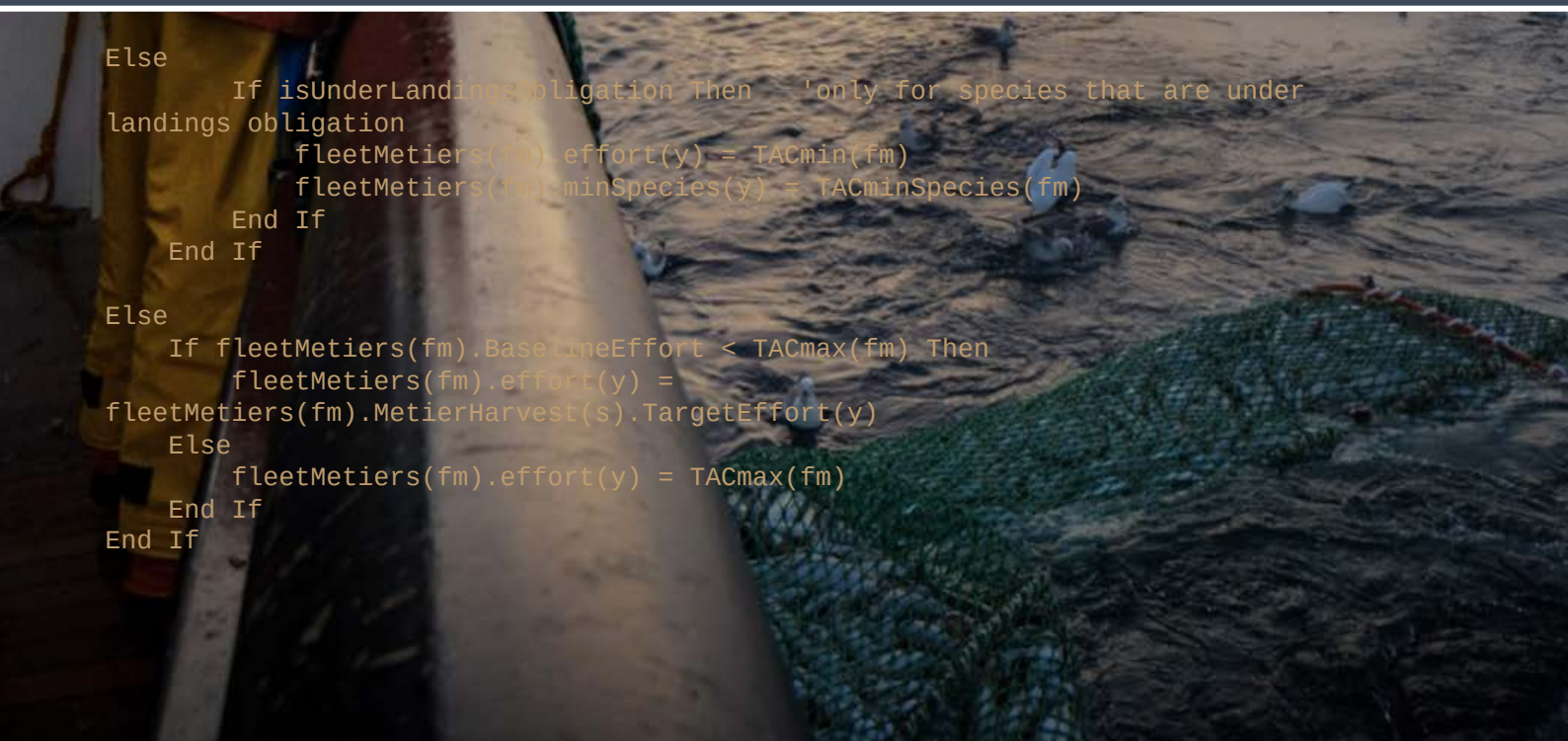
SEAFISH BIOECONOMIC MODELLING

Analysis of Choke Points and Problem Stocks for UK Fleet under the Landing Obligation, 2017-2019



Seafish Bioeconomic Modelling

Analysis of Choke Points and Problem Stocks for UK Fleet under the Landing Obligation, 2017-2019

April 2017

Authors

Jennifer Russell, Anderson Solutions (Consulting) Ltd

Simon Mardle, Fishor Consulting

Arina Motova, Seafish

Seafish Report No SR703

ISBN No 978-1-911073-09-3

Sea Fish Industry Authority

18 Logie Mill

Logie Green Road

Edinburgh, EH7 4HS

Front cover photograph courtesy of Ian Reid, fisherman

Contents

Summary

Overview of approach

The bioeconomic model that Seafish has developed can be asked a multitude of questions about the impact of policy on the UK fishing fleet. The focus to date is the potential impact of the landing obligation. The focus of the analysis presented in the report is on the likelihood that choke stocks could occur as a result of the landing obligation in five UK demersal fleet segments in 2017, 2018 and 2019 and whether the movement of quota could delay the choke points identified.

