PROJECT UK

DELIVERING FISHERY IMPROVEMENTS IN THE NORTH EAST ATLANTIC

North Sea Lemon Sole and Plaice fisheries: Review of alternative measures that minimise mortality of unwanted catch or ETP species

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Version 7

May 2021

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Executive Summary

In line with the MSC Fisheries Assessment Methodology requiring that fisheries adequately consider the MSC Principles & Criteria in relation to gear selectivity. This paper provides a review of current and potential alternative measures, to minimise the mortality of unwanted catch and ETP species within the North Sea plaice and lemon sole fisheries.

Through a catch composition analysis carried out on the fisheries geographic area and an observer programme, several key ETP species have been identified, including spurdog, common skate, white skate, undulate ray, thornback ray, and starry ray (

). Of which, common skate and starry ray are on the EU prohibited species list. An updated set of technical conservation regulations being discussed as well as the landing obligation having been phased in. The industry has already been proactive to introduce data collection programs and management strategies to ensure, where needed, corrective actions are innated in relation to ETP species. There is also assessment of the effects of Osprey trawler's fishery on the starry ray stock.

The introduction of the EU landing obligation posed a significant challenge for some mixed species UK and EU fisheries. There have been important advances in improving selectivity in fisheries in recent years and the assessment and management plans are working towards reducing choke species through more flexible TAC setting within a range around F_{MSY}. However, it has been recognised that there is still a need to find solutions for reducing discards by improving selectivity in the broadest sense. The formation of Fisheries Innovation Scotland (FIS) has proved to be a valuable platform for the industry in meeting identifying research requirements and implementing projects to respond to these challenges. In addition to Fisheries Innovation Scotland, there are other examples of communication and knowledge exchange initiatives within the UK and Scottish fisheries sector aimed at fishery managers, fishers and industry groups, including: FMAC; the Fisheries Management and Conservation Group, which is a decision making body concerning all issues concerning management of seafish in Scottish waters, Gear Innovation and Technology Advisory Group (GITAG), Marine Scotland Project DiscardLess, Seafish Quay Issues and Seafish gear technology courses.

This paper concludes that given both the regulatory obligation and the existence of numerous initiatives aiming to deliver and communicate the required research into improved selectivity, it should be recognised that SG80 is met - in that there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species and they are implemented as appropriate.

Appendix 1 discusses the effects of technical measures on lemon sole, plaice, cod and haddock selectivity in relation to cod end mesh sizes in mixed fisheries, and some information on, length frequency distributions and how these translate into commercial grades of fish. Appendix 2 discusses the SFSAG survey of ETP species, and the status of the stocks of these species.

Version number	Date published	Key contributors	Description of key changes
1.0 – 6.0		William Lart, Cameron Moffat, David Parker and Mike Mitchell	
7.0		William Lart, Kenny Coull, Cameron Moffat	Inclusion of information pasted in from Kenny Coull; Kenny to check he is OK with what has been done

1 Introduction

The MSC Fisheries Assessment Methodology requires that fisheries adequately consider the MSC Principles & Criteria, in relation to gear selectivity, namely that fisheries should:

"Make use of fishing gear and practices designed to avoid the capture of non-target species (and non-target size, age, and/or sex of the target species); minimise mortality of this catch where it cannot be avoided, and reduce discards of what cannot be released alive" (Criterion 3B.12).

In addition, FAO (1995), states that;

*"selective and environmentally safe fishing gear and practices should be further developed and applied, to the extent practicable, in order to maintain biodiversity and to conserve the population structure and aquatic ecosystems and protect fish quality. **Where proper selective and environmentally safe fishing gear and practices exist, they should be recognized and accorded a priority in establishing conservation and management measures for fisheries."***

To ensure this, the MSC has recently added a "Review of alternative measures" to several performance indicators to encourage the development and implementation of technologies and operational methods that minimise mortality of unwanted catch or ETP species", the desired outcomes being:

- To motivate fishers to continually "think smart" about their impact on the environment (species and habitats); both in delivering the sustainable impact most efficiently - and continuing to reduce their impact beyond that.
- To balance this desire with efficiency by not spending a lot of money and time generating only marginal improvements.

To achieve this for species, the scoring issue has been added to the P1 Harvest Strategy (PI 1.2.1) and P2 Species Management PIs (PI 2.1.2, 2.2.2, 2.3.2) requiring fisheries to continually review alternative measures to encourage the development and implementation of technologies and operational methods that minimise mortality of unwanted catch or ETP species, taking into account the practicality of the measures, their potential impact on other species and habitats and on the overall cost of implementing the measures.

Fisheries need to either review alternative measures that are shown to minimise mortality of the species or species group in question. Fisheries also need to consider alternative measures to reduce impacts on habitats. Fisheries should also take account of the potential for both positive and negative impacts of alternative measures on species and habitats when considering whether such measures should be implemented.

Alternative measures should avoid capture of the species in the first place or increase its survivability if released. Alternatively, in the case of in-scope species, they could utilise the unwanted catch in some way so that it would no longer be 'unwanted'. If there are no unwanted species, the scoring issue on reviewing alternative measures does not need to be scored in that PI.

Alternative Measures Definition: Fishing gear and practices that have been shown to minimise the rate of incidental mortality of the species or species type to the lowest achievable levels.

Alternative Measures Scoring Guideposts

- SG 60 There has been **a review** of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species.
- SG 80 There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species and they are implemented as appropriate.
- SG 100 There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species., and they are implemented, as appropriate.

Table 1 Tabulation of scoring guideposts

Performance indicator and scoring issue	Species group	Comment
1.2.1 Harvest strategy (f)	Target species	SG80-100
2.1.2 Primary species management strategy (e)	Main species cod had whiting	SG100 based on mixed fishery assessment and the FMAC
2.2.2 Secondary Species management strategy (e)	Secondary species	TBC
2.3.2 ETP species management strategy (e)	ETP species	SG80-100 based on continued monitoring of ETP species

2 Fishery Management measures

These are divided into input controls and output controls.

Input controls are designed to regulate the quantity and type of fishing 'effort', often quantified in terms of vessel, size, power and time at sea. Days at sea regulations, where vessels of a given power and gear type are restricted to a certain number of days at sea in a given period, are input controls. Technical measures can be considered a subset of input controls as they directly control the design and deployment of the gear, including selectivity devices and mesh sizes and also seasonal and area closures.

Output controls are designed to control the quantity and composition of the catch and include Minimum Landing Sizes (now described as Minimum Conservation Reference Sizes), Total Allowable Catches (TACs), which may be shared into quotas for individual nations or fishers, and so-called 'bag limits' which limit the quantity of fish a fisher can remove in a day.

Technical Conservation Measures

The links for recent documents are;

- Technical Conservation measures see; EU 2019/1241; Technical Conservation Regulations
- Discard plan for North Sea https://ec.europa.eu/transparency/regdoc/rep/3/2018/EN/C-2018-6793-F1-EN-MAIN-PART-1.PDF

From the Technical Conservation Regulations **Article 4** states that;

1. Technical measures shall aim to ensure;
    a. That catches of marine species below minimum conservation reference sizes are reduced as far as possible in accordance with Article 2(2) and Article 15 of Regulation (EU) No 1380/2013
    b. That bycatches of marine mammals, marine reptiles, seabirds and other non-commercially exploited species do not exceed levels provided for in Union legislation and international agreements that are binding on the Union.
    c. Ensure that the environmental impacts of fishing activities on seabed habitats are in line with Article 2 (5) (j) of Regulation (EU) No 1380/2013
2. The extent to which these targets have been achieved shall be reviewed as part of the reporting process set out in Article 34.

Article 34

1) By the end of [2020 and every third year] thereafter, and on the basis of information supplied by Member States and the relevant Advisory Councils and following evaluation by the STECF, the Commission shall submit a report to the European Parliament and to the Council on the implementation of this Regulation. This report shall assess the extent to which technical measures both regionally and at Union level have contributed to achieving the objectives set out in Article 3 and in reaching the targets set out in Article 4.

2) On the basis of that report, where at regional level there is evidence that the objectives and targets have not been met, within six twelve months after the submission of the report as referred to in paragraph 1 Member States within that region shall submit a plan setting out the corrective actions to be taken to ensure those objectives and targets can be met.

3) The Commission may also propose to the European Parliament and to the Council any necessary amendments to this Regulation on the basis of that report.

This paper recognises that following The European Union (Withdrawal Agreement) Act 2020 and the subsequent Fisheries Act 2020, the technical measures detailed above may be subject to changes as the Joint fisheries Statement is developed, as such, this document will be updated accordingly.

2.1 Fisheries Management and conservation group

The Fisheries Management and Conservation Group (FMAC)[1], which replaces the Scottish Fisheries Council (SFC), builds on the Conservation Credit Steering Group (CCSG) and is a decision-making body and discussion forum concerned with all issues connected to sea fisheries management (in Scotland). It meets 2-3 times a year. The remit of FMAC includes the development of measures designed to better conserve and sustainably exploit stocks of seafish, and to enable fishermen and other persons with an interest to contribute to such development. Indeed, it is through this process that Scottish Government have provided updated guidance[2] and direction to the Scottish Fleet on an annual basis as the developing challenges of the Landings Obligation have been met. Through this process, specific measures (technical and spatial) are considered to address challenges that are arising for the coming year and a range of potential solutions are developed. One such example is the development of a Scottish Cod Avoidance Plan which contributes to the UK Cod Avoidance Plan for 2021[3]. The technical measures and sea area exemptions developed through this process are incorporated into fishing licences with effect from 1 January 2021.

