

Annex XI

Request for a de minimis exemption for cod in trawl and seine fisheries in ICES division VIIb-k (excluding VIId)

Description of the Fisheries

Otter trawlers with codend mesh size over 100mm (TR1) are the predominant fishing gear used in the Celtic Sea, with the highest fishing effort. TR1 gears account for 24% of the total effort (STECF 2017). TR1 fisheries are widespread across the whole area, but most effort is exerted in ICES VII e, f, g and h. The countries that contributed most effort are France, Spain, Ireland and England.

The TR1 fishery is characterised as a mixed fishery, mainly targeting 'gadoid' species, such as haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*) and whiting (*Merlangus merlangus*) as well as anglerfish and megrim. There is an important TR1 mixed fishery in ICES VIIj-k, mainly operated by Irish and Spanish vessels and targeting anglerfish (*Lophius* spp), megrim (*Lepidorhombus whiffiagonis*), hake (*Merluccius merluccius*) with a bycatch of haddock and whiting.

The fishing operations occur in depth ranging from 80 to 250 m. They last between 2 and 4 hours. Fishing trips duration depends on the seasons and on the weather forecast, from 4 to 15 days (~13 days in average for French vessels, 4-9 days for Irish vessels).

The French vessels that would be concerned are mainly bottom otter trawlers. In 2016, 132 vessels of more than 18 meters length were having this activity in Celtic Sea and Western Channel (Cornou et al. 2017).

Otter trawlers using a codend mesh size range between 70-100 mm (TR2) have the second highest recorded effort in Celtic Sea, accounting for 22% of the total effort. According to STECF data (2017), TR2 effort is spread amongst Irish, French, Spanish and UK vessels.

The TR2 fishery in the Celtic Sea is widespread and can be characterized by:

- Fisheries for *Nephrops* operated mainly by Irish trawlers in the Smalls, Labadie and Porcupine bank with a bycatch of mainly haddock, whiting and hake;
- A mixed fishery (otter trawl with codend mesh size 70-99mm) targeting megrim and anglerfish, with hake as the main by-catch. Haddock are also caught as a bycatch in this fishery Effort is distributed on shallow waters of Grand Sole and Porcupine Bank fishing mainly in Division VIIj. This fishery involves vessels from Ireland, France, Spain and the UK; and
- A targeted trawl and seine fishery for whiting with a bycatch of haddock and hake by Irish vessels principally in VIIg.

The French vessels that would be concerned are mainly bottom otter trawlers. In 2016, 152 vessels were having this activity, mainly in the Western channel (Cornou *et al.* 2017).

Fisheries in the Eastern Channel (VIId) are not covered by this de minimis as the fisheries in this area are quite different to the fisheries in the Celtic Sea in terms of catch composition and fleets involved. A range of species including anglerfish, gadoid species and non-quota species such as cuttlefish, red mullet and squid are targeted, with the fisheries taking place in VIId close to the English and French coasts. Many of the demersal fisheries in VIId are an extension of the fisheries in the southern North Sea to all intents and purposes.

Catch and Discard Data

In 2016 STECF data shows total catches of cod in VIIbce-k with all gears were 4,155 tonnes with landings of 3,396 tonnes and discards of 759 tonnes. This gives a discard rate of 18%. In the smaller area of VIIf,g, total catches of cod were 2,302 tonnes made of 2,057 tonnes of landings and 245 tonnes of discards.

Total catches of cod by the TR1 fleets in 2016 for VIIb-k were 2,392 tonnes with landings of 2,284 tonnes and discards of 108 tonnes. In VIIf,g catches were 1,565 tonnes (1,489 tonnes landings and 76 tonnes discards). The average discard rate over the period 2014-2016 was 5% for VIIb-k and VIIf,g.

For the TR2 fleets in 2016 for VIIb-k, total cod catches were 553 tonnes with landings of 512 tonnes and discards of 41 tonnes. In the smaller area of VIIf,g catches were 275 tonnes made of 198 tonnes of landings and 77 tonnes of discards. The average discard rate over the period 2014-2016 was 7% for VIIb-k and 28% in VIIf,g.

