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# SR 657

# Irish Sea Selectivity Trials

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# 1. Contents

# 2. Executive summary

2.1.1 The initial aim of this project was to follow up on previous work undertaken on discard reduction in the Irish Sea *Nephrops* fishery. The objectives of the project were altered to help fulfil a commitment given by the UK authorities to work with fishers to deploy measures that result in significant reductions in cod catches with the aim of securing an exemption from the effort regime which is provided for in Article 11 of the cod plan.

2.1.2 The project was led by a steering group comprising AFBI fishery scientists, a fishery consultant, representatives from the two local Producer Organisations, representatives from DARD, a local net maker, local skippers and a gear specialist. The Steering Group decided to trial four different discard reduction modifications in a standard *Nephrops* trawl on a twin-rig vessel and two single-rig vessels.

2.1.3 The devices chosen by the steering group which had shown positive results in discard reduction in other fisheries were -

- Swedish grid
- Plastic semi flexible grid,
- Coverless, low headline trawl
- Boxed section (4 panel) extension similar to that used in the SELTRA trawl project

2.1.4 The agreed objectives for the project where –

- To develop a device or design alteration that could evidence a reduction in cod catches to be below 1.5% (by weight) of the total catch of the standard Nephrops trawl.
- To reduce, to an acceptable level, the number of discards caught in the trawls used in the Irish Sea Nephrops fishery by trialling three different design alterations to a standard Nephrops trawl.
- To develop a design alteration that is acceptable by the fishermen in Northern Ireland to effectively reduce discard rates in the Nephrops fishery to an acceptable level.

2.1.5 The Swedish grid successfully separated the *Nephrops* and released the larger fish but had severe problems with repeatedly choking up. There are definite safety issues in handling this device on the type of vessels working in the Irish Sea. All three skippers expressed concerns about the safety of their crew during the hauling and shooting of the grids.

2.1.6 The plastic grids were slightly less hazardous to handle onboard but they tended to release too much of the target species. They were also prone to choking up with debris. There were no indications during any of the grid trials that any of the grids used could

effectively be used for release of cod or other by-catch in the Irish Sea nephrops fishery if the industry was to remain viable and not be exposed to unnecessary dangers onboard.

2.1.7 The coverless trawls were modifications of the standard nets used in the fishery. They showed very little difference in the catch composition to the standard trawls and no noticeable reduction in cod catches. They were easy to use but not effective as by-catch or cod release device.

2.1.8 Of the four devices the boxed extension showed most promise of releasing cod from the *Nephrops* trawl without loss of *Nephrops*. For this reason modifications were made to the original design in an attempt to further improve the selectivity of the device and trialled for another series of experimental hauls. This device was easy and safe for the fishermen to use. It is relatively cheap and simple to construct using materials that the crew are familiar with.

2.1.9 As a result of these trials the UK authorities have implemented a management measure to ensure that from 1 October 2010 all vessels fishing for nephrops in Area VIIa use a net that incorporates a boxed extension with a 300mm square mesh top panel. The authorities will continue to monitor the performance of the device under commercial fishing conditions.

2.1.10 There are several modifications and additions that could be combined with the boxed extension to further enhance its discard reduction credentials in the future including -

- Reinstating the 120mm square mesh panel in the trawl (a 90mm smp was included in both the control and experimental nets during the trials but a 120mm panel is more commonly used in the fishery)
- Combining the boxed extension with further square mesh panels further up the body of the trawl such as the twin square mesh panels trialled previously in the Irish Sea which were highly effective in releasing juvenile haddock and whiting.
- Small curtains of netting hanging in the box section to stimulate cod to escape through the large square mesh.

2.1.11 The Department for Agriculture and Rural Development in Northern Ireland is committed to Further work on the box section extension should make it possible to have good discard and by-catch reductions in the Irish Sea *Nephrops* fishery, allowing the fleet to progress in a profitable and sustainable manner.

# 3. Project background

## 3.1 Background

3.1.1 This gear trials project was originally conceived to examine opportunities to reduce the unwanted catch and discards by the Northern Ireland nephrops fleet, which operates mainly in the northern part of the Irish Sea and the Clyde area on the West of Scotland.

3.1.2 In the lead up and during the December 2012 fisheries Council there was extensive engagement between Member States and the Commission about the operation of the Cod Recovery plan and the fishing effort arrangements contained in the plan designed to reduce mortality and help rebuild cod stocks. One outcome of these discussions was a commitment by the UK authorities to work with fishers to deploy measures that result in significant reductions in cod catches with an objective that by 1 July 2012 the Nephrops fleet will fish with gears which will enable them to secure an exemption from the effort regime as laid down in Article 11 of the cod plan. The emphasis of the project changed therefore to examine a range of fishing gear that may be capable of achieving that objective.

3.1.3 The Northern Ireland fishing trawl fleet mainly comprises Nephrops vessels and the numbers of vessels engaged in directed fishing for whitefish have dwindled steadily as the TAC for Irish Sea cod has been reduced. By 2012 there were no vessels engaged in fishing for whitefish full time.

## 3.2 Cod Recovery Plan

3.2.1 Council Regulation (EC) No 1342/2008 establishes a long-term plan for cod stocks and the fisheries exploiting those stocks and repeals regulation (EC) No 423/2004.

3.2.2 This Plan provides for the automatic reduction in the Total Allowable Catch (TAC) for Cod and the reduction of fishing effort for the fleets that are responsible for up to 80% of the total fishing mortality of Cod. These reductions will happen for as long as Cod Stocks are below the critical level which has been set at 6,000 tonnes “spawning stock biomass” for the Irish Sea. Scientists believe that the SSB is below 2,000 tonnes currently and there are no indications that Cod Stocks will recover beyond the critical level soon.

3.2.3 The Cod Plan allows Member States to decide how the total number of days at sea is shared out among its vessels operating in the Cod Recovery Zone – which includes the Irish Sea, West of Scotland and the North Sea. There are limits set for each sea area and the “effort pots” are based on the average fishing effort expended by Member States’ fleets in those areas during the period 2004 to 2006. It is this fishing effort

baseline that is eroded year on year by the automatic reductions mechanism included in the Cod Plan.

3.2.4 Article 11 of the Cod Plan provides an opportunity for groups of vessels to be exempt from all effort restrictions if they deploy fishing gears which reduce cod catches to less than 1.5% of the total catch. These gears must be approved by the Commission's Scientific, Technical and Economic Committee for Fisheries (STECF) and Member States must apply to the Commission to gets groups of vessels exempted. Currently there is only one gear – the Swedish Grid which guarantees exemption.

3.2.5 Article 13 of the Cod Plan allows Member States to "buy back" days at sea if their fleets comply with measures to reduce Cod mortality. These can include technical measures such as more selective fishing gears or management measures to avoid fishing in areas where there are concentrations of juvenile cod or places where cod spawning happens.

3.2.6 Articles 11 and 13 affect therefore affect the choice of fishing gear used by the catching sector.

## 3.3 The challenge

3.3.1 Separation of one species from another is problematic in mixed fisheries such as the Irish Sea due to behavioural differences between species when confronted by a trawl net. Early Irish Sea studies (Briggs, 1992) demonstrated the effectiveness of square shaped mesh panels (SMPs) in allowing juvenile whiting and haddock to escape from *Nephrops* trawls and later work demonstrated the optimum positioning of SMPs (Briggs, 2010, Briggs *et al*.,1999 and Armstrong, *et al.,*1998). However this configuration did not allow cod to escape because cod do not exhibit the upward escape reaction observed in haddock and whiting. Cod tend to swim in the direction of the net, close to the seabed until tired and then turn horizontally close to the seabed and swim into the net close to the belly netting panel (Main and Sangster, 1981).

3.3.2 As each fishery has its own unique ecological characteristics it is important not to extrapolate from results of gear studies in other geographic areas. For example the Irish Sea is primarily a shallow water (<100m) *Nephrops* fishery with haddock and cod by-catch species and due to its unique hydrographical characteristics is a nursery area for many fish species. The North Sea on the other hand is deeper and mature whiting are an important by-catch species in its *Nephrops* fisheries. The performance of gear types used in different fisheries can also vary because of local practices and vessel characteristics which make it essential to carry out gear studies in the fishery for which technical conservation is sought. This is well acknowledged by gear technologists.

3.3.3 In the Irish Sea (VIIa) the seabed is predominately made up of very soft mud and a rich benthos. The gear used by the *Nephrops* fleet has been refined over many years to be suitable for targeting *Nephrops* in this type of environment. The trawls are much lighter in construction with lighter footropes than trawls towed by similar vessels in other UK *Nephrops* grounds. The weight of the gear when on the seabed is critical to the efficiency of the gear. It has to be heavy enough to maintain bottom contact but light enough to skim over the seabed without digging in. The correct tension relationship in respect of the top and bottom panels of netting must be maintained. These criteria have to be considered when any selective device is fitted to the gear as the slightest change in the equilibrium of the gear can result in dramatic changes to its catching efficiency and in some situations may result in concerns for the safety of the vessel.

## 3.4 Project objectives

3.4.1 The agreed objectives for the project where –

- To develop a device or design alteration that could evidence a reduction in cod catches to be below 1.5% (by weight) of the total catch of the standard Nephrops trawl.
- To reduce, to an acceptable level, the number of discards caught in the trawls used in the Irish Sea Nephrops fishery by trialling three different design alterations to a standard Nephrops trawl.
- To develop a design alteration that is acceptable by the fishermen in Northern Ireland to effectively reduce discard rates in the Nephrops fishery to an acceptable level.

# 4. Project Methodology

## 4.1 Project Management

4.1.1 A Steering Committee was set up for the project to ensure all views were considered throughout the term of the project. This committee comprised AFBI fishery scientists, fishery consultant, representatives from the two local POs, representatives from DARD, a local net maker, local skippers and gear specialists. *(appendix1)*

4.1.2 Taking into account knowledge from previous selectivity trials in Northern Ireland and other EU *Nephrops* fisheries along with an understanding of how cod behave both naturally and in the vicinity of a trawl the committee decided on four gear options to trial in the Irish Sea project.

4.1.3 There was a general concern from the committee as to the potential loss of marketable sized fish from the *Nephrops* catch with many of the devices and how this would affect the vessels gross income. With this in mind many of the devices were rigged to try to retain valuable ground fish (monks and flat fish). This can form the majority of the financial return from the overall fish catch.

4.1.4 After discussion it was decided to trial four different discard reduction modifications in a standard *Nephrops* trawl. These would be trialled on a twin-rig vessel and two single-rig vessels.

4.1.5 The devices chosen by the committee were

- Swedish grid
- Plastic semi flexible grid,
- Coverless, low headline trawl
- Boxed section (4 panel) extension similar to that used in the SELTRA trawl project

## 4.2 Participating vessels and gear design

**Vessels**

4.2.1 Tenders were invited for the sea trials from vessels which regularly work the Northern Irish Sea *Nephrops* grounds using the standard traditional gear for that area. There were two separate tenders, one for the twin-rig vessel and one for a pair of single-rig vessels. The single-rig vessels had to be of similar size and engine power, using similar *Nephrops* trawls.

4.2.2 Tenders were received from seven twin-rig boats and seven pairs of single-rig boats. The tenders were evaluated taking into account price and suitability of the vessel and crew to undertake the work. One of the considerations was for all the vessels to have

adequate space and deck machinery for handling the experimental gear in a safe manner to give the various devices maximum opportunity to be properly assessed by their fishing and selectivity properties rather than by handling issues. If the device proved to be effective at releasing cod to the specified requirements the handling problems could be addressed at a later date. Another major consideration for all the vessels was whether the vessel had suitable accommodation for an observer and whether they already had LSA gear to cover the additional person.

MFV Caareen

4.2.3 The vessel chosen were for the twin-rig was *MFV Caareen* from Kilkeel, skippered by Andrew Annett and for the single-rig *MFVs Ocean Venture* and *Argent* skippered by Jim Thomson and Adrian Coffey respectively.

4.2.4 The Caareen is an 18m vessel powered by a 333kw Caterpillar engine built in 1979. She is fitted with a full length shelter deck and both a net drum and crane mounted power block for handling the gear. The vessel normally tows two standard *Nephrops* trawls from Jim Hamilton Nets of Kilkeel with a footrope length of 22 fathom (40.24m) and headline of 20 fathom (36.58m) with a fishing circle of 400mesh of 80mm spread by a set of 6ft Kilkeel Steel Products 'V' doors.

4.2.5 The *Argent* and *Ocean Venture* both tow 35 fathom single *Nephrops* trawls made by local net maker Norman Kelly with 600 x 70mm mesh in the fishing circle. The Argent spreads his gear using 'Pukka' trawl doors and the Ocean Venture standard 'V' doors, both these doors have similar spreading power. The Argent, built in Macduff in 1975, is 20m in length with a Kelvin 8 cylinder 368


MFV Argent and MFV Ocean Venture

kw engine. The Ocean Venture, built in Buckie in1971, is 19.5m in length with the same engine as the Argent. Both vessels have crane mounted power blocks, the Ocean venture also has a net drum to haul the gear with.

### Gear

4.2.6 The gear for the trials was put out to tender which resulted in the two local net makers being successful. The lowest tender for the twin-rig gear was from Jim Hamilton Nets and the lowest for the single-rig was from Norman Kelly. Both already make gear for the respective vessels. Each vessel used gear exactly the same as their normal gear with the necessary alterations being made to accommodate the various discard devices. The nets used in both twin-rig and single-rig vessels are typical of those used by vessels targeting *Nephrops* in the Irish Sea. For the coverless nets each net maker re-designed their standard *Nephrops* trawl to give a reduced headline height and to have no cover (square) in the top sheet.

4.2.7 All the gear was towed using the vessels own trawl doors and sweeps. This helped to ensure that the nets were being towed with the same parameters as a standard *Nephrops* trawl.

## 4.3 Project methodology

4.3.1 The devices were tested on both a twin-rig vessel and two single-rig vessels. The twin-rig vessel using a control net and an experimental net in twin-rig configuration, the single-rig vessels with a control net on one vessel and the experimental net on the other. Tows were performed in parallel. To allow the trials to get underway quickly it was agreed with the skippers that they use their existing trawls as the control net which were of the minimum standard required by legislation.

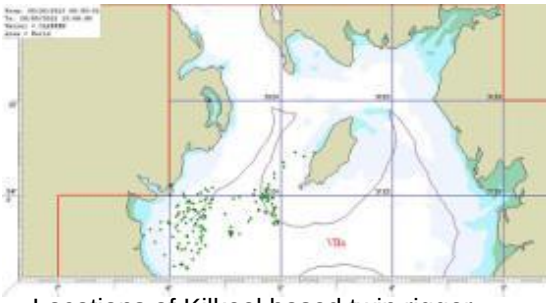
4.3.2 The single-rig trawls and the two twin-rig trawls were previously fitted with more selective 120mm square mesh panels, these were all removed and minimum regulatory 90mm square mesh panels fitted for the trials. The skipper of the twin-rig vessel had fitted one of his nets with two extra 120mm square mesh panels further forward in the net to further reduce discards (Briggs, 2010 and 2011), these were also removed and replaced with 80mm diamond mesh similar to the rest of the trawl.

4.3.3 The two single-rig vessels had their nets made using the minimum size for single-rig in this area of 70mm mesh but normally used 80mm codend and extensions. This configuration was retained for the trials and allowed the various devices to be interchangeable between all the vessels. Each device was fitted into the standard trawl and tested at sea for a few hauls to fine tune the gear. Once the scientific observers and skippers on-board were confident with the fishing performance and on-board handling of

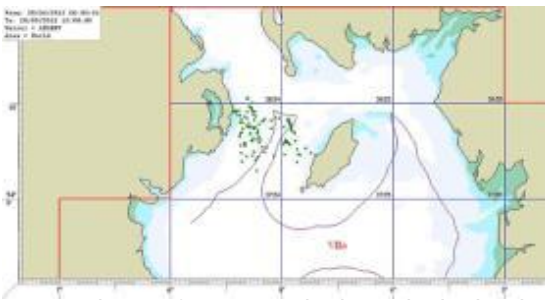
the gear the Experimental fishing trials commenced. Each gear was towed for a minimum of 12 hauls to ensure enough data was collected (Graham, *pers. com*.).

4.3.4 The scientific observers recording the total bulk in each haul, the weight of *Nephrops* and length frequency of all other species caught by each codend. Cod weights were calculated from length compositions using a length to weight relationship for first quarter Irish Sea cod (Jan-Schőn, pers.com.) Observers also recorded comments on the general performance and handling of each gear. The single-rig vessels worked on a daily basis out of Portavogie, the twin-rig vessel worked weekly out of Kilkeel. All three vessels fished on the local western Irish Sea *Nephrops* grounds, with one of the main criteria being to try to work areas where they thought they would encounter a by-catch of cod with the *Nephrops*.

