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Selectivity in Trawl Fishing Gears

Scottish Marine and Freshwater Science Vol 8 No 01

F.G. O'Neill and K. Mutch

marinescotland

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CONTENTS

INTRODUCTION

In this manual we describe the different stages of the fish capture process, highlight how different parts of the gear may influence selection and identify possible design changes which can alter the selectivity of the gear. The intention is to make fishermen, net makers and fisheries managers more aware of the possible modifications that can be made to their gears so that they can design and develop gears with a selective performance suitable for their particular fishery.

We have also assembled a catalogue of fact sheets which provide brief descriptions of many of the catch comparison and selectivity trials that have taken place in the North Atlantic and adjacent seas. This is again to highlight the potential gear modifications that can be made and to provide an indication of their likely effect. It is important to bring together this type of information and to disseminate it as broadly as possible. Not only will the preferred selective performance differ at a fishery by fishery level, it may also vary at a vessel by vessel level, as individual fishermen may wish to tailor their gears to the specific catch and quota restrictions they may face and/or to optimise their response to the prevailing market forces.

The catalogue of factsheets is by no means exhaustive, indeed, it is just a starting point, and it is anticipated that the web version will be added to and built upon.

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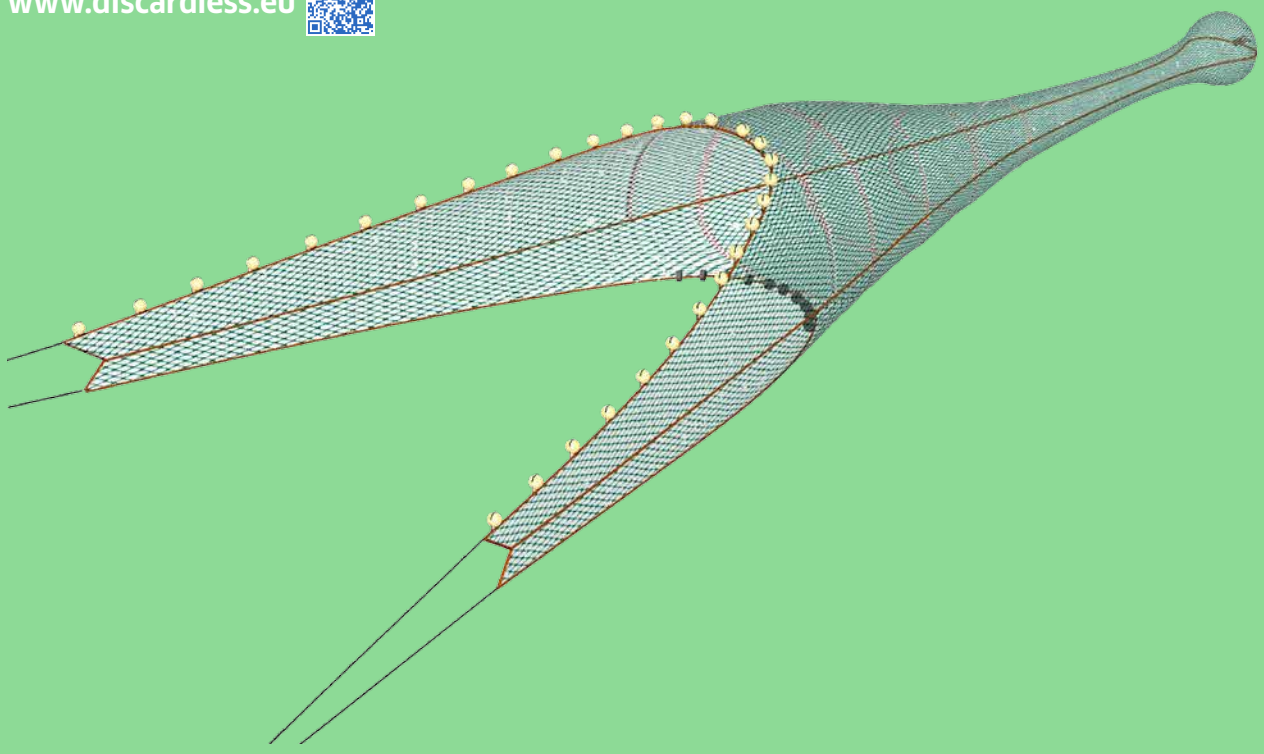
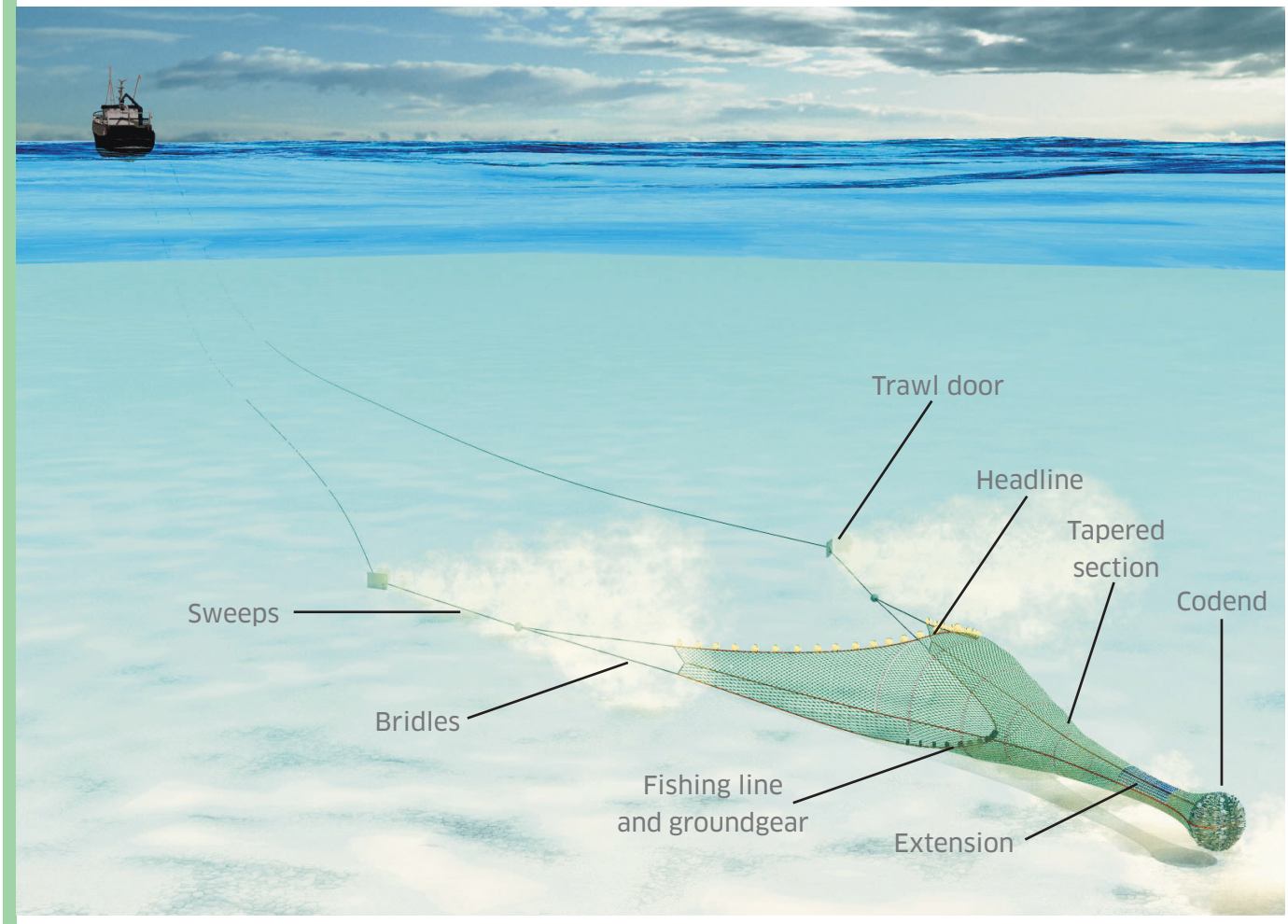


TRAWL SELECTIVITY

The selection process of towed demersal fishing gears begins once fish become aware of the on-coming vessel. They are then likely to hear the approaching vessel and the gear as it makes its way over the seabed. As it gets closer, the sight of the gear, the visual contrast it makes with its surroundings and possibly the pressure field associated with the gear will become apparent. The resulting selectivity of the gear will depend on how fish react to these stimuli: whether they are directed into the path of the on-coming gear; whether they avoid entering the gear; or, if they enter it, can escape from the gear.



AHEAD OF THE TRAWL NET

TRAWL DOORS

The first part of a trawl gear that a demersal fish is likely to encounter is the trawl door. They will at first hear it approach and then depending on light levels, turbidity and the visual acuity of the fish, see it. In the wake of the door there will also be a sediment cloud which again may be visible to the fish and present a region of turbulence where swimming and respiration may be impaired. Some fish will react to these stimuli by being directed either outside the doors away from the trawl or between the doors where they may be further herded by the sand cloud into the path of the trawl.

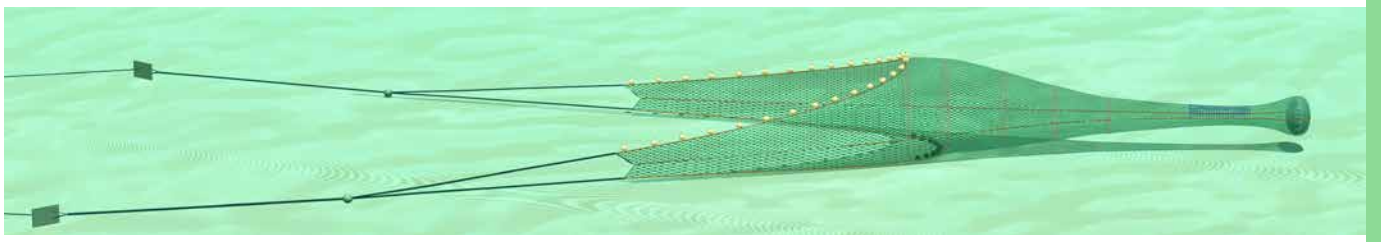


Figure 1. A typical single trawl fishing gear.

One way of reducing this type of directing and herding of fish is to use semi-pelagic doors that do not come into contact with the seabed or to use gears that reduce the amount of sediment put into the water column behind the trawl doors.

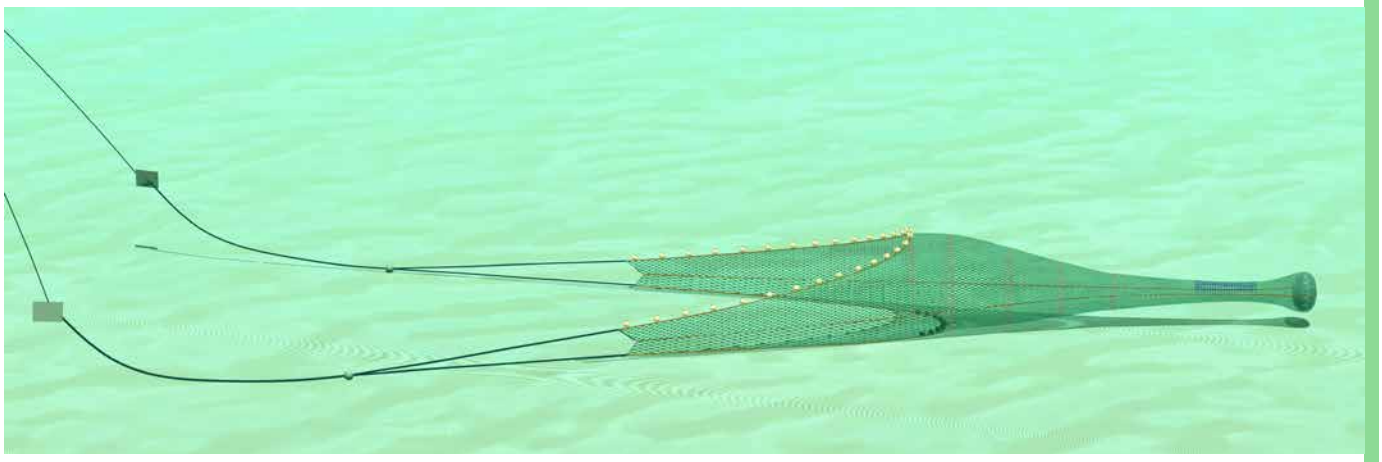


Figure 2. A single trawl with semi-pelagic doors

Semi-pelagic doors have been tested in many fisheries and are usually used with weights or chain that come into contact with the seabed further back along the sweeps. Hence, not only is the sand cloud likely to be reduced, the area swept by the gear is also likely to be smaller which will reduce the area over which the gear fishes.

Door designs that reduce the strength of the wake coming into contact with the seabed will reduce the amount of sediment put into the water column as it is the turbulence in the wake which entrains the sediment and creates the sand cloud. This can be achieved by using high aspect doors or doors which are raised mechanically from the seabed with skids

SWEEPS

The next part of the gear that fish encounter will be the sweeps. The sweeps will also herd fish into the mouth of the trawl. This is particularly the case for flatfish and it is has been shown that the proportion of fish in the path of the sweeps that are herded into the trawl path is dependent on the sweep angle, the sweep length and the contact the sweep makes with the seabed.

If the sweep angle is large, it is more difficult for fish to move out of the way of the advancing sweeps. The sweeps are more likely to overtake the fish and as a result fewer fish are directed inwards towards the gear. The sweep angle can be increased by increasing the spreading force of the doors which can be achieved by modifying the rigging of the backstrops at the back of the doors or by increasing the size of the doors.

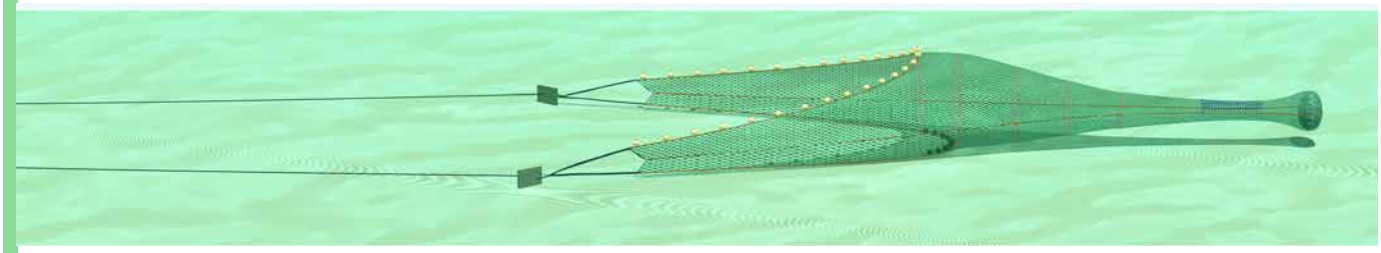


Figure 3. A single trawl with shortened sweeps and bridles.

A relatively simple way of reducing the number of fish that make their way into the trawl path is to shorten the sweep/bridle length. The first otter trawls that were developed had their otter boards attached directly to the wings of the trawl. Sweep bridles were introduced to increase the area swept and to improve catching performance. By reversing this process and shortening the sweeps, fewer herded fish will be directed into the path of the trawl and end up in the catch.

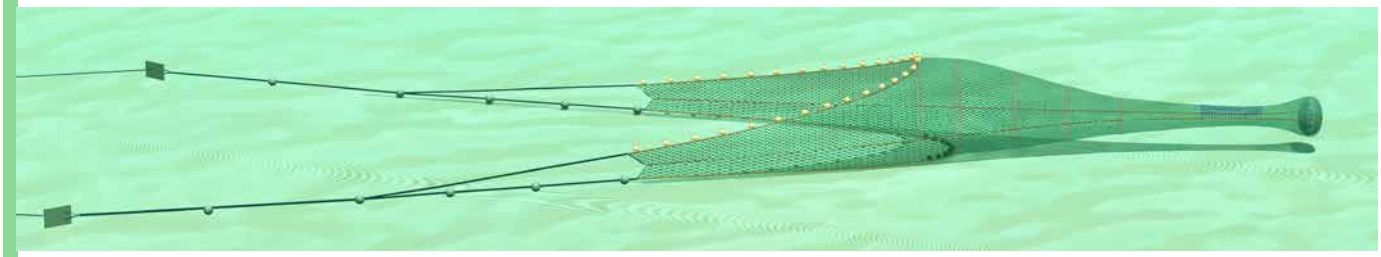


Figure 4. A single trawl with sweeps and bridles raised using bobbins.

Reducing the contact sweeps make with the seabed has also been shown to select fish. This can be done, by adjusting the rigging of the sweeps and, as mentioned above by, using semi-pelagic doors. They can be raised mechanically from the seabed by fitting bobbins at intervals along them; and by using sweeps made from floating or negatively buoyant materials they can be kept above the seabed along their length.

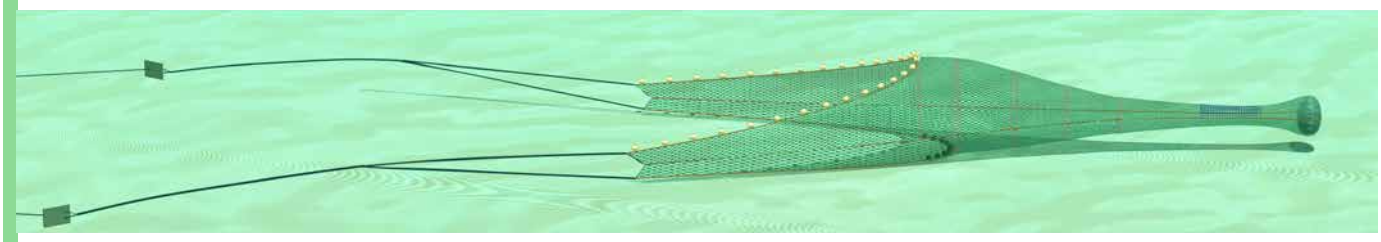


Figure 5. A single trawl with negatively buoyant sweeps and bridles.

MOUTH OF THE TRAWL NET

Once in the path of the trawl fish will either go under the fishing line, into the gear or above the headline as the trawl overtakes them.

UNDER THE FISHING LINE

Some species tend to remain on or close to the seabed and the extent to which these fish go under the fishing line will depend on the height of the fishing line above the seabed and the type, size and design of the groundgear.

One way of setting the height of the fishing line is to use 'dropper' chains. For dropper chains to work successfully the gear must be rigged so that the fishing line fishes above the seabed. The distance between the fishing line and the seabed can then be reduced by attaching dropper chains and can be adjusted by varying their number and density (weight per metre).

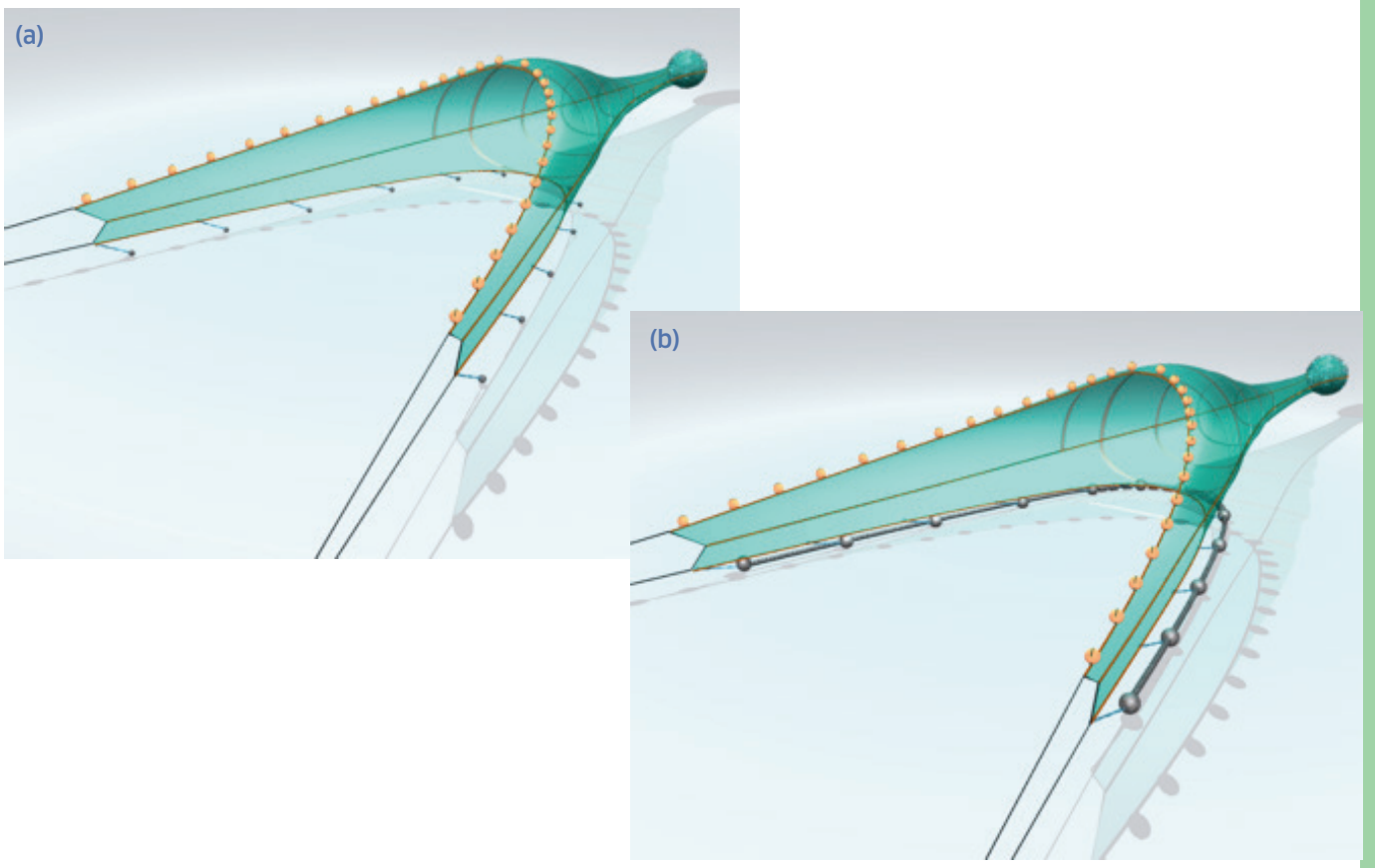


Figure 6. Single trawls with (a) dropper chains along the fishing line and (b) a bobbin ground gear.

Most trawl gears, have a ground gear attached to the fishing line, which both protects the trawl netting from the seabed and ensures that the gear maintains contact with the seabed. Increasing the length of the attachment chains/ropes between the groundgear and the fishing line will increase the height at which the fishing line fishes and increase the possibility of fish passing between the groundgear and the fishing line.

A wide range of ground gears are used, from something as simple as a chain wrapped around the fishing line to large rubber rock hoppers or bobbins. While the specific design will depend to a large degree on the species targeted and the seabed fished, there may still be scope for modifications to provide additional opportunities for fish to pass under the groundgear or between the groundgear and the fishing line. These include changes such as increasing the spacing between disks/bobbins; using fewer of them; and using larger diameter disks/bobbins.

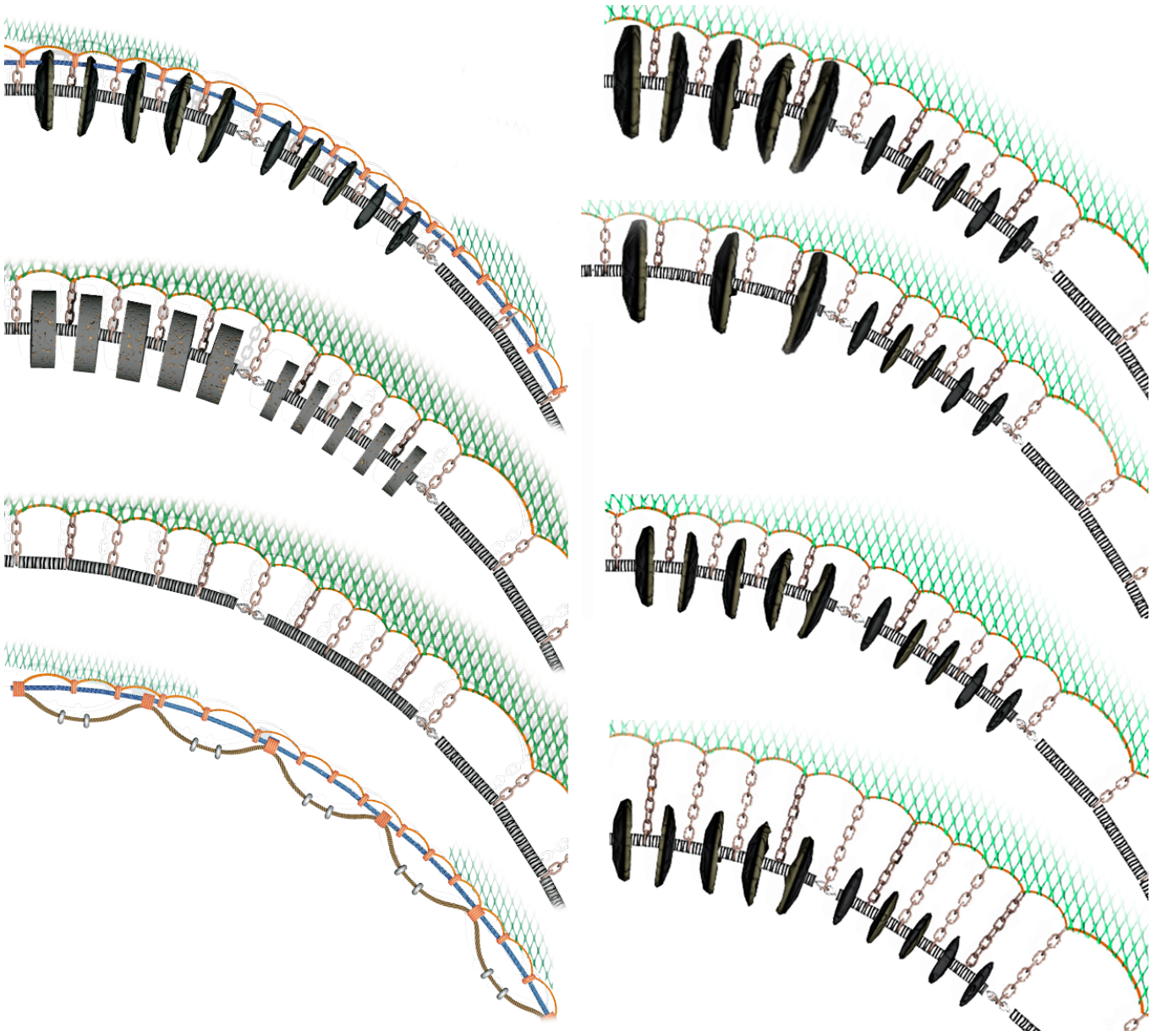


Figure 7.
The first panel illustrates rockhoppers, wheel bobbins, rubber discs and a lead weighted fibre rope. The second panel shows how selection under the fishing line may be modified by increasing the length of the attachment chains, using larger rockhoppers (or bobbins), or using fewer rockhoppers (or bobbins)

ABOVE THE HEADLINE

Some species of fish will maintain their height above the seabed or turn and rise as the trawl overtakes them. Low headline gears, coverless gears and gears with cut-away headlines have been designed to reduce the capture of species that exhibit this type of behaviour. The fish species and the proportion of it caught will depend on the headline height and/or the distance it is behind the fishing line.