Total Irish catches in 2016 were recorded as 1,033 tonnes (905 tonnes landings and 128 tonnes discards). Irish discard rates for the TR1 fishery over the same period averaged 7% and for the TR2 fishery over the same period averaged 10%.

Based on this data a summary of the proposed de minimis exemptions is shown in Table 1.

Table 1 Summary of proposed de minimis exemption for cod VIIb-k

Country	Exemption applied for (species, area, gear type)	Species as a bycatch or target	Number of vessels subject to LO	Landings (by LO subject Vessels)	Estimated Discards	Estimated Catch	Discard Rate	Estimated de minimis volumes
IE	Cod, VIIb-k, TR1	Bycatch	xx	493	34	527	7%	37
IE	Cod, VIIb-k, TR2	Bycatch	xx	177	20	197	10%	14
FR	Cod, VIIb-k, (7d excepted)TR1		xx	1720	64	1783	3%	125
FR	Cod, VIIb-k, (7d excepted)TR2		xx	261	16	276	5%	19
UK	Cod, VIIb-k, TR1	Bycatch	xx	71.64	9.74	81.38	11.97	5.7
UK	Cod, VIIb-k, TR2	Bycatch	xx	47.52	2.77	50.29	5.51	3.52

Current Regulations

The current mesh regulations in the Celtic Sea are complex with different mesh sizes required in different areas within the wider VIIb-k area. These Regulations are contained in Regulation (EC) 850/98 and also Regulation (EC) 737/2012. They are summarised in table 2 below.

Table 2 Current EU Regulations pertaining to the Celtic Sea

Area – Celtic Sea	Species	Minimum Mesh Sizes
VIIb-k (outside Celtic Sea Protection Zone and Hake Box)	All demersal species except <i>Nephrops</i> (max. 30% cod , haddock & saithe & max. 20% hake)	80mm
	Demersal (no restrictions)	100mm
	<i>Nephrops</i> (min. 35% & max. 20% hake)	70mm+80mm smp
	<i>Nephrops</i> (min. 30% & max. 20% hake)	80mm+80mm smp
Inside Hake Box²	All demersal species (no restrictions)	100mm
Celtic Sea Protection zone³	All demersal species except whiting & <i>Nephrops</i> (max. 30% cod , haddock & saithe & max. 20% hake)	80mm+120mm smp
	All demersal species (no restrictions)	100mm+120mm smp
	<i>Nephrops</i> (min 30% & max. 20% hake)	70mm+120mm smp
	<i>Nephrops</i> (min 30% & max. 20% hake)	80mm+120mm smp
Celtic Sea Protection zone east of 8 ° west	All demersal species except whiting & <i>Nephrops</i> (max. 30% cod , haddock & saithe & max. 20% hake; max. 55% whiting)	80mm+120mm smp
	Demersal species except <i>Nephrops</i> with min. 55% whiting	100mm+100mm smp
	<i>Nephrops</i> (min 30% & max. 20% hake)	70mm+120mm smp
	<i>Nephrops</i> (min 30% & max. 20% hake)	80mm+120mm smp

Supporting information

Vessels having a mixed activity catch simultaneously a diversity of species during the same fishing operation. They are depending financially on several species (whiting, haddock, cod, anglerfishes, megrims, cephalopods), which are often spatially and temporally related. Thus, even if preliminary results of selectivity programs are encouraging (CELCELCT, Catchpole et al.), it is very difficult to improve selectivity without causing significant commercial losses.

This difficulty is even truer regarding the differences of those species morphology. Moreover, even with all scientists' efforts on developing mixed species models, it is for now unreal to find the appropriate balance between fishing opportunity taking into account technical and biological interactions. That is why, it is highly necessary to establish suitable solutions.

