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Scientific, Technical and Economic Committee for Fisheries (STECF)
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Technical Measures – Improving selectivity to reduce the risk of choke species (STECF-18-02)

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report identifies fisheries in North Western Waters in which high risk choke stocks are caught and in which of these fisheries improving selectivity is appropriate on the basis that discard rates of these stocks are high. It also identifies appropriate selective gears that could be deployed in these fisheries to reduce the choke risk.

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EWG-18-02 report:

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) – Technical Measures – Improving selectivity to reduce the risk of choke species (STECF-18-02)

Background provided by the Commission

The North Western Waters Advisory Council (NWWAC) has developed a Choke Mitigation tool (CMT) which provides a means for the identification of choke situations for key stocks. It is designed to help assess what tools – improvements in selectivity; avoidance; quota flexibilities; and exemptions included in Article 15 of the CFP - are appropriate for individual stocks/fisheries to mitigate choke situations. It also provides a qualitative assessment of how and to what extent the available tools can reduce the deficit between catch and fishing opportunities.

Two expert workshops have been convened by the NWWAC and the NWW Regional group to work through the different stocks in the Celtic Sea, West of Scotland, the Irish Sea and Channel using the CMT. The threat of choking fisheries has been assessed for each of these stocks/fisheries and sea basins. The aim was to use this analysis to identify residual choke issues that can only be addressed at Union level with alternative measures over and above the existing tools available.

Each of the stocks assessed was classified depending on the extent of the problem as follows:

- "**High risk**" – catches are well in excess of current fishing opportunities and even with all the available mitigation tools applied there is a high risk of choke for multiple Member States.
- "**Moderate risk**" – catches are in excess of fishing opportunities for one or more Member States and the risk of choke is significant for these Member States but mitigation tools potentially can solve the problem.
- **"Low or no apparent risk"** – catches are in line with fishing opportunities and the risk of choke is low or there is no apparent risk with the mitigation tools available.

The choke mitigation tool has proven to be an extremely useful tool for carrying out this evaluation, but the analysis carried out was meant as illustrative and to identify stocks where chokes may be an issue and to identify what tools maybe applicable to mitigate choke situations. The analysis has identified 12 stocks where there is a high risk of residual choke issues. For 6 of these stocks – **whiting VIIb-k; sole and plaice VIIf,g; whiting VI, cod VIIa; plaice VIId,e** - the available measures and tools will significantly reduce the choke risk provide they are used appropriately. For the other 6 stocks – **haddock VIIb-k, skates and rays VI and VII, cod VIa, saithe VI, whiting VIIa and skates and rays VIId,e** - additional measures or a different management approach is likely to be required to prevent multiple fisheries from being choked. The analysis has identified a further 13 stocks where there is a moderate risk of residual choke issues for one or more Member States. The available tools and measures can significantly reduce this risk for these species.

In the case of the 12 high risk stocks, improving selectivity has been identified in 9 of these stocks as one of the main mitigation actions to reduce the risk of fisheries being choked. In addition improving selectivity was seen as an important mitigation action for a further 5 stocks of the 13 identified as having a moderate risk. However, as the CMT is largely qualitative rather than quantitative analysis the extent to which selectivity and in which fisheries was not fully identified.

Request for EWG-18-02

In order to address this and in particular confirm that the high risk stocks identified have residual choke issues that will require additional measures to solve, a further analysis is required. This analysis should identify the fisheries in which the high risk stocks are caught and in which of these fisheries improving selectivity is appropriate on the basis that discard rates are high. The analysis should also identify the selectivity tools available to improve selectivity

and assess the knock-on effects of utilising these tools in the fisheries identified. Therefore for the stocks listed. STECF is requested to*:*

1. Describe the main fisheries in which the high risk stocks identified are caught and identify whether catches are from a targeted fishery or as a bycatch. For these fisheries identify the catches of the relevant stock and the main gear types used.
2. Assess in which of these fisheries improving selectivity may be possible.
3. Identify in these fisheries what selectivity devices and gear modifications are available that could improve selectivity.
4. Assess the likely reductions in unwanted catches of the relevant stock that might reasonably be achieved based on the results of past trials carried out with these selectivity devices and gear modifications,
5. Assess the likely economic impacts resulting from such changes in selectivity on the basis of losses of marketable catches of the stock or reductions in the marketable catches of other species contrasted with the economic impacts of a choke situation.

The High risk stocks are:

- Haddock VIIb-k
- Whiting VIIb-k
- Sole VIIf,g
- Plaice VIIf,g
- Cod VIa
- Whiting VIa
- Cod VIIa
- Whiting VIIa
- Plaice VIId,e

The moderate risk stocks are:

- Hake VI and VII
- Cod VIIb-k
- Haddock VIa
- Haddock VIb
- Haddock VIIa

Request to the STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF observations

STECF acknowledges the work undertaken by the EWG chair and experts to produce the report of EWG 18-02, Technical Measures. EWG-18-02 identified fisheries (gear, target species and area combination) in which there is a high risk of choke problems that will persist unless additional tools or measures, over and above what is contained in the CFP and supporting legislation, are applied. As detailed below, STECF notes that there are a large number of cases of high risk stocks,, and a fully detailed assessment of each ToR for each stock and fishery could not be performed within one week. The EWG provides therefore a very good overview about the issues, sources of information, data and models available and represents a very

useful preliminary assessment of the likely impacts of the alternative scenarios on fishing businesses. STECF notes however that a more detailed case-by-case assessment may be further required in order to inform decisions about policy or regulatory steps that could be taken to avoid choke situations.

STECF observes that high risk stocks (high risk of causing a choke situation) identified are caught either as target species or as a bycatch. For fisheries involving high risk stocks, the catches of the relevant stock and the main gear types used are provided. **TOR 1, Description of the main fisheries,** is fully addressed in section 3 of the EWG 18-02 report.

STECF observes that **TOR 2**, **Assessing Fisheries for which Selectivity may be Improved**, is addressed in section 4 of the EWG 18-02 report, where these fisheries (stock groups) are listed in a table at page 42. The fisheries were identified as having high discards quantity and also high discard rates thus vessels involved would benefit most from selectivity improvements. The majority of these fisheries involve vessels using TR2 or BT2 gear, with codend mesh sizes of less than 100 mm. There are also several TR1 fisheries with high level of discards and high discard rates.

The EWG identified available selectivity devices and gear modifications (**TOR 3,** section 5) that could be used when fishing for or trying to select out these high risk stock groups. STECF observes that, given the wide range of selective gear options that have been tested for different fisheries, and the time available to the EWG, it was not possible for EWG 18-02 to fully assess the effect of all the potential gear modifications on unwanted catches of the relevant stocks. STECF notes that, as ICES and STECF do not routinely report catches-at-length for the relevant stocks, the evaluation of the relative impact of different selectivity changes on catches-at-length is limited. Therefore, in **TOR 4**, **Likely reductions in unwanted catches** (section 6), EWG 18-02 explored the potential effect on catch profile using different selectivity improvements only for a limited range of roundfish species and sea areas where these are considered as high risk of causing choke situations.

STECF observes that EWG 18-02 was not able to assess all the economic impacts (**TOR 5, Likely Economic Impacts**, section 7), namely loss of marketable catch, for all the fisheries, due to the complexity of the issue and time constraints. The report provides two case studies applying a Landing Obligation Impact Assessment Model, a fairly simple and limited Excel model developed during the EWG meeting and applied to several sea areas, and the SEAFISH model (Mardle et al., 2017), a more comprehensive, bio-economic model developed for the UK fleet. Both models were developed to provide information on possible choke stocks and effects on fleets.

STECF observes that the simple Excel model created during the meeting was applied to fisheries in areas VIIbk, VIIfg, VIIde, VIIa and VI and includes a limited number of stocks. Analysis shows that MS fleets would be affected differently. In some cases, vessels would reach a choke situation even if they had implemented mitigation measures and subsequently would forego a substantial amount of catch of other stocks. In other cases, after adopting mitigation measures, and given the assumptions made, vessels would be able to avoid choke situations and land a higher quantity of fish after applying the mitigation measures. The impacts are analysed for stocks listed in the EWG ToRs and for which data were made specifically available for the meeting, and a large number of species are missing.

STECF notes that the SEAFISH model was used to provide information on choke effects and possible impacts of new technical measures for three UK fleets. The EWG report provides results for UK Northern Irish *Nephrops* fleet fishing in area 7 and Scottish *Nephrops* trawl and Demersal trawl fleets fishing in West of Scotland (ICES Area 6a). The SEAFISH model estimates at which point stocks might choke the fleet under different modelled scenarios with and without additional selectivity measures. It was also possible to show how changes in quota allocations to the fleets may reduce the choke effects. The UK analysis shows that changes of selectivity in combination with the quota management can help UK fleets to delay the choke point or reduce the level of foregone catch before choke occurs. However the selectivity

improvements tested do not fully eliminate the problem of choke and its economic implications. The extent to which gear selectivity can help to mitigate against the risk of choke varies according to the fleet and the stocks.

Fleet	Model outputs
Northern Irish *Nephrops* trawl fleet in area 7	Fleet chokes on whiting 7a in 2019. Selectivity adjustment can improve situation for all scenarios (compared to initial scenario), effect is limited, choke risk remains without extra quota for the fleet.
Scottish *Nephrops* trawl fleet in area 6	Zero TAC stocks (cod and whiting) are choke stocks area 6. Use of 80mm + 160mm square mesh panel, in combination with quota movement, allows fleet to increase effort until choke point from 9% of 2016 days at sea in B4 to 50% of 2016 days at sea in both quota trade scenarios.
Scottish demersal trawl fleet in area 6	Effort of the fleet was mostly in North Sea, but 23% annual effort was in area 6, using TR1 and TR2. Selectivity improvements and quota management delays choke point until 54% of 2016 actual days at sea.

STECF conclusions

STECF concludes that the EWG 18-02 report identifies some key stocks with high risk of causing choke situations and some gear selectivity improvements that could reduce the risk of choke situations occurring at all, or could potentially delay choke situations to a point later in year, in the Celtic Sea, West of Scotland, the Irish Sea and Channel. Delaying a choke situation until later in the year could allow enough revenues and operating profit to enable a vessel business to continue to operate as solutions are found to avoid choke situations altogether.

STECF concludes that the limited review of gear trials did identify some modifications that might improve selectivity, with a view to avoiding choke situations. STECF concludes that there are also likely to be other trials, not included in the review, which have identified gear modifications that could improve selectivity. STECF concludes that some of the gear modifications listed in one sea area might also be relevant to other sea areas.

STECF concludes that further investigation is needed to assess the potential for gear modifications to prevent or delay choke situations in the identified stocks/fisheries. In recent years there have been several trials to test the effects of modifying gear. While many of these trials are limited in time and space, many have demonstrated the potential to change selectivity. Nevertheless, the trials have also highlighted how difficult it is to improve selectivity without reducing marketable catch to the extent that fishing operations are not profitable. This difficulty exists particularly for trials testing larger codend mesh sizes, owing to the discrepancy in the marketable size of different species caught simultaneously. STECF concludes nevertheless that large-mesh and/or square-mesh panels in the trawl body may offer effective alternative or complementary solutions to avoid or delay choke situations under the landing obligation (see Table 1 below).

STECF recognises that most trials consist of a relatively low number of hauls, and modified trawl designs are tested only to a limited extent. STECF concludes that, until economic

incentives motivate vessel operators to improve selectivity, the full potential to improve selectivity cannot be determined. The intended consequence of the landing obligation is to motivate vessel operators to avoid unwanted catches, but the incentive will not arise unless the regulation is adequately enforced. The ability to avoid choke by illegally discarding unwanted catches, could remove the need and the potential for gear-based selectivity improvement. With effective enforcement of the landing obligation, vessel operators would begin to base decisions on their choice of gear on trade-offs between risk of choke, risk of infringement and risk of less profitable or unprofitable fishing due to loss marketable catches. There are examples of proactive vessel operators who are making positive progress to reducing unwanted catches through gear selectivity (and through other changes to fishing practices) but the overall discard rates for fleets indicate that these individuals are in the minority.

STECF notes that the dissemination of gear trial results to fishermen is important and recent initiatives, including the gear trial factsheets of the H2020 Project DISCARDLESS (www.discardless.eu/selectivity_manual) and the Gearing Up initiative (https://gearingup.eu), are increasing access to trial information for fishermen.

STECF concludes that the results from the simple excel model are of some interest but the usefulness of some results is limited because the model does not use data on all fish stocks, is based on unrealistic assumptions and presents only partial economic impact assessment. Some of the scenarios presented simply rely on the assumption that somehow the first choke stock has been resolved, and then go to show which stock would be the next to cause choke. E.g. for demersal fish species in Area 6a, a scenario is presented that assumes that somehow, the choke on cod 6a has been resolved for all fleets. For most fleets tested, the mitigation of choke situations resulting from selectivity improvements was relatively small.

STECF concludes that the SEAFISH model is a useful tool for assessing the likely choke stocks and choke points based on assumptions of either status quo catch rates or improved selectivity catch rates, combined with quota management measures. For the UK fleets shown, STECF concludes that gear selectivity improvements tested may delay but are unlikely to enable fleets to avoid choke situations.

STECF concludes that, to assess economic effects of selective gear on choke mitigation, it is not sufficient to just explore possible losses of marketable catch as a change in fishing practice would most likely mean change in costs and/or changes in other economic variables, e.g. fish price. The application of more advanced analyses and bio-economic models, such as the SEAFISH model, but also including the long term effects of increased selectivity, would be useful but would demand a lot more time and preparatory work.

STECF concludes that although improvements to gear selectivity can help delay choke points, gear adaptation is only one of several changes that fishing businesses may need to make in order to fish legally and profitably under the landing obligation.

References

Mardle, S., Russell, J., Motova, A., 2017. Seafish Bio-economic Modelling: Methodology Report, 34 pp.

Table 1. Summary table based on the analysis of the relevant fisheries described in Section 3, and identified by EWG 18-02 where improvements in selectivity may be made. These fisheries were identified as having high discards and also high discard rates. For each fishery, STECF reported the relevant Primary choke stocks, the past experiments, and the EWG 18-02 suitable main findings to improve gear selectivity. Note: affix numbers added in parenthesis after the acronym (see list below) represent when present the mesh sizes.

Region	Gear Type	Fishery	Choke stocks	Experiments	STECF summary of EWG 18-02 most promising of the measures reviewed
Celtic Sea	TR1 DMC100+SMP120	Mixed Gadoid	Haddock	LDC, T90	Square mesh panels (SMP various mesh sizes); T90 cod-end and extension piece
	TR2	*Nephrops*	Haddock, whiting	LDC+SMP, SMC(45,55,65) LDC+SELTRA, CLH, DCA	Increasing cod-end mesh size (LDC), with larger mesh, square-mesh panels (SMP). Dual cod-end (separator trawl). Potential for BRDs(*)
	TR2	Directed whiting/hake (trawl and seine)	Haddock	LDC+SMP, T90	Cod-end mesh increase (DMC) with SMP
	TR2	Mixed demersal (angler, megrim, hake)	Hake	LDC+SMP	Cod-end mesh increase (DMC) with SMP
	BT2	Mixed demersal (angler, megrim, sole, plaice)	Haddock, whiting, plaice	LDC+SMP (conducted in Channel)	Cod-end mesh increase (DMC) with SMP (consider also T90). Potential for SMC(*)
Irish Sea	TR2	*Nephrops*	Whiting	LDC(80,90,100), CLH, SMC, SELTRA, SMP(120,200,300), BRD	Increasing cod-end mesh size (LDC), with larger mesh square-mesh panels (SMP). Potential for BRD(*)
	TR2	Queen Scallop	Whiting	-	Low unwanted catches, solution through internal UK quota swap

Region	Gear Type	Fishery	Choke stocks	Experiments	STECF summary of EWG 18-02 most promising of the measures reviewed
West of Scotland	TR1 DMC(120)+SMP(120)	Mixed Gadoid	Cod	LDB, LDC, LSP	Nothing identified as promising
	TR1	Mixed demersal	Cod		
	TR2	*Nephrops*	Cod	LDC(80,90,100)+SMP120, SMP, LDP in front the trawl, BRD	Cod-end mesh increase (DMC) with SMP
Channel	TR2	Mixed demersal/Non quota	Haddock	SMP(80,90,100,115), SMY in extension, LDP in front the trawl, T90 codend or extension, BRD	Cod-end mesh increase (DMC) with SMP; T90; SMY; LDP in front of trawl
	BT2	Sole	Plaice	LDM in extension, T90, SMC, LSP in front the trawl, HSP	Nothing identified as promising
	BT2	Mixed demersal/Non quota	Plaice		

*** Added by STECF as an additional potential suggestion List of acronyms used in the table.**

1. BRD: bycatch reduction devices (e.g. grids)
2. CLH: coverless and low headline trawls
3. DMC: diamond-mesh codend
4. DCA: dual codend arrangement/separator trawl
5. HSP: horizontal separator panel
6. LDM: large diamond-mesh
7. LDB: large-mesh belly sections
8. LDC: large diamond-mesh codend
9. LDP: large diamond-mesh panel
10. LSP: large square-mesh panel
11. SELTRA: SELTRA trawl
12. SMC: square-mesh codend
13. SMY: square-mesh cylinder
14. SMP: square-mesh panel
15. T90: diamond-mesh rotated of 90°

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REPORT TO THE STECF

EXPERT WORKING GROUP ON TECHNICAL MEASURES – IMPROVING SELECTIVITY TO REDUCE THE RISK OF CHOKE SPECIES (EWG-18-02)

Dublin, Ireland, 5-9 March 2018

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

EXECUTIVE SUMMARY

Background

The North Western Waters Advisory Council (NWWAC) has developed a Choke Mitigation tool (CMT) which provides a means for the identification of choke situations for key stocks under the Landing Obligation. The CMT assesses what tools – improvements in selectivity; avoidance; quota flexibilities; and exemptions included in Article 15 of the CFP - are appropriate for individual stocks/fisheries to mitigate choke situations. It provides a qualitative assessment of how and to what extent the available tools can reduce the deficit between catch and fishing opportunities.

The CMT identified twelve stocks in the North Western Waters where there is a high risk of residual choke issues, forcing fisheries to close early in the year. Improving selectivity was acknowledged as one of the main mitigation actions to reduce the risk of fisheries being choked for nine of these stocks. In addition improving selectivity was seen as an important mitigation action for a further five stocks of thirteen identified through the CMT as having a moderate risk.

EWG 18-02 was requested to describe the fisheries in which the high risk stocks are caught and in which of these fisheries improving selectivity is appropriate on the basis that discard rates are high. EWG 18-02 was also requested to identify the selectivity tools available to improve selectivity in these fisheries and to assess the knock-on effects of utilising these tools in the fisheries identified.

EWG 18-02 Conclusions

EWG 18-02 has reaffirmed the findings of the analysis carried out using the CMT that for some of the high risk (and several moderate risk) stocks improvements in selectivity are possible. However, there is a need to balance increased selectivity with maintaining economic viability and for some fisheries this will be difficult to achieve.

EWG 18-02 has described the key fisheries by gear groupings (TR1, TR2 etc.) in each of the regions in North Western Waters. Based on this analysis EWG 18-02 has identified the fisheries in which improvements in selectivity should be prioritised. This analysis highlights that selectivity improvements should be focused on trawl and beam trawl fisheries (TR1, TR2 and BT2) as these are the gear groups with the highest discard rates for the choke stocks identified. EWG 18-02 acknowledges that there are significant catches of the high risk choke stocks with other gears (e.g. Gillnets and longlines), but these gears are generally regarding as being selective. Attempting to improve selectivity further would yield only marginal benefits from a choke perspective, while potentially reducing the economic viability of such fisheries.

From the number of trawl and beam trawl fisheries identified in EWG 18-02 in the different regions of the North Western Waters where there are catches of the high risk choke stocks, five fisheries in the Celtic Sea, three fisheries in the West of Scotland, one fishery in the Irish Sea and three fisheries in the Channel where identified as fisheries where improvements in selectivity were needed. These fisheries by area are:

Celtic Sea:

- Mixed gadoid TR1
- *Nephrops* TR2
- Directed whiting and hake trawl and seine TR2
- Mixed demersal (megrim, hake, angler) TR2
- Mixed demersal beam trawl (angler, megrim, sole, plaice) BT2

Irish Sea

- *Nephrops* TR2

West of Scotland

- Mixed gadoid TR1
- Mixed demersal (hake, megrim, anglerfish, haddock) TR1
- *Nephrops* TR2

Western and Eastern Channel

- Western and Eastern Channel mixed demersal/non quota TR2
- Directed beam trawl fishery for sole BT2
- Mixed demersal/non quota beam trawl fishery BT2

EWG 18-02 has identified that most effort to improve selectivity is required in the small mesh (less than 100mm) mixed demersal and *Nephrops* trawl fisheries as unwanted catches of the high risk choke species are highest in these fisheries. Levels of unwanted catches are also high in a number of beam trawl fisheries. However, improving selectivity in these fisheries is much more difficult particularly in beam trawl fisheries targeting sole as losses of marketable sole likely following selectivity improvements would make such fisheries uneconomic.

EWG 18-02 has reviewed different selectivity devices and gear modifications that have been tested and shown to reduce the level of unwanted catches in the fisheries identified. The reductions achievable vary by fishery and by species but in many cases are significant. However, for many of these gears there is a consequential reduction in the marketable catches which will impact on fishermen. Based on the analysis EWG 18-02 has provided observations on the most appropriate selective gear options for each of the different fisheries by area as follows:

Celtic Sea

Mixed gadoid (TR1) - Based on the results of recent trials the simplest solution in this fishery would be to increase the codend mesh size and maintain the existing 120mm smp. This would bring this fishery in line with the current regulated gears used in the West of Scotland and would make this gear highly selective for haddock. The alternatives would be look at T90 mesh in the codend and extension which has also been shown to improve selectivity for gadoids. Any increases in selectivity will undoubtedly reduce the marketable catch of whiting, hake and flatfish species.

Nephrops (TR2) – There is a management choice to be made to improve the size selectivity that will maintain the retention of fish bycatch in the fishery and/or to change the profile of these fisheries so that the fish bycatch is excluded, converting them to a single species fisheries. This will depend on quota allocation and uptake at an individual fleet or vessel level. If quota uptake necessitates the exclusion of all large (~ < 40 cm) haddock, whiting and cod from catches then a trawl gear incorporating some type of sorting grid or dual codend trawls should be considered. If it is acceptable to land certain amounts of these fish then square mesh panels (of appropriate mesh size and appropriately positioned) should be considered and if it is the intention to protect the juvenile of these species then measures which modify the codend size selection such as mesh size increase should be considered.

Directed whiting (TR2) – Levels of unwanted catches of haddock and hake are reportedly high in this fishery so consideration should be given to increasing mesh size (i.e. 100mmm) and also using square mesh panels of at least 100mm. T90 mesh codends could also be considered as an option although based on the trials carried out the mesh size would need to be in excess of 80mm to improve selectivity for haddock which is the principal choke species in this fishery.

Mixed demersal (TR2) - In mixed demersal fisheries, the mandatory introduction of square-mesh panels should be considered. Increasing codend mesh size (100 mm) in the TR2 mixed demersal fisheries would also help reduce unwanted catches of haddock and hake.

Beam Trawl (TR2) – Reducing unwanted catches of the choke stocks in these fisheries is technically challenging without severely impacting on the retention of marketable sole and megrim. Therefore the options to improve selectivity are limited. In order to achieve meaningful reductions in, the mesh size would need to increase substantially (i.e. 100mm - 110 mm) but based on the results of trials in beam trawl fisheries this would result in losses of sole in excess of 50% rendering the fisheries uneconomic. The existing measures introduced under the NWW discard plan of using 120mm in the extension should be maintained as this will help to reduce unwanted to catches to some degree. Using large mesh panels at the front of the trawl and also incorporating T90 mesh into the codend and extension may help to reduce unwanted catches of gadoids.

Irish Sea

Nephrops (TR2) - The measures outlined for the *Nephrops* fisheries in the Celtic Sea are relevant to the Irish Sea. EWG 18-02 considers it important to maintain the measures already introduced by Ireland and the UK to reduce unwanted catches of whiting which has the highest choke risk in the Irish Sea.

West of Scotland

Mixed gadoid and mixed demersal fisheries (TR1) – The options to improve selectivity in these fisheries are limited given the current regulation gear (120mm+120mm smp) is already highly selective for whiting and haddock. The measures introduced under the Scottish Conservation Credit Scheme such as large mesh panels at the front of the trawl in conjunction with the current mesh size regulations should continue to be used given they have been shown to have some benefits particularly in the mixed demersal fisheries. Other options to improve selectivity in these fisheries are limited

Nephrops (TR2) - The measures described for the Celtic Sea ansd Irish Sea *Nephrops* fisheries are relevant to the West of Scotland where cod and whiting are the primary choke species. At the very least EWG 18-02 considers it is important to maintain the measures already introduced under the Scottish Conservation Credit Scheme for *Nephrops* fisheries.

Western and Eastern Channel

Mixed demersal/non quota (TR2) – EWG 18-02 notes there is a number of different fisheries with different catch compositions, with a reliance on non-quota species such as cuttlefish, squid and red mullet and also involving small inshore vessels. Increasing selectivity in such fisheries is difficult without impacting on marketable catches and finding one measure that could be applied to all of the different fisheries is not an optimal solution. Notwithstanding this, discard rates in many of these fisheries are high and the level of unwanted catches is significant. The mandatory introduction of square-mesh panels of at least 100mm or the square mesh cylinder concept tested by France could be considered. Increasing codend mesh size (90 mm) would also help reduce unwanted catches of whiting and hake considerably and to a lesser extent plaice. Other options would be to consider using T90 mesh in the extension and codend.

Beam Trawl (TR2) – The same comments for the BT2 fisheries in the Celtic Sea apply in the Western and eastern Channel beam trawl fisheries. Increasing selectivity is challenging where sole is an important component of the catch. Increasing selectivity in the mixed demersal beam trawl fisheries while difficult has been shown to be possible through the use of large mesh panels at the front of the trawl and also incorporating T90 mesh into the codend and extension.

EWG 18-02 was requested to assess the likely reductions in unwanted catches of the relevant stock that might reasonably be achieved based on the results of past trials carried out with these selectivity devices and gear modifications. However, due to time constraints it was not possible carry out such an analysis for all of the different selectivity devices. Therefore EWG 18-02 considered some representative devices or gear modifications in the identified fisheries and evaluated the benefits in terms of reducing the choke risk and extending the time fisheries would remain open. This varies from fishery to fishery and is highly dependent on the population structure of the targeted stocks.

EWG 18-02 was unable to assess fully the likely economic impacts resulting from changes in selectivity on the basis of losses of marketable catches of the stock or reductions in the marketable catches of other species contrasted with the economic impacts of a choke situation. However, EWG 18-02 has looked at two case studies – a Landing Obligation Impact Assessment Model and a UK case study - which provide an indication of the benefits of selectivity in certain circumstances to mitigate against risk of fisheries being choked.

The Landing Obligation Impact Assessment Model developed during EWG 18-02 shows the effect of high risk choke stocks on different fleets and what impact selectivity measures applied to those fleets has in mitigating against the risks of choke. From a gear selectivity perspective, the main results show that gear selectivity measures can only partially resolve the choke species problem in all areas. Positive results were seen for the Irish fleet in the Celtic Sea VIIb-k for the TR2 fleet where the selectivity device reduced the choke impact of haddock significantly.

In the Celtic Sea VIIf,g the gear selectivity of 100mm codend mesh size increase is very effective for the beam trawl fleets leading to the overall discard rate of plaice falling from 60% to 24%.

This resolves all issues for the UK fleet (in fact leading to a 25% increase in landings) but not for the Belgian fleet due to lack of quota.

In the English Channel VIId,e the 100mm mesh size increase is highly effective for the beam trawl fleets reducing the discard rate form 41% to 13% as is the use of the SELTRA in the TR2 fleet. This latter device reduces the discard rate of plaice from 76% to 56% and leads to increased landings for the French and English fleets.

In the Irish Sea VIIa the 80mm T90 for beam trawls reduces the discard rate from 91% to 71%. The SELTRA is also effective for the Irish TR2 fleet but due to lack of quota does not resolve the choke issue for the UK TR2 fleet.

In the West of Scotland VIa the 130 mm mesh size increase for the TR1 metier is effective, reducing the discard rate from 24% to 9% for whiting. However, without a resolution to the zero TAC issue with cod, all fleets in VIa will be tied up from the start of the year.

The UK case study has looked at the impact of selectivity in the *Nephrops* fisheries in the Irish Sea and the West of Scotland. The analysis shows that changes of selectivity in combination with the quota management can help UK fleets to mitigate risk of choke. However it doesn't fully eliminate the problem. The level that selectivity can help to mitigate against the risk depends on the fleet and the fishery. For the Irish Sea *Nephrops* fleet the model shows it will choke on whiting 7a in 2019 and the selectivity improvement can improve the situation for all scenarios (compared to initial scenario). However, the effect is limited and cannot fully alleviate the choke risk without provision of additional quota to the fleet. In the case of Scottish demersal fleet in area 6 the effort of 49 vessels belonging to the fleet was mostly allocated to the North Sea. However, these vessels allocated 23% of their annual effort to area 6 and used both demersal trawls (TR1 and TR2). The model predictions are similar to the Irish Seas *Nephrops* fleet.

1. INTRODUCTION

The North Western Waters Advisory Council (NWWAC) has developed a Choke Mitigation Tool (CMT) which provides a means for the identification of choke situations for key stocks. It is designed to help assess what tools – improvements in selectivity; avoidance; quota flexibilities; and exemptions included in Article 15 of the CFP - are appropriate for individual stocks/fisheries to mitigate choke situations. It also provides a qualitative assessment of how and to what extent the available tools can reduce the deficit between catch and fishing opportunities.

Two expert workshops have been convened by the NWWAC and the NWW Regional group to work through the different stocks in the Celtic Sea, West of Scotland, the Irish Sea and Channel using the CMT. The threat of choking fisheries has been assessed for each of these stocks/fisheries and sea basins. The aim was to use this analysis to identify residual choke issues that can only be addressed at Union level with alternative measures over and above the existing tools available.

Each of the stocks assessed was classified depending on the extent of the problem as follows:

- "**High risk**" – catches are well in excess of current fishing opportunities and even with all the available mitigation tools applied there is a high risk of choke for multiple Member States.
- "**Moderate risk**" – catches are in excess of fishing opportunities for one or more Member States and the risk of choke is significant for these Member States but mitigation tools potentially can solve the problem.
- **"Low or no apparent risk"** – catches are in line with fishing opportunities and the risk of choke is low or there is no apparent risk with the mitigation tools available.