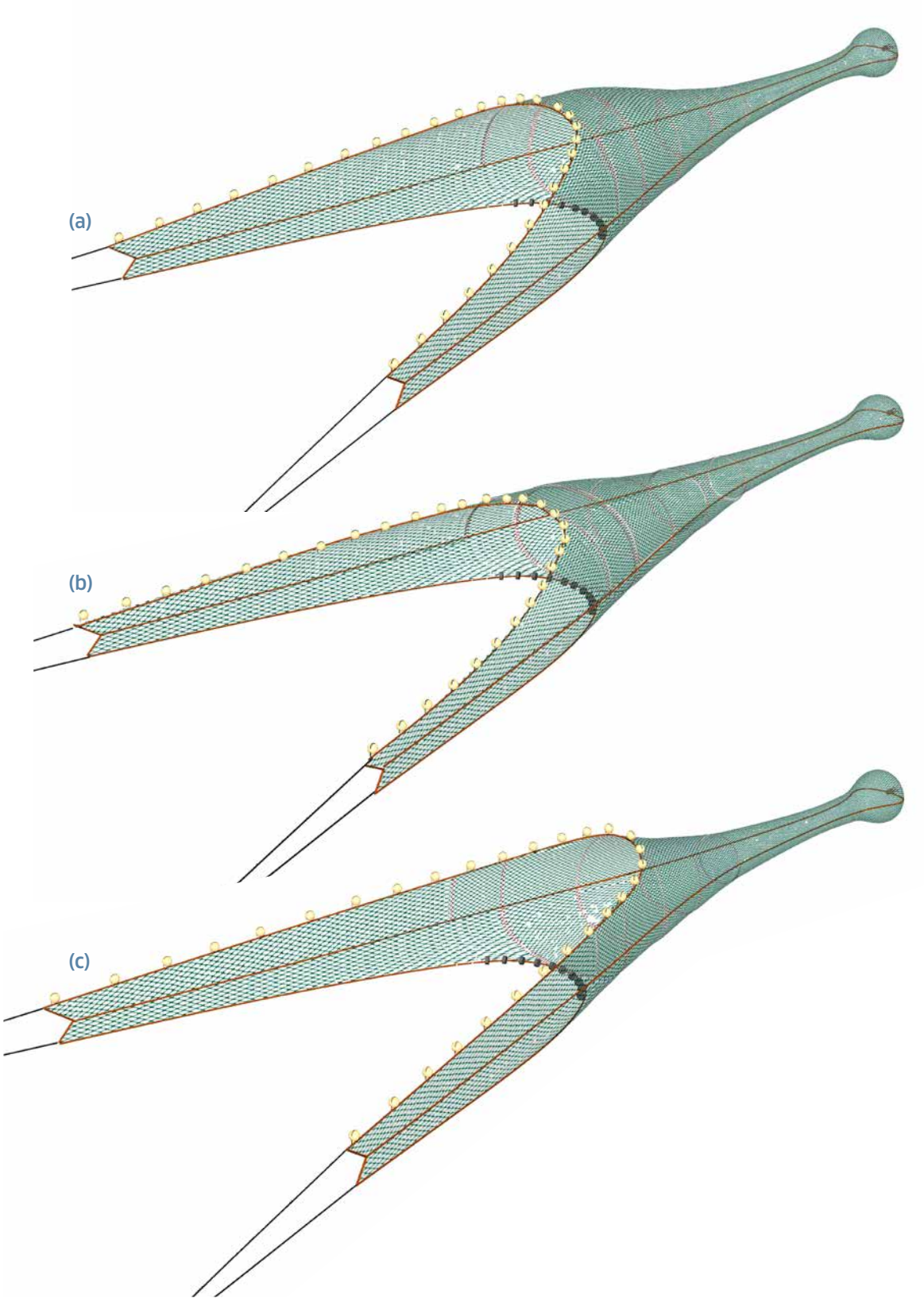


Figure 8. (a) a typical single trawl, (b) a low headline trawl and (c) a cut-away or coverless trawl.

IN THE TRAWL GEAR

The fish that don't escape under the fishing line or over the headline will enter the trawl gear. How and where they enter will vary by species (and within species by size). Some will enter across the full width of the trawl while others are more likely to be herded and enter more centrally. They will also be vertically distributed and having entered the gear will follow specific behaviour patterns. These include:

- **orientating themselves and swimming in the towing direction of the gear;**
- **swimming from side to side;**
- **actively swimming further back into the trawl; and,**
- **more passively, being overtaken by the trawl.**

FRONT END OF A TRAWL

It may be possible to reduce the number of fish retained by the gear at this stage of the capture process by increasing the mesh size, changing the mesh shape or altering the hanging ratio of panels or sections of netting in the upper or lower wings, or in the upper or lower belly sections.

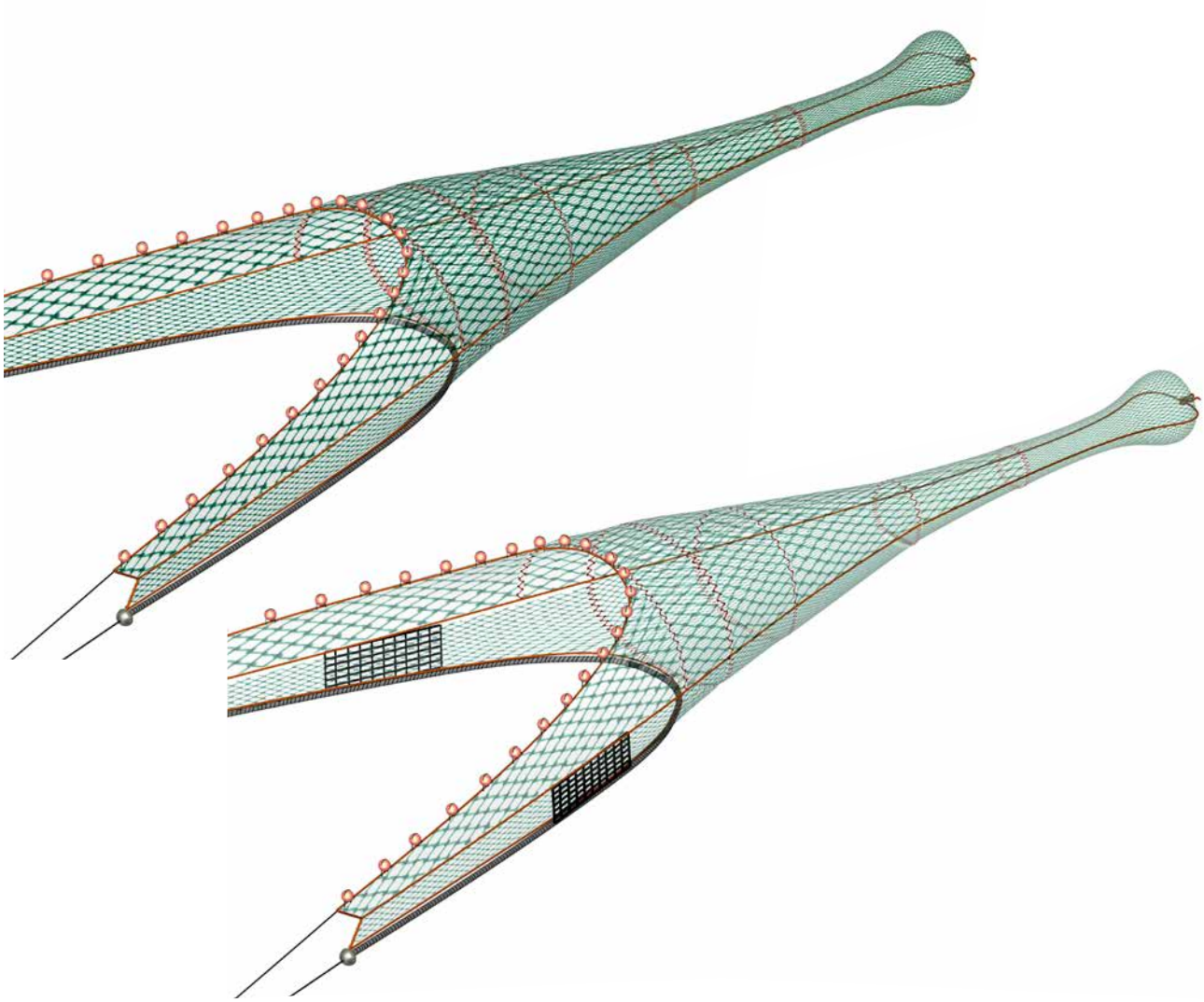


Figure 9. Examples of possible modifications at the front end and taper section of a trawl gear.

Horizontal separator panels have been used to harness the vertical separation behaviour of some species on entering a trawl gear. These operate in much the same way as the low headline, coverless and cut-away headline gears above, but offer more flexibility, insofar as they allow further selection of the separated fish. There have been many trials with these gears and it has been shown that the extent to which a species can be directed above or below the horizontal panel depends on (i) the height of the panel above the fishing line and (ii) the distance it is behind the fishing line.

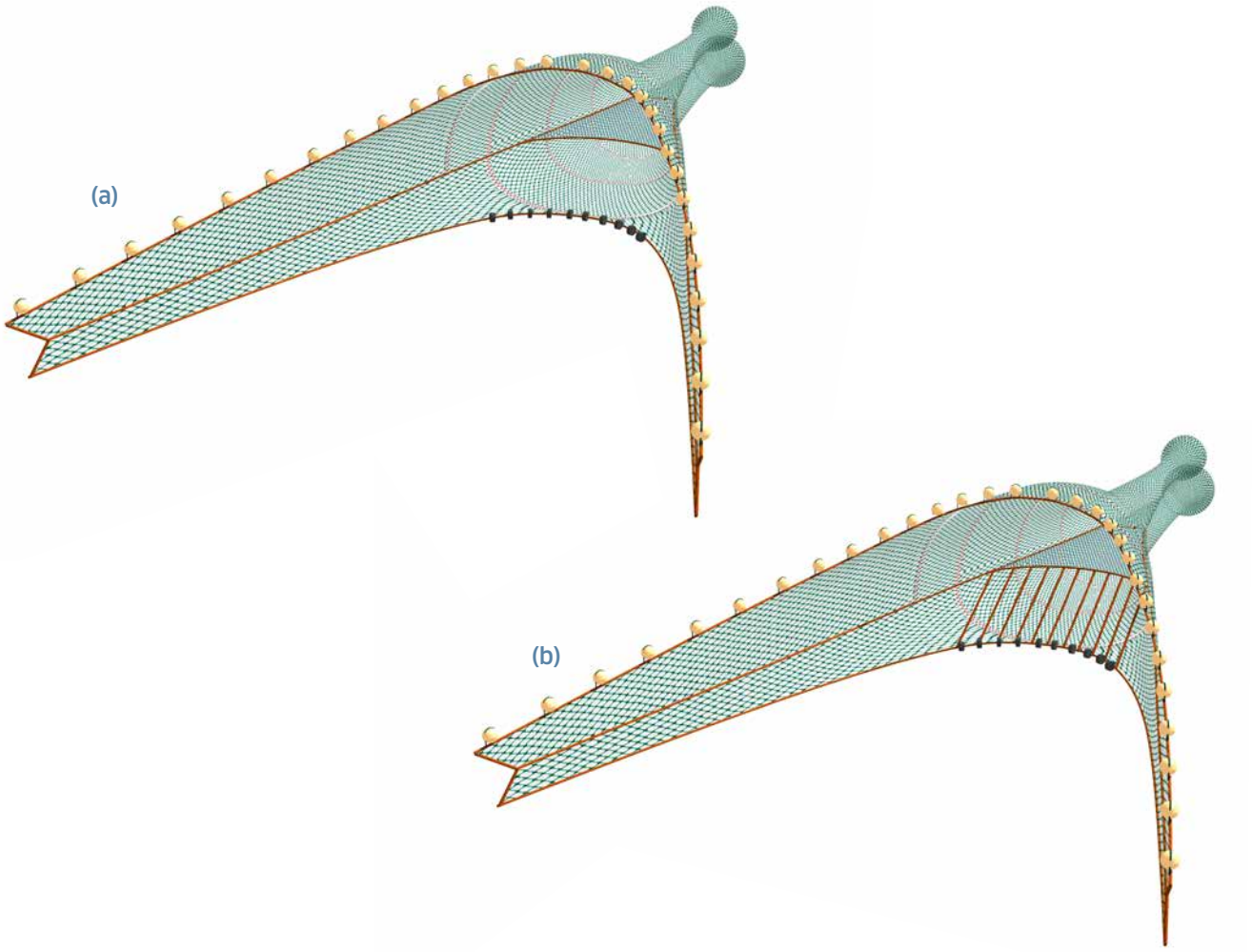


Figure 10.
(a) a single trawl with a horizontal separator panel leading to two different codends and (b) a single trawl with guiding ropes ahead of a horizontal separator panel.

There have also been attempts to modify the vertical separation of species in these types of trawls by using ropes or netting panels to guide fish above or below the separator panel. The success of guiding ropes and panels depends on there being behavioural and/or size differences which favour the passage of one species past the ropes or through the panel and inhibits another.

THE TAPERED SECTION

As the fish travels down through the fishing gear the net tapers progressively until it reaches the extension section. Escape is also possible though the netting panels that make up the tapered section and many of the approaches, mentioned above, such as increasing the mesh size, changing the mesh shape or altering the hanging ratio of panels or sections of netting have been examined. Guiding panels and grids have also been used in this area of a trawl to direct fish to netting panels through which they can escape or to exit holes where the netting has been cut out.

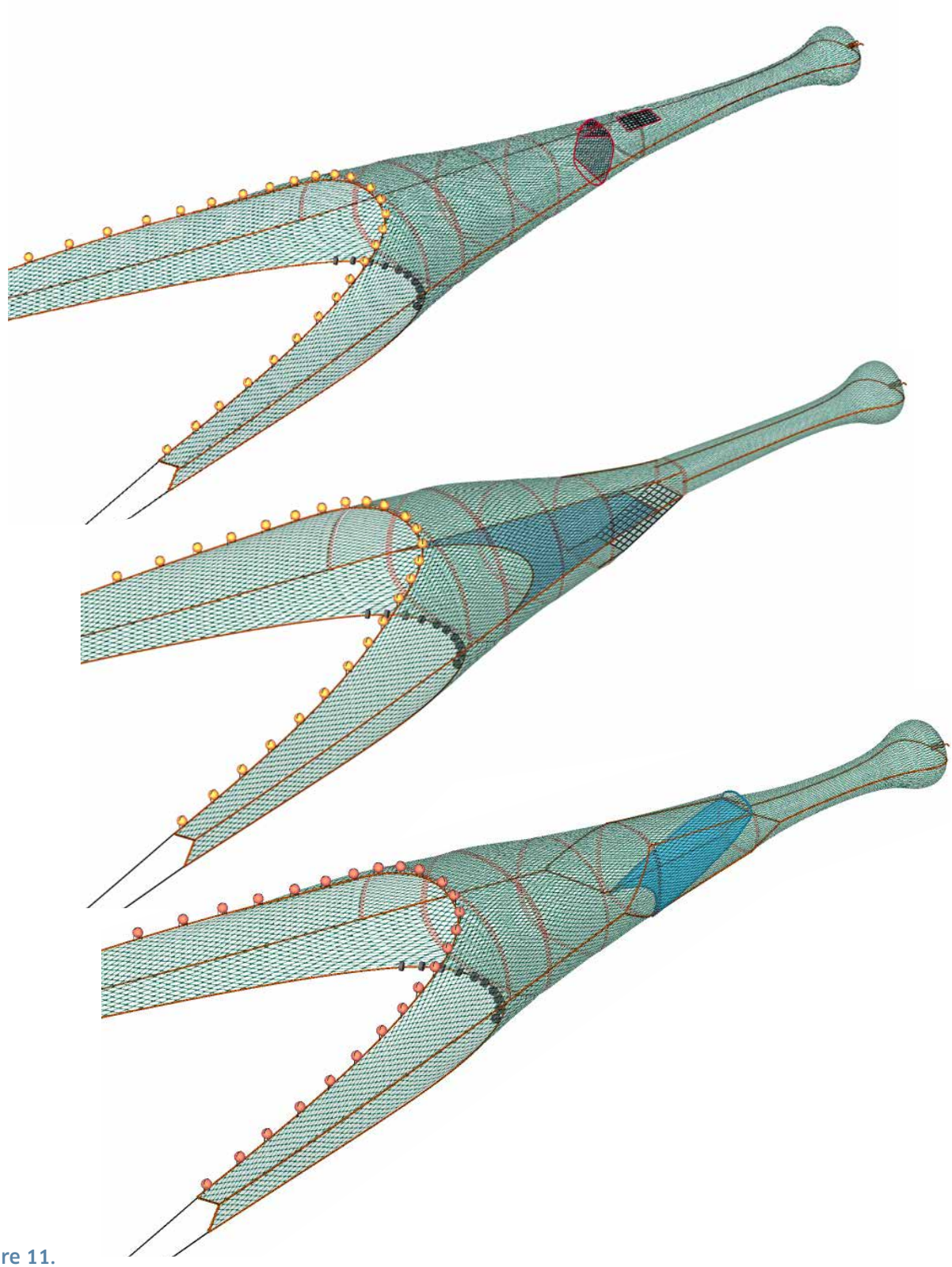


Figure 11.
Examples of the types of modifications that have been made to the tapered and extension sections of a trawl gear.

THE EXTENSION

Many trawls have a straight section called the extension between the end of the tapered section and the codend. It is generally made of diamond mesh netting, the meshes of which tend to close as the netting come under tension as the gear is being towed. The selectivity of a trawl gear decreases as the extension length increases. In long extensions, the meshes close more, the extension is narrower and opposite netting panels are more likely to meet. It is thought that as fish pass down the extension, they are more likely to be abraded and stressed, limiting their ability to make successful escape attempts. Consequently, a simple way of improving selectivity is to reduce the extension length as much as possible.

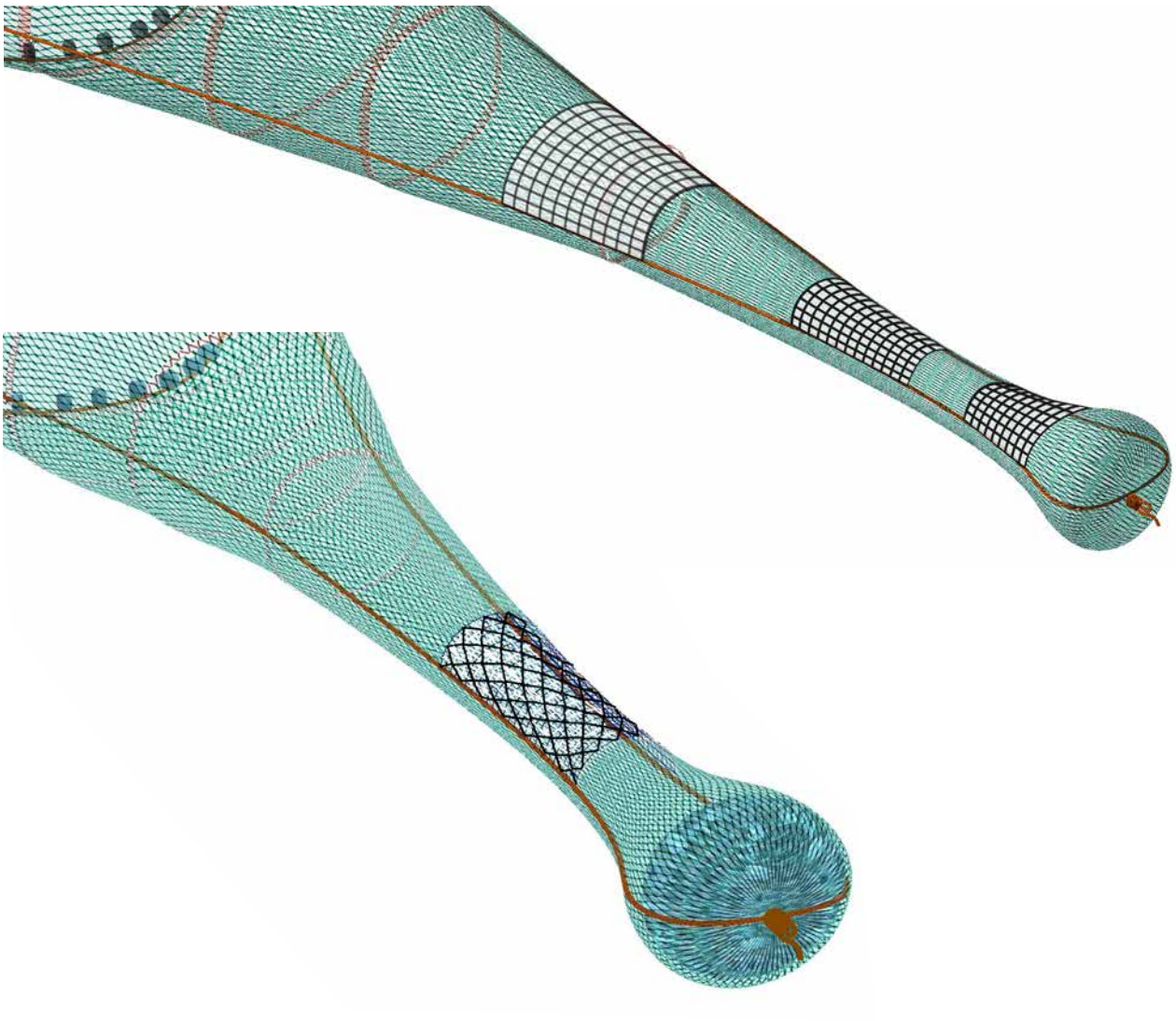


Figure 12.
Netting sections and panels fitted to the tapered and extension sections and the codend of demersal trawls.

Many other ways have been tried to increase the number of escape opportunities in this part of the gear, including fitting different types of netting panels or netting sections. These can have a larger mesh size, a larger hanging ratio or a mesh shape which remains open when under tension. Depending on the species being selected, the panels or sections can be placed in the upper, side and lower parts of the extension and can also extended the full circumference of the extension. There has been a particular focus on square mesh panels and it has been shown that their effectiveness increases as their mesh size increases and the closer they are fitted to the codline.

Rigid, flexible and netting grids have also been utilized in many different types of configurations for both size and species selection. Depending on how they are rigged and fitted and on their design specification, they can be used to reduce the capture of the smaller fish, which pass through them, and retain the larger ones that can't; or to catch a smaller species and permit the escape of a larger one, in which case they are often used in conjunction with exit holes or sections where the netting has been replaced by ropes.

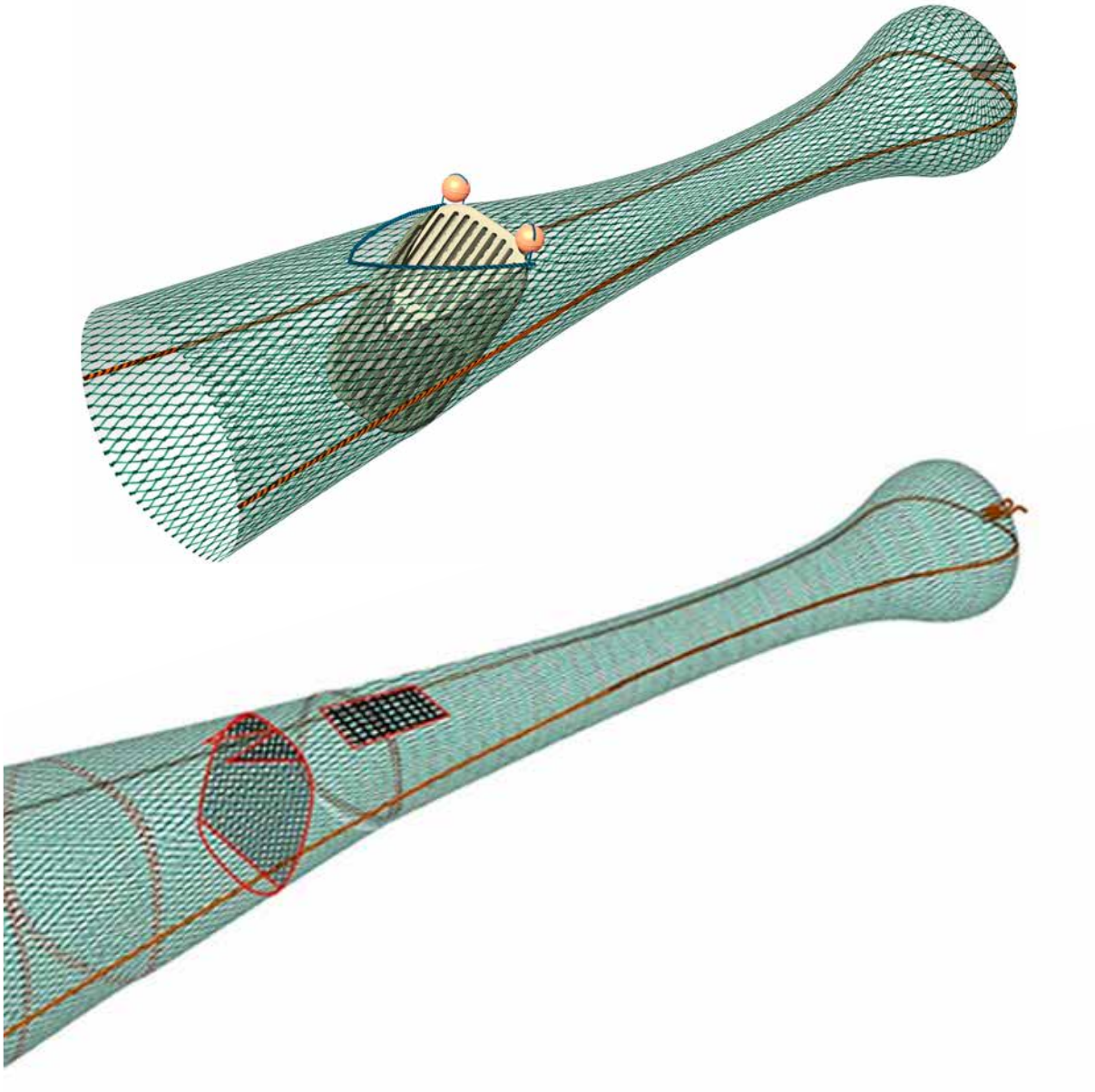


Figure 13. (a) a Swedish grid and (b) a netting grid.

Efforts have been made to improve the effectiveness of these devices. Guiding panels and tunnels, and baffles and deflectors have been used to direct fish towards a selective device or to increase the length of time fish are close to them. Ropes, floats and flapping panels of netting or fabric have been employed to encourage or inhibit the route a fish takes; and deflectors made from fabric, netting or more solid materials have been used to modify the flow patterns in this part of the fishing gear to increase the chance that fish encounter parts of the gear from where they have the possibility of escape.

Attempts to modify the flow patterns in the extension have tried to create areas of low or zero flow in the wake of objects, fine mesh netting or fabric sheets. The idea here is that fish will hold station in the low flow region close to which there will be larger mesh sections or escape holes through which the fish can pass.

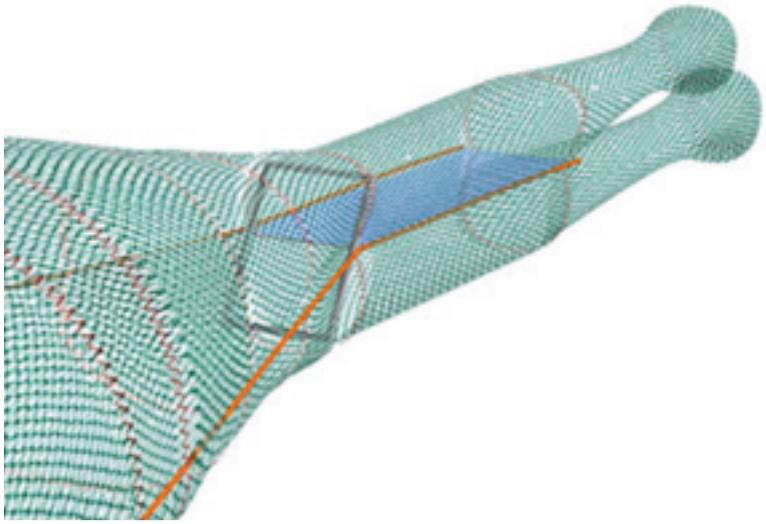


Figure 14. A trawl gear with a frame leading to two separate codends.

Gears have also been developed to separate fish at this point in the gear into different compartments or codends from where further selection can take place. These gears often use guiding panels, grids and/or frames in the extension to enable separation and to facilitate rigging.

THE CODEND

After passing through the extension fish will arrive at the codend. This is the rearmost part of a trawl gear and where the catch accumulates. It offers the last opportunity to escape and most approaches for improving trawl selectivity have focused on selection from this part of the gear.

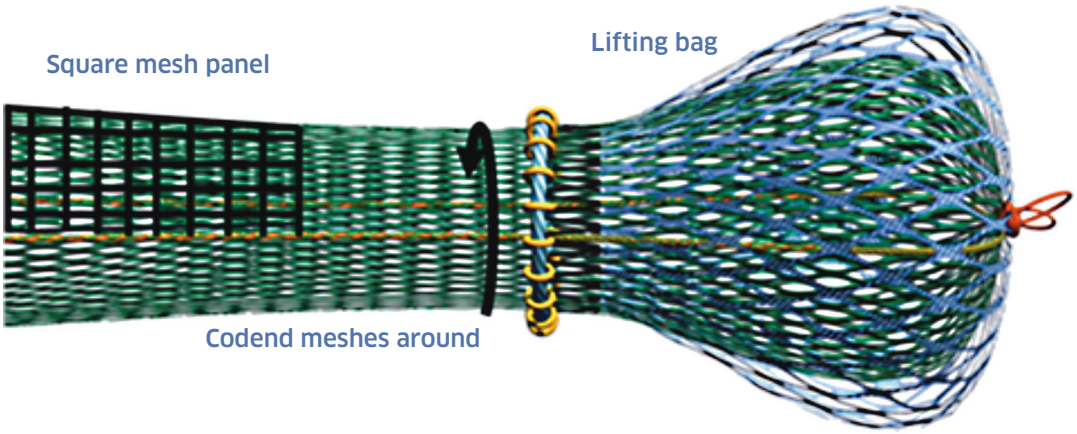


Figure 15. Some of the design characteristics of a codend that influence selection.

The most common way of improving codend selection has been to increase the codend mesh size. However, factors such as mesh shape, twine number and thickness and the number of meshes in circumference have also been shown to be important. The effect of these factors is often more subtle than that for mesh size and can depend on the morphology of the species under consideration. A change of mesh shape (or orientation) from diamond to square or T90 has been shown to improve the selectivity of round fish but can reduce the selection of flat fish or fish with a more elliptical cross-section which can pass more easily through partially opened diamond meshes.