Through this annual cycle, FMAC provides an opportunity for regularly reviewing measures that are relevant to Fishery Improvement Plans

2.2 Implications of technical conservation measures

So, these two articles imply that for the European fisheries as a whole the effectiveness of the technical conservation regulation is reviewed every three years and a plan setting out corrective action is implemented. As far as the discard plan under the landing obligation is concerned, there will be survivability and *de minimus* exemptions for a number of species' fisheries including plaice and skates and rays, which are to be reviewed by STECF during 2019.

The effect of Brexit means that European and UK vessels have to comply with UK technical conservation measures within the UK EEZ. The FMAC has implemented cod avoidance measures for 2021, and will continue to review measures implemented in UK waters on at least an annual basis.

There is scope for examining how the new technical conservation and landings obligation regime is likely to affect the catches and discarding practices in relation to commercial requirements of the supply

[1] https://www.gov.scot/groups/fisheries-management--conservation-group-fmac/

[2] https://www.gov.scot/publications/fishing-vessel-landing-obligation-guidance-2021/

[3] https://www.gov.scot/publications/north-sea-cod-plan/

chain. Appendix 1 outlines some of the information available which could be used to make this assessment.

Output controls

Under the North Sea Multi Annual Plan (Regulation (EU) 2018/973) TACs are set for the main resource species caught within mixed demersal fisheries cod, haddock, saithe, whiting and plaice are set so that the fishing mortality within the F_{MSY} range implying a maximum decrease in long term yield of -5% compared with maximum sustainable yield. The aim is to set the TACs to avoid these species becoming a choke species in North Sea fisheries.

To aid this process ICES has adopted the advised catch for each stock is given as an MSY range, corresponding to fishing mortality resulting in catches of no less than -5% of MSY. These results and the ICES Greater North Sea ecoregion overview, which are carried out annually are available to improve managers' understanding of the implications different catch levels in relation to choke species and MSY for the individual stocks. This is available to advise the annual TAC setting process during the EU December council. Although the mixed fisheries advice has been available annually for a number of years, the MAP has been implemented in 2018, so 2019 is the first year these assessments were available for TAC setting under this plan. However, it may be some time before this approach would be fully implemented, and there is now the added complication of UK exit from the EU, with the result that the default advice for shared stocks (between UK and EU) is given as MSY, although the -5% options are given in the options table.

Lemon sole is not included in the ICES mixed fishery assessments, however ICES report that some discarding does take place (recorded between 2013-16) and further interrogation of ICES catch data and landings information is required to improve the understanding of this aspect. Seafish analysis so far (Motova and Catchpole, 2018) suggests that lemon sole is currently at low risk of becoming a choke species at least for the UK fleets (see dag_feb2018_ukloanalysis_seafish.pdf — Seafish).

2.3 Implications in relation to output controls

The use of F_{MSY} ranges by under the MAP implies that the TAC levels set under the plan should be designed to minimise catches of unwanted resource species. The plan is to utilise the approach to set TACs annually implying annual review with guidance from the mixed fisheries assessment.

3 Endangered Threatened and Protected (ETP) species

3.1 Scottish North Sea demersal fishery

The Scottish Fishermen's Federation Observer survey was conducted in the North Sea in 2019. Full details are given in Appendix 2. In addition to the specific action point of obtaining records of interaction levels for species on the ETP list, SFSAG now propose to update their comments to the spreadsheet. The amended comments are shown below in Table 2

Under the Technical Conservation Measures Article 4 quoted above these species are expected to be managed by technical conservation measures. ETP species present in geographic area include allis

shad, porbeagle, spurdog, common skate, starry ray and grey seal. The porbeagle, common skate and starry ray are on the EU prohibited species list (COUNCIL REGULATION (EU) 2018/120).

These conservation measures rely on deterring fishers from targeting of these species, and returning to the sea alive those fish which are caught as by catch. Spurdog is subject to zero TAC over most of the Northeast Atlantic but not Sub area 4 and division 3a. Methods for spurdog bycatch avoidance including the southern North Sea are being developed under the UK shark, skate and ray conservation plan (Defra , 201. http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=19725.

For grey seals in Scotland, the SMRU advice (annual) includes an assessment of seal bycatch in commercial fisheries (mainly in static net fisheries); they have a unit dedicated to monitoring and evaluating bycatch of all marine mammal species in fisheries.

Table 2 SFSAG comments to be included in ETP species list (as developed for PUKFI) Species

	Stock advice	Proposed amended comments to ETPs list
Harbour seal	Y	Based on experience, Harbour seal bycatch not an issue for the SFSAG vessels operating in North Sea. No records in 2019 SFF trips.
Harbour Porpoise	Y	Based on experience, Porpoise bycatch not an issue for the SFSAG vessels operating in North Sea. No records in 2019 SFF trips.
Grey seal	Y	Based on experience, Grey seal bycatch not an issue for the SFSAG vessels operating in North Sea. No records in 2019 SFF trips.
Basking shark	?	Based on experience, Basking shark bycatch not an issue for the SFSAG vessels operating in North Sea. No records in 2019 SFF trips.
Angel shark	?	No records of catches encountered in 2019 SFF trips.
Common skate	Y	Evidence from SFF Observer Scheme, and the state of the stock, demonstrates that there is no directed fishing for Common skate and that incidental by-catch is relatively low - medium. For these reasons, interactions between White skate and SFSAG vessels can be regarded as "low – moderate" with the risk to stock status being "low".
White skate	Y	Evidence from SFF Observer Scheme, and the state of the stock, demonstrates that there is no directed fishing for White skate and that incidental by-catch is not an issue. For these reasons, interactions between White skate and SFSAG vessels can be regarded as "low risk".
Undulate ray	N	Evidence from SFF Observer Scheme, and the distribution of the stock, demonstrates that there is no directed fishing for Undulate ray and that incidental by-catch is not an issue. For these reasons, interactions between Undulate ray and SFSAG vessels can be regarded as "low risk".
Porbeagle	?	No records of catches encountered in 2019 SFF trips.
Spurdog	Y	Based on data examined and the advice from ICES, interactions between spurdog and SFSAG vessels is at a low to moderate level and an assumption on the risk to spurdog stock status could be justifiably classed as "Low".
Sturgeon	?	No records of catches encountered in 2019 SFF trips.
Allis shad	?	Only 1 fish encountered in the 2019 SFF trips.
Twaite shad	?	No records of catches encountered in 2019 SFF trips.
Sandy ray	Y	Based on our current understanding, it would be appropriate to regard the interaction between Sandy ray and SFSAG vessels as "low". No records of discards were encountered SFF trips. In 2019. Sandy ray was not reported in the landings from SFF trips in 2019. There were 6 trips where they could potentially have been included in the grouping "mixed rays". Based on our current understanding, it would be appropriate to regard the interaction between Sandy ray and SFSAG vessels as "low".
Starry ray	Y	**Based on our current understanding, it would be appropriate to regard the interaction between Starry ray and SFSAG vessels as "moderate". Consideration of survival rate studies may justify amending the risk category for Starry ray to "low".**
Thornback ray	Y	Given that Thornback rays were only discarded on 4 of the 74 SFF Observer trips in 2019 and that EU commercial landings were within the ICES advice and TACs set, it would be appropriate to note that while interactions may be regarded as "moderate", the risk to stock status should be regarded as "low".
Norwegian skate	?	No records of catches encountered in 2019 SFF trips.
European smelt	?	No records of catches encountered in 2019 SFF trips.

3.2 Industry initiatives on ETP

Two industry initiatives are in progress which are of relevance;

3.2.1 SFSAG Northern Demersal stocks

Quoted from (Jones and Honneland 2018) Client action plan described in SFSAG Northern Demersal Stocks 2rd Surveillance report – Jun 18;

Action plan for conditions 2, 3 and 4: Ensure data collection requirements are met under current PET [ETP] observer programme. Also continue distribution of skate and ray identification cards, to member vessels and request interactions with starry ray and common skate to be logged so that the rate of interactions can be adequately assessed. On the basis of the recorded data, the fishery impact on those species will be assessed and appropriate management actions will be reviewed and implemented as required.

- Year 1: continue distribution of skate and ray identification cards and reporting instructions. Review data collection requirements to assess fishery impacts on common skate and starry ray and put in place additional data collection measures as required.
- Year 2: Data collection and provisional review of fishery impact
- Year 3: Data collection and assessment of fishery impact. Review of management options to reduce fishery impact on starry ray and common skate as required. Determine which management options can provide objective basis for confidence that the strategy – if required - will work.
- Year 4: Data collection and implementation of management strategy.
- Year 5: Data collection and final review of impacts and effectiveness management strategy.

Data collection still on-going, we would need to integrate the finding at a later date

3.2.2 Osprey trawler's Starry Ray Impacts

Quoted from Andrews and Milner (2018) surveillance report on Trawlers North Sea twin-rigged plaice certification report.

"This information shows that the fishery overlaps with the starry ray distribution in the central North Sea, and that the starry ray range extends considerably further north, beyond the extent of the twin-rig trawl fishery."