The choke mitigation tool has proven to be an extremely useful tool for carrying out this evaluation, but the analysis carried out was meant as illustrative and to identify stocks where chokes may be an issue and to identify what tools maybe applicable to mitigate choke situations.

The analysis has identified 12 stocks where there is a high risk of residual choke issues. For 6 of these stocks – **whiting VIIb-k; sole and plaice VIIf,g; whiting VI, cod VIIa; plaice VIId,e** - the available measures and tools will significantly reduce the choke risk provide they are used appropriately. For the other 6 stocks – **haddock VIIb-k, skates and rays VI and VII, cod**

VIa, saithe VI, whiting VIIa and skates and rays VIId,e - additional measures or a different management approach is likely to be required to prevent multiple fisheries from being choked. The analysis has identified a further 13 stocks where there is a moderate risk of residual choke issues for one or more Member States. The available tools and measures can significantly reduce this risk for these species.

In the case of the 12 high risk stocks, improving selectivity has been identified in 9 of these stocks as one of the main mitigation actions to reduce the risk of fisheries being choked. In addition improving selectivity was seen as an important mitigation action for a further 5 stocks of the 13 identified as having a moderate risk. However, as the CMT is largely qualitative rather than quantitative analysis the extent to which selectivity and in which fisheries was not fully identified.

In order to address this and in particular confirm that the high risk stocks identified have residual choke issues that will require additional measures to solve, a further analysis is required. This analysis should identify the fisheries in which the high risk stocks are caught and in which of these fisheries improving selectivity is appropriate on the basis that discard rates are high. The analysis should also identify the selectivity tools available to improve selectivity and assess the knock-on effects of utilising these tools in the fisheries identified.

1.1. Terms of Reference for EWG 18-02

For the stocks listed STECF is requested to*:*

1. Describe the main fisheries in which the high risk stocks identified are caught and identify whether catches are from a targeted fishery or as a bycatch. For these fisheries identify the catches of the relevant stock and the main gear types used.
2. Assess in which of these fisheries improving selectivity may be possible.
3. Identify in these fisheries what selectivity devices and gear modifications are available that could improve selectivity.
4. Assess the likely reductions in unwanted catches of the relevant stock that might reasonably be achieved based on the results of past trials carried out with these selectivity devices and gear modifications.
5. Assess the likely economic impacts resulting from such changes in selectivity on the basis of losses of marketable catches of the stock or reductions in the marketable catches of other species contrasted with the economic impacts of a choke situation.

The high risk choke stocks identified by the CMT are:

- Haddock VIIb-k
- Whiting VIIb-k;
- Sole VIIf,g
- Plaice VIIf,g;
- Cod VIa;
- Whiting VIa;
- Cod VIIa;
- Whiting VIIa
- Plaice VIId,e

The moderate risk choke stocks are:

- Hake VI and VII
- Cod VIIb-k
- Haddock VIa
- Haddock VIb
- Haddock VIIa

2. THE CHOKE MITIGATION TOOL (CMT)

The Choke Mitigation Tool (CMT) was originally developed by the North Western Waters Advisory Council (NWWAC) and was fine-tuned following discussions between the NWWAC and the North Western Waters Member States Regional Group (Rihan et al., 2017). It was designed to identify and assess the severity of potential choke situations, in order to develop contingency plans before full implementation of the landing obligation by the 1st of January 2019. It also aims to identify solutions to choke problems that may arise in the future.

2.1. Description of the CMT

The CMT consists of 3 parts:

PART 1: Stock Identification

A separate worksheet was created for each individual stock managed under TAC.

PART 2: Quantifying the choke problem (based on 2015 and 2016 data)

This part of the tool compares the level of catches (landings plus discards) with the available quota across the relevant Member States in order to provide an indication of the likely surplus or deficit between catches and quota. TAC top-ups are also factored into the analysis to account for previously discarded fish.

Based on this, potential choke situations were identified and categorised according to the definitions developed at the Member States workshop on 'Access to Quota' (14 -15 April 2016, Edinburgh):

Category 1: Sufficient quota is available at Member State level. The choke species is due to the distribution of quota within the Member State, such that a region or fleet segment does not have enough available quota to cover catches. This situation may be resolved by the Member State itself and species falling into this category are not considered further in this report.

Category 2: Sufficient quota is available at EU level but insufficient quota exists at Member State level. The choke species is due to the distribution of quota between Member States and may be resolved between Member States in a regional context.

Category 3: Insufficient quota exists at EU level. The choke species is due to insufficient quota within the relevant sea basin to cover current catches or catches that cannot be otherwise reduced (e.g. by selectivity or avoidance), resulting in the total cessation of fishing of the flag vessels of a Member State or Member States.

For each stock the relative contribution to the overall catches for each gear type by Member State is included.

PART 3: Solutions for choke problem

This part of the tool is designed to identify which mitigation tools are appropriate for each stock/fishery and how and to what extent the available tools can reduce the deficit between catch and quota. Four different types of mitigation actions are identified:

A. Avoidance actions:

- Closures of specific areas or depth ranges can be spatial, temporal (e.g. closure of spawning, nursery areas) or only restricted to certain fleets.
- Real-time closures to avoid certain hotspot areas of unwanted catch.
- Real time catch information shared among vessels to promote voluntary avoidance of certain hotspot areas. This action differs from the previous as the 'hotspot' area would still be open for fishing and it would be the skipper's responsibility to decide whether it is advisable to fish in such an area.

B. Selectivity actions:

Selectivity actions are divided into two different categories: size and species selectivity measures. The former can be achieved by increasing codend mesh size and/or installing escape panels. The latter refers to use of sorting devices such as grids and trawl modifications such as low headline trawls.

C. Quota flexibilities: These are split into commonly used quota management tools, quota flexibilities included under Article 15 of the CFP and other quota flexibilities that would be possible under the CFP but not regularly used.

Quota management tools include quota swaps, annual banking and borrowing of quotas under Council Regulation (EC) No 847/96 and the quota deduction/transfer mechanism allowed for under Article 105 of the Control Regulation (Council Regulation (EC) No 1224/2009).

The main quota flexibility included under Article 15 is interspecies flexibility which is possible if the non-target stock (which in this case would be a choke) is within safe biological limits (as defined in art 15 §8 and art 4 §18 of Regulation (EU) 1380/2013). There is also inter annual quota flexibility included in Article 15 §9 which allow Member State to land of additional quantities of a stock that is subject to the landing obligation provided that such quantities do not exceed 10 % of the quota allocated to that Member State. This is similar to the existing banking and borrowing Regulation.

The other quota flexibilities considered were:

- Setting a quota for "Other species" whereby Member States without quota could account for unavoidable bycatch by offsetting such catches against this "others" quota allocation. This allocation is not necessarily allocated on a Member State basis but rather a "global" allocation.
- Bycatch Quota: Set a specific bycatch TAC as a percentage of the total TAC for targeted species, particularly in cases where one or more Member State may have low levels of incidental catches but has no quota allocation.
- Removing TACs: In certain cases where a TAC creates a potential choke risk but that TAC has no real value as a management tool as it does not control fishing mortality, there may be reason to remove a TAC. This on the basis that alternative measures were put in place and that removing the TAC carried no risk to the state of the stock.
- Inter area flexibility: For a number of TACs currently there is flexibility between areas to record part of the TAC in an adjacent management area (i.e. between Area IV and Area VIa). In certain cases this flexibility may help MS manage quotas.
- Merging TAC regions: In certain circumstances it may be applicable to merge the TAC management area to match the scientific assessment for a particular stock. This may introduce flexibility that would allow MS to allocate quotas more efficiently.

D. Exemptions: These are the exemptions for high survivability and de minimis allowed for under Article 15 and already used by Member States in certain fisheries. In the case of de minimis to date these have tended to be defined on a single species or fishery basis, but in some cases it may be desirable to combine the catches of a range of species to create a combined de minimis which potentially increases flexibility.

2.2.Stocks assessed using the CMT

Two expert workshops were convened in June and September by the NWWAC and the NWW Regional group of Member States to work through the different stocks in the Celtic Sea, West of Scotland, the Irish Sea and Western and Eastern Channel using the CMT. The risk of choking fisheries was assessed for each of these stocks/fisheries and sea basins. The stocks covered are shown in Table 2.2.1.

Celtic Sea	West of Scotland	Irish Sea	Western and Eastern Channel
Anglerfish VII	Anglerfish VI	Cod VIIa	Cod VIId
Cod VIIb-k	Blue Ling VI and VII	Haddock VIIa	Plaice VIId,e
Haddock VIIb-k	Cod VIa	Plaice VIIa	Sole VIId
Hake VI and VII	Cod VIb	Sole VIIa	Sole VIIe
Megrim VII	Haddock VIa	Whiting VIIa	Skates and Rays VIId
Nephrops VII	Haddock VIb		
Plaice VIIf,g	Ling VI and VII		

Plaice VII h,j,k Pollack VII Skates & Rays VI and VII Sole VIIf,g Sole VIIh,j,k Whiting VIIb-k	Megrim VI *Nephrops* VI Saithe VI Tusk V,VI,VII Whiting VI		

Each of these stocks was classified depending on the extent of the problem as:

- "**High risk**" – catches are well in excess of current fishing opportunities and even with all the available mitigation tools applied there is a high risk of choke for multiple Member States.
- "**Moderate risk**" – catches are in excess of fishing opportunities for one or more Member States and the risk of choke is significant for these Member States but mitigation tools potentially can solve the problem.
- **"Low or no apparent risk"** – catches are in line with fishing opportunities and the risk of choke is low or there is no apparent risk with the mitigation tools available.

2.3. Main findings for 2015

The analysis was based on STECF catch data from 2015 (most recently available at the time of the workshops) and implied TAC top-ups to take account of catches previously discarded. The main findings by sea basin for the different stocks using the CMT were as follows:

2.3.1. Celtic Sea

High Risk – catches exceed the TAC with multiple Member States impacted

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Haddock VIIb-k	BE, ES, FR, IE, NL, UK	Improving selectivity Avoidance ISF	Significant deficit between catches and quotas across MS Mitigation actions unlikely to prevent choking of fisheries
Skates and Rays VI & VII	BE, ES, FR, IE, UK	Avoidance High survivability	Significant deficit between catches and quotas across MS Mitigation actions unlikely to prevent choking of fisheries
Whiting VIIb-k	BE, ES, FR, IE, NL, UK	Improving selectivity Avoidance De minimis	Mitigation actions likely to reduce the risk of choking significantly
Plaice VIIf,g	BE, FR, IE	High survivability Improving selectivity	Mitigation actions likely to reduce the risk of choking significantly
Sole VIIf,g	BE, FR, IE	High survivability Improving selectivity De minimis ISF	Mitigation actions likely to reduce the risk significantly

Moderate Risk - catches are less than TAC but for some Member States catches exceed quota

Species	Member States	Relevant Mitigation	Conclusion

	Impacted	Actions	
Hake VI & VII	ES, IE	Quota swaps Improving selectivity ISF De minimis	Mitigation actions likely to reduce the risk of choking significantly High dependence on quota swaps
Anglerfish VII	ES, IE, UK	Quota swaps De minimis	High dependence on quota swaps
Cod VIIb-k (excluding VIId)	IE, UK	Quota swaps Improving selectivity Avoidance	Mitigation actions likely to reduce the risk of choking significantly High dependence on quota swaps
Sole VIIh,j,k	BE, FR	High survivability Remove TAC Quota swaps	Mitigation actions likely to reduce the risk of choking significantly
Plaice VIIh,j,k	FR	High survivability Remove TAC	Mitigation actions likely to reduce the risk of choking significantly
Megrim VII	UK	Quota swaps	Dependence on quota swaps

Low or no apparent risk - catches are below the TAC and no Member State catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
***Nephrops* VII**	IE, BE	Quota Swaps	Low risk
Pollack VII	None	NA	No apparent risk

2.3.2. West of Scotland

High Risk – catches exceed the TAC with multiple Member States impacted

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Cod VIa	FR, IE, UK	Improving selectivity Avoidance	Zero TAC Mitigation actions unlikely to fully resolve the issues Change in management approach required
Saithe VIa	ES, FR, NL, UK	ISF De minimis	Significant deficit between catches and quotas across MS Mitigation actions unlikely to prevent choking of fisheries
Whiting VIa	IE, NL, UK	Improving selectivity Avoidance	Mitigation actions likely to reduce the risk significantly

Moderate Risk - catches are less than TAC but for some Member States catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Anglerfish VI	IE, UK	Quota swaps	Dependence on quota swaps

		De minimis	
Haddock VIa	ES, IE, NL ,UK	Improving selectivity Avoidance Quota swaps Inter area flexibility	Mitigation actions likely to reduce the risk of choking significantly
Haddock VIb	IE, UK	Improving selectivity ISF De minimis	Mitigation actions likely to reduce the risk of choking significantly

Low or no apparent risk - catches are below the TAC and no Member State catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Blue Ling V, VI & VII	None	NA	No apparent risk
Cod VIb	None	NA	No apparent risk
Ling V, VI, VII	None	NA	No apparent risk
Megrim VI	IE	Quota swaps	Low risk
***Nephrops* VI**	None	NA	No apparent risk
Tusk V, VI, VII	ES	Quota swaps	Low risk

2.3.3. Irish Sea

High Risk – catches exceed the TAC with multiple Member States impacted

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Cod VIIa	BE, IE, UK	Improving selectivity Avoidance	Mitigation actions likely to reduce the risk of choking significantly
Whiting VIIa	BE, IE, UK	Improving selectivity Removal of TAC	Significant deficit between catches and quotas across MS Mitigation actions unlikely to prevent choking of fisheries

Moderate Risk - catches are less than TAC but for some Member States catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Haddock VIIa	UK	Improving selectivity ISF	Mitigation actions likely to reduce the risk of choking significantly
Sole VIIa	BE	High survivability De minimis Avoidance	Mitigation actions likely to reduce the risk of choking significantly

Low or no apparent risk - catches are below the TAC and no Member State catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Plaice VIIa	BE	Quota swaps	Low risk

2.3.4. Western and Eastern Channel

High Risk – catches exceed the TAC with multiple Member States impacted

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Plaice VIId, e	BE, FR, NL, UK	Improving selectivity High survivability Inter area flexibility	TAC uplift in 2016/2017 has largely removed choke risk
Skates & Rays VIId	BE, FR, UK	Avoidance measures High survivability	Significant deficit between catches and quotas across MS Mitigation actions unlikely to prevent choking of fisheries

Moderate Risk - catches are less than TAC but for some Member States catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Sole VIId	BE	High survivability De minimis Inter area flexibility	Mitigation actions likely to reduce the risk of choking significantly
Sole VIIe	BE	High survivability De minimis Inter area flexibility	Mitigation actions likely to reduce the risk of choking significantly

Low or no apparent risk - catches are below the TAC and no Member State catches exceed quota

Species	Member States Impacted	Relevant Mitigation Actions	Conclusion
Cod VIId	None	ISF	Low risk

2.4.Main findings for 2016 and comparison with 2015

Following the two workshops, the analysis was re-run by the NWWAC using 2016 STECF catch data. By and large the results remained the same as for 2015. The major changes are outlined in sections 2.4.1 to 2.4.4.

2.4.1. Celtic Sea

Species	Member States Impacted	Level of Risk 2015	Level of Risk 2016	Conclusion

Haddock VIIb-k	BE, ES, FR, IE, NL, UK	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high Significant differences between ICES and STECF discard rates
Skates and Rays VI & VII	BE, ES, FR, IE, UK	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high STECF catch data highly variable for 2016
Whiting VIIb-k	BE, ES, FR, IE, NL, UK	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high Significant differences between ICES and STECF discard rates
Plaice VIIf,g	BE, FR, IE, UK	High	High	Catches significantly reduced in 2016 and IE and FR have a surplus rather than deficit. Catches still in excess of TAC and choke risk remains high
Sole VIIf,g	BE, FR, IE	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high
Hake VI & VII	ES, IE , NL	Moderate	Moderate	NL has a deficit in 2016 in addition to IE and ES High dependence on quota swaps and inter-area quota transfers
Anglerfish VII	ES, IE, UK	Moderate	Moderate	No change for 2016 IE, UK, ES still have significant deficits and a high dependence on quota swaps. No quota uplift as ICES advises discards are negligible. STECF reports discard rates of between 7-21%
Cod VIIb-k (excluding VIId)	IE, UK	Moderate	Moderate	No change for 2016 IE and UK have deficits and NL has no quota but small catches. High dependence on quota swaps
Sole VIIh,j,k	BE, FR	Moderate	Moderate	No change for 2016 Catches remain low

Plaice VIIh,j,k	BE, FR	Moderate	Moderate	No change for 2016 No discard data available by MS
Megrim VII	UK	Moderate	Moderate	No change for 2016 UK reliant on quota swaps
***Nephrops* VII**	IE, BE	Low	Low	No change for 2016 IE and BE (zero quota) reliant on quota swaps Significant differences between ICES and STECF discard rates but choke risk remains low
Pollack VII	IE, NL	Low	Low	IE has small deficit in 2016. NL has no reported catches in 2016 Choke risk remains low

2.4.2. West of Scotland

Species	Member States Impacted	Level of Risk 2015	Level of Risk 2016	Conclusion
Cod VIa	FR, IE, UK	High	High	No change for 2016 Catches still in excess of TAC (zero TAC) and choke risk remains high
Saithe VIa	ES, FR, NL, UK	High	Moderate	Catches below TAC in 2016 largely due to a reduction in FR catches. UK still has a significant deficit
Whiting VIa	IE, NL, UK	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high Significant differences between ICES and STECF discard rates
Anglerfish VI	IE, UK,ES	Moderate	Moderate	No change for 2016 except for a small deficit for ES Catches remain more or less in line with the TAC IE remain reliant on swaps
Haddock VIa	ES, IE, NL ,UK	Moderate	Moderate	IE has large deficit in 2016 compared to 2015 but total catches remain below TAC Significant differences between ICES and STECF discard rates
Haddock VIb	IE, UK	Moderate	Low	No MS with deficit in 2016 Choke risk assessed as being low in

				2016
Blue Ling V, VI & VII	IE, ES	Low	Moderate	ES (significant) and IE (small) have deficits in 2016 Choke risk assessed as being moderate in 2016 Significant differences between ICES and STECF discard rates
Cod VIb	IE	Low	Low	No change for 2016 Catches remain low and choke risk remains low
Ling V, VI, VII	BE, IE	Low	Moderate	IE has a deficit in 2016 compared to 2015 but total catches remain well below TAC No quota uplift as ICES advises discards are negligible. STECF reports discard rates of between 2-14%
Megrim VI	IE	Low	Low	No change for 2016 Catches remain well below TAC ES and UK report quite high discard rates
***Nephrops* VI**	None	Low	Low	No change for 2016 Choke risk remains low No discards reported by UK
Tusk V, VI, VII	BE, NL, ES	Low	Moderate	Deficit for ES increased in 2016 Choke risk assessed as being moderate No quota uplift as ICES advises discards are negligible. STECF reports discard rates of between 1-20%

2.4.3. Irish Sea

Species	Member States Impacted	Level of Risk 2015	Level of Risk 2016	Conclusion
Cod VIIa	BE, IE, UK	High	Moderate	Catches below TAC in 2016 largely due to a reduction in IE and UK catches. UK still has a significant deficit Choke risk assessed as moderate
Whiting VIIa	BE, IE, UK	High	High	No change for 2016 Catches still in excess of TAC (zero

				TAC) and choke risk remains high although a reduction in discards is reported for both IE and UK
Haddock VIIa	UK	Moderate	Low	Catches well below TAC in 2016 Choke risk assessed as low Significant differences between ICES and STECF catch data
Sole VIIa	BE	Moderate	Moderate	No change for 2016 and catches more or less in line TAC reflecting current fishing patterns Choke risk remains moderate given low level of TAC
Plaice VIIa	BE	Low	Low	No change for 2016 and catches well below TAC reflecting current fishing patterns Choke risk remains low

2.4.4. Western and Eastern Channel

Species	Member States Impacted	Level of Risk 2015	Level of Risk 2016	Conclusion
Plaice VIId, e	BE, FR, NL, UK	High	Moderate	TAC uplift resulted in catches being well below TAC in 2016 BE still has a significant deficit but FR and UK deficits are significantly reduced
Skates & Rays VIId	BE, FR, UK	High	High	No change for 2016 Catches still in excess of TAC and choke risk remains high No discard data available by MS
Sole VIId	FR, BE	Moderate	Moderate	Catches remain more or less in line with the TAC FR has a deficit in 2016. BE has a surplus FR report a very high discard rate
Sole VIIe	BE,UK	Moderate	Moderate	Catches remain more or less in line with the TAC UK reported a deficit in 2016 along with BE
Cod VIId	None	Low	Low	No change for 2016 and catches remain well below TAC reflecting current fishing patterns Choke risk remains low given low level of catches

2.5. Overall Conclusions

The CMT analysis identified fisheries in which there is a high risk of residual problems leading to choking of fisheries that will persist without additional tools or measures over and above what is contained in the CFP and supporting legislation. However, the analysis can only indicate qualitatively where these potential problems exist for specific stocks and the most relevant mitigation tools to reduce the choke risk for these stocks. Data limitations make it difficult to provide a more quantified assessment.

In addition the choke species issue is complex and the exposure to the risk of choke species varies between stocks, fisheries and Member States. The NWW is characterised by many different stocks and fisheries that all interact. This dynamic system makes predicting choke situation even more difficult, and hence there is a need for further evaluation covering the high risk stocks to identify which fisheries for these stocks are particularly problematic.

In cases where there is a high risk of choking which cannot be readily solved with the available tools and measures the NWWAC and Member States concluded that a more detailed assessment of the likely impacts on Member States and fleets is required. The work of EWG 18-02 is a first attempt at such an assessment.

3. TOR 1 – Description of the main fisheries

Tor 1: Describe the main fisheries in which the high risk stocks identified are caught and identify whether catches are from a targeted fishery or as a bycatch. For these fisheries identify the catches of the relevant stock and the main gear types used.

The analysis focuses on catches of the high and moderate risk species prioritised in the Commission's request (section 1.1). For the other high risk stocks identified through the CMT - skates and rays VI, VII and VIId and saithe VI - as well as the moderate risk stocks other than the ones identified by the Commission, no analysis has been completed as improvements in selectivity were not identified as being relevant or other tools were identified as being more appropriate to reduce the choke risk. In the case of skates and rays, STECF EWG 17-12 has considered possible but limited gear modifications that may improve selectivity of skates and rays in certain fisheries (STECF, 2017a).

3.1. Overview

Data on high and moderate risk stocks listed in the terms of reference were compiled by the NWWAC from the STECF database (STECF 2017b) and made available to EWG 18-02. These data were summarised according to the identified stocks and the main gear codes (see Annex I for definitions of the gear codes) in order to assess where the main discarding/unwanted catch issues are occurring. Average landings and discards for 2014-2016 were calculated as the mean across these years, and average catches were calculated as the sum of average landings and discards for every given species-country-metier combination. Average discards were divided by the average catches to calculate the average discard rates. Blank cells indicate 'NA's in the original STECF data, i.e. no information is available.

The data presented in table 3.1.1.are limited to key demersal trawl fisheries where discard issues are apparent from the STECF data and where improvements in selectivity may be possible. Any issues in other metiers are noted in the text below.

Table 3.1.1 STECF catch data on high and moderate risk stocks

Area	Species	Gear codes	Catch (t)	Landings (t)	Discards (t)	Discard rate (%)
Celtic Sea VIIb-k	HAD	TR1	9198	4926	4272	46
		TR2	4094	1731	2362	58
		BT2	1528	381	1146	75
	WHG	TR1	9985	7096	2889	29
		TR2	8501	5733	2767	33

		BT2	1006	269	737	73
Celtic Sea VIIf-g	SOL	BT2	801	778	22	3
		TR1	72	60	12	17
		TR2	68	53	15	22
	PLE	BT2	605	198	406	67
		TR1	468	153	315	67
		TR2	176	49	127	72
West of Scotland	COD	TR1	1183	215	968	82
		TR2	190	7	183	96
		R_OTTER	4	4	0	2
	WHG	TR2	953	6	947	99
		TR1	281	174	107	38
		R_OTTER	5	5	1	16
Irish Sea VIIa	COD	TR2	171	104	68	39
		TR1	31	15	17	53
		BT2	26	24	2	9
	WHG	TR2	1350	10	1339	99
		TR1	40	11	29	72
		BT2	14	1	13	90
English Channel	PLE d,e	TR2	4470	1233	3238	72
		BT2	3622	1982	1640	45
		R_OTTER	1281	561	720	56
		TR1	68	54	14	20
Celtic Sea VIIf-g	HKE (6&7)	TR2	14014	9873	4141	30
		BT2	262	120	142	54
Celtic Sea VIIb-k	COD	TR1	2702	2414	287	11
		TR2	961	782	179	19
		BT2	438	316	122	28
West of Scotland	HAD 6a	TR1	4128	3876	252	6
		TR2	1704	136	1568	92
		R_OTTER	16	16	0	0
	HAD 6b	Bottom Trawl	7434	5826	1608	22
Irish Sea VIIa	HAD	TR1	612	580	32	5
		TR2	540	163	377	70
		BT2	35	13	22	63

*Catch and discards are based on average figures from the years 2014 to 2016

An overview of the catches by stock is as follows:

Haddock VIIb-k: The TR1 fleet is responsible for the majority of the trawl catches (62%) and discards (55%) but the BT2 and TR2 metiers have the highest discard rates of 75% and 58%.

Whiting VIIb-k: The TR1 and TR2 fleets catch most of the whiting and are responsible for most of the discards with relatively similar discard rates of 29% and 33% respectively. The BT2 metier has the highest discard rate but is responsible for just 5% of the catches.

Cod VIIb-k: Cod in the Celtic Sea are predominantly caught by the TR1 fleet (66%) and to a lesser extent by the TR2 (23%) and BT2 (11%) fleets. The discard rate of 11% is lowest in the TR1 fleet. The TR2 and BT2 fleets have discard rates of 19 % and 28%.

Hake VI and VII: STECF data were only provided for ICES areas VIIf and g. In these areas the TR2 is the predominant trawl fleet with 98% of catches with the remainder caught by BT2. The TR2 fleet has a discard rate of 30% and the BT2 metier has a discard rate of 54%.

Sole VIIf,g: The BT2 metier catches 85% of sole in this area and has a low discard rate of 3%. The TR1 and TR2 fleets only take around 7% of the sole catches each and have higher discard rates of 17% and 22%.

Plaice VIIf,g: The predominant metiers catching plaice in this area are BT2 (48%) and TR2 (37%) with the remainder caught by TR2. The three metiers have similar relatively high discard rates of around 70%.

Cod VIIa: The TR2 metier catches most of the cod in VIIa (75%) with the remainder almost evenly split between the TR1 and BT2 metiers. The TR2 metier is also responsible for most of the discards (78%) but has a slightly lower discard rate of 39% compared with the TR1 metier (53%). The BT2 metier has a relatively low discard rate of 9%.

Whiting VIIa: The TR2 fleet catches most of the whiting in the Irish Sea (96%) and discards almost the entire catch (99%). The TR1 and BT2 metiers catch relatively small amounts of whiting but also have high discard rates of 90% and 72%.

Haddock VIIa: Haddock in VIIa is mainly caught in TR1 (52%) and TR2 (46%) with the remainder caught in the BT2 metier. The TR1 metier has a discard rate of just 5% while the TR2 and BT2 metiers have discard rates of 70% and 63%.

Cod in VIa: Cod in VIa termed West of Scotland in the STECF data are principally caught by the TR1 fleet (85%) with most of the remainder caught by the TR2 fleet. High discards rates of 82% and 96% occurred in these metiers.

Whiting VIa: Referred to as West of Scotland whiting in the STECF data, whiting in this area are mainly caught by the TR2 metier (77%) with most of the remainder caught by the TR1 metier. Almost the entire catch (99%) in the TR2 metier is discarded while TR1 metier has a lower discard rate of 38%.

Haddock VIa: Haddock in VIa are mainly caught in the TR1 metier (71%) with the remainder mainly caught in the TR2 metier. The TR1 metier has a discard rate of just 6% while the TR2 metier has a discard rate of 92%.

Haddock VIb: Data provided by STECF in relation to Haddock in Area VI are divided into haddock in VIa and haddock. Catch data in the STECF database are provided for a generic 'bottom trawl' category, with catches of 612 t and a low discard rate of 5%.

Plaice VIId-e: STECF data on plaice in this area were provided separately for VIId and VIIe but were combined together in order to meet the terms of reference on identified stocks. The main metiers which catch plaice in this area are TR2 (47%) and BT2 (38%) gears. The remainder is mostly caught by the R_Otter metier (14%). The TR2 metier has the highest discard rate of 72%. The BT2 and R_Otter metiers have slightly lower discard rates of 45% and 56%. Less than 1% of catches are taken by the TR1 metier with a relatively low discard rate of 20%.

Table 3.1.2 provides a summary of STECF catches of the identified species by gear codes for all areas. TR2 catches the highest proportion (45%) of the identified species and with a discard rate of 47%, is responsible for the majority of discards across all gear codes. TR1 vessels catch 35% of the identified species and are responsible for 28% of discards but have a lower overall discard rate of 32%. The BT2 gear code catches 10% of the identified species but has a slightly higher discard rate (51%) compared with TR2. This summary shows that the smaller mesh demersal trawl metiers are generally responsible for most of the discards in relation to the identified species. Larger mesh trawl fisheries represent major components of trawl catches and discards but have lower discard rates compared with the smaller mesh trawls.

Table 3.1.2 Summary of Table 3.1.1, aggregated by metier

Gear codes	Catches (t)	Proportion of catches (%)	Discards (t)	Proportion of discards (%)	Discard rate (%)
TR2	37192	45	17312	52	47
TR1	28768	35	9193	28	32
BT2	8337	10	4254	13	51
Bottom Trawl	7434	9	1608	5	22
R_OTTER	1307	2	721	2	55

EWG 18-02 considered the catches of the choke stocks in gillnet, trammel net and longline fisheries. On the whole absolute discards in gillnet, trammel and longline fisheries were low compared to total catches. In addition improving selectivity further in these fisheries is difficult given the gears used are selective compared to trawl gears. Therefore it was decided not to further analysis these fisheries in the context of this report. However, EWG 18-02 noted the following:

- Gillnets account for 25% of the average overall hake catch in VIIf-g, and 9.95% of the average overall discards (across all stocks), with an average discard rate of 11.84%. This is compared to the discard rate of 30% in the TR2 fisheries.
- Absolute quantities and proportions of gill and trammel net discards compared to overall discards for plaice in Celtic Sea VIIf-g and in the Channel are relatively small, the respective discard rates are high (76%, 38% and 37% for VIIf-g, VIId and VIIe, respectively).
- The discard rates in several gillnet fishery are high for Celtic Sea VIIb-k cod (78%) and whiting (44%), Celtic Sea VIIf-g hake (55%), and Channel VIId and VIIe plaice (38% and 41%, respectively), but the overall discard amounts and proportions in relation to overall discards are low.
- An exception is Celtic Sea VIIb-k cod, for which discards in the gillnetfishery account for 21% of overall average discards, compared to less than 5% of the overall average catches.