This specificity of mixed demersal fisheries justifies this exemption request due to this difficulty to improve the selectivity. Several results can attest of commercial catch losses link to selective gear tested until now on mixed gadoids fishery in the Channel (SELECCAB, SELECMER...). For example, the SELECMER program reveals commercial losses between 30% and 36% (pages 49, 54, 59) with the use of different selective devices aiming to reduce cod and small whiting catches (selective grid, eliminator trawl, square mesh...).

In addition to those situations of choke species, landing application enforcement may generate disproportionate cost due to hold overloading and increase the sorting time by the crew. Those arguments justify this de minimis request also for disproportionate costs. Several studies demonstrate those aspects: EODE program (Balazuc et al. 2016), discard study Cobrenord (OP COBRENORD, 2015), discard study OPN (Filippi, 2015), Catchpole (Catchpole et al, 2014). In combining those results on trawlers operating in the Channel and the Celtic Sea, we can emphasize that:

- Choke situation with a total landing obligation situation would cause a diminution of approximately 86% of turnover of bottom trawlers in the Channel and the Celtic Sea, with potential fishery closure in March (OP COBRENORD, 2015);
- The increase of variable costs due to treatment of unwanted catches causes a negative profitability for their exploitation, particularly for small size vessel (<12m) (Catchpole, page 32);
- In bottom trawler case in the Channel, total landing obligation enforcement would cause a workable time increase on board of 32% to 68% depending on vessel size (EODE, 2016). Besides, 20% of fishing trip could be concerned by hold overloading issues (EODE, 2016) and cause an increase of travel time of 9% to the detriment of fishing time (OP COBRENORD, 2015).

This de minimis request aims at giving some flexibility needed for fishermen, exercising bottom trawler metier, to implement the landing obligation.

Compared to most other cod stocks, Celtic Sea cod have a large growth rate and move through the selection window of current legal gears fairly rapidly. The mean length of 1 year old fish is estimated to be ~38 cm increasing to ~60 cm by age 2. Even at age 1, a reasonable majority of this year class will be beyond the selection span of current legal gears. In this case in order to protect cod of 2 years and above

very large changes in mesh selection would be required which would render many of the fisheries in the Celtic Sea uneconomic.

Mixed demersal fisheries

There are limited selective gear options for reducing cod catches across the age structure of the stock. While there are no directed trawl fisheries for cod in the Celtic Sea, cod are an important bycatch in many Celtic Sea fisheries. The fleets in the Celtic Sea targeting mixed demersal species currently can use mesh sizes of 80mm (outside of the Celtic Sea Protection Zone), 80mm+120mm smp, 100mm, 100mm+100mm smp (when targeting whiting) or 100mm+120mm depending on the area of operation (see Figure 1). There is only limited data available from selectivity trials for cod carried out in the Celtic Sea. However, based on the predictions generated from the selectivity model developed by Madsen and Ferro (Anon., 2002) that none of these gears used are particularly selective for cod. Table 3 below provided the 50% retention lengths¹ and selection ranges (SR)² for cod generated by this model for a range of gear combinations.

Table 3 Selectivity parameters for cod for a range of gear combinations based on predictions from the model developed by Madsen and Ferro.

Gear combination ¹	L50 (cm)	SR (cm)
80mm ²	20.4	4.3
100mm ²	29.8	6.3
110mm	33.5	7.1
120mm	37.2	7.9
80mm+120mm smp ²	28.6	6.1
100mm+100mm smp ²	34.2	7.3
100mm+120mm smp ²	37.2	7.9
110mm+120mm smp	40.0	8.5
120mm+120mm smp	42.8	9.1

¹ Based on double 4mm twine thickness in the codend and square mesh panels placed at 9-12m from the codline

² Indicates gears that can be currently used legally within VIIb-k to target mixed demersal species

Table 3 indicates that codend of mesh sizes of 100mm and below are unselective for cod with predicted L50s less than the mcrs. Increasing codend mesh size above 100mm leads to increases in L50 with catches of smaller cod at or below the mcrs of 35cm. Increasing codend mesh size to 120mm will give a 50% retention length of ~37cm and result in marginal reductions of catches of undersize cod. To attain a L50 for cod in excess of 40cm would require a codend mesh size of around 140mm.