The conclusion of this assessment is that the direct effect of this fishery (the capture of around 70t of starry rays in just part of the species overall range) is unlikely to hinder the recovery of rebuilding of starry rays in the North Sea, meeting the SG60 requirements.

The level of certainty of this assessment is not sufficient to warrant a higher score than this, however. The evidence presented at this surveillance audit demonstrates that there is a research plan in place to gather information about the catch of starry ray by Ekofish Group vessels, and to estimate the impact that the Ekofish Group fishery may have on starry ray.

Since the surveillance report was published a study by the Wageningen Marine University & Research centre, (Oversee, et al 2019) has been estimating the overall population of starry rays in the North Sea and the discarded bycatch and survival rates in the MSC certified otter trawl (i.e. twinrig and outrig) and flyshoot fishery (Coöperative Visserij Organisatie, Osprey and Ekofish)

3.3 Implications in relation to technical conservation measures

Conservation of most of the ETP species is reliant on technical measures which are reviewed every three years and a plan setting out corrective action is implemented. Spurdog is assessed biennially and seal stocks are assessed every year (See Appendix 2). There are also new industry measures for improving visibility and understanding of skates and rays catches in relevant fisheries as discussed above see Section 3.2

3.4 Manager's Review of Alternative Measures

3.4.1 Fisheries Innovation Scotland

The introduction of the EU landing obligation posed a significant challenge for some mixed species UK fisheries. Whilst there have been important advances in improving selectivity in fisheries in recent years, it was recognised that there was still a need to find solutions for reducing discards by improving selectivity in the broadest sense.

As part of its 2011 manifesto commitment, the Scottish Government pledged to investigate the potential of establishing a Scottish 'Centre of Expertise for Fisheries Management' to provide sound advice, based on applied research, to inform policy and practice in the management of Scottish fisheries. The result, after extensive consultation with the fisheries sector, was the formation of Fisheries Innovation Scotland (FIS). FIS has a range of members including representatives from the fishing industry, government organisations, processing/retail sector and environmental NGO's.

Against this background, the public/private sector multi-stakeholder initiative Fisheries Innovation Scotland has funded a number of projects that seek to address the management challenge of fishing more selectively. This includes a piece of research known as FIS11a, which ran between April to November 2016 and was intended as a comprehensive management review of innovative fishing gear technologies. The main contractor for this work was MRAG and the funding was supplied by FIS sponsors plus matched funds from the European Maritime and Fisheries Fund. The full project title was:

"Developing and facilitating a range of possible future FIS projects in innovation in selectivity through on-net or alternative technologies."

The project had five objectives:

1. To provide a concise review of the state of knowledge and advances in selectivity, including a typology of selective gears, devices and practices in use worldwide;
2. To identify and scope novel ideas and innovations, inspired from other disciplines and sectors, that may be relevant to improving selectivity;
3. To chart the pathway to developing selective gears and practices and to identify roadblocks to the development and uptake stages;
4. To provide a strategic plan for future multidisciplinary initiatives aimed at improving selectivity in Scottish fisheries; and
5. To identify possible funding sources to support future selectivity research projects and initiatives

The products of this future research, whilst indirectly linked to the outputs of this project, are intended to support Scottish fishers in respect to adapting to the EU landing obligation by bringing about improvements in selectivity. The report discussed that the selectivity of fishing can be modified at three main stages of the capture operation:

Pre-capture - unwanted fish can be avoided pre-capture, such as by adopting certain fishing behaviours, restricting where fishing is allowed, using deterrents or by modifying the profile of a gear. Pre-capture avoidance methods are usually based on ecological knowledge of the fish, such as its spatial distribution, its response to stimuli or its swimming behaviour when disturbed by fishing gear. Avoiding fish at this stage has the advantage of minimising or avoiding entirely the interaction between fish and fishing gear. Examples of innovative fishery management measures identified by the report to improve pre-capture selectivity were:

- Coverless trawl
- Eliminator trawl
- Acoustic deterrents (pingers)
- Marine Protected Areas
- Real Time Closures
- Depth restrictions

Post-capture - unwanted fish can be allowed to escape from fishing gear post-capture by incorporating design features in the gear such as square mesh panels, escape holes, sorting grids and artificial light. These post-capture methods generally work by exploiting variation in size or swimming behaviour between wanted and unwanted fish to sort them within the gear. In trawl gear the escape of unwanted fish usually occurs before they reach the cod end, although the process of escaping can result in injury or mortality. Examples of innovative fishery management measures identified by the report to improve post-capture selectivity were:

- Square mesh panels
- T90 cod end configuration
- Inclined grid
- 'Flip flap" netting trawl grid
- LED light rings
- Deep Vision automatic sorting system
- Reduced setting time
- Reduced vessel speed

Post-harvest - unwanted fish can be sorted and/or graded post-harvest and returned alive to the sea, using manual or automatic methods. The sorting of fish at this stage of the operation is most commonly associated with the discarding of fish that a fisher cannot or does not want to land or store on board. This is not an ideal stage for applying selectivity methods, as fish have passed through the full fishing operation and, depending on the method of fishing, may be in poor condition or already dead. However, the practice of sorting and release at this stage may be an effective selectivity method for certain resilient species or in situations where fish are maintained in a near-pristine condition until the point of sorting.

3.4.2 Ongoing FIS research into selectivity innovation.

Fisheries Innovation Scotland provides a valuable platform for identifying research requirements from both industry and governmental perspectives. Improvements in fishing selectivity remains a priority for the organisation and further research was commissioned in 2018 which builds on FIS 011a and FIS011b and refines in-water fish recognition technologies and in-water live fish grading techniques.

This research is known as: "Intelligent fishing: next steps for improving underwater selectivity." (FIS024) This project, which builds on and refines the in-water fish recognition technologies explored in FIS011b,

is concerned with 'intelligent fishing' – investigation and development of novel technologies to allow absolute selectivity in fishing activity through in-water identification and grading of fish by species and size / age in line with fishery management requirements and in association with market requirements.

3.4.3 Fishing selectivity - knowledge exchange and communication

In addition to Fisheries Innovation Scotland, there are other examples of communication and knowledge exchange initiatives within the UK and Scottish fisheries sector aimed at fishery managers, fishers and industry groups, including:

Gear Innovation and Technology Advisory Group (GITAG). Part of GITAG's mandate is to "establish knowledge dissemination routes and suitable vehicles, ensuring fullest possible industry coverage". To date this has been done mainly through publishing news and articles on the Scottish Fishermen's Federation's website, and also through attending meetings and conferences.

Marine Scotland Project DiscardLess.

The MariFish-funded DiscardLess has published a Selectivity Manual and gear fact-sheets to aid awareness of gear selectivity. Following from this publication, Marine Scotland Science have committed to ensure industry and NGOs are made aware of these knowledge products. The results of this and other selectivity experiments can be found on the website http://www.discardless.eu/selectivity_manual

Seafish Quay Issues.

This is a magazine for the fishing industry and tells some of the stories uncovered during the Seafish annual Fleet Survey. Quay Issues looks at some of the challenges facing the industry and the creative and innovative approaches fishing vessel owners around the country are taking to overcome them. Issue 2 included content on developing selective gear, which has also been filmed as a YouTube segment.30

Seafish gear technology courses.

Seafish Gear Technologists run training courses for fishermen, often funded through the EU, in trawl gear technology and selectivity. These courses have been held mainly at the Sintef Flume Tank in Hirtshals, Denmark. Recent courses have been structured around a standard gear syllabus that is relevant to all trawling and covers the principles of trawl gear and selective modifications and devices.

The Clean Catch UK project.

The main theme of the Clean Catch UK project is bycatch of wildlife species and the website includes a bycatch mitigation hub, containing links to information on bycatch mitigation measures in fisheries and there is also reference to a self-reporting App for bycatch, set up for Cornish fisheries at present. This is being led by the Centre for Environment, Fisheries & Aquaculture Science (Cefas) in collaboration with Mindfully Wired Communications and includes data from across northern Europe and fishing gear trials carried out in French, Scottish, Danish, Swedish, German, Dutch, Irish and English fisheries.

There is extensive multi-stakeholder engagement across these numerous initiatives, including:

- UK government agencies including Defra and Marine Scotland
- UK fishery science agencies including Cefas and Marine Scotland Science
- UK fishing federations including SFF, SWFPA and NFFO

Sumaris project

The Sumaris project https://sumaris-project.com/en/homepage/ was an EU Interreg project with Belgian, Dutch, French and UK partners centred around the Southern North Sea and Eastern English Channel. This project has built an understanding of biology and ecology of rays post discard survival of ray species, assessment and management approaches, ray identification and handling practices (including a guide to Identification and handling of rays (Sumaris, 2020)

4 Conclusion

The MSC SG 80 requires that:

"There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species and they are implemented as appropriate."

This paper proposes that alternative measures are reviewed at two levels:

1) **Systemically,** as part of the regulatory governance obligations of the Member State, for example:

North Sea Multi-Annual Plan (MAP)

- Under the North Sea Multi Annual Plan (Regulation (EU) 2018/973) TACs are set for the main resource species caught within mixed demersal fisheries: cod, haddock, saithe, whiting and plaice. The aim is to set the TACs within F_{MSY} ranges (to a maximum of -5% of F_{MSY}) to avoid these species becoming a choke species in North Sea fisheries.