EWG 18-02 also considered the issue of bycatch of demersal stocks in pelagic fisheries. The Pelagic Advisory Council (PELAC) had identified that these catches could create choke situations for pelagic vessels, mainly due to a lack of demersal quota held by pelagic vessels, or for demersal vessels due to an increased rate of demersal quota uptake.

EWG 18-02 concluded that data on the extent of this bycatch is quite poor but in the past few years, due to the implementation of the Landing Obligation in pelagic fisheries in 2015, there has been an increased focus on the issue.

Available data shows that significant bycatches of some demersal species does occur in pelagic fisheries. For whiting in VIIb-k it is estimated that catches in pelagic fisheries amounted 2% in 2015 and 3.7% in 2016 of the total catches.

There has been concern that these catches present a significant risk of choking the herring fishery if they persist and in 2016 the herring fishery was almost closed because of the overall uptake of the whiting TAC.

Significant bycatches of hake are also recorded in pelagic fisheries in North Western Waters and in 2015 these amounted to 2.4% of total catches in Areas VI and VII. The issue has been analysed in detail using the CMT by the Pelagic Advisory Council (PELAC).

Table 3.1.3 shows estimated quantities from 2015 for some of the high and moderate risk demersal stocks are caught in pelagic trawls and in some cases discarded (data from Pelagic CMT report which was in turn extracted from the STECF database).

Table 3.1.3 Estimated catches of demersal species in pelagic fisheries

Stock	Pelagic Landings 2015 (tonnes)	Pelagic Discards 2015 (tonnes)
Whiting VIIe-k	459	89
Haddock VIIb-k	13	0
Whiting VIa	24	0
Hake VI and VII	806	422
Haddock VIa	12	0

Most bycatch of demersal species in pelagic fisheries are landed without discarding as the catches are either graded out from the target species onshore at processing factories (from RSW vessels) or during on-board processing (pelagic freezer vessels).

Improving selectivity in pelagic fisheries to the extent that it would improve bycatches of demersal species is difficult for a number of reasons. Pelagic nets have small mesh sizes in the aft part in order to avoid meshing damage to fish and associated economic losses. Increasing these mesh sizes sufficiently to allow the escape of larger demersal fish would obviously result in unacceptably high losses of the target pelagic species. Other selectivity devices such as separator grids or panels have been trialled with some positive results in terms of reduction of demersal bycatches but also with losses of pelagic species. A detailed analysis of these measures is given in a 2014 Pelagic Regional Advisory Council report on recommendations on implementing the EU Landing Obligation in pelagic fisheries (PELAC, 2014).

EWG 18-02 concluded that it is likely that other mitigation measures such as the use of inter-species flexibility, *de minimis* exemptions or swapping are more likely to successfully address this issue than selectivity improvements and for this reason EWG 18-02 did not include these fisheries further in the analysis.

3.2.Celtic Sea

TR1 (trawls and seines with a codend mesh size greater than equal or equal to100mm) is the predominant fishing gear used in the Celtic Sea, with the highest fishing effort. TR1 gears account for 24% of the total effort (STECF 2017b). TR1 fisheries are widespread across the whole area, but most of the effort is exerted in ICES VIIf,g and h. The countries that contributed most effort are France, Spain, Ireland and England.

The TR1 fishery is characterized 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*), haddock and whiting.

TR2 (otter trawlers with a codend mesh size range 70-100mm) is the gear with the second highest 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: 1) fisheries for *Nephrops* operated mainly by Irish trawlers in the Smalls, Labadie and Porcupine bank; 2) a mixed trawl and seine fishery targeting anglerfish, gadoid species and non-quota species (cuttlefish, red mullet and squid), taking place in VIId and VIIe close to the English and French

cost. These fisheries are an extension of the fisheries in the southern North Sea to all intents and purposes; 3) A predominantly Spanish-mixed fishery (otter trawl with codend mesh size 70-99mm) targeting principally megrim and anglerfish, with hake as the main by-catch. Effort is distributed on shallow waters of Grand Sole and Porcupine Bank fishing mainly in Division VIIj; and 4) A targeted trawl and seine fishery for whiting with a bycatch of haddock and hake by Irish vessels principally in VIIg.

The only beam-trawl category operating in the Celtic Sea are beam trawlers with 80-120mm codend mesh size (BT2). The BT1 (mesh size >120mm) have a negligible effort in this area. The BT2 effort accounts for 11% of the total effort in the Celtic Sea and is mainly carried out by English, Belgium and Irish vessels (STECF, 2017b). The fisheries are distributed over ICES VIIf,g and h. Many Belgian and English vessels also operate in VIId,e.

Table 3.2.1 summarises the catch data by gear code and also shows the average discard rate and the discard rate range across Member States.

Table 3.2.1 Summary catch data with average discard rates and discard rate range by gear code

Stock	Level of Landings	Landings Tons	Discards Tons	Discard Rate	Av. DR	DR range across MS	Member States	
				TR1				
Cod	High	2414	287	Low	0.11	.08 to .17	UK,IE,ES,FR	
Haddock	High	6423	4272	High	0.46	.37 to .57	UK,IE,ES,FR	
Whiting	High	7096	2889	Moderate	0.29	.26 to .99	UK,IE,ES,FR	
Hake VI & VII	High	5739	2059	Moderate	0.2	.16 to .23	UK,IE,ES,FR	
Sole VIIf,g	Low	60	12	Low	0.19	.16 to .23	UK,IE,ES,FR	
Plaice VIIf,g	Low	153	315	High	0.69	.66 to .75	UK,IE,ES,FR	
				TR2				
Cod	Moderate	782	179	Low	0.19	.13 to .29	FR,UK,IE,NL, BE	
Haddock	High	1731	2362	High	0.58	.52 to .69	FR,UK,IE,NL, BE	
Whiting	High	5733	2767	High	0.33	.24 to .43	FR,UK,IE,NL, BE	
Hake VI & VII	High	1361	1695	High	0.51	.26 to .61	FR,UK,IE,NL, BE	
Sole VIIf,g	Low	53	15	Low	0.19	.14 to .23	FR,UK,IE,NL, BE	
Plaice VIIf,g	Low	49	127	High	0.7	.58 to .76	FR,UK,IE,NL, BE	
				BT2				
Cod	Moderate	316	122	.ow/Moderate	0.28	.15 to .33	IE, BE,UK	
Haddock	Moderate/High	381	1146	High	0.75	.63 to .88	IE, BE,UK	
Whiting	Moderate	269	737	High	0.73	.69 to .75	IE, BE,UK	
Hake VI & VII	Low	120	143	High	0.55	.43 to .68	IE, BE,UK	
Sole VIIf,g	High	778	22	Low	0.12	.02 to .31	IE, BE,UK	
Plaice VIIf,g	Low/Moderate	199	406	High	0.76	.57 to .93	IE, BE,UK	

Based on expert knowledge EWG 18-02 identified seven trawl and beam trawl fisheries in the Celtic Sea with catches of the high and moderate risk choke stocks identified by the CMT analysis. The seven fisheries are as follows:

- Mixed Gadoid TR1
- Mixed demersal (angler, megrim, hake) TR1
- *Nephrops* TR2
- Directed whiting and hake trawl and seine TR2
- Mixed demersal/non quota TR2 (this fishery is included under the Western and Eastern Channel as it largely occurs in VIId,e rather than in VIIb,c and VIIf,g,h,j,k)
- Mixed demersal (megrim, hake, angler) TR2
- Mixed demersal beam trawl (angler, megrim, sole, plaice) BT2

Based on the analysis of the STECF FDI database, as described in section 3.1, and using expert knowledge, table 3.2.2 indicates whether the high and moderate risk choke species are a target or bycatch in the relevant fisheries; the level of landings; and ranks the discard rate as low, moderate or high. It also indicates the main reasons for discarding for each stock in each fishery.

Table 3.2.2 Main Fisheries in the Celtic Sea with catches of the choke risk stocks

Stock	Member States	Primary Gear Code	Fishery Description	Target	Bycatch	Level of Landings	Discard Rate	Lack of quota	Below MCRS	Comments
Cod	UK, IE,FR	TR1	Mixed Gadoid	Y	Y	High	Low	Y	N	FR has no quota issues
Haddock				Y	Y	High	High	Y	Y	50:50 between over quota and below mcrs
Whiting				N	Y	High	High	N	Y	IE has over quota catches
Hake				N	Y	Moderate	Moderate	N	Y	Market price
Sole VIIf,g				N	Y	Low	Low	?	N	FR,IE have small quotas
Plaice VIIf,g				N	Y	Low	High	N	Y	Market price
Cod	UK,IE,ES,FR	TR1	Mixed demersal (angler, megrim, hake)	N	Y	Low	Low	Y	N	FR has no quota issues. ES - Zero quota
Haddock				N	Y	High	Moderate	Y	Y	ES- Zero quota
Whiting				N	Y	Low	Moderate	N	Y	ES - Zero quota
Hake				Y	Y	High	Moderate	N	Y	Market price
Cod	IE,FR	TR2	*Nephrops*	N	Y	Moderate	Low	Y	?	FR has no quota issues
Haddock				N	Y	High	High	Y	Y	High volume of below mcrs
Whiting				N	Y	High	High	N	Y	Market price
Hake				N	Y	Low	Low	N	Y	Market price
Sole VIIf,g				N	Y	Low	Low	Y	N	Very small quota
Plaice VIIf,g				N	Y	Low	Low	N	Y	Market price
Cod	IE	TR2	Whiting, hake	N	Y	Low	Low	Y	N	

Haddock				N	Y	Moderate	High	Y	Y	
Whiting				Y	N	High	High	N	Y	
Hake				N	Y	Low	Low/	N	Y	Market price
Sole VIIf,g				N	Y	Low	Low	Y	N	Very small quota
Plaice VIIf,g				N	Y	Low	Low	N	Y	Market price
Cod	IE,ES,UK,FR	TR2	Mixed demersal (angler, megrim, hake)	N	Y	Low	Low	Y	N	ES has zero quota
Haddock				N	Y	Moderate	Moderate	Y	Y	ES hs zero quota
Whiting				N	Y	Low	Moderate	N	Y	ES has zero quota
Hake				Y	Y	High	High	N	Y	
Cod	IE, BE,UK	BT2	Mixed demersal (angler, megrim, sole, plaice)	N	Y	Moderate	Low	N	Y	IE may have some over quota catches
Haddock				N	Y	High	High	Y	Y	
Whiting				N	Y	Moderate	High	N	Y	
Hake				N	Y	Low	Low	N	Y	Market price
Sole VIIf,g				Y	N	High	Low	Y	N	IE- very small quota
Plaice VIIf,g				N	Y	Low	High	N	Y	Market price

3.3.Irish Sea

In the Irish Sea, effort has followed a declining trend since 2003. In particular, effort in the trawl and beam trawl sectors has reduced significantly and is now at historically low levels. Despite this decline, demersal trawl and seine fisheries remain the predominant gear types used representing 40% of total Irish Sea effort in 2016 (STECF, 2017b).

Historically, TR1 vessels primarily targeted cod, haddock, hake and whiting with effort focused in the North Channel and western Irish Sea. A considerable decline in effort was observed between 2003 and 2007, linked to the reduction in catch opportunities for cod in particular. Subsequently, TR1 effort continued to decline at a slower rate to an overall low level and now represents only 4% of the total effort in the Irish Sea. With no directed fishing, effort distribution is uniform throughout the entire area. Currently the TR1 effort is associated mainly with a demersal fishery targeting skates and rays and a trawl and seine fishery in the southern Irish Sea focussed on haddock. For stock assessment purposes the catches of haddock in the ICES statistical rectangles 34E2 and 34E3 are reallocated and assigned to the Celtic Sea haddock stock. At present there is no commercial fishery directed at cod. The main countries contributing effort are Ireland and the UK (STECF, 2017b).

TR2 gears account for 36% of the total effort in the Irish Sea. *Nephrops* are the main target species for the TR2 category. This species lives on areas of soft clay muds which are distributed in two distinct patches, an area in the western Irish Sea and a smaller region in the eastern Irish Sea. The use of the gear is concentrated in the defined *Nephrops* regions. Highest TR2 effort is on the larger *Nephrops* grounds in the western Irish Sea by Irish and Northern Irish vessels. There is also a trawl fishery targeting queen scallops (*Aequipecten opercularis*) centred round the Isle of Man. The main countries involved in this fishery are Northern Ireland and the Isle of Man (STECF, 2017b).

Beam trawl fisheries in the Irish Sea belong to the BT2 (80-119mm) category. These fisheries traditionally targeted sole and plaice but have declined in recent years primarily due to the decreasing catch opportunities for sole. Beam trawl effort has significantly reduced in the Irish Sea, and accounted for only 4% of the total effort in the Irish Sea. Beam trawl activity is now concentrated on an area in the central western Irish Sea in a directed fishery for skates and rays. There is limited activity in the more traditional grounds in the central eastern Irish Sea where sole and plaice were targeted. The main countries involved in this fishery are Belgian and Irish vessels. Belgian effort has declined significantly in recent years.

Table 3.3.1 summarises the catch data by gear code and also shows the average discard rate and the discard rate range across Member States.

Table 3.3.1 Summary catch data with average discard rates and discard rate range by gear code

Stock	Landings (Tons)	Discards (Tons)	Discard Rate (DR)	DR range across MS
TR1				
Cod	15	17	0.53	.09 to .77
Haddock	580	32	0.05	.02 to .21
Whiting	11	29	0.72	.32 to .74
Average TR1 Discard Rate for these stocks = 0.11				
TR2				
Cod	104	68	0.40	.02 to .61
Haddock	163	403	0.71	.63 to .73
Whiting	10	1422	0.99	0.99
Average TR2 Discard Rate for these stocks = 0.87				
BT2				
Cod	24	2	0.09	0.09
Haddock	13	22	0.63	.54 to .74
Whiting	2	13	0.89	.74 to .92
Average BT2 Discard Rate for these stocks = 0.49				

EWG 18-02 identified five fisheries in the Irish Sea with catches of the stocks identified by the CMT analysis as being high risk - cod and whiting - and for which improvements in selectivity was identified as a potential way of reducing the choke risk. Haddock in VIIa is also included as a moderate risk choke stock and where improvements in selectivity are also deemed possible.

The five fisheries are as follows:

- Skates and rays trawl TR1
- Haddock and hake trawl TR1
- *Nephrops* TR2
- Queen Scallop TR2
- Mixed demersal (skates and rays, plaice) beam trawl BT2

Table 3.3.2 describes these fisheries.

Table 3.3.2 Main Fisheries in the Irish Sea with catches of the choke risk stocks

Choke Stock	Member States	Primary Gear Code	Fishery Description	Target	Bycatch	Contribution of fishery to total landings	Discard Rate	Reasons for discarding		
								Lack of quota	Below MCRS	Comments
Cod	IE	TR1	Skates & Rays	N	Y	Low	Low	?	?	Low catches
Haddock				N	Y	Low	Low	N	Y	Low catches
Whiting				N	Y	Low	Low	N	Y	Low catches
Cod	IE, UK	TR1	Haddock & hake	N	Y	Low	Low	?	?	Discards largely over quota fish
Haddock				Y	N	High	Low	N	Y	
Whiting				N	Y	Low	Low/Moderate	N	Y	Discards low and mainly small whiting < 20cm
Cod	IE, UK	TR2	*Nephrops*	N	Y	Low	High	Y	N	Discards largely over quota fish
Haddock				N	Y	Moderate	High	N	Y	
Whiting				N	Y	Low	High	N	Y	Discards mainly small whiting< 20cm
Cod	UK	TR2	Queen Scallop	N	Y	Low	High	Y	Y	IOM has no quota for cod, haddock and whiting
Haddock				N	Y	Low	High	N	Y	
Whiting				N	Y	Low	High	Y	Y	
Cod	BE,IE	BT2	Mixed demersal (skates & rays, plaice)	N	Y	Low	Low	Y	N	BE has small quotas
Haddock				N	Y	Low	Low	Y	N	
Whiting				N	Y	Low	Low	Y	N	

3.4. West of Scotland

According to STECF (2017b) the predominant fisheries in the West of Scotland are trawl and seine fisheries which account for 35% of the total effort in the sea basin. As with the Irish Sea, effort in the demersal trawl fisheries has followed a declining trend since 2003 although fishing effort has been more stable since 2012. There are also extensive pelagic trawl fisheries for mackerel, herring, blue whiting and horse mackerel. These fisheries account for 33% of the total effort but are not discussed in this analysis.

Otter trawls are the predominant gear in the West of Scotland with 35% of all effort accounted for by otter trawls targeting demersal species (STECF, 2017b). Three categories of these gears are present although effort in one of them, TR3 (small mesh), is insignificant and have negligible catches of the choke stocks and are not considered further. Fisheries using demersal otter trawls with mesh size >100mm (TR1) are distributed throughout VIa, with its use in the most recent years most prevalent along the shelf edge and particularly in the more northerly regions. The countries utilising the most effort are Scotland, Ireland and Germany. The TR1 fisheries accounted for 19% of the effort in the West of Scotland region in 2016.

The TR1 fisheries can be characterised as mixed fisheries taking predominantly gadoid species such as haddock and saithe and groundfish species including anglerfish and megrim. Historically, cod was targeted but the depleted nature of the stock has seen a marked reduction in fishing effort. In recent years, hake has become increasingly important. In the deeper water on the shelf slope, species such as black scabbard (*Aphanopus carbo*), blue ling (*Molva dypterygia*) are also caught. There is also a traditional haddock fishery on the Rockall Bank in ICES Division VIa involving in Irish and UK vessels. Additionally there are mixed demersal fisheries for anglerfish, megrim and witch in the deeper waters on the Rockall Shelf edge involving Irish, Scottish and Spanish vessels. These fisheries are not included in the STECF evaluation of fishing effort.

The other major demersal trawl fishery (TR2) operates with mesh size in the range 80-100mm targeting *Nephrops*. The main areas of operation are the inshore areas of the North and South Minch and the Firth of Clyde. The TR2 fisheries make up 16% of the total effort in the region (STECF, 2017b). Effort in the Firth of Clyde is particularly intense. Some activity for *Nephrops* also takes place sporadically in the slightly more offshore area of Stanton Bank. A bycatch of mainly gadoid species occurs in this fishery. Scotland is the country expending most effort, with some activity from Irish vessels. There is also a seasonal trawl fishery for queen scallop in the southern parts of VIa off the Donegal coast involving UK vessels.

Table 3.4.1 summarises the catch data by gear code and also shows the average discard rate and the discard rate range across Member States.

Table 3.4.1 Summary catch data with average discard rates and discard rate range by gear code

Stock	Landings (Tons)	Discards (Tons)	Discard Rate (DR)	DR range across MS
Bottom Trawl				
Haddock VIb	1993	367	0.16	0.16
TR1				
Cod VIa	215	968	0.82	.78 to .84
Haddock VIa	3876	252	0.06	.01 to .09
Whiting VIa	174	107	0.38	.26 to .46
Average TR1 Discard Rate for these stocks = 0.24				
TR2				
Cod VIa	7	183	0.96	0.96
Haddock VIa	136	1568	0.92	.91 to .93
Whiting VIa	6	947	0.99	0.99
Average TR2 Discard Rate for these stocks = 0.95				

EWG 18-02 identified seven fisheries in the West of Scotland and Rockall with catches of the choke stocks identified by the CMT analysis – cod and whiting - and for which improvements in selectivity was identified as a potential way of reducing the choke risk. Haddock in VIa and VIb are also included as moderate risk choke stocks and where improvements in selectivity are deemed possible. The seven fisheries are as follows:

- Mixed gadoid TR1
- Directed saithe fishery TR1
- Mixed demersal (hake, megrim, anglerfish, haddock) TR1
- *Nephrops* TR2
- Queen scallop TR2
- Rockall haddock TR1
- Rockall mixed demersal (angler, megrim, witch) TR1

Table 3.4.2 describes these fisheries.

Table 3.4.2 Main Fisheries in West of Scotland and Rockall with catches of the choke risk stocks

Choke Stock	Member States	Primary Gear Code	Fishery Description	Target	Bycatch	Contribution of fishery to total landings	Discard Rate	Reasons for discarding		
								Lack of quota	Below MCRS	Comments
Cod	UK	TR1	Mixed Gadoid	N	Y	Low	High	Y	N	Zero TAC
Haddock				Y	Y	High	Low	N	Y	
Whiting				N	Y	Low	Moderate	Y	N	
Cod	UK,FR,DE	TR1	Saithe	N	Y	Low	Low	Y	N	Zero TAC
Haddock				N	Y	Moderate	Low	N	Y	Low catches
Whiting				N	Y	Low	Low	Y	N	Low catches
Cod	IE,ES,FR,UK	TR1	Mixed demersal (anglerfish, hake)	N	Y	Low	High	Y	N	Zero TAC
Haddock				N	Y	High?	Low	N	N	ES - Zero quota
Whiting				N	Y	Low	Low	Y	N	ES - Zero quota
Cod	UK	TR2	*Nephrops*	N	Y	Low	High	Y	?	Zero TAC
Haddock				N	Y	Low	High	N	Y	
Whiting				N	Y	Low	High	N	Y	
Cod	UK	TR2	Queen Scallop	N	Y	Low	Low	Y	N	Zero TAC
Haddock				N	Y	Low	Low	?	?	Low catches
Whiting				N	Y	Low	Low	?	?	Low catches
Cod	UK,IE	TR1	Rockall Haddock	N	Y	Low	Low	Y	N	Very low catches
Haddock				Y	N	High	Moderate	N	Y	
Whiting				N	Y	Low	Low	Y	N	Very low catches
Cod	UK,IE	TR1	Rockall mixed demersal	N	Y	Low	Low	Y	N	Very low catches
Haddock				N	Y	Low	Moderate	N	Y	
Whiting				N	Y	Low	Low	Y	N	Very low catches

3.5.Western and Eastern Channel

The fisheries in the Eastern (VIId) and Western Channel (VIIe) are numerous and complex. Many of the fisheries in the Western Channel are extensions of fisheries in the wider Celtic Sea, while the fisheries in the Eastern Channel tend to be extensions of fisheries in the southern North Sea. There is also considerable overlap between the fisheries in the Western and Eastern Channel. Separate fishing opportunities are only allocated for plaice and sole (VIId and VIIe), for cod (VIId) and skates and rays (VIId,e). For other species such as haddock, whiting, megrim etc the fishing opportunities for VIId and VIIe are covered in the TAC for the wider Celtic Sea. STECF reports on fishing effort for the Western Channel in the context of Annex IIC of the Council Regulation (EC) No 72/2016[1] (sole and plaice management plan). In the Eastern Channel, fishing effort is reported as part of the North Sea and Skagerrak (STECF, 2017b). This makes defining the fisheries in this region much more difficult than for the over areas.

In both areas the predominant gears are beam trawls (BT2) and otter trawls and seines (TR2). The main TR2 fishery is a mixed fishery taking place in the more southerly parts of the North Sea and centred on the eastern Channel in which whiting and non-quota species (e.g. red mullet, cuttlefish, squid) are important constituents. This is predominantly a French fishery. In the Western Channel there are similar mixed demersal/non quota fisheries (TR2) using both trawls and seines involving French, UK and more recently Irish vessels specifically targeting cuttlefish.

The BT2 gear is mainly used in a fishery located in most Southerly parts of the North Sea and into the eastern Channel. This mixed flatfish fishery targets sole, plaice and other flatfish, is operated principally by the UK and Belgium. There is also a mixed demersal beam trawl fishery that targets anglerfish and megrim as well as non-quota species such as cuttlefish.

In the Western Channel there is also a TR1 fishery targeting mixed gadoids and anglerfish. This is predominantly a French fishery.

Table 3.5.1 summarises the catch data by gear code and also shows the average discard rate and the discard rate range across Member States.

Table 3.5.1 Summary catch data with average discard rates and discard rate range by gear code

Stock	Level of Landings	Landings Tons	Discards Tons	Discard Rate	Av. DR	DR range across MS
			BT2			
Plaice VIId	Low	1885	1558	High	0.45	.3 to .47
Plaice VIIe	Low	96	82	High	0.46	0.46
Whiting VIId	Low	58	117	High	0.67	0.67
Whiting VIIe	Low	56	42	High	0.43	.42 to .56
Haddock VIIe	Low	42	87	High	0.68	0.68
			Otter			
Plaice VIIe	Low	562	720	High	0.56	.48 to .82
Whg VIIe	High	3563	1752	Moderate	0.33	.32 to .38
			TR2			
Plaice VIId	Low	182	150	High	0.45	.42 to .59
Plaice VIIe	Low	1052	3088	High	0.75	.51 to .75
Whiting VIId	High	3403	6760	High	0.67	.6 to .84

[1] COUNCIL REGULATION (EU) 2016/72 of 22 January 2016 fixing for 2016 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2015/104. OJ L.22, 28.1.2016, p.1.

EWG 18-02 identified five fisheries in the Western and eastern Channel with catches of the stocks identified by the CMT analysis as being high risk - plaice in VIId and VIIe - and for which improvements in selectivity was identified as a potential way of reducing the choke risk. In addition haddock, whiting and hake are also included as the TAC areas for these stocks extend into the channel and they are caught in the fisheries identified.

The five fisheries are as follows:

- Western Channel mixed gadoid and anglerfish TR1
- Western Channel mixed demersal/non quota TR2
- Eastern Channel mixed demersal mixed demersal/pelagic/non quota TR2
- Directed beam trawl fishery for sole BT2
- Mixed demersal/non quota beam trawl fishery BT2

Table 3.5.2 describes these fisheries.

Table 3.5.1 Main Fisheries in Western and Eastern Channel with catches of the choke risk stocks

Area	Stock	Member States	Primary Gear Code 1	Fishery Description	Target	Bycatch	Level of Landings	Discard Rate	Reasons for discarding		
									Lack of quota	Below MCRS	Other
Western Channel	Cod	FR,UK	TR1	Mixed gadoid and anglerfish	N	Y	Low	Low	N	N	Currently low catches
	Haddock				N	Y	Moderate/High	Low	Y	Y	Both undersize and over quota
	Whiting				N	Y	Moderate/High	Low	N	Y	Low level of discards
Western Channel (VIIe)	Cod	FR,UK,IE,NL,BE	TR2	Mixed demersal/Non quota	N	N	Low	Low	Y	N	Currently low catches
	Haddock				N	Y	High	High	Y	Y	
	Whiting				Y	Y	High	High	N	Y	
	Hake				N	Y	Low	Low	N	Y	Very low catches
	Plaice				N	Y	Moderate/high	High	Y	Y	
Eastern & Western Channel (VIId,e)	Plaice	BE,UK	BT2	Sole	N	Y	High	High	Y	Y	Market price
Eastern & Western Channel (VIId,e)	Plaice	BE,UK	BT2	Mixed demersal/non quota	N	Y	?	High	Y	Y	Market Proce
Eastern Channel (VIId)	Haddock	FR,UK,NL, BE	TR2	Mixed demersal/Non quota/pelagic	N	Y	Low	Low	Y	Y	Low catches
	Whiting				Y	Y	High	High	N	Y	Dependent on fishery
	Plaice				N	Y	High	High	Y	Y	Market price

4. TOR 2 – ASSESSING FISHERIES WHERE SELECTIVITY MAY BE IMPROVED

Tor 2 -Assess in which of these fisheries improving selectivity may be possible.

Based on the analysis of the relevant fisheries described in Section 3, EWG 18-02 identified the fisheries listed in table 4.1 where improvements in selectivity may be made. These fisheries were identified as having high discard rates making them fisheries where Member States should prioritised selectivity improvements. As identified the majority of these fisheries are TR2 or BT2 fisheries with codend mesh sizes of less than 100mm. There are also several TR1 fisheries where the discard rate is high. For each fishery, the relevant primary and secondary choke stocks is identified where:

- The primary choke sock is the one with the highest discards and is therefore the most likely to choke the fishery first; and
- The secondary choke stocks are the other high risk choke stocks that would also impact on the fishery.

Table 4.1 Fisheries where selectivity may be improved

Region	Gear Type	Fishery	Primary choke stocks	Secondary choke stocks
Celtic Sea	TR1	Mixed Gadoid	Haddock	Whiting, plaice
Celtic Sea	TR2	*Nephrops*	Haddock, whiting	Plaice, hake
Celtic Sea	TR2	Directed whiting/hake (trawl and seine)	Haddock	Whiting, hake
Celtic Sea	TR2	Mixed demersal (angler, megrim, hake)	Hake	Haddock, whiting, plaice
Celtic Sea	BT2	Mixed demersal (angler, megrim, sole, plaice)	Haddock, whiting, plaice	Hake
Irish Sea	TR2	*Nephrops*	Whiting	Cod, haddock
Irish Sea[1]	TR2	Queen Scallop	Whiting	Cod, haddock
West of Scotland	TR1	Mixed Gadoid	Cod[2]	Whiting
West of Scotland	TR1	Mixed demersal	Cod[2]	Whiting, hake
West of Scotland	TR2	*Nephrops*	Cod	Haddock, whiting
Channel	TR2	Mixed demersal/Non quota	Haddock	Whiting, plaice
Channel	BT2	Sole	Plaice	Haddock, whiting
Channel	BT2	Mixed demersal/Non quota	Plaice	Haddock, whiting

[1] This fishery has a very high discard but the actual volumes of discards are very small

[2] The current regulatory gear in the TR1 fisheries in the West of Scotland is 120mm+120mm smp. This gear is selective for haddock and whiting but not for cod. The discard rate is high for cod and whiting. The level of discards is low for haddock and whiting.

5. TOR 3 – IDENTIFYING AVAILABLE SELECTIVITY DEVICES AND GEAR MODIFICATIONS

Tor 3: Identify in these fisheries what selectivity devices and gear modifications are available that could improve selectivity.

Having identified the fisheries to prioritise for improving selectivity, EWG 18-02 has collated information on the relevant trials with selective gears carried out by region and by fishery over the last number of years. The trials listed are taken from a number of sources including the DISCARDLESS project (http://www.discardless.eu/selectivity_manual), Gearingup database (https://gearingup.eu/), as well as information supplied by the experts and also from the fishing industry (French, UK and Ireland). The lists are not definitive. For each selective gear a summary of the main results in terms of observed reductions in unwanted catches and losses of marketable catch is provided.