The bioeconomic model uses different simulations to estimate what could happen in future years. Unless otherwise stated all simulations assume that the initial quota allocation to the UK fleet, as calculated for each year, is the quota available, i.e. before international quota swaps. Four of the simulations are referred to as baseline simulations and explore the cumulative value of expected policy and industry mitigation measures. The final baseline simulation (B4) is considered to best indicate the challenge faced by UK fleet segments, and therefore the extent of change that could be required to keep fishing at similar levels of effort as fished in 2015. There are two further simulations which are applied to the B4 baseline simulation, these explore the extent to which choke stocks could potentially be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2).

There is a substantial amount of detail in the methodology and assumptions used to conduct the analysis. Key points are presented in Chapter 2 and a more detailed description can be found in the separate methodology report. The following points are highlighted for consideration when reviewing the findings from the analysis:

- Assumptions must be made to create an effective model, the diversity of quota holdings, method of operation and catch rate between individual vessels cannot be accurately replicated in such a large model. The model undertakes the analysis at the lowest feasible level which is metier level analysis within PO fleet segments. These findings are then aggregated to present the results for the home-nation fleet segments shown in the report. The aggregation process may obscure some localised challenges.
- Uncertainty exists in situations where decisions are still to be made, assumptions in the model are based on what has occurred so far and what is planned under the landing obligation. For example, estimates of future TAC/quota uplift reflect calculations by the EU so far, and rules during the transition period are informed by plans and proposals published by Regional Groups in 2016.
- Unlike the previous report by Seafish, the model does not consider the potential benefit of exemptions and derogations that may be available under the landing obligation, i.e. de minimis, survivability and interspecies flexibility. However, these could be incorporated in additional simulations.
- There is inherent uncertainty in available discard rates as they are based on a sample of fishing trips. Discard rates can vary year on year and the model is informed by discard rates recorded for 2015. Furthermore, if no discard rates are available for a gear and a metier, then an input of zero discards is provided to the model. The data source used for discard rates is the STECF FDI database which collates member state sampling data and provides the same data as that used by STECF working groups. Such holes in the data is a weakness as there are stocks, such as haddock 7e, which industry expects to be a challenging stock but for which discard sampling data is not available. For the UK this is more likely to exist for stocks in area 7 as North Sea and

West of Scotland are for the most part well-sampled. However, the input data can be amended in future should information become available from a source other than STECF FDI database.

- The model is informed by data from 2015 and is therefore influenced by any major events that affected catch or quota swaps and that were particular to 2015;
- The findings provide an understanding of the scale of the challenge that different UK fleet segments may face by quantifying what could be required to avoid a choke situation. The main measure used to quantify the challenge is the quota required to avoid choke. However, the tables at the end of each fleet segment's chapter provide an estimate of the selectivity improvement required to avoid choke. These are modelling outcomes and are therefore indicative and should not be treated as absolute targets. There are many variables that can influence the actual outcome, including natural, policy and industry led variables. Furthermore, quota and improved selectivity are not the only options to avoid a choke situation. Avoidance measures, new policy initiatives and new industry initiatives could all have a vital role to play.

The intention of the analysis is to:

- provide the best quantitative analysis possible at this time so as to support discussion on appropriate mitigation measures to reduce the impact of a potential choke stock; and
- demonstrate the type of analysis that is possible using the model developed by Seafish and the information reported by government in the UK and at the EU level. The hope is that as more information becomes available the analysis will be updated; and that the model can be used to test the potential value to the UK fleet of proposed mitigation measures.

Overview of main findings

The two quota simulations applied in the model, build on baseline simulation B4 which includes a catch allowance for zero-TAC stocks, quota uplift (also known as quota top-up or quota adjustment) and mobility of quota between metiers within a PO fleet segment.