- These assessments are carried out annually to advise the annual TAC setting process during the EU December council. Although the mixed fisheries advice has been available annually for a number of years, the MAP has been implemented in 2018, so 2019 is the first year these assessments have been available for TAC setting under this plan.

- The MAP has been implemented in UK law, but after the UK exit from the European Union headline advice for MSY is given for shared stocks, and the F_{MSY} ranges given in the Options Table in the ICES' Advice.

- Therefore, the ICES Advice and MAP framework is available to enable the setting of TACs which minimise risks of stocks becoming choke species in North Sea fisheries, but the negotiations are carried out in the context of the EU, UK and Norway acting as independent Coastal entities (Coastal States in the case of the UK and Norway).

Technical Conservation Regulation EU 2019/1241;

- The Technical Conservation Regulations Article 4 states that technical measures shall aim to ensure that catches of marine species below minimum conservation reference sizes are reduced as far as possible, that bycatches of marine mammals, marine reptiles, seabirds and other non-commercially exploited species do not exceed levels provided for in Union legislation and other binding international agreements, and that they ensure that the environmental impacts of fishing activities on seabed habitats are in line with regulatory requirements.

- The extent to which these targets have been achieved shall be reviewed every third year, in accordance with the reporting process set out in Article 34.

- These two articles would require that for European fisheries, the effectiveness of the technical conservation regulation is reviewed every three years and that a plan setting out corrective action is implemented.

- For UK in Scottish waters the Fisheries Management and Conservation Group meets 2-3 times a year with a remit to develop measures to conserve and sustainably exploit stocks of Seafish avoidance scheme; UK waters tech measures rule in UK waters

2) Procedurally, through science and industry federation initiatives:

- Fisheries management and conservation group; see text
- There are a number of voluntary public/private sector initiatives that seek to review and assess alternative fishing methods - this is an on-going process within the UK

These initiatives aim to;

- Identify funding for future innovations
- Deliver research and development that seeks to operationalise novel concepts
- Communicate the development of new selectivity solutions to the fishing industry for implementation where they are proven effective.

Given both the regulatory obligation and the existence of numerous initiatives aiming to deliver and communicate the required research into improved selectivity, it should be recognised that SG100 is met - in that there is at least a biennial review review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock/secondary species/ ETP Species and they are implemented as appropriate.

Appendix 1 Implications of new technical cons measures

From the EU technical conservation measures as of June 2019 (Annex V; part B);

Whole of North Sea, ≥120 mm mesh and ≥ 90 mm in the Skagerrak and Kattegat in all in all towed gear with the exception of catches which compose less than 20% cod, haddock and saithe under the following conditions;

- North Sea south of 57º30'N (approx. latitude of Peterhead) Directed fishing for plaice and sole (minimum of 50% of catch) with beam trawls, otter trawls and seines to use a minimum of 100mm. A square mesh panel of at least 90mm shall be fitted.
- ICES 4b and 4c; North Sea, directed fishing for sole with beam trawls and whiting with bottom trawls are permitted to use a minimum of 80 mm mesh
- ICES division 4 c directed fishing for sole with otter trawls at least 80 mm
- Directed fishing for Nephrops in the North Sea ≥ 80 mm mesh with use of sorting grid or with a maximum bar spacing of 35mm or equivalent selectivity device shall be fitted or 120 mm SMP compulsory
- Directed fishing for Nephrops in the Skagerrak and Kattegat at least 70 mm square mesh or 90 mm diamond mesh
- Div 4c only; Sole targeted otter trawls (min 15%) and pulse (to be phased out in July 2021) /beam (sole targeted) ≥ 80 mm mesh. SMP required for sole targeted otter trawls
- Directed fishing for species not covered by catch limits (40%) ≥ 80 mm. A square mesh panel of at least 80mm shall be fitted.
- Directed fishing for skates and rays (70%) ≥ 80mm

Spatial measures;

- Plaice box along the west coast of Denmark Germany and part of the Netherlands, to be retained restricting access of vessels of more than 221 kw and similar rules within UK, France, Netherlands, part of the West Coast of Denmark and Belgian 12-mile limits.

Relevance to plaice and lemon sole

Issues which could affect discarded bycatch levels are;

1. Selectivity of the gear and length distributions of the fish encountered
2. Commercial demand for certain size groups
3. Other species caught in a mixed fishery
4. Landing obligation requirements

Selectivity of the gear and length distributions encountered

L_{50}s are provisional and actual discards levels would depend on populations encountered

Table 3 Approximate L_{50}s in cm for several North Sea species based on Herrman et al (2008) assuming a range of mesh opening of between 30º and 47º

	Mesh Size mm				North Sea MCRS (cm)
Species	80	100	120	140	
Plaice	17-18	25	26-27	32	27
Lemon sole	20	24-25	29	34	
Cod	20-26	24-33	28-38	32-44	35
Haddock	18-25	22-30	26-36	30-42	30

- Relevance to plaice; 120 mm mesh approximately equivalent to L_{50} = 26-27 cm compared with MCRS of 27 cm for plaice, compared with 100 mm which is approximately equivalent L_{50} of 22 cm. Smaller mesh (80 mm) *Nephrops* beam and pulse trawls would continue to catch small plaice.
- Relevance to lemon sole; 120 mm mesh approximately equivalent to L_{50} = 29 cm and 100 mm approx. L_{50} 24 cm which indicates a lower proportion of small lemon soles would be caught in this mesh. Smaller mesh (80 mm) *Nephrops* beam and pulse trawls would continue to catch small lemon sole.

4.1.1 Length-frequency distributions

Shown below are some length frequency distributions of lemon sole and plaice catches obtained from the literature (Figure 1Figure 7). ICES WKNSEA (ICES, 2018) also reports commercial length frequency results for lemon sole (Figure 8).

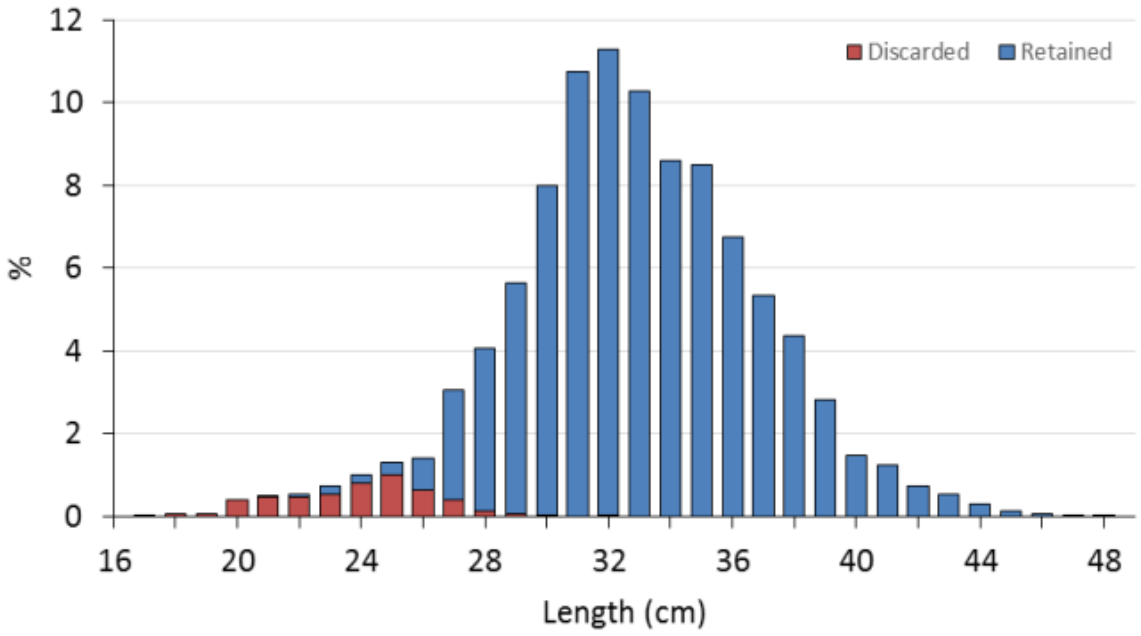

Figure 1 Raised length frequency distribution of the overall discarded and retained portion of the lemon sole catch (n=7,467), in what would be expected to be 120 mm minimum mesh cod end. L_{50} for 120 mm mesh indicated by an arrow. Shetland length frequency data from 2013-2015 one trip per month on Shetland vessels From Macdonald et al (2017) Data Limited Fish Stocks in the Northern North Sea (pdf)