5.1. Celtic Sea (VIIb-k excluding VIId and VIIe)

In the Celtic Sea, as identified in Section 4, the fisheries where selectivity could be improved are the TR1 mixed gadoid, the TR2 fisheries for *Nephrops*, mixed demersal species and the Irish directed whiting/hake fishery as well as the BT2 fishery for mixed demersal species. For reference purposes the current regulations in the Celtic Sea are shown in table 5.1.1.

Table 5.1.1 Current mesh size regulations pertaining to the Celtic Sea

	Species	Minimum Mesh Sizes
VIIb-k (outside Celtic Sea Protection Zone and Hake Box) – Trawls and seines	All demersal species except *Nephrops* (max. 30% cod, haddock & saithe & max. 20% hake)	80mm
	Demersal (no restrictions)	100mm
	Nephrops (min. 35% & max. 20% hake) *Nephrops* (min. 30% & max. 20% hake)	70mm+80mm smp 80mm+80mm smp
Inside Hake Box[2] – Trawls and Seines	All demersal species (no restrictions)	100mm
Celtic Sea Protection zone[3] – Trawls and Seines	All demersal species except whiting & *Nephrops* (max. 30% cod, haddock & saithe & max. 20% hake)	80mm+120mm smp
	All demersal species (no restrictions)	100mm+120mm smp
	Nephrops (min 30% & max. 20% hake) *Nephrops* (min 30% & max. 20% hake)	70mm + 120mm smp 80mm+120mm smp
Celtic Sea Protection zone east of 8 ° west	All demersal species except whiting & *Nephrops* (max. 30% cod, haddock & saithe & max. 20% hake; max. 55% whiting)	80mm+120mm smp
	Demersal species except *Nephrops* with min. 55% whiting	100mm+100mm smp
	Nephrops (min 30% & max. 20% hake *Nephrops* (min 30% & max. 20% hake)	70mm+120mm smp 80mm+120mm smp

Beam Trawls (Whole of Celtic Sea)	Demersal species (max. 30% cod, haddock & saithe & max. 20% hake)	80mm + 180mm headline panel

5.1.1. Mixed gadoid TR1 fisheries

For the TR1 fishery, Ireland and France have carried out a number of trials in recent years testing a range of options to improve selectivity (BIM, 2010; BIM, 2012a; BIM, 2012b; BIM, 2012c; BIM, 2013; BIM, 2014a; McDonald, 2011; OP Cobrenord, 2018; Weiller et al., 2018). Ireland has carried out trials with both trawls and seine nets. These trials have concentrated on using square mesh panels of varying mesh size and T90 mesh in the codend and extension. All of the options tested have shown positive reductions in unwanted catches of haddock, whiting and to a lesser extent hake but with corresponding losses of marketable catch. Table 5.1.1.1 summarises the trials carried out and the indicative results. Annex II contains a more detailed summary of the individual trials.

Table 5.1.1.1 Summary of results from selectivity trials in the mixed gadoid TR1 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Square mesh panel	3	2 – Seine net	100mm smp	-59% haddock	-60% haddock -81% whiting -49% hake
			110mm smp	-58% haddock	-2% haddock -36% whiting
		1 - Twin-rig demersal trawl	100mm square mesh tube	-50% haddock -50% whiting	-10% anglerfish
Codend and square mesh panel	3	Single rig demersal trawl	110mm+100mm smp	L50 haddock 32.8cm SR 8.8cm L50 whiting 35.3cm SR 9.4cm	
			120mm+100mm smp	L50 haddock 38.7cm SR 15cm L50 whiting 33cm SR 10.1cm	
			120mm+120mm smp	L50 haddock 35.4cm SR 17.5cm L50 whiting 39.3cm SR 17cm	
T90 mesh	3	Twin-rig demersal trawl	100mm T90 codend and extension	-90% haddock	-30-70% squid -50% red mullet

			100mm T90 + 120mm smp	-20-70% haddock -85-90% whiting -80% hake	-20-30% whiting
			100mm T90 panel in the extension		

5.1.2. *Nephrops* Fisheries

The TR2 *Nephrops* fisheries in the Celtic Sea are predominantly Irish fisheries and accordingly any selectivity work carried out has been completed by Ireland (BIM, 2009a; BIM, 2009b; BIM, 2014b; BIM, 2014c; Cosgrove et al. 2015; Cosgrove et al., 2016a; Cosgrove et al., 2016b). Most of these trials have been conducted on the Smalls grounds in FU 22. The *Nephrops* fishery in this FU is reported to have the highest discards in the Celtic Sea (ICES, 2017a). A further set of trials was carried out in FU 21-22 on the Labadie grounds. No recent experiments are reported in the other *Nephrops* FUs in the Celtic Sea. ICES report levels of unwanted catches to be reasonably high in the Aran fishery (FU17) but lower in the Porcupine fishery (FU16) (ICES, 2017b and 2017c). It should also be noted that a significant number of selectivity work has been carried out in the *Nephrops* fishery in the Irish Sea which is relevant to the *Nephrops* fisheries in the Celtic Sea (See section 5.2.1).

The gear modifications that have been tested are as follows:

- Increases in diamond mesh codend size in combination with square mesh panels;
- Square mesh codends (45mm, 55mm, 65mm);
- Large square mesh and SELTRA box codends;
- Coverless trawls or low headline trawls;
- Dual codend arrangement

The most effective options in these fisheries appear to be increasing mesh size in combination with large mesh square mesh panels. The dual codend arrangement tested also shows potential but is a more complex gear. Square mesh codends improve selectivity but result in significant losses of *Nephrops*. The coverless or low headline trawls show only limited benefits for reducing unwanted catches of haddock and whiting. Table 5.1.2.1 summarises the trials carried out in the *Nephrops* fisheries. Annex II contains a more detailed summary of the individual trials.

Table 5.1.2.1 Summary of results from selectivity trials in the Nephrops TR2 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Square mesh codend	3	Quad-rig *Nephrops* Trawls	45mm smc	+18% haddock +8% whiting	+17% haddock -9% whiting -9% *Nephrops* 25-31mm CL)
			55mm smc	-36%	-34%

				haddock -49% whiting	haddock -42% whiting -63% *Nephrops* (25-31mm CL)
			65mm smc	-62% haddock -66% whiting	-7% whiting -63% *Nephrops* (25-31mm CL)
Square mesh panel	1	Twin-rig Nephrops Trawls	200mm smp	No information	-98% haddock -17% hake
Codend and square mesh panel	2	Quad-rig Nephrops Trawls	90mm +100mm smp	-27% haddock -77% whiting	No information
			100mm+120mm smp	-41% haddock -81% whiting	No information
Coverless Trawl	1	Twin-rig Nephrops Trawls	Coverless trawl	No information	-42% haddock -12% hake
Low headline trawl	1	Quad-rig Nephrops Trawls	Quad-rig low headline trawls	-38% haddock catches -3% whiting catches -61% cod Increase in *Nephrops* catches	
Dual codend	1	Quad-rig Nephrops Trawls	Dual codend – 90mm T90 top codend & 80mm bottom codend with inclined separator panel	-11% *Nephrops* -49% haddock -84% whiting	-54% whiting +9% haddock

5.1.3. Directed whiting fishery

In the directed whiting TR2 fishery, which is solely an Irish fishery, several trials have been carried out in recent years (BIM, 2010; Browne et al., 2016; McHugh et al, 2017). These have looked at an increase in codend mesh size combined with square mesh panels, the use of T90 mesh in the codend and extension and also a raised footrope trawl designed primarily to reduce the catches of cod. Cod was identified as a moderate risk, choke stock in the Celtic Sea. The codend/smp gear options would appear to improve selectivity for haddock and whiting, while the T90 codend increases selectivity for whiting but not for haddock. The raised codend trawl reduced catches of cod and skates and rays while increased the catches of haddock and whiting across all size classes. All gear options tested result in losses of marketable catch. The results from the trials in the mixed gadoid TR 1 fishery are also relevant. Table 5.1.3.1 summarises the trials

carried out in the directed whiting fisheries. Annex II contains a more detailed summary of the individual trials.

Table 5.1.3.1 Summary of results from selectivity trials in the directed whiting TR2 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
T90 codend and extension	1	Twin-rig demersal trawls	80mm T90 codend and extension	-6% haddock -60% whiting	+204% haddock -7% whiting
Square mesh panel and codend	2	Single-rig demersal trawl	80mm+110mm smp	L50 haddock 33cm SR 14.1cm L50 whiting 32.1cm SR 6.6cm L50 hake 31cm SR 9.6cm	
			100mm+100mm smp	L50 haddock 34.5cm SR 18.3cm L50 whiting 37.2cm SR 9cm L50 megrim 33.2cm SR 14.6cm	
Raised footrope	1	Twin-rig demersal trawls	Raised footrope trawl	-39% cod catches - 80% skates and rays catches +37% haddock catches +87% whiting catches	

5.1.4. Mixed demersal fisheries

As described in Section 3.2, given the similarities in catch composition it is difficult to separate the TR1 and TR2 mixed demersal fisheries. In cases where the larger codend mesh size (i.e. > 100mm) and hence such vessels are characterised as TR1 vessels, selectivity is greater than in the TR2 fisheries. TR1 vessels tend to work in the deeper waters along the shelf edge, targeting anglerfish and have much lower catches of haddock and whiting. Irish and Spanish vessels targeting hake and megrim using the smaller codend mesh size reportedly have higher catches of gadoid species.

Ireland has carried out a number of selectivity experiments in these fisheries. Spain is also reported to have a carried out a number of experiments but as there were no Spanish experts present at EWG 18-02 no details could be provided (BIM, 2010; BIM, 2012b; BIM, 2013; BIM, 2014a). The trials carried out by Ireland have concentrated on increases in codend mesh size and the use of square mesh panels of varying mesh sizes. The main objective has been to reduce unwanted catches of haddock, whiting and megrim. There is less information for hake. Selectivity is improved as codend mesh size is increased and also with the introduction of square meshes panels. However, the larger the codend mesh size, the higher the losses of marketable catch, particularly megrim. Table 5.1.4.1 summarises the trials carried out in these mixed demersal fisheries. Annex II contains a more detailed summary of the individual trials.

Table 5.1.4.1 Summary of results from selectivity trials in the mixed demersal TR1/TR2 fisheries

Selective	Number of	Gear type	Gears tested	Selectivity parameters

Trials	Trials			
Codend mesh size	4	Single-rig demersal trawl	90mm codend	L50 haddock 27.1cm SR 13.1cm L50 whiting 31.1cm 9.6cm L50 megrim 33.8cm SR 17.4cm
			100mm codend	L50 haddock 28cm SR 11.9cm L50 whiting 36cm 14cm L50 megrim 34.6cm SR 11cm
			110mm codend	L50 haddock 33cm SR 19.5cm L50 whiting 37.4cm 18cm L50 megrim 38.5cm SR 14.7cm
			120mm codend	L50 haddock 42.7cm SR 9cm L50 megrim 41.3cm SR 9.5cm
Square mesh panels	5	Single-rig demersal trawls	80mm+140mm smp	L50 haddock 25cm SR 15cm L50 whiting 47cm SR 16cm L50 megrim 21.5cm SR 9.9cm
			100mm+160mm smp	L50 haddock 38.7cm SR 15cm L50 whiting 52.2cm 13.5cm L50 megrim 30.5cm SR 20.5cm
			80mm+120mm smp	L50 haddock 28.2cm SR 14.8cm L50 whiting 32.8cm SR 13.5cm L50 megrim 29.1cm SR 15.6cm
			90mm+120mm smp	L50 haddock 34.5cm SR 18.3cm L50 whiting 37.2cm SR 9cm L50 hake 32.3cm SR 17.8cm
			100mm+120mm smp	L50 haddock 39.2cm SR 10.8cm L50 megrim 38.8cm SR 16.2cm

5.1.5. Mixed demersal beam trawl fishery

No recent selectivity trials in the BT2 fishery in the Celtic Sea have been carried out. However, there have been a number of trials in the BT2 fisheries in the Western and eastern Channel which are reported in Section 5.6. The results from these trials are relevant for the wider Celtic sea fisheries and are summarised in table 5.4.2.1 and in Annex V.

5.1.6. Summary Findings

The following are the main findings for the fisheries identified:

- Mixed gadoid (TR1) - The current regulation gear inside the Celtic Sea Protection Zone of 100mm+120mm smp where the majority of landings are taken in this fishery is selective for whiting but less so for haddock. EWG 18-02 concludes that based on the results of recent trials the simplest solution would be to increase the codend mesh size and maintain the existing 120mm smp. This would bring this fishery in line with the current regulated gears used in the West of Scotland and would make this gear highly selective for haddock. The alternatives would be look at T90 mesh in the codend and extension which has also been shown to improve selectivity for gadoids. Any increases in selectivity will undoubtedly reduce the marketable catch of whiting, hake and flatfish species.

- *Nephrops* – In the *Nephrops* fisheries in the Celtic Seas, EWG 18-02 concludes that there is a management choice to be made to improve the size selectivity that will maintain the retention of fish bycatch in the fishery and/or to change the profile of these fisheries so that the fish bycatch is excluded, converting them to a single species fisheries. This will depend on quota allocation and uptake at an individual fleet or vessel level. If quota uptake necessitates the exclusion of all large (~ < 40 cm) haddock, whiting and cod from catches then a trawl gear incorporating some type of sorting grid should be considered. If it is acceptable to land certain amounts of these fish then square mesh panels (of appropriate mesh size and appropriately positioned) or dual codends which separate the catches and allow different selectivity meaures to be applied to Nephrops and fish species should be considered. If it is the intention to protect the juvenile of these species then measures then dual codends which modify the codend size selection such as mesh size increase should be considered. This concurs with an earlier report prepared for STECF on possible selectivity measures in the Celtic Sea (Anon. 2012). Extending the requirement to use selective gears as introduced into the Irish Sea *Nephrops* fishery by Ireland (DAFM, 2017) and the UK (DAERA, 2018) (https://www.daera-ni.gov.uk/articles/cod-conservation-measures) would seem an appropriate short-term approach.

- Directed whiting – Given this fishery targets whiting it is difficult to improve selectivity without impacting adversely on marketable catch rates. However, discards of haddock and hake are reportedly high in this fishery so consideration should be given to increasing mesh size (i.e. 100mmm) and also using square mesh panels of at least 100mm. T90 mesh codends could also be considered as an option although based on the trials carried out the mesh size would need to be in excess of 80mm to improve selectivity for haddock which is the principal choke species in this fishery.

- Mixed demersal (TR2) - In mixed demersal fisheries, the mandatory introduction of square-mesh panels should be considered. Increasing codend mesh size (100 mm) in the TR2 mixed demersal fisheries would also help reduce unwanted catches of haddock and hake considerably. Unwanted catches of whiting are less of an issue in these fisheries.

- Beam Trawl (TR2) – The beam trawl fisheries have high levels of unwanted catches of plaice as well as haddock and whiting and to a lesser extent hake. However, reducing unwanted catches of these species is technically challenging without severely impacting on the retention of marketable sole and megrim. The options to improve selectivity are limited. In order to achieve meaningful reductions in, the mesh size would need to increase substantially i.e. 100mm - 110 mm but based on the results of trials in beam trawl fisheries this would result in losses of sole in excess of 50% rendering the fisheries uneconomic. The existing measures introduced under the NWW discard plan of using 120mm in the extension should be maintained as this will help to reduce unwanted to catches to some degree. Using large mesh panels at the front of the trawl and also

incorporating T90 mesh into the codend and extension may help to reduce unwanted catches of gadoids.

5.2.Irish Sea

In the Irish Sea, as identified in Section 4, the main fishery where selectivity should be improved is the TR2 fishery for *Nephrops*. The TR2 fishery for Queen scallop also has high discard rates, with 99% of catches of cod, haddock and whiting under mcrs. However, the volumes of unwanted catches are small in this fishery and it is likely such unwanted catches, at least in the case of haddock and cod, can be resolved through internal UK quota swap to cover such catches.

The TR1 fisheries in the Irish Sea currently are characterised by having lower discard rates and lower catches of the main choke species – whiting and cod. Only one trial in the TR1 fishery for skates and rays has been reported in recent years with a SELTRA box codend to reduce catches of cod in this fishery. It is understood both Ireland and the UK are investigating the potential improvements in selectivity that can be achieved by increasing codend mesh size to 120mm in the TR1 fisheries but no results were available to EWG 18-02.

The BT2 fishery in the Irish Sea is currently at quite low levels of effort and the vessels using this gear have tended to target skates and rays in recent years, where, as with the TR1 fisheries, levels of unwanted catches are small. Fishing effort in the plaice and sole fishery has been limited reflecting the low level of the sole stock. The current regulations in the Irish Sea are shown in table 5.2.1.

Table 5.2.1 Current mesh size regulations pertaining to the Irish Sea

	Species	Minimum Mesh Sizes
VIIa (Irish Sea) – Trawls and Seines	Demersal species except *Nephrops*, Queen scallop (max. 30% cod, haddock & saithe & max. 20% hake)	80mm+80mm smp
	Demersal (no restrictions)	100mm
	Nephrops (min. 35% & max. 20% hake) *Nephrops* (min. 30% & max. 20% hake)	70mm+80mm smp 80mm+80mm smp
	Queen Scallop (min. 85% & max. 5% cod)	80mm
Beam Trawls (Whole of Irish Sea)	Demersal species (max. 30% cod, haddock & saithe & max. 20% hake)	80mm + 180mm headline panel

5.2.1. *Nephrops* fishery

Ireland (BIM, 2009a; BIM, 2012c; BIM, 2014b; Cosgrove et al., 2015; McHugh et al., 2017; Tyndall et al., 2017) and the UK (Anon. 2010; Montgomerie and Briggs, 2012) have carried out multiple trials in the *Nephrops* fishery over the last few years. The main objective has been to reduce the level of unwanted catches of mainly whiting and cod and to a lesser extent haddock while not reducing the marketable catches of *Nephrops*. In addition both Ireland and the UK have made the use of more selective gears mandatory in the Irish Sea linked to the cod recovery plan (Articles 11 and 13 of Regulation (EC) 1342/2008). In addition Ireland has increased the mesh size in *Nephrops* fisheries from 70mm to 80mm from 1 January 2017 under SI 510 of 2016 (http://www.sfpa.ie/Portals/0/legislation/fisheries%20conservation/statutory%20instruments/2016/SI%20510%20of%202016%20Sea%20Fisheries%20(Codend%20Mesh%20Size)%20Regulations%202016.pdf).

A range of gear options have been tested as follows:

- Increases in codend mesh size (i.e. 80mm, 90mm and 100mm)
- Square mesh codends
- Square mesh panels of varying mesh sizes and positioning (i.e. 120mm, 200mm, 300mm placed in the last tapered section or close to the codend))
- SELTRA box codends (i.e. 200mm and 300mm)
- Rigid and flexible sorting grids
- Coverless and low headline trawls

As in the Celtic Sea the most effective options in this fishery appear to be increasing mesh size in combination with square mesh panels. However, given the relatively small size of *Nephrops* prevalent in the Irish Sea, mesh size increases beyond 80mm are not seen as economically viable, given the losses of marketable *Nephrops*. It is understood that Ireland and the UK are currently undertaking further trials with 90mm codend mesh size in the Nephrops fishery to reduce the catch of very small whiting (< 20cm) in the Nephrops fishery. No results of these trials were available to EWG 18-02 although earlier indications that loss of marketable *Nephrops* is in excess of 30%.

In recent years both Ireland and the UK have focused on large mesh square mesh panels of 200mm and 300mm and also the SELTRA box codend. These devices have been shown to reduce significantly unwanted catches of haddock and whiting.

Rigid and semi-rigid grids have been demonstrated to be highly efficient at reducing catches of cod, haddock and whiting as well as other species across all size classes. Grids have proven unpopular with fishermen given almost all fish catches are excluded, both marketable and unwanted. Handling difficulties have also been noted.

Trials with coverless or low headline trawls have shown only limited benefits for reducing unwanted catches.

Table 5.2.1.1 summarises the trials carried out in the *Nephrops* fisheries. Annex III contains a more detailed summary of the individual trials.

Table 5.2.1.1 Summary of results from selectivity trials in the Irish Sea *Nephrops* fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Sorting grids	7	Quad rig *Nephrops* Trawls	Swedish sorting grid with 35mm bar spacing	-91-92% haddock catches -77-87% whiting catches -100% cod catches	-2-20% Nephrops
		Twin rig *Nephrops* Trawls	Swedish sorting grid with 35mm bar spacing	-80-90% whiting catches	-15% Nephrops
			Stornway flexible grid	Reductions of whiting and haddock	-39% Nephrops

				catches	
		Single rig *Nephrops* Trawls	Swedish sorting grid with 35mm bar spacing	Reductions of whiting and haddock catches	-82% Nephrops catch
			Danish flexible grid	Reductions of whiting and haddock catches	-45% Nehrops
Codend mesh size	3	Quad rig *Nephrops* trawls	80mm+120mm smp	No reduction in cod, haddock and whiting catches -45% Nephrops	-11% Nephrops
			90mm+120mm smp	-68% whiting No reduction in haddock and cod -45% Nephrops	-21% Nephrops
			100mm+120mm smp	-4% haddock -6% whiting -55% Nephrops	-20% Nephrops
Square mesh panels	6	Quad rig *Nephrops* Trawls	300mm smp	-70% haddock catches -52% whiting catches	+14% Nephrops
		Twin rig *Nephrops* Trawls	120mm smp various positions	-30-54% haddock catches -20-65% whiting catches -10-20% Nephrops	
SELTRA box codends	9	Quad rig *Nephrops* trawls	200mm SELTRA	-70% haddock catches -52% whiting catches +14% Nephrops	
			300mm SELTRA	-54-89% haddock -18-53% whiting	-44-98% haddock -53-74% whiting

				-16-33% Nephrops	+19-24% Nephrops
		Twin rig *Nephrops* trawls	200mm SELTRA	-67% cod catches Unspecified reductions in haddock and whiting catches +5-6% Nephrops catches	
			300mm SELTRA	-32-82% cod catches Unspecified reductions in haddock and whiting catches -11% and +40% Nephrops catches	
Square mesh codends	1	Twin rig *Nephrops* trawls	50mm smc	-44% haddock catches -75% whiting catches -58% Nephrops catches	
Coverless trawls	2	Twin rig *Nephrops* trawls	Coverless *Nephrops* trawl	No significant differences in catches	
		Nephrops single rig trawl	Coverless *Nephrops* trawl	No reduction in fish catches -36% Nephrops	

5.2.2. Summary Findings

The measures outlined for the *Nephrops* fisheries in the Celtic Sea are relevant to the Irish Sea. It is considered important to maintain the measures already introduced by Ireland and the UK as based on the most recent ICES advice (ICES, 2017d and 2017e) levels of unwanted catches of whiting have reduced in the last few years.

5.3.West of Scotland

In the West of Scotland there are three fisheries identified where selectivity could be improved- the TR1 mixed gadoid and mixed demersal fisheries and the TR2 *Nephrops* fishery. Cod and whiting as well as to a lesser extent hake and haddock are the main choke stocks for which improvements in selectivity should be prioritised. The mesh size regulations currently in force are shown in Table 5.3.1.

Table 5.3.1 Current mesh size regulations pertaining to the West of Scotland

Area – West of Scotland & Rockall	Species	Minimum Mesh Sizes
VIa (Restricted area inside French line)	All demersal species except Saithe & Nephrops (max. 1.5% bycatch of cod)	≤ 15m 110mm+110mm smp ≥15m 120mm+120mm smp
	Saithe (min. 90% saithe & max. 1.5% bycatch of cod)	120mm
	Nephrops (min. 30% Nephrops & max.	80mm+120mm smp or sorting grid

	1.5% bycatch of cod & max. 20% of hake)	
VIa (Outside French Line) & VIb (Rockall)	All demersal species except Saithe & *Nephrops* (max. 1.5% bycatch of cod except in VIb where max. 5% cod is allowed)	100mm+90mm smp
	Saithe (min. 70% saithe & max. 1.5% bycatch of cod except in VIb where max. 3% cod is allowed)	110mm+90mm smp
	Nephrops (min. 30% *Nephrops* & max. 1.5% bycatch of cod except in VIb where max. 5% cod is allowed & max. 20% hake)	70mm+80mm smp
VIa South of 56° N – Beam Trawls	Demersal species (no restrictions)	100mm + 180mm headline panel

5.3.1. Mixed gadoid and mixed demersal TR1 fisheries

Following from the introduction of measures to protect cod, haddock and whiting stocks in Area VIa inside the so-called "French line" in 2009 the codend mesh size in the TR1 fisheries in the West of Scotland encompassing the mixed gadoid and mixed demersal fisheries was increased to 120mm + 120mm smp (110mm +110mm smp for vessels < 15m). Compared to the gears used in all other parts of NWW, this is a highly selective gear. Trials carried out by Ireland in 2009 and 2010 showed this gear to have L50s for whiting and haddock well in excess of the mcrs and also to be highly selective for species such as megrim and hake caught as a bycatch in this fishery (BIM, 2009b). To increase the selectivity for cod would involve increasing codend mesh size further which would render the fisheries uneconomic due to likely losses of marketable catches. Therefore most research in recent years has concentrated on avoidance measures for cod rather than increasing selectivity.

A range of selective gears has been identified by the Scottish Government Conservation Credit Scheme as part of the cod recovery plan which defines a number of selective gears. The use of these gears is linked to increased fishing opportunities and exemption from fishing effort restrictions. Depending on how selective the specified gear was the bigger the reward (STECF, 2013). Examples of such gears to improve selectivity included; nets incorporating large mesh belly sections, larger mesh cod-end, large meshed Square Mesh Panel. For this reason there have been few selectivity trials years in recent years in these fisheries. Only a few trials carried out by the UK (Campbell et al., 2017; Kynoch et al., 2017) and one in Ireland (BIM, 2010) in these fisheries were identified. The trials with the large mesh panels at the front of the trawl show some reductions in cod catches in the smaller size classes. Table 5.3.1.1 summarises the limited number of trials carried out in the TR1 fisheries in recent years. Annex IV contains a more detailed summary of the individual trials.

Table 5.3.1.1 Summary of results from selectivity trials in the mixed gadoid and mixed demersal TR1 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted	Losses of marketable

				catches	fish
Square mesh panels	1	Single rig whitefish trawl	110mm+120mm smp	+38% haddock catches +44% whiting catches	
Large mesh diamond mesh panels	1	Twin rig whitefish trawls	300mm diamond mesh panels	No reduction in haddock and whiting catches Fewer cod < 78cm -16% anglerfish -43% megrim	
Removing tickler chain	1	Single rig whitefish trawl	Trawl without tickler chain	No reduction in cod, haddock and whiting catches Significant reductions in catches of anglerfish and skates and rays	

5.3.2. *Nephrops* fishery

The UK has carried out multiple trials in the West of Scotland *Nephrops* fishery over the last few years (Drewery et al., 2017a; Drewery et al., 2017b)) The main objective has been to reduce the level of unwanted catches of mainly whiting and cod and to a lesser extent haddock while not reducing the marketable catches of *Nephrops*. Gear options tested in the Celtic Sea and Irish Sea *Nephrops* fisheries (sections 5.1.2 and 5.2.1) are also relevant. A range of gear options have been tested as follows:

- Increases in codend mesh size (i.e. 80mm, 90mm and 100mm) in combination with a 120mm smp
- Square mesh panels in varying positions (i.e. 9-12m and 6-9m from the codline)
- Large mesh panels in the front of the trawl
- Rigid and flexible sorting grids

As in the Celtic Sea the most effective options in this fishery appear to be increasing mesh size in combination with square mesh panels. However, given the relatively small size of Nephrops prevalent in the Irish Sea, mesh size increases beyond 80mm are not seen as economically viable, given the losses of marketable *Nephrops*.

Rigid and semi-rigid grids have been demonstrated to be highly efficient at reducing catches of cod, haddock and whiting as well as other species across all size classes. However, they have proven unpopular with fishermen given almost all fish catches are excluded, both marketable and unwanted. Handling difficulties have also been noted. Trials with coverless or low headline trawls have shown only limited benefits for reducing unwanted catches. Table 5.3.2.1 summarises the trials carried out in the TR2 *Nephrops* fisheries. Annex IV contains a more detailed summary of the individual trials.

Table 5.3.2.1 Summary of results from selectivity trials in the directed *Nephrops* TR2 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Codend mesh size and twine thickness	3	Twin-rig Nephrops trawls	80mm x 4mm single twine	Unspecified reductions in unwanted catches of haddock and whiting	

				Selectivity increases over the size range of Nephrops (< 38mm)
			100mm x 5mm double twine	Unspecified reductions in unwanted catches of haddock and whiting Selectivity increases over the size range 39mm-47mm of Nephrops
			120mm x 5mm double twine	Unspecified reductions in unwanted catches of haddock and whiting Selectivity increases for Nephorps over entire size range
Sorting grids	1	Twin rig *Nephrops* trawls	Sorting grid with 35mm bar spacing	100% reduction in fish catches above mcrs -10-25% Nephrops
Square mesh panels	2	Twin-rig Nephrops trawls	120mm smp @ 6-9m and 12-15m from codline	No difference in catches of fish species
Large mesh top sheet panels	1	Twin rig Nephrops trawls	290mm diamond mesh top sheet panels	No differences in catches of gadoid species

5.3.3. Summary Findings

The following are the main findings for the fisheries identified:

- Mixed gadoid and mixed demersal fisheries (TR1) – EWG 18-02 concludes that the current regulation gear of 120mm+120mm smp is selective for whiting and haddock but less selective for cod. There seem limited options to improve selectivity further in this fishery for cod, which is the primary choke species without significantly reducing marketable catches of other species. The measures introduced under the Scottish Conservation Credit Scheme such as large mesh panels at the front of the trawl in conjunction with the current mesh size regulations should continue to be used given they have been shown to have some benefits particularly in the mixed demersal fisheries.
- *Nephrops* fisheries - The measures in the Celtic Sea are relevant to the West of Scotland where cod and whiting are the primary choke species. At the very least EWG 18-02 considers it is important to maintain the measures already introduced under the Scottish Conservation Credit Scheme for *Nephrops* fisheries (STECF, 2013).

5.4.Western and Eastern Channel

Section 3.5 identifies three fisheries in the Western and Eastern Channel where improvements in selectivity should be prioritised – TR2 Mixed demersal/Non quota fisheries and the BT2 fisheries for sole and for mixed demersal species. Both fisheries are extensions of fisheries in the wider Celtic Sea or the southern North Sea. All of them are characterised as being multi-species and therefore by nature difficult fisheries to improve selectivity without significantly reducing marketable catches. However, EWG 18-02 notes that the current regulations (as shown in Table

5.4.1) in these areas are relatively simple and would appear to leave scope for some level of improved selectivity given the discard rates in the fisheries is high.