## 4.4 Location of experiments

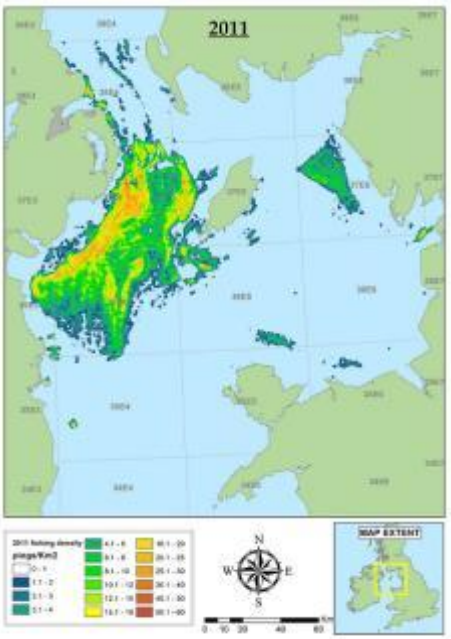


Locations of Kilkeel based twin rigger MFV Caareen during the Trials



Locations of Portavogie based single rig vessel MFV Argent during the trials

Locations of Portavogie based single rig vessel MFV Ocean venture during the trials




Map showing where Nephrops fishing areas in Irish Sea

# 5. The gears trialled

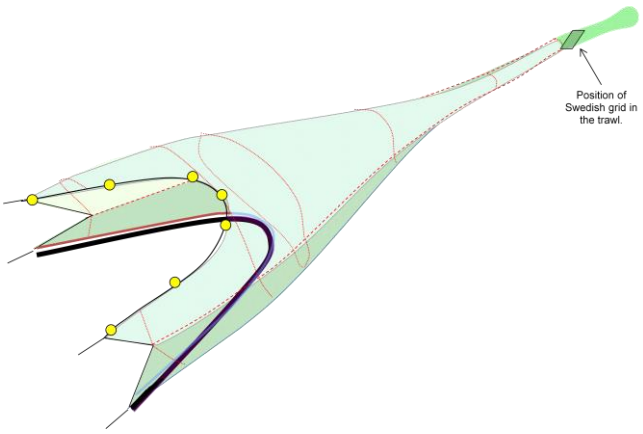
## 5.1 Swedish Grid

5.1.1 As the Swedish grid was the only device already accepted by the European Commission as being able to reduce the cod catch to below 1.5%, it was agreed that it should be trialled as a priority. If this proved to be an acceptable option it could be implemented immediately – but it would also serve as a benchmark to judge the success or otherwise of other trials. The grid used was a standard Swedish grid built and fitted to the specification in legislation[1].

5.1.2 This states that: -

- The grid shall be rectangular.
- The bars of the grid shall be parallel to the longitudinal axis of the grid.
- The bar spacing of the grid shall not exceed 35 mm.
- It shall be permitted to use one or more hinges in order to facilitate its storage on the net drum.
- The grid shall be mounted diagonally in the trawl, upwards backwards, anywhere from just in front of the codend to the anterior end of the un-tapered section.
- All sides of the grid shall be attached to the trawl.
- In the upper panel of the trawl there shall be an unblocked fish outlet in immediate connection to the upper side of the grid.

5.1.3 This regulation stipulates that the grid has to be fitted somewhere in the extension of the trawl, angled to direct larger fish out through a hole in the top of the trawl. The extensions of the prawn trawls in the trials had a circumference of 100 (open) meshes of 80mm inside mesh. With this in mind a grid with dimensions of 1200mm long by 650mm wide was used for these trials. This was the maximum size that could fit into that area of the trawl without excessively stretching the meshes at that point. It was also made of lighter materials than many that are already in use by other

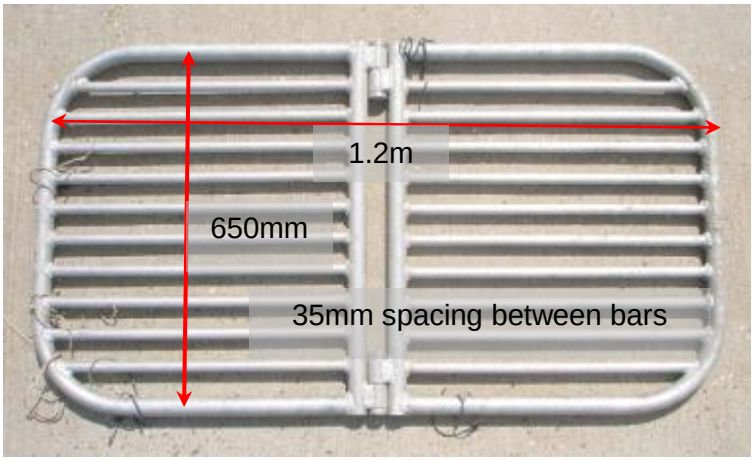



Position of Swedish grid in the trawl

[1] Council Regulation (EC) No 43/2009 (Appendix 2 to Annex III, paragraphs b, c and d)

vessels in the Irish Sea. It was constructed using 30mm diameter aluminium pipe for the outer frame and 18mm for the longitudinal bars.

5.1.4 The commonly used Swedish Grid is slightly larger at 1.5m by 0.850m. It was thought that this smaller lighter made grid would be more compatible with the lighter construction of the trawls used by the Northern Ireland Nephrops fleet. It would also fit better into the net between the end of the tapered section and the codend where regulation stipulates that it should be positioned. This size of grid would still require the meshes in this area of the trawl to be open to 24% of their mesh length, when it is generally agreed that in this area of the trawl the mesh opening would be in the region of 15-20% of the mesh length. This would result in the grid forcing open the meshes close to it and result in loss




Swedish Grid Used in the Sea Trials

of, or meshing of *Nephrops*. The grid would also be projecting below and above the line of the meshes in the top and bottom panels of the net respectively. Before undertaking the trials with an aluminium grid the skippers were encouraged to undertake a specific risk assessment to cover the handling, shooting and hauling the grids. The grid has been tested both in the North Sea (Catchpole *et al*., 2006) and in the Celtic Sea (Rihan, pers. com).

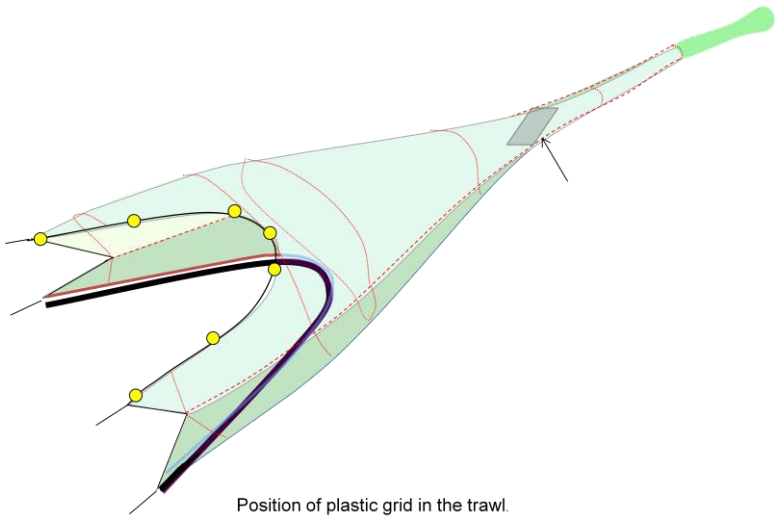
## 5.2 Plastic grid (2 variants)

5.2.1 Plastic semi-rigid grid of similar size and designed to that of a Swedish Grid, but with an oval shape to fit the section of the trawl better. This type of grid has been tested with some success in the North Sea *Nephrops* fishery by some Danish trawlers and a few Scottish vessels. It is fitted in the last tapered section of the trawl at approximately 45 degrees to deflect larger fish upwards and out of the trawl through an escape gap cut in the top panel. *Nephrops* and smaller fish pass through the gaps and into the codend.

5.2.2 The bar spacing in this grid was 45 mm; this is similar to plastic grids that have been tested in the North Sea recently by Marine Scotland. The bar spacing is 10mm greater than stipulated for the Swedish grid in an attempt to retain more of the larger *Nephrops*. This grid had a gap at the bottom in the region of a 200mm vertical opening to allow the valuable bottom fish (monks, megrims etc.) to pass through into the codend. The grid is made of a material that should allow it to be wound onto a net drum but return to its flat state when the gear is shot and towing. This is a custom made device similar to those being tested by many Danish net makers in their *Nephrops* and shrimp fisheries. Two versions were made available to the vessels. One being a grid made by Carlsen Nets from Denmark and similar to that being trialled by fishermen from Scotland and Denmark in the North Sea.

Danish Made Plastic grid

5.2.3 This grid is semi-flexible but not soft enough to haul round the net drum or through the power block of the vessels undertaking the trials. It is a rectangular shape, 1500mm in length by 850mm wide and 28mm thick, with rounded corners. The vertical bars are 10mm wide (approx.) at 45mm spacing. It had a 200mm gap at the bottom that reduced to a 150mm vertical opening when inserted at 45 degrees. The second plastic grid was made by Stornoway Plastics using sheet of high density polyethylene (HDPE) sheet 8mm thick. It was the same size and bar spacing as the Danish grid but the vertical bars were approximately 20mm wide. It had a similar gap at the bottom. This grid was much more flexible and was intended to be able to pass through a power block and wind onto the net drum.



Position of plastic grid in the trawl.

5.2.4 The size of these grids required that they were fitted into a section of the trawl approximately 200 open meshes in circumference to allow correct fitting of the grid in relation to the expected mesh opening. This should ensure that the shape of the trawl was maintained and the meshes were not excessively distorted. This resulted in the grid being fitted in the trawls approximately 5 metres up from the end of the tapered section of the trawl. This position in both trawls resulted in the grid being a few metres forward of the square mesh panels. Each grid was fitted at the correct angle into a section of netting 50 meshes long with a circumference of 200 meshes. This enabled the grid to be quickly inserted in the correct position in each trawl. In the twin-rig the grid made by Stornoway plastics from sheet HDPE was used. The grid had basic dimensions of 1.5m by 0.850m wide with 45mm bar spacing. When fitted at 45 degrees this requires a cross section of net to be approximately 1m high by 850 wide, or a circumference of 3.700m with an expected mesh opening of between 20% and 25% at this area of the trawl this results in it requiring to be fitted into a point in the trawl with a circumference of approximately 200 meshes. Much less than 200 and the netting would be stretched open too much, many more meshes than 200 and the net would be restricted in its opening.

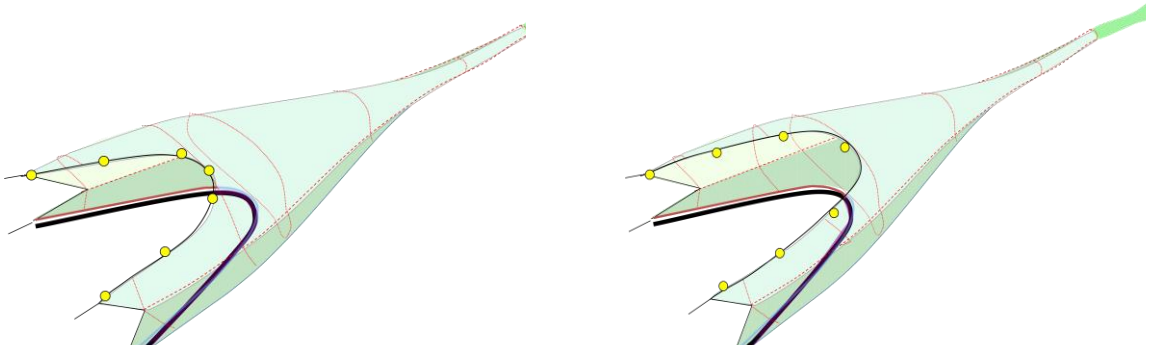
Section of netting with grid fitted at 45 degrees ready for fitting in the trawl

5.2.5 A triangular shaped hole was cut in the top panel of the netting section, its widest point being 700mm and the same as the width at the top of the grid. This grid had a 200mm gap at the bottom to allow fish and debris that were close to the bottom panel of the trawl to pass unhindered into the codend. The trawl was cut around its circumference at a point approximately 5 metres up from the end of the tapered section with 200 open meshes in the circumference and the grid section inserted.

## 5.3 Low headline and coverless trawl

5.3.1 Coverless trawls have proved to be very successful at reducing the by-catch of round fish such as whiting and haddock in prawn trawls used in several other *Nephrops* fisheries around the UK. However they have not proved successful in the past at reducing the cod catches. Taking into account that the Irish Sea is one of the few areas around the UK that cod are successfully targeted using pelagic and semi pelagic gear it is likely that cod in this area have different behavioural patterns to those in most other UK waters. For this fishery to be successful the fish must be swimming higher off the seabed and therefore be above the low headline of the coverless trawl. For this reason it was decided to trial a low headline coverless trawl in the Irish Sea.

5.3.2 Two versions of coverless /low headline trawls were made, one suitable for the single-rig vessels by Norman Kelly and one for the twin-rig vessel by Jim Hamilton. Both net makers used their standard prawn trawl design, as used by the respective vessels in the



Standard Trawl Coverless Trawl

Standard trawl and coverless showing cutback headline

trials, as a basis for their version of the coverless trawl. They both re-designed their trawls by extending the headline of the trawl to be a similar length as the footrope and with a reduced number of meshes in the wings to lower the headline height. Both net makers worked in co-operation with each other and with the project manager (M.M.) in the re-design of the new trawls. The top panel of each trawl from the headline bosom to a point about half way down the bag was made using larger diamond mesh to help with the escape of small round fish. This would also reduce drag and help to minimise

headline height by reducing the 'uplift' effect of the small mesh in this position. The mesh size was increased from the standard 70-80mm to approximately 160mm. Each trawl was fitted with a regulation 90mm square mesh panels as in the control net.

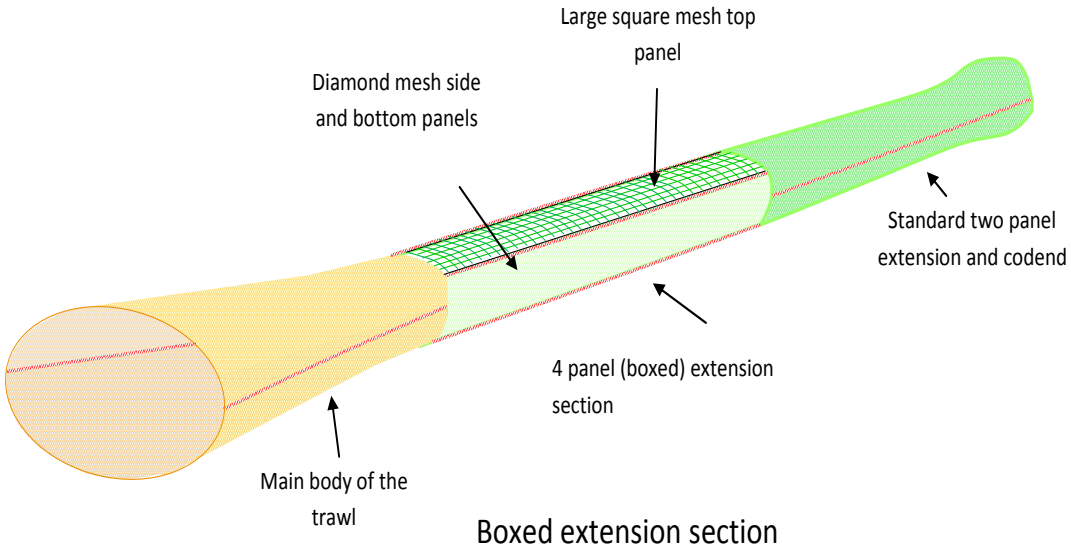
## 5.4 Boxed extension (SELTRA) – 2 variants

5.4.1 This is a version of a design that has recently been trialled with some success in the Skagerrak/Kattegat *Nephrops* fishery (SELTRA project). Versions are also being trialled by some skippers in Scotland and by BIM in the southern Irish Sea. In these trials the extension of the trawl has been converted to a box section (4 panels instead of the usual 2). This gives the codend and extension more stability and improves water flow inside the trawl. A 4 panel extension and codend tends to stay more open when compared to the standard 2 panel extension.

5.4.2 The boxed section was made with the two sides and bottom panels in 80mm mesh of 4mm PE twine similar to that normally used by the vessels in their extension sections. These were 50 meshes long with 25 open meshes in each panel to maintain the same overall circumference of 100 open meshes as in a standard extension and codend.

### Version 1

5.4.3 The top panel was made initially with 200mm square mesh in 5mm knotted PE twine, 4m long by 600mm (6 bars) wide. The length of this was made the equivalent to the 50 mesh section of 80mm (inside knot) netting. The width being six bars across, (600mm)




Boxed extension section

equivalent to the presumed width of 25 open meshes when the gear is being towed. Behind this the original 2 panel codend and extension was retained to maintain the

same selectivity of the codend throughout all the trials. This format was used in Experiment 2 in the twin-rig and Experiment 3 in the single-rig trials.

## Version 2

5.4.4 As there seemed to be some success with this device it was trialled again in both single and twin-rig scenarios with slight modifications. In the twin-rig the 200mm square mesh in the top panel was replaced with 300mm and extended to a total length of 6.75m. The panel now extended up into the tapered part of the trawl for 1m. The side panels were also fitted with triangular sections, with bar cuts on each side. The top and bottom panels were also re-cut to match this bar cut to make a smooth transition at each end of the 4 panel box section the net from 2 to 4.

Boxed extension section showing large square mesh in the top and smaller diamond mesh in the sides and bottom panel

5.4.5 In the single-rig the square mesh was again increased to 300mm. The length of the section was set at 4 metres, the exact length of the 50 mesh section of the 70mm (inside mesh) netting that the single-rig vessels use in the Irish Sea fishery. As in the twin-rig trial this was tailored at each end to ensure a streamlined change from the four panels into two panels. The standard two panel diamond mesh codend and extension was used behind the modified extension in all these experiments.

# 6. Results

6.1.1 It was planned to work on approximately 5 days fishing for each gear type, a day for changeover of gear then 4 days fishing time. The twin-rig trials started on Monday 23rd April 2012 and the single-rig vessels a week later on Monday 30th April. Each trial then progressed for six weeks, changing gear on a weekly basis, with only a few days being lost due to poor weather. Ten Experiments were undertaken, five by single-rig and five by the twin-rigger.

| Exp. | Gear | Start | End | Rig | Port |
|---|---|---|---|---|---|
| 1 | Swedish Grid | 24-April | 28-April | Twin-rig | Kilkeel |
| 2 | Box trawl (200mm) | 30-April | 5-April | Twin-rig | Kilkeel |
| 3 | Box trawl (200mm) | 01-May | 08-May | Single-rig | Portavogie |
| 4 | Swedish Grid | 09-May | 11-May | Single-rig | Portavogie |
| 5 | Plastic grid (D) | 08-May | 15-May | Twin-rig | Kilkeel |
| 6 | Plastic grid (SY) | 14-May | 21-May | Single-rig | Portavogie |
| 7 | Coverless trawl | 22-May | 29-May | Single-rig | Portavogie |
| 8 | Coverless trawl | 16-May | 22-May | Twin-rig | Kilkeel |
| 9 | Box trawl (2) (300mm) | 24 May | 30 May | Twin-rig | Kilkeel |
| 10 | Box trawl (3) (300mm) | 31-June | 6-June | Single-rig | Portavogie |

## 6.2 Swedish Grid - Experiment 1 (twin-rig)

6.2.1 Hauls 4,10 and 12 (shaded in tables and charts below) were blocked up resulting in just 9 out of the 12 hauls being valid for performance comparison. The conclusions refer only to valid hauls.

