -47% marketable WHG -17% HKE -64% BIB -66% undersized HAD	Y	Possible slipping of the knots
BT	T90 extensions	-36% COD -22% BLL -9% SOL	Y	Possible slip-ping of the knots
BT	Alterations to the top panel	Selectivity for WHG and HAD improved, much less for COD. -12%...6% COD	Y	
BT	Cutaway cover	-16%...5% COD	Y	
BT	Cutaway cover + inclined separation panel	-39% COD	Y	Easiest with chain matrix beam trawls
BT	Pulse beam trawl	-80%COD -60...65% discard -20...25% SOL & PLE	Y, used	Method formally banned by EU-Regulation. Can save up to 50% in energy. Technically feasible, used in commercial practice. More data needed on cod.
TBS	Sieve or veil net	-?COD -50% discard fish -16...26% small shrimp -5...20% big shrimp	Y	Low cod bycatches, difficult to prove effect. More data needed on cod. Technically feasible, 60 – 70mm mesh. Not effective at lengths < 10cm. Clogging might be a problem.
TBS	'Letterbox' release hole	-?COD - no shrimp loss	Y	No cod data, difficult to prove effect. More data needed on cod. Effective on small PLE. Less effective on bull rout and five bearded rockling.
TBS	Sorting grid	-?COD -50% discard fish -10% shrimp	Y?	Low cod bycatches, difficult to prove effect. More data needed on cod. Technically feasible, but fishermen do not like rigid grids. Not effec-tive at lengths < 10cm. Clogging might be a problem.

Gear Group	Technique	Effectiveness	Applicability	Comments
TBS	Pulse stimulation	-?COD -50% discard fish	Y	Low cod bycatches, difficult to prove effect. More data needed on cod. Technically feasible, with fewer bobbins on footrope. Best solution might be pulse stimulation with sieve net.

6 General conclusions

- There are a number of interesting options to consider for the Dutch and Belgian fisheries:
  - Larger mesh (e.g. Eliminator, Orkney / Shetland, 300-800mm belly panel) in parts of the trawl in TR1 gears.
  - The Flip-Flap, Faithlie, SCIF, Ultra-V arrangement in TR2 *Nephrops* trawls.
  - The Swedish Grid, Sorting Box or SELTRA arrangement in TR2 *Nephrops* trawls.
  - The square mesh panel in TR2 *Nephrops* trawls.
  - Large mesh top panels, T90 mesh in the extension of the cod-end, an inclined separator panel, and the pulse trawl in BT flatfish beam trawls.
  - The pulse beam trawl (with sieve net) in TBS shrimp beam trawls.

- Transferring gear adjustments from other gear types and metiers without further tests and fine-tuning is risky because circumstances differ in each fishery and on each fishing ground. All new techniques need to be tested in each metier on their particular grounds, and adapted to their own gear design on a commercial boat under acceptable conditions, and with scientific guidance (data acquisition and statistical analysis).

- Involve the industry in choices to consider to gain acceptance. Many developed gear adaptations were never used in practice, even when the industry was consulted. The reason was often a suspected loss of target fish and income.

- Ensure that fishermen have a clear incentive to use the more selective net. Strong incentives might be access to ground when using selective nets, getting certification, fuel and costs savings, or rewards in terms of extra days at sea. It helps to create strong incentives, when some loss of target species has to be overcome.

- It is necessary to understand in which fisheries substantial reductions can be achieved. In some fisheries, hardly any cod are caught. Fishermen in those fisheries will not be motivated to put an effort in reducing cod catches.

- Research and development of gear adjustments ask for adequate scientific guidance. Claims that cannot be justified will not make it through scientific peer review and in considerations by the European Commission.

- If a decision is made to develop a certain gear adjustment, results cannot be expected overnight: experiments should at least cover 2-3 weeks. Experience shows that a solution is never found during the first series of experiments and in most cases repeated trials are needed.

7 Applicability to Dutch and Belgium fleets

In this study we did not investigate in detail how much cod is caught in the various fisheries mentioned above. When gear adjustments are introduced, it is relevant to ask this question: how much cod is caught and how many cod can be saved with an adjustment? For example, it was estimated that cod landings by the beam trawl fishery (80-120mm) in the Eastern Channel, North Sea and Skagerrak are 4-5% of total landings of all other gears (years 2010 and 2011) (STECF, 2012). This kind of information on landings, as well as on discards, are needed for deciding in which fleet an effort to reduce cod catch is most effective. Insight in amount of cad being caught by fishery, may be obtained from the cod monitoring funded by the Dutch ministry of Economic Affairs in 2012.

TR1 Otter trawlers fishing for cod (120mm mesh size)

Most of the gear adjustments in this segment are not applicable to Dutch or Belgian fisheries, even though they may be excellent cod releasers. The adjustments were developed for the Scottish whitefish fleet targeting haddock and whiting. This is a fleet segment which is negligible in the Netherlands and Belgium. The best possible option seems to follow the developments in the Baltic cod fishery, where either the BACOMA cod-end or a T90 cod-end is used.