Table 5.4.1 Current mesh size regulations pertaining to the Western and Eastern Channel

	Species	Minimum Mesh Sizes
Western And Eastern Channel – trawls and seines	All demersal species except *Nephrops* (max. 30% cod, haddock & saithe & max. 20% hake)	80mm
	Demersal (no restrictions)	100mm
	Nephrops (min. 35% & max. 20% hake) *Nephrops* (min. 30% & max. 20% hake)	70mm+80mm smp 80mm+80mm smp
Western and Eastern Channel – beam trawls	Demersal species (max. 30% cod, haddock & saithe & max. 20% hake)	80mm

5.4.1. Mixed demersal/non-quota TR2 fisheries

Trials have been carried up by France (SELECFISH and REJEMCELEC) and the UK in various TR2 fisheries in the Western and Eastern Channel and on a range of vessel sizes (Weiller et al, 2014 and OP COBRENORD, 2018). Some of these trials have been carried out in the southern North Sea but the results are directly relevant given the fisheries are an extension of the North Sea fisheries. The Netherlands has also carried out one trial in this area (STECF, 2017c). All of the trials have been carried out on otter trawlers so no information is available for the seine net vessels that also operate in the Channel.

A range of gear options have been considered:

- Square mesh panels in a range of mesh sizes (80mm, 90mm, 100mm, 115mm) and in a range of positions (i.e. close to the codend, 9-12m from the codline and in the tapered section)
- Square mesh cylinders placed in the extension of the trawl
- Large mesh panels at the front of the trawl
- T90 mesh panels and in the codend and the extension
- Cylindrical rigid grids

Most of these gear options reduce the level of unwanted catches for haddock and whiting and also in the eastern Channel have been shown to reduce catches of pelagic species such as mackerel and horse mackerel. Several gear modifications (e.g. the Dutch cylindrical grid and the square mesh cylinders) have also been shown to reduce catches of plaice below mcrs. However, the limiting factor with all of the gears tested is the reduction in marketable catches. Reductions in catches of high value non-quota species such as cuttlefish and red mullet have been observed to be significant in a number of these trials. Table 5.4.1.1 summarises the trials carried out in the TR2 mixed demersal/non-quota fisheries. Annex V contains a more detailed summary of the individual trials.

Table 5.4.1.1 Summary of results from selectivity trials in the mixed demersal/non-quota TR2 fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Square mesh panels	7	Twin rig demersal trawls	115mm smp	-45-80% haddock catches Significant losses of most marketable species	
		Single rig demersal trawls	80mm square mesh panel	-35% whiting	-90% mackerel -76% horse mackerel
			90mm square mesh panel	-56% whiting	-40% whiting
Coverless trawl and square mesh panels	2	Twin rig demersal trawls	Coverless trawl with a 100mm smp	Unspecified reductions in catches of haddock and whiting below mcrs	-15% haddock -55% whiting -15% anglerfish
Large mesh diamond mesh top sheet	1	Twin rig demersal trawls	200mm diamond mesh	-45% haddock catches	
Cylindrical grids	1	Twin rig demersal trawls	Three cylindrical grids	Unspecified reductions in catches of plaice	
T90 Panels	1	Single rig demersal trawl	80mm T90 panel	-68% haddock -73% whiting	-44% whiting -85% mackerel -48% horse mackerel
Square mesh cylinders	7	Single rig demersal trawl	1m x 80mm square mesh cylinders	-28% whiting -45% mackerel -23% plaice	-1% whiting -54% mackerel -24% plaice
			2m x 80mm square mesh cylinders	-34-93% whiting -22-39% plaice -45-55% mackerel	-2-50% whiting -3-57% plaice -38-55% mackerel -4-29% cuttlefish

5.4.2. Beam Trawl (BT2) Fisheries

The sole and mixed demersal beam trawl fisheries in the Western and Eastern Channel have been subject of a significant number of selectivity trials over the last twenty years or more. This work has largely been carried out by Belgium and the UK (Bayse and Polet, 2015; Depestele et al., 2011). The most recent of these trials are shown in Table 5.4.2 and have tested:

- Increasing the mesh size in the extension of a beam trawl
- Using T90 and square mesh codends
- Large mesh square mesh panels in the front of the beam trawl
- Horizontal separator panels to sort flatfish from roundfish

Despite these and previous trials, gear adaptations to separate sole from plaice and other species without losing significant amounts of marketable sole catch have not been forthcoming. Some success has been achieved in reducing unwanted catches of gadoid species, particularly haddock and whiting but limited success has been achieved in reducing plaice catches, which is one of the main choke species in the Channel beam trawl fisheries. Regardless of this, some positive selectivity initiatives have been taken in recent years. For instance since June 2013 the mesh size in the front of the top panel of beam trawl gear has been increased to at least 300 mm instead of the mandatory 180 mm, while as part of the NWW discard plan, availing of a de minimis allowance for sole in the Celtic Sea and Channel has been conditional on vessels using a 120mm mesh extension piece. Annex V contains a more detailed summary of the individual trials.

Table 5.4.2.1 Summary of results from selectivity trials in the beam trawl fisheries

Selective Trials	Number of Trials	Gear type	Gears tested	Range of reduction in unwanted catches	Losses of marketable fish
Codend mesh size	1	Beam trawl	150mm extension piece	-40% sole	-16% sole
T90 mesh	1	Beam trawl	80mm T90 codend	-86% whiting -64% pouting No reduction in sole and plaice catches	
Square mesh top sheet panels	2	Beam trawl	120mm square mesh top panels	-43-63% haddock -48-66% whiting -12% cod -6-13% sole -1% plaice	
Square mesh codends	1	Beam trawl	80mm smc	No reduction in sole and plaice catches	
Horizontal separator panels	1	Beam trawl	Horizontal separator panel	70-88% of sole were retained in the lower codend 40-75% of plaice retained in the lower codend	

5.4.3. SUMMARY FINDINGS

The following are the main findings for the fisheries identified:

- Mixed demersal/non quota (TR2) – EWG 18-02 notes there is a number of different fisheries with different catch compositions, with a reliance on non-quota species such as cuttlefish, squid and red mullet and also involving small inshore vessels. Increasing selectivity in such fisheries is difficult without impacting on marketable catches and finding one measure that could be applied to all of the different fisheries is not an optimal solution. Notwithstanding this, discard rates in many of these fisheries are high and the level of unwanted catches is significant. The mandatory introduction of square-mesh panels of at least 100mm or the square mesh cylinder concept tested by France could be considered. Increasing codend mesh size (90 mm) would also help reduce unwanted catches of whiting and hake considerably and to a lesser extent plaice. Other options would be to consider using T90 mesh in the extension and codend.
- Beam Trawl (TR2) – The same comments for the BT2 fisheries in the Celtic Sea apply in the Western and eastern Channel beam trawl fisheries. Increasing selectivity is challenging where sole is an important component of the catch. Increasing selectivity in the mixed demersal beam trawl fisheries while difficult has been shown to be possible through the use of large mesh panels at the front of the trawl and also incorporating T90 mesh into the codend and extension.

6. TOR 4 – SELECTIVITY IMPROVEMENTS

Tor 4 - Assess the likely reductions in unwanted catches of the relevant stock that might reasonably be achieved based on the results of past trials carried out with these selectivity devices and gear modifications

A wide range of selective gear options have been tested across different fisheries and it was not possible for EWG 18-02 to assess fully the likely reductions in unwanted catches of the relevant stock achievable. This is further limited in that ICES and STECF do not routinely report stock numbers-at-length for the relevant demersal stocks, but stock numbers-at-age. This limits the evaluation of the relative impact of different selectivity changes, given that gear selectivity parameters (L50, SR) are typically length-based. The only publicly available population length structure information for the areas/stocks of interest comes from bottom trawl surveys included in the DATRAS database.

EWG 18-02 has carried out an analysis of the potential change in catches from the use of gears with different selectivity. Such changes were explored for a range of roundfish species in areas where these are considered as choke species. EWG 18-02 has considered:

- The effect of changing the codend mesh size from 120 mm to 130 and 140 mm and of using 120 and 140 mm SMPs on the cod, whiting and haddock stocks in the West of Scotland (VIa) and
- The effect of changing the codend mesh size from 120 mm to 130 and 140 mm on the haddock and whiting stocks of the Celtic Sea (VIIfghjk).

Changes in landings and discards were expressed as proportional changes in relation to a standard 120mm codend trawl as used in the North Sea.

For this purpose the following information is required:

1) population length structure of analyzed species/stock
2) selection parameters L50 and SR for standard end test gears
3) MCRS of each analyzed species/stock
4) Length-weight relationship for each analyzed species/stock

The analysis was performed using the SELNET software (Herrmann et al., 2012; 2013). For each area of interest the population structure at length data from bottom trawl surveys were extracted from DATRAS. Survey data for the West of Scotland came from the 2017 Scottish bottom trawl survey (SWC-IBTS), while data for the Celtic Sea came from the 2015 French bottom trawl survey (EVHOE). The spatial resolution of this data is higher than the stock areas (Figures 6.1

and 6.2). The effect of changes in selectivity was not examined in other choke species of the NWW waters, either due to the lack of recent survey data (such as in the case of the Irish Sea stocks), or due to the limited occurrence of these species in the existing surveys (e.g. cod in Celtic Sea).

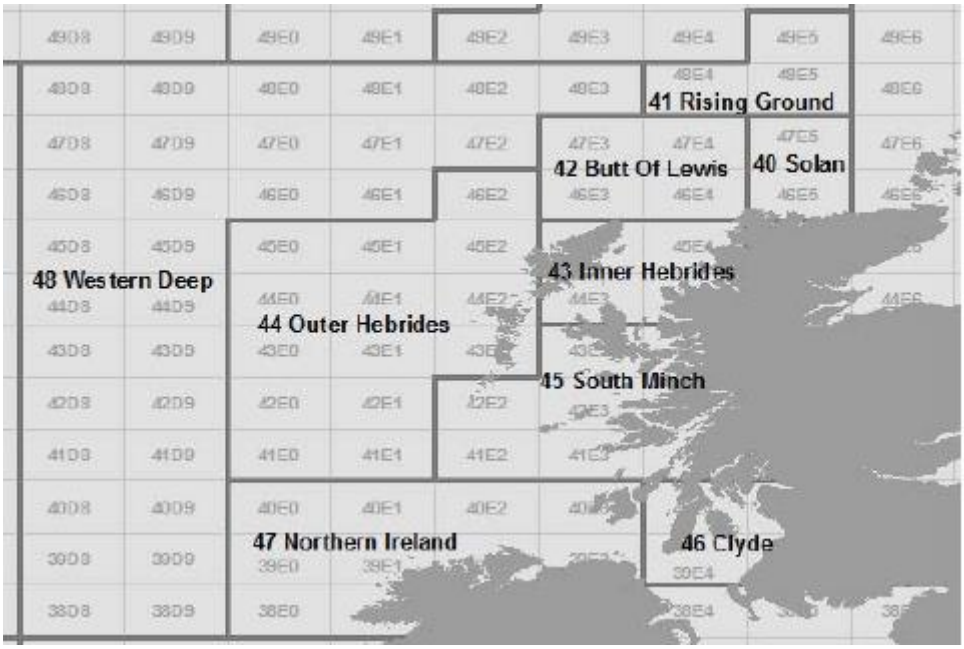

Figure 6.1 Scottish demersal areas in the West of Scotland where SWC-IBTS is carried out. Relevant CPUE-at-length data in DATRAS are provided separately for each of these areas

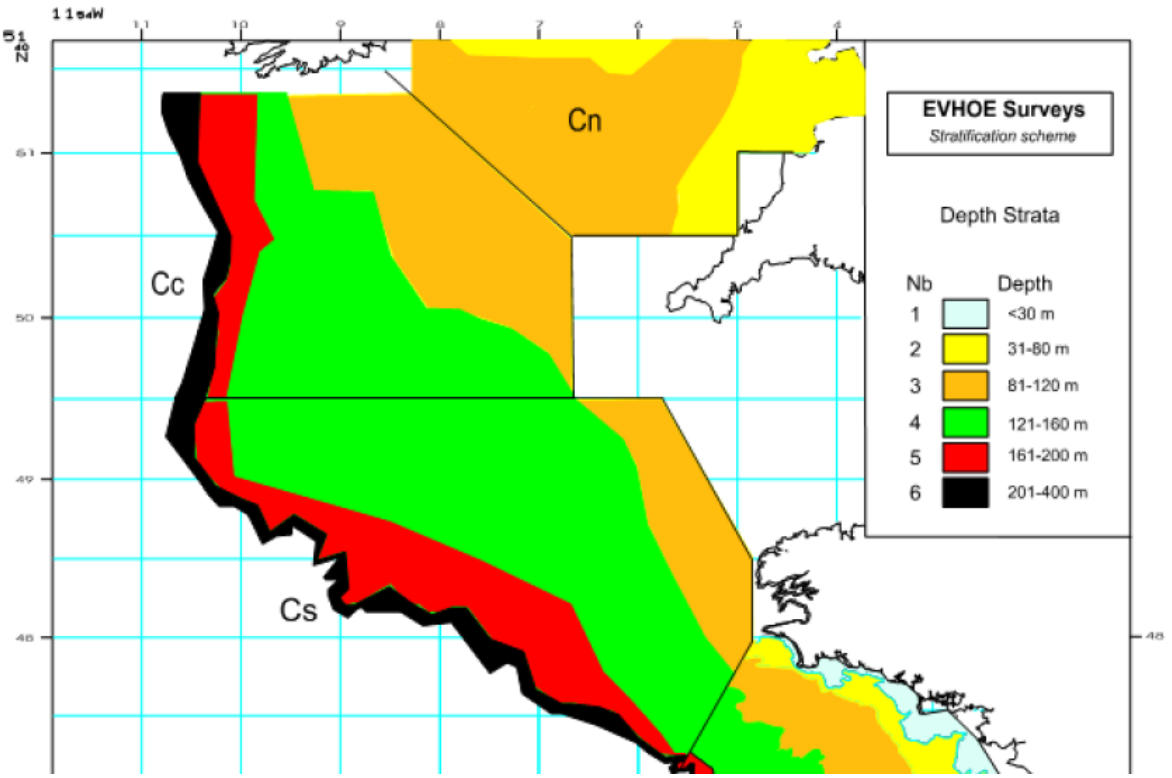

Figure 6.2 Three EVHOE areas (Cn: Celtic North, Cc: Celtic Central, Cs: Celtic South) Relevant CPUE-at-length data in DATRAS are provided separately for each of these three areas.

In the West of Scotland, DATRAS data indicated different population structures in each of the Scottish demersal areas for haddock (Fig. 6.3), whiting (Fig. 6.4) and cod (Fig. 6.5). In general, inshore areas (e.g. 43 and 45) host more small fish than offshore ones (e.g. 42 and 44). Similarly, in the Celtic Sea, the shallower northern part hosts more small haddock and whiting than the deeper central and southern ones (Fig. 6.6 and 6.7).

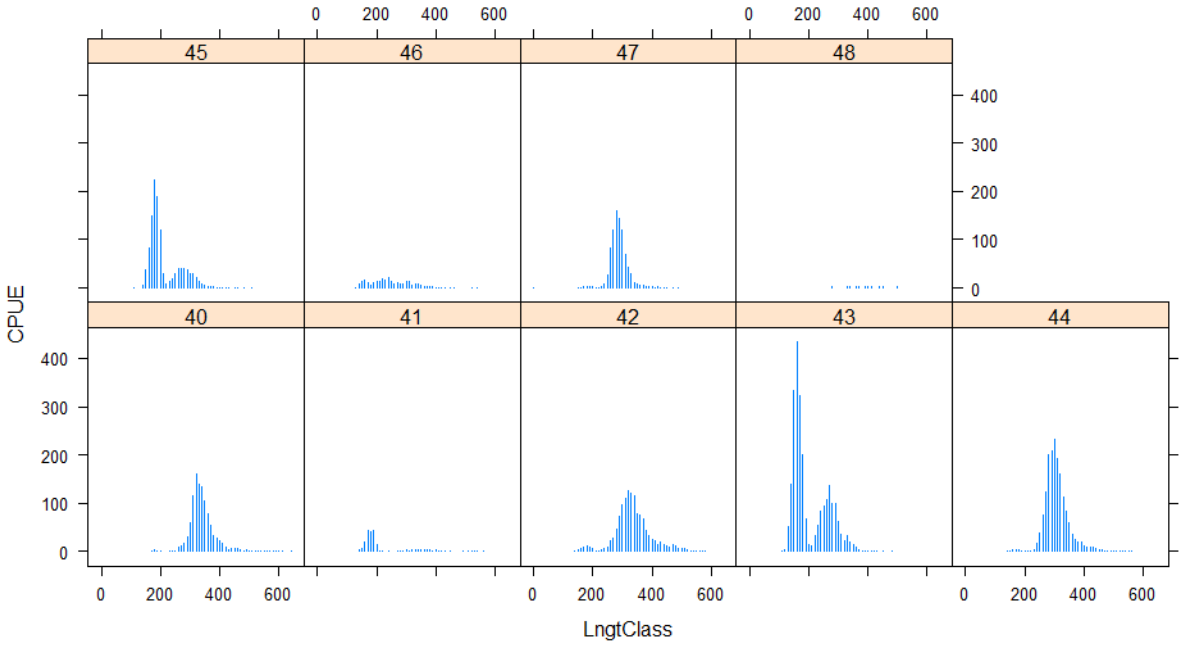

Figure 6.3 Population structure of haddock for the different demersal areas in the West of Scotland (2017 SWC-IBTS survey)

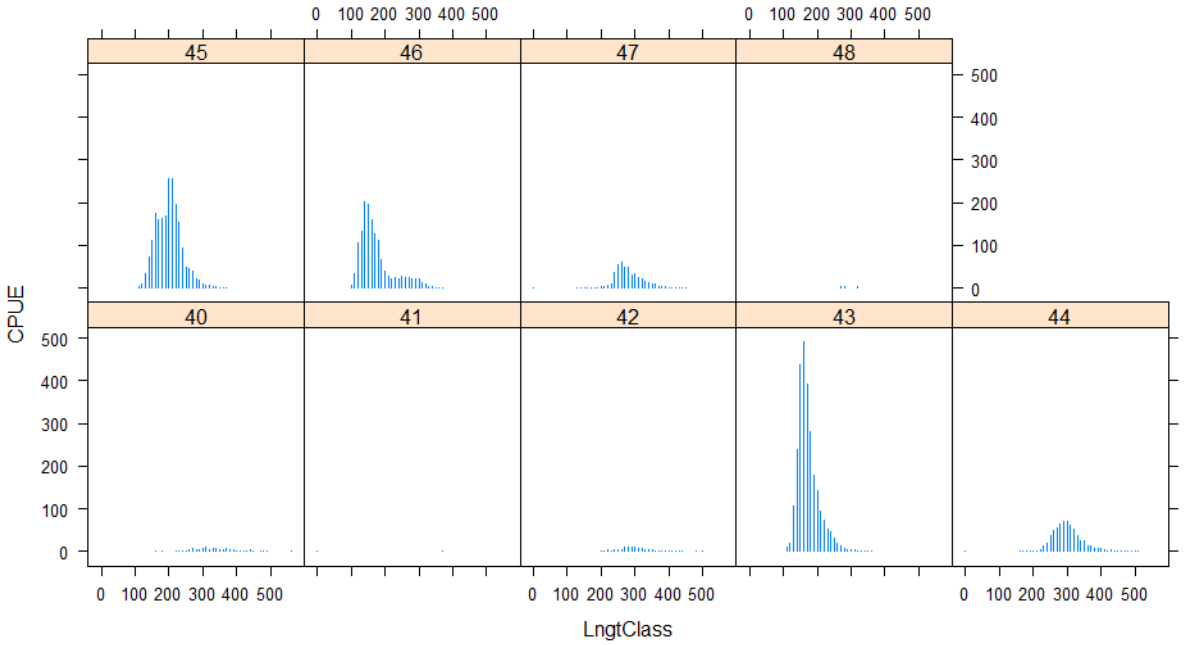

Figure 6.4 Population structure of whiting for the different demersal areas in the West of Scotland (2017 SWC-IBTS survey)

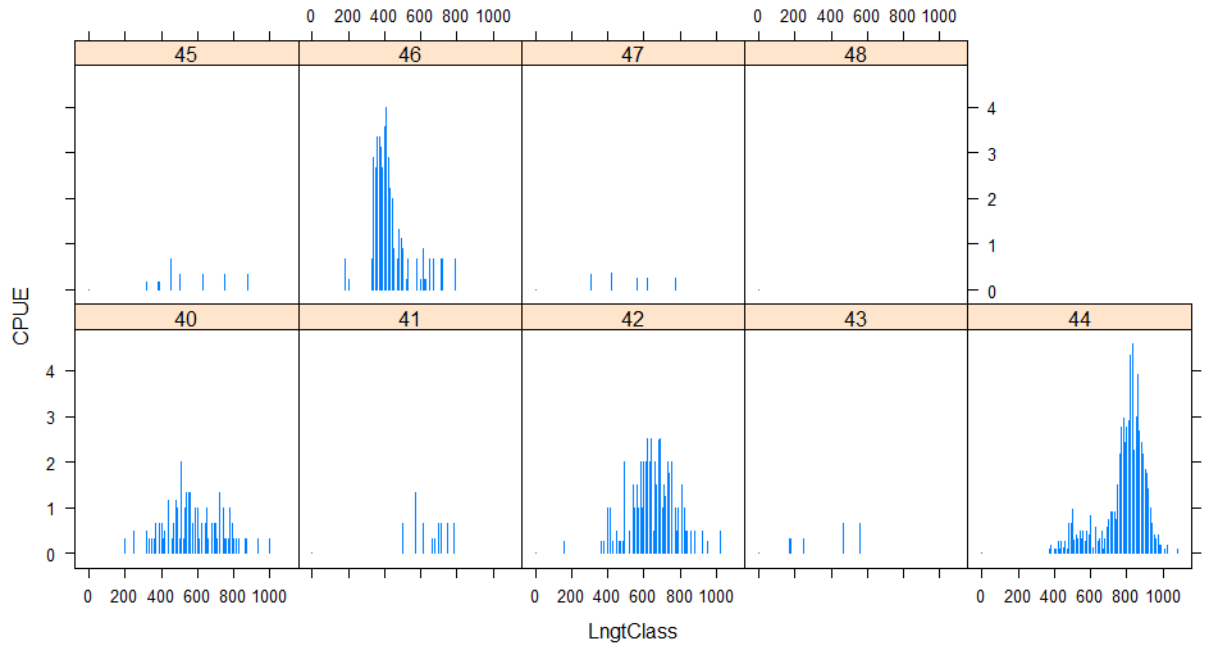

Figure 6.5 Population structure of cod for the different demersal areas in the West of Scotland (2017 SWC-IBTS survey)

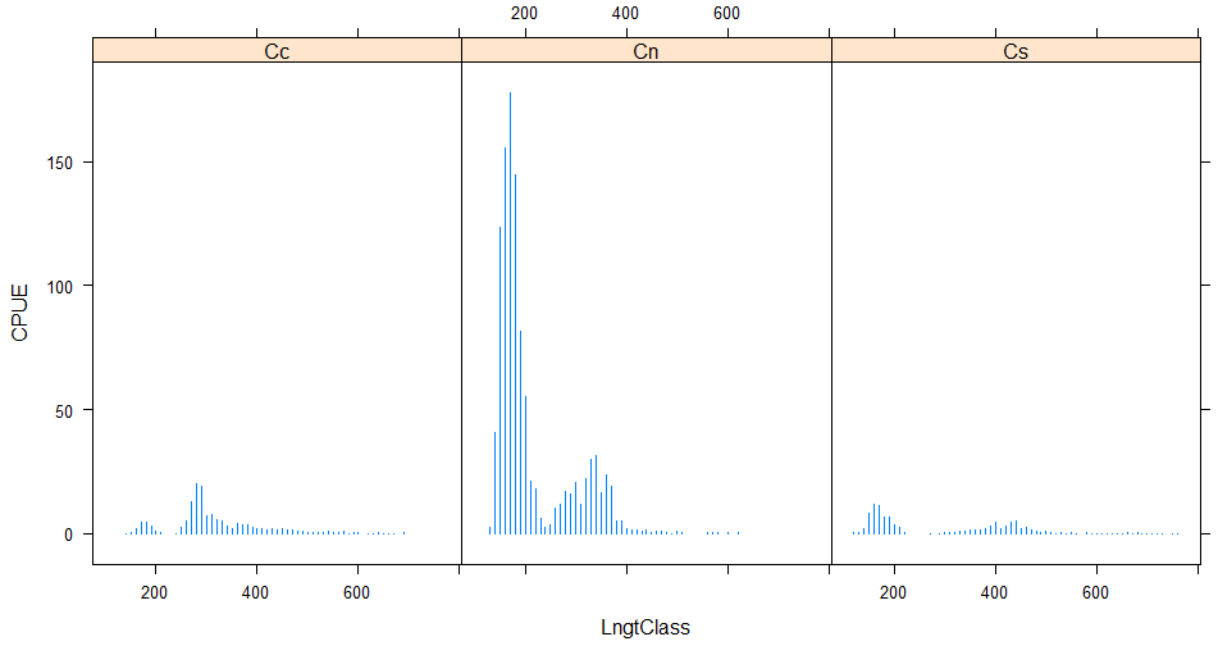

Figure 6.6 Population structure of haddock for the different areas of the Celtic Sea (2015 EVHOE survey)

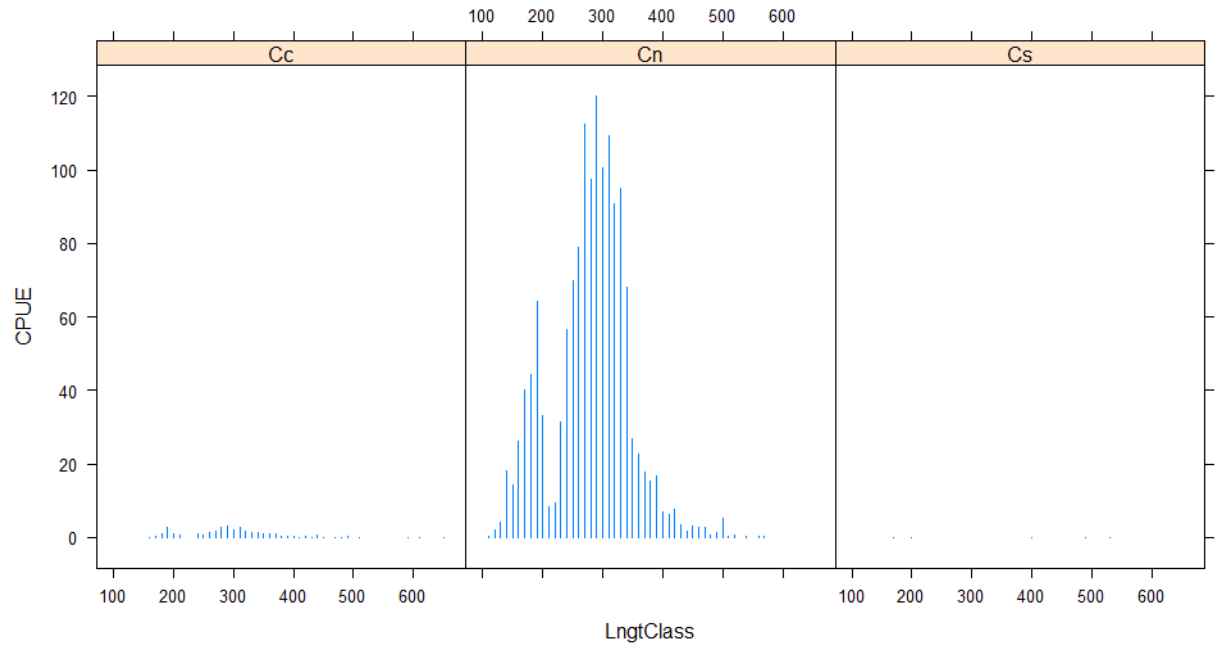

Figure 6.7 Population structure of whiting for the different areas of the Celtic Sea (2015 EVHOE survey)

For the West of Scotland, the effect of the different gears on landings and discards was simulated for inshore and offshore populations. The population structure from area 44 (Outer Hebrides) was chosen to represent offshore populations of haddock, whiting and cod. The population structure from area 45 (South Minch) was used to represent inshore haddock and whiting and that from area 46 (Clyde) was chosen for inshore cod. For the Celtic Sea, the effect of the different gears on landings and discards was simulated using the population structure of each of the three areas separately for haddock, and of Cn and Cc separately for whiting.

In the second step, the size selection parameters were collected (Table 6.1).

Table 6.1 Size selection parameters for cod, haddock and whiting

Species	Selectivity parameter	120mm codend	130mm codend	140mm codend	120mm codend + 120 mm SMP	120mm codend + 140mm SMP
Cod	L50 [cm]	38.84	42.57	46.29	45.64	48.88
	SR [cm]	8.25	9.04	9.83	9.69	10.38
Haddock	L50 [cm]	34.74	38.07	41.4	40.82	43.72
	SR [cm]	6.07	6.78	7.49	6.07	6.07
Whiting	L50 [cm]	40.37	44.24	48.11	47.44	50.8
	SR [cm]	11.55	12.65	13.76	13.57	14.53

Using the selectivity parameters from Table 6.1, size selection curves for each gear were recreated. Using the population size structure data obtained from bottom trawl surveys and MCRS for each species (cod = 35 cm; haddock = 30 cm; whiting = 27 cm), it was possible to simulate the number of individual that would be retained by each codend in each analysed area. Using the MCRS it was possible to distinguish between landings and discards. Everything retained by the codend that was below MCRS falls under the category of discards and everything above MCRS falls under the category of landings. In this part of the analysis, the landings and discard are given in number of individuals. To present the results in terms of weight a length-weight relationship needs to be applied. For the purpose of this study, the length-weight relationships for the West of Scotland cod, haddock and whiting were taken from Coull et al. (1989) and those for Celtic sea haddock and whiting were obtained from Silva et al. (2013). This allowed us to

estimate proportional changes in catch weight for the more selective gears in relation to the standard 120mm trawl codend (Table 6.2). The recreated size selection curves for each gear fishing in relation to each fished population are showed in figures 6.8 and 6.9.