Table 6.2 - Twin - rig Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 225 | 75 | 375 | 90 | 270 | 315 | 270 | 270 | 150 | 240 | 240 | 270 | 2190 |
| Nephrops | 33 | 28 | 102 | 4 | 102 | 106 | 77 | 98 | 45 | 73 | 73 | 41 | 664 |
| Cod | 4.43 | 0 | 0 | 0 | 0 | 4.36 | 2.36 | 1.56 | 0 | 0 | 6.99 | 0 | 19.7 |
| % Cod | 1.97 | 0 | 0 | 0 | 0 | 1.39 | 0.87 | 0.58 | 0 | 0 | 2.91 | 0 | 0.90% |

| Experimental | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 180 | 75 | 165 | 30 | 270 | 330 | 240 | 240 | 120 | 75 | 180 | 83 | 1800 |
| Nephrops | 33 | 18 | 45 | 2 | 102 | 106 | 74 | 95 | 45 | 16 | 45 | 9 | 563 |
| Cod | 0 | 0 | 0 | 3.5 | 0 | 0 | 0 | 0.06 | 0.11 | 0 | 0 | 0 | 0.17 |
| % Cod | 0 | 0 | 0 | 11.65 | 0 | 0 | 0 | 0.03 | 0.09 | 0 | 0 | 0 | 0.01% |

## Impact on Cod

6.2.2 A total of 11 fish (19.7kg) were caught in the control net and 2 cod (0.17kg) in the experimental net. This was a reduction from 0.9% of the total catch to 0.01% of the total catch

6.2.3 From the various graphs below it can be seen that the Swedish grid, if it is working correctly and not blocking up with debris, is effectively releasing the majority of the larger fish, reducing the cod catch to below 1.5% but retaining only 85% of the *Nephrops.*

Fig 6.2a

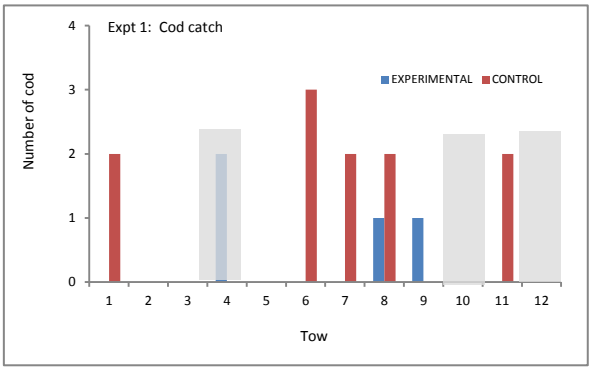
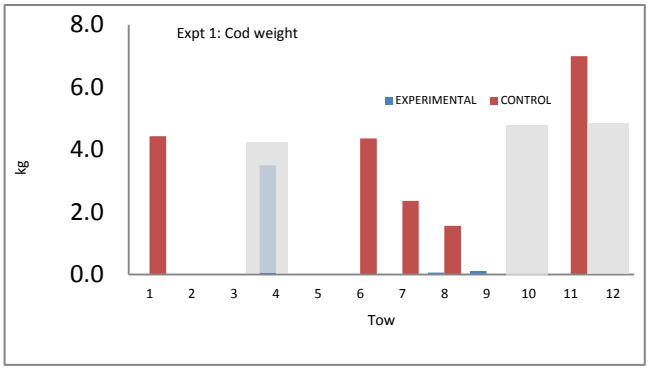



Fig 6.2b




## Discard reduction

6.2.4 The total catch reduced from 2190kg in the control net to 1800kg in the experimental net (18% reduction). There was a similar reduction in the by-catch, the majority of which would have been discarded.

Fig 6.2c

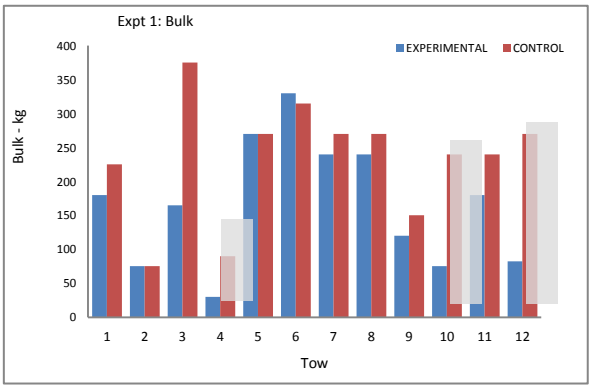


Fig 6.2d

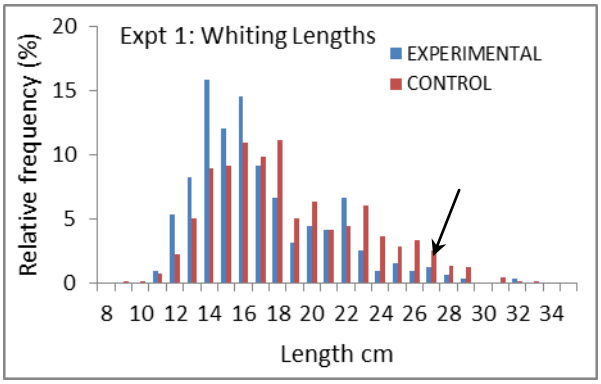
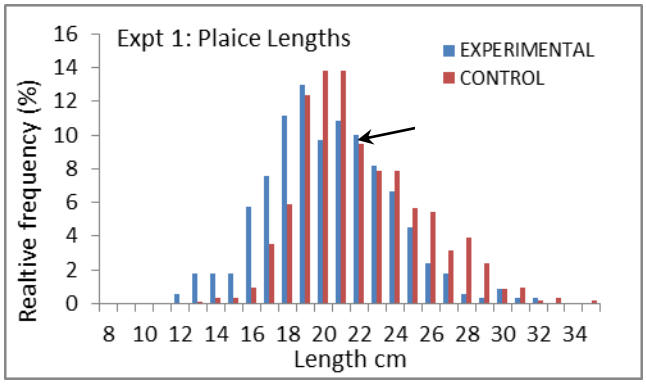


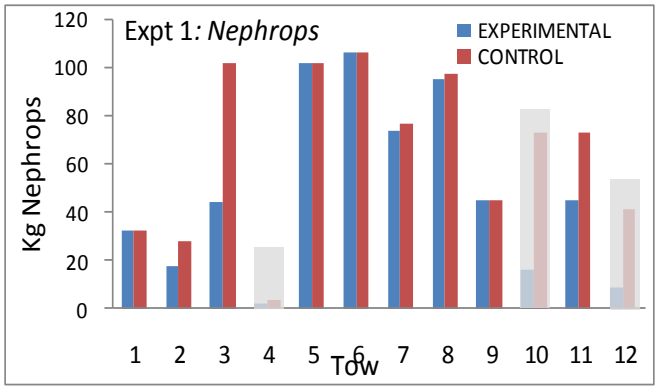

Fig 6.2e




6.2.5 The total catch reduced in the experimental net as result of the release of whiting above 160mm, (Figure 6.2d) and plaice above 180mm (figure 6.2e). No haddock were caught in either net in this trial. There is a definite trend for a greater proportion of the smaller plaice and whiting to be retained by the experimental net. (Figs 6.2d and e). This could be due to changes in the selectivity of the codend on this trawl due to the reduced bulk in it.

## Acceptability of design

Fig 6.2f




6.2.6 The total catch of *Nephrops* (In figure 6.2f) for the 9 hauls (when the grid was not blocked) was 664kg in the control net and 563kg in the experimental net, a reduction of 101kg or 15%.

6.2.7 Although the data suggests that the Swedish grid could be a viable option the overall picture is different. Right from the start of the sea trial the vessel had difficulty handling the grid. It would not fit onto the net drum or pass through the power block. This vessel had a bar across the top of the net drum that prevented the grid going on the drum. All vessels will have a restriction like this at some point around the drum, on some it will be the superstructure ahead of the drum, on others it will simple be the base of the net drum. These necessary obstacles all prevent the rigid grid passing round the drum. On the twin rigger the crew had to haul the grid as far as possible onto the net drum and then had to haul the remaining net by hand. This is not a practical option.


Swedish Grid hauled onto the netdrum on MFV Caareen

6.2.8 With the grid being close to the codend (regulation stipulates the position), as the catch is taken forward to empty the codend, the grid had to be paid out into the water again. This created problems and safety issues in that the crew had to manhandle the grid again. There were also problems with the netting in the water becoming entangled in the vessels rudder and propeller. As the grid remains a rigid form in the trawl it creates pockets of slack netting that are prone to catching on parts of the vessel and crew as the gear is hauled and shot away. Despite writing up a risk assessment prior to the trials the skipper felt that this was not adequate for the use of the grid, saying ‘’if I had known what

The Swedish Grid choked with seabed debris at the stern of the vessel

the grid was like to work I would have scored the points in the risk assessment much higher''.


Swedish grid coming onboard partially choked with skate and a plastic drum

6.2.9 In perfect conditions the grid did exclude all the larger fish, leaving a catch of clean *Nephrops* in the experimental net. However there was also a 15% reduction in the *Nephrops* catch in the experimental net and this is the main target species in this fishery.

6.2.10 The grid was also prone to choking up with seabed debris such as plastic bags and old netting along with benthic organisms such as echinoderms, skate, shells and seaweed. Depending when the grid choked up and to what degree this occurred dictated how much, if anything, was in the codend of the experimental net. This can be seen in tows 4, 10 and 12 (Table 6.2) where there is a big difference in the overall bulk in the two codends and a much reduced nephrops catch. The skipper did try moving to other *Nephrops* areas but got similar results.

Swedish grid being cleared of debris.

6.2.11 The skipper found that to get the best out of the grid he had to keep to short, straight tows with minimum turning in case the grid choked up. The trials took place during a period of good weather. The skipper was concerned about the use of the grid in poorer weather as this would become a safety issue and also result in poor *Nephrops* retention.

## Conclusions: Swedish Grid - Experiment 1 (twin-rig)

- There were very few cod caught by either the control or experimental net
- The Swedish grid will release all of the larger fish but also allows 15% of the *Nephrops* to escape (in comparison to the control net for valid hauls).
- In this trial the grid reduced the cod catch to below 0.01% of the total catch
- The grid releases the majority of cod whiting and plaice above 22cms
- The grid was found to be blocked in 3 of the 12 hauls. When this happens almost all the catch is lost depending at what stage in the tow it becomes blocked.
- Problems with handling the grid on-board were encountered throughout the trials on MFV Caareen.
- Safety concerns when hauling and shooting the gear fitted with the grid.
- It is possible that some refinement in grid design, fitting and handling would improve the situation but the system used here was completely impractical.
- Vessels would have to fully redesign their deck layout and hauling arrangements to use the grid safely.

## 6.3 Swedish Grid - Experiment 4 (single rig)

6.3.1 This trial was aborted after 7 hauls as in every haul the grid was blocked with seabed debris. Conclusions have been drawn from these 7 blocked hauls.

Table 6.3 Single-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two gears

| Control | | | | | | | | TOTALS for all hauls |
|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Bulk | 127 | 64 | 223 | 95 | 51 | 76 | 32 | 668 |
| Nephrops | 102 | 59 | 197 | 60 | 32 | 60 | 8 | 519 |
| Cod | 0.45 | 1.82 | 2 | 0.66 | 0 | 0.22 | 1.51 | 6.67 |
| % Cod | 0.36 | 2.87 | 0.9 | 0.69 | 0 | 0.29 | 4.76 | 1% |
| | | | | | | | | |
| Experimental | | | | | | | | TOTALS for all hauls |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Bulk | 0 | 80 | 50 | 50 | 75 | 100 | 20 | 375 |
| Nephrops | | 19 | 9 | 19 | 23 | 20 | 6 | 96 |
| Cod | 0 | 0 | 0.1 | 0.13 | 0.05 | 0.35 | 0 | 0.64 |
| % Cod | 0 | 0 | 0.2 | 0.3 | 0.1 | 0.4 | 0 | 0.17% |

### Impact on cod

6.3.2 Very few cod were caught throughout the seven hauls. In the control net there were 25 fish with a total weight of 6.67kg making up only 1% of the total catch. In the experimental net there were 5 fish with a total weight of 0.64k representing 0.17% of the total catch. In Fig 6.3b showing the weights of cod it can be seen that the only cod getting through the grid are small fish with an average weight of 0.12kg all less than 18cms in length.

Fig 6.3a

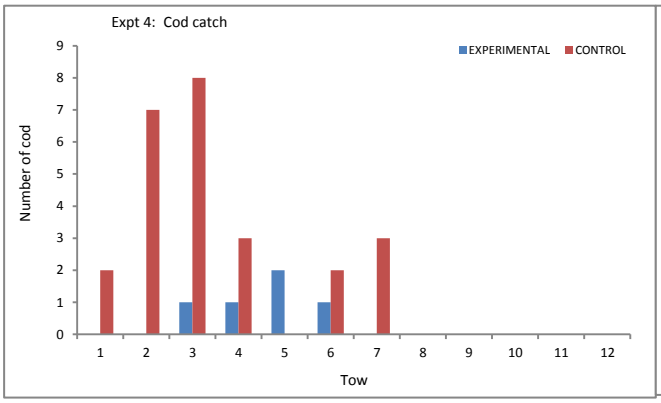
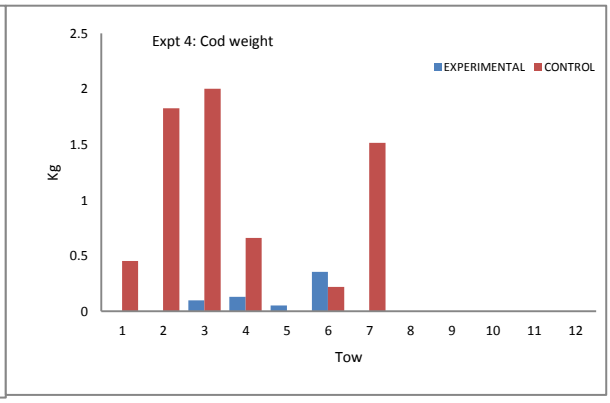



Fig 6.3b



## Discard reduction

6.3.3 The figures are erratic in this trial as there is no way of knowing at what point in the tow the grid become blocked up and to what extent . In haul 1 (Table 6.3.1) the grid was completely blocked up with debris and nothing in the codend at all.

6.3.4 Generally during this trial there was not many *Nephrops* or fish on the grounds with the control net having a total catch of 668kg for the seven hauls (Table 6.3.1). Of this 519kg was *Nephrops.* In the same seven hauls the experimental net had a total catch of 375kg, 56% of control net, with only 96kg of *Nephrops*, a reduction of 82% compared to the control net. This tends to indicate that when the grid is blocked there is a greater loss of *Nephrops* than other fish.

6.3.5 In Fig 6.3d (whiting) and Fig 6.3e (haddock) it can be seen that there were very few haddock and whiting above the minimum landing size (MLS) during these trials. The experimental net released more of the larger fish, whiting and haddock above 20cms and plaice above 22cms but retained a greater proportion of fish less than 17cms. There is a large variation in the numbers and size of plaice caught (Fig 6.3f), this is probably due to the repeated blocking of the grid. Despite this there is still a trend for the grid to release most of the plaice above the MLS.

Fig 6.3c

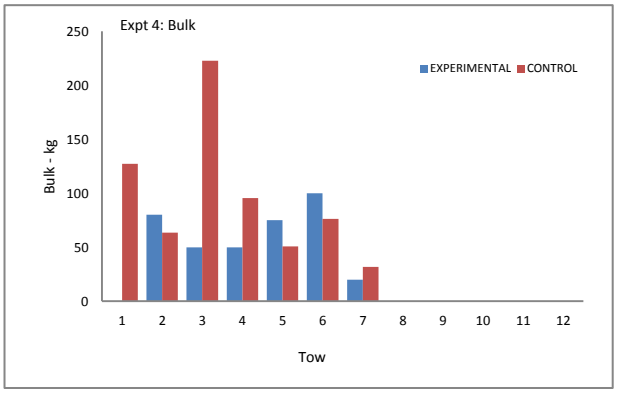



Fig 6.3d

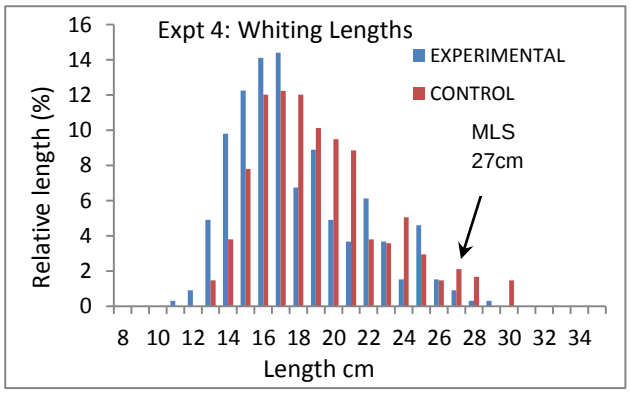



**Fig 6.3e**

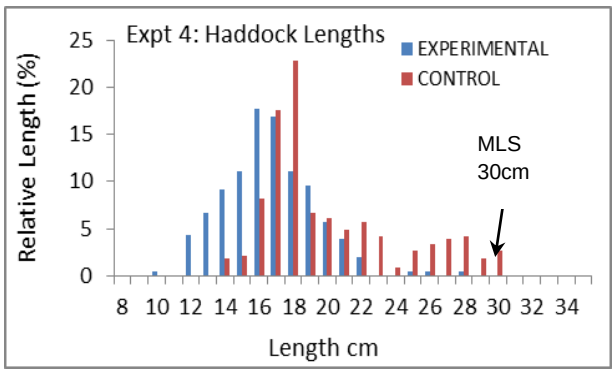
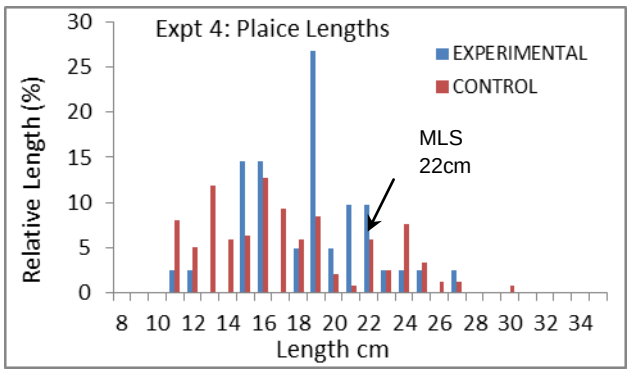



**Fig 6.3f**



## Acceptability of design

6.3.6 Both the single-rig vessels encountered problems when using the Swedish grid. The handling on deck when shooting and hauling entailed much manual handling from the crew, putting them in unnecessary dangerous situations. It was fine weather during the these trials but the two skippers were doubtful if they could fish safely with the grid in poor weather. The major problem was the grid getting choked up with seabed debris, heart urchins, mud and shells. The situation was so bad that the trial had to be abandoned after seven hauls. When the grid clogged most of the catch tended to be washed out through the escape hole in the top of the netting or was trapped in the blockage in front of the grid. This caused problems for the crew as there was no simple and safe way to clear the blockages at the stern of the vessel. Some Irish skippers who have worked Swedish grids in this area have cut a 150mm gap at the bottom of the grid to allow the mud and debris to pass through into the codend. This has had limited success.