TR1 Twin-riggers fishing for plaice (120mm mesh size)

Twinriggers targeting plaice also catch other species like lemon sole and turbot. Cod bycatches are usually small, but can be substantial when the fishermen go fishing near the Danish coast. A sorting grid such as the Swedish one might be a solution, but with an open lower half, or the Sorting Box.

TR2 *Nephrops* trawlers

There are various good options for a *Nephrops* fishery with relatively low cod catches: the Flip-flap, Faithlie, Scotnet solutions, or the Swedish grid, Sorting Box or SELTRA-trawl. The final selection of the most promising adjustment depends on local circumstances and preferences in the fishing industry.

BT2 Beam trawlers (80 – 100mm mesh size)

Releasing cod in beam trawls remains a difficult problem. A partial release in V-nets can be accomplished with Large Mesh Top Panels. This technique developed in the mid-1990s could be taken up. With extra stimulation of cod, e.g. with a Faithlie or Scotnet sort of panel, the effects might increase. Promising are also the Inclined Separator Panel, that works well in chain-mat gears and possibly also on pulse trawls with more attachment possibilities in the forward part of the gear, and T90 extensions and cod-ends. The pulse trawl is also a technique reducing cod bycatches, but with some inflicted spinal damage on larger cod (that are retained by the net anyhow). Increasing the mesh size for sole in combination to increasing the MLS, although likely to meet strong resistance in the industry, is another theoretical way to reduce discards.

TR2 Fly-shooters (80 – 100mm mesh size)

Little is known about cod bycatches in this fishery, often in the British Channel, but there are no reports of cod landings in Belgium. They often catch non-quota species such as: red mullet, gurnards, horse mackerel, sea bass. The fish are retained during haul-back, and possibly subject to large towing speeds when heaving-in (not during the herding phase of the fishing operation). T90 or square mesh might be an option.

TBS shrimp fishing (16-32mm mesh size)

In all trials with gear adjustments in the shrimp fishery, cod catches were too low to draw conclusions on suitable gear adjustments for even further reducing the cod catch. The shrimp fishery may be one of those fisheries where so few cod are caught, that effort to reduce those amounts will not lead to substantial gain.

8 Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

9 References

Agricola, J.B., 1985. Experiments on electrical stimulation of flatfish in beamtrawling during 1984. ICES CM 1985/B:36, 21.

Armstrong, M.J., Briggs, R.P., Rihan, D., 1998. A study of optimum positioning of square-mesh escape panels in Irish Sea Nephrops trawls. Fisheries Research 34, 179-189.

Bahamon, N., Sardà, F., Suuronen, P., 2006. Improvement of trawl selectivity in the NW Mediterranean demersal fishery by using a 40 mm square mesh codend. Fisheries Research 81, 15-25.

Beutel, D., Skrobe, L., Castro, K., Ruhle Sr, P., Ruhle Jr, P., O'Grady, J., Knight, J., 2008. Bycatch reduction in the Northeast USA directed haddock bottom trawl fishery. Fisheries Research 94, 190-198.

Boonstra, G.P., de Groot, S.J., 1974. The development of an electrified shrimp-trawl in the Netherlands. J. Cons. int. Explor. Mer 35 (2), 165-170.

Briggs, R.P., 1983. Net selectivity studies in the Northern Ireland Nephrops fishery. Fisheries Research 2, 29-46.

Briggs, R.P., 1986. A general review of mesh selection for Nephrops norvegicus (L.). Fisheries Research 4, 59-73.

Briggs, R.P., 1992. An assessment of nets with a square mesh panel as a whiting conservation tool in the Irish Sea Nephrops fishery. Fisheries Research 13, 133-152.

Briggs, R.P., 2010. A novel escape panel for trawl nets used in the Irish Sea Nephrops fishery. Fisheries Research 105, 118-124.

Bullough, L.W., Napier, I.R., Laurenson, C.H., Riley, D., Fryer, R.J., Ferro, R.S.T., Kynoch, R.J., 2007. A year-long trial of a square mesh panel in a commercial demersal trawl. Fisheries Research 83, 105-112.

Campbell, R., Harcus, T., Weirman, D., Fryer, R.J., Kynoch, R.J., O'Neill, F.G., 2010. The reduction of cod discards by inserting 300 mm diamond mesh netting in the forward sections of a trawl gear. Fisheries Research 102, 221-226.

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.

Catchpole, T.L., Tidd, A.N., Kell, L.T., Revill, A.S., Dunlin, G., 2007. The potential for new Nephrops trawl designs to positively effect North Sea stocks of cod, haddock and whiting. Fisheries Research 86, 262-267.

de Groot, S.J., Boonstra, G.P., 1970. Preliminary notes on the development of an electrical tickler chain for sole (Solea solea L.). ICES C.M. 1970/B:4, 4.