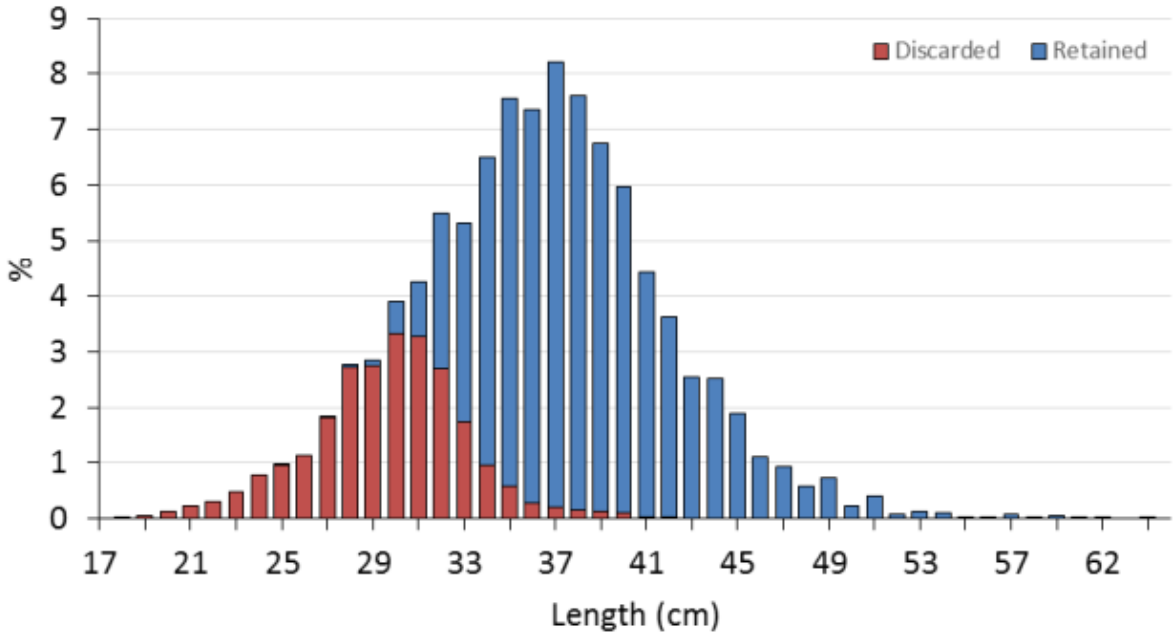

Figure 2 Raised length frequency distribution of the overall discarded and retained portion of the plaice catch (n=12,913) should be 120 mm minimum mesh cod end Shetland length frequency data from 2013-2015 one trip per month on Shetland vessels From Macdonald et al (2017) Data Limited Fish Stocks in the Northern North Sea (pdf)

Central – Western North Sea; Cefas Fisheries Science partnership data 2005-6 (Armstrong et al 2006)

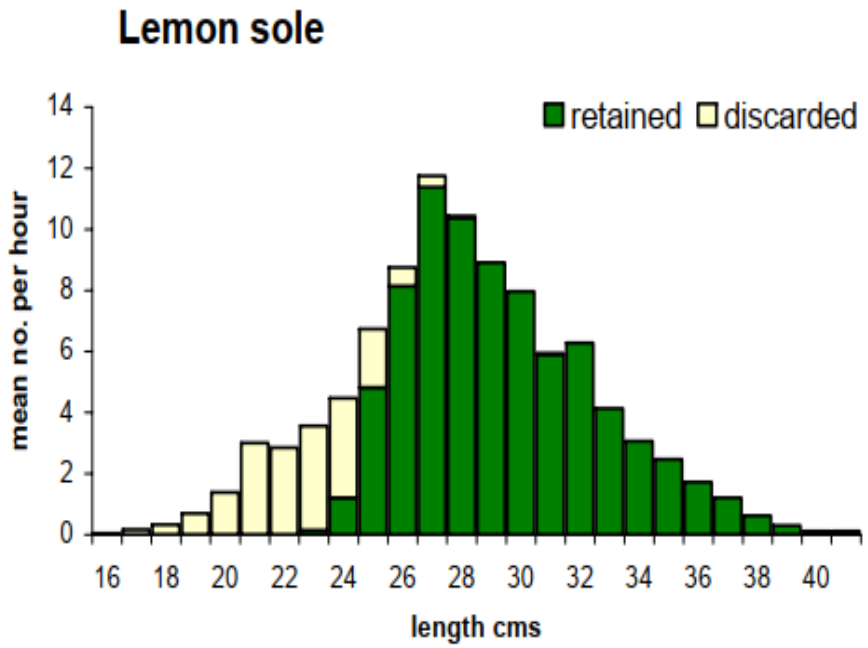

Figure 3 Lemon sole Length-frequency distributions central North Sea FSP survey July 2005 twin rig trawling 100 mm mesh

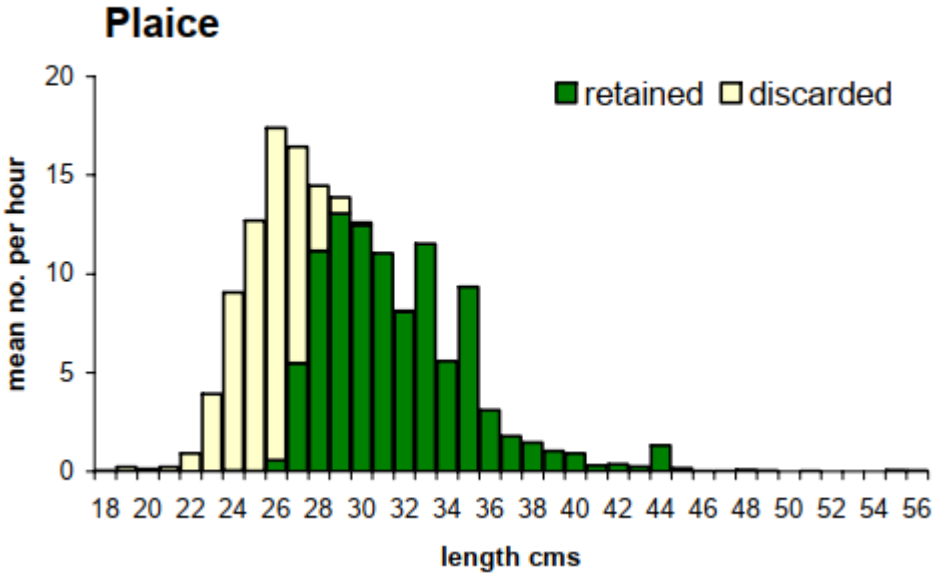

Figure 4 Plaice Length-frequency distributions central North Sea FSP survey July 2005 twin rig trawling 100 mm mesh

Central – Western North Sea; Cefas Fisheries Science partnership data 2005-6 (Parker-Humphreys, etal, 2008)

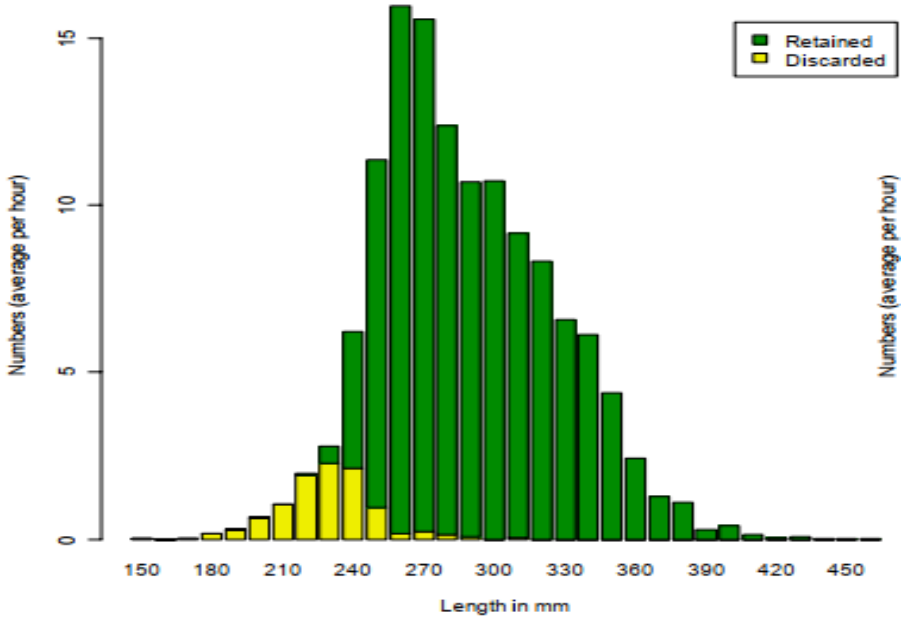

Figure 5 Lemon sole Length-frequency distributions central North Sea FSP survey June-July 2006 twin rig trawling 100 mm mesh

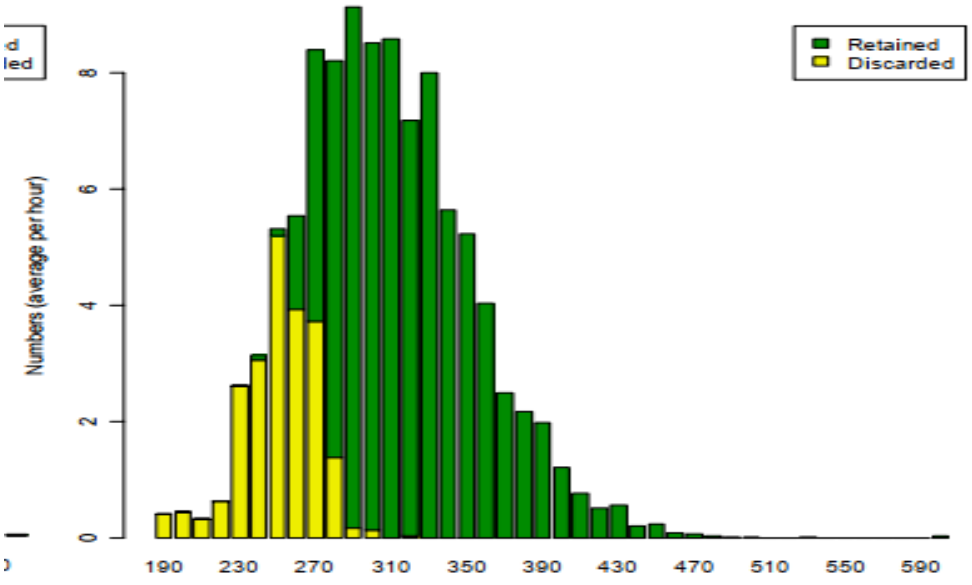

Figure 6 Plaice Length-frequency distributions central North Sea FSP survey June- July 2006 twin rig trawling 100 mm mesh