6.3.7 There was evidence of abrasion on the lower side of the grid suggesting that the grid was rubbing and possible 'ploughing' into the seabed. This could be due to the grid being too big for this position in the trawl. This effect is probably aggravated by the basic design of a *Nephrops* trawl as used by the Northern Ireland industry, in that the bottom panel of the trawl is designed to be flat and towed very close to the seabed. There is nothing in the trawl to lift the netting off the seabed as in many other trawls used in European waters. There was also evidence of loss of *Nephrops* through the distorted meshes next to the grid.

## Conclusions: Swedish Grid - Experiment 4 (single rig)

- There were no hauls were the grid functioned properly (without clogging) so no valid performance comparison can be made.
- When the grid becomes blocked almost all the catch is lost depending at what stage in the tow it becomes blocked.
- Problems with handling the grid on-board were encountered throughout the trials on both vessels.
- The grid will not pass through a power block and will only go part way round a net drum.
- Safety concerns when hauling and shooting the gear fitted with the grid.
- Vessels would have to fully redesign their deck layout and hauling arrangements to use the grid safely.
- It is possible that some refinement in grid design, fitting and handling would improve the situation but the system used here was completely impractical.

## 6.4 Plastic grid (Stornoway design) - Experiment 7 (twin-rig)

6.4.1 Three hauls out of the twelve were blocked in this trial, they are shaded on the chart below. The conclusions refer to only valid hauls.

Table 6.4 Twin-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 420 | 555 | 720 | 134 | 360 | 600 | 240 | 330 | 600 | 1050 | 750 | 270 | 4019 |
| Nephrops | 134 | 134 | 220 | 127 | 95 | 146 | 57 | 92 | 159 | 76 | 223 | 51 | 1184 |
| Cod | 0 | 0.24 | 0.26 | 0 | 0 | 0 | 0.07 | 0.1 | 0.17 | 0 | 0 | 0 | 0.67 |
| % Cod | 0 | 0.04 | 0.04 | 0 | 0 | 0 | 0.03 | 0.03 | 0.03 | 0 | 0 | 0 | 0.02% |

| Experimental | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 360 | 390 | 450 | 240 | 150 | 330 | 150 | 270 | 150 | 150 | 480 | 150 | 2820 |
| Nephrops | 115 | 134 | 111 | 48 | 25 | 73 | 22 | 60 | 19 | 6 | 121 | 35 | 719 |
| Cod | 0.35 | 0 | 0.1 | 0 | 0.09 | 0 | 0.75 | 0 | 0 | 0 | 0 | 0 | 1.2 |
| % Cod | 0.1 | 0 | 0.02 | 0 | 0.06 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0.04% |

### Impact on cod

6.4.2 Very few cod were caught throughout the seven hauls. In the control net there were 7 fish with a total weight of only 0.67kg (0.02% of the total catch). In the experimental net there were 3 fish with a total weight of 1.2kg in the experimental net (Table 6.4.), with the cod percentage increasing to 0.04%.

6.4.3 As in other trials the actual numbers of cod were very low.(Fig 6.4a and b) in the control net, 7 fish and experimental net 3 fish. All were small fish below the MLS. A total weight in the control net of only 0.67kg (0.02% of the total catch) and 1.2kg in the experimental net (Table 6.4.), with the cod percentage increasing to 0.04%.

Fig 6.4a

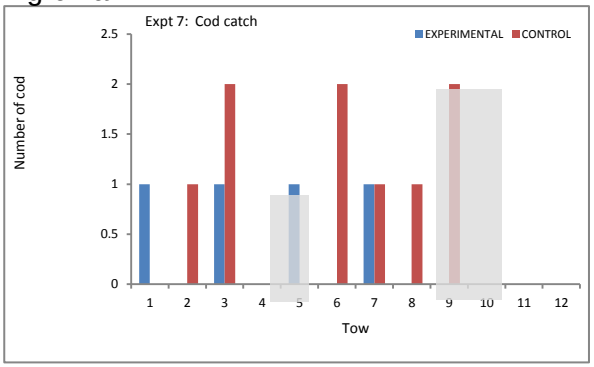
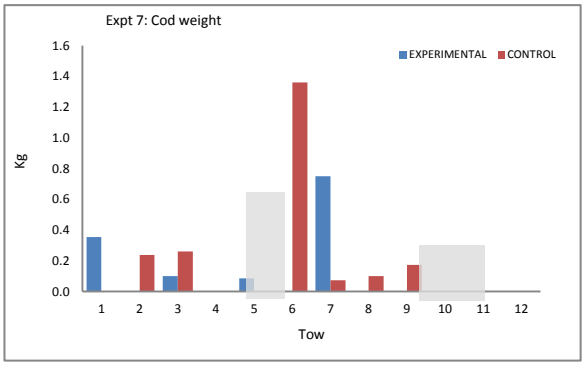



Fig 6.4b



## Discard reduction

6.4.4 Out of the 12 hauls, in hauls 5, 9 and 10 the grid was found to be blocked when the gear was hauled. Fig 6.4c below shows there was a marked reduction in total catch by the experimental net. The total catch for the nine valid hauls from the control net was recorded at 4019kg and 2820kg for the experimental net.

6.4.5 In several other hauls, 6, 7 and 12 in particular there was no evidence of blocking up when the gear was hauled but judging by the large reduction in total catch in these hauls it would appear that the gear may have been blocked at some stage during the tow and cleared again before the gear was hauled.

6.4.6 There was evidence of greater numbers of small whiting and haddock passing through the grid into the codend in the experimental net. There were very few haddock and whiting caught in either net above MLS. Although not many plaice were caught there is some indication in fig 6.4f that when compared to the control net, the experimental net released more plaice above MLS but retained more of the small plaice below 18cms.

Fig 6.4c

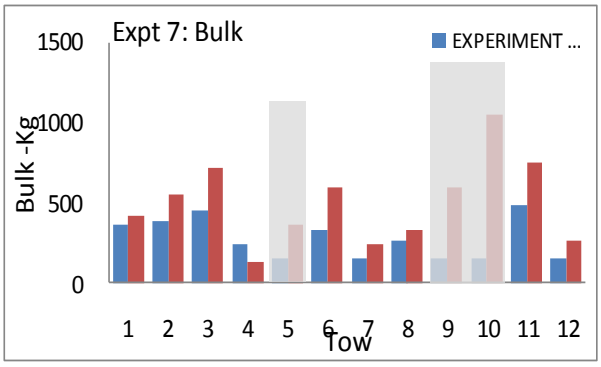



Fig 6.4d

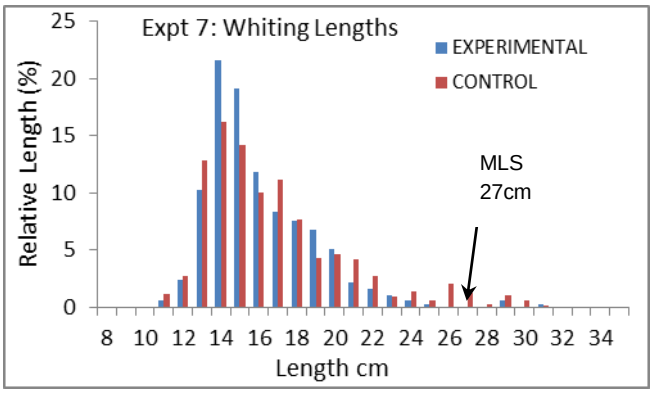



Fig 6.4e

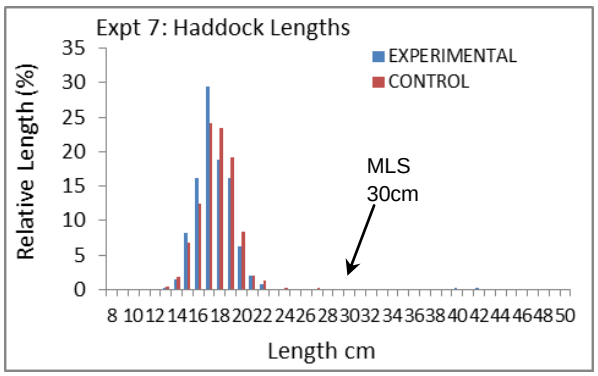
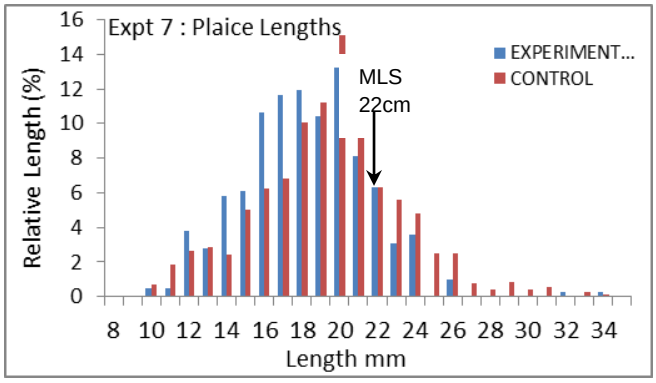



Fig 6.4f



## Acceptability of design

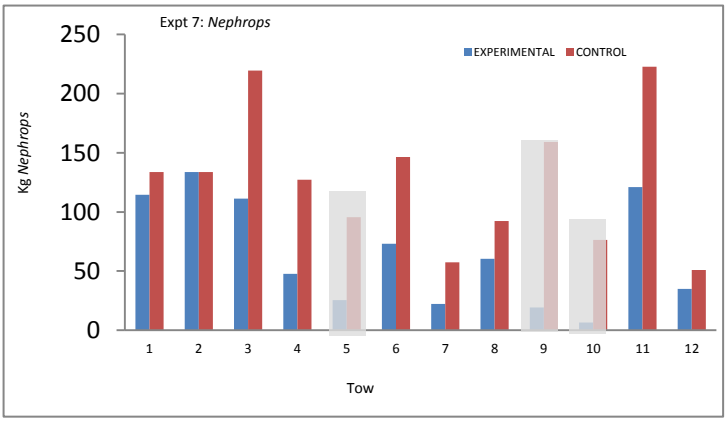
6.4.7 As the net was taken on-board it soon became evident that this semi flexible grid was 'more user friendly' in that there was some 'give' as it went aboard. It flexed enough to allow it to be hauled directly onto the net drum and it regained its shape as the trawl was shot away. This made it much easier and safer to handle than a rigid grid.

The Stornoway grid hauled onto the netdrum on MFV Caareen

6.4.8 As the grid was fitted further up the trawl there was no need for it to come off the net drum as the catch was hauled forward to empty the codend. As with the Swedish grid it was liable to get choked with debris and seaweed. In this case it seemed to be seaweed that was the main problem and was attributed to the plastic bars not being as smooth as the aluminium, thereby preventing the weed sliding up the bars. As with the Swedish grid if there was any blockage at all the overall catch in the net with the grid was drastically reduced.

6.4.9 When the grid was not blocked the experimental net caught 39% fewer *Nephrops* than the control net (Fig 6.4g) with 1184kg in the control net and 719kg in the experimental net.

Fig 6.4g



6.4.10 It was thought that the wider bars, creating a greater frontal area on this grid compared to the Swedish grid contributed greatly to the loss of catch. This grid had 25mm wide square edge bars compared to the 18mm round bars in the Swedish grid that are much more conducive to passage of nephrops.

## Conclusions: Plastic grid (Stornoway design) - Experiment 7 (twin-rig)

- The Stornoway plastic grid was liable to blocking up with seabed debris.
- In the 9 of the 12 hauls where there was no evidence of blockages there was a 30% (approx.) reduction in total catch when using this grid.
- In the same hauls there was a 39% reduction in the Nephrops catch by the experimental net.
- The gear was easy to handle and could be wound onto the vessel's net drum.
- It was reasonably safe to handle onboard
- Design modifications would be needed for this grid to be acceptable.

## 6.5 Plastic grid (Danish Grid) - Experiment 8 (single-rig)

6.5.1 Two hauls out of the twelve were blocked in this trial, they are shaded on the chart below. The conclusions refer to valid hauls only.

Table 6.5 Single-rig Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 159 | 95 | 191 | 159 | 127 | 95 | 286 | 255 | 172 | 159 | 223 | 64 | 1443 |
| Nephrops | 146 | 78 | 169 | 134 | 95 | 83 | 235 | 216 | 143 | 143 | 115 | 38 | 1235 |
| Cod | 1.33 | 0 | 0.51 | 0.19 | 0.21 | 5.42 | 11.5 | 6.6 | 10.13 | 3.82 | 76.65 | 16.61 | 22.59 |
| % Cod | 0.84 | 0 | 0.26 | 0.12 | 0.17 | 5.68 | 4.01 | 2.59 | 5.9 | 2.4 | 34.42 | 26.11 | 1.57% |

| Experimental | | | | | | | | | | | | | TOTALS for valid hauls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Bulk | 130 | 170 | 10 | 220 | 175 | 150 | 200 | 180 | 175 | 150 | 20 | 125 | 1675 |
| Nephrops | 46 | 56 | | 76 | 62 | 57 | 114 | 78 | 87 | 66 | | 38 | 680 |
| Cod | 0.93 | 0 | 0 | 0 | 0.21 | 1.21 | 0 | 0 | 0 | 0 | 0 | 5 | 7.35 |
| % Cod | 0.7 | 0 | 0 | 0 | 0.1 | 0.8 | 0 | 0 | 0 | 0 | 0 | 4 | 0.44% |

### Impact on Cod

6.5.2 There was more cod on the grounds during this trial with 33 fish in the control net and 4 in the experimental net for the ten valid tows (Fig 6.5.a). Table 6.5 shows a reduction in weight of cod from 22.59kg (1.57%) in the control net to 7.35kg (0.44%) in the experimental net. Even with a 200mm vertical gap at the bottom of this grid it is evident that the net released all the larger cod only retaining some of the smaller ones that can pass through the bar spacing (Fig 6.5a and 6.5b).

Fig 6.5a

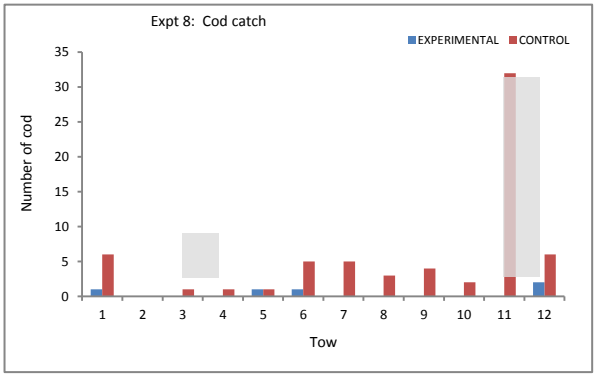
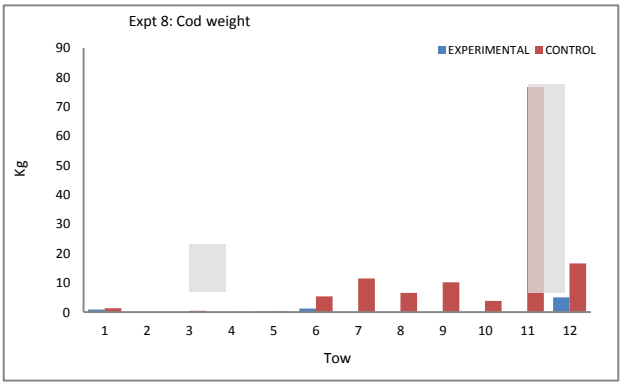



Fig 6.5b



## Discard reduction

6.5.3 Over the 10 valid hauls (Fig 6.5c) there was greater total catch in the experimental net (1675 kg) than the control net (1443kg) This equates to a 16% increase in total catch in the experimental net.