Engås, A., Jørgensen, T., West, C.W., 1998. A species-selective trawl for demersal gadoid fisheries. ICES J. Mar. Sci. 55, 835-845.

Fonteyne, R., M'Rabet, R., 1992. Selectivity experiments on sole with diamond and square mesh codends in the Belgian coastal beam trawl fishery. Fisheries Research 13, 221-233.

Fonteyne, R., Polet, H., 2002. Reducing the benthos by-catch in flatfish beam trawling by means of technical modifications. Fisheries Research 55, 219-230.

Fonteyne, R., Polet, H., van Marlen, B., MacMullen, P., Swarbrick, J., 1997. Optimization of a species selective beam trawl (SOBETRA).

Frandsen, R.P., Holst, R., Madsen, N., 2009. Evaluation of three levels of selective devices relevant to management of the Danish Kattegat-Skagerrak Nephrops fishery. Fisheries Research 97, 243-252.

Graham, N., Kynoch, R.J., 2001. Square mesh panels in demersal trawls: some data on haddock selectivity in relation to mesh size and position. Fisheries Research 49, 207-218.

Graham, N., Kynoch, R.J., Fryer, R.J., 2003. Square mesh panels in demersal trawls: further data relating haddock and whiting selectivity to panel position. Fisheries Research 62, 361-375.

Graham, N., O'Neill, F.G., Fryer, R.J., Galbraith, R.D., Myklebust, A., 2004. Selectivity of a 120 mm diamond cod-end and the effect of inserting a rigid grid or a square mesh panel. Fisheries Research 67, 151-161.

Graham, N., Radcliffe, C.C.S., 1998. By-catch reduction in the brown shrimp, Crangon crangon, fishery using a rigid separation grid. Working paper presented at the ICES WGFTFB meeting, April 1998, La Coruña, Spain.

Halliday, R.G., Cooper, C.G., Fanning, P., Hickey, W.M., Gagnon, P., 1999. Size selection of Atlantic cod, haddock and pollock (saithe) by otter trawls with square and diamond mesh codends of 130-155 mm mesh size. Fisheries Research 41, 255-271.

He, P., 2007. Selectivity of large mesh trawl codends in the Gulf of Maine: I. Comparison of square and diamond mesh. Fisheries Research 83, 44-59.

Herrmann, B., Krag, L.A., Frandsen, R.P., Madsen, N., Lundgren, B., Stæhr, K.-J., 2009. Prediction of selectivity from morphological conditions: Methodology and a case study on cod (Gadus morhua). Fisheries Research 97, 59-71.

Herrmann, B., Priour, D., Krag, L.A., 2007. Simulation-based study of the combined effect on cod-end size selection of turning meshes by 90° and reducing the number of meshes in the circumference for round fish. Fisheries Research 84, 222-232.

Holst, R., Revill, A.S., 2009. A simple statistical method for catch comparison studies. Fisheries Research 95, 254-259.

ICES, 2010. Report of the Workshop to Assess the Ecosystem Effects of Electric Pulse Trawls (WKPULSE) - 24-26 February 2010, IJmuiden, the Netherlands.

ICES, 2011. Report of the Study Group on Electrical Trawling (SGELECTRA). ICES CM 2011/SSGESST:09. p. 93.

ICES, 2012. Report of the Study Group on Electrical Trawling (SGELECTRA). ICES CM 2012/SSGESST:06. 54.

Krag, L.A., Holst, R., Madsen, N., 2009. The vertical separation of fish in the aft end of a demersal trawl. ICES J. Mar. Sci. 66, 772-777.

Kurc, C., 1971. La pêche électrique en eau de mer - Pêche a l'électricité avec lumière artificielle et pompe. Reu. Trau. Inst. Pêches marit. 35 (1), 5-12.

Kynoch, R., Edridge, A., O'Neill, F.G., 2012. Catch Comparison Trials with the Faithlie Cod Avoidance Panel (FCAP). Scottish marine and freshwater science. Volume 3, Number 8. ISBN: 978-1-78256-107-1. p. 21.

Kynoch, R.J., O'Neill, F.G., Fryer, R.J., 2011a. Test of 300 and 600 mm netting in the forward sections of a Scottish whitefish trawl. Fisheries Research 108, 277-282.

Kynoch, R.J., O'Neill, F.G., Summerbell, K., 2011b. 300, 600 and 800 mm Diamond Mesh Belly Panels in Whitefish Demersal Trawl Fisheries. Scottish marine and freshwater science. Volume 2, number 6. ISBN: 978-1-78045-205-0. p. 17.

Lamarque, P., 1976. Un appareil de pêche à l'électricité pour les eaux de forte conductivité (eaux saumatres et marines). Rev. Trav. Inst. Pêches marit. 40 (3 & 4), 646-647.