Central eastern North Sea; Osprey Trawlers North Sea twin-rigged plaice certification report (Andrews et al, 2016)

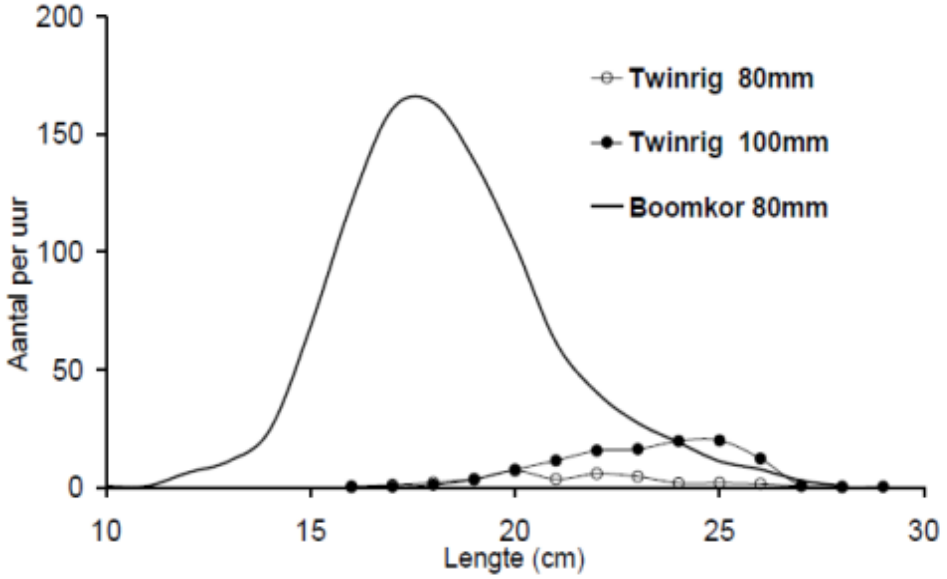

Figure 7 Length distribution of plaice discards from 80mm and 100mm twinrig trawl fisheries and 80mm beam trawls ("Boomkor") from before 2004 data (shown in Andrews, et al 2016)

ICES (WGNSSK 2019 for lemon sole for whole stock

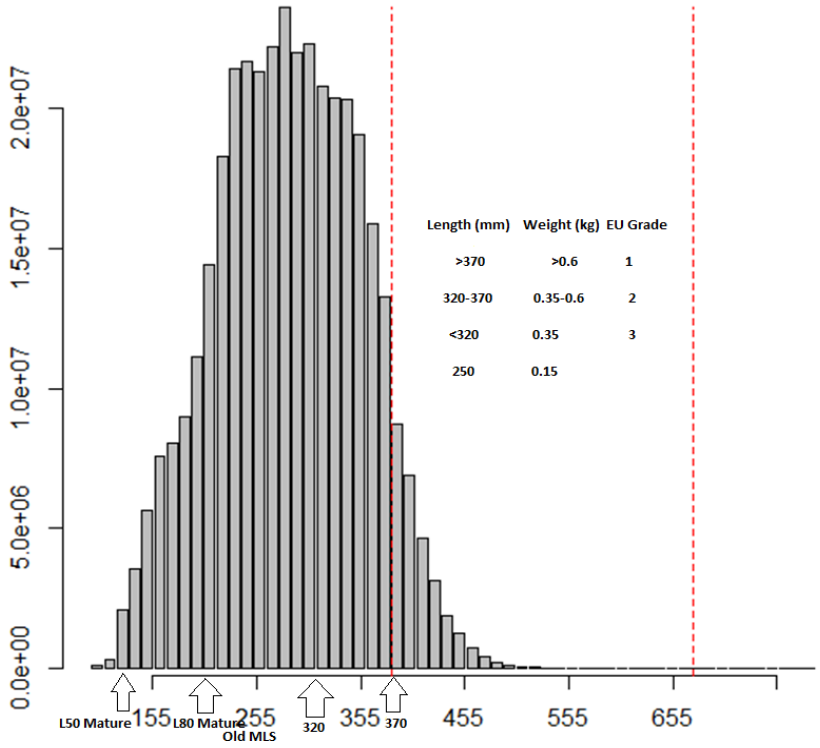

Figure 8 Lemon sole in Subarea 4, and divisions 3.a and 7.d. Length distribution of the commercial catch data (2002-18) (discards and landings) from ICES WGNSSK (2019). The red lines give (from left to right) the 99%ile of the distribution (385 mm) and the longest observed fish (675 mm). Estimates of Length at 50% maturity (L50) = 128 mm Length at 80% maturity (L80) = 190 mm from WGNSSK (2019), the old MLS of 250 mm and the EU grade boundaries are tabulated and the length boundaries are shown on the x axis

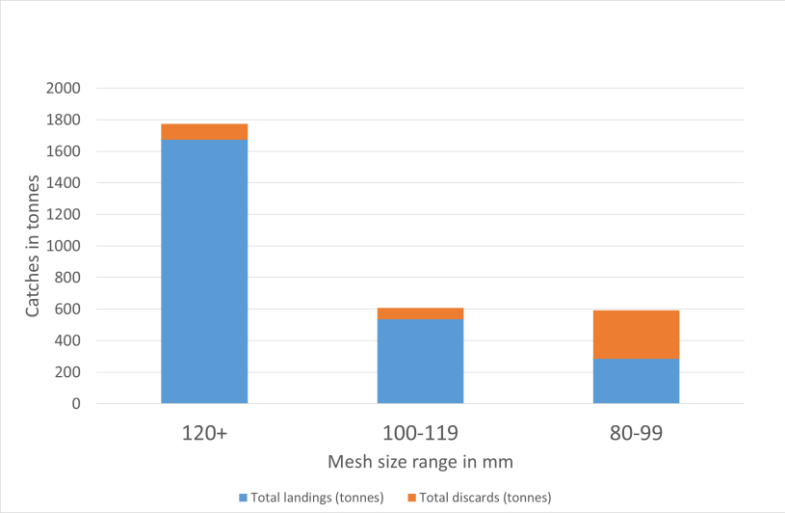

Figure 9 Catch distribution of North Sea and Skagerrak and eastern English Channel lemon sole by mesh size 2019; data from STECF

Length-weight relationships

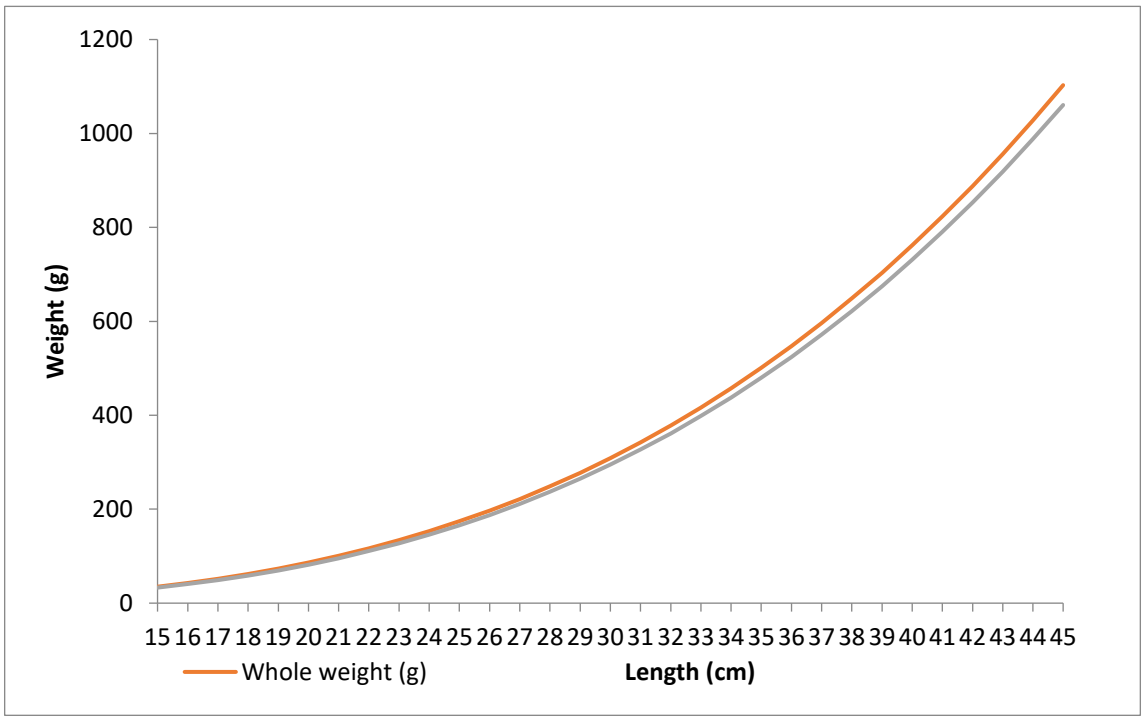

Figure 10 Length-weight relationship for lemon sole from Macdonald et al (2017)