Fig 6.5c

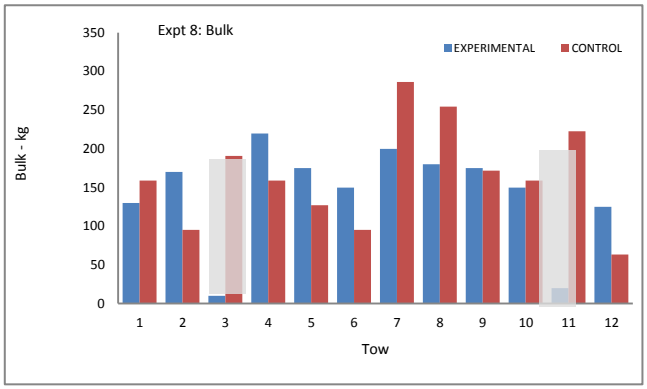



Fig 6.5d

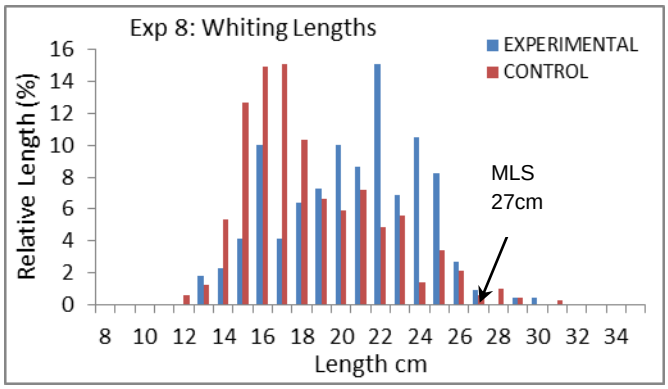



Fig 6.5e

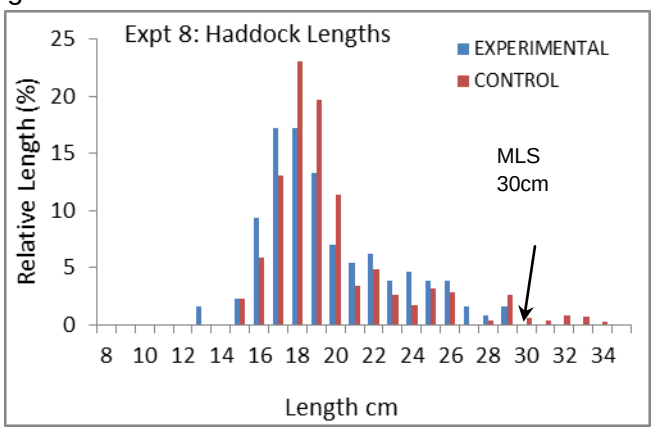
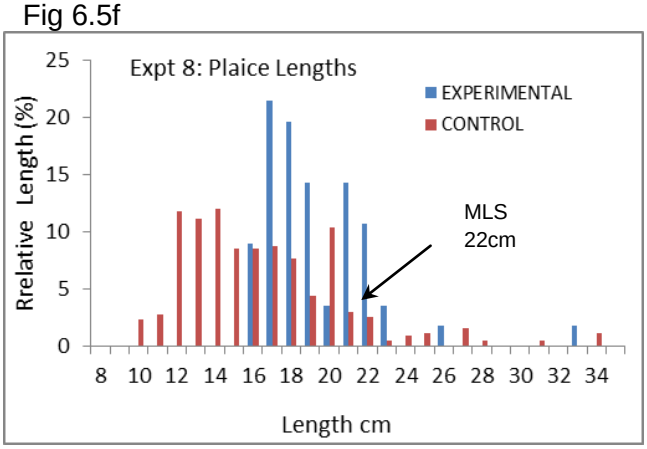



Fig 6.5f

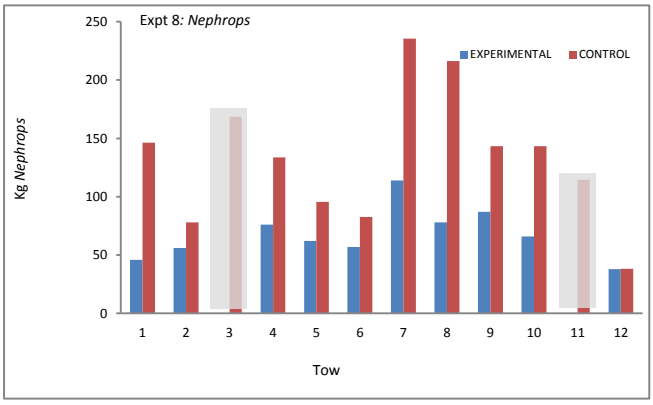



6.5.4 There were very few whiting, haddock and plaice caught in either net above their respective MLS. (Figs 6.5d, e and f). As for these species below MLS the graphs are inconclusive showing a wide variation in retained and released patterns.

## Acceptability of design

6.5.5 There was a 45% reduction in the nephrops catch with the Danish plastic grid (Table 6.5g) with 1235kg in the control net and only 680kg in the experimental net. This may have been caused by the grid allowing much of the general discards (benthic debris, small skate, rays, dogfish, crabs etc) to pass through the grid or the gap at the bottom but deflected many of the Nephrops out the release hole.

Fig 6.5g




6.5.6 Since the grid was fitted further up the trawl this allowed the codend to be hauled forward to be emptied on deck without the need to put the grid over the side again. Choking up with seabed debris, skate, starfish, shells and mud remained a problem with this grid on these fishing grounds and any blockage resulted in very little catch in the codend. Several different fishing areas were fished to try to get clear hauls.

6.5.7 Repeated choking up of the grid can lead to excessive strain on the top panel of the trawl causing it to stretch. This design of trawl depends on a slight tension in its top panel, any stretching of the netting will dramatically reduce the efficiency of the trawl.

6.5.8 The Danish plastic grid, although semi-flexible was very similar to the Swedish grid to handle in that it remains rigid and would not go through the power block or round the net drum. As with the Swedish grid it required much physical work to haul and shoot, requiring the crew to lift the grid over the vessels side rail each time. The skippers expressed concern about the safety of their crews in handling the grid in any poor weather

## Conclusions: Plastic grid (Danish Grid) - Experiment 8 (single-rig)

- The Danish plastic grid reduced the cod catch from 1.57% to 0.44% of total catch.
- Nephrops catch in the experimental net was 45% less than the control net.
- The Danish plastic grid was more awkward to handle due to its limited flexibility and will not go round a net drum or through a power block.
- The grid is prone to clogging by debris and when it does so it loses most of the catch.
- There were concerns about crew safety when using the grid.

## 6.6 Coverless trawl - Experiment 6 (twin-rig)

Table 6.6. Twin-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 420 | 300 | 360 | 345 | 390 | 300 | 510 | 375 | 210 | 240 | 510 | 480 | 4440 |
| Nephrops | 140 | 92 | 124 | 121 | 121 | 92 | 178 | 89 | 67 | 70 | 197 | 159 | 1451 |
| Cod | 0.81 | 0.00 | 0.00 | 0.00 | 1.93 | 1.73 | 0.17 | 0.76 | 0.44 | 0.00 | 0.00 | 5.69 | 11.52 |
| % Cod | 0.19 | 0.00 | 0.00 | 0.00 | 0.49 | 0.58 | 0.03 | 0.20 | 0.21 | 0.00 | 0.00 | 1.18 | 0.30 |
| | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 390 | 300 | 360 | 330 | 360 | 360 | 480 | 330 | 270 | 240 | 390 | 495 | 4305 |
| Nephrops | 140 | 83 | 124 | 121 | 102 | 102 | 159 | 115 | 89 | 70 | 140 | 159 | 1,403 |
| Cod | 0.00 | 0.35 | 0.18 | 0.00 | 2.49 | 2.89 | 0.00 | 0.28 | 0.00 | 0.00 | 2.36 | 1.93 | 10.48 |
| % Cod | 0.0 | 0.1 | 0.0 | 0.0 | 0.7 | 0.8 | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.4 | 0.2 |

### Impact on cod

6.6.1 Again with this twin rig trial there were very few cod on the grounds, a total of 24 fish between the two nets. (Table 6.6.1). Despite there being very few cod on the grounds, the cod catches differed very little with both nets catching 12 fish (Fig 6.6a and b). In the control there was 11.52kg (0.3% of total catch) with the experimental net catching 10.48kg (0.24% of the total catch) for the 12 hauls.

Fig 6.6a

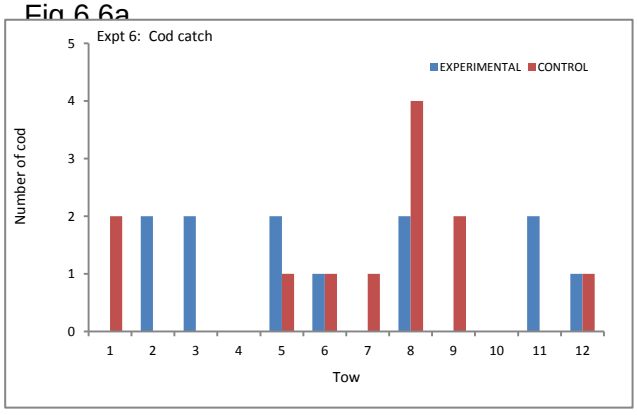
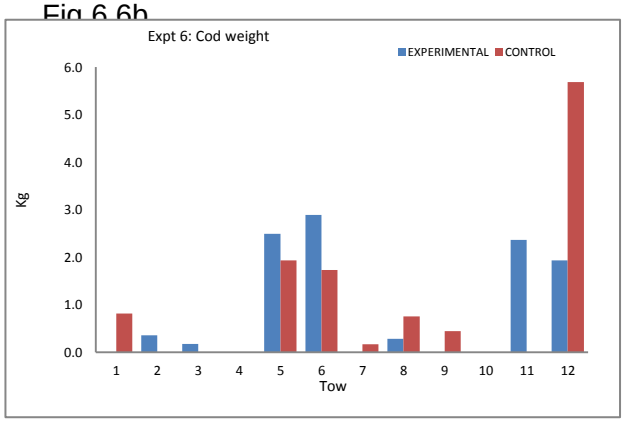



Fig 6.6b




### Discard reduction

6.6.2 The total catch of both nets was similar in each haul (Fig 6.6c) with total of 4440kg in the control net and 4305kg in the experimental net. Considering the whiting, haddock and plaice graphs (Figure 6.6d, e and f) there is very little difference in the catches of these

species either. In Fig 6.6 e there were several haddock between 40 and 48cms caught in the experimental net but none in this size rage were found in the control net. This is the size range that one would expect the experimental net to catch due to the low cut back headline. Otherwise there is very little difference in the selectivity of control net and this design of coverless net (the experimental net). Both nets demonstrated a similar catch composition and catch quantity during these sea trials.

Fig 6.6c

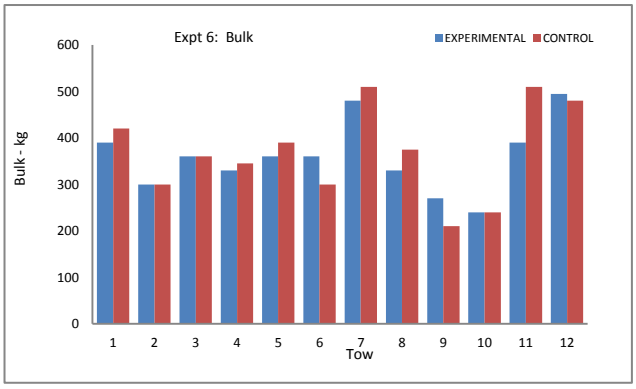



Fig 6.6d

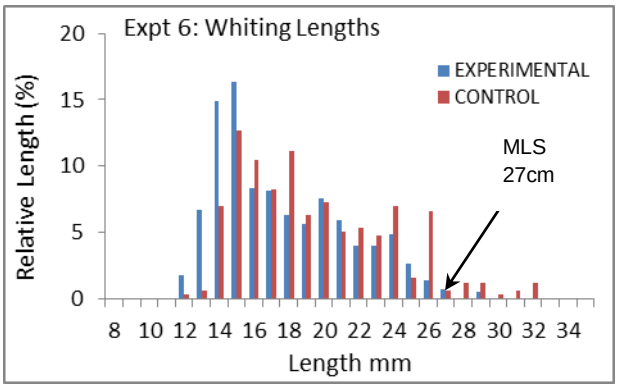



Fig 6.6e

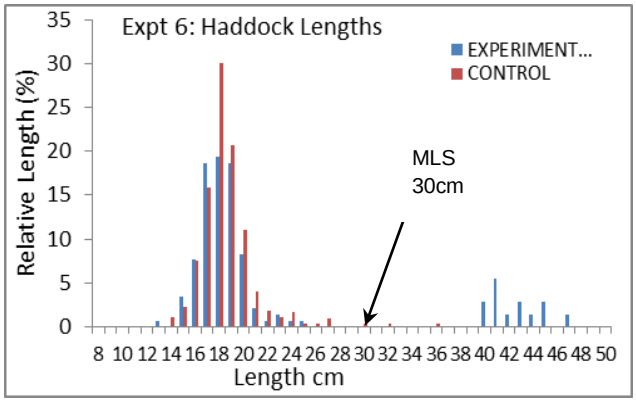
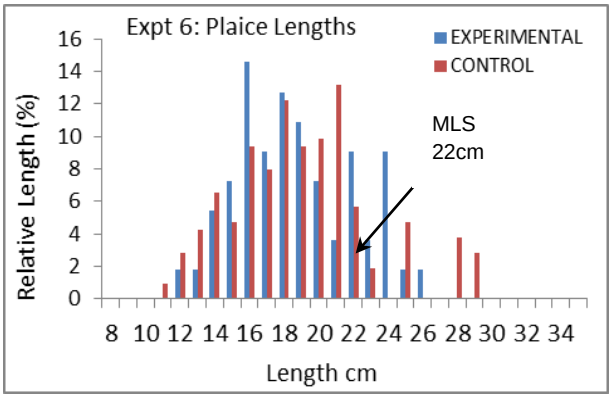



Fig 6.6f



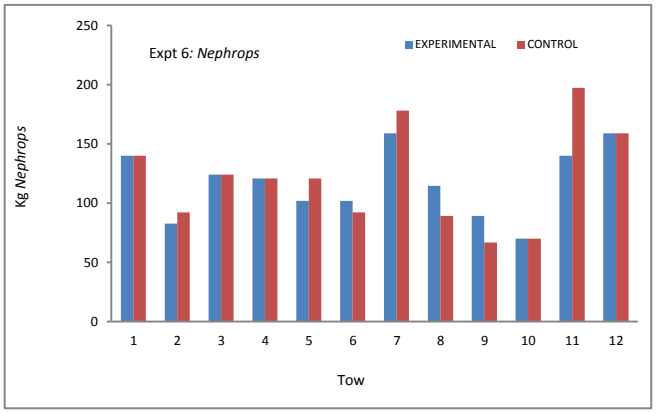

## Acceptability of design

6.6.3 The *Nephrops* catch (Fig 6.6g was similar for all 12 hauls in both trawls with a total of 1451kg in the control and 1403kg in the experimental net. There was however evidence of *Nephrops* being lost through 160mm mesh in top panel, particularly close to selvedges. This can be a problem with coverless trawls due to changes in the water flow through the trawl. This problem can be overcome by altering mesh sizes in certain areas of the trawl.

6.6.4 Initial reactions from the skipper and crew were that the trawl very much resembled the trawls they traditionally used. The trawl was exactly the same to haul and shoot with no obvious problems in the handling. The skipper did find that the trawl was easier to tow,

probably due to the low headline height, the reduction of netting in the wings and the larger mesh top panels. There was a slight (300mm) increase in the opening of the trawl (wing end spread) due to the increased headline length.

6.6.5 The skipper of the Caareen was interested in continuing to use the coverless trawl as it had similar catch composition as his existing trawls but showed potential in fuel saving.




## Conclusions: Coverless trawl - Experiment 6 (twin-rig)

- The cod catch was similar for the control and the experimental nets although there were few cod caught with each net catching approximately 11kg in total for 12 tows.
- In twin rig configuration the coverless net is not an effective cod avoidance measure in this sea area.
- The selectivity of this gear may be more evident and beneficial when there were more, larger round fish on the grounds.
- The coverless trawl has similar catch composition characteristics as the traditional low headline height trawl in the Northern Ireland nephrops fishery

## 6.7 Coverless trawl - Experiment 5 (single-rig)

Table 6.7 Single-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14.00 | 15 | 16 | 17 | TOTAL |
| Bulk | 115 | 108 | 127 | 178 | 210 | 178 | 127 | 108 | 172 | 191 | 146 | 223 | 178 | 108.00 | 95 | 76 | 191 | 2533 |
| Nephrops | 97 | 51 | 89 | 150 | 178 | 159 | 118 | 67 | 150 | 169 | 134 | 197 | 162 | 54.00 | 32 | 25 | 64 | 1895 |
| Cod | 5.59 | 47.11 | 21.10 | 4.93 | 20.29 | 16.65 | 4.18 | 27.53 | 10.79 | 9.97 | 3.25 | 0.45 | 4.84 | 41.20 | 27.12 | 37.30 | 96.63 | 378.94 |
| % Cod | 4.88 | 43.55 | 16.58 | 2.77 | 9.66 | 9.35 | 3.29 | 25.45 | 6.28 | 5.22 | 2.22 | 0.20 | 2.72 | 38.09 | 28.42 | 48.84 | 50.61 | 15.00 |
| | | | | | | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14.00 | 15 | 16 | 17 | TOTAL |
| Bulk | 200 | 200 | 200 | 200 | 300 | 300 | 175 | 250 | 220 | 175 | 300 | 250 | 200 | 230.00 | 250 | 200 | 200 | 3,850 |
| Nephrops | 47 | 42 | 44 | 69 | 171 | 121 | 99 | 76 | 60 | 87 | 88 | 136 | 57 | 27.00 | 25 | 36 | 24 | 1,209 |
| Cod | 7 | 62 | 3 | 1 | 15 | 10 | 2 | 7 | 6 | 2 | 5 | 5 | 0 | 63.00 | 37 | 39 | 87 | 351 |
| % Cod | 3.4 | 30.9 | 1.3 | 0.3 | 5.1 | 3.4 | 1.2 | 2.8 | 2.5 | 1.3 | 1.6 | 2.1 | 0.2 | 27.30 | 15.0 | 19.7 | 43.6 | 9.1 |

## 6.8 Impact on cod

6.8.1 There was very little difference in cod catches between the experimental and the control net with 378.94kg (15% of the total catch) in the control and 351kg (9.1% of the total catch) in the coverless net. (Table 6.7.b).