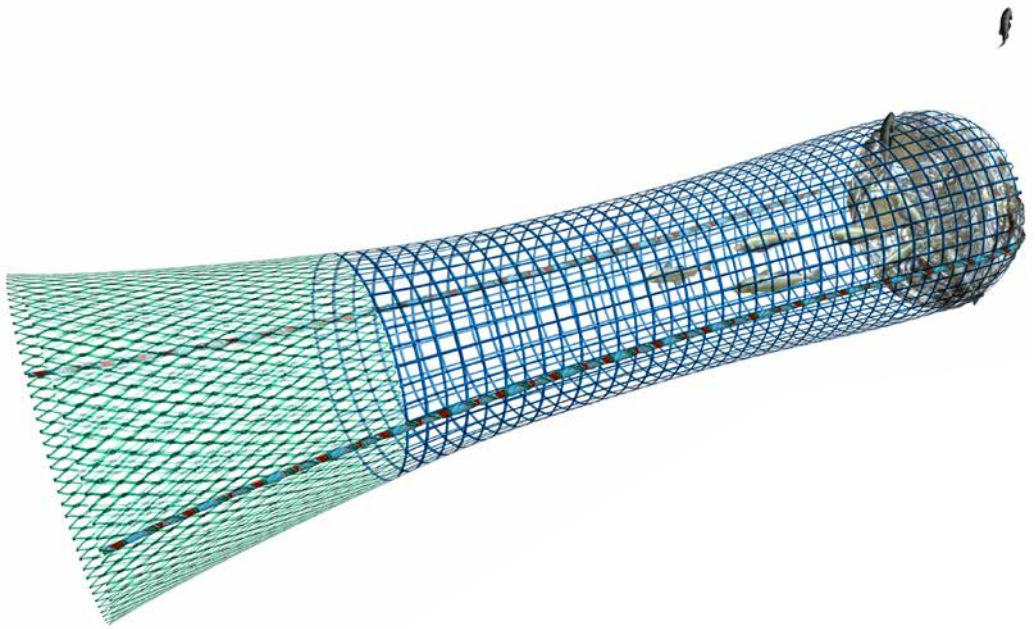


Figure 16. A square mesh codend

Similarly, decreasing the twine thickness or the twine number of the netting material of a diamond mesh codend may improve the selectivity of round fish and reduce that of flatfish. This is because thinner twines are generally less stiff and as a result it may be easier to open standard diamond mesh netting made from thinner twines in the lateral direction. Twine thickness and number may also have a behavioural effect and netting material made from thinner twines will present less of a visual barrier to fish and one which they may be more willing to penetrate. From this point of view the effect of reducing twine number and thickness may increase the selection of both round and flat fish.

Reducing the number of meshes in circumference can also lead to an improvement of the selectivity of roundfish and a reduction of that of flatfish. For a given catch size, the meshes of a codend with fewer meshes around its circumference will have to open more in the lateral direction in comparison to those of a codend with more meshes. As above this can be beneficial for the selectivity of roundfish and detrimental to that of flatfish.

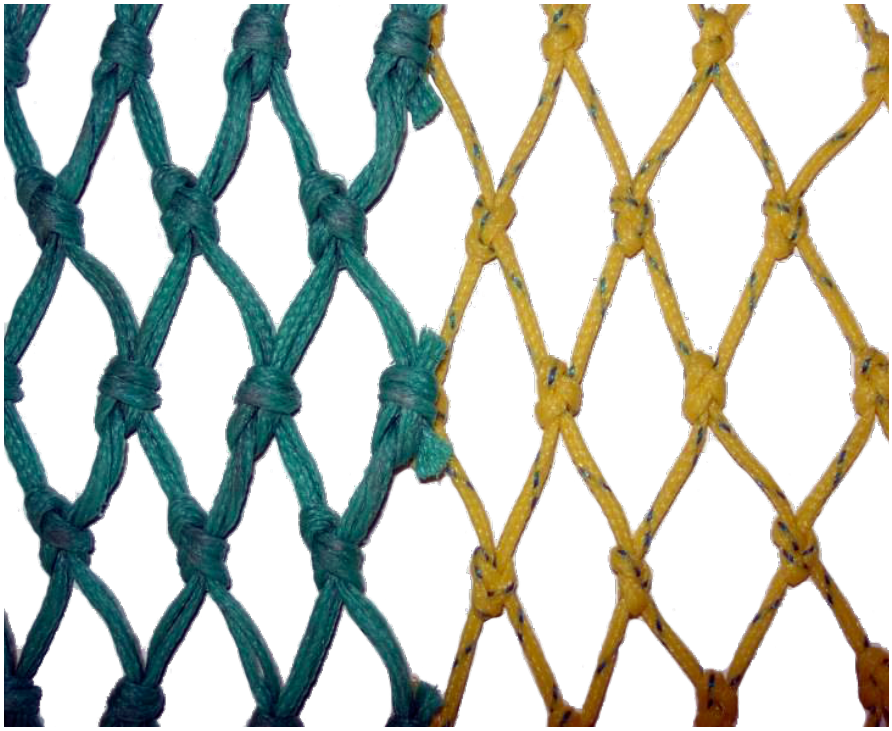


Figure 17.
Two pieces of netting of the same mesh size but made from double and single twine, highlighting how twine num ber may influence the visual contrast of netting.

The use of lifting bags and double codends has been shown to reduce codend selection. In these codends the second layer of netting leads to masking of at least some of the meshes reducing escape opportunities and/or creating a greater visual barrier which fish are less likely to want to penetrate.

Lateral lastridge ropes, lifting beckets or any other attachment which can reduce the cross-sectional diameter of the codend will also reduce the selectivity of roundfish but may lead to an improvement of that of flatfish. Restricting the lateral circumference of the codend also restricts the lateral opening of the meshes which, as explained above, may beneficial for the escape of flat fish and fish with a more elliptical crossection. Longitudinal lastridge ropes fitted in such a way that they are shorter than the stretched length of the netting to which they are attached. These types of lastridge ropes bear the tension that would usually be in the mesh bars allowing the meshes to be opened and deformed more easily. The extent to which this happens will depend on the extent to which the lastridge ropes are shorter than the stretched length of netting to which they are attached.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the many people who have contributed to this manual and the associated factsheets. These include those who were directly involved in the preparation of the factsheets to the fishermen and scientists who took part in the many experimental trials that are reported on. It is important that the results of these types of trials are disseminated as widely as possible as it is by testing and developing new gears to address the discard and unwanted by-catch problems they face, that the fishing industry will ensure a future that is both economically viable and environmentally sustainable.

We must also acknowledge the huge debt we owe the many scientists, fish behaviourists, fishing gear technologists, net makers and fishermen whose research, developments and insights have led us to our present understanding of the fish capture process. Our manual is only the briefest of summaries of this process and, for more comprehensive and in-depth descriptions, we recommend the many reports, studies and reviews that been written by many authors.

APPENDIX

DISCARDLESS FACT SHEETS

using an inclined netting panel to separate fish from *Nephrops*

TARGET SPECIES

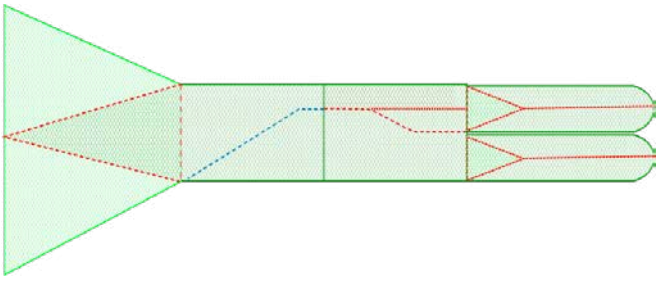
Nephrops **and mixed round and flatfish**

AREA, VESSEL

16 twin trawl catch comparison hauls were carried out in the North Sea on board the Amity II PD177 (21m, 400kW)

GEAR MODIFICATION

a four panel section was fitted into the extension of one of the nets of a twin rig prawn trawl.
The four panel section had an inclined panel made of square mesh netting.
Fish which went over the panel were directed to the upper codend and those which went though it were directed to the lower codend.
Three different mesh sizes of the inclined square mesh panel were tested: 200, 300 and 400mm.



Percentage of catch in upper cod-end			
inclined panel mesh size (mm)	***200***	***300***	***400***
Cod	92	79	47
Haddock	99	-	97
Whiting	96	77	94
Anglerfish	99	-	45
Plaice	97	-	38
Mixed Flatfish	52	49	22
Nephrops	32	12	2

RESULTS

- **a large proportion of the fish catch can be separated from the target species, *Nephrops*.**
- **Nearly all haddock and whiting went over the panel regardless of the mesh size and into the upper codend**
- **larger quantities of cod, anglerfish, plaice and other flats go through the inclined panel as the mesh size increases and into the lower codend**
- **the quality of the fish and *Nephrops* in the separated codends is better**

FURTHER INFORMATION

Kenny Coull (k.coull@sff.co.uk);
James Birnie (j.birnie@sff.co.uk)

SCOTTISH FISHERMEN'S FEDERATION

using rigid Swedish grids to reduce the capture of fish species in a *Nephrops* trawl

TARGET SPECIES
Nephrops

AREA, VESSEL
31 twin trawl catch comparison hauls were carried out in the North Sea and east of Shetland on board the Fruitful Bough PD 109 (522kW) during 2010.

GEAR MODIFICATION
Two Swedish grids were tested in a standard *Nephrops* trawl. They had

(i) 35 mm bar spacing and

(ii) 40 mm bar spacing

The catches were compared with those in a 40 mm codend which estimates the population on the fishing grounds

% population retained by the grid gears

	35 mm grid	40 mm grid
Nephrops	83	87
Cod	4	7
Haddock	12	13
Whiting	17	15

RESULTS
Both grids eliminated catches of large fish

There was a loss of smaller *Nephrops* (< 41-45 mm carapace length) due to their selection from the 80mm codend

There was no significant loss of larger *Nephrops*.

FURTHER INFORMATION
Jim Drewery (j.drewery@marlab.ac.uk)
Drewery J., 2011. 35 and 40mm Swedish grids in a Scottish *Nephrops* trawl fishery. Scottish Marine and Freshwater Science Vol 02 No 04.

marinescotland science

The Scottish Government

using a flexible grid to reduce capture of haddock, whiting and cod in a *Nephrops* trawl

TARGET SPECIES

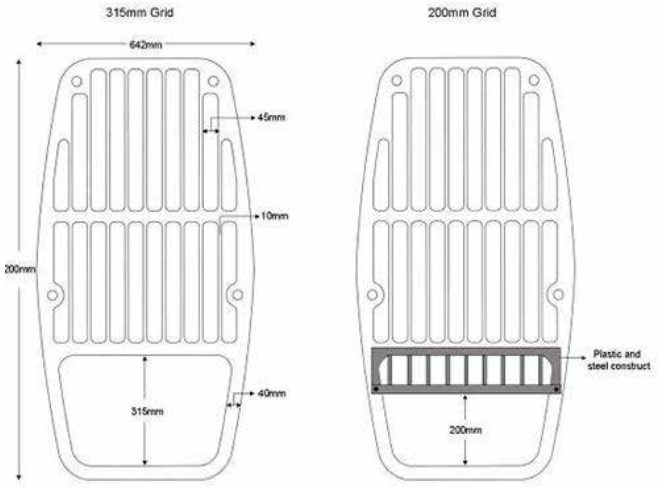
***Nephrops* and mixed round and flatfish**

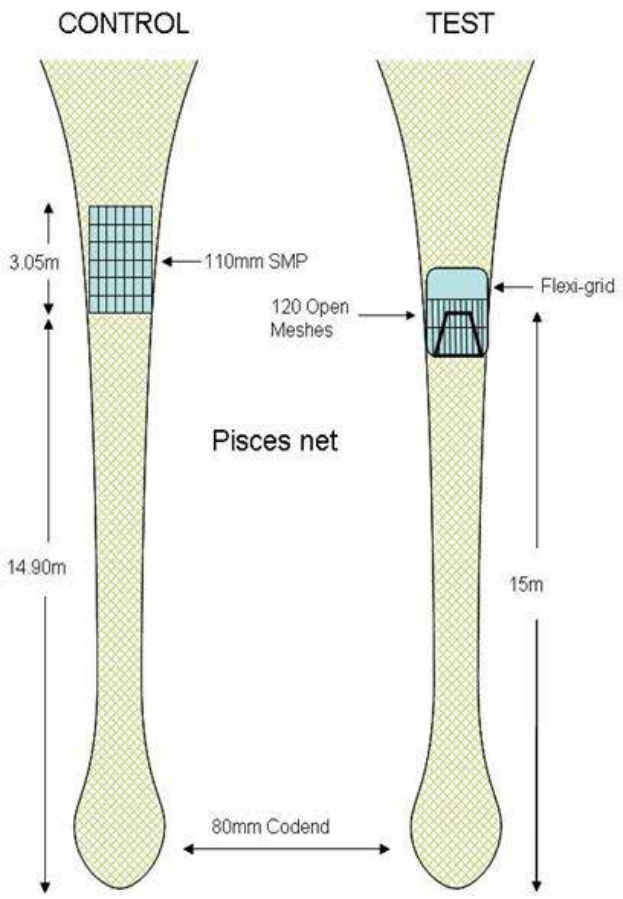
AREA, VESSEL

25 catch comparison hauls took place in the North Sea on board the FV Amity II PD 177 (21m, 400kW) during November 2012.

GEAR MODIFICATION

A flexible grid with 45mm bar spacing and with bottom gaps of (i) 315mm and (ii) 200mm was fitted into the extension of a *Nephrops* trawl





Average % reduction		
grid	315 mm	200 mm
Cod	66	95
Haddock	55	78
Whiting	73	81
Monkfish	76	84
Saithe	87	98
plaice	78	74
Lemon sole	23	24
Nephrops	-3	-1

RESULTS

- **there were no losses of haddock or whiting**
- **fewer smaller cod (< 78 cm) were caught, but above 78 cm, there was no difference**
- **monkfish catches were 16% less, but these were all small (< 55cm)**
- **megrim catches were reduced by 43%**

FURTHER INFORMATION

Jim Drewery (j.drewery@marlab.ac.uk)

marinescotland science

The Scottish Government

DiscardLess

www.discardless.eu/selectivity_manual

changing the groundgear to reduce the capture of small flatfish in a *Nephrops* trawl

TARGET SPECIES

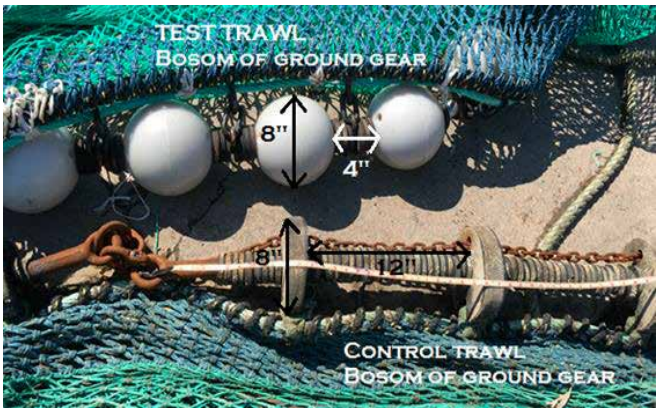
Nephrops **and mixed round and flatfish**

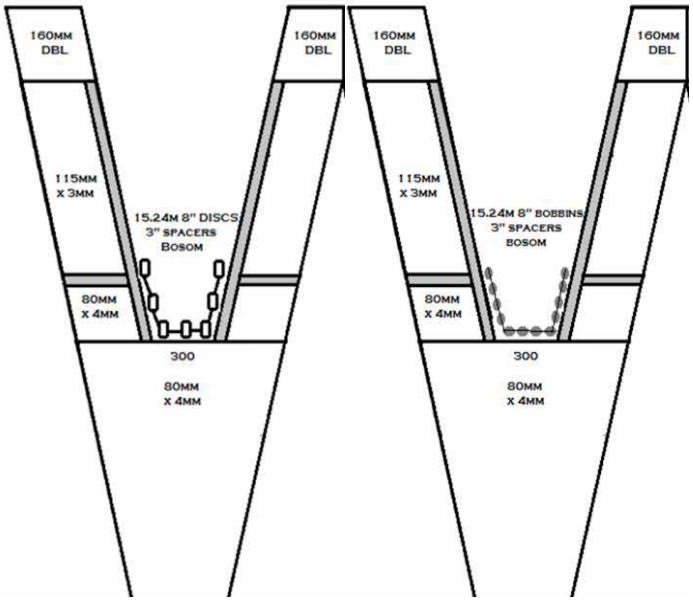
AREA, VESSEL

24 twin trawl catch comparison hauls were carried out in the North Sea on board the Zenith BF106 (671 HP)

GEAR MODIFICATION

The catching performance of a low headline 'Letterbox' trawl with 200mm spherical bobbins in the 15m centre section of the groungear is compared with a similar gear with 200mm rockhopper discs in the centre section.





disc gear bobbin gear

	discs	bobbins	
	Total Weight (kg)		% diff
Lemon Sole	144	148	2.9
Plaice	261	257	-1.4
Witch	108	96	-11
Megrim	173	132	-24
Comon dab	59	50	-16
Long rough dab	178	81	-54

RESULTS

Using the spherical bobbins reduced the catches of flatfish species.

This was length dependent and smaller flatfish were less likely to be retained than larger ones.

For plaice and lemon sole there were greater catches of the larger individuals.

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The Scottish Government

FURTHER INFORMATION

Matt Kinghorn
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SCOTTISH FISHERMEN'S FEDERATION

DiscardLess

www.discardless.eu/selectivity_manual

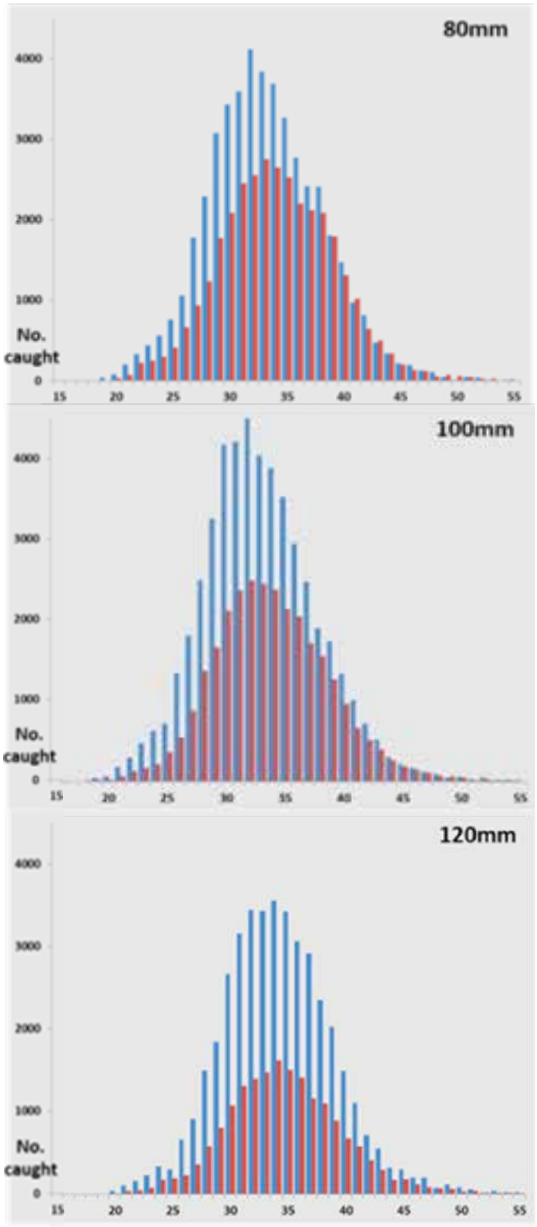
increasing codend mesh size to reduce discards of *Nephrops*, haddock and whiting in a *Nephrops* trawl

TARGET SPECIES

Nephrops **and mixed whitefish and flatfish species**

AREA, VESSEL

41 twin trawl hauls took place in the west of Scotland on board the Ocean Trust PD787 during July 2014



GEAR MODIFICATION

The catches in a *Nephrops* trawl with

- **80mm diamond mesh codend of 4mm single PE twine**
- **100mm diamond mesh codend of 5mm double PE twine**
- **120mm diamond mesh codend of 5mm double PE twine**

are compared.

RESULTS

Increasing mesh size reduces discards of *Nephrops*, haddock and whiting.

For *Nephrops*:
in the 80mm mesh codend most selectivity occurs over the lower size range (< 38mm);
in the 100mm codend some selectivity also occurs over 39-47mm size range;
and in the 120mm codend selection occurs across the full length range.

FURTHER INFORMATION

Drewery, J, et al., 2015. Effects of Codend Mesh Size and Twine Number on Nephrops Selectivity. Scottish Marine and Freshwater Science Vol 6 No 3. DOI: 10.7489/1552-1

marinescotland science

The Scottish Government

DiscardLess

www.discardless.eu/selectivity_manual

inserting an FCAP netting grid to reduce the capture of cod, haddock and whiting in a *Nephrops* trawl

TARGET SPECIES

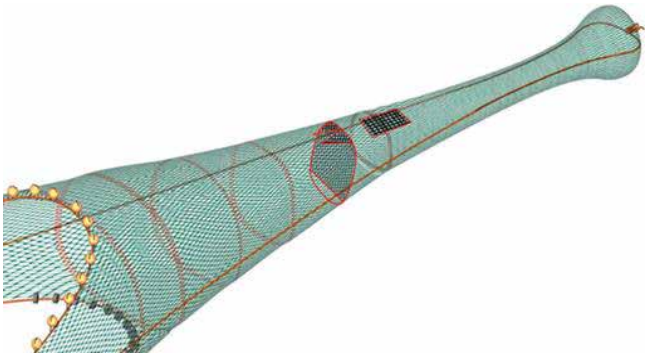
Nephrops **and mixed whitefish and flatfish species**

AREA, VESSEL

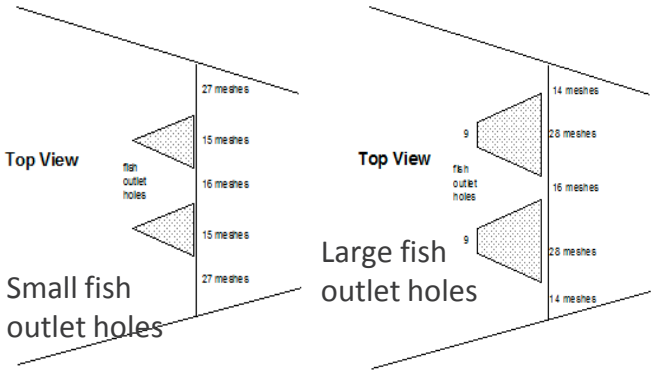
19 twin trawl catch comparison hauls were carried out in the North Sea (ICES IVa) on board the Victoria May PD267 (597kW)

GEAR MODIFICATION

The FCAP gear has a 300mm inclined netting panel attached to the tapered part of the trawl ahead of the extension. It has two escape holes cut out of the top sheet in front of the vertical panel, two sizes of which were tested



Species	Fish outlet hole size	Catch (kg)		% reduction in catch
		Control	Test	Test/Control
Cod	Small	2845	1839	35
	Large	2498	939	62
Haddock	Small	895	367	59
	Large	595	155	74
Whiting	Small	385	227	41
	Large	225	76	66



RESULTS

The FCAP with the smaller fish outlet holes reduced the capture of cod, haddock and whiting by 35, 59 and 41% respectively

The FCAP with the larger fish outlet holes reduced the capture of cod, haddock and whiting by 62, 74 and 66% respectively.

FURTHER INFORMATION

Kynoch, R.J. et al., 2012. Catch comparison trials with the Faithlie Cod Avoidance Panel (FCAP). Scottish Marine and Freshwater Science Vol 3 No 8.

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SCOTTISH FISHERMEN'S FEDERATION

DiscardLess

www.discardless.eu/selectivity_manual

using a Flip Flap netting grid to reduce the capture of cod, haddock and whiting in a *Nephrops* trawl

TARGET SPECIES

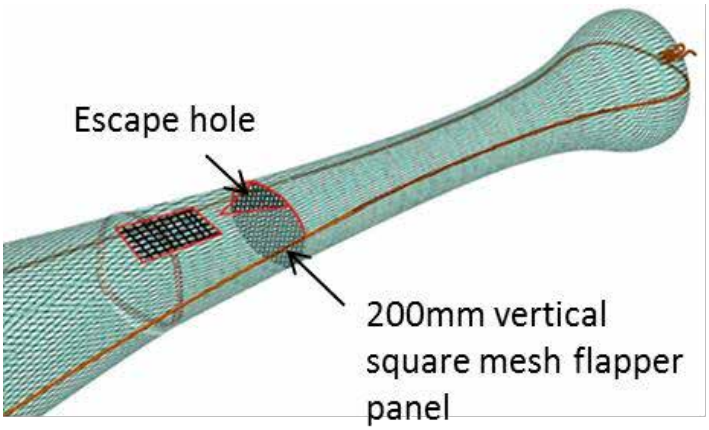
Nephrops **and mixed whitefish and flatfish species**

AREA, VESSEL

The trials took place in the North Sea (ICES IVa) Fladen Grounds and the Moray Firth on board the Sardonyx II (BF 206) (18m, 373kW)

GEAR MODIFICATION

The Flip Flap gear has a 200mm vertical square mesh flapper panel in the extension. The top half of this panel is attached to the extension and the bottom half is weighted along its perimeter, but free to 'flap'. There is a hole cut out of the top sheet in front of the vertical panel to facilitate the escape of roundfish



Species	Flip/Flap gear catch (kg)	Standard gear catch (kg)	% catch reduction
Cod	2183	8147	73
Haddock	1018	3057	67
Whiting	177	974	82
Nephrops	292	304	4
Monkfish	380	435	13
Megrim	318	356	11

RESULTS

Nephrops **catches of the two gears were very similar.**

There was a large reduction in the retention of cod, haddock and whiting, and a small reduction in the catches of monkfish and megrim.

FURTHER INFORMATION

J Drewery, J. 2012. Catch comparison trials of the Flip Flap netting grid trawl. Marine Scotland Science Report 08/12

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The Scottish Government

SCOTTISH FISHERMEN'S FEDERATION

DiscardLess

www.discardless.eu/selectivity_manual

300mm diamond mesh netting panels to reduce discards of cod in a whitefish trawl gear

TARGET SPECIES

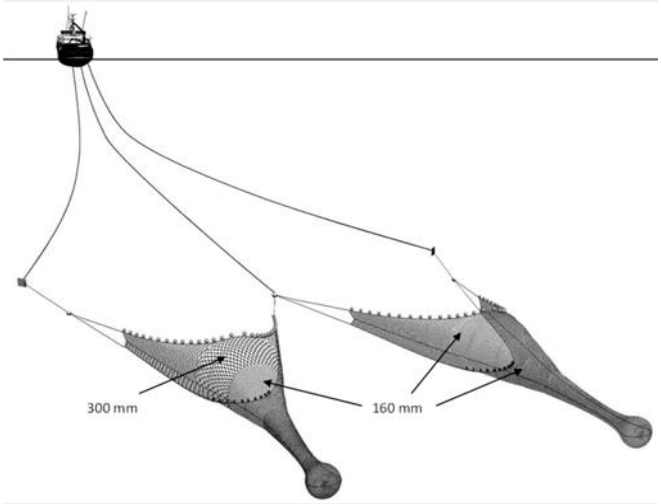
Haddock, whiting, cod, monkfish, megrim

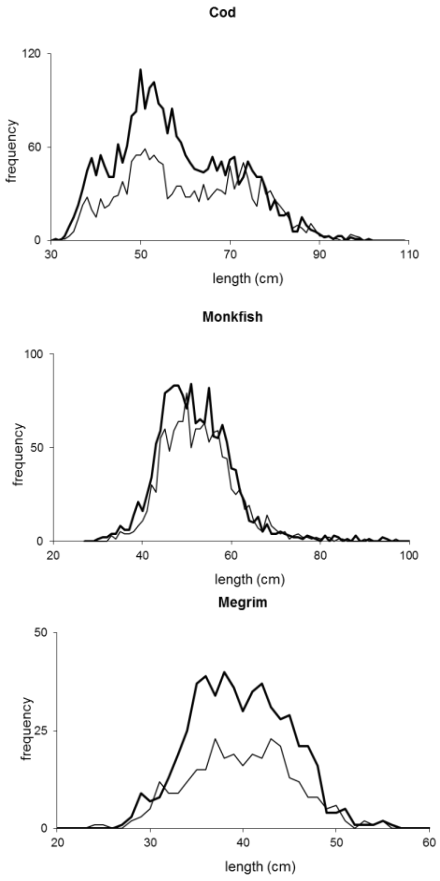
AREA, VESSEL

30 twin trawl catch comparison hauls took place west of Shetland on board the Russa Taign K1102 (34 m, 2600 kW) during 2008

GEAR MODIFICATION

a standard whitefish net that has 160 mm netting in the forward sections is compared to one with 300mm netting in the forward sections





RESULTS

- **there were no losses of haddock or whiting**
- **fewer smaller cod (< 78 cm) were caught, but above 78 cm, there was no difference**
- **monkfish catches were 16% less, but these were all small (< 55cm)**
- **megrim catches were reduced by 43%**

FURTHER INFORMATION

Campbell, R. et al, 2010. The reduction of cod discards by inserting 300mm diamond mesh netting in the forward sections of a trawl gear. Fis Res, 102, 221 - 226.