Madsen, N., Frandsen, R.P., Holst, R., Krag, L.A., 2010. Development of new concepts for escape windows to minimise cod catches in Norway lobster fisheries. Fisheries Research 103, 25-29.

Madsen, N., Hansen, K.E., 2001. Danish experiments with a grid system tested in the North Sea shrimp fishery. Fisheries Research 52, 203-216.

Madsen, N., Holst, R., 2002. Assessment of the cover effect in trawl codend selectivity experiments. Fisheries Research 56, 289-301.

Madsen, N., Moth-Poulsen, T., Holst, R., Wileman, D., 1999. Selectivity experiments with escape windows in the North Sea Nephrops (Nephrops norvegicus) trawl fishery. Fisheries Research 42, 167-181.

Madsen, N., Valentinsson, D., 2010. Use of selective devices in trawls to support recovery of the Kattegat cod stock: a review of experiments and experience. ICES Journal of Marine Science 67, 2042-2050.

Main, J., Sangster, G.I., 1982. A Study of a Multi-Level Bottom Trawl for Species Separation Using Direct Observation Techniques. p. 17.

Main, J., Sangster, G.I., 1985. Trawling experiments with a two-level net to minimise the undersized gaboid by-catch in a Nephrops fishery. Fisheries Research 3, 131-145.

O'Neill, F.G., Kynoch, R.J., Fryer, R.J., 2006. Square mesh panels in North Sea demersal trawls: Separate estimates of panel and cod-end selectivity. Fisheries Research 78, 333-341.

Polet, H., 2002. Selectivity experiments with sorting grids in the North Sea brown shrimp (Crangon crangon) fishery. Fisheries Research 54, 217-233.
Polet, H., Coenjaerts, J., Verschoore, R., 2004. Evaluation of the sieve net as a selectivity-improving device in the Belgian brown shrimp (Crangon crangon) fishery. Fisheries Research 69, 35-48.
Polet, H., Delanghe, F., Verschoore, R., 2005a. On electrical fishing for brown shrimp (Crangon crangon): I. Laboratory experiments. Fisheries Research 72, 1-12.
Polet, H., Delanghe, F., Verschoore, R., 2005b. On electrical fishing for brown shrimp (Crangon crangon): II. Sea trials. Fisheries Research 72, 13-27.
Revill, A., Holst, R., 2004a. The selective properties of some sieve nets. Fisheries Research 66, 171-183.
Revill, A.S., Catchpole, T.L., Dunlin, G., 2007. Recent work to improve the efficacy of square-mesh panels used in a North Sea Nephrops norvegicus directed fishery. Fisheries Research 85, 321-327.
Revill, A.S., Holst, R., 2004b. Reducing discards of North Sea brown shrimp (C. crangon) by trawl modification. Fisheries Research 68, 113-122.
Revill, A.S., Pascoe, S., Radcliffe, C., Riemann, S., Redant, F., Polet, H., Damm, U., Neudecker, T., Kristensen, P.S., Jensen, D., 1999. The economic and biological consequences of discarding in Crangon fisheries - The ECODISC Project. Study report to the European Commission No 97/SE/025. p. 118.
Robertson, J.H.B., 1986. Design and Construction of Square Mesh Cod-ends. p. 10.
Robertson, J.H.B., 1993. Design and Fitting of Square Mesh Windows in Whitefish and Prawn Trawls and Seine Nets. p. 7.
Robertson, J.H.B., Stewart, P.A.M., 1986. An analysis of length selection data from comparative fishing experiments on haddock and whiting with square and diamond mesh codends. p. 31.
Robertson, J.H.B., Stewart, P.A.M., 1988. A comparison of size selection of haddock and whiting by square and diamond mesh codends. ICES J. Mar. Sci. 44, 148-161.
Sala, A., Lucchetti, A., Piccinetti, C., Ferretti, M., 2008. Size selection by diamond- and square-mesh codends in multi-species Mediterranean demersal trawl fisheries. Fisheries Research 93, 8-21.
STECF (Ed.), 2012. 41st Plenary meeting report of the Scientific, Technical and Economic Committee for Fisheries (STECF PLEN-12-03). (eds. Casey, J. & Doerner, H.). Publications Office of the European Union, Luxembourg, JRC 76701 - EUR 25579 EN.
Steenbergen, J., Machiels, M.A.M., Leijzer, T.B., 2011. Reducing discards in Shrimp fisheries with the Letterbox. IMARES Report C023/11. p. 37.
Stewart, P.A.M., 1975. Catch selectivity by electrical fishing systems. J. Cons. int. Explor. Mer 36 (2), 106-109.
Stewart, P.A.M., 1977. A study of the response of flatfish (Pleuronectidae) to electrical stimulation. J. Cons. int. Explor. Mer 37 (2), 123-129.
Stewart, P.A.M., 1978. Comparative Fishing for Flatfish using a Beam Trawl fitted with Electric Ticklers. Scottish Fisheries Research Report, No 11, ISSN 0308-8022.
van Marlen, B., 2003. Improving the selectivity of beam trawls in The Netherlands: The effect of large mesh top panels on the catch rates of sole, plaice, cod and whiting. Fisheries Research 63, 155-168.
van Marlen, B., Boon, A.R., Oschatz, L.G., van Duijn, J.B., Fonds, M., 2000. Experiments in 1999 on a 7 m beam trawl with electrical stimulation. p. 49.
van Marlen, B., Burggraaf, D., de Haan, D., de Wilde, J.W., Revill, A.S., Catchpole, T., Reese, A., Tidd, A., Rodgers, P., Ferro, R.S.T., Kynoch, R., Northridge, S., Murphy, S., Mackay, A., O'Shea, T., Larsen, F., Bova, D., Dunlin, G., Larnaud, P., Morizur, Y., Priour, D., Vincent, B., Ridoux, V., Spitz, J., Viricel, A., D'Hardivillé, C., Meillat, M., Morandeau, F., Talidec, C., Tachoires, S., Biseau, A., Macher, C., Scalabrin, C., Le Gall, Y., Souami, Y., Dabin, W., van Canneyt, O., Chevaillier, P., Suuronen, P., Tschernij, V., Madsen, N., Krag, L.A., Munch-Petersen, S., Frandsen, R.P., Holst, R., Frost, H., Metz, S., Boom, J.T., Buisman, E., Innes, J., Taal, K., Rodgers, P., Graham, N., Valentinsson, D., Ulmestrand, M., Rihan, D., Cosgrove, R., McDonald, D., Jackson, E., Rogan, E., Nolan, C., Philpott, E., Polet, H., Vanderperren, E., Fonseca, P., Campos, A., Parente, J., Puente, E., Moreno, G., Boyra, G., Arregi, L., Sarda, F., Bahamon, N., Sala, A., Morello, E.B., Lucchetti, A., Froglia, C., Petrakis, G., Smith, C.,