Incorporating mesh size increases with square mesh panels will also lead to marginal improvements in selectivity. Using a combination of 110mm and 120mm smp the model predicts an L50 of ~40cm, while increasing this to 120mm codend and 120mm smp gear combination as required in the West of Scotland (Area VIa),

¹ The 50% retention length (L50) is the length of fish that has a 50% probability of being retained or escaping after entering the codend

² The selection range is the difference in length between the fish that has a 75% probability of retention and that with a 25% probability of retention. It is a measure of the sharpness of selection

would give an estimated L50 of ~43cm for cod. Based on the model predictions increasing the size of the square mesh panel to 160mm in combination with a 100mm codend will give equivalent selectivity for cod as a 120mm+120mm smp.

Increasing selectivity will come at a cost to the marketable catches of other species caught with cod and in particular haddock and whiting, which are the two main species associated with cod catches in the Celtic Sea. Table 4 shows the L50 and SR's range for the same gear combinations based on Irish selectivity trials. The values in brackets are the model estimates for the different gear combinations. The experimental results are taken from several trials which differed in the vessels (e.g. size and horsepower), trawl types, area and methodology. This explains the variability in results compared with the model predictions. In several cases (e.g. 120mm; 100mm+120mm smp) the experimental results are thought to be an overestimation.

Table 4 Experimental and model selectivity parameters for haddock and whiting

Gear combination ¹	Haddock		Whiting	
	L50 (cm)	SR (cm)	L50 (cm)	SR (cm)
80mm ²	24.2 (18.3)	11.2 (3.7)	26.4 (21.2)	12 (6.1)
100mm ²	28 (26.6)	11.9 (5.1)	36 (30.9)	14 (8.8)
110mm	32.4 (29.9)	19.5 (5.9)	37.4 (34.8)	18 (10)
120mm	42.7 (33.3)	9 (6.6)	Na (38.7)	Na (11.1)
80mm+120mm smp ²	28.2 (25.6)	14.8 (3.7)	32.8 (29.7)	13.5 (8.5)
100mm+100mm smp ²	33.4 (30.6)	8.2 (5.1)	37.4 (35.6)	9.6 (10.2)
100mm+120mm smp ²	39.2 (33.3)	10.8 (5.1)	Na (39)	Na (11)
110mm+120mm smp	36.7 (35.8)	20 (5.9)	Na (41.6)	Na (11.9)
120mm+120mm smp	38.1 (38.3)	10.1 (6.6)	47.2 (44.5)	12.1 (12.7)

¹ Based on double 4mm twine thickness in the codend and square mesh panels placed at 9-12m from the codline

² Indicates gears that can be currently used legally within VIIb-k to target mixed demersal species

Allowing for the variability in the experimental data, these results indicate a similar pattern for haddock selectivity to cod - increasing codend mesh size and installing a square mesh panel leads to selectivity increases, resulting in L50s in excess of the mcrs of 30cm. Based on 2014 trials, a gear combination of 120mm+120mm smp would lead to reductions in catches of haddock > mcrs of ~50% (BIM, 2014).

For whiting the L50 is increased above the mcrs of 27cm at much smaller codend/smp mesh sizes. Trials with a 100mm+100mm smp combination resulted in an L50 for whiting of 37.4cm and a reduction of catch at or below mcrs cm of 75%. Indications from the trials suggest that increasing codend/smp mesh size beyond this will lead to very large reductions in whiting catches. Trials with 120mm/120mm smp combination indicated reductions in marketable whiting catches of 75%. In fisheries in the Celtic Sea where whiting are one of the main target species such losses would be uneconomic.

Table 5 provides selectivity estimates for megrim and hake with the listed gear combinations. These are key species in many mixed demersal fisheries in the Celtic Sea. In these fisheries cod catches would generally be lower than in fisheries targeting haddock and whiting. For megrim the results indicate that any of the gear combinations are selective for megrim with L50s in excess of the mcrs of 20cm. Increasing codend mesh size above 100mm would result in large losses of marketable catch of megrim (~70%). Only limited selectivity data is available for hake and little can be concluded on the optimum gear combinations.