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The Scottish Government

SCOTTISH FISHERMEN'S FEDERATION

DiscardLess

www.discardless.eu/selectivity_manual

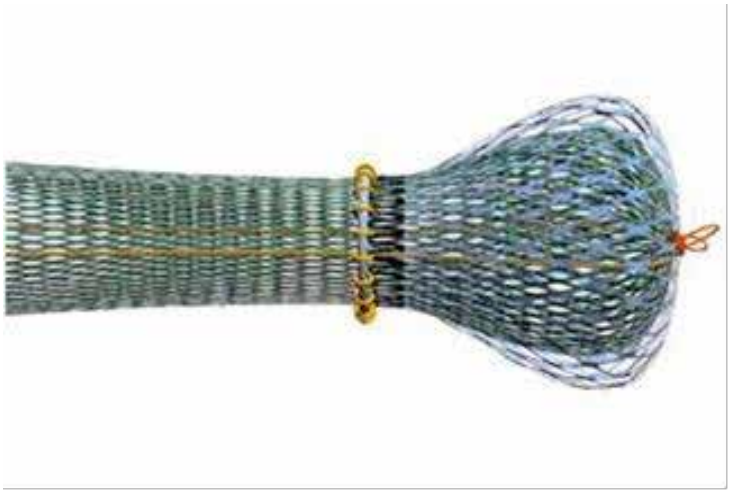
removing codend lifting bags
to reduce capture of undersized haddock and whiting

TARGET SPECIES
Haddock and whiting

AREA, VESSEL
26 hauls using the covered codend technique took place East of Orkney (ICES area IVa) on board the Aalskere K373 (33.9 m, 298 kW) during June 2001

GEAR MODIFICATION
a single trawl was fished with

(i) a 110 mm codend
(ii) A 110 mm codend with a 265 mm lifting bag
(iii) a 120 mm mesh codend and
(iv) A 120 mm codend with a 265mm lifting bag



	% reduction of haddock after removing lifting bag from	
Size range	110 mm codend	120 mm codend
< 30 cm	~	71
30 - 33.5 cm	28	45
34 - 41.5 cm	8	15
34 - 41.5 cm	~	~
> 49.5 cm	~	~

RESULTS
- removing the lifting bag from 110 mm and 120 mm codends reduces the catches of smaller sizes of haddock

- there is no effect on the large haddock sizes ranges (> 42 cm)

FURTHER INFORMATION
Kynoch et al., 2004. The effect of strengthening bags on codend selectivity of a Scottish demersal trawl. Fish Res. 68, 249-257

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The Scottish Government

lowering headline height (<1 m) to reduce the capture of haddock and whiting in a *Nephrops* trawl

TARGET SPECIES

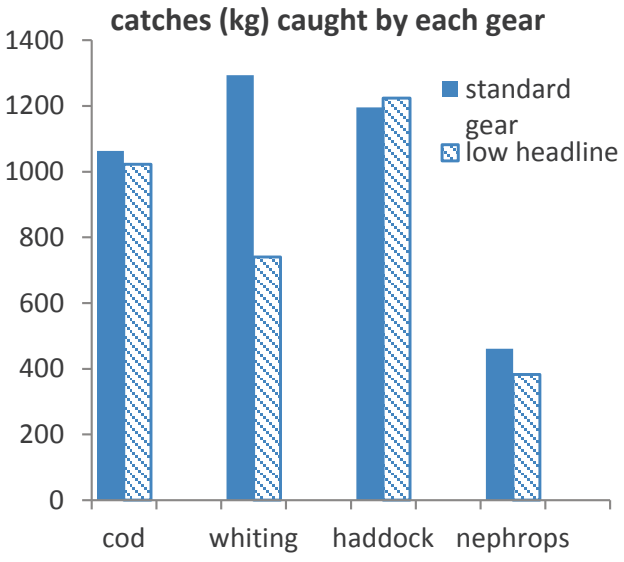
Nephrops **and mixed whitefish and flatfish species**

AREA, VESSEL

14 twin trawl, catch comparison hauls took place in the N.Sea (ICES area IVa), North East of Fraserburgh, on board the Favonius (PD17) (23m, 480kW) during November 2010.

GEAR MODIFICATION

a standard prawn trawl with a headline height of ~ 2 m is compared with a newly designed prawn trawl that has a headline height of ~ 1 m.



RESULTS

Cod:
The low headline did not affect the catches of cod.

Haddock and Whiting:
there was no difference between the two trawls for smaller whiting and haddock. However, fewer large whiting (> 28 cm) and large haddock (> 31 cm) were caught in the low headline gear

***Nephrops*:**
The standard gear caught more *Nephrops* with carapace length from 37mm (18%) to 50mm (32%).

marinescotland science

The Scottish Government

FURTHER INFORMATION

Kynoch, R.J., et al., 2011. Trials to assess the potential for Nephrops trawls with low headline heights (<1M) in reducing whitefish by-catches.Scottish Industry Science Partnership Report Number 02/11.

increasing codend mesh size and inserting a square mesh panel

to reduce discards of haddock and whiting in a seine net

TARGET SPECIES

Haddock, whiting and cod

AREA, VESSEL

90 alternate shots were carried out west of Shetland on board the Harmony LK63 (23m, 298hp) during 2001.

% reduction of haddock and whiting in comparison to the 100mm codend

grades	< MLS	IV	III	II	I
haddock					
110 mm codend	**48**	-	-	-	-
110 mm codend + 90 mm smp	**68**	**41**	-	-	-
120 mm codend	**89**	**77**	**57**	-	-
whiting					
110 mm codend	**74**	**50**	-	-	-
110 mm codend + 90 mm smp	**96**	**81**	**58**	-	-
120 mm codend	**80**	**91**	**94**	**88**	-

GEAR MODIFICATION

a seine net fishing a 100 mm diamond mesh codend was compared with one fishing

(i) **a 110 mm mesh codend;**

(ii) **a 110 mm mesh codend with a 90 mm smp 6 – 9m from the codline and**

(iii) **a 120 mm cod end**

RESULTS

- there was a substantial reduction in the discarding of undersized haddock and whiting in all three codends

- fitting a 90mm square-mesh panel in the 110mm cod-end substantially reduced catches of both undersized and marketable fish.

FURTHER INFORMATION

Report on Scottish trials assessing the selectivity of trawls and seines. Industry/Science Partnership 2001 – 2002 Vol 1.

marinescotland science

The Scottish Government

increasing codend mesh size in a whitefish codend

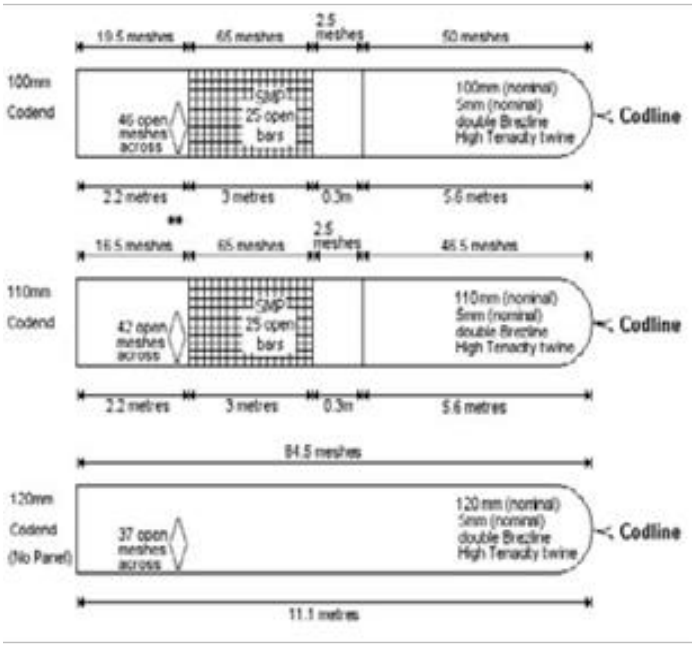
to reduce the capture of undersized haddock and whiting

TARGET SPECIES

Haddock and whiting

AREA, VESSEL

32 pairs of alternate hauls took place East of Shetland (ICES area IVa) on board the Sharyn Louise LK250 (19m, 298kW)



grade	under sized	IV	III	II	I
	reduction of haddock catches				
110mm codend with 90mm smp	65	~	~	~	~
120mm codend	85	72	~	~	~
	reduction of whiting catches				
110mm codend with 90mm smp	~	68	61	~	~
120mm codend	91	87	77	~	~

GEAR MODIFICATION

a 100mm diamond mesh codend fitted with a 90mm SMP is compared with

(i) a 110mm diamond mesh codend with a 90mm SMP and

(ii) a 120mm diamond mesh codend

RESULTS

- **the 110mm cod-end with a 90mm smp and the 120mm cod-end reduced catches of undersized haddock.**
- **the 120mm cod-end reduced catches of grade IV haddock.**
- **the 110 cod-end with a 90mm smp and 120mm cod-end also reduced catches of grade IV and grade III whiting.**
- **the 120mm cod-end had a greater effect than the 110mm cod-end with a 90mm smp.**

FURTHER INFORMATION

Report on Scottish trials assessing the selectivity of trawls and seines. Industry/Science Partnership 2001 – 2002 Vol 1.

marinescotland science

The Scottish Government

DiscardLess

www.discardless.eu/selectivity_manual

moving a square mesh panel (smp) closer to the codline

to reduce discards of haddock and whiting in a whitefish trawl

TARGET SPECIES

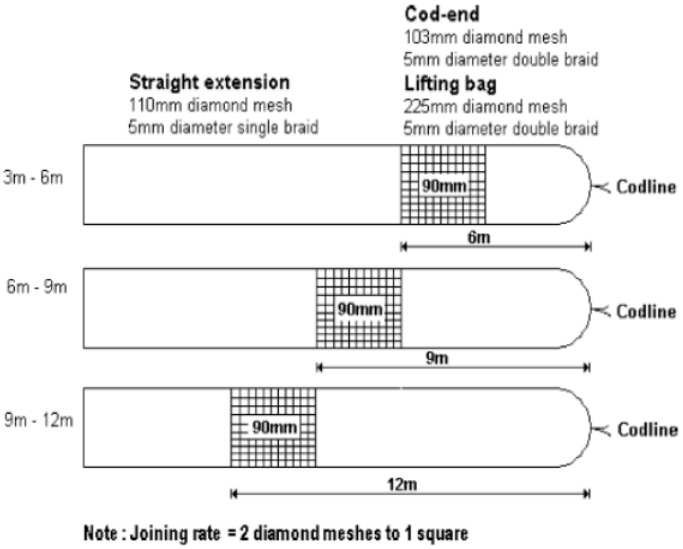
Haddock and whiting

AREA, VESSEL

20 catch comparison twin trawl hauls took place in the North Sea on board the Challenge UL33 (27.69 m, 731 kW) during 2001

GEAR MODIFICATION

The effect of inserting a 90 mm smp panel at 3 different positions; 3 - 6 m, 6 - 9 m, and 9 - 12 m, in a 100 mm codend is investigated.



Note : Joining rate = 2 diamond meshes to 1 square

% reduction of haddock catches when a 90mm SMP is fitted to a 100mm codend

SMP position	Discards (<30cm)	Grade IV (30-33.5cm)	Grade III (34-41.5cm)	Grade II (42-49.5cm)	Grade I (>49.5cm)
9-12 m	39	No significant difference			
6-9 m	43	No significant difference			
3-6 m	74	20	6	Not significant	

% reduction of whiting catches when a 90mm SMP is fitted to a 100mm codend

SMP position	Discards (<30cm)	Grade IV (30-33.5cm)	Grade III (34-41.5cm)	Grade II (42-49.5cm)	Grade I (>49.5cm)
9-12 m	No significant difference				
6-9 m	No significant difference				
3-6 m	87	53	Not significant		

RESULTS

- **inserting a 90 mm square mesh panel at any of the three positions reduces the number of discards.**

- **more fish escaped through the panel positioned 3 – 6 m from the codline than through those positioned 6 - 9 m or 9 - 12 m from the codline.**

FURTHER INFORMATION

Graham, N. et al., 2003. Square mesh panels in demersal trawls: further data relating haddock and whiting selectivity to panel position. Fish Res. 62, 361-375

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The Scottish Government

DiscardLess

www.discardless.eu/selectivity_manual

using a 35mm Swedish grid and 120mm square mesh panels (smp) to reduce capture of fish in a *Nephrops* trawl

TARGET SPECIES

Nephrops

AREA, VESSEL

24 twin trawl hauls in the west of Scotland n board the Ocean Trust OB38 (375kW) and 34 twin trawl hauls in the North Sea on board the Fruitful Bough PD 109 (522kW)

GEAR MODIFICATION

The catches of a standard *Nephrops* trawl with

(i) a 35 mm Swedish grid,
(ii) a 120 mm SMP at 6-9 m from the codline and
(iii) a 120 mm SMP at 12-15 m from the codline.

were compared with those of a 40 mm codend

RESULTS

- **There were no loss of smaller *Nephrops* (< 40 mm carapace length) from the Swedish grid gear, but there were losses of between 10-25% in the length range 41-58 mm.**
- **The SMP gears retain all large prawns but lose between 12 and 30% of those below about 37 mm.**
- **The grid gear did not catch any large fish**
- **The position of the SMPs did not influence catches of *Nephrops*, cod, haddock, or whiting.**

FURTHER INFORMATION

Jim Drewery (j.drewery@marlab.ac.uk)

Drewery J. et al., 2010. The selectivity of the Swedish grid and 120mm square mesh panels in the Scottish *Nephrops* trawl fishery. Fisheries Research, 106, 454 – 459.

marinescotland science

The Scottish Government

removing a tickler chain from a whitefish trawl to reduce the capture of skates, rays and sharks while retaining commercial species

TARGET SPECIES

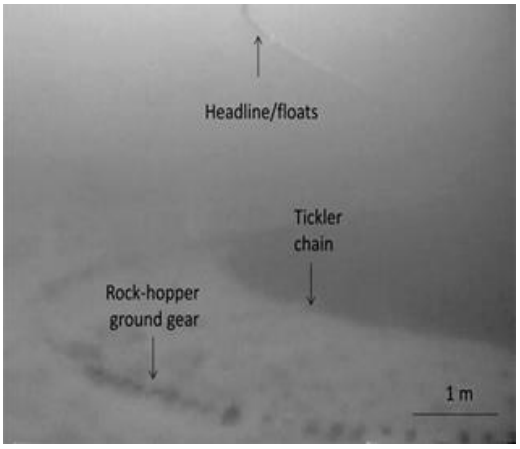
Haddock, whiting and monkfish

AREA, VESSEL

17 paired alternate hauls took place in the west of Scotland on board the MRV *Scotia*

GEAR MODIFICATION

A commercial whitefish trawl was towed both with and without a tickler chain.
Tickler chain was 37.5m long, made from 19 mm mid-link chain



the tickler chain running along the seabed 4m ahead of the rock-hopper groundgear.

% retained in trawl when		
	tickler on	tickler off
Skates		
Cuckoo ray	63	25
Flapper skate	64	23
Spotted ray	87	48
Thornback ray	53	54
Sharks		
Blackmouth	12	5
Lesser spotted	58	45
Spurdog	96	92
Flatfish		
Lemon sole	69	64
Megrim sole	45	88
Plaice	78	77
Anglerfish		
Angler	31	15
Gadoids		
Haddock	98	97
Whiting	91	78

RESULTS

removing the tickler chain:
- significantly lowered the catch rate of skates and sharks,
- had little effect on catch rates of haddock, whiting, and flatfish, but
- caused a marked decrease in the catch rate of commercially valuable anglerfish.

FURTHER INFORMATION

Kynoch, R. J. et al., 2015. A simple technical measure to reduce bycatch and discard of skates and sharks in mixed-species bottom-trawl fisheries. ICES JMarSci 72: 1861–1868.

marinescotland science

The Scottish Government

DiscardLess

www.discardless.eu/selectivity_manual

using a 100 mm mesh size square mesh panel (SMP)

to reduce discarding of horse mackerel, mackerel, blue whiting and juvenile hake

TARGET SPECIES

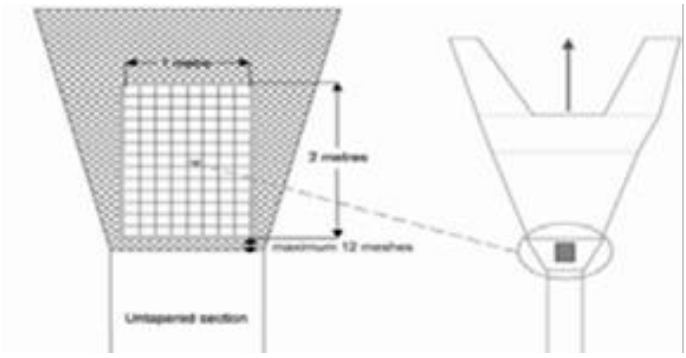
monkfish, megrim, hake, squid and red mullet

AREA, VESSEL

several cruises took place from 2011 to 2013 in the Basque otter trawl fishery.

GEAR MODIFICATION

the effectiveness of a 100 mm mesh size SMP in conjunction with a 70 mm diamond mesh codend was tested. A small mesh cover is used to catch the fish which escape through the SMP



		70 mm codend	100 mm SMP
Hake	number	6238	278
	Mean size (cm)	20.7	21.9
Blue whiting	number	57,272	30,621
	Mean size (cm)	21.3	21.2
Horse mackerel	number	906	209
	Mean size (cm)	19.2	15.1

RESULTS

- **4% of hake, 35% blue whiting and 19% of horse mackerel escaped through the 100 mm SMP**
- **The horse mackerel that escape through the SMP are smaller than those that are retained by the 70 mm codend.**

FURTHER INFORMATION

Luis Arregi: larregi@azti.es;

Alzorriz, N et al., 2016. Questioning the effectiveness of technical measures implemented by the Basque bottom otter trawl fleet. Fish. Res., 175: 116-126

azti tecnalia

using square mesh panels to reduce discarding of horse mackerel, mackerel, blue whiting and juvenile hake in the Basque pair trawl fishery

TARGET SPECIES
hake

AREA, VESSEL
21 hauls took place during several cruises in 2015 and 2016 in the Basque pair trawl fishery.

GEAR MODIFICATION
The effectiveness of 86 mm and 100 mm mesh size SMPs in conjunction with a 100 mm diamond mesh codend were tested. A small mesh cover is used to catch the fish which escape through the SMPs.

hake passing through the SMP

SMP mesh size	% of total catch	% < 27 cm	% > 27 cm of catch > 27 cm
86 mm	11	87	8
100 mm	12	64	6

RESULTS
There is no significant difference between hake escape through the 86 mm and the 100 mm SMPs.

A large percentage of hake escaping through the 86 and 100 mm SMPs is undersized (87 and 64%, respectively).

Nevertheless some marketable fish (> 27 cm) escape from both SMPs: 8% from the 86 mm SMP and 6% from the 100 mm SMP.

FURTHER INFORMATION
Luis Arregi: larregi@azti.es

azti tecnalia

DiscardLess

www.discardless.eu/selectivity_manual

diamond and square mesh codends to improve the selectivity of the Mediterranean bottom trawl fishery

TARGET SPECIES

striped red mullet; hake; Norway lobster; red shrimp

AREA, VESSEL

31 pairs of hauls were carried out at depths of between 50 and 800 m in the Balearic Islands multispecies bottom trawl fishery on board the F/V *Moralti Nou* (22 m)

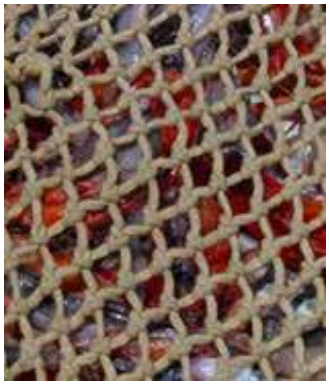
GEAR MODIFICATION

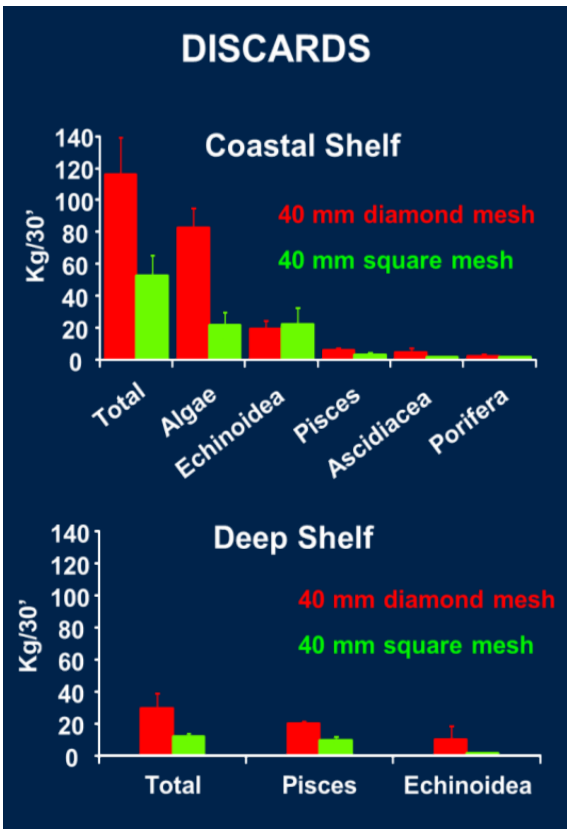
The catching performance of codends made of

(i) 40 mm diamond mesh and

(ii) 40 mm square mesh

were compared





RESULTS

There were no differences in the commercial landings and economic yields for the main target species, but picarel landings decreased by 80% in the 40 mm square mesh codend

There were large reductions in the discards of algae (70%) and fish (50%) on the coastal and deep shelf respectively, when using the 40 mm square mesh codend

With the exception of megrim, monkfish and skates, fewer smaller fish were caught in the 40 mm square mesh codend

FURTHER INFORMATION

enric.massuti@ba.ieo.es; toni.quetglas@ba.ieo.es

Guijarro B. and E. Massutí.- 2006. Selectivity of diamond- and square-mesh codends in the deepwater crustacean trawl fishery off the Balearic Islands (western Mediterranean). ICES Journal of Marine Science, 62: 52-67.

using flexible sorting grids to improve the selectivity of the Mediterranean bottom trawl fishery

TARGET SPECIES

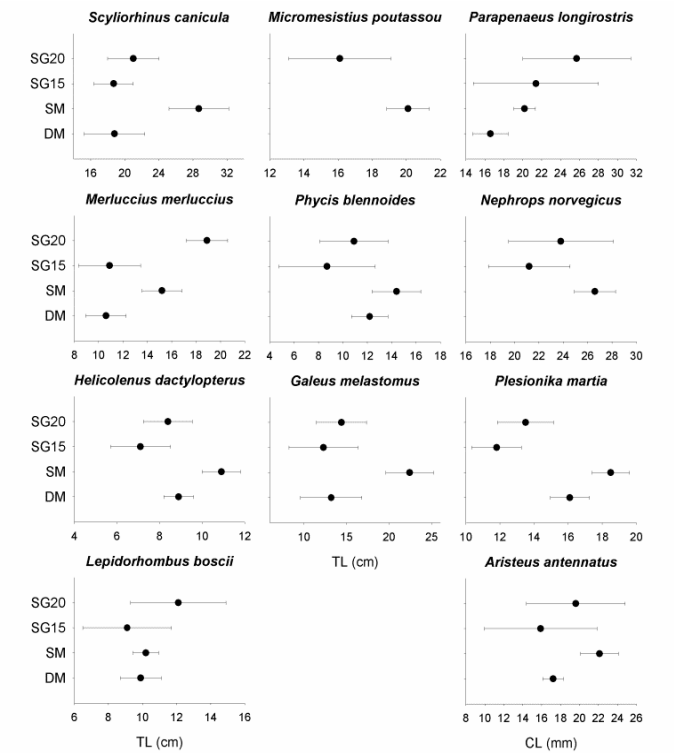
hake; Norway lobster; red shrimp

AREA, VESSEL

21 hauls were carried out in the Balearic Islands multispecies bottom trawl fishery on board the FV Moralti Nou (22.05 m, 365 HP)

GEAR MODIFICATION

The catching performance of two flexible sorting grids, installed in extension piece, were compared on a divided bottom trawl. The lower 25% of the grids did not have bars and led to a 40 mm diamond mesh codend. The upper 75% had bar spacing of either 15 mm (SG15) or 20 mm (SG20)



RESULTS

The 15 mm grid gear retained more smaller individuals of all species.

The 20 mm grid gear was more selective and had fewer discards.

It was concluded that using a 20 mm grid with a 40 mm square mesh codend could be a plausible additional measure to improve selectivity.

FURTHER INFORMATION

enric.massuti@ba.ieo.es

Massutí E., et al.- 2009. Efficiency of flexible sorting grids to improve size selectivity of bottom trawl in the Balearic Islands (western Mediterranean), with comparison to a change in mesh cod-end geometry. Journal of Applied Ichthyology, 25: 153-161.

using 50 mm diamond and 40 mm square mesh codends

to improve the selectivity of the Mediterranean bottom trawl fishery

TARGET SPECIES

striped red mullet; hake; Norway lobster; red shrimp

AREA, VESSEL

315 hauls were carried out in the Balearic Islands bottom trawl fishery on fishing vessels in the size and power ranges of 15 - 23 m and 100 - 400 HP

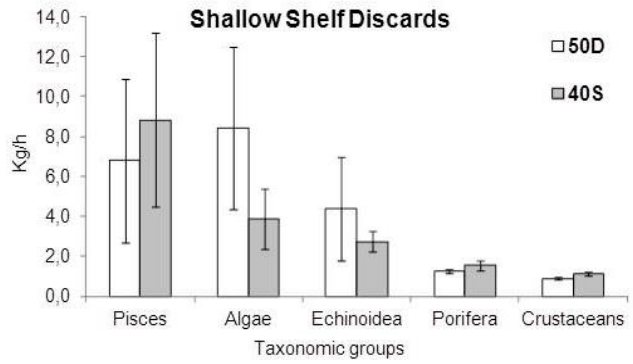
GEAR MODIFICATION

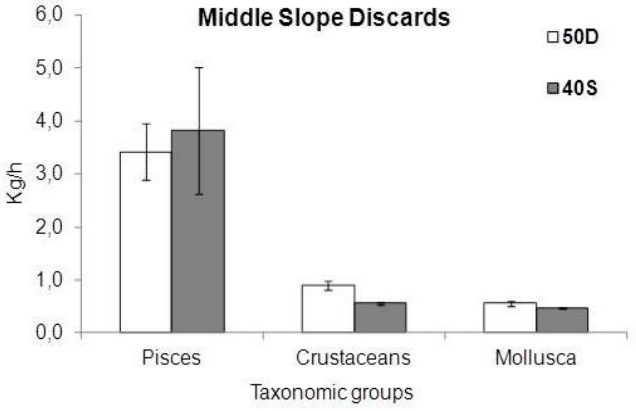
The catching performance of codends made of

(i) 50 mm diamond mesh and

(ii) 40 mm square mesh

were compared





RESULTS

- the 50 mm diamond codend had higher discard rates than the 40mm square mesh codend, especially for the main discards on the shelf (red algae) and on the slope (crustaceans).

- the length frequency distributions did not show overall differences between the 50D and the 40S, but the mean length of hake catches below the minimum landing size (MLS) was significantly higher with the 40S (17 cm) than with the 50D (16 cm).

FURTHER INFORMATION

enric.massuti@ba.ieo.es;

Zapata M.A. F. Ordines and B. Guijarro.- Submitted. Selectivity in a Mediterranean bottom trawl fishery

changing mesh shape and increasing mesh size

to reduce discards in the bottom trawl fishery in the southern Black Sea, Turkey

TARGET SPECIES

Whiting and red mullet

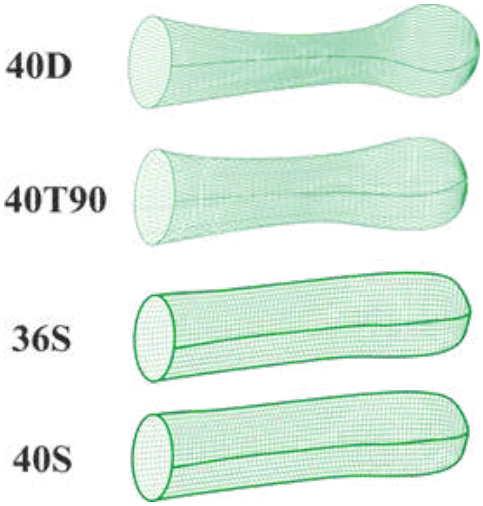
AREA, VESSEL

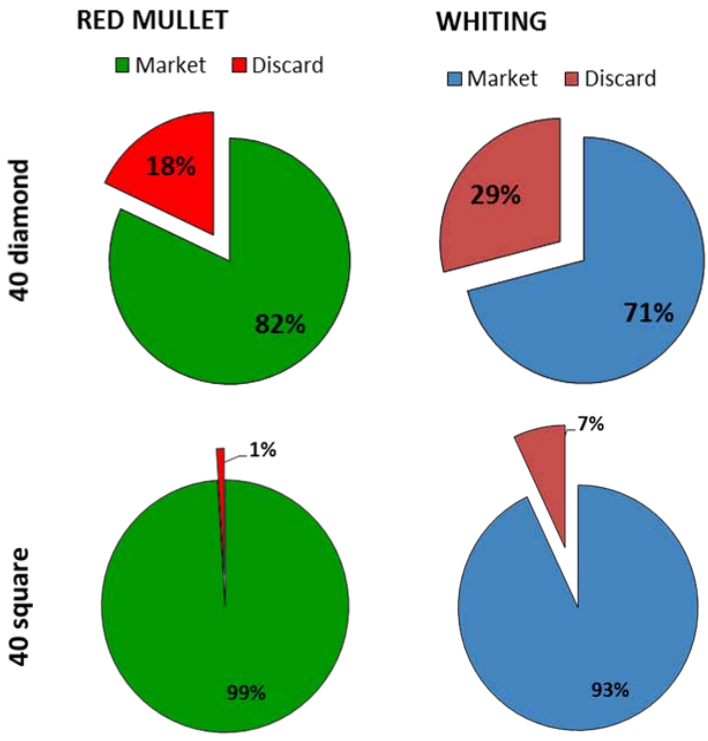
21 covered codend hauls were carried out in the southern Black Sea during 2014.