Papadopoulou, N., Tokac, A., Özbilgin, H., Dahm, K.E., Wienbeck, H., 2007. NEphrops and CEtacean Species Selection Information and TechnologY (NECESSITY). In: van Marlen, B.s (Ed.), p. 62.
van Marlen, B., de Haan, D., Revill, A.S., Dahm, K.E., Wienbeck, H., Purps, M., Coenjaerts, J., Polet, H., 2001a. By-catch reduction devices in the European Crangon fisheries. ICES CM 2001/R:10.
van Marlen, B., de Haan, D., Revill, A.S., Dahm, K.E., Wienbeck, H., Purps, M., Coenjaerts, J., Polet, H., 2001b. Reduction of discards in crangon trawls (DISCRAN): final report for the period 01-03-1999 / 28-02-2001.
van Marlen, B., de Haan, D., Wardle, C.S., Glass, C.W., Huse, I., Engås, A., Horton, R., Lart, W.J., Gabriel, O., Lange, K., Lehtonen, E., Kiviniemi, M., 1997a. Revised Final Report EU Concerted Action ALTSTIM - Alternative Stimulation in Fisheries. p. 163.
van Marlen, B., Redant, F., Polet, H., Radcliffe, C., Revill, A.S., Kristensen, P.S., Hansen, K.E., Kuhlmann, H.J., Riemann, S., Neudecker, T., Brabant, J.C., 1997b. Research into Crangon Fisheries Unerring Effect (RESCUE) - EU study 94/044.
van Marlen, B., van Duijn, J.B., 2005. Experiments with a large mesh top panel in a chain mat beam trawl.
van Marlen, B., van Helmond, A.T.M., Buyvoets, E., 2009. Reduction of discards by technical modifications of beam trawls. p. 69.
van Marlen, B., van Lavieren, H., Piet, G.J., van Duijn, J.B., 1999. Catch comparison of a prototype 7 m electrical beam trawl and a conventional tickler chain beam trawl. p. 42.
Vanden Broucke, G., 1973. Further investigations on electrical fishing. ICES C.M. 1973/B:14.
Verschueren, B., Vanelslander, B., Polet, H., 2012. Verduurzaming van de Garnalenvisserij met de Garnalenpuls: eindrapport. ILVO MEDEDELING nr 116, oktober 2012, ISSN 1784-3197., p. 102.
Walsh, S.J., Cooper, C.G., Hickey, W.M., 1989. Size selection of plaice by square and diamond mesh cod-ends.
Walsh, S.J., Millar, R.B., Cooper, C.G., Hickey, W.M., 1992. Codend selection in American plaice: diamond versus square mesh. Fisheries Research 13, 235-254.
Wienbeck, H., 1995. Sorting grids - an alternative to sieve- or veilnets in the brown shrimp fishery. Infn Fischw. 42 (1), 36-42.
Wienbeck, H., 1998a. Analysis of the by-catch reduction by means of sievenets in the commercial brown shrimp fishery. Infn Fischw. 45 (1), 18-22.
Wienbeck, H., 1998b. First trials on the selection of a sorting grid in commercial fishery for brown shrimps. Anim.-Res.-Dev. 47, 71-78.
Wienbeck, H., 1999. Analysis of the bycatch reduction by means of sorting grids in the commercial brown shrimp fishery. Infn Fischw. 46 (1), 33-35.
Wienbeck, H., Herrmann, B., Moderhak, W., Stepputtis, D., 2011. Effect of netting direction and number of meshes around on size selection in the codend for Baltic cod (Gadus morhua). Fisheries Research 109, 80-88.