Table 5 Selectivity data from Irish trials for megrim and hake for a range of gear combinations

Gear combination ¹	Megrim		Hake	
	L50 (cm)	SR (cm)	L50 (cm)	SR (cm)
80mm ²	27.6	12.7	Na	Na
100mm ²	34.6	11	Na	Na
110mm	38.5	14.7	38.1	7.6
120mm	41.2	9.5	Na	NA
80mm+120mm smp ²	29.1	15.6	Na	Na
100mm+100mm smp ²	Na	NA	37.9	9.6
100mm+120mm smp ²	38.8	16.2	37.4	21.6
110mm+120mm smp	Na	9.7	Na	Na
120mm+120mm smp	41.6	11.1	50.1	29.7

¹ Based on double 4mm twine thickness in the codend and square mesh panels placed at 9-12m from the codline

² Indicates gears that can be currently used legally within VIIb-k to target mixed demersal species

In addition to the gear combinations outlined there are several other selective gear options that have been considered with the specific objective of reducing cod catches. In these cases the aim has been to reduce cod catch across all size classes (species selectivity) rather than reduce catches of undersize cod (size selectivity).

The first option is the use of discrete large diamond mesh (300mm, 600mm and 800mm) netting panels inserted into the belly sheets of trawls. These have been trialled in the North Sea by Scotland. These panels were designed to release cod but maintain haddock and whiting catches. The results show that catch rates of cod, anglerfish and megrim were significantly reduced for the 600mm and 800mm test gears but unaffected for the 300mm test gear. The 600mm and 800mm gears caught significantly fewer cod than the control gear. The 600mm gear caught between 57 and 33% fewer cod in the length range 34 - 67cm and the 800mm gear caught between 76 and 53% fewer in the length range 34 - 75cm. The 300mm gear caught ~30% fewer cod in the length range 47 - 53cm. For haddock there was evidence that the 300mm and 600mm test gears caught increased numbers of smaller fish and the 300mm and 800mm fewer larger fish. There was no significant difference in catch rates of whiting between the 300mm and 600mm test gears and the control, but there was evidence that the 800mm gear caught fewer larger whiting. These gears may have some potential in demersal fisheries targeting predominantly haddock and whiting but would require further testing in Celtic Sea mixed demersal fisheries.

The other option is to raise the fishing line above the seabed to sort cod from species such as haddock, whiting, hake and saithe. Cod and other groundfish species such as anglerfish, skates and rays and megrim pass under the trawl and escape. Research in Denmark has demonstrated reductions in cod catches of 55% during day time and 82% at night time by raising the fishing line by ~ 60 cm from the seabed. Further trials in Ireland resulted in a reduction of cod catches by 39% by weight in the raised fishing line compared with a standard fishing line. Whiting and haddock catches increased by 87% and 37% by weight respectively in the raised fishing line. This led to an increase in total catch value of 14% offsetting loss in catches of commercial species such as flatfish and monkfish in the modified gear. Catches of skates and rays were also reduced by 80% by weight in the raised fishing line. This type of selective gear would seem to have potential in fisheries targeting haddock and whiting, particularly in situations where vessels have limited access to cod quota. However, as with the large diamond mesh panels, further work is needed before it could be seen as an option in the short-term.

Nephrops fisheries

The vessels operating in this fishery in the Celtic Sea have been subject to the Landing Obligation since 2015 for *Nephrops* and whiting. Cod has not been subject to the Landing Obligation as yet. ICES report that discarding of cod in the *Nephrops* fisheries in the Celtic Sea is relatively low with discard rates between 5-10%. Discard rates differ between FUs with the highest rates reported in the Smalls (FU 22) with much lower discard rates in the other FUs.