Simulation S1 is the most complex quota simulation tested. The simulation moves unused quota between POs in the UK to mitigate the potential impact of choke stocks. The process by which the simulation does this is described in the methodology report. Simulation S1 does not include the potential benefit of international swaps but this is a development that could be considered in future simulations of the model. The unused quota may be available under simulation S1 because:

- a PO's vessels have encountered a choke stock that has stopped them from fully utilising a quota which is then made available through the simulation to other POs. An inherent assumption in this is that there will be full compliance with the landing obligation;
- the unused quota may be identified as unused in the simulation and made available to other POs but it could be quota that is traditionally traded in international swaps;
- the stock has little economic value so has been fully discarded. If no landings were ever recorded by a PO fleet segment, the model assumes that the fleet does not catch the stock. This is a limitation of available discard data. If the fleet holds quota for the stock, this will be made available to other POs in the simulation; or
- a PO fleet segment holds quota which it does not use.

For the majority of fleet segments, simulation S1 is the most beneficial quota simulation tested. However, for the Scotland whitefish trawl fleet, simulation S1 has limited benefit and simulation S2, is more positive.

Simulation S2 provides an indication of the potential value of historic levels of international quota swaps. Simulation S2 repeats baseline simulation B4 but instead of using the initial quota allocation to each fleet segment, as used in the baseline simulations, simulation S2 is informed by the quota held by the UK at the end of 2015. The end of year quota is distributed to PO fleet segments in the data input framework according to FQAs held.

Findings under the quota simulations

The best-case simulation for the England demersal trawl and England beam trawl fleets in Area 7 is simulation S1, which moves unused quota between UK POs. Under simulation S1 there is no impact from choke stocks until 2019, and the expected impact in 2019 is relatively limited. However, this finding is caveated with concerns over a lack of discard information in 2015 for these fleet segments in Area 7. It is possible that the data available at the time of preparation of the report does not reflect the catch taken by these fleet segments in Area 7, and therefore potential choke stocks and their choke points could be obscured. The second figure on the first page of each analysis chapter shows the extent of discards recorded for a fleet segment.

The best-case simulation for the Scotland nephrops trawl fleet segment in Area 6 and the Northern Ireland nephrops fleet segment in Area 7 is simulation S1, which moves unused quota between UK POs. Under simulation S1, both fleets could be relatively unaffected by choke stocks until 2019. This is because they often require only a relatively small amount of quota to resolve choke points identified under baseline simulation B4. However, in 2019 the challenge for these fleets is notably greater as the estimated choke point dramatically drops. Under simulation S1 in 2019, the Scotland nephrops fleet is expected to encounter a choke point in 43% of 2015 days at sea in Area 6, an average of 38 days per vessel; and the Northern Ireland nephrops trawl fleet is expected to encounter a choke point in 6% of 2015 days at sea in Area 7, an average of six days per vessel. In 2019, neither quota simulation improves the estimated choke point for the Northern Ireland nephrops trawl fleet in Area 7.

The fleet segments and sea areas of more immediate concern are those that depend on Area 4: Scotland whitefish trawl fleet segment and the Scotland nephrops trawl fleet segment. Whilst some impact is expected in 2017, challenging choke points are estimated for these fleet segments in 2018, with a further decline in 2019. Uniquely, simulation S2 is consistently the best-case simulation for the Scotland whitefish trawl fleet in Area 4. In 2019, simulation S2 is also the best case simulation for the Scotland nephrops trawl fleet.

Despite the diversity in the UK fleet there are similarities in the choke stocks identified in this summary analysis. In Area 4 saithe in 2018 and hake in 2019 are common problems. In this summary, Area 6 only appears once, and anglerfish is identified as the potential primary choke stock in 2019. In Area 7, cod 7b-k is identified as a common primary choke stock for the English fleets in 2019, and in Area 7a in 2019 the Northern Ireland fleet is expected to face a significant challenge from its catch of whiting 7a. The quota simulations have offered substantial mitigation to some fleets but, for other fleet segments, even the free movement of quota cannot fully address, and in at least one case does nothing to address, the challenge of choke stocks. Furthermore there are secondary choke stocks that could still create challenges.

TAC uplifts and quota trading are not the only potential solution to the challenges identified in the report. Solutions could also include gear selectivity improvements, avoidance and further policy initiatives such as interspecies flexibility, de minimis and survivability. These are not tested in the results of the model presented in this report.