Justification

Rapport C147/12
Project Number: 4308101044

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Henk Heessen
Senior scientist

Signature:

Date: 16 January

Approved: Dr. ir. T.P. Bult
Head of department Fisheries

Signature:

Date: 16 January

10 Appendix A. Summary of measures in place in the Netherlands for reduction of cod catches. A letter from IMARES to the ministry of Economic Affairs

IMARES WAGENINGEN UR

For quality of life

Postbus 68 | 1970 AB IJmuiden

Ministerie EL&I
T.a.v. Ir.M.C. Kersbergen en Ir. H.R. Offringa
Organisatie AKV
Postbus 20401
2500 EK Den Haag

Visserij

DATUM
12 oktober 2012

ONDERWERP
Helpdeskvraag overzicht maatregelen om kabeljauw te sparen

ONS KENMERK
12.IMA0714-FQ-mnb

POSTADRES
Postbus 68
1970 AB IJmuiden

BEZOEKADRES
Haringkade 1
1976 CP IJmuiden

INTERNET
www.wageningenUR.nl/imares

KvK NUMMER
09098104

CONTACTPERSOON
Ir. F.J. Quirijns

TELEFOON
+31 (0)317 487190

E-MAIL
floor.quirijns@wur.nl

Beste Mevrouw Kersbergen en heer Offringa,

In een helpdeskvraag vroeg u ons om een overzicht van maatregelen om kabeljauw te sparen. Hierbij was u geïnteresseerd in maatregelen die in Nederland in gebruik zijn en in maatregelen die in Schotland, Engeland en Denemarken in gebruik zijn. U wilde van ons horen welke aanvullende maatregelen nog mogelijk zijn in Nederland en wat voor effecten deze maatregelen zouden kunnen hebben. In deze brief gaan wij in op uw vraag.

Overzicht huidige maatregelen in Nederland

Kabeljauw wordt met vrijwel alle in de Noordzee toegepaste vistuigen gevangen. Het percentage kabeljauw in de vangst kan aanzienlijk variëren. Nederlandse schepen die gericht op kabeljauw vissen zijn er bijna niet (meer). Meer informatie hierover is te vinden in Helmond et al (2011) en Kraan (2012).

Tabel 1 geeft een overzicht van de bestaande monitoringsprogramma's en maatregelen per tuigcategorie in Nederland. We houden hier de tuigcategorieën aan die ook in de communicatie op Europees niveau worden gebruikt. Het is belangrijk te realiseren dat elke tuigcategorie meerdere tuigen kan omvatten. Vooral de TR-categorie is een gevarieerde categorie. Binnen die groep zitten vissersschepen die gericht op kabeljauw vissen, maar ook schepen die nauwelijks of geen kabeljauw vangen. Soms wordt er ten onrechte vanuit gegaan dat alle schepen in de categorie TR1.2[1] (met maaswijdtes van 119 mm of meer) – met name de bordenvisserij – gericht vissen op kabeljauw. Dit hoeft niet zo te zijn: sommige van deze schepen vissen gericht op schol. Niet alleen het type tuig in combinatie met maaswijdte bepaalt de doelsoort, ook de plek en het tijdstip van vissen.

Europa en Noorwegen zijn een kabeljauwherstelplan overeengekomen (Council Regulation (EC) 1342/2008). Daarnaast is voor de TR tuigen een nationaal kabeljauwvermijdingsplan ("*cod avoidance plan*") van kracht. Het doel van dat laatste plan is de kabeljauwvangsten te verlagen. Dat zou moeten gebeuren door nationale maatregelen zoals:

- Real Time Closures (RTCs),
- seizoenssluitingen,
- tuigaanpassingen,
- "*move on*" maatregelen,
- deelname aan *fully documented fishery* (FDF) en
- zelf-bemonstering van kabeljauwvangsten ("kabeljauwmonitoring").

[1] Zie tabel 1 voor toelichting codes

Wageningen UR (Wageningen University, Van Hall Larenstein University of Applied Sciences and various research institutes) is specialised in the domain of healthy food and living environment.

IMARES, part of Wageningen UR, is a leading, independent research institute that concentrates on research into strategic and applied marine ecology.