GEAR MODIFICATION

The catching performance of a standard commercial 40 mm diamond mesh codend is compared with the catching performance of

(i) a 36 mm square mesh codend
(ii) a 40 mm square mesh codend
(iii) a 40 mm T90 mesh codend





RESULTS

The conventional 40 mm diamond mesh codend is the least selective and has discard rates of 18% for red mullet and 29% for whiting.

The 40 mm square mesh codend is the most selective and has discard rates of 1% for red mullet and 7% for whiting

The 36 mm square mesh codend and the 40 mm T90 codend have intermediate selectivity values.

FURTHER INFORMATION

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using a 40 mm square mesh codend to reduce discards in the eastern Mediterranean

TARGET SPECIES

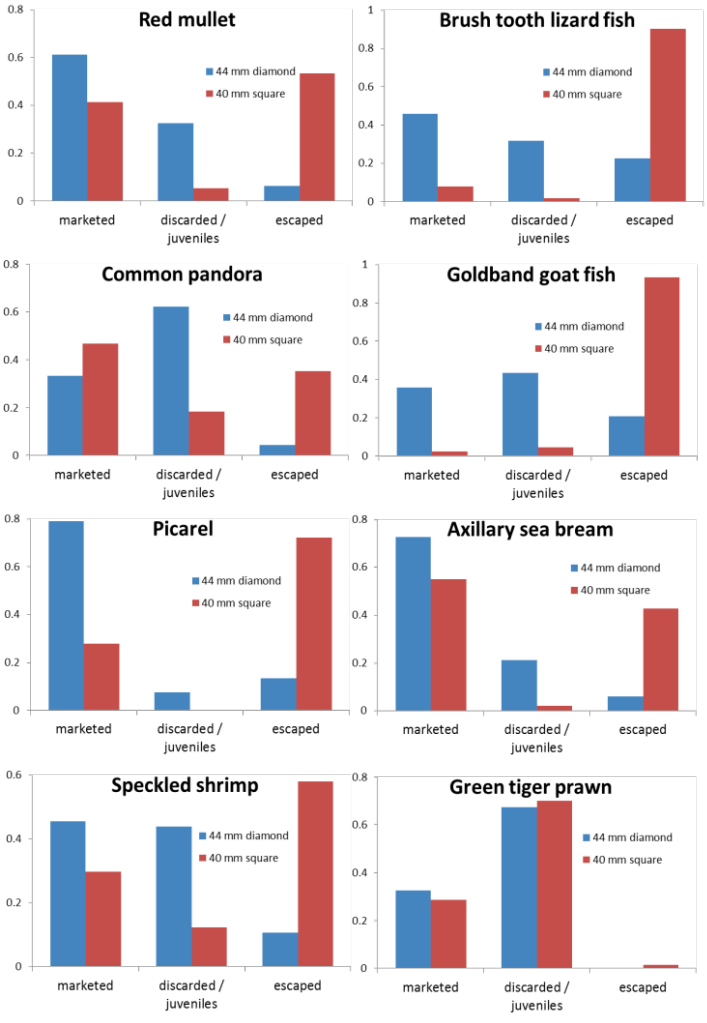
Red mullet, brush tooth lizardfish, common pandora, goldband goat fish, picarel, axillary sea bream, speckled shrimp, green tiger prawn and other marketable fish and crustaceans

AREA, VESSEL

46 covered codend hauls were carried out onboard commercial trawler 'Azim' (18 m LOA, 350 HP) in Mersin Bay in 2011.

GEAR MODIFICATION

The catching performance of a hand made 44 mm diamond mesh commercial codend was compared with that of machine woven 40 mm square mesh codend.



RESULTS

the square mesh codend reduced the numbers of juveniles caught. But there were also significant losses of marketable brushtooth lizard fish and goldband goat fish.

FURTHER INFORMATION

Hüseyin Özbilgin (ozbilginh@gmail.com) Project: TUBITAK/109O684
Mersin University, Fisheries Faculty, Mersin, Turkey

using a modified Nordmore grid to sort out blue whiting and boarfish in a crustacean fishery

TARGET SPECIES

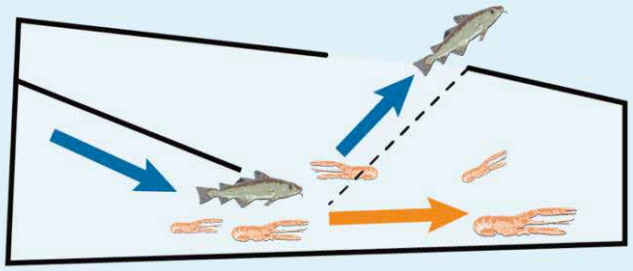
***Nephrops*, rose shrimp, red shrimp**

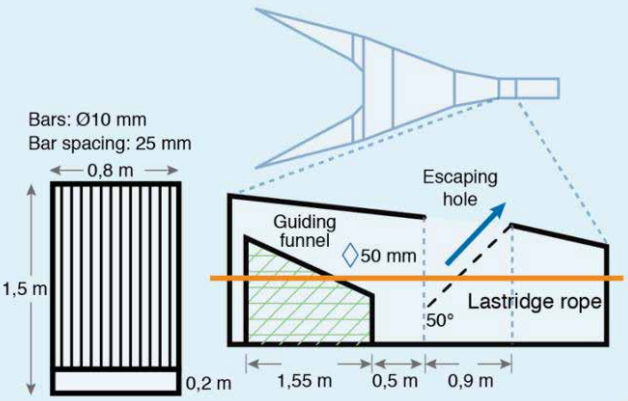
AREA, VESSEL

41 hauls were carried out in crustacean fishing grounds on the Portuguese south coast onboard the RV *Noruega* (47.5m, 1500 HP) during May 2001

GEAR MODIFICATION

Using a modified Nordmore grid with a lower opening passage and a guiding funnel. The system was designed to sort out fish bycatch while retaining crustaceans





RESULTS

Catches of blue whiting and boarfish were reduced by 75 and 48%.

The marketable losses of rose shrimp and *Nephrops* were 3.7% and of red shrimp 5.7%.

FURTHER INFORMATION

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using a modified Nordmore grid to sort out fish bycatch in a crustacean fishery

TARGET SPECIES

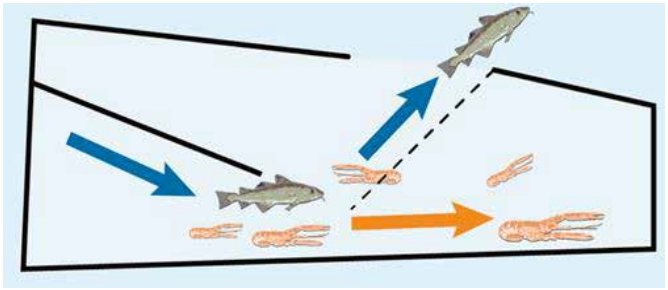
***Nephrops*, rose shrimp, red shrimp**

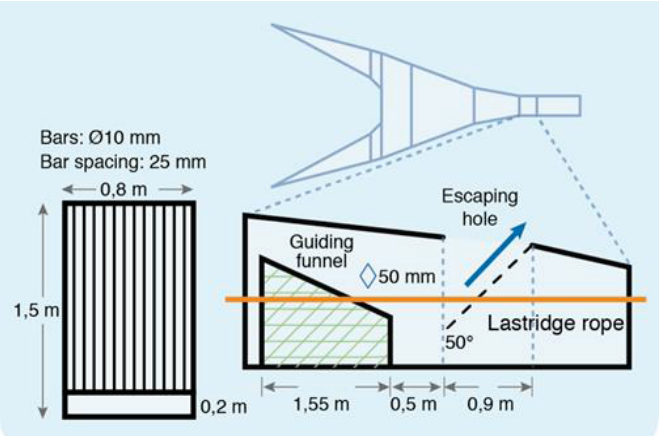
AREA, VESSEL

5 hauls were carried out in the crustacean fishery on the Portuguese south coast on board the FV *Costa Sul* (24.0m, 600 HP) during November 2004

GEAR MODIFICATION

Using a modified Nordmore grid with a lower opening passage and a guiding funnel. The system was designed to sort out fish bycatch while retaining crustaceans





RESULTS

The grid sorted out

- **93.3% of blue whiting**
- **86.8% of unmarketable hake and 69.6% of marketable ones.**
- **4.3% of marketable rose shrimp**
- **5.9% of marketable *Nephrops***

FURTHER INFORMATION

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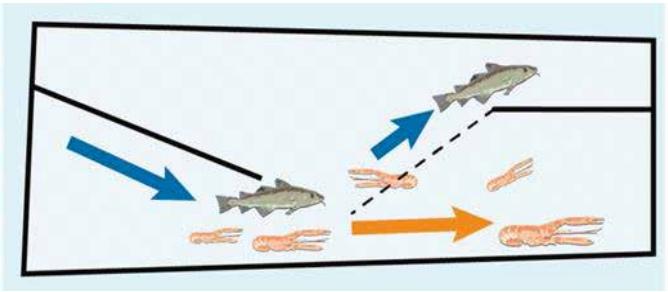
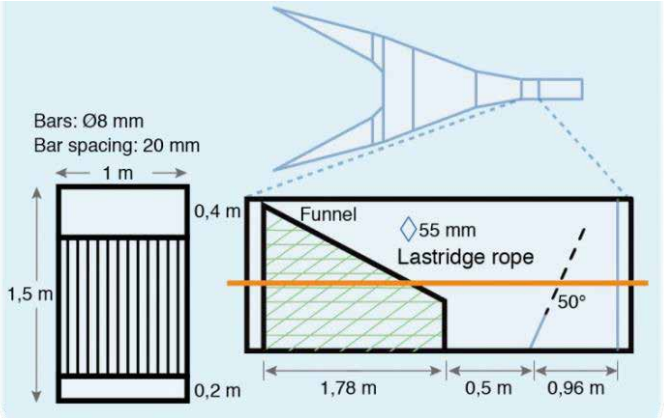
using a grid in a crustacean fishery
to separate crustaceans from fish bycatch

TARGET SPECIES
***Nephrops*, rose shrimp**

AREA, VESSEL
18 hauls were carried out in the crustacean fishery on the Portuguese south coast on board the RV *Noruega* (47.5m, 1500 HP) during July 2005

GEAR MODIFICATION
a grid connected to two sections is fitted in the extension section of a crustacean demersal trawl. The grid has a 20 mm bar spacing and is designed to separate crustaceans and fish into a lower and an upper codend where further selection can take place.





RESULTS
30% of *Nephrops* were caught at the upper codend

blue whiting was equally distributed between the two codends

FURTHER INFORMATION
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DiscardLess

www.discardless.eu/selectivity_manual

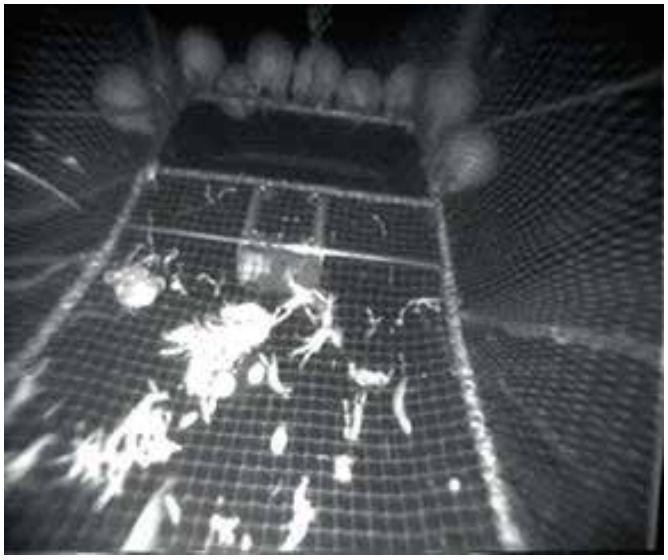
using a square mesh netting grid to sort out juvenile *Nephrops* in crustacean fishery

TARGET SPECIES

***Nephrops*, rose shrimp, commercial hake**

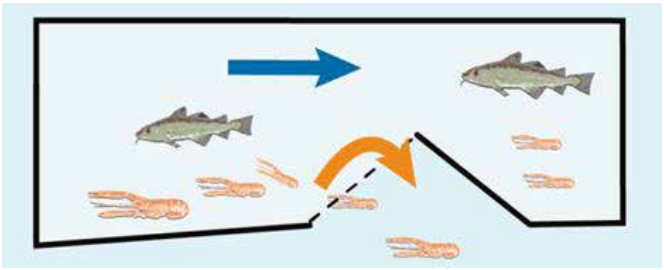
AREA, VESSEL

22 hauls were carried out in the crustacean fishery on the Portuguese south coast on board the FV Gemini (24.0 m, 600 HP) during November 2005

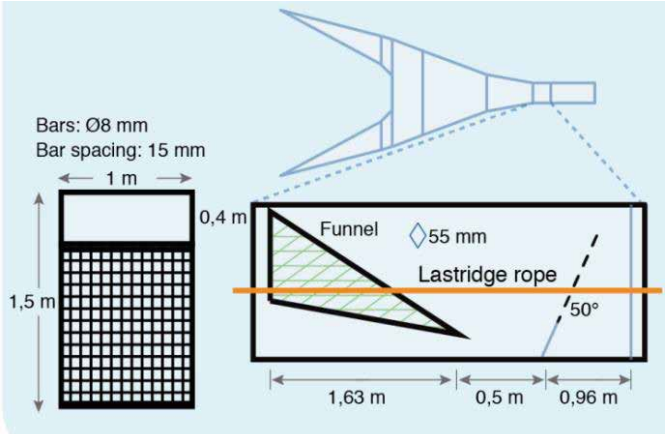


GEAR MODIFICATION

a grid with a square mesh netting lower escape section and an upper section connected to the codend is fitted into the extension of a crustacean demersal trawl.



The selection is essentially mechanical, based mainly on size differences



RESULTS

27.1 % of immature and 6.1 % of mature *Nephrops* were excluded.

12.8% of unmarketable hake were excluded, while all marketable hake were retained.

4.3% of blue whiting were excluded.

FURTHER INFORMATION

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DiscardLess

www.discardless.eu/selectivity_manual

using a square mesh codend to sort out juvenile *Nephrops* in a crustacean fishery

TARGET SPECIES

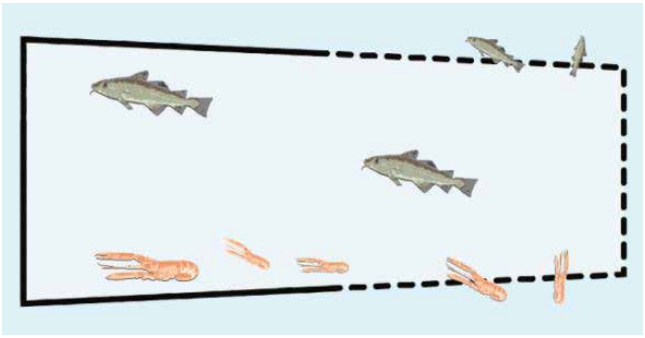
***Nephrops*, rose shrimp, hake**

AREA, VESSEL

22 hauls were carried out in the crustacean fishery on the Portuguese south coast on board the FV *Saturno* (24.8 m, 800 HP) during August 2006

GEAR MODIFICATION

a 60mm square mesh codend made from 3.5mm double twine Euroline Premium netting was used



RESULTS

69 % of immature and 41 % of mature *Nephrops* were excluded.

62 % of undersized and 39 % of marketable rose shrimp were excluded

71% of unmarketable hake were excluded, but there were no losses of marketable hake.

nearly all blue whiting was excluded.

FURTHER INFORMATION

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increasing the mesh size of a diamond mesh codend

to reduce capture of undersized fish in Mediterranean bottom trawls

TARGET SPECIES

Red mullet, European hake, little squid and all marketable species

AREA, VESSEL

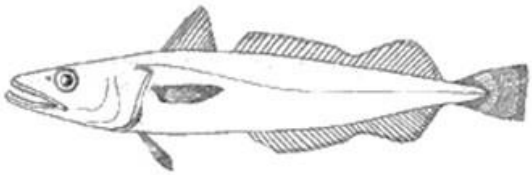
68 hauls took place during 2005 on board the RV "G. Dallaporta" (810 kW; 35.30 m; 285 GT) in the Central Adriatic

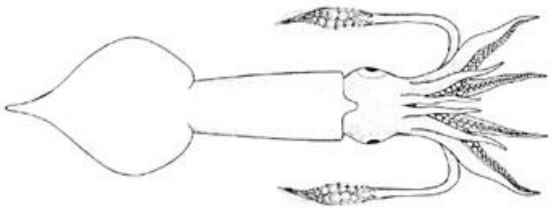
GEAR MODIFICATION

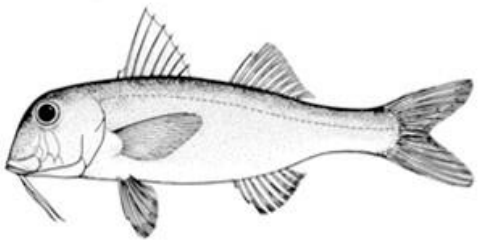
The catches from a Mediterranean demersal trawl with

- **a 48 mm diamond mesh codend and**
- **a 56 mm diamond mesh codend**

are compared







RESULTS

Increasing the mesh size from 48 to 56 mm

- **increased the selectivity of European hake by 42% and 15%**
- **increased the selectivity of red mullet by 19% and 33%;**
- **increased the selectivity of little squid by 16% and 22% and**

FURTHER INFORMATION

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Consiglio Nazionale delle Ricerche

inserting a 50 mm square mesh panel (SMP) to reduce capture of undersized fish in Mediterranean bottom trawls

TARGET SPECIES

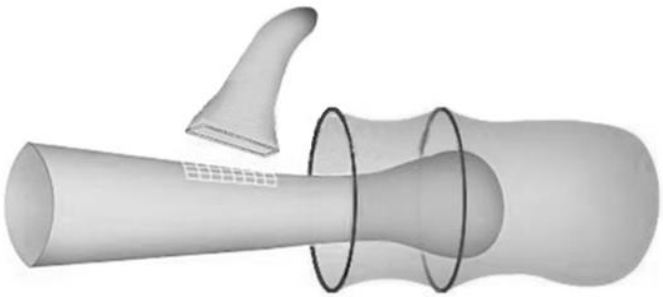
Atlantic horse mackerel, European hake, poor cod, broadtail shortfin squid, deep-water rose shrimp and all marketable species

AREA, VESSEL

8 hauls took place during 2012 on board the commercial trawler "Angela Madre" (206 kW, 22.7 m, 67 GT) in the Tyrrhenian Sea

GEAR MODIFICATION

A 50 mm square-mesh panel was inserted 8 m in front of a 50 mm diamond mesh codend in a Mediterranean bottom trawl.
Small mesh covers were used to catch the fish escaping through the SMP and the codend.



RESULTS

The square mesh panel did not contribute much to the overall release efficiency.
This may be due to the large distance it was from the codline (8 m)

% escaping through the smp

	undersized	marketable	total
Atlantic horse mackerel	8.6	0.5	5.3
European hake	0.9	0	0.8
Red mullet	7.7	0.9	1.3
Poor cod			1.7
Broadtail shortfin squid			0.2
Deep-water rose shrimp	4.8	1	2

% retained in the codend

	undersized	marketable	total
Atlantic horse mackerel	6	79	36
European hake	30	100	39
Red mullet	69	81	80
Poor cod			47
Broadtail shortfin squid			66
Deep-water rose shrimp	38	91	76

FURTHER INFORMATION

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Consiglio Nazionale delle Ricerche

DiscardLess

www.discardless.eu/selectivity_manual

inserting an excluder grid to avoid catching Blackmouth catshark in the Mediterranean bottom trawl fishery.

TARGET SPECIES

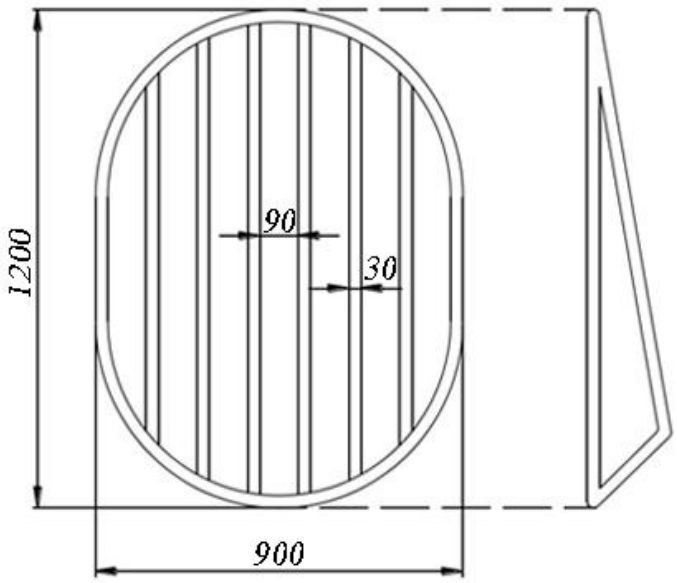
Norway lobster, greater forkbeard and all marketable species

AREA, VESSEL

6 hauls took place during 2012 on board the FV "Angela Madre" (206 kW, 22.7 m, 67 GT) in the Tyrrhenian Sea.

GEAR MODIFICATION

An excluder grid of 90 mm bar spacing was inserted in front of the 50 mm diamond mesh codend of a standard commercial demersal trawl



% retained	Blackmouth catshark	Norway lobster	Greater forkbeard
undersized	-	88	-
marketable	-	94	-
total	79	94	39

RESULTS

Bigger individuals of Blackmouth catshark escaped ahead of the grid.
A large proportion of greater forkbeard were excluded by the grid.
A small percentage of marketable Norway lobster were excluded by the grid.
Reducing the grid bar spacing to 70 mm could provide a good trade-off between the reduction of Blackmouth catshark catches while keeping a high catch rate of greater forkbeard and Norway lobster.

FURTHER INFORMATION

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Consiglio Nazionale delle Ricerche

decreasing the circumference of a diamond mesh codend

to reduce capture of undersized fish in the Italian demersal trawl fishery

TARGET SPECIES

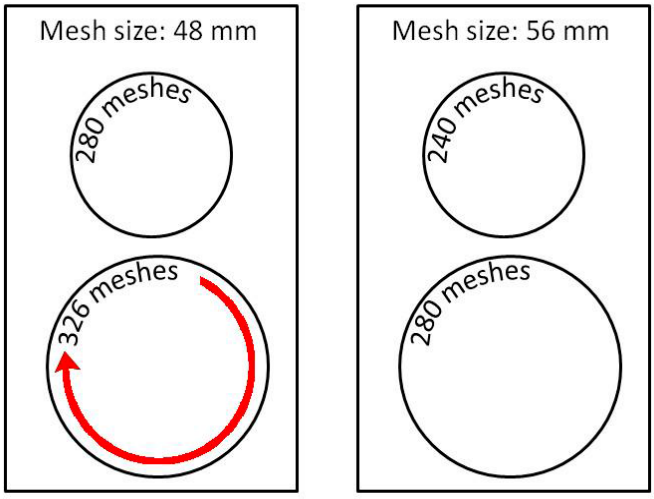
red mullet, european hake, little squid and all marketable species

AREA, VESSEL

68 hauls took place during 2005 on board the RV "G. Dallaporta" (810 kW; 35.30 m; 285 GT) in the Central Adriatic

GEAR MODIFICATION

The catches from
- two 48mm diamond mesh codends, having 280 and 326 meshes in circumference
and those from
- two 56 mm diamond mesh codends with 240 and 280 meshes in circumference are compared



RESULTS

Increasing the codend circumference

- decreased the selectivity of red mullet by 30% and 38%

- decreased the selectivity of european hake by 9% and 41% and

- decreased the selectivity of little squid by 18% and 13%

FURTHER INFORMATION

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Consiglio Nazionale delle Ricerche

DiscardLess

www.discardless.eu/selectivity_manual

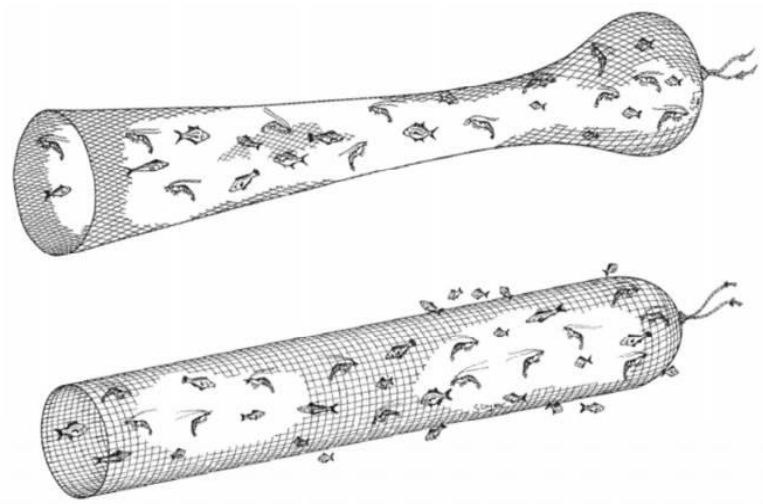
using 40mm square mesh codend to reduce capture of undersized fish in the Italian demersal trawl fishery

TARGET SPECIES

Mediterranean scaldfish, broad-tail shortfin squid, European hake, red mullet, Norway lobster, common pandora, deepwater rose shrimp, Mediterranean horse mackerel, poor-cod and all marketable species

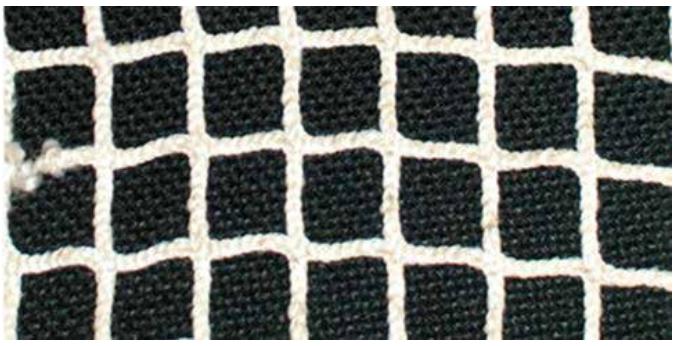
AREA, VESSEL

47 hauls took place during 2004 on board the RV Andrea (29.15 m; 285 GT) in the Central Adriatic Sea



GEAR MODIFICATION

The catch from a 40 mm diamond mesh codend is compared with that of a 40 mm square mesh codend



RESULTS

the 40 mm square mesh codend was more selective then 40 mm diamond mesh for all species except for the flatfish, Mediterranean scaldfish

The improvement was
76% for broad-tail shortfin squid
70% for European hake
36% for red mullet
23% for Norway lobster
27% for common pandora
26% for deepwater rose shrimp
36% for Mediterranean horse mackerel and
36% for poor-cod.
For Mediterranean scaldfish the square mesh codend was 8% less selective than the 40 mm diamond mesh codend.

FURTHER INFORMATION
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Consiglio Nazionale delle Ricerche

DiscardLess

www.discardless.eu/selectivity_manual

reducing codend twine thickness to reduce capture of undersized fish in the Italian demersal trawl fishery

TARGET SPECIES

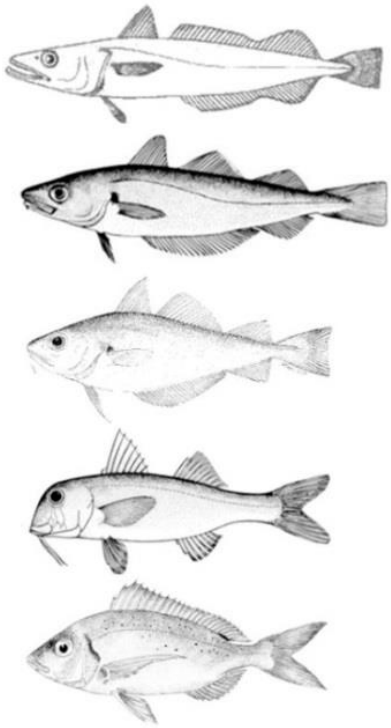
European hake, Whiting, Poor-cod, Red mullet, Common pandora and all marketable species

AREA, VESSEL

54 hauls took place during 2004 on board the RV "G. Dallaporta" (810 kW; 35.30 m; 285 GT) in the Central Adriatic

GEAR MODIFICATION

The catches from two codends with the same mesh size (44 mm) but with different twine thicknesses are compared. The twine thicknesses are as follows
(i) light PA: R3644tex, Ø 2.38 mm
(ii) heavy PA: R5312tex, Ø 2.89 mm



RESULTS

Using a codend made from thinner twine (2.38 mm) instead of one made from thicker twine (2.89 mm) improves the selectivity for all species

There is an improvement of
25% for European hake,
23% for whiting,
30% for poor cod,
20% for red mullet and
23% for common pandora.