1. Introduction

A bioeconomic model has been developed by Seafish to support high quality analysis of the UK fishing industry. The model provides Seafish with an impact assessment tool to analyse the potential impact of policy measures on the UK fishing fleet, with a particular focus on the potential effect of the landing obligation.

The landing obligation is an EU requirement to land all quota species. For the EU demersal fleet this began with a phased approach in 2016, with full implementation due in January 2019.

The model is designed to analyse the potential impact of the landing obligation for demersal quota stocks on the UK fishing fleet. More specifically the model is designed to:

- analyse the potential impact of choke stocks on different UK fleet segments; and
- analyse the potential value of mitigation measures to delay or remove potential choke situations.

A choke stock is a stock for which there is expected to be insufficient quota to support recent levels of fishing effort (days at sea). A choke stock can either be a target species or a non-target species and, in the results, will always be a demersal quota stock.

1.1. Purpose of Report

The purpose of this report is to present findings from a model of the landing obligation developed by Seafish (from hereon the Seafish model). Several simulations are presented to evaluate the impacts on UK demersal fleets. A previous Seafish report (Landing Obligation Economic Impact Assessment), published in February 2016, reported on an earlier version of the model. The development of the model was undertaken to:

- incorporate UK fleet activity at a metier level in the model, as the previous version of the model did not include metier level information but information at a sea area level;
- include most recently available and agreed transition information (e.g. phasing of fleets and quota uplifts); and
- use 2015 data (e.g. landings, discards, effort, costs etc) to inform the simulations, as the previous model used information from 2013 as the basis for the simulations.

The questions that the report responds to are focused on the next three years (2017-2019):

- which stocks are likely to create potential choke points for the main UK demersal fleets?
- when might choke points occur?
- which of the potential choke stocks present the greatest challenge?
- how substantial is the challenge?
- what capacity could the UK have to address the most challenging choke stocks through quota movement?

The report is also designed to demonstrate the capabilities of the model so that stakeholders know the type of questions that can be asked of the model. Seafish intends to continue to update the model for use as an analytical tool to support high quality analysis of the potential consequences of new policy initiatives for the UK fleet, or specific segments of the UK fleet.

1.2. Overview of Approach and Main Assumptions

The report uses the bioeconomic model to respond to the questions above. Bioeconomic modelling provides a framework for analysis that is consistent with the activities of fleets and the interactions between those activities and stocks. Modelling enables analyses to be conducted that inform the likely outcomes of policy interventions in fisheries. Policy interventions such as the landing obligation are a step-change in policy for which there is no known impact historically on fleets. With best available data, bioeconomic modelling allows simulations to be undertaken that evaluate the potential impacts of policy under different assumptions thus providing an indication of outcomes on fleets in future years.

A simplified description of what occurs in the model is:

- The UK fleet is segmented based on the activity of vessels in 2015. This results in groups of vessels that are defined by producer organisation (PO) and main gear (i.e. PO fleet segment) and the metiers (sea area and gear) in which they fish.
    - There are 96 PO and non-sector fleet segments (from hereon PO fleet segments) and 412 PO fleet segment metiers in the model.
- Bioeconomic analysis is undertaken which simulates the activity of fleets over a period of time (2015-2024) for each stock, in each metier. Once stocks are subject to the landing obligation, activity is limited by available quota.
    - There are 72 demersal quota stocks in the model, on average 12 are caught in each metier;
- The findings from each simulation, for each stock, in each metier by year are aggregated to create analyses at home-nation fleet segment level.
    - There are 33 home-nation fleet segments in the model.

Each simulation contains a number of assumptions that are applied to the future activity of fleets, for example there are assumptions about quota uplift and quota movement across metiers and/or fleets. Results are therefore specific to each simulation. Furthermore, in each simulation the biomass and total allowable catch (TAC) of a stock responds to the fishing mortality (catch) associated with that simulation in the previous year. This is managed through a harvest control rule that takes account of dynamic changes to stock biomass (e.g. through stock growth minus catches taken), where such stock data is available. The amount of catch in a day is also linked to the stock biomass calculated under each simulation i.e. in a simulation where the biomass of a stock is increasing over time, the weight of catch per day will also increase.

Six different simulations of what could happen under the landing obligation in 2017-2019 were developed for this version of the model. Four of these are referred to as baseline simulations and, using a calculated initial quota allocation in each year, explore the value of expected policy and industry mitigation measures. The baseline simulations indicate the challenge faced by UK fleet segments, and therefore the extent of change that could be required to avoid choke stocks and keep fishing.