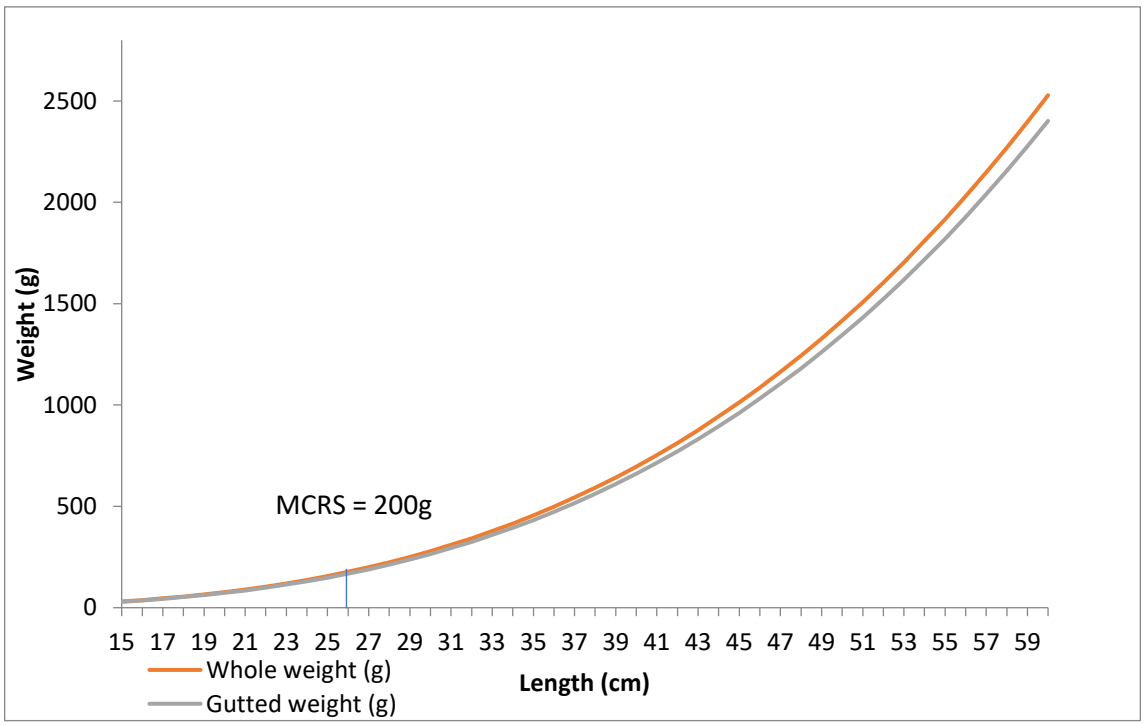

Figure 11 Length-weight relationship for plaice from Macdonald et al (2017)

Appendix 2; Summary of SFSAG vessel survey of ETP species' catches

This Appendix summarises information from Scottish Fishermen's Federation (SFF) – who have a shared database with Marine Scotland Science. In 2013 FMAC (Fisheries Management and Conservation Group) agreed to develop and operate a combined Marine Scotland Science and Scottish Fishermen's Federation Observer Sampling Scheme to make better use of total observer resource[4]. The joint scheme was intended to provide:

- A single, definitive source of Scottish discard data collected, stored and analysed in a unified way
- Statistically robust estimates of catch and discards for all required purposes (ICES and reporting to Commission)
- A reduction in some of the variance associated with discard estimation
- A larger pool of vessels sampled each year providing greater coverage
- More efficient utilisation of the resource and greater acceptance by all stakeholders that 'best possible' use is being made of available data

SFF observers undergo the same training and operate to the same protocols as Marine Scotland Science Observers. Trips sampled are determined by allocating resources to fishing metiers in proportion to their contribution to overall landings (by area and directed fisheries) and are conducted on vessels, allocated from a random list of vessels in the relevant metier.

Method

Given ongoing issues relating to provision of reports from the Joint Observer Scheme, it was agreed that SFF would provide summary information from trips undertaken by their staff during 2019. While acknowledging that this is a rather limited period of observer data, it was felt that this would give an indication of the level of interaction between the SFSAG vessels and a group of species on the ETP list which had been identified for consideration. The data analyst responsible for the SFF Observer data examined all trips completed by SFF observers in the North Sea area during 2019. A summary of the number of trips and hauls sampled are provided in Table 1.

[4] https://www.sff.co.uk/independent-on-board-observer-scheme-ioos/

Table 1: *Summary of SFF Observer trips in 2019 analysed.*

ICES Division	Gear	Number of trips	Number of hauls
4a	OTB	16	139
4a	OTT	38	606
4a	PTB	6	155
4a	SSC	2	46
4b	OTT	7	55
4b	OTB	5	14
Total North Sea	**All gears sampled**	**74**	**1015**

For each of the species identified for consideration, all occurrence in the observers sub sample were recorded. Due to the design of the observer sampling scheme protocols, it is not appropriate to attempt to raise the observed data to provide quantitative outputs but it does serve to offer a qualitative indicator in the first instance. Table 2 provides an overview of the presence of the ETP species, either in the sub samples of "discards" or recorded in the landings for the vessel trips.

With only one record of Allis shad recorded in all SFF Observed trips in the North Sea in 2019, it is not unreasonable to suggest that this should be classed as a relatively "low risk" in relation to interaction with SFSAG vessels. From the summary information and an initial analysis of the data, it would appear that the species that may be considered at risk of interaction and merits further consideration is limited to Spurdog and some skate species.

Results

Table 2: *Presence of ETP species in SFF Observed trips in 2019.*

Species	Scientific name	Present in discard samples (2019)	Present in "landings" (2019)
Harbour seal	*Phoca vitulina*	X	X
Harbour Porpoise	*Phocoena phocoena*	X	X
Grey seal	*Halichoerus grypus*	X	X
Basking shark	*Cetorhinus maximus*	X	X
Angel shark	*Squatina squatina*	X	X
Common skate	*Dipturus batis*	✓	? Mixed rays
White skate	*Rostroraja alba*	X	? Mixed rays
Undulate ray	*Raja undulata*	X	? Mixed rays
Porbeagle	*Lamna nasus*	X	X
Spurdog	*Squalus acanthias*	✓	X
Sturgeon	*Acipenser sturio*	X	X
Allis shad	*Alosa alosa*	✓ (1 record)	X
Twaite shad	*Alosa fallax*	X	X
Sandy ray	*Leucoraja circularis*	X	? Mixed rays
Spiny dogfish	*Squalus acanthias*	X	X
Starry ray	*Amblyraja radiata*	✓	X
Thornback ray	*Raja clavata*		✓ and Mixed rays
Norwegian skate	*Raja nidarosiensis*	X	X
European smelt	*Osmerus eperlanus*	X	X

Having identified the ETP species that were present on SFF Observer trips in 2019, further analysis was conducted in order to estimate the actual quantities encountered. On completion of analysis it was discovered that the sampling protocols during trips relating to offshore Nephrops targeted vessels and Pair Trawl vessels targeting demersal species meant that on occasions it may not be possible to sample every haul (for differing reasons). As these trips had not been identified during this initial analysis, estimates of raised numbers should be assumed to be an underestimate. However, for the purpose of identifying ETP species at risk of interaction with SFSAG vessels, the exercise serves its purpose. Further analysis will be conducted, when time permits to rectify these anomalies.

Table 3: *Estimates of numbers of ETP species discarded during SFF Observer trips in 2019.*

Species	No of trips with discards present in sample	No of hauls with discards present in sample	Average raised number of discards per haul during trip	Range of estimated number of discards
Spurdog	29	104	9	1-46
Common skate	21	49	4	1-12
White skate	0	0	0	0
Undulate ray	0	0	0	0
Starry ray	35	254	21	1-109
Thornback ray	4	9	5	2-39

While Table 3 provides an indication of the occurrence of the ETP species discarded during commercial trips targeting demersal species, Nephrops and associated bycatch species, there is a need to understand the wider interactions by considering the landings component of the catch. In relation to the ETP species considered, the only species that were landed as part of the catch were skates and rays. Unfortunately, in 2019, the data on landings of skates and rays is seldom recorded at species level and is usually grouped as "mixed rays".

From the 74 observer trips completed by SFF staff in 2019, landings of skate species were limited to 10 trips, of which 4 only had Thornback Skate present and 6 had skate species recorded as "Mixed rays". The quantities of skate landed from SFF Observer trips in 2019 are presented in Table 4. It remains unclear which skate species would have been present in the "Mixed rays" grouping.

Of the 10 trips where skate species were landed only one was on a trip which was directed at Nephrops as the target species. The others trips related to single and pair trawlers fishing for demersal species. All records of skate species being landed occurred within ICES Subarea 4a.