Since 2009, nine studies have been carried out by Ireland testing the selectivity of a range of gear combinations in directed *Nephrops* fisheries. Much of this work has been carried out in the *Nephrops* fisheries in the Irish Sea but is considered representative of the *Nephrops* fisheries in the Celtic Sea given the gears used and the catch compositions are similar. Table 6 summarises the trials conducted and the gear combinations tested.

Table 6 Relevant gear selectivity trials in *Nephrops* fisheries

Date	Vessel	Vessel Type	LOA	KW	Gear combinations tested	Method Used
March/April 2009	Supreme II	OTB Twin-rig	24.7	421	Swedish sorting grid Inclined separator panel 100mm codend + 160mm SMP	Twin-trawl
June 2009	Ocean Pioneer	OTB twin-rig	22.4	440	100mm + 200mm SMP Coverless Trawl	Twin-trawl

April/May 2012	Celtic Warrior II	OTB twin-rig	24.9	370	SELTRA Sorting Box (200mm smp)	Twin-trawl
August 2014	Stella Nova	OTB quad-rig	23.5	441	70mm codend + 300mm smp	Quad-rig
September 2015	Stella Nova	OTB quad-rig	23.5	441	SELTRA sorting Box (300mm smp)	Quad-rig
September 2015	Our Lass II	OTB quad-rig	22	484	Swedish grid Nephrops Sorting grid + 70mm codend Nephrops Sorting grid + 75mm codend	Quad-rig
September 2016	Ocean Breeze	OTB Twin-rig	18	224	SELTRA Sorting Box (300m smp)	Twin-rig
December 2016	Ocean Breeze	OTB Twin-rig	18	224	SELTRA Sorting Box (300m smp) with adapter section	Twin-rig
April 2017	Ocean Breeze	OTB Twin-rig	18	224	SELTRA Sorting Box (300m smp) with adapter section and inclined panel	Twin-rig

The most relevant trials to consider in the context of this de minimis exemption are those with 300mm square mesh panels, the SELTRA box codend and the Swedish sorting grid. All three of these gears are recognised as highly selective gears and currently Irish vessels targeting *Nephrops* in the Irish Sea must use one of these three gears. A summary of the results observed with these gears is provided in the following sections.

300mm Square Mesh Panels

Assessment of a 300 mm square-mesh panel (as shown in Figure 1) in the Irish Sea *Nephrops* fishery was carried out in 2014 and again in 2016 (compared to a SELTRA sorting box) on board the mfvs “Stella Nova” and “Ocean Breeze”. These trials were carried out as catch comparison experiments testing against the current legal gear of 80mm codend with 80mm smp required in the Irish Sea.

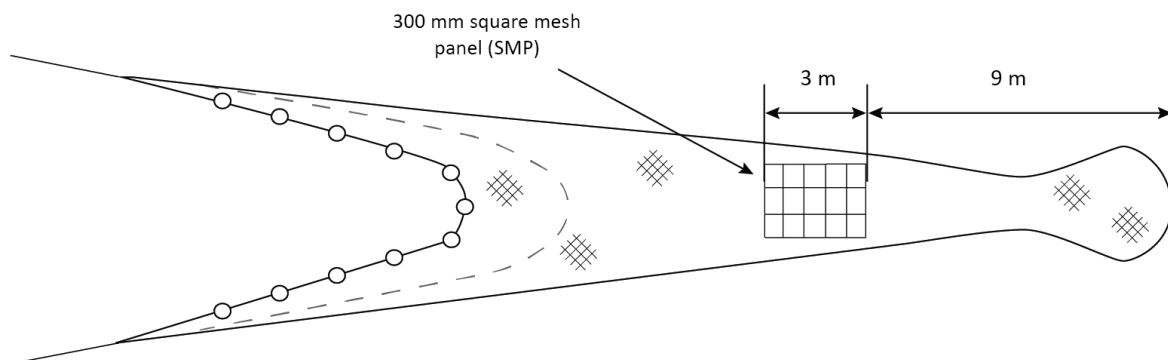


Figure 1 300mm smp

During the first set of trials reductions of total catches of haddock and whiting of 52% and 70% respectively were observed. Over 80% of the haddock and whiting caught were below the mcrcs so these reductions apply primarily to fish below mcrcs. Marginal increases in *Nephrops* and reductions in flatfish catches compared with the standard trawl were observed. Reductions in catches were consistent across size classes for haddock and whiting. There was very few cod caught during this trial in either the control or test gear so no conclusions can be drawn as to whether the 300smp does reduce cod catches.