Tabel 1. Monitoringprogramma's en maatregelen per tuigcategorie met het oog op kabeljauw. TR: bodemtrawls en zegens. Maaswijdtes: TR1.1, 100-119mm; TR1.2 ≥ 119 mm; TR2, 70-99 mm en TR3, 16-32 mm. BT1, boomkor ≥ 120mm; BT2, 80-120mm. LL1: longline, in Nederland komt dat neer op beroepsmatige visserij met hengels. (Deels gebaseerd op STECF 2011)

Categorie	Monitoring programmas	Technische maatregelen	Overige maatregelen
TR2	- DCF	Nephrops: - maaswijdte van min. 70mm en max. 100mm. In de bovenkap heeft het net minimaal 15 grote mazen (≥140mm). Het net is voorzien van een paneel met vierkante mazen (90mm maaswijdte).	- Maximaal 20% kabeljauw in de vangst - RTCs – 9 sluitingen van 64 nm² per maand. Sluiting gebaseerd op LPUE (hoogste aanlandingen van kabeljauw in 1/16 ICES kwadrant). Sluitingsduur: 1 maand. - Seinzoenssluiting o.b.v. wetenschappelijke eisurvey, in samenwerking met Verenigd Koninkrijk - "Move on": bij meer dan 5% kabeljauw in de vangst in twee opeenvolgende trekken, moet de visser minimaal 5 nm verderop gaan vissen.
TR1.1	- DCF - Kabeljauwmonitoring	- kuil met 130 mm maaswijdte of ruimer; of - kuil met 120-129 mm maaswijdte eb vierkante mazen van 90 mm; of - panelen met vierkante mazen van minimaal 100 mm maaswijdte.	- Maximaal 20% kabeljauw in de vangst - RTCs – 9 sluitingen van 64 nm² per maand. Sluiting gebaseerd op LPUE (hoogste aanlandingen van kabeljauw in 1/16 ICES kwadrant). Sluitingsduur: 1 maand. - Seinzoenssluiting o.b.v. wetenschappelijke eisurvey, in samenwerking met Verenigd Koninkrijk. - "Move on": bij meer dan 5% kabeljauw in de vangst in twee opeenvolgende trekken, moet de visser minimaal 5 nm verderop gaan vissen.
TR1.2	- DCF - Kabeljauwmonitoring - FDF ('vrijwillig') + aanlanden alle kabeljauw (incl. ondermaats)	- kuil met 130 mm maaswijdte of ruimer; of - kuil met 120-129 mm maaswijdte eb vierkante mazen van 90 mm; of - panelen met vierkante mazen van minimaal 100 mm maaswijdte.	- Maximaal 20% kabeljauw in de vangst - RTCs – 9 sluitingen van 64 nm² per maand. Sluiting gebaseerd op LPUE (hoogste aanlandingen van kabeljauw in 1/16 ICES kwadrant). Sluitingsduur: 1 maand. - Seinzoenssluiting o.b.v. wetenschappelijke eisurvey, in samenwerking met Verenigd Koninkrijk
BT1/BT2	DCF	-	Maximaal 20% kabeljauw in de vangst
LL1	-	-	Maximaal 20% kabeljauw in de vangst

Maatregelen in andere landen

In de EU-landen met de grootste aanvoer van Noordzee kabeljauw - Engeland, Schotland en Denemarken - zijn de afgelopen jaren ook verschillende maatregelen genomen met als doel de (bij)vangst van kabeljauw beter te documenteren en waar mogelijk te reduceren. Hieronder wordt daarvan, zeer in het kort, een overzicht gegeven.

DATUM
12 oktober 2012

ONS KENMERK
12.IMA0714-FQ-mnb

PAGINA
3 van 4

Real Time Closures (RTC)

ICES-kwadranten of delen daarvan, met een hoge concentratie jonge kabeljauw (op basis van gegevens van bestandsopnamen met onderzoeksvaartuigen, of meldingen van vissersschepen), of concentraties van paaiende kabeljauw, worden voor bepaalde tijd gesloten voor de visserij.

Hiermee is ervaring opgedaan in Engeland en Schotland (bijv. 185 RTC's in 2011). In Schotland sluit men gebieden op basis van informatie over aanlandingen per eenheid van inspanning (LPUE), VMS gegevens, dagelijkse logboekregistraties en inspecties aan boord.

Onderzoek naar technische maatregelen om de (bij)vangst van kabeljauw te reduceren.

In Engeland heeft CEFAS onderzoek gedaan aan netten waarmee op *Nephrops* wordt gevist (een relevante optie voor NL), en tests gedaan met toepassing van panelen met vierkante mazen van 160 mm.

In Schotland is geëxperimenteerd met een maaswijdte van 130 mm, de Orkney trawl, panelen met vierkante mazen van 200 mm, en 600 mm mazen in de onderkant van het net.