There are two further simulations which explore to what extent the UK can address the challenge of choke stocks through quota trading within the UK or through quota swaps with other EU member states. However, TAC uplifts and quota trading are not the only potential solution to the challenges identified. Solutions could also include gear selectivity improvements, avoidance and further policy initiatives such as interspecies flexibility, de minimis and survivability. These are not tested in the results of the model presented here.

As mentioned above, the findings for PO fleet segment at metier level from different simulations are aggregated into home-nation fleet segments. It is findings for five of these home-nation fleet segments that are presented in the report (Table 1-1).

Table 1-1: Home-nation fleet segments included in the report and share of demersal quota catch in 2015

	Scotland nephrops trawl	Scotland whitefish trawl	Northern Ireland nephrops trawl	England beam trawl	England demersal trawl
Share of demersal stock catch in 2015	10%	28%	6%	10%	8%

The next chapter presents more information on the segmentation of the UK fleet, the simulations developed and the aggregation process. However, for more detailed understanding of the model and the assumptions used, please refer to the methodology report which has been published separately.

We also take this opportunity to highlight that the outputs from a modelling exercise should be used appropriately. The model and the analysis presented in the report are designed to produce the best quantitative analysis possible across a diverse UK fleet using available information. However, information in fisheries is often imperfect and natural fluctuations in fish stocks are inevitable. The results are not intended to, and are unlikely to, provide an exact prediction of the number of days the vessels in a fleet segment will fish in 2019. However, the findings are expected to provide a solid indication of when, where and to what extent challenges exist, particularly in sea areas and fleet segments where more robust information exists on stock biomass and discard rates. Our hope is that the results are used to inform discussions on the potential outcomes of the landing obligation and the scale of the challenge faced by the UK fleet; and, that the results and the ongoing development of the model support the development of successful mitigation measures.

1.3. Structure of the Report

The remainder of the report is structured as follows:

- Chapter 2 provides more information on the structure and operation of the model;
- Chapters 3-7 provide an analysis of a home-nation fleet segment. This analysis includes:
    - An overview of the fleet segment's activity in 2015.
    - For each key sea area for the fleet, the following information is provided:
        - A choke point analysis for 2015-2019;
        - The most challenging stocks;
        - The amount of quota required to avoid the most challenging stocks creating a choke point;
        - The extent to which the quota simulations can provide the required quota; and
        - The extent to which addressing the most challenging stock supports a delay to the choke point.
    - Two tables which provide more detail on the information provided for each sea area, and an assessment of the improvement in selectivity required as an alternative to more quota; and
    - A table which contains information on the first five choke stocks identified for each home-nation fleet segment under baseline simulation B4 in 2019, once all demersal stocks are subject to the landing obligation.
- The final chapter in the report contains an overview of the analysis and summarises the findings from the best-case simulations for each fleet segment in its main sea area(s).
- Appendices A, B and C provide information on quota uplift, discard rates and the transitional phasing of stocks in 2016-2018, as used in the model.