FURTHER INFORMATION

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Consiglio Nazionale delle Ricerche

DiscardLess

www.discardless.eu/selectivity_manual

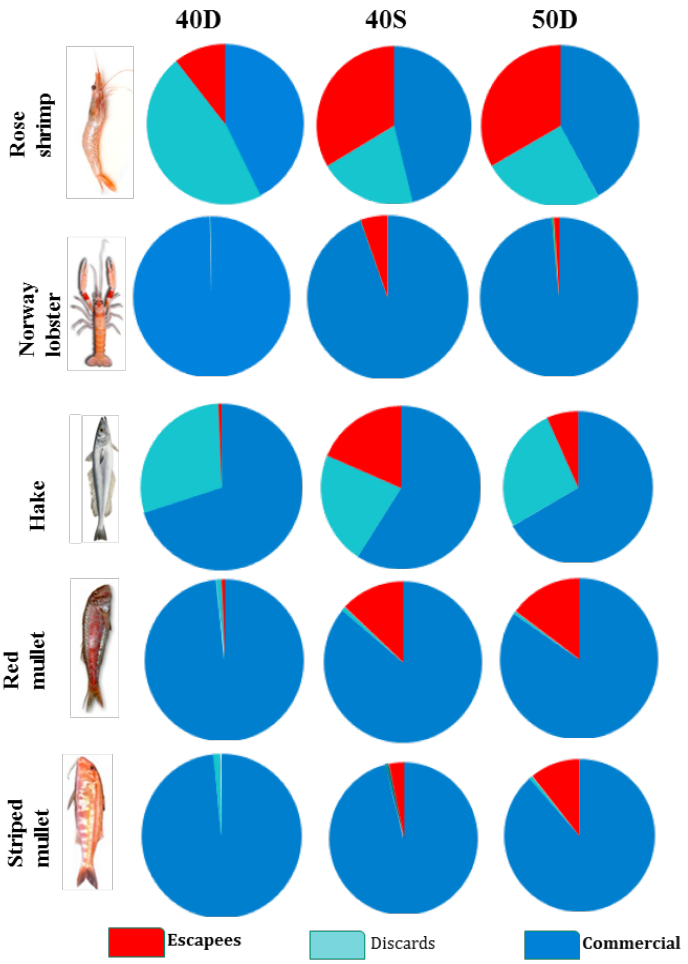
diamond and square mesh codends to improve selection and reduce discards in the Greek demersal trawl fishery

TARGET SPECIES

Hake, red mullet, striped mullet, rose shrimp and *Nephrops*

AREA, VESSEL

162 hauls were carried out in the South Aegean Sea on board the Takis-Mimis NX 411 (29m, 357kW) during 2014 and 2015.



GEAR MODIFICATION

The catching performance of codends made of

(i) 40 mm diamond mesh
(ii) 40 mm square mesh and
(iii) 50 mm diamond mesh
were compared

RESULTS

In general, there were more escapes from the 40 mm square and the 50 mm diamond codends.

- Nevertheless, commercial catch was not significantly altered, except for stripped mullet in the 50mm diamond mesh codend

- the 40 mm square mesh reduced discards of hake, rose shrimp and *Nephrops*

- the 50 mm diamond mesh codend reduced discards of rose shrimp and *Nephrops*

FURTHER INFORMATION

Chryssi Mytilineou, chryssi@hcmr.gr .
http://epilexis.hcmr.gr/index.php?lang=en

hcmr ΕΛΚΕΘΕ

DiscardLess

www.discardless.eu/selectivity_manual

using a 300mm Square Mesh Panel to reduce fish discards in a *Nephrops* trawl

AIM

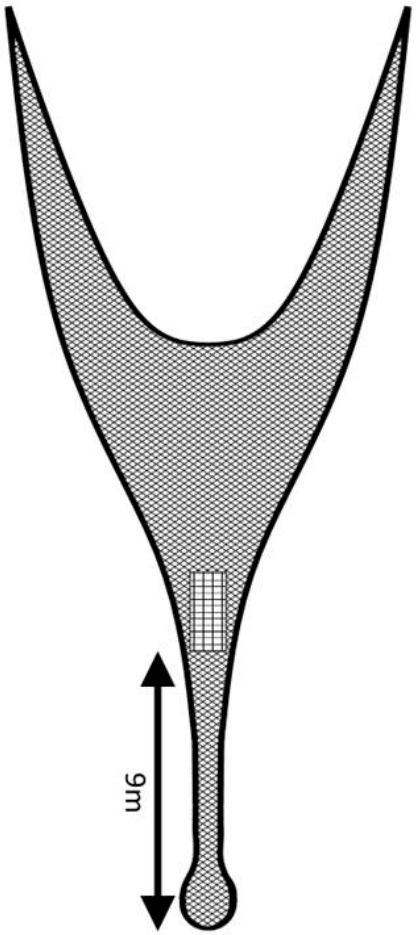
To assess the effect of fitting a 300mm square mesh panel on catches of fish and *Nephrops*.

TARGET SPECIES

Nephrops

AREA, VESSEL

23 quad-rig catch comparison hauls took place in the western Irish Sea (ICES VIIa) on board MFV Stella Nova (DA57) (23.5m, 441kW) during August 2014.



GEAR MODIFICATION

A 300mm square mesh panel was inserted 9m from the cod-line in the test gear.
The standard gear was identical but without a square mesh panel.
Nominal codend mesh size and fishing circle were 80 mm and 386 X 70 mm.

Species	Standard gear catch (kg)	300mm SMP catch (kg)	Difference (%)
Haddock	214	65	-70
Whiting	136	66	-52
Nephrops	1106	1262	14

RESULTS

There were reduced catches of haddock and whiting across all size grades.

The *Nephrops* catches were not reduced.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)
http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

increasing codend mesh size from 70 to 80mm to reduce *Nephrops* discards

AIM

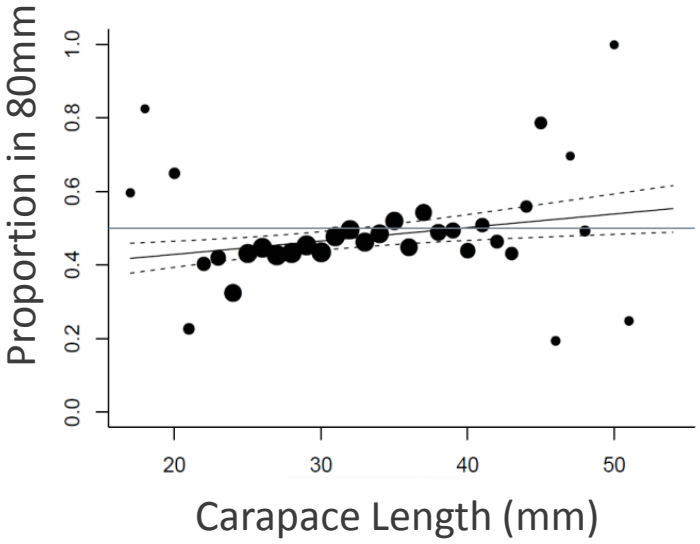
To assess the effect of an increase in diamond codend mesh size from 70 to 80mm on catches of *Nephrops*.

TARGET SPECIES

Nephrops

AREA, VESSEL

13 quad-rig catch comparison hauls took place in the western Irish Sea (ICES VIIa) on board a 22m *Nephrops* trawler during July 2015.



Species	70mm codend (kg)	80mm codend (kg)	Difference (%)
Nephrops <25mm CL	53	29	-45.3
Nephrops ≥25mm CL	2040	1808	-11.4

GEAR MODIFICATION

70 and 80mm (nominal) diamond mesh codends were tested simultaneously on identical quad-rigged *Nephrops* trawls (fishing circle 380 x 80mm).

RESULTS

There were significant reductions in the proportion of small *Nephrops* caught.

Economic modelling showed that there was no loss in profitability over the course of a fishing season.

Catching fewer small *Nephrops* provides the opportunity to catch increased quantities of larger more valuable size grades.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)

http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a modified Nordmøre grid to reduce *Nephrops* discarding

AIM

To assess the effect of a sorting grid on catches of *Nephrops*

TARGET SPECIES

Nephrops

AREA, VESSEL

The quad-rig catch comparison trial took place in the western Irish Sea (ICES VIIa) on board MFV Our Lass II (DA261) (21.7m, 484kW) during September 2015.

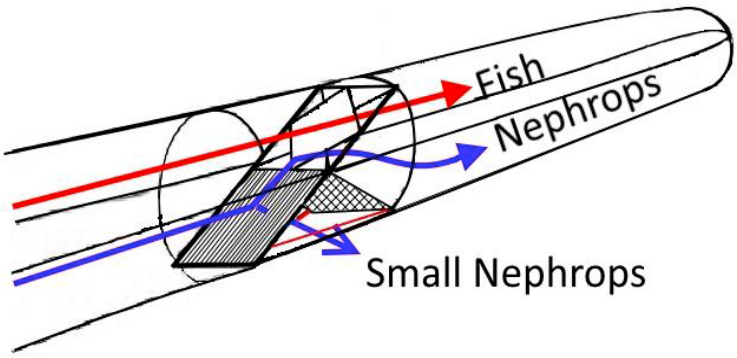
GEAR MODIFICATION

The test gear was fitted with a modified Nordmøre grid:

- **Vertical bars spaced 15mm apart in the lower half**
- **Reinforced opening in the top half**
- **Guiding panel and escape hole in bottom sheet of trawl to the rear of the grid**

The standard gear was identical but without a rigid grid.

Nominal codend mesh size and fishing circle were 70mm and 380 X 80 mm.



Species	Standard gear catch (kg)	Grid gear catch (kg)	Difference (%)
Nephrops <25mm CL	454	293	-35
Nephrops ≥25mm CL	1454	1232	-15
Nephrops >31mm CL	346	332	-4

RESULTS

- **There was a reduction of 35% in small *Nephrops*.**
- **A reduction of 4% in whole *Nephrops* (>31mm).**
- **There was no reduction in catches of small or large fish.**

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)

http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a quad-rig trawl to improve selection in a *Nephrops* fishery

AIM

To compare catches of *Nephrops* and fish in twin and quad-rigged *Nephrops* trawls

TARGET SPECIES

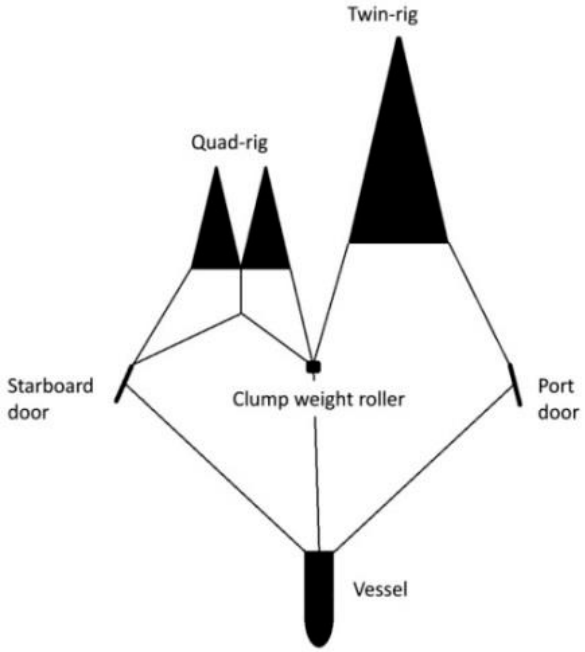
Nephrops

AREA, VESSEL

30 catch comparison hauls, using a hybrid twin/ quad-rig, took place in the Celtic Sea (ICES VIIg) on board MFV Celtic Chieftain (DA2) (22.4m, 431kW) during April 2014.

GEAR MODIFICATION

Half a twin-rig and half a quad-rig were towed side by side.
Nominal fishing circle for the quad and twin-rig trawls was 380 x 80mm and 650 x 80mm respectively.
Nominal mesh size was 70mm throughout and a 110mm square mesh panel was fitted between 9 and 12m from the codline in all gears.



Species	Twin- rig (kg)	Quad-rig (kg)	Difference (%)
Tailed *Nephrops*	90	185	106
Whole *Nephrops*	379	537	48
Cod	137	53	-61
Haddock	428	266	-38
Whiting	259	252	-3

RESULTS

In the quad-rig there were increased catches of *Nephrops* of all sizes.
Increased catches of small *Nephrops* and small cod.
Reduced catches of large cod and haddock of all sizes.

The results demonstrate improved species selectivity but also a need to improve size selectivity in the quad-rig.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)
http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a Swedish grid with a bottom gap to reduce fish discards in a *Nephrops* trawl

AIM

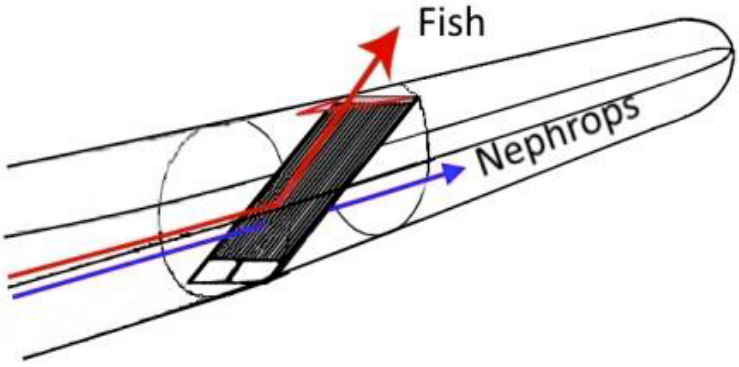
To assess the effect of a rigid grid with a bottom gap to sort catches of fish and *Nephrops*.

TARGET SPECIES

Nephrops

AREA, VESSEL

12 quad-rig catch comparison hauls took place in the western Irish Sea (ICES VIIa) on board MFV Our Lass II (DA261) (21.7m, 484kW) during September 2015.



Species	Standard gear catch (kg)	Grid catch (kg)	Difference (%)
Whiting	183	42	-77.0
Cod	75	0	-100.0
Haddock	42	4	-90.5
Nephrops <25mm CL	454	445	-2.0
Nephrops ≥25mm CL	1454	1389	-4.5

GEAR MODIFICATION

The test gear was fitted with a Swedish grid that had

- **Vertical bars spaced 35mm apart in the lower and upper halves of the grid.**
- **A 15cm reinforced horizontal gap in the bottom of the grid**
- **An escape hole in the top sheet forward of the grid.**

The standard gear was identical but without a rigid grid.

Nominal codend mesh size was 70mm for both gears.

RESULTS

There was a substantial reduction in whiting, cod and haddock across all length classes,

and a small reduction in catches of *Nephrops* across all length classes.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)

http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a 65mm square mesh codend to reduce discards in a *Nephrops* trawl

AIM

To investigate the effect of a 65mm square mesh codend on catches of *Nephrops* and fish.

TARGET SPECIES

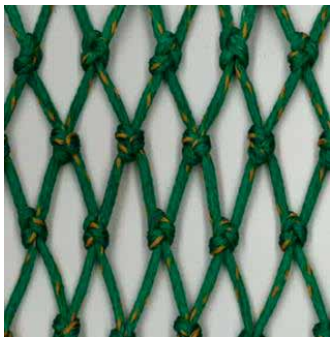
Nephrops

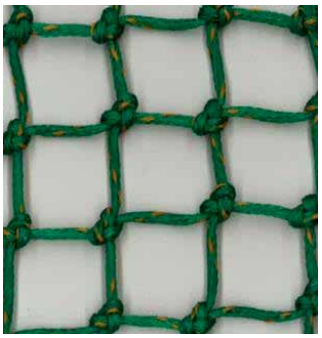
AREA, VESSEL

12 catch comparison hauls took place at the Smalls ground in the Celtic Sea (ICES VIIg) on board MFV Stella Nova (DA57) (23.5m, 441kW).

GEAR MODIFICATION

A 65 mm (nominal) square mesh codend was tested against a 75mm (nominal) diamond mesh codend using identical quad-rigged *Nephrops* trawls. Nominal fishing circle was 420 x 80 mm.





Species		75mm diamond (kg)	65mm square mesh (kg)	Diff (%)
Nephrops	< 25 mm CL	60	22	-63
	tails (25 – 31 mm CL)	416	154	-63
	whole (> 31 mm CL)	830	526	-37
whiting		116	74	-37
haddock		476	256	-46

RESULTS

In the 65 mm square mesh codend there were large reductions in catches of whole, tailed and unmarketable *Nephrops*.

There were also large reductions in haddock and whiting catches.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)

http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a T90 mesh codend and extension to reduce whiting discards

AIM

To assess the effect of T90 mesh in the codend and extension piece on catches of whiting.

TARGET SPECIES

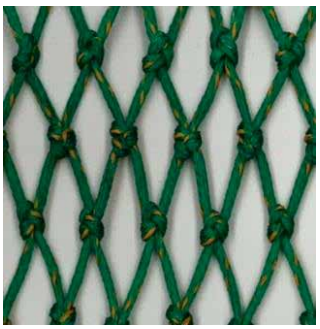
Whiting

AREA, VESSEL

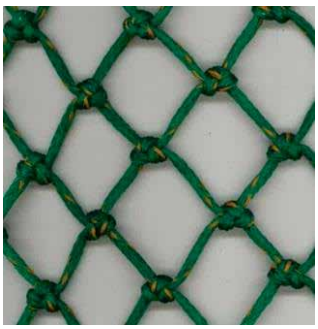
13 twin-rig catch comparison hauls took place in the Celtic Sea (ICES VIIg) on board MFV Foyle Fisher (G497) (24.7m, 441kW) during April 2016.

GEAR MODIFICATION

Test gear fitted with codend and extension piece constructed with T90 mesh.
Standard gear was identical but the codend and extension piece were constructed with diamond mesh.
80mm nominal double 4mm compact PE twine used on both gears.



diamond mesh



T90

Species		Standard gear catch (count)	T90 catch (count)	Diff (%)
whiting	< 32 cm	2628	857	-67
	≥ 32 cm	6691	7774	16
haddock	< 30 cm	238	223	-6
	≥ 30 cm	3432	10427	204
plaice	< 27 cm	394	837	113
	≥ 27 cm	562	639	14

RESULTS

In the T90 codend there were significant reductions in the catches of small whiting and haddock.
There were increases in the catches of larger haddock, whiting and plaice.
However, there was also a significant increase in catches of small plaice.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)
http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using a 45mm square mesh codend to reduce discards in a *Nephrops* trawl

AIM

To investigate the effect of a 45mm square mesh codend on catches of *Nephrops* and fish.

TARGET SPECIES

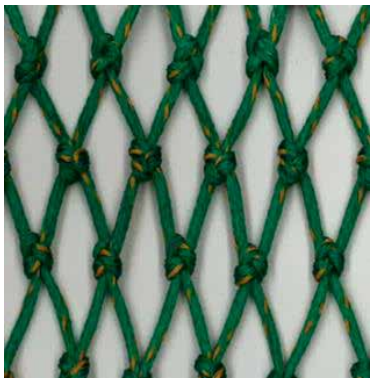
Nephrops

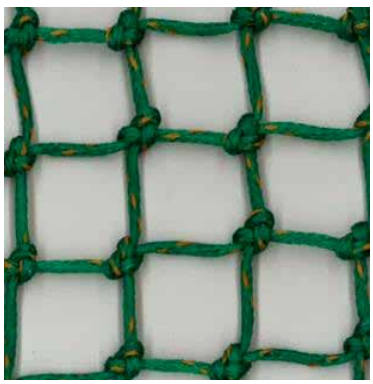
AREA, VESSEL

12 quad-rig catch comparison hauls took place at the Smalls ground in the Celtic Sea (ICES VIIg) on board MFV Stella Nova (DA57) (23.5m, 441kW).

GEAR MODIFICATION

A 45mm (nominal) square mesh codend was tested against a 75mm diamond mesh codend using identical quad-rigged *Nephrops* trawls. Nominal fishing circle was 420 X 80mm.





Species		75mm diamond (kg)	45mm square mesh (kg)	Diff (%)
Nephrops	< 25 mm CL	60	53	-10
	tails (25 – 31 mm CL)	416	379	-9
	whole (> 31 mm CL)	830	892	7
whiting		116	120	3
haddock		476	532	12

RESULTS

In the 45 mm square mesh codend there were small reductions in catches of unmarketable and tailed *Nephrops* and a small increase in catches of whole *Nephrops*.

There were also small increases in haddock and whiting catches.

FURTHER INFORMATION

Daragh Browne (browned@bim.ie)

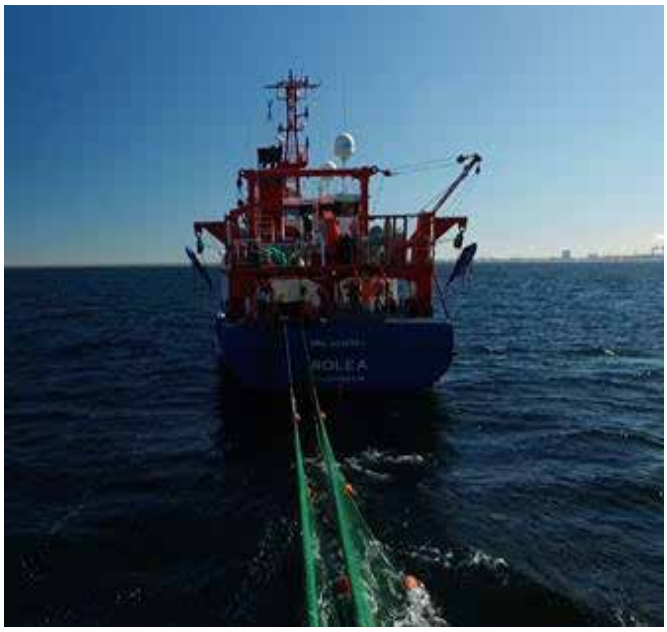
http://www.bim.ie/our-publications/fisheries/

BIM Ireland's Seafood Development Agency

using FLEX – FLatfish EXcluder –
to reduce the bycatch of flatfish and undersized roundfish in trawl fisheries

TARGET SPECIES
cod and other roundfish.

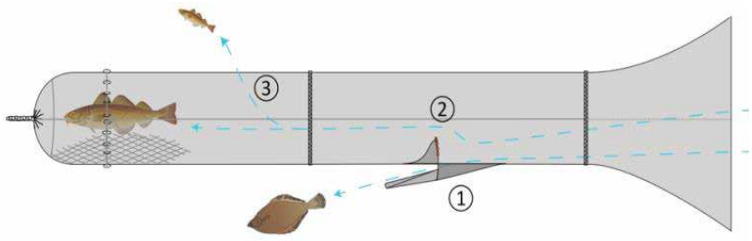
AREA, VESSEL
Tested in the western Baltic sea (SD24) onboard the RV Solea (42.40 m, 1780 kW).

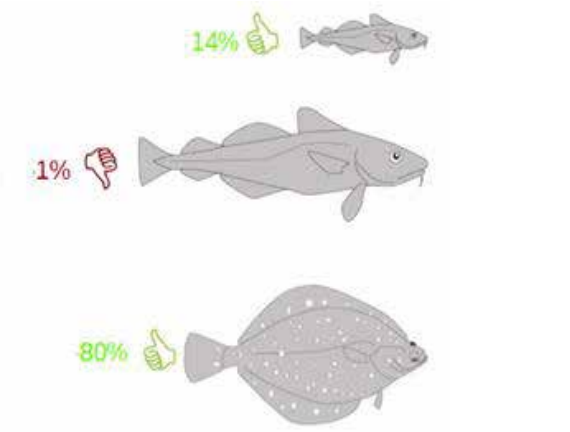


GEAR MODIFICATION
1) **FLEX is an outlet in the lower panel of the net, designed to take advantage of the swimming path of flatfish to improve their escape.**

2) **A flapper situated above the outlet discourages roundfish using FLEX.**

3) **Further selection of fish that do not pass through FLEX takes place in the codend.**





RESULTS
Fishing with FLEX reduces catches of juvenile cod by 14% and plaice by 80%. There were only 1% losses of marketable cod.

FURTHER INFORMATION
juan.santos@thuenen.de; Bernd.mieske@thuenen.de
Demo video: https://vimeo.com/124924775

THÜNEN

DiscardLess

www.discardless.eu/selectivity_manual

using FRESWIND

to reduce the capture of flatfish and undersized roundfish in trawl fisheries

TARGET SPECIES

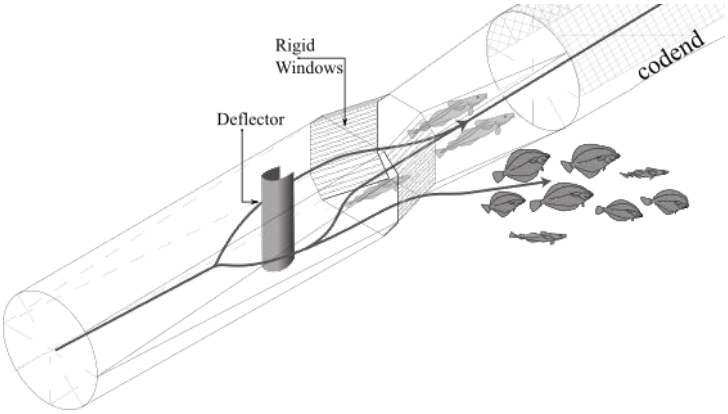
Cod and other roundfish

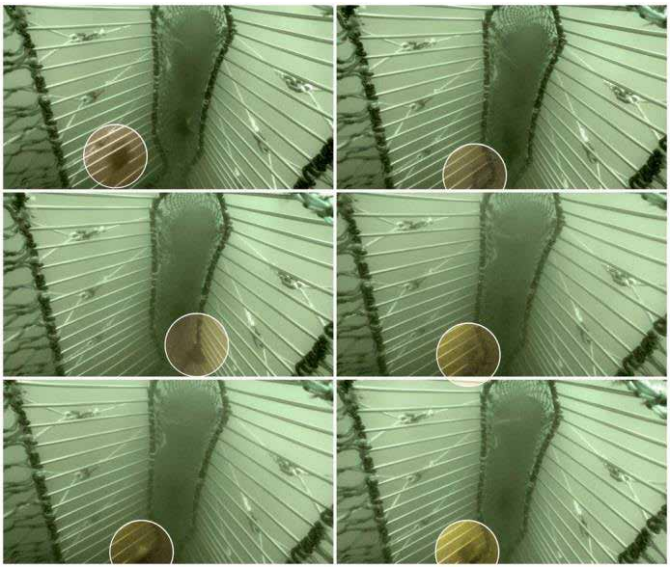
AREA, VESSEL

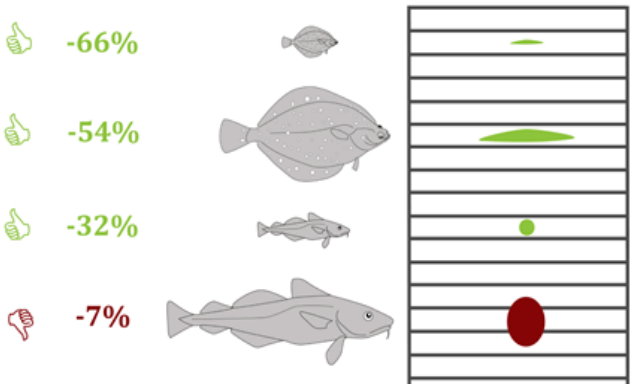
Trials took place in the western Baltic sea (SD24) onboard the RV Clupea (28.80m, 478 kW) and the FV Crampas (18 m, 219 kW).

GEAR MODIFICATION

Fish entering the gear are guided sideways by the deflector towards the escapement windows where size selection takes place. Fish not using FRESWIND to escape will be size selected in the codend.







RESULTS

Using Freswind reduces catches of flatfish by between 54 and 66% and undersized cod by 32%.
There is a 7% loss of marketable cod.