SELTRA Sorting Box Trawl

A number of assessments of the SELTRA sorting box (as shown in Figure 2) in the Irish Sea and Celtic Sea have been carried out in 2012, 2015, 2016 and 2017 on the mfvs “Celtic Warrior”, “Stella Nova” and “Ocean Breeze”. These trials have also been conducted as catch comparison trials comparing the SELTRA sorting box codend of 200mm and 300mm smp and 70mm codends with standard Regulation gear and in one case against a trawl fitted with a 70mm codend and 300mm smp.

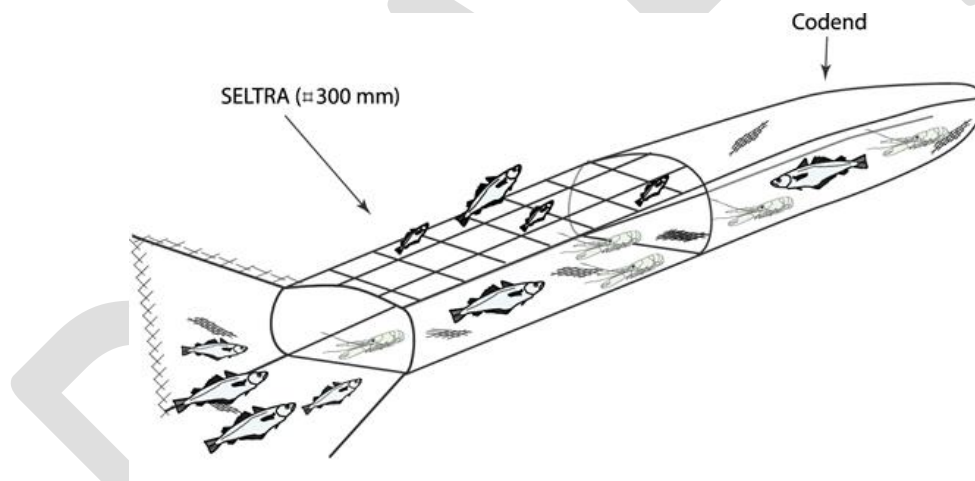


Figure 2 SELTRA Box codend

In all trials substantial reductions in fish catches in the SELTRA compared with a standard trawl or 300mm smp were observed. Reductions in catches of 81%, 91% of and 57% were recorded for cod, haddock and whiting respectively. *Nephrops* catches improved by 9% in the SELTRA compared with a standard trawl (BIM, 2012, 2015, 2016 and 2017).

Sorting Grids

Testing of sorting grids (as shown in Figure 3) began in 2009 in the Celtic Sea on board the mfv “Supreme II”, in 2010 in the Irish Sea on the mfv “Mater Dei”. More recent work completed 2015 in the Irish Sea was completed on board the mfv “Our

Lass II". A standard Swedish fish sorting grid and a modified *Nephrops* sorting grid were tested during these trials on the basis of catch comparison experiments.

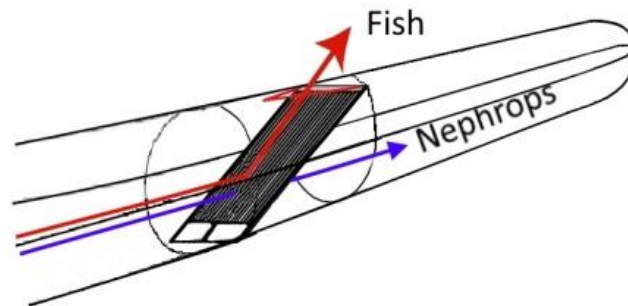


Figure 3 Swedish Sorting Grid

In all trials with the sorting grid, the results have shown that it reduces haddock and whiting catches by 60% and 70% respectively of haddock and whiting above ~ 23cm while reducing cod catches by almost 100%.