6.8.2 In Figs 6.7a and 6.7b) it can be seen that the amount of cod caught by both nets was similar in each haul. There was a large variation in the cod catches from haul to haul.

Fig 6.7a

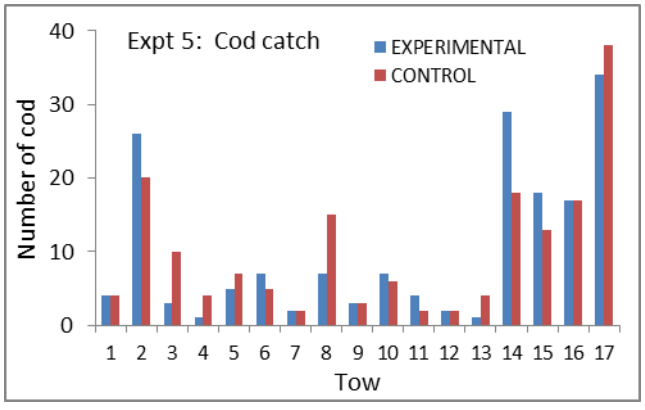
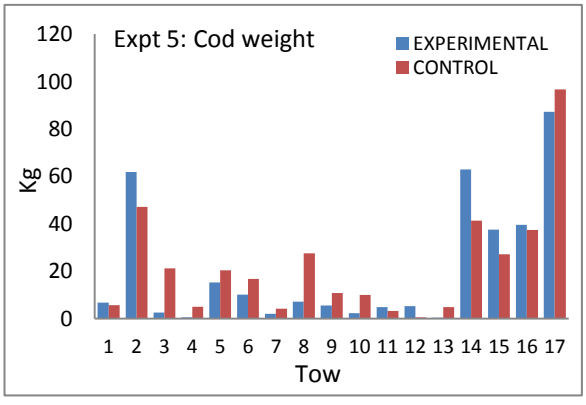



Fig 6.7b



## Discard reduction

6.8.3 This trial showed an increase in the total catch in the experimental trawl in each haul, (Fig 6.7c) total of 2533kg in the control net increasing to 3850kg in the experimental net. However this trend was not replicated in the Nephrops catch or the cod catches.

6.8.4 Whiting and haddock catches, above and below their MLS, were also similar in both gears throughout the trials (Fig 6.7d and e). There was greater numbers of 'trash fish', such as dogfish. caught by the coverless trawl, this could account for much of the increased bulk in the experimental trawl.

6.8.5 There was a noticeable increase in the plaice catches above the MLS. (Fig 6.7f ). This is possible due to the variation in spread of the gear as a result of the extended headline in the experimental net. This will cause a difference in seabed contact between the coverless net and the standard net (control net).

Fig 6.7c

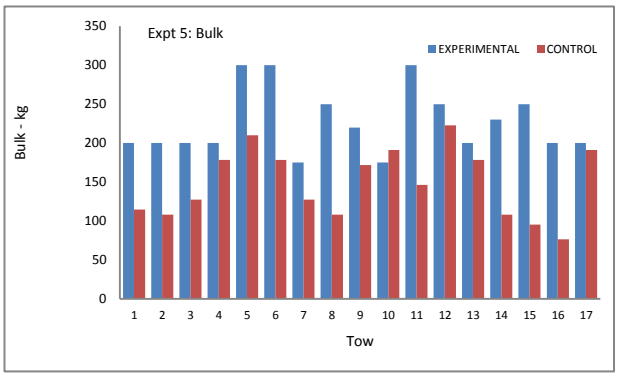



Fig 6.7d

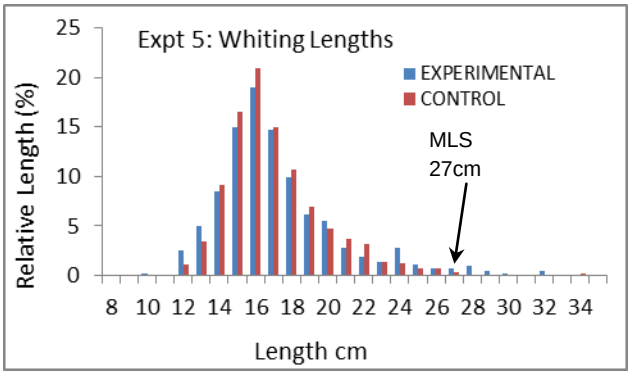



Fig 6.7e

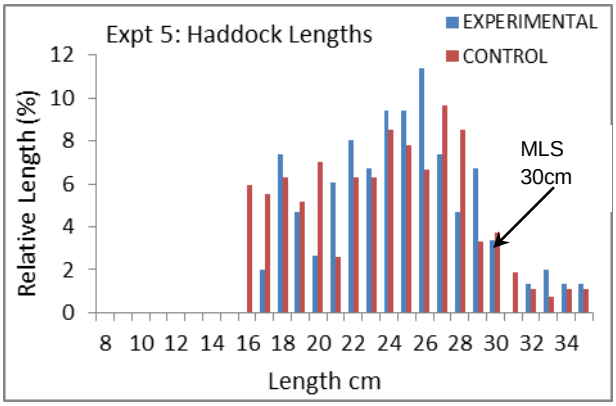
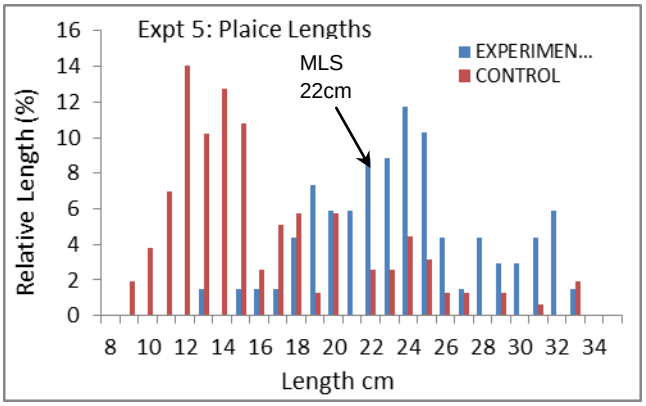



Fig 6.7f



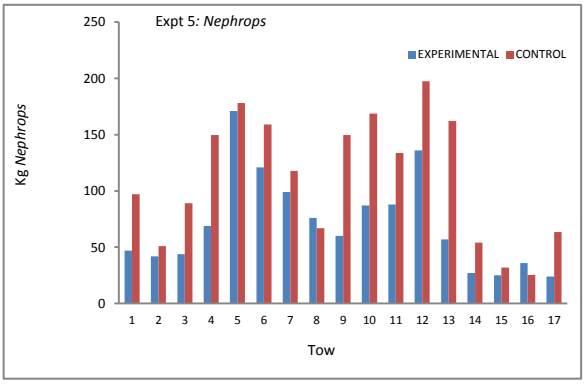

## Acceptability of design

6.8.6 Despite the trawl being re-modelled in the generally accepted manner of extending the headline and reducing the meshes in the wings, the skippers were not happy with its fishing efficiency. Although the data show that over the seventeen hauls the overall bulk was greater in the coverless trawl but there was 40% less Nephrops catch. The

Nephrops catch in the control net was 1895kg and in the experimental it was 1209kg (Table 6.7.1 and Fig 6.7g). This would prove commercially unviable for the vessels.

6.8.7 The loss of Nephrops catch could have be due to the use of a new extension and codend on the experimental trawl allowing the release of many small nephrops. This is a common problem with codends and extensions until they have been used for several trips. Another cause could be incorrect wing end spread but without door or wing end sensors it was impossible to verify this. It would appear that this version of the coverless trawl requires further tuning before it could be effectively compared with the standard trawl.

Fig 6.7g




## Conclusions: Coverless trawl - Experiment 5 (single-rig)

- The coverless net is not effective as a cod avoidance measure and there was little difference in the performance between the control net and the experimental net.
- The total catch was 52% more experimental net but this was not replicated in the Nephrops catch or the cod catches
- The selectivity of this gear may be more evident and beneficial when there were more, larger round fish on the grounds.
- The loss of *Nephrops (-36%)* makes this gear, in its present design commercially unacceptable, with little apparent benefit for cod mortality.
- This coverless trawl requires further 'tuning' to improve its Nephrops catches.

## 6.9 Boxed codend extension version 1 - Experiment 2 (twin-rig)

Table 6.8 Twin-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | TOTAL |
| Bulk | 150 | 330 | 300 | 285 | 390 | 690 | 480 | 720 | 570 | 495 | 540 | 480 | 180 | 5610 |
| Nephrops | 8 | 44.5 | 35 | 44.5 | 79.5 | 190.9 | 79.5 | 152.7 | 197.3 | 120.9 | 120.9 | 101.8 | 41.4 | 1217 |
| Cod | 0.00 | 6.00 | 7.92 | 5.81 | 4.57 | 0.00 | 1.54 | 3.18 | 1.12 | 0.85 | 0.00 | 0.11 | 0.00 | 31.10 |
| % Cod | 0.00 | 0.00 | 2.64 | 2.04 | 1.17 | 0.00 | 0.32 | 0.44 | 0.20 | 0.17 | 0.00 | 0.02 | 0.00 | 0.55 |
| | | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | TOTAL |
| Bulk | 90 | 330 | 90 | 255 | 390 | 870 | 465 | 600 | 510 | 525 | 540 | 330 | 180 | 5175 |
| Nephrops | 9 | 60 | 45 | 45 | 60 | 235 | 89 | 172 | 172 | 140 | 140 | 80 | 41 | 1288 |
| Cod | 1.45 | 0.00 | 0.00 | 0.42 | 2.82 | 0.21 | 1.77 | 0.94 | 1.54 | 0.99 | 0.00 | 0.00 | 0.00 | 10.16 |
| % Cod | 1.61 | 0.00 | 0.00 | 0.17 | 0.72 | 0.02 | 0.38 | 0.16 | 0.30 | 0.19 | 0.00 | 0.00 | 0.00 | 0.20 |

### Impact on cod

6.9.1 Over the thirteen hauls there was a decrease in cod numbers from 52 in the control net to 18 in the experimental net (Fig 6.8.a and b). The weight of cod decreased from 31.1 kg to 10.16kg in the experimental net, a reduction of 66%. The percentage of cod in the total catch reduced from 0.55% in the control net to 0.2% in the experimental net

Fig 6.8a

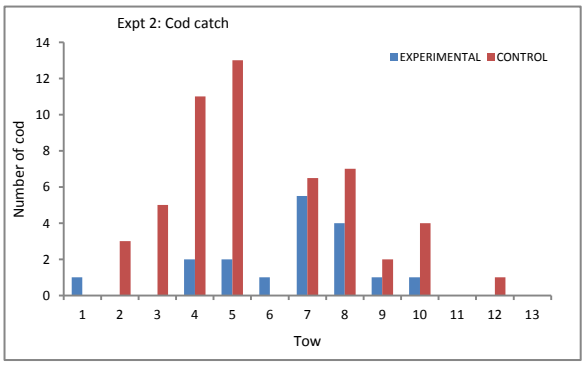
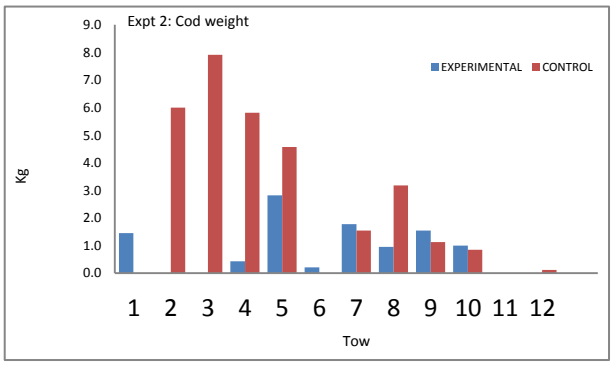



Fig 6.8 b




### Discard reduction

6.9.2 In Table 6.8 it can be seen that over the thirteen hauls both nets had similar total catches with the control net at 5610kg and the experimental net 5175kg. Apart from haul

3 where the experimental net had only 30% of the weight that was in the control net, the two nets were fairly consistent throughout the trial.

6.9.3 This experimental net showed a decrease of haddock and whiting above the MLS, but the numbers of these species were very low. In the haddock, whiting and plaice graphs (Fig 6.8d,e and f) it can be seen that the experimental net retained more of these fish below 20 cms.

Fig 6.8c

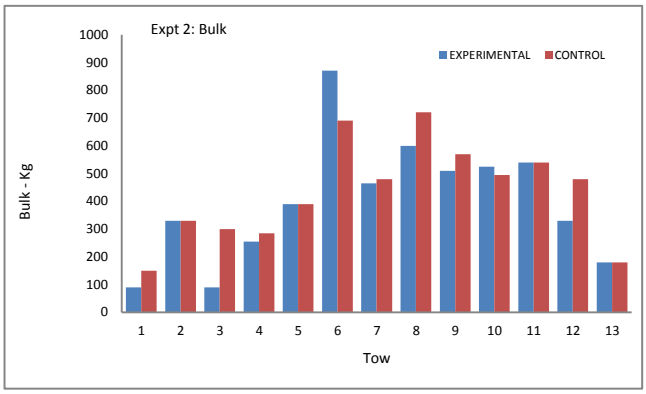



Fig 6.8d

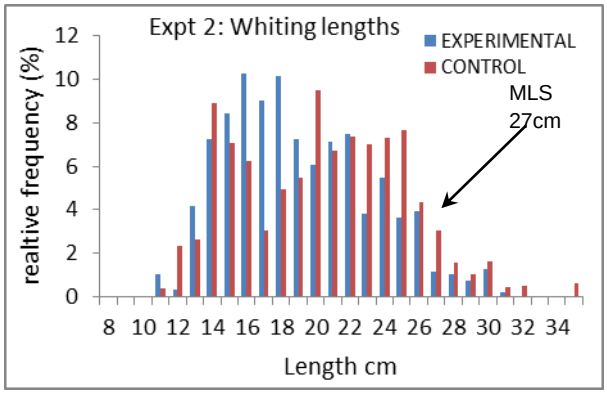



Fig 6.8e

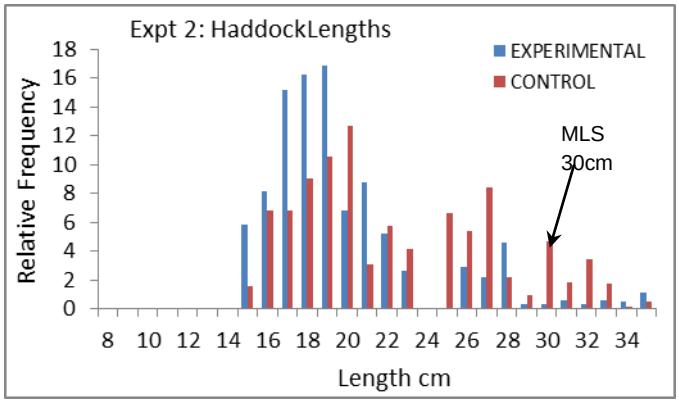
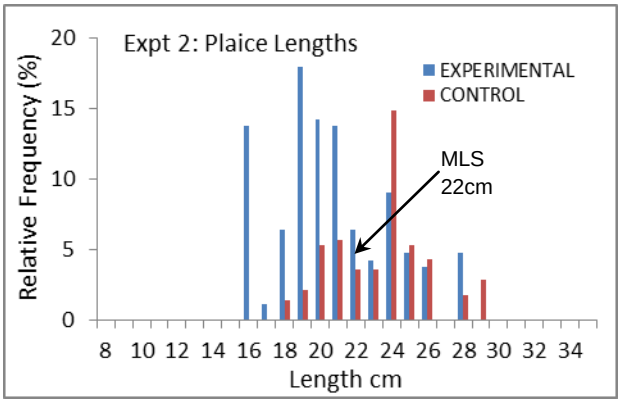



Fig 6.8f



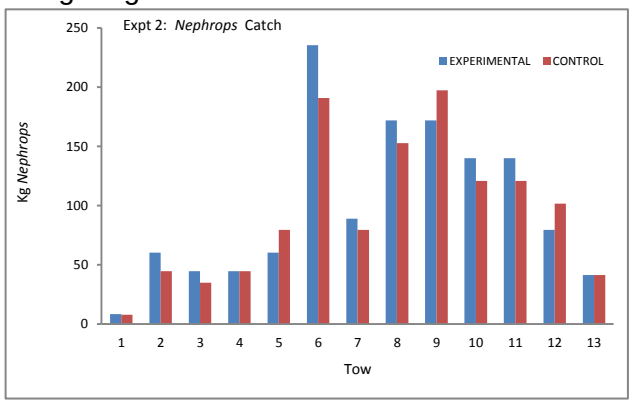

## Acceptability of design

6.9.4 The skipper and crew agreed that the boxed extension net was very similar in use to their standard gear. They had no problems with hauling, shooting and general handling of the gear. Both Experiments showed a marked reduction in by-catch in the experimental without losing *Nephrops* (Fig 6.8g).

6.9.5 The total Nephrops catches from the two nets was (Table 6.8) similar with 1217kg in the control net and 1288kg in the experimental net, an increase of 71kg or 5.5% in the

experimental net. In seven hauls the nephrops catch was greater in the experimental net than the control net.

Fig 6.8g




## Conclusions: Boxed codend extension version 1 - Experiment 2 (twin-rig

- The boxed codend extension (version 1) released 66.7% of the cod by weight and 67.3% by number.
- There was no significant difference in catches of haddock or whiting.
- There was a 5.5% increase in nephrops catch in the experimental net
- The experimental net was easy to operate and encountered no hauling problems.