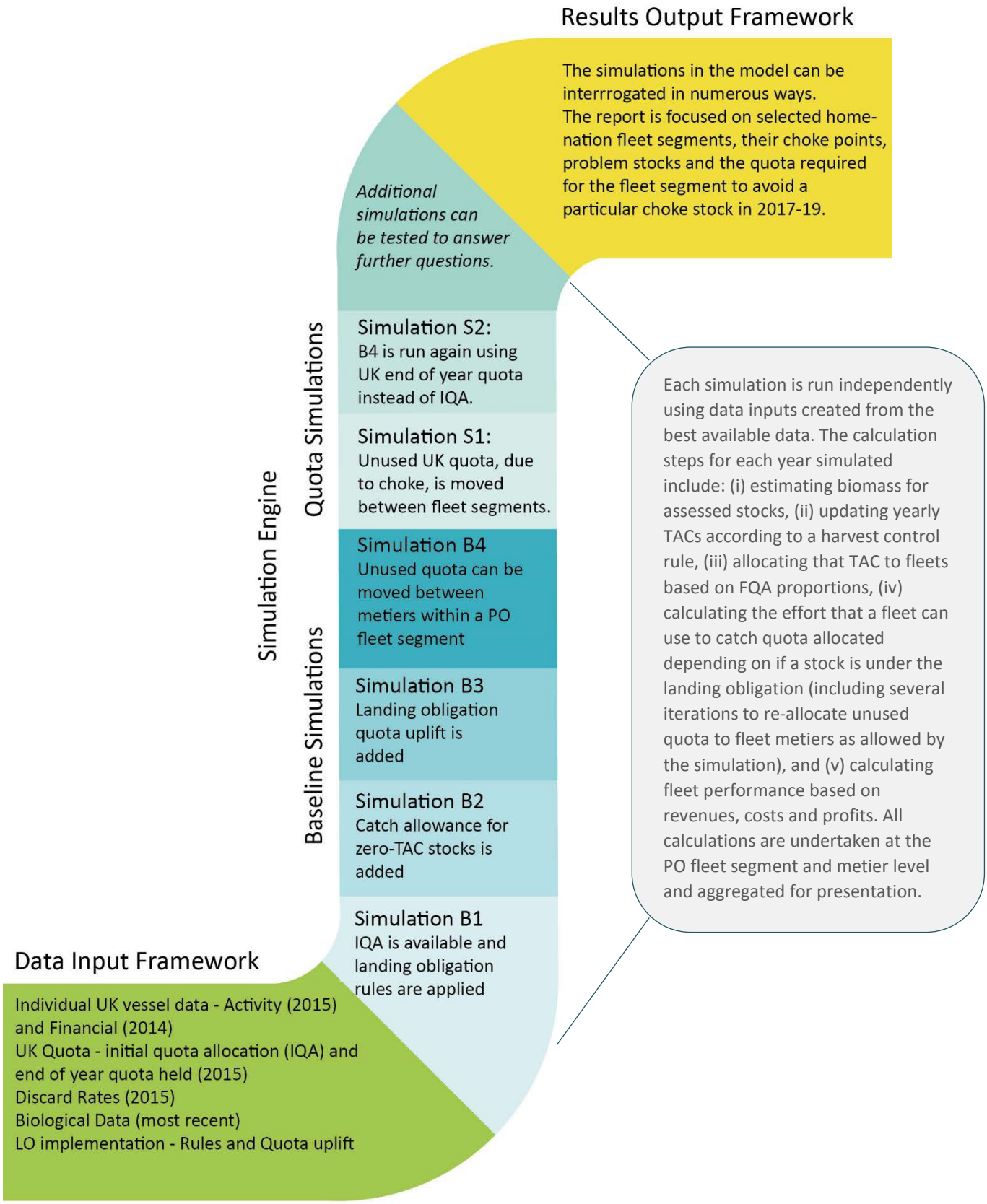
2. Introduction to the Seafish model

The Seafish model has been developed using three distinct modules: data input, simulation engine and results output. The data input framework takes large amounts of fleet and fishery data from disparate sources and combines it into a consistent and usable format for input into the model. The simulation engine models the defined fleets using different simulations developed to investigate the impact of different policy options and sub-policy options (e.g. landing obligation and mitigation measures). The results output framework takes the results from the model and aggregates them into a format and level of detail suitable for dissemination in public reports. See Figure 2-1 for a visual overview of the three modules.

This chapter provides an introduction to the model. For further detail please see the separately published methodology report. The chapter includes:

- an overview of the model structure;
- an overview of how the UK fleet has been segmented and key facts on the data input framework;
- a description of the simulations tested in the model and key facts on how the simulations operate;
- a description of how the findings from the simulations are analysed and key facts about the results output framework.