Table 6.2 Percentage change in catch weight compared to standard 120mm trawl codend (44: Outer Hebrides; 45: South Minch; 46: Clyde)

Species	Area	Catch	130mm (%)	140mm (%)	120mm codend + 120 mm SMP	120mm codend + 140mm SMP
cod	44	Landings	1	0.99	0.99	0.99
		Discards	n/a	n/a	n/a	n/a
		Total	1	0.99	0.99	0.99
	46	Landings	0.86	0.73	0.75	0.66
		Discards	0.51	0.28	0.31	0.19
		Total	0.85	0.73	0.75	0.66
Haddock	44	Landings	0.61	0.37	0.35	0.19
		Discards	0.46	0.24	0.12	0.04
		Total	0.6	0.36	0.33	0.18
	45	Landings	0.56	0.32	0.27	0.14
		Discards	0.47	0.26	0.12	0.04
		Total	0.54	0.31	0.25	0.13
Whiting	44	Landings	0.66	0.45	0.48	0.35
		Discards	0.67	0.48	0.5	0.39
		Total	0.66	0.45	0.48	0.35
	45	Landings	0.64	0.43	0.46	0.34
		Discards	0.70	0.52	0.54	0.43
		Total	0.67	0.48	0.51	0.39

Table 6.3 Percentage change in catch weight compared to standard 120mm trawl codend (cc: central Celtic Sea; cn: north Celtic Sea; cs: south Celtic Sea)

Species	Area	Catch	130mm (%)	140mm (%)
Haddock	cc	Landings	0.84	0.69
		Discards	0.49	0.22
		Total	0.83	0.68
	cn	Landings	0.65	0.39
		Discards	0.46	0.23
		Total	0.65	0.38
	cs	Landings	0.88	0.73
		Discards	0.4	0.45
		Total	0.88	0.73
Whiting	cn	Landings	0.7	0.49
		Discards	0.67	0.5
		Total	0.7	0.49
	cc	Landings	0.72	0.58
		Discards	0.73	0.64
		Total	0.72	0.58

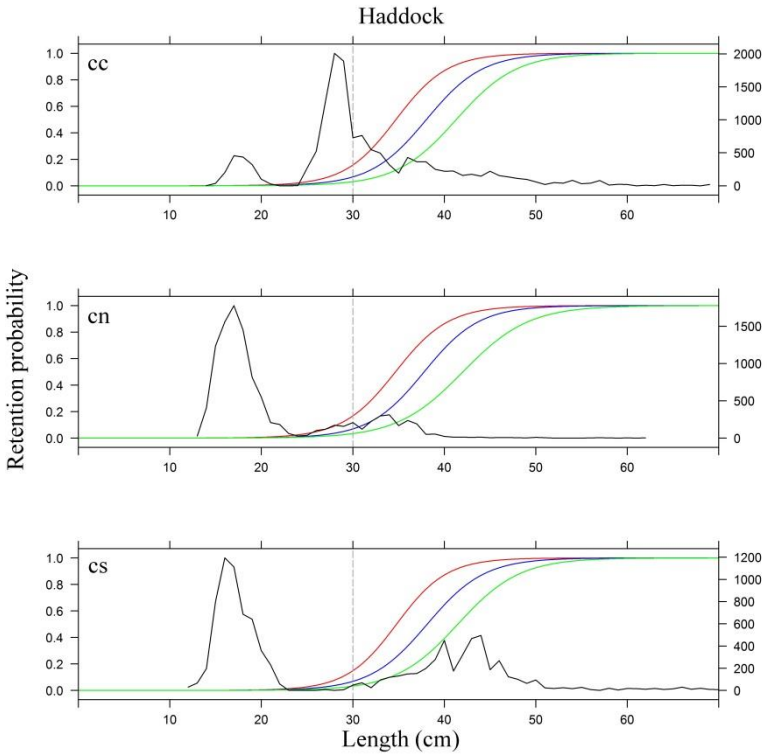

Figure 6.8 Size selection curves for 120mm (red), 130 mm (blue) and 140 mm (green) for haddock. Black solid curve represents population size structure obtained from the trawl surveys for central (cc), north (cn) and south (cs) Celtic sea. Vertical dashed line represents species MCRS.

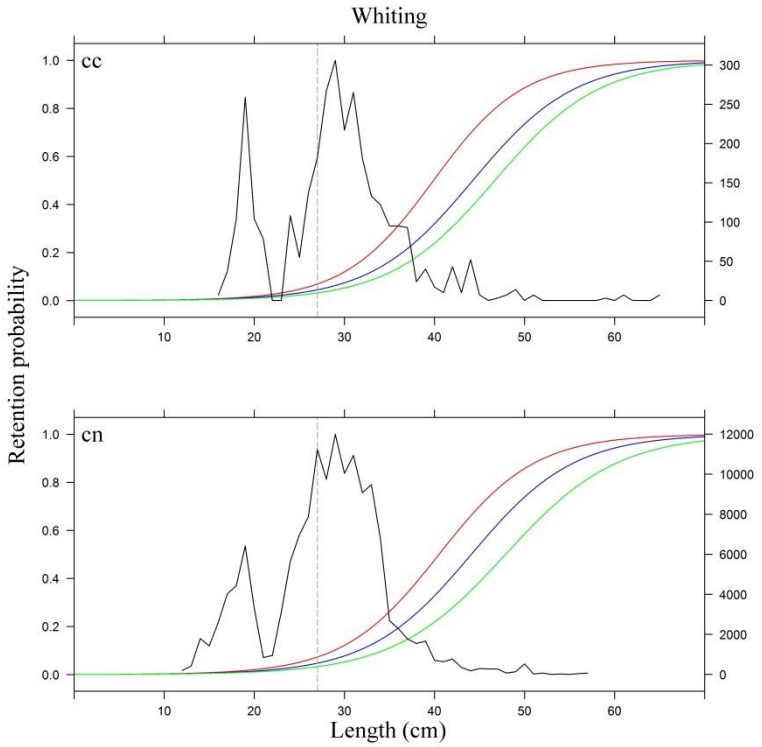

Figure 6.9 Size selection curves for 120mm (red), 130 mm (blue) and 140 mm (green) for whiting. Black solid curve represent population size structure obtained from the trawl surveys for central (cc) and north (cn) Celtic sea. Vertical dashed line represents species MCRS

The results of the analysis highlight the variability of the effects of changes in selectivity on landings and discards, depending on the population structure of the targeted stocks. For cod, there are marked differences in the effect of the more selective gears between areas 44 and 46 (Table 6.2). The more selective gears have no effect in area 44 where the population size structure is such that there are very few smaller fish that would benefit from an increase in the 50% retention length of the gears. However, when the same gears are applied to the population used to represent area 46, which is predominantly made up of fish close to these 50% retention lengths, there are large reductions of landings, discards and total catch. Similar differences can be seen for haddock in the three Celtic sea areas (Table 6.3). While the results of the gears measures in the West of Scotland, which focus on increasing the 50% retention length, are variable for cod (depending on population structure), they are, in these examples, more consistent for haddock and whiting, and lead to reductions of landings and discards of as much as 81% and 96% for haddock and 66% and 61% for whiting (for the most selective gear examined) (Table 6.2). Again similar trends can be seen in the Celtic Sea areas (Table 6.3).

The pronounced effect of population structure on the landings and discards coming from gears with different selectivity is of particular importance for species which exhibit pronounced recruitment pulses resulting in significant year-to-year changes of population structure (e.g. haddock). Hence, more in-depth analysis is needed to assess the sensitivity of the effects of changes in selectivity to changes in population structure, in order to obtain a more robust understanding of the expected implications for landings, discards and economic performance.

7. TOR 5 – LIKELY ECONOMIC IMPACTS

Tor 5 - Assess the likely economic impacts resulting from such changes in selectivity on the basis of losses of marketable catches of the stock or reductions in the marketable catches of other species contrasted with the economic impacts of a choke situation.

Given the time constraints it was not possible for EWG 18-02 to assess fully the likely economic impacts resulting from changes in selectivity. However, two case studies are presented that were considered by EWG 18-02 that are indicative of the impacts that may be achievable.

7.1. Landing Obligation Impact Assessment Model

This is a simple EXCEL based model that attempts to indicate the impacts of choke stocks with and without selectivity measures applied.

The assumptions of the Landing Obligation Impact Assessment Model are as follows;

- Area based - The 5 areas of VIIbk, VIIfg, VIIde, VIIa and VI are modelled separately. Choke stocks in one area do not impact activity in another area
- Problematic stocks by area are assessed as potential chokes. The landings of other species such as *Nephrops*, anglerfish etc. are not included in the data file and so the potential impact on fishing activity is not completely refelcted
- The TAC overshoot by Member State (MS) is assessed for the main choke stocks
- The most significant choke species per MS is selected for each area. For Area VI the second choke is also utilised
- Landings are adjusted by proportional reduction of most significant choke
- Impact here is measured in tonnes of landings of included stocks
- It is assumed that the pattern of landings is consistent throughout the year therefore if the choke species from a quota where only 40% of catches is landed, then activity will fall by 60% across all species landed by the fleet i.e. activity is choked at the 40% mark of the year
- Two scenarios are simulated - Status Quo 2019 and Mitigation 2019 where:
    - Status Quo 2019 shows the impact in fishing activity if no adaptation to the Landing Obligation occurs and fishing activity is curtailed by the main choke species of each fleet.
    - Mitigation 2019 shows the impact in fishing activity where selectivity measures are utilised, where possible, at the metier level to ameliorate the impact of choke species and the Landing Obligation.
- Selectivity adjustments are implemented at the metier level by adjusting the catch (and implicitly the discard) rates of species below and above the MRCS (minimum reference conservation size)
    - For each MS and area the discard issue is identified to be either quota or size related and estimated proportions are applied to the discards, i.e. for the Celtic Sea VIIbk 92% of French discards are deemed to be of above sized species and the result of lack of quota and/or highgrading (Marine Institute, 2017).
    - Selectivity measures can;
        - reduce the amount of undersized discards. This will not change the adapted total catch from hitting the most significant choke stock but it will alter the discard rate thereby leading to increased landings.
          or
        - reduce discards and catches of all sizes to prevent hitting the most significant choke stock. This will extend fishing activity to the second most significant choke
    - Metiers are independent so that any metier with zero catches of a chokestock in the data file are not affected by the choke and can continue their activity.
    - Results are summarised at the MS level

7.1.1. Celtic Sea, Area VIIbk

In In the Celtic Sea, Area VIIb-k, the species analysed are cod, haddock, whiting and hake. The fleets of France, Ireland, the UK, Belgium, Netherlands and Spain have fishing activity in this area. In table 7.1.1.1 below the proportion of national quota to catch for the fleets are shown to identify the most significant choke species.

Table 7.1.1.1 Identification of the main choke species per member state in in Area VIIb-k

Member State	COD	**HAD**	WHG	HKE
FRA	127%	**48%**	167%	102%
IRL	88%	**33%**	59%	76%
UK	66%	**40%**	167%	143%
BEL	175%	**8%**	21%	1072%
NLD	100%	**0%**	265%	NA
ESP	NA	**0%**	NA	83%
Celtic Sea 7b-k Total	111%	**41%**	106%	100%

It can be seen that haddock is the most significant choke species for all MS in Area VIIb-k. Discards of haddock here are greater than the level of landings (10,113 tonnes discards and 7,559 tonnes landings). For France haddock is the only choke stock. For the UK, haddock is the main choke followed by cod. Belgium is choked by haddock followed by whiting. Spain is choked by haddock followed by hake but has no quota for cod and whiting so these could be potential chokes for this fleet also. Ireland is choked by haddock, followed by whiting, then hake and finally cod.

Measures are applied to each MS to reduce their catch and discards of haddock so as to extend the period before the fleets are choke as far into the fishing year as possible. If no gear selectivity measures are applied to the fishing fleets then the French fleet will experience a 52% reduction in fishing activity, which is applicable across all landed species. The Irish fleet will see a reduction in fishing activity of 67% as the haddock quota is only 33% of the catches. The UK fleet will suffer a 6% reduction in fishing activity. The Belgium fleet will fall by 92% due to lack of haddock quota. Finally, the Netherlands and Spanish fleets will both see their activity completely eliminated due to their lack of quota.

According to the Marine Institute Stock Book 2017, for the Celtic Sea haddock stock the French fleet discards are due to lack of quota and hence estimate that 92% of discards are overquota fish above MRCS. For the Irish fleet the discard problem is largely size based as only 35% of discards are reportedly above MRCS. The UK fleet discards are mainly a quota issue with 72% of discards overquota fish above MRCS.

The main gear groups used here are TR1, TR2 and BT2. For all fleets using TR1, France, Ireland and the UK, an effective gear adaptation tested by IFREMER (2m square mesh cylinder) had an effect of reducing undersized catches of haddock by 90%. For TR2, used mainly by the Spanish, Irish, France (VIId and e) and UK fleets but also to a lesser degree by Belgium and Netherlands, two selectivity devices are applied. It is assumed that the French and UK TR2 fleets are targeting the mixed groundfish fishery and so an 80mm codend with 140mm square mesh panel (SMP) are applied which reduce undersized discards by 63% and marketable catches by 10%. The Irish TR2 fleet is assumed to target *Nephrops* and so a SELTRA box codend is applied which reduces all catches of haddock by 91%. For the BT2 metier, Belgium, Ireland and the UK are the fleets active and a Belgian selectivity device (120mm extension) is applied to these fleets which reduces catches of all haddock sizes by 43%.

The results can be seen in figure 7.1.1.1. The figures show three scenarios of the landings in 2016 *(Landings 2016)*, the future landings if no adaptation is made *(Status Quo 2016)* and the future landings if adaptations are made *(Mitigation 2016)*. The figure on the left includes hake while the figure on the right only shows cod, haddock and whiting. The reason for this is that landings of hake dominate this sea region and the majority of landings of this stock are by French, Spanish and UK fleets that utilise gillnets or longlines. Here, the impact of the LO has not been simulated for these metiers due to their high selectivity for the target species. The difference in the scenarios can be clearly seen in the figure on the right where under status quo landings fall by 50% for the whitefish species. Utilising gear selectivity innovations leads to a marginal improvement in the mitigation scenario for each species.

The Status Quo 2019 scenario leads to a reduction of 52% in landings of cod, 55% reduction in volume of haddock, a 56% reduction in whiting and a 12% reduction in hake. Applying selectivity measures leads to small improvements on the status quo scenario but overall lead to a 46% reduction in cod, a 51% reduction in haddock, a 46% reduction in whiting and a 10% reduction in hake in the Mitigation 2019 scenario.

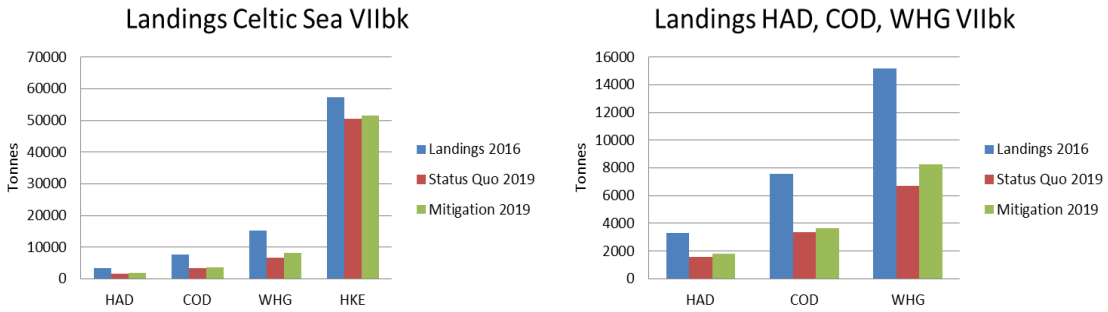

Figure 7.1.1.1 Results by main species including and excluding hake

Results of the analysis by MS are shown in figure 7.1.1.2. The left figure includes hake while the right does not. In the left figure it can be seen that the impact by MS is not largely significant because of the dominance of hake in this sea region. It is more appropriate to assess the figure on the right which shows significant impacts on the MS fleets on their landings of cod, haddock and whiting. The impact is mainly on the TR1 and TR2 fleets.

The overall impact on the French fleet is a 25% reduction in landings under status quo and a 23% reduction if selectivity measures are implemented. The Irish fleet landings fall 58% in status quo and 43% with gear changes. The UK landings fall 18% in status quo and 15% with gear changes. The Belgian fleet landings fall 92% in status quo and 75% with gear changes. The Dutch fleet landings fall 54% under both scenarios while the Spanish fleet landings fall 7% in both scenarios.

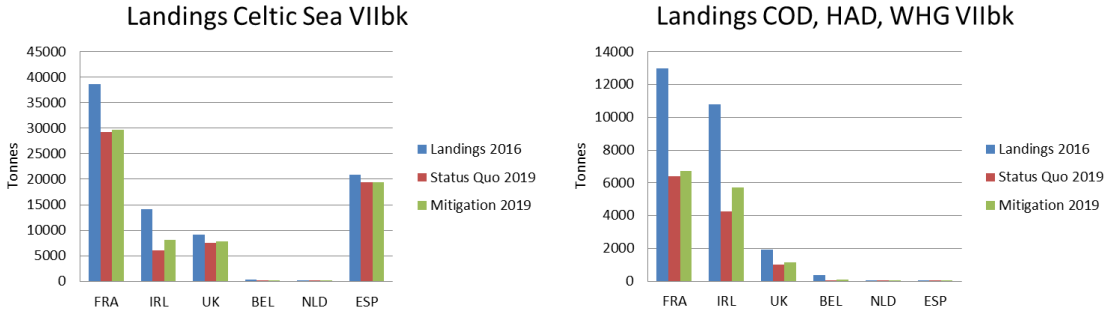

Figure 7.1.1.2 results by main fleets active in VIIb-k including and excluding hake

The economic impact by fleet has not been calculated as the data file does not contain all species landed and so the full monetary impact could not be estimated. The results show that the catches of the longliners and gillnetters targeting hake, which are mainly from the French and Spanish fleets, mask the overall effect of the LO in this sea region. The impact on trawlers is significant for all fleets and will reduce their activity by around 50% for most fleets, even with gear selectivity improvements.

7.1.2. Celtic Sea, Area VIIfg

In the Celtic Sea, Area VIIf,g, the species analysed are plaice and sole. The fleets of Belgium, Ireland, France, the UK and to a lesser extent Spain and Netherlands are active here. In the table below the proportion of national quota to catch for the fleets are shown to identify the most significant choke species.

Table 2: Identification of the main choke species per member state in Area VIIfg

Member State	PLE	SOL
BEL	**13%**	85%
IRL	**105%**	**92%**
FRA	**61%**	64%
UK	**43%**	121%
ESP	**NA**	NA
NLD	NA	NA
Celtic Sea 7f&g Total	45%	91%

It can be seen that plaice is the main choke for all MS fleets except Ireland, where sole is the main choke. The discard problem in this area is with plaice with discards higher than landings (for 432 tonnes landings by all MS of plaice there are 501 tonnes of discards). Ireland is the only MS with sufficient quota of plaice.

Without selectivity measures being implemented in this fishery then the impact on the fleets will be as follows; Belgian landings fall 87%; French landings will fall 39%; Irish landings fall 8%; Netherlands landings fall 100%; UK landings fall 57% and Spanish landings fall 100%.

Based on expert knowledge it is known that the discard problem here is mainly of undersized plaice. It is assumed that 90% of discards are undersized and 10% oversized for all MS and fleets here.

The main gears used here are BT2 (mainly Belgian but UK and Irish fleets also), TR1 (mainly French and Irish) and TR2 (mainly Irish, UK and to a lesser extent Belgian and French). Three gear changes of 100mm T90, SELTRA with 300 square mesh panel, and 100mm mesh size increase are respectively applied to the TR1, TR2 and BT2 fleets. The 100mm T90 has unknown effects on selectivity therefore catches and discards of plaice and sole do not change for the TR1 metier. The SELTRA with 300 square mesh panel leads to a 40% reduction in catches of all sizes of plaice and sole for the TR2 metier. The 100mm mesh size increase for the BT2 metier leads to a 23% reduction in undersized plaice and 73% reduction in sole and a 4% reduction in above MCRS plaice and 39% reduction in marketable sole.

The results can be seen in figure 7.1.2.1 below.

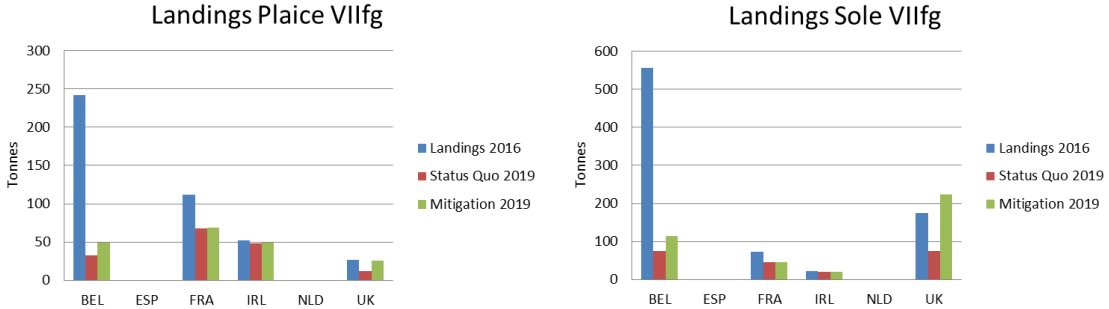

Figure 7.1.2.1 Results for plaice and sole in Area VIIf,g

The Belgian fleet is the most affected in this area with landings falling by 87% under the Status Quo 2019 scenario. Applying gear changes slightly reduces the impact to 80%. The French fleet suffers a 39% decrease in landings of plaice and sole in both scenarios due to the limited effective of the selectivity options for the TR1 fleets. The Irish fleets landings fall by 8% in the Status Quo 2019 scenario but by applying the gear changes on the TR2 and BT2 metiers the impact falls to a 5% reduction in total landings. For the UK fleet, landings fall by 57% under the Status Quo scenario. However, by applying selectivity measures they can completely negate this impact on landings and in fact increase their landings by 25% of these two species.

To conclude, the Belgian fleet is the most affected here as no selectivity measures can sufficiently ameliorate the impact of the LO. The French fleet is significantly impacted by nearly 40% of current landings. The Irish fleet is barely affected and selectivity measures can reduce any impact on the UK fleet.

7.1.3. English Channel, Area VIIde

In the English Channel VIId,e the main choke stock is plaice. The MS with landings in this area are Belgium, France, Netherlands and the UK. The French and UK fleets have sufficient quota. However, they still have a significant discard problem with France discarding 73% of their plaice catch and the UK discarding 32% of their plaice catch. Belgium and the Netherlands both overshoot their quota, with the Dutch fleet having no quota here.

Table 3: Identification of the main choke species per member state in Area VIId,e

Country2	**PLE**
FRA	116%
BEL	**53%**
UK	225%
NLD	**0%**
English Channel Total	109%

Without selectivity measures being implemented in this fishery then the impact on the fleets will be as follows; Belgium landings fall 47%; Dutch landings fall 100%; no change for the French and UK fleets.

Based on expert knowledge it is known that the discard problem here is mainly of undersized plaice. It is assumed that 90% of discards are undersized and 10% is over quota for all MS and fleets.

The main gears used are TR2 and BT2, GT1, GN1, and TR1. There is very limited TR1 in this area, so the SELTRA is applied to TR2 and increasing codend mesh size to 100 mm mesh is applied to the BT2 fleets respectively. The SELTRA leads to a 40% reduction in catches of all sizes of plaice. The 100 mm mesh size increase for BT2 leads to a 23% reduction in catches of undersized plaice and a 4% decrease in oversized plaice.

The results are shown in figure 7.1.3.1.

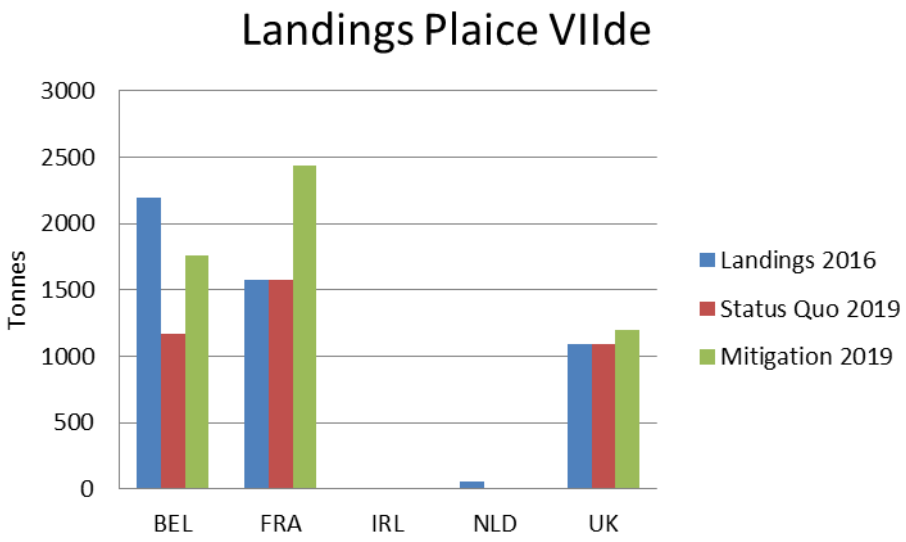

Figure 7.1.3.1 Results for plaice in VIId,e

The largest impact is felt on the Belgian fleet with landings falling 47% in the Status Quo 2019 scenario. With gear changes the impact is reduced significantly and overall landings fall by 20% for the Belgian fleet in the Mitigation 2019 scenario. As the French fleet is not quota limited here there is no impact in the Status Quo 2019 scenario. By implementing gear changes increased landings occur in the French TR2 and BT2 fleets which lead to landings increasing significantly, by 54%. This is without increasing catches and is due to the more selective operations of the fleet. The small landings of the Dutch fleet are eliminated in both scenarios and the UK fleet suffers no reduction in the Status Quo 2019 scenario and increases landings like the French fleet due to more efficient gears used in the Otter, TR1 and BT2 metiers by 10%.

7.1.4. Irish Sea, Area VIIa

In the Irish Sea VIIa cod, haddock and whiting are the species analysed. The MS with landings here are the UK, Ireland and Belgium. France has quota for all species here but does not utilise it. As can be seen in table 7.1.4.1, whiting is the main choke here for the UK, Ireland and Belgium.

Table 7.1.4.1 Identification of the main choke species per member state in Area VIIa

Country2	COD	HAD	**WHG**
UK	31%	92%	**2%**
IRL	78%	453%	**25%**
BEL	19%	152%	**0%**
Irish Sea VIIa Total	54%	159%	**4%**

Without selectivity measure being implemented the impact on the fleets will be as follows; Belgium landings fall 100%; UK landings fall 98%; Irish landings fall 75%.

Based on expert knowledge it is known that the discard problem here is mainly of undersized whiting. It is assumed that 99% of discards are undersized and 1% over quota for all MS.

The main gears used in the Irish Sea are TR2 for catches of whiting and cod (UK and Ireland) with landings of haddock mainly by the TR1 fleets (Ireland and the UK). The BT2 gear is used by the Belgian and Irish fleets. The selectivity measures applied are again the SELTRA for the TR2 fleet and an 80 mm T90 for the BT2 fleet. No selectivity improvement was applied to the TR1 fleet as discards by these fleets are quite low. The SELTRA reduces whiting catches by 40%. The 80 mm T90 reduces undersized whiting by 23% and marketable whiting by 4%. The results are shown in figure 7.1.4.1.

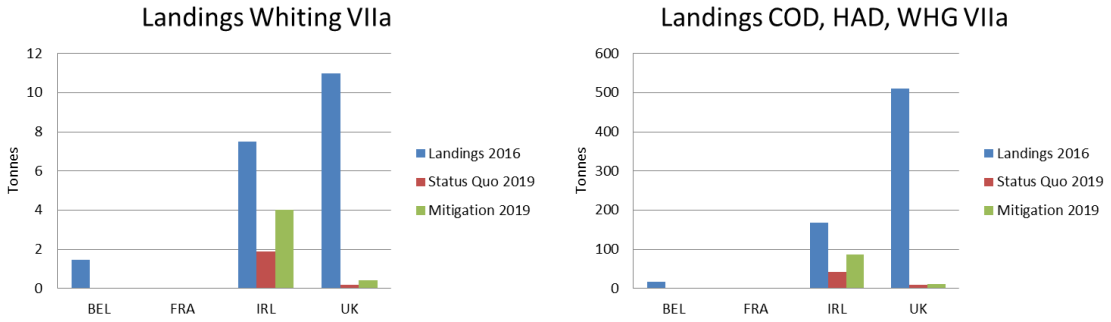

Figure 7.1.4.1 Results for the whiting choke and all landings of included species in the Irish Sea VIIa

The UK fleet is the most affected in the Irish Sea suffering a 98% reduction in landings from choking on whiting. By implementing gear changes there is only a minimal reduction in the impact. The Irish fleet landings fall by 75% in the Status Quo 2019 scenario. By implementing gear changes the impact is reduced significantly to an impact of 47%. Landings of the Belgian fleet are eliminated entirely with the selectivity measures having no appreciable effect.

7.1.5. West of Scotland, Area VI

In the West of Scotland, Area VI, the five stocks of Cod, haddock and whiting in VIa, as well as cod and haddock in VIb were analysed. The MS fleets with landings of the aforementioned species here include the UK, France, Ireland, Spain and the Netherlands (Belgium and Germany have quota but no recorded landings in the data file). In terms of choke species Area VIa has two highly problematic stocks – cod and whiting. Cod VIa is the main choke for all fleets as currently there is a zero TAC. The other choke stock is whiting.

Table xx Identification of the main choke species per member state in Area VI

Country2	**COD 6a**	**COD 6b**	HAD 6b	HAD 6a	**WHG**
UK		**3%**	48%	123%	22%
FRA		**9%**	472%	814%	1793%
IRL		118%	42%	130%	**13%**
BEL		**NA**	NA	NA	NA
ESP		**NA**	0%	0%	NA
NLD		NA	NA	0%	**NA**
GER		NA	NA	NA	NA
West of Scotland Total		4%	52%	134%	20%

Without selectivity measures being implemented fishing activity in this sea region will be eliminated for all fleets by cod in VIa. If this choke can be resolved somehow then whiting will have the following impact under Status Quo 2019 scenario; the Spanish landings fall by 100%; Dutch landings fall by 100%; French landings fall by 0%; Irish landings fall by 87%; and UK landings fall by 78%.

Based on expert knowledge it is known that the discard problem here is quota related. It is therefore assumed that 10% of discards are undersized and 90% are over quota.

The main metiers used here are TR1 (mainly UK and Ireland) and TR2 (mainly UK with Ireland). For the TR1 fleet an increase in codend mesh size is applied and the SELTRA is applied to the TR2

fleet. The effect of this on cod is that it reduces undersized cod by 48% and oversized cod by 6%. Its effect on whiting is a 36% reduction in undersized and a 33% reduction in marketable whiting. The results are show in figure 7.1.5.1.