Table 4: *Summary of trips where skate species were landed.*

Species / Group	Area	Gear	Target Species of Trip	Weight landed (Kg)
Mixed rays	4a	OTB	Demersal	32
Mixed rays	4a	OTT	Demersal	288
Thornback	4a	OTT	Demersal	141
Mixed rays	4a	OTT	Nephrop - Offshore	200
Mixed rays	4a	OTB	Demersal	320
Thornback	4a	OTB	Demersal	140
Mixed rays	4a	OTB	Demersal	45
Mixed rays	4a	OTB	Demersal	180
Thornback	4a	OTB	Demersal	6
Thornback	4a	OTT	Demersal	20

Discussion

From the work completed to date, we have been able to fully assess the interactions between SFSAG vessels and the ETP species in 2019. In some cases, we do know there were no discards observed (White skate and Undulate ray) but are unable to give categoric assurance on the landings of skate species. In order to provide a greater understanding of the interactions, or likely interactions, a brief resume of ICES advice and comments are provided below (for skate species and spurdog).

Spurdog

The most recent ICES Advice for spurdog advises that there should be no targeted fisheries on this stock in 2021 and 2022. Based on medium-term predictions (30 years), annual catches at the recent assumed level (2468 tonnes) would allow the stock to increase at a rate that is similar (8% lower) to that estimated with zero catches; therefore, ICES consider that bycatch should not exceed the recent assumed level of total catches of 2468 tonnes.

Adhering to the ICES advice, total biomass for 2022 and 2023 relative to the total biomass for 2021 is estimated to increase by 3.0% and 6.1% respectively. Summaries from the SFF Observer Scheme provides evidence that SFSAG members are not participating in directed fisheries for spurdog. Based on data examined and the advice from ICES, interactions between spurdog and SFSAG vessels is at a low to moderate level and an assumption on the risk to spurdog stock status could be justifiably classed as “Low”.

Common skate

No landings of these species have been allowed from EU waters since 2009.

Latest ICES Advice for Common skate suggest that while catch rates from Fishery-independent surveys are too low to provide a stock size indicator, the consistent occurrence of this species in surveys in recent years could be indicative of a gradually improving stock status.

Evidence from SFF Observer Scheme, and the state of the stock, demonstrates that there is no directed fishing for Common skate and that incidental by-catch is relatively low - medium. For these reasons, interactions between common skate and SFSAG vessels can be regarded as "low – moderate" with the risk to stock status being "low".

White skate

Latest ICES Advice for White skate advises that there should be zero catches in each of the years 2020 – 2023. This species has disappeared from most areas of former habitat in the Northeast Atlantic. There are very few recent, authenticated record of white skate in this area; these isolated records are from the English Channel, western Irish waters, and Portuguese waters. According to historical literature it appears to have occurred more frequently in previous decades. ICES therefore consider this stock is depleted. Given the depleted nature of the stock, many fishers and sea-going staff are unfamiliar with this species. Improved identification and educational material should be developed and circulated to fishers, in order to aid data collection and highlight the need for releasing prohibited species. While Council Regulation (EC) 2017/127 continues to prohibit EU vessels to fish for, to retain onboard, to tranship or to land *R. alba* in Union waters of ICES subareas 6 – 10, this does not extend to ICES subareas 2, 3 & 4.

R. alba is legally protected in UK waters, being listed on the Wildlife and Countryside Act. Evidence from SFF Observer Scheme, and the state of the stock, demonstrates that there is no directed fishing for White skate and that incidental by-catch is not an issue. For these reasons, interactions between White skate and SFSAG vessels can be regarded as "low risk".

Undulate ray

ICES does not currently provide advice for Undulate ray in ICES Subareas 4(North Sea) and 3a (Skagerrak). According to the information provided by the Shark Trust[5], Undulate ray is not designated as a prohibited species in these areas (Figure 10). However, an overview of the distribution of Undulate ray (figure 11) which was presented to the North West Waters Advisory Council[6] highlights that these areas are out with the areas where records were recorded (needs further consideration).

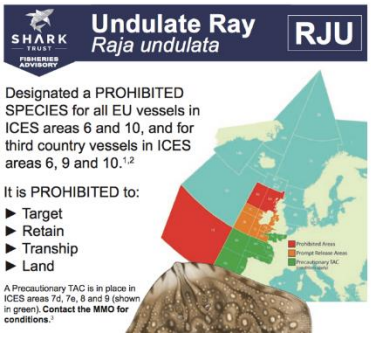

Figure 12 ***Prohibited areas for Undulate ray***

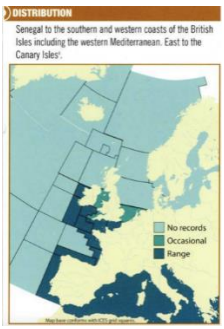

Figure 13 ***Distribution of Undulate ray.***

[5] *https://www.sharktrust.org/Handlers/Download.ashx?IDMF=adec8d8c-80ac-4843-aa3c-4d12ae10cc6f*

[6] *http://www.nwwac.org/_fileupload/Image/European_Undulate_Ray_Ban_NFFO_160911_EN.pdf*

Evidence from SFF Observer Scheme, and the distribution of the stock, demonstrates that there is no directed fishing for Undulate ray and that incidental by-catch is not an issue. For these reasons, interactions between Undulate ray and SFSAG vessels can be regarded as "low risk".

Sandy Ray

ICES Advice for Sandy ray forms part of the advice for other rays & skates in Subarea 4 and in divisions 3.a and 7.d. ICES cannot provide advice on the status of these stocks owing to a lack of reliable survey and catch data. Evidence from the SFF Observer scheme demonstrates that were no discards of Sandy ray in the 74 trips sampled in 2019. No landings were attributed to this species but it is possible that they were included in the grouping "mixed rays". However, given that "mixed rays" were only landed from 6 trips in 2019, totalling 1065 kgs (Table 4) it is not unreasonable to assume landings of Sandy ray from SFSAG vessels is relatively low.

Based on our current understanding, it would be appropriate to regard the interaction between Sandy ray and SFSAG vessels as "low".

Starry ray

Latest ICES advice for Starry ray state that when the precautionary approach is applied, there should be zero catches in each of the years 2020– 2023. This species is widespread in the Central and Northern North Sea and is a common bycatch of bottom trawls. However, they also inform that the stock size indicator has continuously declined since the 1990's. Evidence from the SFF Observer Scheme (2019) supports the understanding that Starry ray is treated as a bycatch species. We can be confident that Starry ray does not contribute to the landing component of the catch as experience is that this species has no commercial value and retention onboard is not permitted. Discards of Starry ray were recorded in 35 of the 74 trips undertaken in 2019 by SFF Observers and numbers encountered suggest that this is a relatively common species in the area operated by SFSAG vessels.

Based on our current understanding, it would be appropriate to regard the interaction between Starry ray and SFSAG vessels as "moderate".

Survival studies

A recent report on "Starry ray in the ottertrawl and flyshoot fishery[7] highlighted results from a literature search on survivability for Starry ray highlighted that; Mandelman et al. (2013) found a mortality rate of 66% for starry ray caught within the commercial otter trawl in the western North Atlantic after a 7 day monitoring period in the laboratory (.

Consideration of survival rate studies may justify amending the risk category for Starry ray to "low".

[7] *H.M.J. van Overzee, J.J. Poos, J. Batsleer & P. Molenaar, 2019. Starry ray in the ottertrawl and flyshoot fishery*. Wageningen, Wageningen Marine Research (University & Research centre), Wageningen Marine Research report. 38 pp.

Thornback ray

ICES advises that when the precautionary approach is applied, landings of Thornback ray in Subarea 4 and division 3a and 7d should be no more than 2237 tonnes in each of the years 2020 and 2021.

Examination of the history of ICES advice, agreed TAC and ICES estimates of landings since 2010 show that landings have been less than the advice and agreed TAC (for the stock area).

Given that Thornback rays were only discarded on 4 of the 74 SFF Observer trips in 2019 and that EU commercial landings were within the ICES advice and TACs set, it would be appropriate to note that while interactions may be regarded as "moderate", the risk to stock status should be regarded as "low". Consideration of the current stock status in Figure 3 would also support this interpretation.

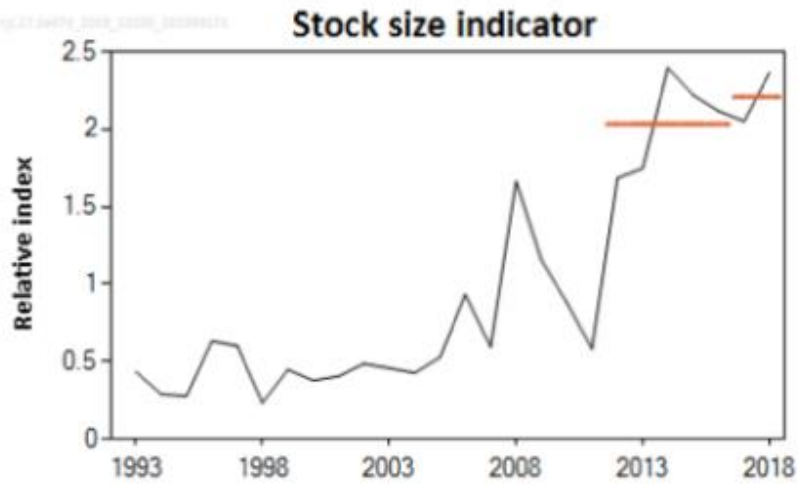

***Figure 13**: Thornback ray stock size indicator index*

Continuation of the Joint Marine Scotland Science and Scottish Fishermen's Federation Observer Sampling Scheme will provide supporting evidence that the interactions between SFSAG vessels and ETP species is monitored.

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