## 6.10 Boxed codend extension version 1 - Experiment 3 (single-rig)

6.9 Single-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 172 | 159 | 210 | 255 | 95 | 95 | 57 | 191 | 76 | 127 | 127 | 223 | 1788 |
| Nephrops | 121 | 102 | 159 | 217 | 45 | 73 | 38 | 13 | 48 | 73 | 2 | 181 | 1072 |
| Cod | 5.06 | 9.40 | 29.62 | 9.70 | 19.11 | 0.97 | 3.89 | 2.87 | 9.10 | 5.60 | 1.06 | 3.73 | 100.0 |
| % Cod | 2.95 | 5.91 | 14.11 | 3.81 | 20.02 | 1.02 | 6.80 | 1.50 | 11.91 | 4.40 | 0.83 | 1.67 | 5.60 |
| | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 300 | 200 | 200 | 500 | 125 | 200 | 100 | 120 | 150 | 175 | 300 | 500 | 2870 |
| Nephrops | 246 | 124 | 114 | 232 | 39 | 51 | 33 | 12 | 15 | 34 | 2 | 168 | 1070 |
| Cod | 4.00 | 0.00 | 11.00 | 12.00 | 31.00 | 38.00 | 2.00 | 1.00 | 0.00 | 7.00 | 9.00 | 4.00 | 120.0 |
| % Cod | 1.40 | 0.00 | 5.60 | 2.40 | 25.20 | 19.20 | 1.70 | 0.50 | 0.20 | 3.90 | 3.10 | 0.80 | 4.20 |

### Impact on cod

6.10.1 Over the twelve hauls the experimental net caught 20kg more cod than the control net. Much of this increase can be attributed to hauls 5 and 6 where there appears to have been greater numbers of large cod in the nets. Many of these fish would not be able to escape through the 200mm square mesh. Although the weight of cod caught in the experimental net was greater the control net the cod component of the catch was increase in total catch meant that the cod component of the catch was 5.5% in the control to 4.2% in the experimental net due to the increase in total catch in the experimental net (Figs 6.9a and b).

Fig 6.9a

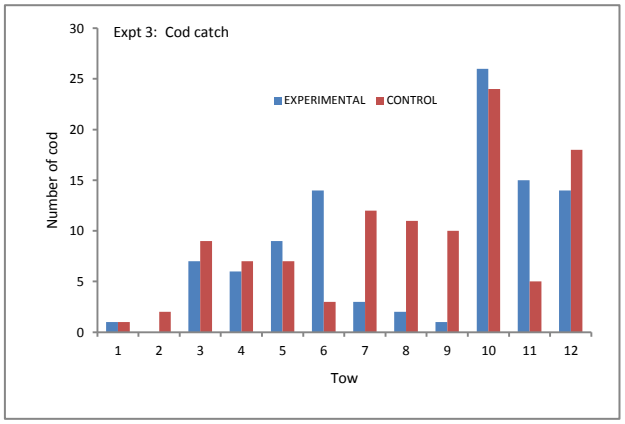
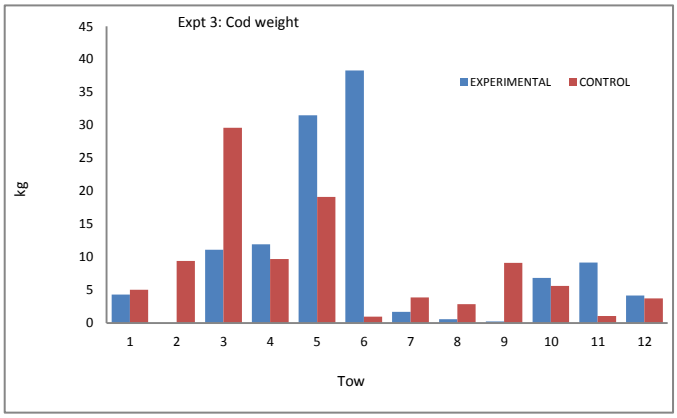



Fig 6.9 b



## Discard reduction

6.10.2 The experimental net had a 60% greater total catch over the twelve hauls (Table 6.9) with 2870 kg in the experimental net and 1788kg in the control net.

6.10.3 The experimental net showed a decrease of haddock and whiting above the MLS, but the numbers of these species were very low. In the haddock, whiting and plaice graphs (Fig 6.9d,e and f) it can be seen that the experimental net retained more of these fish below 20 cms.

Fig 6.9c

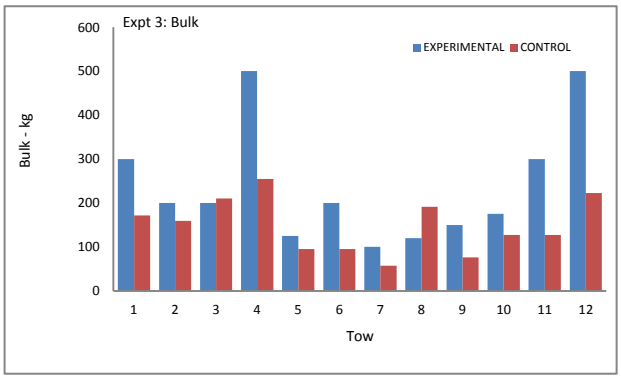



Fig 6.9d

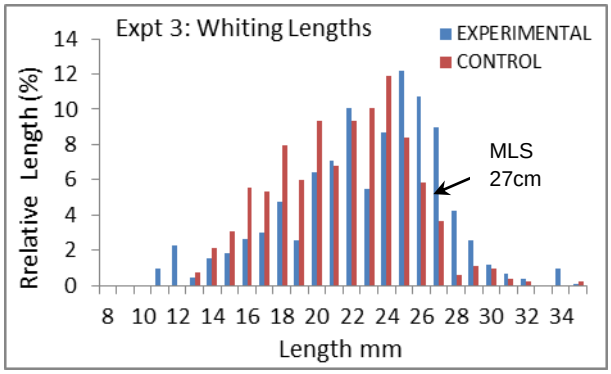



Fig 6.9 e

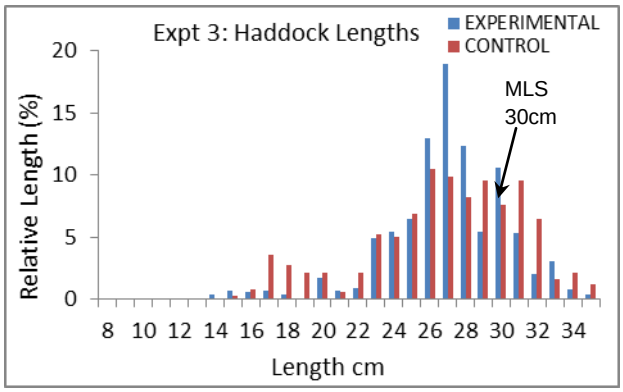
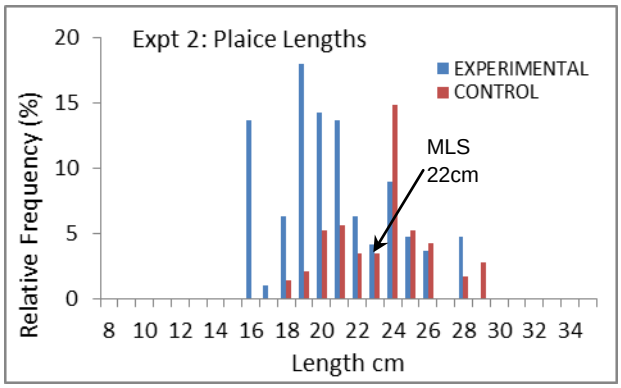


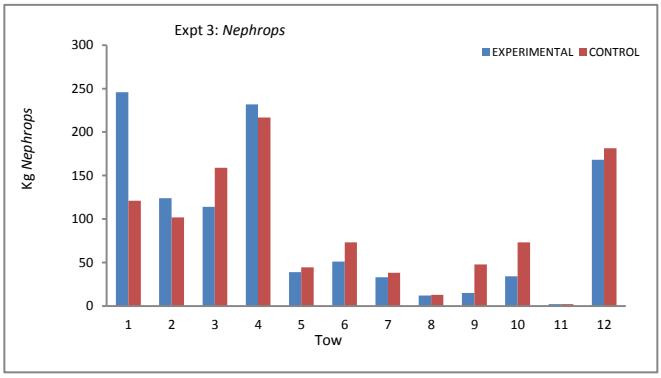

Fig 6.9f



## Acceptability of design

6.10.4 The *Nephrops* catch for the same twelve hauls was very similar with 1072 kg in the control net and 1070 kg in the experimental net (Fig 6.9g).

Fig 6.9g




## Conclusions: Boxed codend extension version 1 - Experiment 3 (single-rig)

- The experimental net had a 60% greater total catch
- There was an 20% increase in weight cod in the experimental net
- The percentage of cod dropped from 5.6% in the experimental net to 4.2% in the control (due to the greater bulk in the experimental net)
- There was a decrease in numbers of haddock or whiting above MLS but an increase in smaller fish in the experimental net
- Over the 12 hauls there was no loss of nephrops in the experimental trawl.
- The experimental gear was easy to operate and encountered no hauling problems.

## 6.11 Boxed codend extension version 2 - Experiment 9 (twin-rig)

Table 6.10 Twin-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 480 | 750 | 525 | 300 | 510 | 450 | 600 | 210 | 480 | 570 | 660 | 540 | 6075 |
| Nephrops | 220 | 255 | 178 | 99 | 197 | 137 | 223 | 45 | 169 | 178 | 216 | 181 | 2097 |
| Cod | 1.83 | 0.07 | 0.00 | 0.00 | 0.11 | 0.00 | 5.47 | 13.51 | 0.11 | 2.15 | 4.36 | 0.09 | 27.69 |
| % Cod | 0.38 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 | 0.91 | 6.43 | 0.02 | 0.38 | 0.66 | 0.02 | 0.46 |
| | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 510 | 510 | 480 | 300 | 390 | 150 | 480 | 255 | 480 | 420 | 540 | 510 | 5025 |
| Nephrops | 220 | 216 | 188 | 99 | 140 | 82 | 197 | 64 | 169 | 156 | 178 | 162 | 1,870 |
| Cod | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 2.89 | 0.00 | 3.04 |
| % Cod | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.1 |

6.11.1 As the initial trials with the boxed codend extension showed some success in reducing by-catch of cod and reducing discards without loss of nephrops a refined version was trialled on both in a twin rig configuration. In version 2 of the boxed codend extension the size of the square mesh in the top panel was increased from 200mm to 300mm.

### Impact on cod

6.11.2 In experiment 9 there was a marked difference in the cod catches, with the numbers dropping from 17 (27.69kg) in the control net to 3 (3.04kg) in the experimental net (Fig 6.10a and b) when expressed as a percentage of total catch this represents a reduction from 0.46% to 0.1%. Almost all the cod catch in the experimental net was made up of just one 2.89kg in haul 11. (Table 6.10.1)

Fig 6.10a

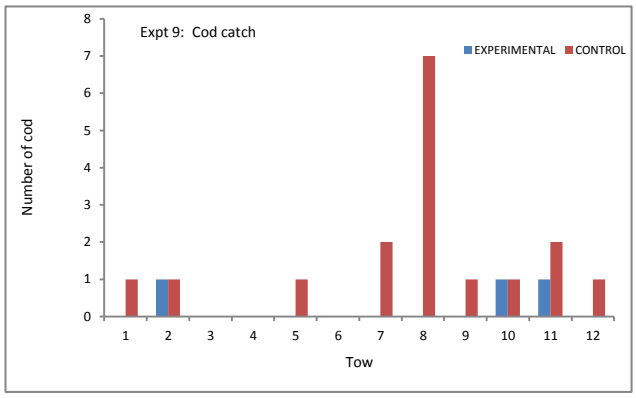
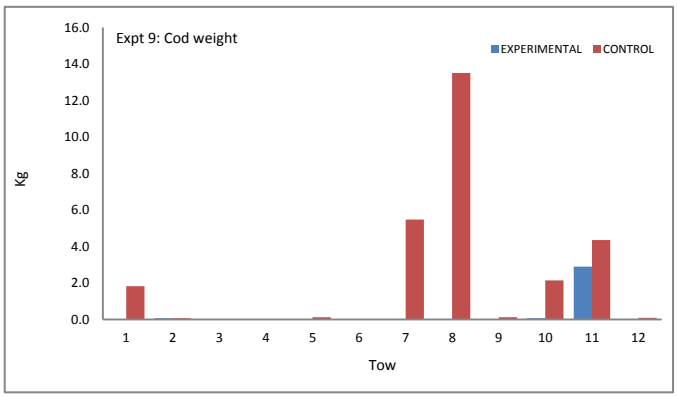



Fig 6.10b



## Discard reduction

6.11.3 There was a 17% decrease in total catch (table 6.10.1 Fig 6.10c) from 6075 kg in the control net to 5025 kg in the experimental net.

6.11.4 Very few whiting, haddock and plaice above the MLS caught during the trials. (Fig 6.10d, e and f). but there seems to be more of the smaller fish retained by the experimental net as in previous trials with version 1 of boxed extension gear.

Fig 6.10c

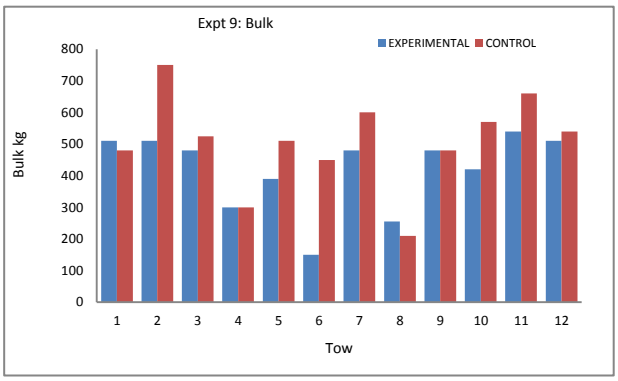



Fig 6.10d

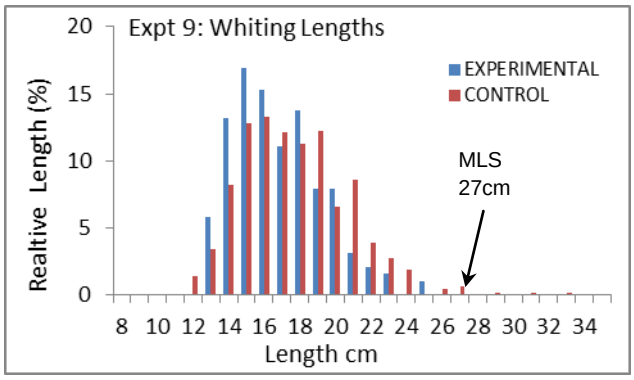



Fig 6.10e

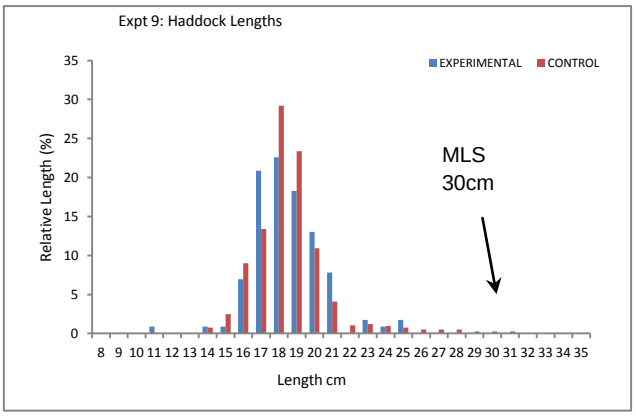
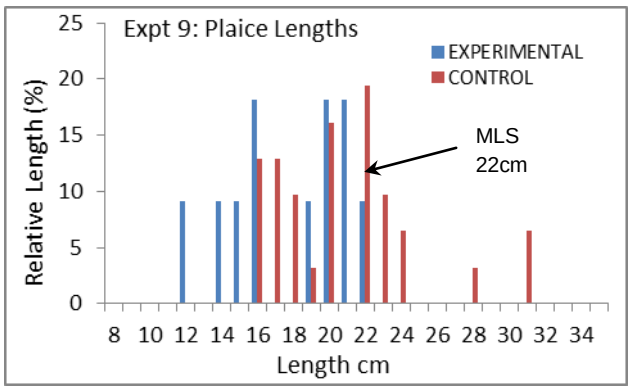


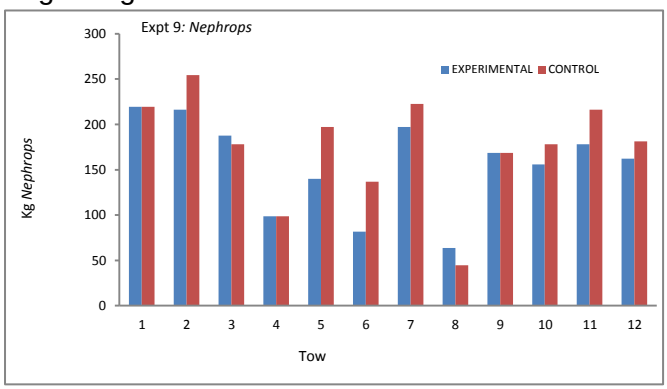

Fig 6.10f



## Acceptability of design

6.11.5 There was an 11% drop in the *Nephrops* catch from 2097 kg in the control to1870 kg in the experimental net. (Fig 6.10g) Only five hauls 1, 3, 4, 8,and 9, did the experimental net catch the same or more nephrops than the control net.

Fig 6.10g




## Conclusions: Boxed codend extension version 2 - Experiment 9 (twin-rig)

- There was a decrease in cod catches in the experimental net -. 89% by weight and 82% by number of fish.
- The cod catch was reduced from 0.46% to 0.1%. expressed as a percentage of the weight of total catch.
- There was a 11% decrease in the Nephrops catch compared to no loss in Version 1 of the boxed codend extension (with 200mm square mesh top panel).
- The experimental gear was easy to operate and encountered no hauling problems.