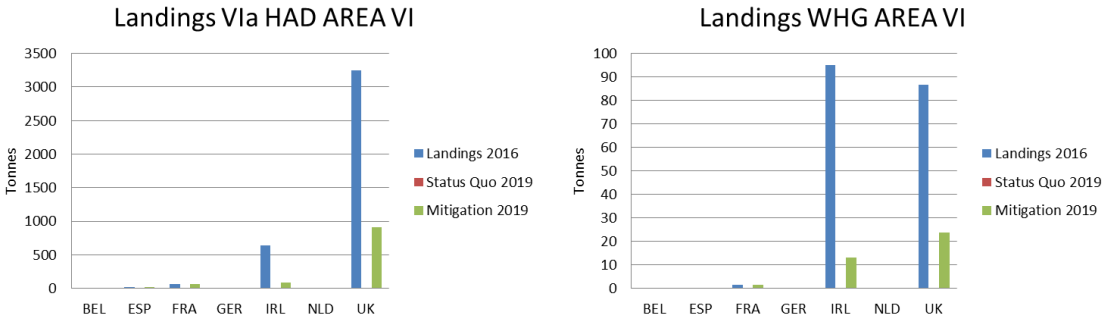

Figure 7.1.5.1 Results for main species caught in Area VIa

As figure 7.1.5.1 shows adoption of the selectivity measures has mixed results for landings of each species and for each fleet. Landings of the UK fleet from VIa fall 100% in the Status Quo 2019 scenario due to cod. In the Mitigation 2019 scenario the impact improves significantly to a reduction of 72% of previous landings, rather than 100%. The gear selectivity measure for TR1 is effective reducing the discard rate form 24% to 9% therefore extending the fishery. The main impact for the UK fleet is on the TR1 gear with landings of haddock falling from over 3,000 tonnes to under 900. Overall the UK landings fall 31% in Area VI.

The landings of the Irish fleet in VIa fall 100% in the Status Quo 2019 scenario. Under Mitigation 2019 landings fall 86% for Area VIa. The improvement over the Status Quo 2019 scenario occurs for the TR1 fleet and its catches of VIa haddock and whiting. Overall landings in Area VI fall 43% for the Irish fleet.

The overall impact on MS fleets is shown in figure 7.1.5.2

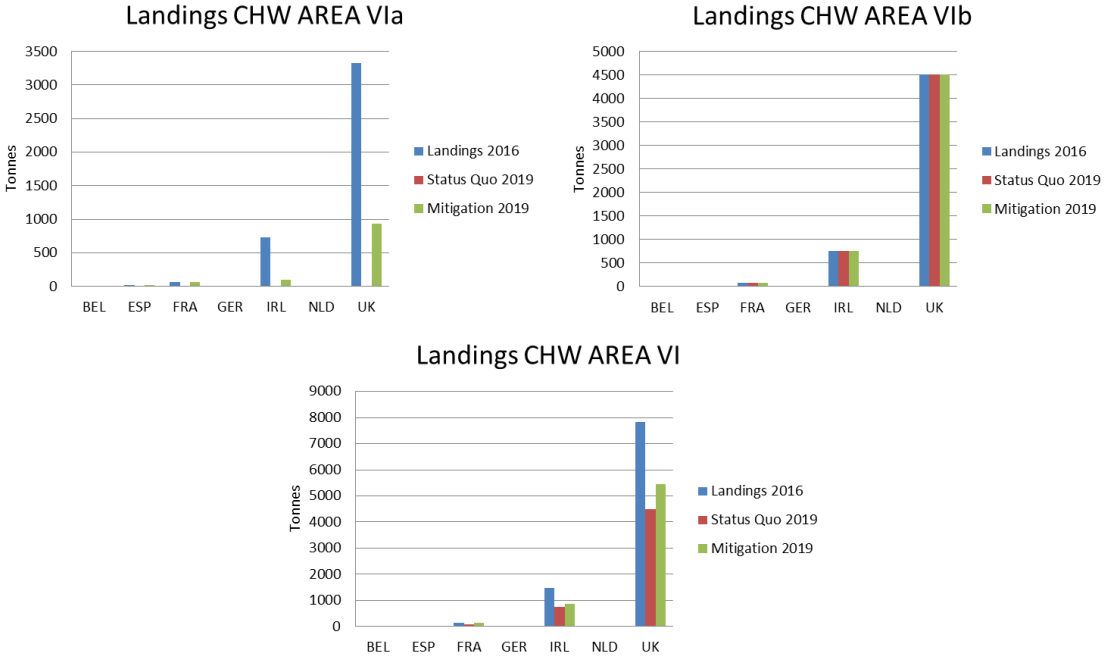

Figure 7.1.5.2 Main impact on MS fleets in Area VI

7.1.6. Conclusions

A range of impacts are evident across the sea regions analysed. It is important to note that these impacts are only for the species included in the data file used by EWG18-02 and does not include a large number of other species that are exploited by these fleets in these areas. This is the reason that the economic impact has not been assessed as it would have only been a partial economic impact no including important target and bycatch species.

The assumptions used have been necessary to provide an impact model during the time available. Nevertheless, the model provided here is logical, relatively straightforward and the results are explainable.

The assumption of fleets being independent means that if one or a number of fleets of a MS are choked, others of the same MS that have no catches of the choke can continue to fish. This is a broad assumption and for example leads to a significant softening of the impact in VIIb-k as the French and Spanish longliners and gillnetters continue fishing hake which is by far the most plentiful species in this data file.

From a gear selectivity perspective, the main results show that gear selectivity measures can only partially resolve the choke species problem in all areas. Positive results were seen for the Irish fleet in the Celtic Sea VIIb-k for the TR2 fleet where the selectivity device reduced the choke impact of haddock significantly. Rather than reducing activity by 58% under the status quo this measure gives a 15% improvement leading to a 43% reduction in activity. In this area the Belgian fleet's implementation of large square mesh panels leads to a 17% improvement with activity falling 75% rather than 92% with the gear.

In the Celtic Sea VIIf,g the gear selectivity of 100mm codend mesh size increase is very effective for the beam trawl fleets leading to the overall discard rate of plaice falling from 60% to 24%. This resolves all issues for the UK fleet (in fact leading to a 25% increase in landings) but not for the Belgian fleet due to lack of quota.

In the English Channel VIId,e the 100mm mesh size increase is highly effective for the beam trawl fleets reducing the discard rate form 41% to 13% as is the use of the SELTRA in the TR2 fleet. This latter device reduces the discard rate of plaice from 76% to 56% and leads to increased landings for the French and English fleets.

In the Irish Sea VIIa the 80mm T90 for beam trawls reduces the discard rate from 91% to 71%. The SELTRA is also effective for the Irish TR2 fleet but due to lack of quota does not resolve the choke issue for the UK TR2 fleet.

In the West of Scotland VIa the 130 mm mesh size increase for the TR1 metier is effective, reducing the discard rate from 24% to 9% for whiting. However, without a resolution to the zero TAC issue with cod, all fleets in VIa will be tied up from the start of the year.

7.2. UK Case Study

For the purpose of this case study the SEAFISH model covering UK fishing fleets has been used. The model version with 2016 baseline was used. The description of the model is available online (see footnote[2]).

The main SEAFISH model features and modelling assumptions, beyond what is described in the methodology report, are as follows (Catchpole *et al*., 2017):

- The model is parametrised using 2016 data and forecasts from 2017.
- Full compliance with the LO is assumed (all catches are deducted from quota and fishing stops when choke points are met).
- The model includes 54 UK fishing stocks.

[2] http://www.seafish.org/media/Publications/Seafish_Bioeconomic_Methodology_Report_FINAL.pdf

- Pelagic stocks are excluded from this analysis (while some pelagic stocks have the potential to act as choke species, this is considered a consequence of domestic pelagic quota distribution).
- Stock catch estimates and stock level discard rates, used to calculate quota uplifts, are taken from the latest ICES' advice.
- The TAC uplift method applied at the stock level is the same as that used in previous years. Within the UK the quota, uplift is allocated in alignment with Fishing Quota Allocations (FQAs).
- Total catches are limited to that which can be taken by fishing effort exerted in 2016.
- Interspecies flexibilities and de minimis exemptions are not included in the model.
- Skates and rays are assumed to have gained exemption from the Landing Obligation by 2019 on the basis of high survivability; the model does not include any other exemptions.
- Discard rates at the métier (fleet) level are calculated from the STECF FDI database, based on landings and discard estimates from 2016 data.
- For métiers where stocks have a discard rate of 100%, these have been adjusted to 99.5%, so that total catch can be calculated when landings occur.
- For métiers with no reported landings, no catch is calculated, even if discards are reported. This potentially underestimates the total catch but is not considered to influence the results.
- Constant catch rates by fleet are based on catch estimates and days-at-sea fishing effort, and catchability is adjusted in line with stock biomass.
- The domestic movement of quota (between POs, and non-sector fleet segments), is simulated to optimise quota usage.
- The UK quota allocation at the start of the year is used to explore the effect of an absence of international quota movement.
- The scenario that includes international quota movement is based on the end of year quota uptake as recorded in 2016 (uplifts are applied to all end of year quota).
- To project the size of assessed stocks in 2019, a biomass dynamic model using the Schaefer Model was applied (this is a modification to the previous model version, details in Annex 4).
- Following biological stock projections, TAC setting is based on achieving FMSY subject to a maximum change between years of either +/-5% or +/-15%, depending on historical changes for each stock (this is a modification to the previous version of the Seafish model, details Annex 4).

Additional modifications of the model made during STECF EWG meeting:

- As agreed during the STECF EWG meeting there was no top up provided for whiting in area 7a due to stock status, despite of ICES estimated discard rate of 98% for the stock

SEAFISH model includes seven different scenarios which are built adding mitigation measures on top of each other (see Figure 7.2.1).

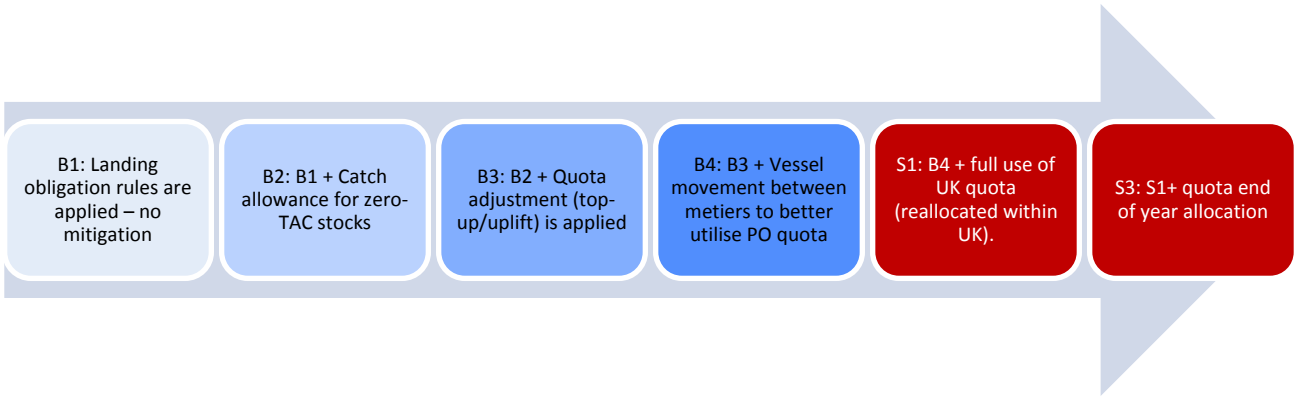

Figure 7.2.1 SEAFISH model scenarios[3]

To test the effect of selectivity on UK demersal fleets EWG 18-02 proposed the list of devices, which increase selectivity in the different areas (see Table 7.2.1).

Table 7.2.1 Gear adjustments applied and modelled

SEAFISG model Area	Gear	Device/selectivity adjustment
7fg & 7hjk	TR1	120 mm + 120mm SMP
	TR2	80 mm + 160mm SMP
	BT2	T90 cod end
7d&7e	TR2	Sepnep net
7a	TR2	SELTRA codend
West of Scotland	TR1	130 mm mesh size
	TR2	80 mm + 160mm SMP

These devices and their selectivity data were tested on top of the SEAFISH model baseline and scenarios. Selectivity adjustments were applied to the baseline landings and discard rates of the model. For some stocks landings decrease, however discard rates, increase.

Discard rates of the model ('norm') and with selectivity data applied to the gears of interest ('select') are presented in Table 7.2.2.

[3] See scenario definitions in Seafish Bioeconomic Modelling: Methodology Report: http://www.seafish.org/media/Publications/Seafish_Bioeconomic_Methodology_Report_FINAL.pdf

Table 7.2.2 Initial discard rates of the model and after implementation of selectivity adjustments

Area	Stock	Scenario	TR1	TR2	
			Scotland	Scotland	Northern Ireland
VI	Cod 5b6a	norm	69.9%	97.3%	
		select	38.8%	18.1%	
	Cod 6b	norm	0.0%		
		select	0.0%		
	Haddock 5b6a	norm	5.4%	93.4%	77.1%
		select	3.9%	33.2%	27.4%
	Haddock 6b	norm	5.4%		
		select	3.9%		
	Hake 6-7	norm	25.3%	92.3%	
		select	25.3%	92.3%	
	Whiting 6	norm	52.3%	99.2%	99.2%
		select	51.5%	69.3%	69.4%
VIIa	Cod 7a	norm		57.1%	57.0%
		select		57.1%	57.0%
	Haddock 7a	norm		45.8%	37.1%
		select		55.9%	45.3%
	Hake 6-7	norm		0.0%	0.0%
		select		0.0%	0.0%
	Whiting 7a	norm			99.4%
		select			106.4%
VIIfg	Cod 7b-k(ex.d)	norm	3.5%	88.9%	46.0%
		select	1.3%	16.6%	8.6%
	Haddock 7b-k	norm	44.3%	57.4%	67.3%
		select	17.4%	20.4%	23.9%
	Hake 6-7	norm	13.4%	50.0%	43.8%
		select	13.4%	50.0%	43.8%
	Plaice 7fg	norm	50.0%	52.7%	66.7%
		select	50.0%	52.7%	66.7%
	Sole 7fg	norm	0.0%	0.0%	0.0%
		select	0.0%	0.0%	0.0%
	Whiting 7b-k	norm	23.0%	53.8%	43.5%
		select	22.6%	37.6%	30.4%
VIIhjk	Cod 7b-k(ex.d)	norm	3.3%	6.0%	
		select	1.2%	1.1%	
	Haddock 7b-k	norm	50.9%		
		select	20.0%		
	Hake 6-7	norm	19.5%	47.9%	
		select	19.5%	47.9%	
	Whiting 7b-k	norm	23.6%		
		select	23.2%		

Results

The results below are based on 2016 baseline fleet activity and landing obligation rules as agreed by the middle of 2017. The overall effort of the fleets is limited to baseline effort in 2016 noting that the model is parametrised using 2016 data and no changes of fishing pattern is modelled.

Northern Irish Nephrops trawl fleet in area 7

Figure 7.2.2 shows the choke points calculated for the Northern Ireland *Nephrops* trawl fleet segment under four simulations in Area 7 between 2017 and 2019 and the same simulations after a selectivity improvement. The analysis shows that the fleet is expected to choke on whiting 7a in 2019 and the selectivity improvement can improve the situation for all scenarios (compared to initial scenario). However, the effect is limited and cannot fully alleviate the choke risk without provision of additional quota (quota top up) to the fleet.

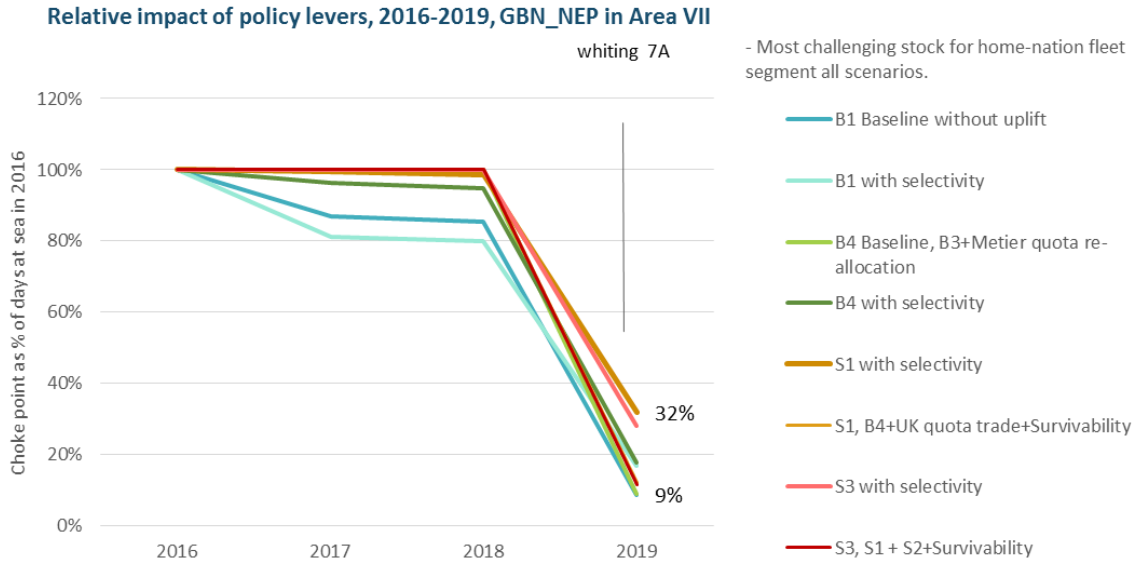

Figure 7.2.2. Northern Ireland nephrops fleet - Area 7 choke points under different simulations, compared to 2016 DAS

Scottish Nephrops trawl fleet in area 6

The zero TAC for cod and the limited TAC for whiting are choke stocks for the Scottish *Nephrops* fleet in the area 6. As we can see from figure 7.2.3 the use of an 80 mm + 160mm square mesh panel in combination with quota swaps allows the fleet to increase effort from 9% of 2016 days at sea in B4 scenario to 50% of 2016 days at sea in both quota trade scenarios.

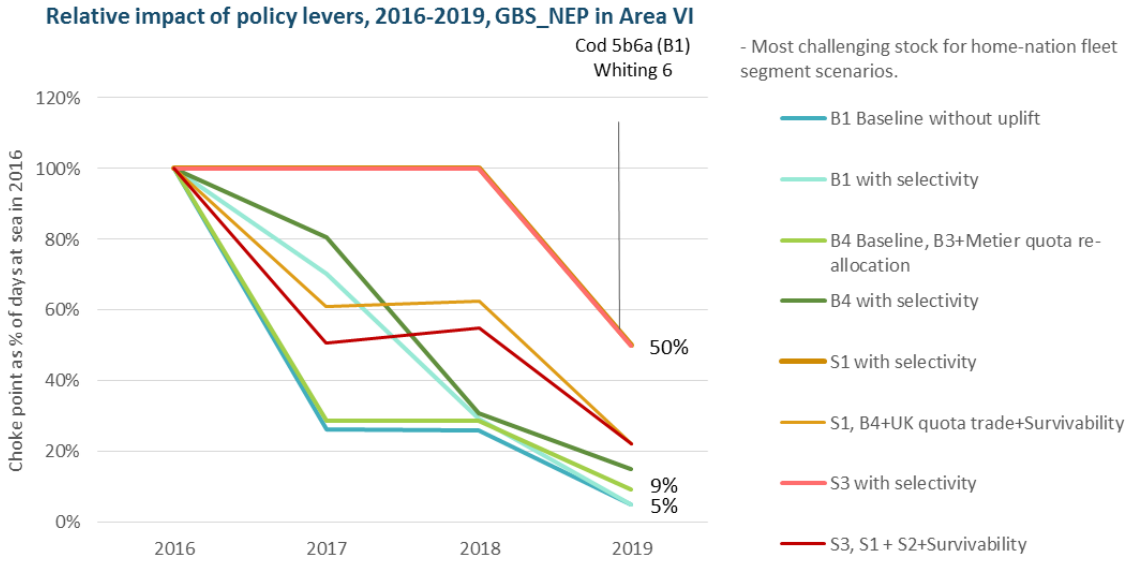

Figure 7.2.3 Scotland *Nephrops* fleet - Area 6 choke points under different simulations, compared to 2016 DAS

Scottish demersal trawl fleet in the area 6

In the case of Scottish demersal fleet in area 6 the effort of 49 vessels belonging to the fleet was mostly allocated to the North Sea. However, these vessels allocated 23% of their annual effort to area 6 and used both demersal trawls (TR1 and TR2). The model simulations are similar to the Irish Seas *Nephrops* fleet (see above) as shown in figure 7.2.4.

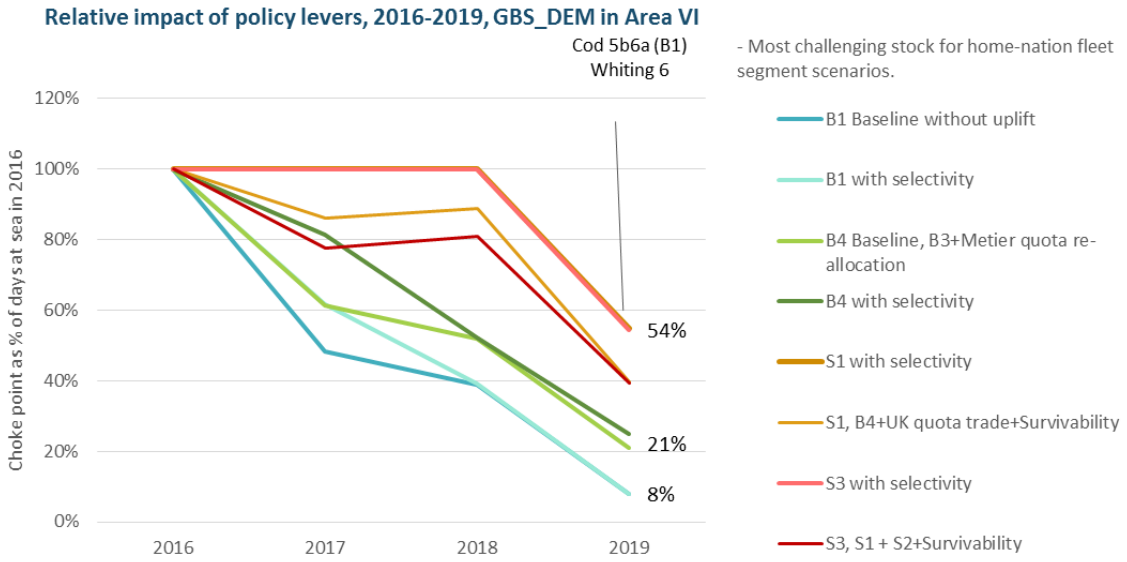

Figure 7.2.4 Scotland demersal fleet - Area 6 choke points under different simulations, compared to 2016 DAS

The overall conclusion from this case study is that changes of selectivity in combination with the quota management can help UK fleets to mitigate risk of choke. However, it does not fully eliminate the problem. The level that selectivity can help to mitigate against the risk depends on the fleet and the fishery.

8. CONCLUSIONS

- EWG 18-02 has reaffirmed the findings of the analysis carried out using the CMT that for some of the high risk (and several moderate risk) stocks improvements in selectivity are possible. However, there is a need to balance increased selectivity with maintaining economic viability and for some fisheries this will be difficult to acheive.

- Based on the analysis carried out by EWG 18-02 improvements in selectivity should be focused on trawl and beam trawl fisheries (TR1, TR2 and BT2) as these are the gear groups with the highest discard rates for the choke stocks identified.

- EWG 18-02 has identified that there are significant catches of the high risk choke stocks with other gears (e.g. Gillnets and longlines), but these gears are generally regarding as being selective. Attempting to improve selectivity further would yield only marginal benefits from a choke perspective, while potentially reducing the economic viability of such fisheries.

- EWG 18-02 has identified a number of trawl and beam trawl fisheries in the different regions of the North Western Waters where there are catches of the high risk choke stocks. Of these, 5 fisheries in the Celtic Sea, 3 fisheries in the West of Scotland, 1 fishery in the Irish Sea and 3 fisheries in the Channel where identified as fisheries where improvements in selectivity were possible.

- EWG 18-02 has identified that most effort to improve selectivity is required in the small mesh (less than 100mm) mixed demersal and *Nephrops* trawl fisheries as unwanted catches of the high risk choke species are highest in these fisheries.

- Levels of unwanted catches are also high in a number of beam trawl fisheries (BT2). However, improving selectivity in these fisheries is much more difficult, particularly in beam trawl fisheries targeting sole as losses of marketable sole likley following selectivity improvements would make such fisheries uneconomic.

- EWG 18-02 has reviewed a number of different selectivity devices and gear modifications that have been tested and shown to reduce the level of unwanted catches in the fisheries identified. The reductions achievable vary by fishery and by species but in some cases are significant. However, for many of these gears there is a consequential reduction in the marketable catches which will impact on fishermen.

- Given the wide range of selective gear options that have been tested across different fisheries it was not possible for EWG 18-02 to assess fully the likely reductions in unwanted catches of the relevant stocks that might reasonably be achieved. EWG 18-02 has managed to assess the likely benefits of improving selectivity using some representative devices or gear modifications in the identified fisheries in terms of reducing the choke risk and extending the time fisheries would remain open. This varies from fishery to fishery and is highly dependent on the population structure of the targeted stocks.

- EWG 18-02 was unable to assess fully the likely economic impacts resulting from changes in selectivity on the basis of losses of marketable catches of the stock or reductions in the marketable catches of other species contrasted with the economic impacts of a choke situation. However, EWG 18-02 has looked at two case studies which provide an indication of the benefits of selectivity in certain circumstances.

- The Landing Obligation Impact Assessment Model developed during EWG 18-02 shows the effect of high risk choke stocks on different fleets and what impact selectivity measures applied to those fleets has in mitigating against the risks of choke. In most cases the effect is relatively small with selectivity reducing the impact in the region of 5-20% depending on the fleet and fishery. The selectivity measures can have a beneficial effect but rarely resolve these choke problems for most fleets.

- The UK case study shows that changes of selectivity in combination with the quota management can help UK fleets to mitigate risk of choke. However it doesn't fully eliminate the problem. The level that selectivity can help to mitigate against the risk depends on the fleet and the fishery.