Fully Documented Fisheries (FDF)

Aan boord van een aantal schepen, doorgaans warnetschepen die gericht op kabeljauw vissen, wordt door middel van video-opnamen de hele vangst gedocumenteerd. Op deze manier is na te gaan welk deel van de vangst gediscard wordt, evenals de eventuele bijvangst van zeezoogdieren. Met name in Denemarken wordt deze methode toegepast, maar ook in Engeland en in Schotland.

Conservation credit scheme

In Schotland in werking sinds 2008. Schotse vissers krijgen extra zeedagen als ze bepaalde maatregelen (RTC, "Amber Avoidance Areas", technische maatregelen, verbod op highgraden) in acht nemen. Het doel hiervan was het verminderen van visserijsterfte bij kabeljauw. In het rapport van de ICES Noordzee en Skagerrak werkgroep (WGNSSK) staat dat sinds het begin van het programma het discardspercentage van kabeljauw is afgenomen van 62% (2008) naar 24% (2011). Implementatie van maatregelen met een daarbij behorende "beloning" lijkt erg aantrekkelijk.

Verdere details over de systemen gebruikt in Schotland en inmiddels ook in Engeland zijn te vinden via:

- http://www.scotland.gov.uk/Resource/0040/00402349.doc
- http://www.marinemanagement.org.uk/fisheries/management/days_cod.htm

Mogelijkheden voor extra maatregelen Nederland en de effecten

De maatregelen die in Nederland en andere landen rond de Noordzee zijn getroffen voor het verminderen van kabeljauwvangst, zijn enerzijds technische maatregelen en anderzijds overige beheermaatregelen. De maatregelen die in andere landen worden toegepast, zoals hierboven beschreven, zijn grotendeels ook in Nederland al in gebruik. Dat neemt niet weg dat er geen nieuwe maatregelen meer mogelijk zijn. Welke maatregel ook in het leven geroepen wordt, het is van belang dat er goede, onafhankelijke monitoring plaatsvindt. Ook verdient het aanbeveling om maatregelen in goed overleg met de visserijsector te nemen. Als de sector achter de maatregelen staat, zal het de naleving ten goede komen. Bovendien kan de sector goed inschatten welke maatregelen uitvoerbaar en zinvol zijn.

Het belonen van individuele vissers voor goed gedrag, zoals dat gedaan wordt in het Schotse Conservation Credit Scheme, is wellicht een goede aanvulling voor Nederland. Door individuele vissers te belonen voor goed gedrag, worden vissers meer gestimuleerd om minder kabeljauw te vangen. Bij een individuele benadering zijn er twee zaken van belang:

1. Vissers moeten niet hun vangst kunnen en/of willen manipuleren om bepaalde targets te halen zodat ze extra quotum of zeedagen krijgen. *Bijvoorbeeld: als ze bij maximaal 1.5% kabeljauw bijvangst extra dagen krijgen, kan het aantrekkelijk zijn om kabeljauw overboord te gooien zodat ze dat streefpercentage halen.*
2. Bij de maatregelen/beloning moeten niet alleen de vissers betrokken zijn die zonder of met weinig moeite al de targets halen, maar juist ook de vissers die substantiële hoeveelheden kabeljauw (bij)vangen.

Het invoeren van technische maatregelen zoals tuigaanpassingen heeft alleen zin als zulke maatregelen ook echt effectief zijn. IMARES inventariseerde in 2011 de mogelijkheden voor technische netaanpassingen in de Noorse kreeftenvisserij voor het verminderen van kabeljauwbijvangst (Nijman et al, 2011). Daaruit bleek dat technische aanpassingen voor het verminderen van kabeljauwvangst moeilijk haalbaar zijn. Kabeljauw heeft de neiging om bij "gevaar" naar beneden te duiken en komt daardoor onderin het net terecht, net als de meeste doelsoorten. Daarom werken ontsnappingspanelen vaak slecht of geheel niet.

Referenties

Council Regulation (EC) 1342/2008. Establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No 423/2004. 18 December 2008.

Kraan, M., 2012. Preliminary results (2) cod self-sampling program. Memo aan het ministerie van EL&I, 28 september 2012

Nijman, R., Rasenberg, M. en Quirijns, F.J., 2011. Kabeljauwvangst in de Noorse Kreeftvisserij. IMARES Rapport C192/11, 36 pp.

STECF, 2011. 38th Plenary meeting report of the scientific, technical and economic committee for fisheries (PLEN-11-03). *Corrigendum relating to Section 8.4: NL cod avoidance plan.*

Helmond, A.T.M., van. Uhlmann, S.S., Overzee, H.M.J., van, Bierman, S.M., Bol, R.A., Nijman, R.R., 2011. Discards Sampling of the Dutch bottom-trawl fisheries in 2009 and 2010. IJmuiden, CVO report: 11.008.

Met vriendelijke groet,

Ir. F.J. Quirijns
Alsmede Dr. H.J.L Heessen en Ir. J. Steenbergen
Onderzoeker