While it is possible to combine the grid with a more selective codend constructed in a bigger mesh size or constructed in square mesh, BIM trials of such measures have shown that they will reduce the catches of *Nephrops* significantly and potentially make the fishery uneconomic. Losses of larger *Nephrops* have been reported when using the Swedish grid. In the most recent trials a reduction of 11% in *Nephrops* > 31 mm compared with the control net was observed. Other trials have shown no reductions in *Nephrops* catches.

In conclusion the trials conducted have shown all three of the three gears to be selective for haddock, whiting and to a lesser extent cod. The sorting grid and SELTRA seem particularly effective at reducing cod catches. However, they also have been shown to give significant reductions in marketable catches. The 300mm smp is less effective at reducing unwanted catches but has corresponding lower losses of marketable catch. None of these devices seem to significantly reduce the catch of *Nephrops*. It is therefore considered that these three gear options are a reasonable compromise between increased selectivity and maintaining economically viable fisheries. Fishermen may choose to use these gears depending on whether they have quota for bycatch species such as haddock, whiting and cod. In situations where they have little or no quota then the grid and SELTRA are more appropriate devices to continue fishing.

Conclusions

- The catch data for cod for 2016 catch reports total catches with trawl and seine gears of 2,945 tonnes with landings of 2,796 tonnes and discards of 149 tonnes. Discards of cod are a mixture of undersize and overquota cod.

- Short-term improvements in selectivity to reduce unwanted catches in mixed demersal fisheries by increasing mesh size or using square mesh panels, would have only limited impact on cod catches as they will make little difference to fish that reach in excess of 40 cm very quickly. There are limited selective gear options for reducing cod catches across the age structure of the stock.
- There is only limited data from selectivity trials available for cod in the Celtic Sea. However, based on the predictions generated from the selectivity model developed by Madsen and Ferro (Anon., 2002) none of the gears currently used in the mixed demersal fisheries in the Celtic Sea are particularly selective for cod.
- Increasing codend mesh size above 100mm leads to increases in L50 with catches of smaller cod at or below the mcrs of 35cm. Increasing codend mesh size to 120mm will give a 50% retention length of ~37cm and result in marginal reductions of catches of undersize cod.
- Incorporating mesh size increases with square mesh panels will also lead to marginal improvements in selectivity. Using a combination of 110mm and 120mm smp the model predicts an L50 of ~40cm, while increasing this to 120mm codend and 120mm smp gear combination as required in the West of Scotland (Area VIa), would give an estimated L50 of ~43cm for cod.
- Increasing selectivity will come at a cost to the marketable catches of other species caught with cod and in particular haddock and whiting, which are the two main species associated with cod catches in the Celtic Sea. Based on Irish selectivity trials a gear combination of 120mm+120mm smp would lead to reductions of 50% and 75% in catches of haddock and whiting greater than mcrs respectively.
- Catches of megrim will also be significantly reduce when codend mesh size is increased in excess of 100mm
- Limited trials with large mesh diamond mesh panels instakled in the belly sheets of whitefish trawls and trawls with raised fishing lines have shown to reduce cod catches across all size classes. These gears have potential but need further testing in Celtic sea fisheries to assess their applicability.
- The most relevant gears to consider in the context of in the *Nephrops* fisheries in the Celtic Sea are the 300mm square mesh panels, the SELTRA box codend and the Swedish sorting grid. All three of these gears are recognised as highly selective and currently Irish vessels targeting *Nephrops* in the Irish Sea must use one of these three gears.
- The SELTRA box codend or a sorting grid has been shown to reduce cod catches across all size classes. There is no information for the other selective gear option – 300mm smp. In situations where fishermen have little or no cod quota then these gears will allow continuation of fishing for *Nephrops*.

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