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11. ANNEXES

11.1. ANNEX I GEAR GROUPINGS

Gear groupings

(a) Bottom trawls and seines (OTB, OTT, PTB, SDN, SSC, SPR) of mesh:

TR1 equal to or larger than 100 mm,

TR2 equal to or larger than 70 mm and less than 100 mm,

TR3 equal to or larger than 16 mm and less than 32 mm;

(b) Beam trawls (TBB) of mesh:

BT1 equal to or larger than 120 mm

BT2 equal to or larger than 80 mm and less than 120 mm;

(c) Gill nets, entangling nets (GN);

(d) Trammel nets (GT);

(e) Longlines (LL)

11.2. Annex II Celtic Sea selectivity trials

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Mixed gadoid fishery (TR1)	Testing a 110mm smp in a seine net in the mixed gadoid fishery in the Celtic Sea	IE	Seine Net	Alternate Haul catch comaprison	100mm codend and extension	110mm smp @ 9-12m from the codline	Catches of undersized haddock were reduced by 59%. No whiting or hake below mcrs were caught in either gear Marketable catches of haddock were reduced by 60%, whiting by 81% and hake by 49%
	Using a 100mm smp in a seine net in the mixed gadoid fishery in the Celtic Sea to reduce discards	IE	Seine Net	Alternate Hauls catch comparison	100mm codend and extension	110mm smp @ 9-12m from the codline	Catches of undersized haddock were reduced by 58%. No whiting or hake below mcrs were caught in either gear Marketable catches of haddock were reduced by 2%, whiting by 36% and hake catches were unchanged
	Using a 110mm codend and a 100 smp in the mixed gadoid fishery in the Celtic Sea to reduce discards	IE	Single-rig	Covered codend selectivity experiment	100mm codend	110mm codend & 100mm smp @ 9-12m from the codline	L50 for haddock of 32.8cm and SR of 8.8cm L50 for whiting of 35.3cm and SR of 9.4cm
	Using a 120mm codend and a 100 smp in the mixed gadoid fishery in the Celtic Sea to reduce discards	IE	Single-rig	Covered codend selectivity experiment	100mm codend	120mm codend & 100mm smp @ 9-12m from the codline	L50 for haddock of 38.7cm and SR of 15cm L50 for whiting of 33cm and SR of 10.1cm

	Using a 120mm codend and a 120 smp in the mixed gadoid fishery in the Celtic Sea to reduce discards	IE	Single-rig	Covered codend selectivity experiment	100mm codend	120mm codend & 120mm smp @ 9-12m from the codline	L50 for haddock of 35.4cm and SR of 17.5cm L50 for whiting of 39.3cm and SR of 17cm
	Using 100mm T90 netting in the extension and codend to reduce discards in whitefish fisheries	FR	Demersal trawl (twin-rig)	Catch comparison	100mm codend	100mm T90 codend and extension	Up to 90% reduction in catches of undersized haddock 75-85% reduction in boarfish catches Reductions in marketable catches of non-quota species e.g. squid (30-70%)and red mullet (50%)
	Using 100mm T90 netting in the extension and codend and a 120mm square mesh panel to reduce discards in whitefish fisheries	FR	demersal (twin rig)	Catch comparison	100mm netting in the extension and codend and a 120mm square mesh panel	100mm T90 netting in the extension and codend & a 120mm square mesh panel	30% reduction of the total discard weight; Reduction in catches of haddock (20-70%); whiting (85-90%); hake (80%) 20-30 reduction in marketable whiting catches.
	Using 100mm square mesh tube In addition to 120mm to reduce discards in whitefish fisheries	FR	demersal (twin rig)	Catch comparison	100mm netting in the extension and codend and a 120mm square mesh panel	100mm square mesh tube section inserted above the extension and codend	30% reduction of total discards by weight. 50% reduction in catches of undersized haddock and reductions in catches of undersized whiting 10% loss in marketable monkfish catches
	Using a large T90 panel in the extension as an alternative to the mandatory square mesh panel	FR	demersal (twin-rig)	Catch comparison	100mm netting in the extension and codend and a 120mm square mesh panel	100mm x 13m section of T90 netting placed 4m from the codline	Reductions in catches of undersized haddock (42%), hake (69%) No significant differences in marketable catches

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Nephrops fishery (TR2)	Using a 45mm square mesh codend to reduce discards in a *Nephrops* trawl	IE	Quad-rigged Nephrops trawl	Catch comparison	75mm diamond mesh codend & 80mm smp	45mm square mesh codend	Reductions of 10% *Nephrops* (<25 mm CL), 9% *Nephrops* (25-31 mm CL), and an increase of 7% *Nephrops* (>31 mm CL). Increase in catches of undersized whiting (8%) and for haddock (18%) Reductions in marketable catches of whiting (9%) and an increase for haddock (17%)
	Using a 55mm square mesh codend to reduce discards in a *Nephrops* trawl	IE	Quad-rigged Nephrops trawls	Catch comparison	75mm diamond mesh codend & 80mm smp	55 mm square mesh codend	Reductions of 46% Nephrops (<25 mm CL), 49% Nephrops (25-31 mm CL), 38% Nephrops (>31 mm CL). Reductions in catches of haddock below mcrs (36%) and whiting. (49%) Reductions in catches of haddock above mcrs (34%) and whiting. (42%)
	Using a 65mm square mesh codend to reduce discards in a *Nephrops* trawl	IE	Quad-rigged Nephrops trawls	Catch comparison	75mm diamond mesh codend & 80mm smp	65 mm square mesh codend	Reductions of 63% Nephrops (<25 mm CL), 63% Nephrops (25-31 mm CL), and 37% Nephrops (>31 mm CL). Reductions in catches of haddock below mcrs (62%) and whiting. (66%) Reductions in catches of whiting above mcrs (7%)

	Using a quad-rig trawl to improve selection in a *Nephrops* fishery	IE	Quad-rig Nephrops trawls	Quad-rig vs twin—rig catch comparison	Twin rig 75mm codends and a 110mm smp @9-12m from the codline	Quad rig 75mm codends and a 110mm smp @9-12m from the codline	+106% Tailed Nephrops, +48% whole Nephrops, -61% Reductions in catches of cod (~61%), Haddock (38%) and whiting (3%)
	Using a large mesh square mesh panel in the Nephrops fisheries in VIIb-k to reduce discards of whitefish	IE	Twin-rig Nephrops trawls	Catch comparison	100mm codend and extension	200 smp @9-12m	Reduction in catches of marketable haddock above mcrs of 98% and hake of 17% Too few fish below mcrs to draw conclusions
	Using a 90mm codend and a 120mm to reduce discards in a directed Nephrops fishery	IE	Quad-rig Nephrops trawls	Catch comparison	80mm codend and 120mm smp @9-12m from the codline	90mm codend and 120mm smp @9-12m from the codline	90mm codend retained 23% of whiting, 51% of cod and 73% of haddock below mcrs compared to 25%, 53% and 78% respectively in the 80mm+120mm smp
	Using a 100mm codend and a 120mm to reduce discards in a directed Nephrops fishery	IE	Quad-rig Nephrops trawls	Catch comparison	80mm codend and 120mm smp @9-12m from the codline	100mm codend and 120mm smp @9-12m from the codline	100mm codend retained 19% of whiting, 51% of cod and 59% of haddock below mcrs compared to 25%, 53% and 78% respectively in the 80mm+120mm smp
	Using a coverless trawl in the Nephrops fisheries in VIIb-k to reduce discards of whitefish	IE	Twin-rig Nephrops trawls	Catch comparison	100mm codend and extension	Coverless trawl with 100mm codend	Reduction in catches of marketable haddock above mcrs of 42% and by hake of 12% Too few fish below mcrs to draw any conclusions

	Using a dual codend arrangement with an inclined separator panel to reduce the catches of undersized gadoids in a *Nephrops* fishery	IE	Quad-rig Nephrops trawls	Catch comparison	80mm codend and extension & 120mm smp @9-12m	Daul codend – 90mm T90 top codend & 80mm bottom codend with inclined separator panel	Reduction of Nephrops catches below mcrs of 11% Reduction in catches of haddock and whiting below mcrs of 84% and 49% respectively Reduction of whiting above mcrs of 54% Haddock catches above mcrs increased by 9%

Fishery	**Description of trial**	**Member State**	**Gear**	**Experimental design**	**Standard gear**	**Tested gear**	**Summary of Results**
Directed whiting fishery (TR2)	Assessment of T90 mesh in a fishery targeting whiting in the Celtic Sea	IE	twin-rig	Catch comparison	80 mm diamond mesh extension and codend & 120mm smp @ 9-12m from the codline	80 mm T90 diamond mesh extension and codend	Overall reduction in whiting catch of 22%- Catches of undersized whiting significantly reduced (60%) and for haddock were reduced by 6% Marketable catches of whiting were reduced by 7% and increased significantly for haddock (204%)
	Using an 80mm codend and a 110 square mesh panel to reduce discards of undersized gadoids	IE	Single-rig	Covered codend selectivity experiment	80mm codend	80mm codend & 110mm smp @ 9-12m from the codline	L50 for haddock of 33cm and SR of 14.1cm L50 for whiting of 32.1cm and SR of 6.6cm L50 for hake of 31cm and SR of 12.8 cm

	Using a 100mm codend with a 100mm square mesh panel to reduce discards of undersized gadoids	IE	Single-rig	Covered codend selectivity experiment	80mm codend	100mm codend & 100mm smp @ 9-12m from the codline	L50 for haddock of 33.4cm and SR of 8.2cm L50 for whiting of 37.4cm and SR of 6.5cm L50 for hake of 37.9cm and SR of 9.6cm
	Using a raised footrope trawl to reduce the catches of cod in a demersal fishery targeting whiting	IE	Twin - rig	Catch comparison	80mm codend+ 100mm smp@ 9-12m from the codline	80mm codend & 120mm smp @9-12m from the codline with a raised fishing line	L50 for haddock of 34.5cm and SR of 18.3cm L50 for whiting of 37.2cm and SR of 9cm L50 for megrim of 33.2cm and SR of 14.6cm L50 for hake of 32.3cm and SR of 17.8cm

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Mixed demersal (TR1/TR2)	Using a 90mm codend to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	90mm codend	L50 for haddock of 27.1cm and SR of 13.1cm L50 for whiting of 31.1cm and SR of 9.6cm L50 for megrim of 33.8cm and SR of 17.4cm
	Using a 100mm codend to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	100mm codend	L50 for haddock of 28cm and SR of 11.9cm L50 for whiting of 36cm and SR of 14cm L50 for megrim of 34.6cm and SR of 11cm

	Using a 110mm codend to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	110mm codend	L50 for haddock of 33cm and SR of 19.5cm L50 for whiting of 37.4cm and SR of 18cm L50 for megrim of 38.5cm and SR of 14.7cm
	Using a 120mm codend to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	120mm codend	L50 for haddock of 42.7cm and SR of 9cm L50 for megrim of 41.3cm and SR of 9.5cm
	Using an 80mm codend with a 140mm smp to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Covered codend selectivity experiment	80mm codend	80mm codend & 140mm smp @ 9-12m from the codline	L50 for haddock of 25cm and SR of 15cm L50 for whiting of 47cm and SR of 16cm L50 for megrim of 21.5cm and SR of 9.9 cm
	Using an 100mm codend with a 160mm smp to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Covered codend selectivity experiment	80mm codend	100mm codend & 160mm smp @ 9-12m from the codline	L50 for haddock of 38.7cm and SR of 15cm L50 for whiting of 52.2cm and SR of 13.5cm L50 for megrim of 30.5cm and SR of 20.5cm

	Using an 80mm codend and a 120mm smp to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	80mm codend & 120mm smp @9-12m from the codline	L50 for haddock of 28.2cm and SR of 14.8cm L50 for whiting of 32.8cm and SR of 13.5cm L50 for megrim of 29.1cm and SR of 15.6cm
	Using a 90mm codend and a 120mm smp to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	90mm codend & 120mm smp @9-12m from the codline	L50 for haddock of 34.5cm and SR of 18.3cm L50 for whiting of 37.2cm and SR of 9cm L50 for megrim of 33.2cm and SR of 14.6cm L50 for hake of 32.3cm and SR of 17.8cm
	Using an 100mm codend and a 120mm smp to reduce catches of undersized gadoids in a mixed demersal fishery	IE	Single-rig	Twin-trawl paired selectivity experiment	80mm codend	90mm codend & 120mm smp @9-12m from the codline	L50 for haddock of 39.2cm and SR of 10.8cm L50 for megrim of 38.8cm and SR of 16.2cm

11.3. Annex III Irish Sea selectivity trials

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Nephrops fishery (TR2)	Using a Swedish grid with a bottom gap to reduce fish catches in a Nephrops trawl	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @9-12m	Swedish sorting grid with 35mm bar spacing and a 15cm escape gap and 70mm codend	2% reduction in Nephrops catches < mcrs and 4.5% reduction in Nephrops catches > mcrs 77% reduction in whiting catches 100% reduction in cod catches 91% reduction in haddock catches
	Assessment of rigid sorting grids in an Irish quad-rig trawl fishery for Nephrops	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @9-12m from codline	Swedish sorting grid with 35mm bar spacing and 70mm codend	4% reduction in Nephrops catches. Biggest reduction of Nephrops > 31cm (11%) 87% reduction in total catches of whiting 100% reduction in catches of cod 92% reduction in catches of haddock
	Assessment of rigid sorting grids in an Irish quad-rig trawl fishery for Nephrops	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @9-12m from codline	Nephrops sorting grid with 15mm bar spacing in lower grid & escape opening in top grid and 70mm codend	15-20% reduction in Nephrops catches. Biggets reductions in Nephoprs < mcrs with 3-4 % reduction in Nephrops > 31cm No reduction in catches of cod, haddock and whiting
	Assessment of an increase in codend mesh size in the Irish Sea Nephrops fishery	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 120mmm smp @9-12m from codline	80mm codend with 120mm smp @9-12m from codline	12% reduction in Nephrops catches. 45% reduction in Nephrops catches < mcrs and 11% reduction in Nephrops catches > mcers No reduction in catches of cod, haddock and whiting

	Assessment of an increase in codend mesh size in the Irish Sea Nephrops fishery	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 120mmm smp @9-12m from codline	90mm codend with 120mm smp @9-12m from codline	22% reduction in Nephrops catches. 44% reduction in Nephrops catches < mcrs and 21% reduction in Nephrops catches > mcers 68% reduction in whiting catches No reduction in catches of cod and haddock
	Assessment of an increase in codend mesh size in the Irish Sea Nephrops fishery	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 120mmm smp @9-12m from codline	100mm codend with 120mm smp @9-12m from codline	21% reduction in Nephrops catches. 55% reduction in Nephrops catches < mcrs and 20% reduction in Nephrops catches > mcers 6% reduction in whiting catches 4% reduction in haddock catches
	Using a 300mm smp to reduce fish catches in a Nephrops trawl fishery	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @9-12m from codline	70mm codend with 300mm smp @9-12m from codline	14% increase in Nephrops catches 70% reduction in haddock catches 52% reduction in whiting catches
	Using a SELTRA Sorting Box in the Irish Sea Nephrops fishery to reduce fish catches	IE	Twin-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp@ 9-12m from the codline	200mm SELTRA and 70mm codend	32% reduction in catches of whole Nephrops and 34% reduction in tailed Nephrops 70% reduction in haddock catches 52% reduction in whiting catches 67% reduction in cod catches
	Using a SELTRA sorting Box in the Irish Sea Nephrops fishery to recue fish catches	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @ 9-12m from the codline	300m SELTRA and 70mm codend	90% reduction in catches of haddock and whiting

	Using a SELTRA sorting Box in the Irish Sea Nephrops fishery to recue fish catches	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 80mm smp @ 9-12m from the codline	300m SELTRA and 70mm codend	9% increase in Nephrops catches 33% reduction in Nephrops catches < 20mm CL and 19% increase in Nephrops catches above 20mm CL 53% reduction in whiting catches < mcrs and 83% reduction in whiting catches > mcrs 89% reduction in haddock catches < mcrs and 98% reduction in haddock catches > mcrs
	Using a SELTRA sorting Box in the Irish Sea Nephrops fishery to recue fish catches	IE	Quad-rig Nephrops trawls	Catch comparison	70mm codend with 300mm smp @ 9-12m from the codline	300m SELTRA and 70mm codend with adapter section	19% increase in Nephrops catches 16% reduction in Nephrops catches < 20mm CL and 24% increase in Nephrops catches above 20mm CL 18% reduction in whiting catches < mcrs and 74% reduction in whiting catches > mcrs 54% reduction in haddock catches < mcrs and 44% reduction in haddock catches > mcrs
	Assessment of an inclined panel and flotation devices in a SELTRA Box trawl	IE	Twin-rig Nephrops Trawls	Catch comparison	300mm SELTRA and 70mm codend	Modified 300mm SELTRA and 70mm codend with inclined panels	12% reduction in Nephrops catches 10% reduction in catches pof whiting < mcrs No reduction in haddock catches

	Assessment of 120mm smp inserted in a Nephrops trawl to reduce fish catches	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm codend with 120mm smp @9-12m from codline	~ 40% reduction in catches of haddock No reduction in whiting catches
	Assessment of 120mm smp constructed in dyneema netting inserted in a Nephrops trawl to reduce fish catches	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm codend with 120mm smp @ 4-6m from codline	~50% reduction in whiting catches No reduction in haddock catches
	Assessment of 120mm smp @ 15-18m inserted in a Nephrops trawl to reduce fish catches	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm codend with 120mm smp @ 15-18m from codline	~10-15% reduction in Nephrops catches ~30-40% reduction in haddock catches ~60-70% reduction in whiting catches
	Assessment of a 50mm square mesh codend to reduce fish catches in a Nephrops trawl fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	50mm square mesh codend and extension codend with 80mm smp @ 9-12m from codline	~58% reduction in Nephrops catches 44% reduction in haddock catches 75% reduction in whiting catches
	Assessment of 120mm smp @ 4.5m – 7.5m inserted in a Nephrops trawl to reduce fish catches	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm codend with 120mm smp @ 4.5m – 7.5mm from codline	~10-20% reduction in Nephrops catches No reduction in haddock catches ~20-30% reduction in whiting catches
	Assessment of a split 120mm smp @ 9-12m inserted in a Nephrops trawl to reduce fish catches	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm codend with 120mm split smp @ 9-12m from codline – strip of diamond mesh inserted between smps	No reduction in Nephrops catches 54% reduction in haddock catches 65% reduction in whiting catches

	Assessment of a Swedish sorting grid in a Nephrops trawl fishery (twin-rig) to reduce discarding of fish	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	Sorting grid with 35mm bar spacing and 80mm codend	18% reduction in total catch 15% reduction in Nephrops catch 80-90% reduction in whiting catches > 22cm
	Assessment of a Swedish sorting grid in a Nephrops trawl fishery (single-rig) to reduce discarding of fish	UK	Single-rig Nephrops Trawls	Alternate hauls Catch comparison	80mm codend and 90mm smp @9-12m from codline	Sorting grid with 35mm bar spacing and 80mm codend	56% reduction in total catch 82% reduction in Nephrops catch Reduction in whiting, plaice and haddock catches > 22cm but increased catches below 17cm
	Assessment of a Stornway flexible sorting grid in a Nephrops trawl fishery (twin-rig) to reduce discarding of fish	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	Flexible grid with 35mm bar spacing and 80mm codend	30% reduction in total catch 39% reduction in Nephrops catch Reduction in whiting, plaice and haddock catches > 22cm but increased catches below 17cm
	Assessment of a Danish flexible sorting grid in a Nephrops trawl fishery (single-rig) to reduce discarding of fish	UK	Single-rig Nephrops Trawls	Alternate haul Catch comparison	80mm codend and 90mm smp @9-12m from codline	Flexible grid with 35mm bar spacing and 80mm codend	45% reduction in Nephrops catch Reduction in whiting, plaice and haddock catches > 22cm but increased catches below 17cm
	Assessment of a coverless Nephrops trawl (twin-rig) to reduce discarding of fishin a Nephrops fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	Coverless trawl with 80mm codend and 90mm smp@ 9-12m from codline	No significant difference in catches
	Assessment of a coverless Nephrops trawl (single-rig) to reduce discarding of fish in a Nephrops fishery	UK	Single-rig Nephrops Trawls	Alternate haul catch comparison	80mm codend and 90mm smp @9-12m from codline	Coverless trawl with 80mm codend and 90mm smp@ 9-12m from codline	36% reduction in Nephrops catches No significant difference in catches of fish

	Assessment of a SELTRA box codend (twin-rig) to reduce discarding of fish in a Nephrops fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	200mm SELTRA with 80mm codend and 90mm smp@ 9-12m from codline	5-6% increase in Nephrops catches 67% reduction in cod catches No significant difference in haddock and whiting catches
	Assessment of a SELTRA box codend (single –rig) to reduce discarding of fish in a Nephrops fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	200mm SELTRA with 80mm codend and 90mm smp@ 9-12m from codline	No difference in Nephrops catches Marginal reduction in cod catches Reduction in whiting, plaice and haddock catches > 22cm but increased catches below 17cm
	Assessment of a SELTRA box codend (twin-rig) to reduce discarding of fish in a Nephrops fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	300mm SELTRA with 80mm codend and 90mm smp@ 9-12m from codline	11% decrease in Nephrops catches 82% reduction in cod catches Reduction in whiting, plaice and haddock catches > 22cm but increased catches below 17cm
	Assessment of a SELTRA box codend (single –rig) to reduce discarding of fish in a Nephrops fishery	UK	Twin-rig Nephrops Trawls	Catch comparison	80mm codend and 90mm smp @9-12m from codline	300mm SELTRA with 80mm codend and 90mm smp@ 9-12m from codline	40% increase in Nephrops catches 32% reduction in cod catches No significant difference in haddock and whiting catches

11.4. Annex IV – West of Scotland selectivity trials

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Mixed gadoid fishery (TR1)	Using 300mm diamond mesh netting panels to reduce discards of cod in a whitefish trawl gear	UK	Twin-rig whitefish trawls	Catch comparison	120mm codend with 160mm front section	120mm codend with 300mm front section	No reductions in catches of haddock and whiting Fewer smaller cod (< 78cm) were retained anglerfish and megrim catches were reduced by 16% and 43%
Mixed demersal fishery (TR1)	Assessment of a 110mm codend and 120mm smp @9-12m compared to the regulation 120mm and 120mm smp gear combination to reduce fish catches in a mixed demersal fishery	IE	Single-rig whitefish trawl	Alternate haul catch comparison	120mm codend and 120mm smp @9-12m from codline	110mm codend and 120mm smp @9-12m from codline	38% increase in haddock catches 44% increase on in whiting catches
	Removing a tickler chain from a whitefish trawl to reduce the capture of skates and rays while retaining commercial species	UK	Single-rig whitefish trawl	Alternate haul catch comparison	120mm codend and 1200mm smp @9-12m from codline and tickler chain	120mm codend and 1200mm smp @9-12m from codline and without tickler chain	No reduction in catches of haddock and whiting Significant reductions in catches of skates and anglerfish

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Nephrops fishery (TR2)	Increasing codend mesh size to reduce discards of *Nephrops*, haddock and whiting in a *Nephrops* trawl	UK	Twin-rig Nephrops trawls	Catch comparison	80mm codend (5mm double PE twine) and 120mm smp @ 9-12m from codline	80mm codend (4mm single) and 120mm smp @ 9-12m from codline	Selectivity increasesover the lower size range of Nephrops (< 38mm)
	Increasing codend mesh size to reduce discards of *Nephrops*, haddock and whiting in a *Nephrops* trawl	UK	Twin-rig Nephrops trawls	Catch comparison	80mm codend (5mm double PE twine) and 120mm smp @ 9-12m from codline	100mm codend (5mm double) and 120mm smp @ 9-12m from codline	Selectivity increases over the size range 39mm-47mms (< 38mm)

	Increasing codend mesh size to reduce discards of *Nephrops*, haddock and whiting in a *Nephrops* trawl	UK	Twin-rig Nephrops trawls	Catch comparison	80mm codend (5mm double PE twine) and 120mm smp @ 9-12m from codline	120mm codend (5mm double) and 120mm smp @ 9-12m from codline	Selectivity increases over entire size range
	Using a 35mm Swedish sorting grid to reduce capture of fish in a *Nephrops* trawl	UK	Twin-rig Nephrops trawls	Twin-trawl paired selectivity experiment	40mm codend	Swedish sorting grid with 35mm bar spacing and 80mm codend	No losses of Nephrops < 40mm CL but losses of 10-25% in the length range 41-58mm 100% reduction in fish catches above mcrs
	Using a 120mm smp @ 6-9m to reduce capture of fish in a *Nephrops* trawl	UK	Twin-rig Nephrops trawls	Twin-trawl paired selectivity experiment	40mm codend	80mm codend with 120mm smp @6-9m from codline	12-30% reduction in Nephrops catches < 37mm No diference between SMP position on catch rates of other species.
	Using a 120mm smp @ 12-15m to reduce capture of fish in a Nephrops trawl	UK	Twin-rig Nephrops trawls	Twin-trawl paired selectivity experiment	40mm codend	80mm codend with 120mm smp @12-15m from codline	12-30% reduction in Nephrops catches < 37mm No difference between SMP position on catch rates of other species
	Using a large mesh top sheet inserted into a *Nephrops* trawl for reducing commercial gadoid species bycatch	UK	Twin-rig Nephrops trawls	Catch comparison	85mm codend with 120mm smp @9-12m from codline	290mm top sheet panel and 85mm codend with 120mm smp @9-12m from codline	No significant differences in catches of gadoid species

11.5. Annex V Western and Eastern Channel selectivity trials

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Mixed Gadoid/Non quota (TR2)	100mm square mesh panels in the codend to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	Coverless trawl with a 100mm codend and a 100mm SMP 9m from the codline	Additional 100 mm SMP in the codend	Released almost all small fish and there were large reductions in unmarketable haddock Some losses of marketable whiting, monkfish and plaice for smaller size classes
	100mm square mesh panels in the codend to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	Coverless trawl with a 100mm codend	Additional 100 mm SMP in the codend & 100mm smp @9-12m from the codline	Released almost all small fish Marketable losses of monkfish ~15%; haddock ~-18%; whiting ~-55%
	115mm and 155mm square mesh panels in the body of a trawl to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	115mm mesh size trawl with a 87mm codend and a 115mm SMP, 6-9m from the codline	Additional 155mm SMP @ 2.5-5.5m from the codline & 155mm SMP @ 9.5-12.5M from the codline.	Reductions in haddock catches across all size ranges ~-60%
	115mm and 155mm square mesh panels in the body of a trawl to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	115mm mesh size trawl with a 87mm codend and a 115mm SMP @6-9m codline	Additional 155mm SMP fitted 9.5m-12.5m from the codline	No reduction in overall haddock catches and significant numbers of small haddock were still caught
	115mm and 155mm square mesh panels in the body of a trawl to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	115mm mesh size trawl with a 87mm codend and a 115mm SMP @6-9m codline	Additional 155mm SMP fitted 2.5-5.5m from the codline	Reduction in catches of haddock above 25cm although substantial catches of small haddock below 25cm were still retained Significant and substantial reduction in cod catches acroos the full length range and reductions in catches of other marketable species

	115mm and 155mm square mesh panels in the body of a trawl to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	155mm mesh size trawl with a 87mm codend	155mm SMPs @ 2.5-5.5m from codline	Significant and substantial reductions in catches of cod and haddock (~-85%) Significant losses of most other marketable species
	200mm diamond-mesh netting in the wings, square and back sections of a trawl to improve size selection and reduce undersized haddock in ICES Area VII	UK	demersal (twin rig)	Twin-trawl catch comparison	115mm mesh size trawl with a 100mm codend	Modified gear incorporated 200mm mesh size wings, square and lower back	Reduction in haddock catch across all length classes (~-45%) with still large quantities of undersized haddock
	Using cylindrical grids in the codend to reduce flatfish discards in the Dutch Nephrops fishery	NL	Twin-rig	Catch comparison	80mm codend	Three cylindrical grids inserted into the codend with an escape hole at the end with a 80mm codend	Reduction in flatfish discards not quantified
	Using a large square mesh panel (90mm) in the last tapered section of the trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend	90mm square mesh panel ($33m^2$) in last tapered section	~56% reduction in whiting catches < mcrs ~40% reduction in whiting catches in size range 27-32cm No reduction in catches of haddock or pelagic species
	Using a large square mesh panel (80mm) in the last tapered section of the trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend	80mm square mesh panel ($14m^2$) in last tapered section	~35% reduction in whiting catches < mcrs 90% reduction in mackerel catches < 20cm 76% reduction in catches of horse mackerel < 76%

	Using an 80mm square mesh panel in the last tapered section and extension of the trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	100mm codend	80mm smp (6.75m long) @ 15-18m from the codline and 100mm codend	35% reduction in catches of haddock < mcrs 13% reduction in haddock catches in size range 30-34cm Reduction in whiting catches < mcrs 71% reduction in whiting catches in size range 27-32cm Reduction in catches of mackerel and horse mackerel of 78% and 65% respectively 46% reduction in catches of red mullet
	Using an 80mm T90 panel in the last tapered section and extension of the trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend	80mm T90 section ($15m^2$) @ 13-18.5m from the codline and 80mm codend	68% reduction in haddock catches < mcrs 73% reduction in whiting catches < mcrs 44% reduction in whiting catches in size class 27-32cm Reduction in catches of mackerel and horse mackerel of 85% and 48% respectively
	Using a 2m cylinder of 80mm square mesh in a whitefish trawl to reduce unwanted catches in vessels greater than 18m	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm square mesh cylinder (2m) and 80mm codend and 80mm smp @9-12m from the codline	34% reductions in whiting catches < mcrs 2% reductions in whiting catches > mcrs 22% reduction in mackerel catches < mcrs 14% increase in mackerel catches > mcrs
	Using a 2m cylinder of 80mm square mesh in a whitefish trawl to reduce unwanted catches in vessels less than 18m	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm square mesh cylinder (2m) and 80mm codend and 80mm smp @9-12m from the codline	1% reduction in total marketable catch and 39% reduction in discards 59% reduction in whiting catches < mcrs 2% reduction in whiting catches > mcrs

							29% reduction in catches of plaice < mcrs 22% reduction in catches of plaice > mcrs 4% reduction in catches of cuttlefish
	Using a 1m cylinder of 80mm square mesh in a whitefish trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm square mesh cylinder (1m) and 80mm codend and 80mm smp @9-12m from the codline	28% reduction in whiting catches < mcrs 1% reduction in whiting catches > mcrs 45% reduction in mackerel catches < mcrs 54% reduction in mackerel catches > mcrs 23% reduction in catches of plaice < mcrs 24% reduction in catches of plaice > mcrs
	Using a 2m cylinder of 115mm square mesh in a whitefish trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	115mm square mesh cylinder (2m) and 80mm codend	22% reduction in total marketable catch and 37% reduction in discards 35% reduction in whiting catches < mcrs 47% reduction in whiting catches > mcrs 54% reduction in mackerel catches < mcrs 49% reduction in mackerel catches > mcrs 14% reduction in catches of plaice < mcrs 3% reduction in catches of plaice > mcrs

	Using a 2m cylinder of 100mm square mesh in a whitefish trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	100mm square mesh cylinder (2m) and 80mm codend and 80mm smp @9-12m from the codline	39% reduction in total marketable catch and 36% reduction in discards 58% reduction in whiting catches < mcrs 50% reduction in whiting catches > mcrs 88% reduction in mackerel catches < mcrs 38% reduction in mackerel catches > mcrs 29% reduction in catches of plaice < mcrs 57% reduction in catches of plaice > mcrs 29% reduction in catches of cuttlefish
	Using a 2m cylinder of 80mm square mesh and semi-rigid grid in a whitefish trawl to reduce unwanted catches	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm square mesh cylinder (2m) and semi rigid grid with 80mm codend	1% reduction in total marketable catch and 8% reduction in discards 34% reduction in whiting catches < mcrs 15% increase in whiting catches > mcrs 55% reduction in mackerel catches < mcrs 19% increase in mackerel catches > mcrs 39% reduction in catches of plaice < mcrs 27% reduction in catches of plaice > mcrs 13% reduction in catches of cuttlefish
	Using a 2m cylinder of 80mm square mesh and horizontal rigid grid in a whitefish trawl to	FR	Single trawl	Alternate haul catch comparison	80mm codend and 80mm smp @9-12m from codline	80mm square mesh cylinder (2m) and horizontal grid with	24% reduction in total marketable catch and 78% reduction in discards

	reduce unwanted catches vessels less than 18m					80mm codend	93% reduction in whiting catches < mcrs 34% reduction in whiting catches > mcrs 42% reduction in catches of plaice < mcrs 28% reduction in catches of plaice > mcrs 55% reduction in catches of cuttlefish

Fishery	Description of trial	Member State	Gear	Experimental design	Standard gear	Tested gear	Summary of Results
Sole & mixed demersal beam trawl fishery (BT2)	Increasing mesh size in the extension of a beam trawl to improve the selectivity of sole	BE	Beam Trawl	Catch comparison	80mm codend with 100mm extension	80mm codend with 150mm extension	20% reduction in total sole catches 40% reduction in sole catches < mcrs 16% reduction in sole catches > mcrs
	Using a T90 netting codend to improve the selectivity of whiting and pouting in the beam trawl fishery	BE	Beam Trawl	Catch comparison	80mm codend	80mm T90 codend	No Reduction in sole or plaice catches 86% reduction in whiting catches and 64% reduction in pouting catches
	Using a square mesh codend in the beam trawl fishery to improve the selection of roundfish	BE	Beam Trawl	Catch comparison	80mm codend	80mm square mesh codend	No reduction in sole and plaice catches
	Using large square mesh top panels to reduce roundfish bycatch in the beam trawl fishery	BE	Beam Trawl	Catch comparison	80mm codend	120mm x 85meshes deep square mesh top panel and 80mm codend	12% reduction in cod catches 48% reduction in whiting catches 43% reduction in haddock catches

							6% reduction in sole catches No reduction in plaice catches
	Using large square mesh top panels to reduce roundfish bycatch in the beam trawl fishery	BE	Beam Trawl	Catch comparison	80mm codend	120mm x 128 meshes deep square mesh top panel and 80mm codend	12% reduction in cod catches 66% reduction in whiting catches 63% reduction in haddock catches 13% reduction in sole catches 1% reduction in plaice catches
	Using a horizontal separator panel to separate bycatch from the catch in the beam trawl fishery	BE	Beam Trawl	Catch comparison	80mm codend	240mm square mesh horizontal separator panel and 80mm codend	70-88% of sole were retained in the lower codend 40-75% of plaice were retained in the lower codend

12. List of Background Documents

Background documents are published on the meeting's web site on:
https://stecf.jrc.ec.europa.eu/ewg1802

List of background documents:

EWG-18-02 – Doc 1 - Declarations of invited and JRC experts (see also section XX of this report – List of participants)

North Western Waters Choke Species Analysis - NWW Member States & NWW Advisory Council October 2017

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STECF

The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

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