## 6.12 Boxed codend extension version 2 - Experiment 10 (single-rig)

Table 6.11 Twin-rig - Total catch (kg) and cod catch (kg) expressed as a percentage of cod in the two trawls

| Control | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 175 | 175 | 150 | 175 | 175 | 200 | 200 | 175 | 230 | 175 | 150 | 150 | 2130 |
| Nephrops | 38 | 29 | 37 | 28 | 28 | 51 | 23 | 39 | 57 | 26 | 30 | 18 | 404 |
| Cod | 25.6 | 1.7 | 0.5 | 29.3 | 0.0 | 1.0 | 0.0 | 0.4 | 0.3 | 8.5 | 20.3 | 21.7 | 109.2 |
| % Cod | 14.6 | 1.0 | 0.3 | 16.8 | 0.0 | 0.5 | 0.0 | 0.2 | 0.1 | 4.9 | 13.5 | 14.4 | 5.1 |
| | | | | | | | | | | | | | |
| Experimental | | | | | | | | | | | | | |
| TOW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL |
| Bulk | 63.6 | 47.7 | 70 | 57.3 | 57.3 | 89.1 | 76.4 | 82.7 | 133.6 | 50.9 | 41.4 | 31.8 | 801.8 |
| Nephrops | 41.4 | 28.6 | 54.1 | 35.0 | 50.9 | 76.4 | 38.2 | 60.5 | 92.3 | 38.2 | 31.8 | 19.1 | 566.4 |
| Cod | 16.9 | 12.2 | 8.6 | 12.1 | 6.8 | 1.9 | 0.5 | 0.3 | 0.2 | 4.9 | 3.0 | 7.2 | 74.5 |
| % Cod | 26.5 | 25.5 | 12.3 | 21.1 | 11.9 | 2.2 | 0.6 | 0.4 | 0.2 | 9.6 | 7.3 | 22.7 | 9.3 |

### Impact on cod

6.12.1 When there was a greater number of fish caught as in hauls number 1, 4, 11 and 12 (see Fig 6.11a) it would appear that the experimental net releases a larger proportion of cod. In those hauls the cod catches were reduced by 40.0% by number and 31.7% by weight Fig 6.11b). When expressed as a percentage of total catch the cod catch for all hauls was 5.1% in the control net and 9.3% in the experimental net. Despite catching significantly fewer cod the experimental net had a higher % cod component because of the large reduction in overall catch.

Fig 6.11a

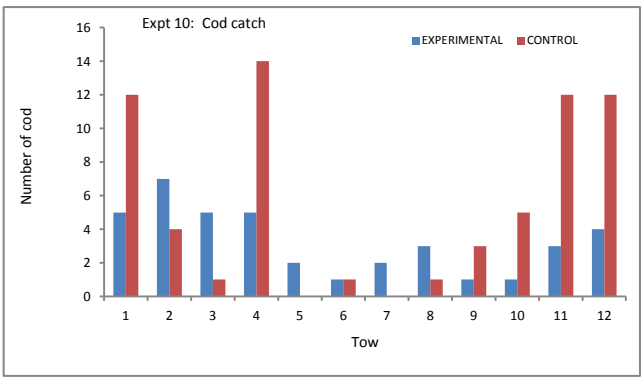
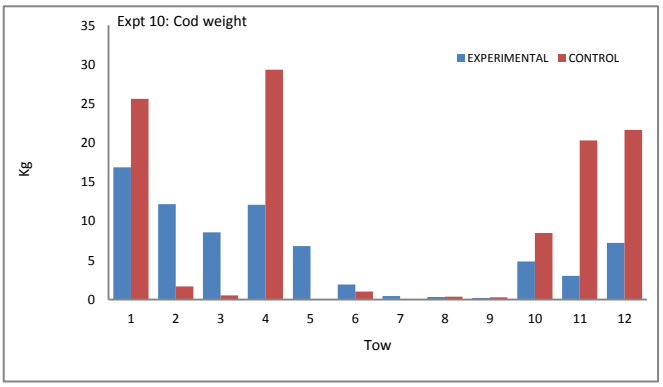



Fig 6.11b



## Discard reduction

6.12.2 With 2130kg in the control net and 802kg in the experimental net (Table 6.10 & Fig 6.10c) there was a 62.3% decrease in total catch by the experimental net.

6.12.3 Relative size composition of whiting, haddock and plaice caught by the two gears demonstrates no significant difference in size selection between gears (Figs 6.11d, e and f).

Fig 6.11c

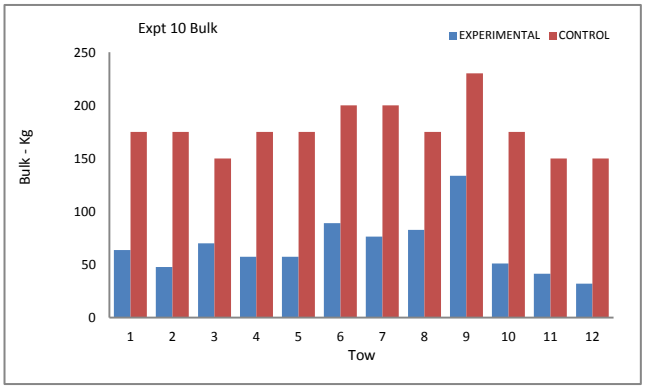



Fig 6.11d

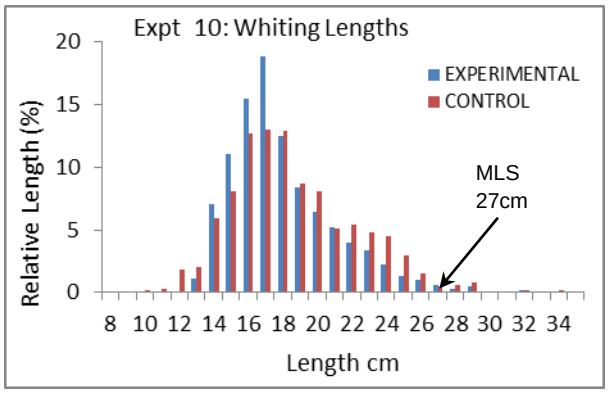



Fig 6.11e

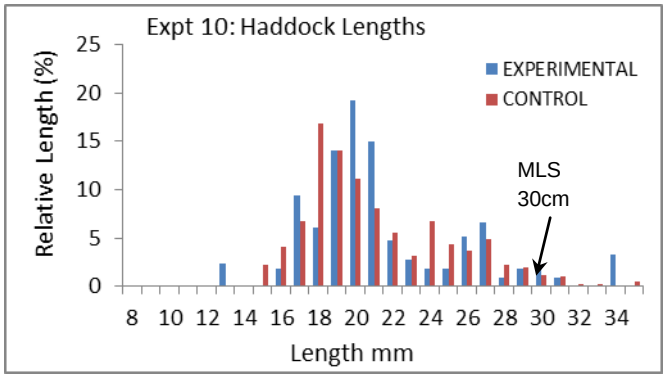
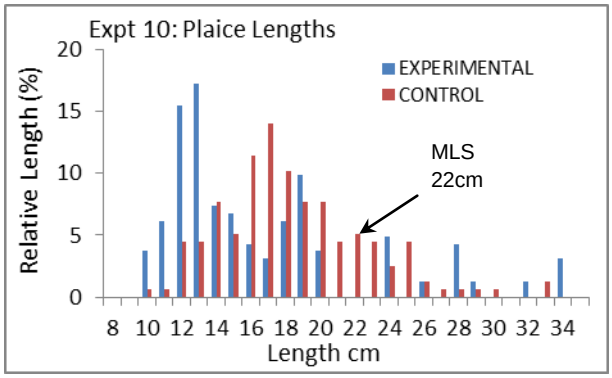


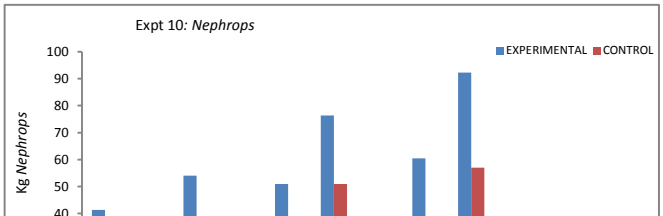

Fig 6.11f




## Acceptability of design

6.12.4 Despite catching less bulk, version 2 of the boxed codend extension caught more *Nephrops* than the control net (Table 6.11 and Fig 6.11g). Nephrops catches were 40% better in the experimental net with an overall catch of 566 kg compared to 404 kg in the control net.

Fig 6.11g



## Conclusions: Boxed codend extension version 2 - Experiment 10 (single-rig)

- Cod catches were reduced by 31.8% by weight in the experimental net
- Expressed as a percentage of the weight of total catch, the cod catch increased from 5.1% to 9.3% due to the large reduction in total catch (discards)
- The experimental net with 300mm square mesh caught significantly less bulk than the standard unmodified net.
- The boxed extension caught 40.2% more Nephrops.
- It is allowing significant amounts of general bulk to escape thus reducing discards.
- The large reduction in bulk by the experimental net was likely to due to escapes of dogfish, trash species and cod.

# 7. Summary

## Swedish grid and plastic grids

7.1.1 The various grids, both rigid and semi rigid were very prone to fouling with seabed debris and large fish (skate, dogfish etc). This caused big losses in *Nephrops* catches in the hauls when the grids became choked up. The Irish Sea has unique hydrodynamics in that there is a gyre or whirlpool effect (Hill, 1996) which accounts for the retention of larvae and sediment in the area and high productivity resulting in rich benthic communities which exasperates the likelihood of fishing gear with ridged grids becoming fouled. Most of the grids eliminate any by-catch of round fish and to a certain degree bottom living fish (monks and flats); to most vessels this forms an appreciable portion of their weekly income. This loss of by-catch, coupled with the possibility of loss of a several hauls each week through blocking of the grid would render many vessels financially unviable.

7.1.2 The Swedish grid was trials on the twin-rig vessel took place during a period of good weather. There were few cod on the grounds with just 20kg of fish appearing in the control trawl and just 2 very small fish (0.17kg) in the experimental net. The grid blocked on 3 of the 12 hauls and the Nephrops catch reduced by 15% for those hauls where a comparison could be made. Trails of the Swedish grid on the single-rig vessels were disappointing and were abandoned after 7 hauls due to repeated blocking of the device. As a consequence it was not possible to make any comparison between the fishing and selectivity performance of the device was possible. Problems with shooting and hauling along with fouling by benthos and litter and loss of the target species would suggest that the Swedish grid is unsuitable for the conditions found in the Nephrops grounds in the northern part of the Irish Sea.

7.1.3 The flexible plastic grid (Stornaway design) proved the better as it did go round the net drum but the design needs some refinement to ensure viable catches. This design was particularly prone to blocking by weed. This may have been as a result of the square profile of the bars which prevented the weed from sliding up the bars. As with the Swedish grid there was a significant loss of catch when the grid became blocked. Even with no evidence of blocking the loss of the Nephrops catch was 39%.

7.1.4 The Danish design of plastic grid was rigid and exhibited the same handling issues as the Swedish grid. This was trailed on single-rig vessels and was effective in reducing the weight of the cod catch by 67% by weight and 88% by number. But the 45% reduction in the Nephrops catch together with handling issues makes this gear design unacceptable.

7.1.5 The rigid grids had to come onboard as a cumbersome device in the trawl. To larger vessels where they haul the gear up a stern ramp, it may be practical to use a rigid grid,

but to the typical vessel in the Irish Sea fleet it presents a high risk to crew and vessel safety with incidents of propeller being fouled not uncommon, especially in poor weather. The rigid grids will not pass through a power block or go round a net drum, one or other or both of which are used by all the Irish Sea fleet to haul their gear. The possibility of the grid clogging up also caused some safety concerns as it resulted in the crew having to deal with a 'heavy awkward obstacle' half way down the trawl. The various grids are effective as a by-catch reduction device in ideal conditions. They are all prone to choking up, (50% of hauls) when almost all catch is lost. According to results from all four grid trials it would appear that a grid is not a viable option for the Irish Sea nephrops fishery.

## Coverless trawl

7.1.6 The coverless trawl was easy to operate and its fishing properties closely resembled those of the traditional low headline gear used in the Northern Ireland *Nephrops* fishery. In the twin-rig trials there was no significant difference in catches either in overall bulk or in composition between the two gears. There were "tuning" issues with the experimental net tested by the single-rig vessels and it performed worse than the control net with a reduction in the Nephrops catch of 36% but total catch increasing by 34%. There was little difference in overall terms between the total catches of cod for the experimental and control nets but there was a large variation in the cod catches from haul to haul.

7.1.7 Anecdotal evidence suggests that cod catch in the *Nephrops* fishery is traditionally low because of this tendency for Irish Sea cod swim higher in the water column than in other waters. It is likely that this behavioural characteristic allows cod to pass over the low headline of the traditional "trawls" used in the fishery and also the coverless trawl. That Irish Sea cod swim higher in the water column is unproven speculation but if it does occur could be attributed to the gyre (Hill, 1996). Studies have shown that thermal stratification of the water column related to the gyre is accompanied by a dome of cold water on the seabed (Gowen *et al*., 2008) which might encourage cod to swim higher in the water column and so avoiding capture in low headline gear.

## Boxed extension

7.1.8 The boxed extension trawl in its initial form (Experiments 2 and 3) with a 200mm square mesh top panel performed differently during the twin-rig and single-rig trials. In the twin-rig trial the experimental net showed a reduction in the overall catch of 8%, an increase in the nephrops catch by 5.5% and a reduction and approximately 67% reduction in cod by number and weight. The single-rig trials resulted in a 60% increase in the overall catch, no change to the nephrops catch and a 20% increase in the cod catch by weight. Most of that increase was attributable to 2 hauls where a number of larger cod were

caught by the experimental net and it is though that these would have been unable to escape through the 200mm square mesh top panel.

7.1.9 In the twin-rig trials the modified boxed extension with the 300mm of square mesh panel showed a reduction of 17% in the total catch, a reduction of 82% by number and 89% by weight for the cod catch and an 11% drop in the Nephrops catch. In the single-rig trials the overall catch was reduced by 62%, cod catch decreased by 40% by number and 32% by weight and the nephrops catch increased by 40% in experimental net. The experimental gear was easy to operate and their were no safety concerns

7.1.10 The boxed extension gear showed good potential as cod conservation tool and for reducing discards overall. Further refinement of the design and monitored sea trials should lead to improvements in the efficiency of this device particularly if combined with other selective devices in the trawl; such as a twin square mesh panel (Briggs, 2010) which could lead to an even cleaner *Nephrops* fishery than at present.

# 8. References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# 9. Appendix 1

## 9.1 Steering Committee Members

| | |
|---|---|
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| Paddy Campbell | DARD Sea Fisheries Policy |
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| Alan McCulla | ANIFPO |
| John Cassidy | ANIFPO |
| Lynn Gilmore | Seafish |

## 9.2 Species Codes.

The table below shows the species encountered during the study along with the species codes used in Table and chart in 8.5.3.

| Codes | Common Names | *Scientific Name* |
|---|---|---|
| AAS | ALLIS SHAD | *Alosa alosa* |
| ANE | EUROPEAN ANCHOVY | *Engraulis encrasicolus* |
| BIB | WHITING-POUT (BIB) | *Trisopterus luscus* |
| BLL | BRILL | *Scophthalmus rhombus* |
| BLR | BLONDE RAY | *Raja brachyura* |
| BSE | BASSES | *Dicentrarchus Spp* |
| CDT | COMMON DRAGONET | *Callionymus lyra* |
| COD | COD | *Gadus morhua* |
| COE | EUROPEAN CONGER EEL | *Conger Conger* |
| CUR | CUCKOO RAY | *Raja naevus* |
| DAB | DAB | *Limanda limanda* |
| DGS | SPURDOG | *Squalus acanthias* |
| FLE | FLOUNDER (EUROPEAN) | *Platichthys flesus* |
| GUG | GREY GURNARD | *Eutrigla gurnardus* |
| GUR | RED GURNARD | *Aspitrigla cuculus* |
| HAD | HADDOCK | *Melanogrammus Aeglefinus* |
| HER | HERRING | *Clupea Harengus* |
| HKE | EUROPEAN HAKE | *Merluccius merluccius* |
| JOD | JOHN DORY | *Zeus faber* |
| LEM | LEMON SOLE | *Microstomus kitt* |
| LIN | COMMON LING | *Molva molva* |
| LNS | LONG-NOSE SKATE | *Raja oxyrinchus* |
| LSD | LESSER SPOTTED DOGFISH | *Scyliorhinus canicula* |
| MAC | MACKEREL | *Scomber scombrus* |
| MEG | MEGRIM | *Lepidorhombus whiffiagonis* |
| MON | ANGLERFISH (MONK) | *Lophius piscatorius* |
| PLE | EUROPEAN PLAICE | *Pleuronectes platessa* |
| POD | POOR COD | *Trisopterus minutus* |
| POL | POLLACK | *Pollachius pollachius* |
| SCU | SCULPIN | *Myoxocephalus Spp* |
| SDF | SCALD FISH | *Arnoglossus laterna* |
| SDR | SPOTTED RAY | *Raja montagui* |
| SOL | SOLE (DOVER SOLE) | *Solea solea* |
| SOT | SOLENETTE | *Buglossidium luteum* |
| SQZ | SQUIDS (NEI) | *Loliginidae* |
| TBS | THICKBACK SOLE | *Microchirus variegatus* |
| THR | THORNBACK RAY (ROKER) | *Raja clavata* |
| TUB | TUB GURNARD | *Trigla lucerna* |
| TUR | TURBOT | *Scophthalmus maximus* |
| WEL | LESSER WEEVER FISH | *Trachinus vipera* |
| WHG | WHITING | *Merlangius merlangus* |
| WIT | WITCH | *Glyptocephalus cynoglossus* |

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