FURTHER INFORMATION

Juan Santos juan.santos@thuenen.de; Bernd Mieske Bernd.mieske@thuenen.de
demo video: https://vimeo.com/111729527

THÜNEN

DiscardLess

www.discardless.eu/selectivity_manual

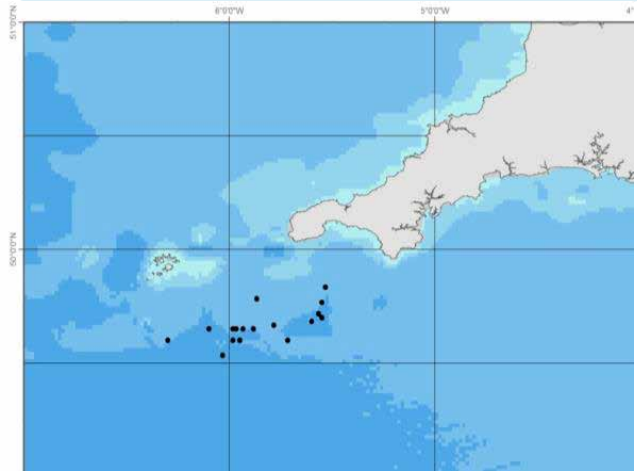
100mm square mesh panels in the codend to improve size selection and reduce undersized haddock in ICES Area VII

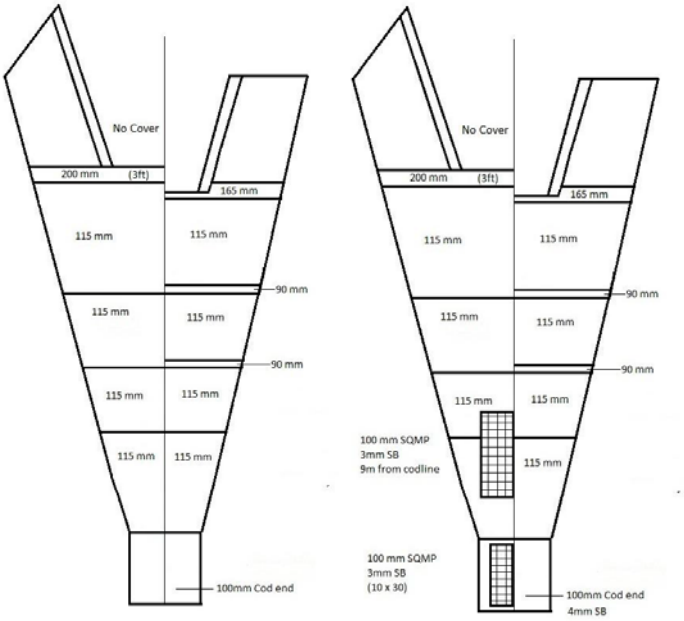
TARGET SPECIES

Cod, haddock and other demersal species

AREA, VESSEL

11 hauls were carried out in the Celtic Sea on board MFV Crystal Sea during July and August 2014 using the twin rig method.

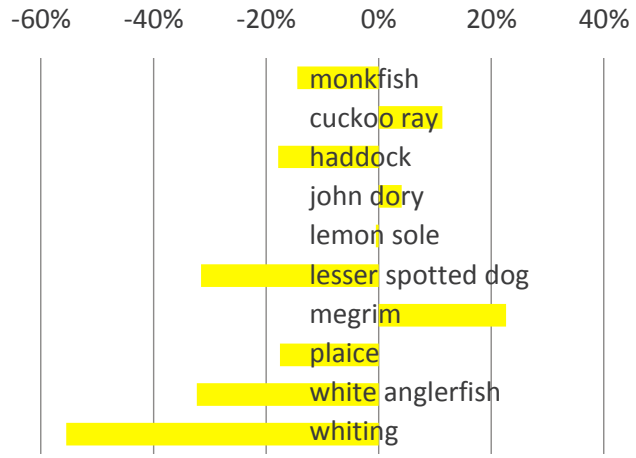




GEAR MODIFICATION

The standard gear was a coverless trawl and fished a 100mm codend.
In addition, the modified gear had a
- 100mm SMP in codend and a
- 100mm SMP @ 9 - 12m.

Percentage difference in weight of landed catches



RESULTS

The modified gear released almost all small fish.

There were losses of some marketable haddock, whiting, monkfish and plaice but these were mainly the smaller size classes.

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

DiscardLess

www.discardless.eu/selectivity_manual

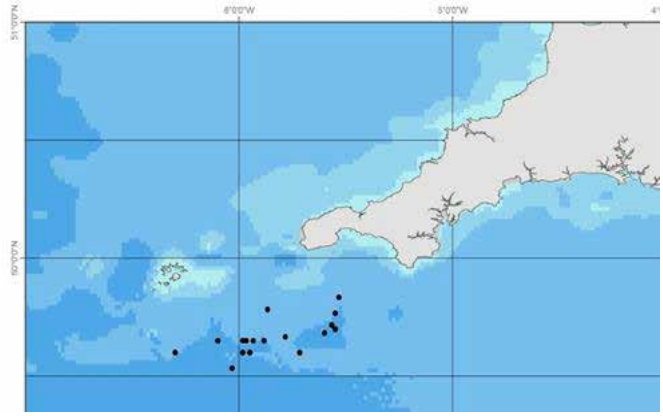
100mm square mesh panels in the codend to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

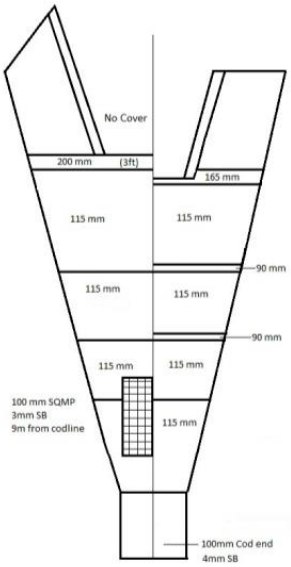
Cod, haddock and other demersal species

AREA, VESSEL

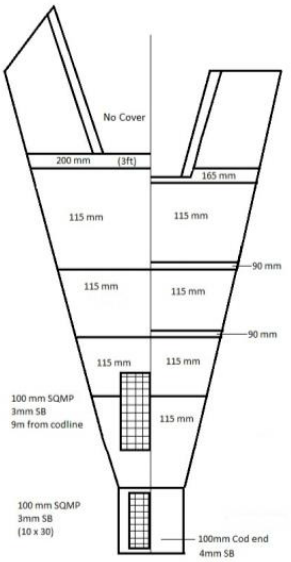
7 hauls were carried out in the Celtic Sea on board MFV Crystal Sea during August 2014 using the twin rig method



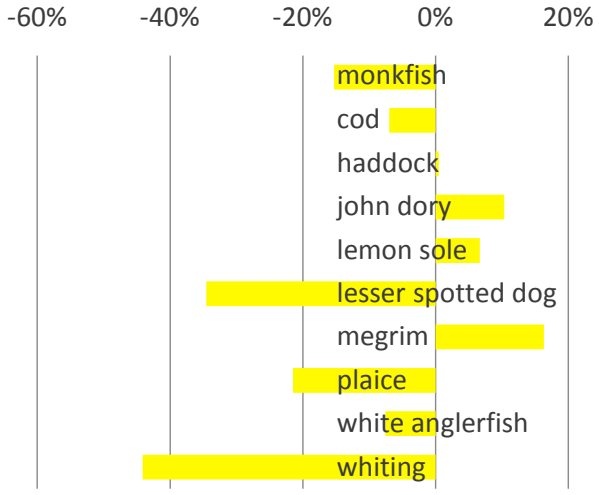
Standard trawl



Experimental Trawl



Percentage difference in weight of landed catches



GEAR MODIFICATION

The standard gear was a coverless trawl with a 100mm codend and a 100mm SMP @ 9 – 12m.

The modified gear had an additional 100mm SMP in the codend

RESULTS

The modified gear released almost all small fish and there were large reductions in unmarketable haddock

There were some losses of marketable whiting, monkfish and plaice but these were mainly the smaller size classes.

There were some gains of megrim, John Dory and lemon sole

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

200mm diamond-mesh netting in the wings, square and back sections of a trawl

to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

Cod, haddock and other demersal species

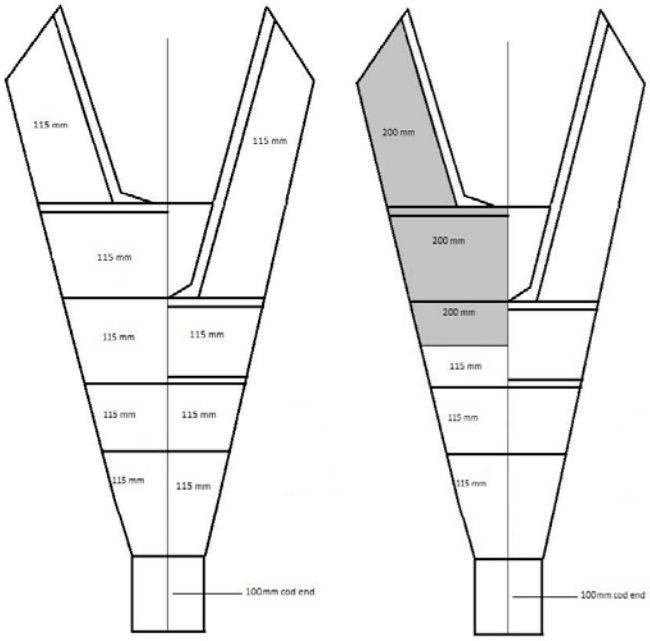
AREA, VESSEL

18 hauls with a single-rig; 9 tows with each rig, on board MFV Valhalla in the Celtic Sea. August and September 2014.

GEAR MODIFICATION

The standard gear was a 115mm mesh size trawl with a 100mm codend.
The modified gear incorporated 200mm mesh size wings, square and lower back

Standard trawl **Experimental Trawl**



Percentage difference in weight of landed catches

RESULTS

- **the modified gear caught fewer haddock across all length classes**
- **nevertheless substantial numbers of unmarketable ones were still caught**

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

115mm and 155mm square mesh panels in the body of a trawl

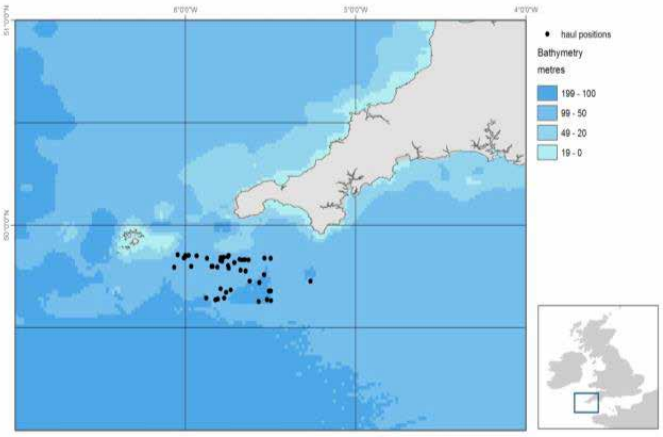
to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

Cod, haddock and other demersal species

AREA, VESSEL

11 hauls with a twin-rig; onboard MFV Our Olivia Belle in the Celtic Sea during August 2014

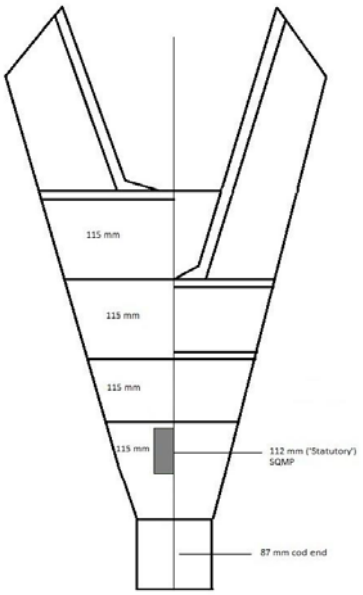


GEAR MODIFICATION

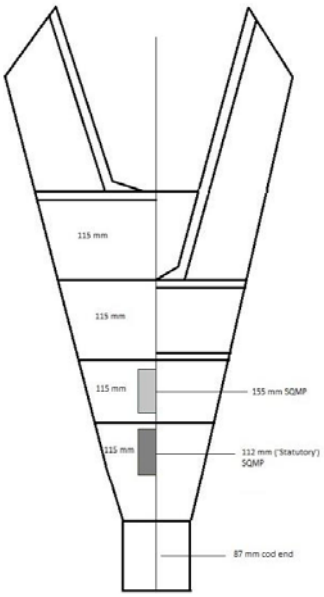
The standard gear was a 115mm mesh size trawl with a 87mm codend and a 115mm SMP @ 6-9m from codline.

In addition the modified gear also had a 155mm SMP @ 9.5-12.5m from codline

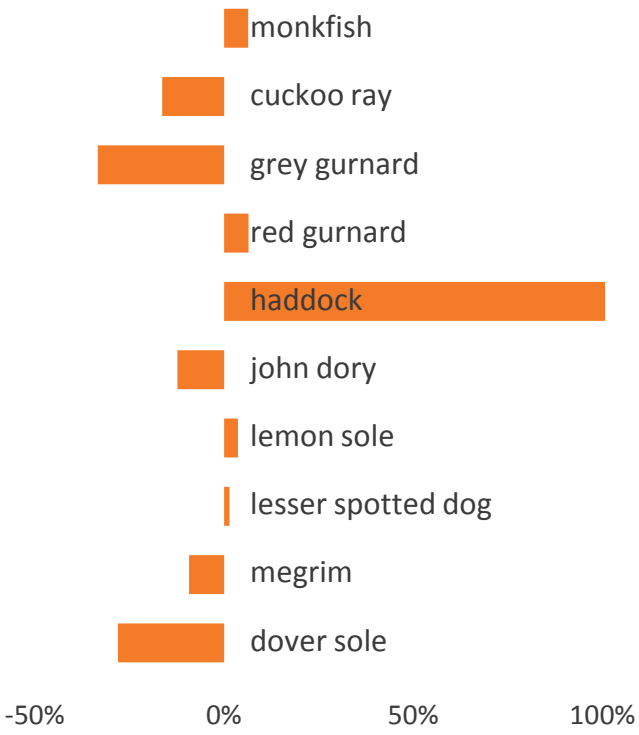
Standard trawl



Experimental Trawl



Percentage difference in weight of landed catches



RESULTS

The addition of the 155mm SMP did not reduce the overall haddock catches and substantial numbers of small haddock were still caught.

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

115mm and 155mm square mesh panels in the body of a trawl

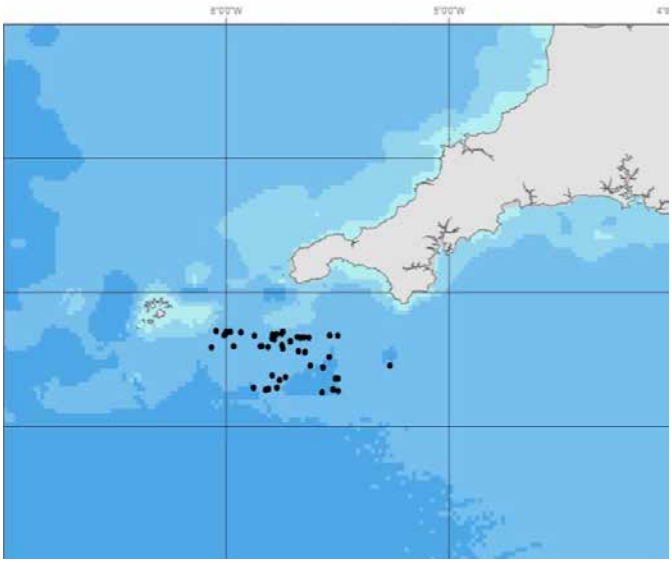
to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

Cod, haddock and other demersal species

AREA, VESSEL

12 hauls with a twin-rig; onboard MFV Our Olivia Belle in the Celtic Sea during August 2014

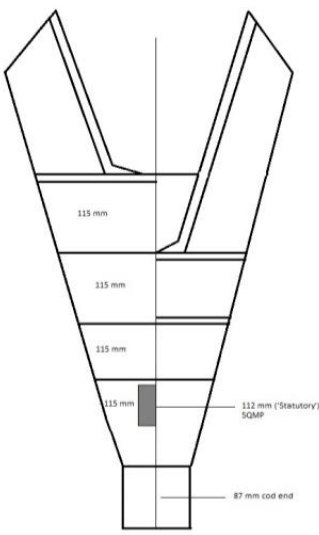


GEAR MODIFICATION

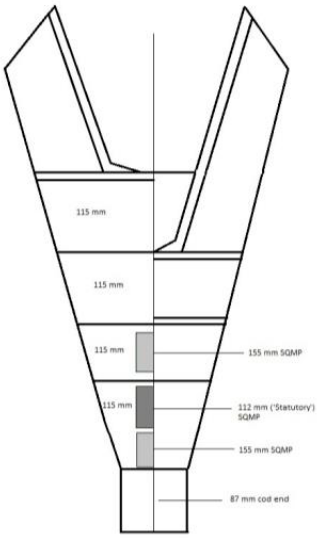
The standard gear was a 115mm mesh size trawl with a 87mm codend and a 115mm SMP @ 6-9m from codline.

The modified gear had two additional SMPs
- a 155mm SMP @ 2.5-5.5m from codline and
- a 155mm SMP @ 9.5-12.5m from codline

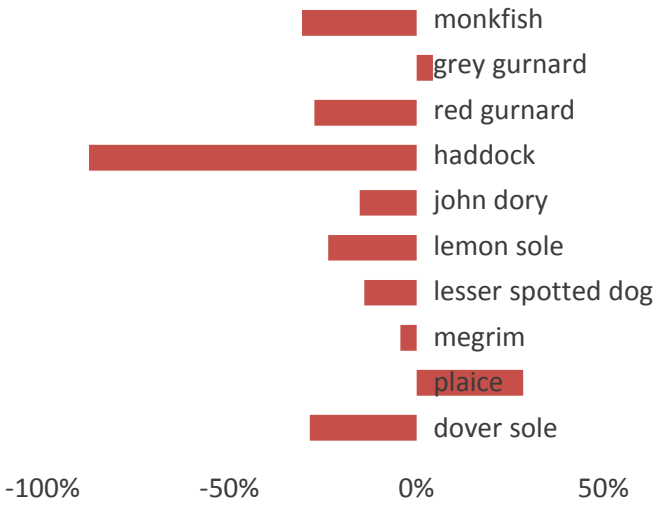
Standard trawl



Experimental Trawl



Percentage difference in weight of landed catches



RESULTS

There were substantial reductions of haddock and cod catches across all size ranges in the modified gear.

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

DiscardLess

www.discardless.eu/selectivity_manual

115mm and 155mm square mesh panels in the body of a trawl

to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

Cod, haddock and other demersal species

AREA, VESSEL

12 hauls with a twin-rig; onboard MFV Our Olivia Belle in the Celtic Sea during August and September 2014

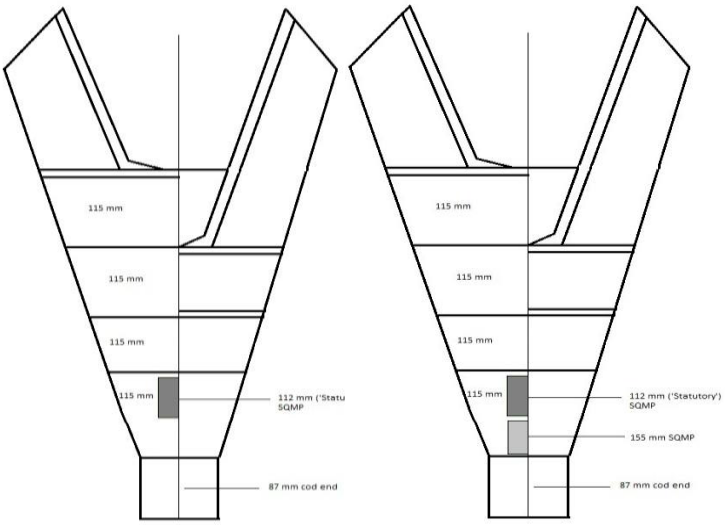
GEAR MODIFICATION

The standard gear was a 115mm mesh size trawl with a 87mm codend and a 115mm SMP @ 6-9m from codline.

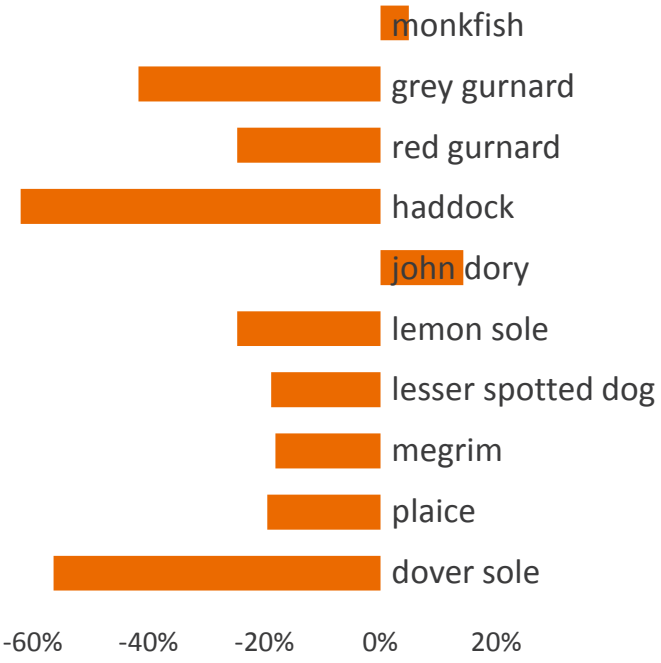
In addition the modified gear had a 155mm SMP @ 2.5-5.5m from codline

Standard trawl

Experimental Trawl



Percentage difference in weight of landed catches



RESULTS

The modified gear reduced catches of haddock above 25 cm significantly, however, substantial numbers of small haddock were still caught.

Significant and substantial reduction in cod catches across the full length range.

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

DiscardLess

www.discardless.eu/selectivity_manual

115mm and 155mm square mesh panels in the body of a trawl

to improve size selection and reduce undersized haddock in ICES Area VII

TARGET SPECIES

Cod, haddock and other demersal species

AREA, VESSEL

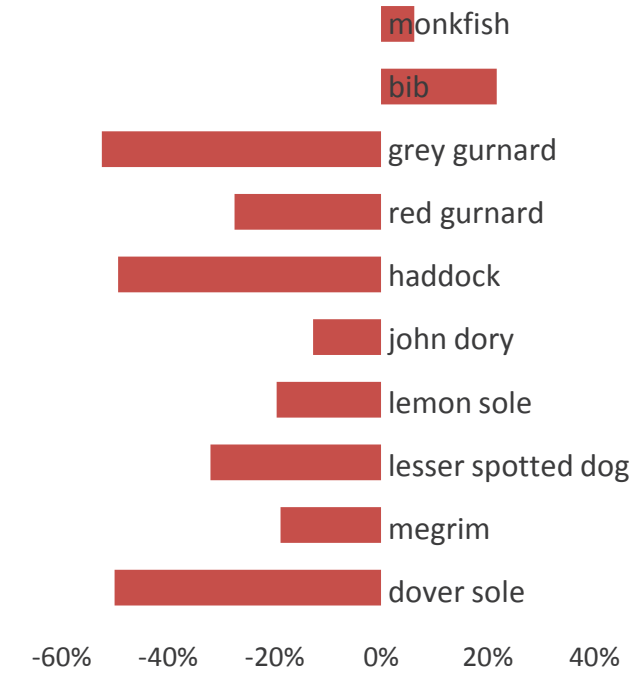
10 hauls with a twin-rig; onboard MFV Our Olivia Belle in the Celtic Sea during September 2014

GEAR MODIFICATION

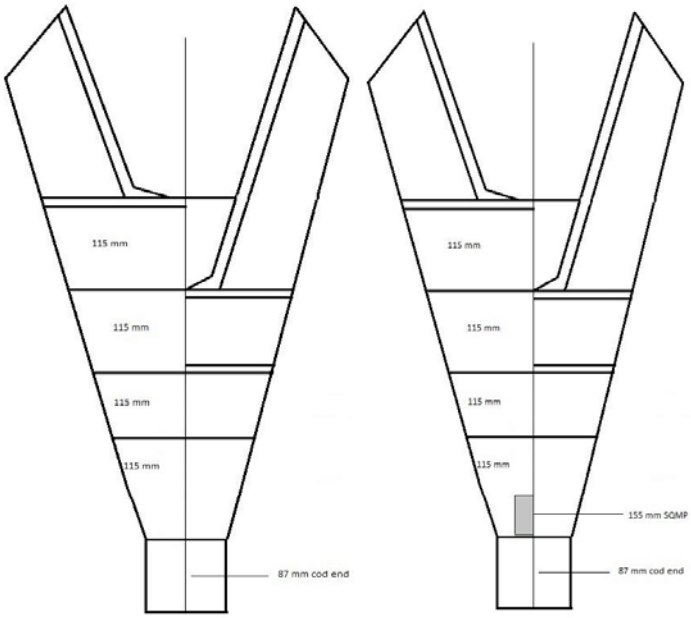
The standard gear was a 115mm mesh size trawl with a 87mm codend.

The modified gear had a 155mm SMP fitted 2.5-5.5m from codline

Percentage difference in weight of landed catches



Standard trawl **Experimental Trawl**



RESULTS

There were significant and substantial reductions in catches of cod and haddock of all sizes in the modified gear.

There were also substantial losses of most other marketable fish.

FURTHER INFORMATION

Cefas.co.uk / Contact: Stephen.mangi@cefas.co.uk; Thomas.catchpole@cefas.co.uk

Centre for Environment Fisheries & Aquaculture Science

Cefas

DiscardLess

www.discardless.eu/selectivity_manual

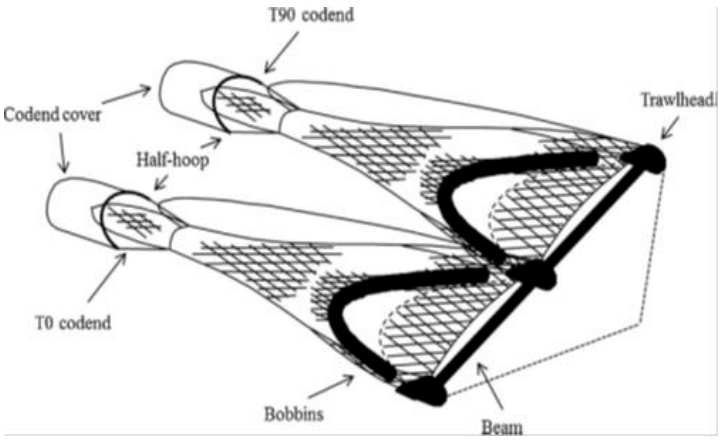
using a T90 netting codend to improve the selectivity of whiting and pouting in the beam trawl fishery

TARGET SPECIES
sole

AREA, VESSEL
15 beam trawl tows were carried out in the Southern North Sea (ICES IVc) on board the RV Belgica

GEAR MODIFICATION
The catches of a standard 80 mm diamond mesh codend (T0) are compared with the catches of an 80mm T90 codend where the standard orientation of the netting is rotated by 90 degrees.

		numbers in the codends	proportion retained in T90 vs T0
Sole	T0	783	1.16
	T90	911	
Plaice	T0	473	1.23
	T90	580	
Dab	T0	761	1.02
	T90	779	
Whiting	T0	1007	0.14
	T90	131	
Pouting	T0	361	0.36
	T90	129	



RESULTS
The T90 codend releases more undersized whiting and pouting than the standard codend.

There may be a higher retention of flatfish (dab, plaice and sole)

FURTHER INFORMATION
Bayse, S.M et al. 2016. Could a T90 mesh codend improve selectivity in the Belgian beam trawl fishery? Fish Res. 174, 201-209.
els.vanderperren@ilvo.vlaanderen.be, Heleen.lenoir@ilvo.vlaanden.be, hans.polet@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

DiscardLess

www.discardless.eu/selectivity_manual

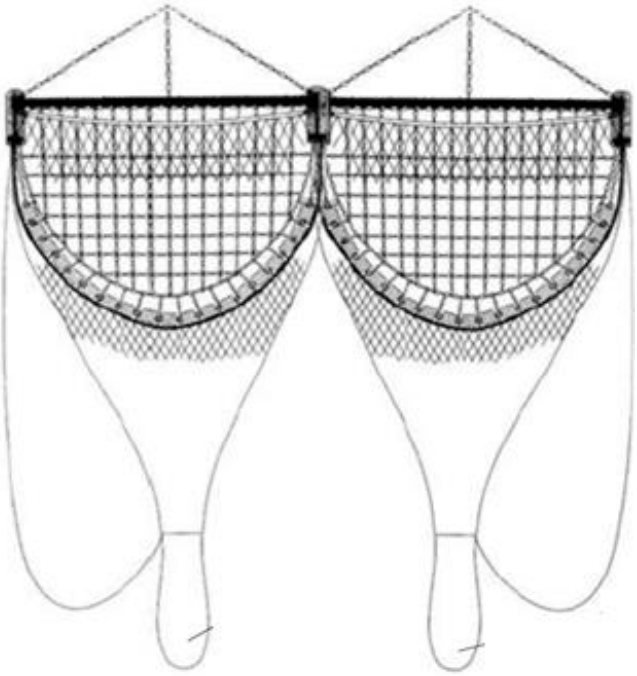
using a square mesh codend in the beam trawl fishery

to improve the selection of roundfish

TARGET SPECIES
sole

AREA, VESSEL
Beam trawl tows were carried out in the Southern North Sea (ICES IVc) on board the RV Belgica

GEAR MODIFICATION
The catches of a standard 80 mm diamond mesh codend are compared with those of an 80mm square mesh codend.



Diamond mesh codend

Square mesh codend

RESULTS
The square mesh codend released more undersized pouting than the diamond mesh codend .

There were no differences in the catches of the target species, sole.

There was some deformation of the square meshes

FURTHER INFORMATION
ADVIS II - ALTERNATIEVEN VOOR DE BOOMKORVISSERIJ. ILVO mededeling 134
heleen.lenoir@ilvo.vlaanderen.be, hans.polet@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

reducing the number of meshes in circumference

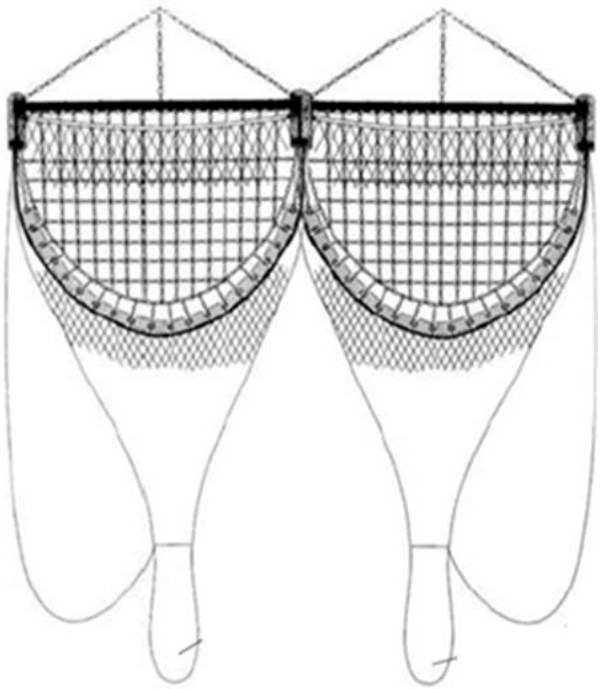
to improve the selection of roundfish of a beam trawl codend

TARGET SPECIES

sole

AREA, VESSEL

15 twin beam trawl tows were carried out in the Southern North Sea (ICES IVc) on board the RV Belgica

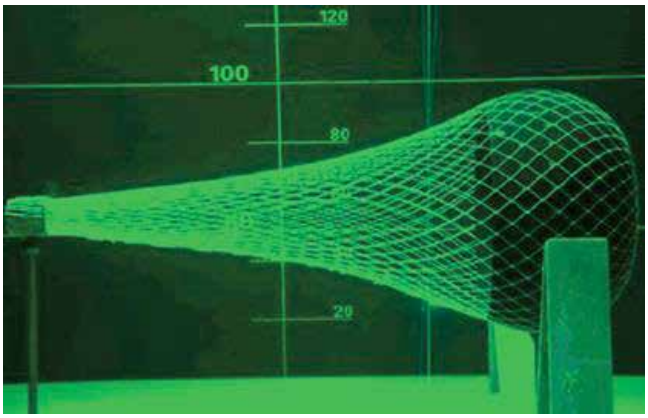


GEAR MODIFICATION

Diamond meshes have the tendency to close when put under tension and their lateral opening reduces. The more meshes around the circumference of the codend, the smaller the lateral mesh opening will be.

Hence, a codend with 80 meshes in circumference should retain fewer roundfish than one with 100 meshes in circumference.

In these trials the catches of a standard 80 mm diamond mesh codend with 100 meshes in circumference are compared with the catches of an 80mm diamond mesh codend with 80 meshes in circumference.



RESULTS

The codend with 80 meshes in circumference released more undersized pouting and sole than the codend with 100 meshes in circumference

FURTHER INFORMATION

ADVIS II - ALTERNATIEVEN VOOR DE BOOMKORVISSERIJ. ILVO mededeling 134

heleen.lenoir@ilvo.vlaanderen.be, hans.polet@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

increasing mesh size in the extension of a beam trawl

to improve the selectivity of sole

TARGET SPECIES

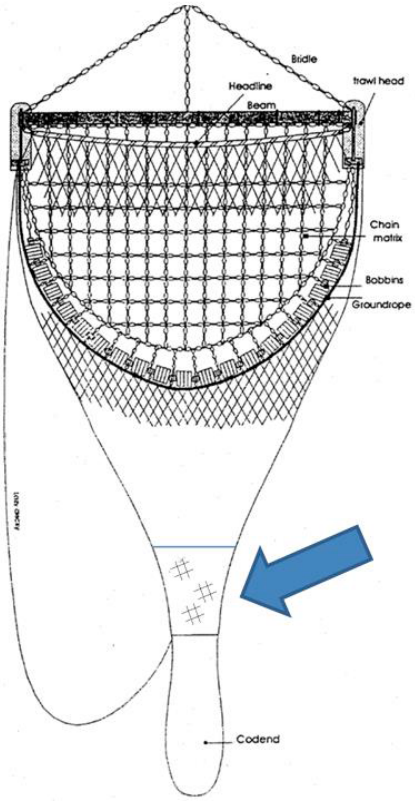
sole

AREA, VESSEL

48 twin beam trawl tows were carried out in the North Sea (ICES IVc) on board the "Sonja" Z19

GEAR MODIFICATION

The catches of a beam trawl with 100 mm diamond mesh netting in the extension are compared with the catches of beam trawl with a 150 mm diamond mesh extension.



	Total	% Change
All Sole		
100 mm	4692	-19.7
150 mm	3770	
Undersized sole (< 24 cm)		
100 mm	708	-40.3
150 mm	423	
marlketable sole (≥ 24 cm)		
100 mm	3984	-16.0
150 mm	3347	

RESULTS

The 150mm diamond mesh extension released more undersized sole.

Commercial levels of catch of marketable sole were maintained

FURTHER INFORMATION

Bayse S., Polet H., 2015. Evaluation of a large mesh extension in a Belgian beam trawl to reduce the capture of sole (*Solea solea*). Instituut voor Landbouw- en Visserijonderzoek.

heleen.lenoir@ilvo.vlaanderen.be, hans.polet@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

DiscardLess

www.discardless.eu/selectivity_manual

using a horizontal separator panel to separate bycatch from the catch in the beam trawl fishery

TARGET SPECIES
Sole and plaice

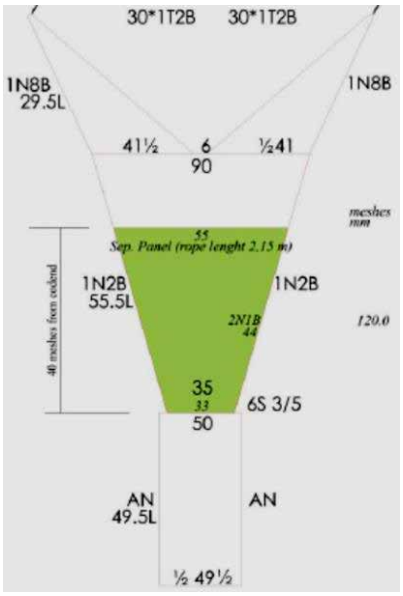
AREA, VESSEL
28 beam trawl tows were carried out in the Southern North Sea on board the RV Belgica

GEAR MODIFICATION
A 240 mm square mesh horizontal separator panel was fitted to a beam trawl to separate sole and plaice from smaller plaice and roundfish.

Two configurations were tested

(i) **an 'open panel' where fish can go above or below the leading edge of the separator panel to the upper or lower codends and**

(ii) **a 'closed panel' where the leading edge of the panel is attached to the lower opening of the net. In this case for fish to arrive at the lower codend they had to pass through the square mesh separator panel.**



% of fish in the lower codend

	Open panel (%)	Closed panel (%)
Sole	88	70
Plaice	75	40

RESULTS
88% of sole and 75 % of plaice swim below the open panel into the lower codend.

70% of sole swim through the closed separator panel into the lower codend. Plaice are more reluctant to pass through the closed separator panel and only 40% get to the lower codend.

FURTHER INFORMATION
heleen.lenoir@ilvo.vlaanderen.be, hans.polet@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

DiscardLess

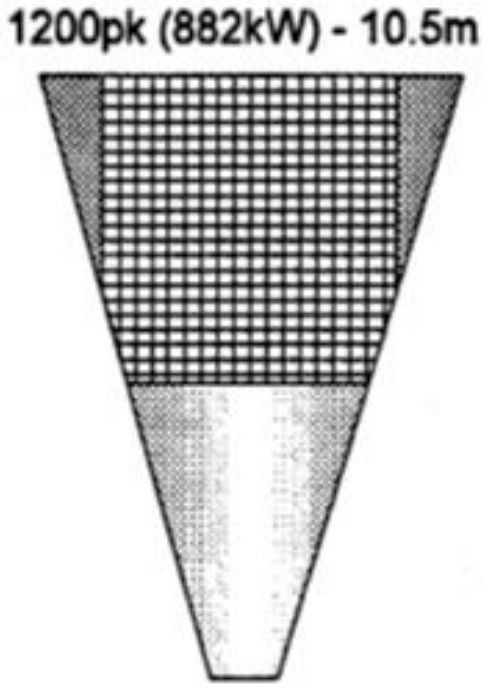
www.discardless.eu/selectivity_manual

using large square mesh top panels to reduce roundfish bycatch in the beam trawl fishery

TARGET SPECIES
Sole and plaice

AREA, VESSEL
63 tows took place on large beam trawlers (1200 HP, 10m) in the Southern North Sea

GEAR MODIFICATION
The top panel of a large beam trawl was fitted with 120 mm square mesh netting panels.
Two panel sizes were investigated and were
(i) 85 meshes deep and
(ii) 128 meshes deep.



% of fish that escape through the panels

Top panel size	85 meshes deep	128 meshes deep
Cod	-12	-12
Whiting	-48	-66
Haddock	-43	-63
Sole	-6	-13
Plaice	0.3	-1

RESULTS
Large amounts of haddock and whiting escape through the top square mesh panels and the larger the panel the greater the number of fish that escape.

There is a small loss of target flatfish species sole and no loss of plaice.

FURTHER INFORMATION
Fonteyne, R., 1997. Optimization of a species selective beam trawl (SOBETRA). Contract Nr AIR2-CT93-1015: Final report 211pp.
Heleen.lenoir@ilvo.vlaanderen.be, jochen.depestele@ilvo.vlaanderen.be

ILVO

efficiency of single and twin/ multi-rig trawling in the *Nephrops* fishery

TARGET SPECIES

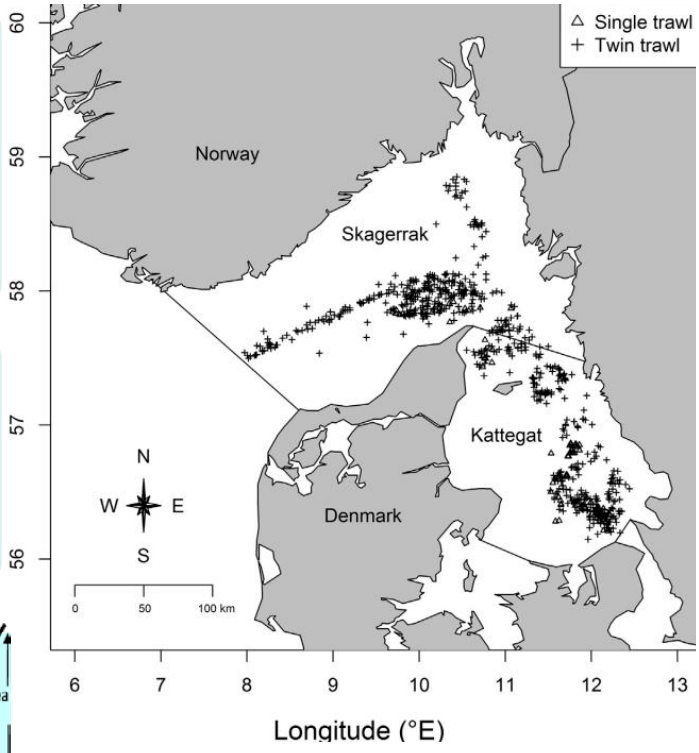
Norway lobster, cod, haddock and plaice

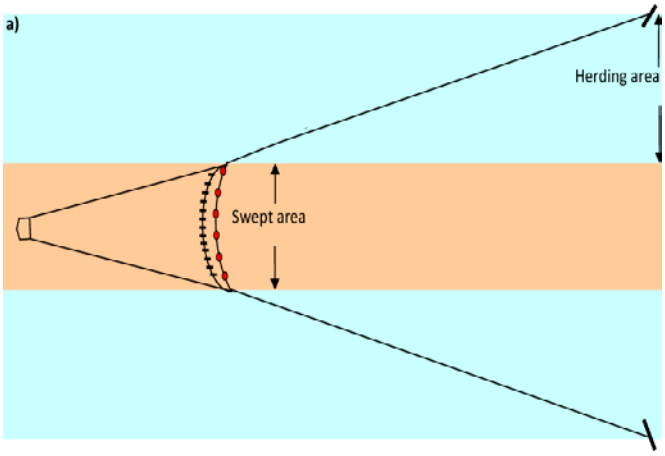
AREA, VESSEL

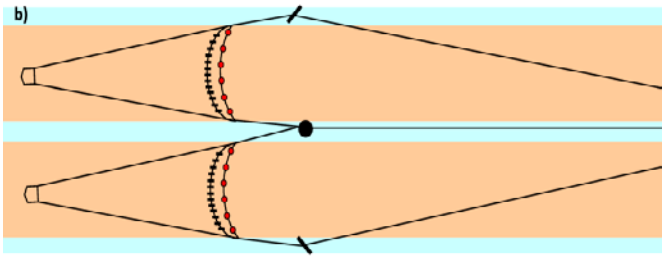
The study utilised discard data (1997-2012) from the Skagerrak and Kattegat

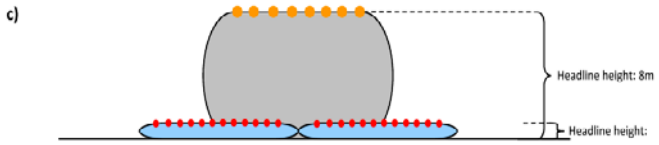
GEARS

The *Nephrops* directed demersal trawl fishery in the Skagerrak and Kattegat (mesh size between 70 and 90 mm) uses single, twin and multi-rig trawls.









COMPARISON STUDY

The catch rates of the four main commercial species caught in single and twin /multi-rig trawls over a 15 year period were compared.

RESULTS

Multi-rig trawls were found to catch approximately 2 times more Norway lobster compared to single trawls.

No significant differences among the two gears were observed for plaice, haddock and cod.

FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)

Feekings et al., Influence of twin and multi-rig trawl systems on CPUE in the DanishNorway lobster (Nephrops norvegicus) fishery. Fisheries Research 175, 51–56.

Technical University of Denmark

actively stimulating fish behaviour to improve escape panel selectivity

TARGET SPECIES

Norway lobster, cod

AREA, VESSEL

The study was carried out in 2013 in the North Sea and Western Skagerrak on board the commercial twin-trawler HM 128 Borkumrif (28 m and 728 kW).

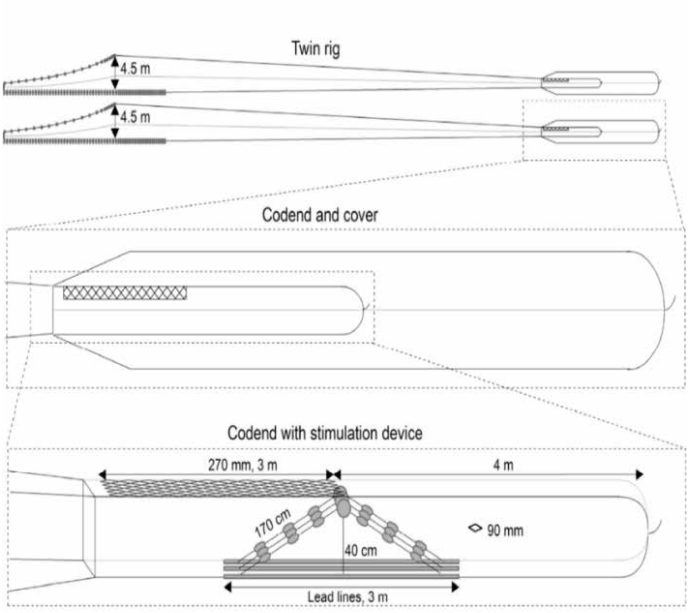
GEAR MODIFICATION

The standard gear was a 90 mm diamond mesh codend with a 270 mm diamond mesh escape panel positioned 4-7 m from the cod-line.

The experimental gear was identical but with a stimulation device.

The stimulation device was made from three 3.4 m long ropes. Each rope had one 20 cm float in the middle and three smaller oval floats placed 40 cm apart on either side. The float ropes were only fixed to the lower netting in the four panel section to allow the passage of seaweed and litter. To compensate for the extra flotation three leaded lines were mounted below the string of floats.

It was hoped that the line of floats would stimulate cod to escape through the large mesh panel.



RESULTS

by actively stimulating escape behaviour the number of cod escaping through square mesh panel can be increased.

The float ropes did not effect the catches of *Nephrops*.

FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)

Krag et al., 2016. Improving escape panel selectivity in Nephrops directed fisheries by actively stimulating fish behaviour. CJFAS, 10.1139/cjfas-2015-0568

DTU Technical University of Denmark

DiscardLess

www.discardless.eu/selectivity_manual

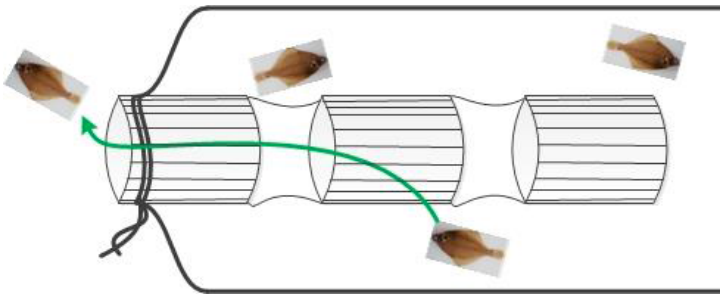
using cylindrical grids in the codend to reduce flatfish discards in the Dutch *Nephrops* fishery

TARGET SPECIES

marketable *Nephrops,* plaice, turbot and brill

AREA, VESSEL

Catch comparison trials were carried out with a multi-rig (6) *Nephrops* trawl in the North Sea (ICES area IVc) on board the Grietje WR189 (23m, 300Hp).



GEAR MODIFICATION

A tube made from three cylindrical grids and with an escape hole at the end was fitted inside a conventional 80 mm codend. The codline is tied around the escape hole which is at the base of the third grid. The idea is that undersized plaice, dab and *Nephrops* will enter the tube through the cylinrical grids and swim out the escape hole. Floats are attached to neutralize weight of the grid.

The catches of this gear were compared with those of the conventional 80 mm codend gear.

RESULTS

- **After initial testing on a commercial vessel the captain reported that the grid did work but did not reduce flatfish discards by 50%.**

FURTHER INFORMATION

pieke.molenaar@wur.nl

IMARES rapport C027/16
(http://library.wur.nl/WebQuery/wurpubs/498943)

Coöperatieve Visserij Organisatie

WAGENINGEN UNIVERSITY & RESEARCH

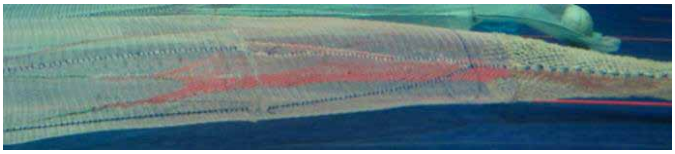
using a horizontal separation panel to improve selection in a pulse beam trawl

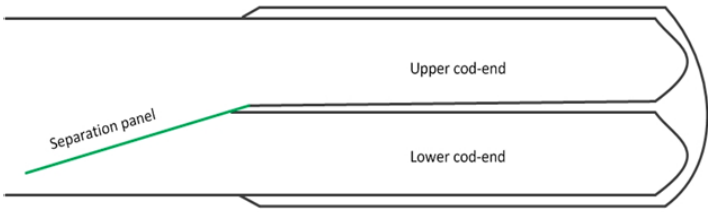
TARGET SPECIES

marketable sole, plaice, turbot and brill

AREA, VESSEL

20 catch comparison trials were carried out with 2 x 12m SumWing pulse beam trawl on grounds in North Sea (ICES area IVc) on board the Jan van Toon TX36 (42.4m, 1470kW)





GEAR MODIFICATION

It is assumed that sole stay at the bottom of the trawl, while other species swim at different heights and can be guided towards an upper cod-end.

Hence, a separation panel was fitted ~15cm above the bottom of the trawl to direct (fish) discards to an upper codend and to direct sole, the target species, to a lower codend.

During the experimental hauls the 80mm mesh size upper and lower codends were used.

	Lower (kg/h)	Upper (kg/h)	% Upper/ total catch
Total catch	149.7	25.4	14.5
Landings	33.6	6.3	15.8
Plaice >27cm	16	3.3	17.1
Sole >24cm	15	1.8	10.7
All Discards	116.1	19.1	14.1
Fish Discards	30.8	12.6	29.0
Sole <24cm	2.1	0.2	8.7
Plaice <27cm	11.5	2.3	16.7
Dab <30cm	6.8	3.1	31.3
whiting <27cm	3.4	4.2	55.3
Grey Gurnard	0.2	0.2	50

RESULTS

The majority of the catch was found in the lower cod-end.

- **this included 89% of the sole catch**

The upper codend caught

- **15% of landings**
- **14% of total discards**
- **and 30% of the fish discards.**
- **31% of discarded dab and 55% of discarded whiting were found in the upper cod-end.**

FURTHER INFORMATION

pieke.molenaar@wur.nl

(http://library.wur.nl/WebQuery/wurpubs/fulltext/387860)

Coöperatieve Visserij Organisatie

WAGENINGEN UNIVERSITY & RESEARCH

DiscardLess

www.discardless.eu/selectivity_manual

fitting square mesh panels to improve bottom trawl selectivity on the Mediterranean continental shelf

TARGET SPECIES

striped red mullet

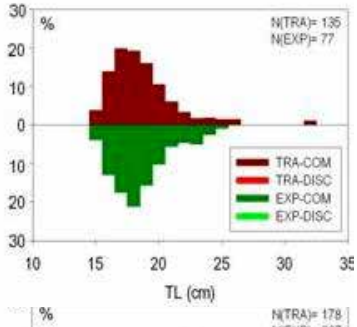
AREA, VESSEL

8 pairs of hauls were carried out in the Balearic Islands bottom trawl fishery on board the FV Nueva Joven Josefina (21 m, 150 HP) at depths between 50 – 80 m.

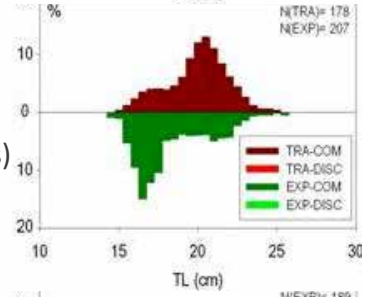
GEAR MODIFICATION

The traditional two-panel bottom trawl net which is fished with semi-pelagic Thyborøn type 15VFS doors, was fitted with a 68 m^2 panel of 54 mm knotless Dyneema square mesh netting (1.2 mm twine thickness) in the upper panel. The codend was made from 40 mm square mesh netting of 3 mm twine thickness

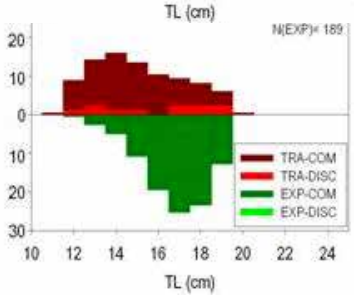
striped red mullet
(Mullus surmuletus)



horse mackerels
(Trachurus trachurus
and T. mediterraneus)



picarel
(Spicara smaris)



RESULTS

The trawl with square mesh in the upper panel caught less commercial and discarded species.

There was no difference in the length frequency distribution of target species, striped red mullet.

fuel consumption was reduced by up to 15%.

It was concluded that the incorporation of square mesh netting in the upper panels could be a plausible additional measure to improve the selectivity of the 40 mm square mesh codend currently in force.

FURTHER INFORMATION enric.massuti@ba.ieo.es; DISCATCH project (DG MARE Contract Nº MARE/2012/24 Lot 2) Final Report: http://en.med-ac.eu/progetti.php

fitting square mesh panels to improve bottom trawl selectivity on the Mediterranean continental slope

TARGET SPECIES

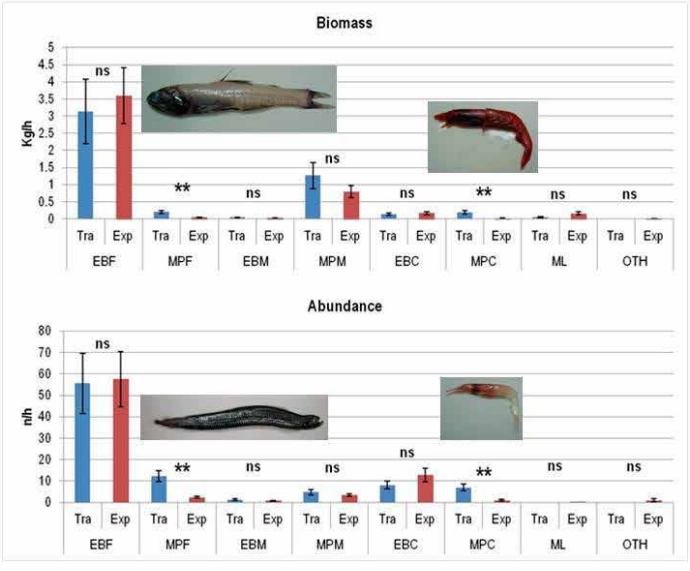
red shrimp

AREA, VESSEL

10 pairs of hauls were carried out in the Balearic Islands bottom trawl fishery on the FV Nueva Joven Josefina (21 m, 150 HP) at depths between 600 – 700 m.

GEAR MODIFICATION

The traditional four-panel bottom trawl net which is fished with semi-pelagic Thyborøn type 15VFS doors, was fitted with 10 square mesh panels. 4 in the upper section (58, 40, 17 and 9 m^2) and 3 in each lateral section (16, 5 and 1 m^2). The square mesh panels were made from 54 mm knotless Dyneema netting (1.2 mm twine thickness). The codend was made from 40 mm square mesh netting of 3 mm twine thickness



Student t-test: (ns) not significant; (*) <0.05; (**) <0.01

EBF: epi-benthic fishes; MPF: meso-pelagic fishes; EBM: epi-benthic molluscs; MPM: meso-pelagic molluscs; EBC: epi-benthic crustaceans; MPC: meso-pelagic crustaceans; ML: marine litter; OTH: others

RESULTS

There was no loss of target species in the trawl with the square mesh panels.

Discards of non-commercial meso-pelagic crustaceans and fish reduced significantly.

Fuel consumption was reduced by up to 10%.

It was concluded that the incorporation of square mesh netting panels could be a plausible additional measure to improve the selectivity of the 40 mm square mesh codend currently in force.

FURTHER INFORMATION

enric.massuti@ba.ieo.es; DISCATCH project (DG MARE Contract Nº MARE/2012/24 Lot 2) Final Report: http://en.med-ac.eu/progetti.php

using an eBRP in the beam trawl fishery to reduce benthos bycatch

TARGET SPECIES

Sole

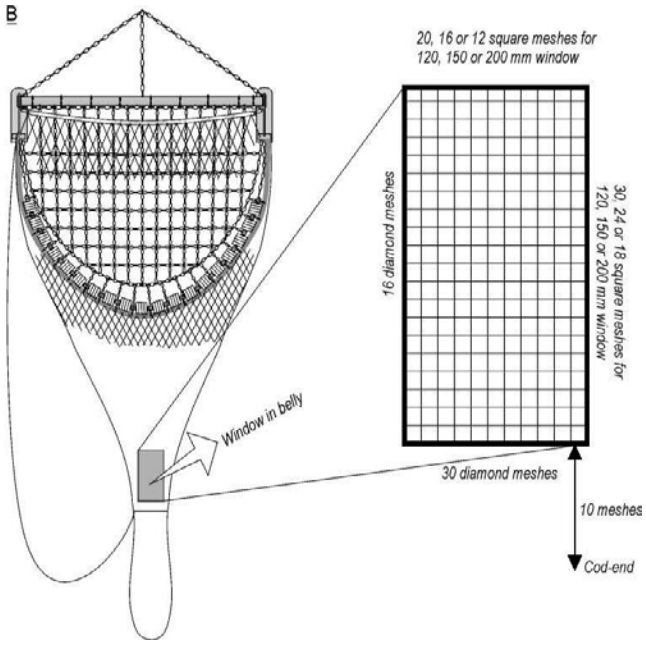
AREA, VESSEL

16 beam trawl tows were carried out in the North Sea (ICES IVc) on board the RV Belgica

GEAR MODIFICATION

Benthos release panels (BRPs) release large amounts of unwanted benthos and debris from demersal beam trawls. Here an 80Hz electric cramp stimulus is combined with a BRP to prevent sole from escaping.

The catches from a beam trawl with an eBRP was compared with a standard beam trawl.



	240 mm BRP versus standard net	240 mm eBRP versus standard net
Benthos	-71%	-82%
Debris	-61%	-74%
Undersized fish	-28%	-32%
sole	-41%	-17%

RESULTS

Adding a 80 Hz electric cramp stimulus to the BRP, resulted in equal catches of sole larger than 25 cm compared to the standard net, without negatively affecting the release of benthos and most undersized commercial fish. Some sole of 24 and 25 cm were still lost.

FURTHER INFORMATION

Soetaert et al. (2016) Reducing bycatch in beam trawls and electrotrawls with (electrified) benthos release panels. ICES Journal of Marine Science

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