Figure 2-1: Overview of the Seafish Bioeconomic Model



2.1. Data Input Framework

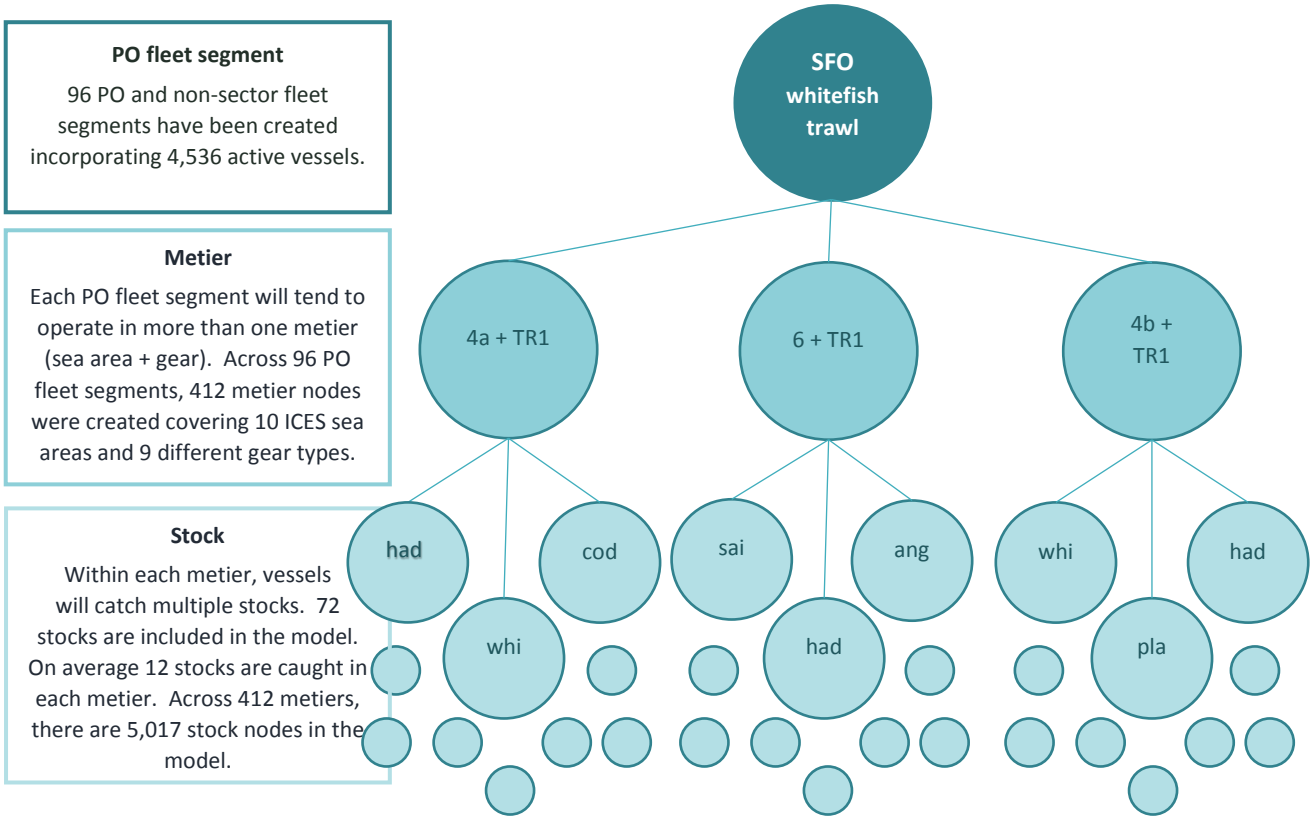
The model requires information on the activity of the UK fleet, the implementation rules of the landing obligation, biological data for the stocks and quota held by the UK fleet. To provide this, an extensive data input framework links the multiple different data sources required to inform the model. This is used to provide data to the model in a consistent format. The data input framework is also designed so that the model can be updated more efficiently on an annual basis as new data becomes available.

2.1.1 Analysing the activity of the UK fleet

The model requires information on the vessels operating in the UK fleet. This information is provided through the data input framework and includes, but is not limited to landings, days at sea and discard rates. Unfortunately, it is not feasible to model the UK fleet on a vessel by vessel basis due to technical capacity. The challenge is therefore to allocate each UK vessel to a group of similar vessels. To enable this, each vessel is defined by its size, main gear type, its home-nation according to its port of registration, its PO membership and the stocks that it predominantly catches. From this information, PO fleet segments and non-sector fleet segments are created. Examples of PO fleet segments include, SFO whitefish trawl, SFO demersal trawl and SFO nephrops trawl (SFO is a PO in Scotland). Unless otherwise specified, all PO fleet segments include only vessels over 10m, as in general most under-10 m vessels are not part of POs. There are specific under-10m fleet segments defined in the model.

Once a PO fleet segment is created, information on the activity of all vessels allocated to it is analysed at a metier level, which is combination of fishing area and gear used. The analysis at metier level identifies the stocks caught by the vessels in a PO fleet segment and effort (days at sea). At this point the individual characteristics of a vessel are obscured and information is summarised to the group. In the simulation phase of the model, it is at the stock and metier level that the baseline simulations are applied. Choke points are then calculated at the metier and PO fleet segment level.

Figure 2-2: Allocation of fishing activity to a PO fleet segment



2.1.2 Key facts on the data input framework

Key facts about the data input framework include:

- Activity data (effort and landings weight and value) from 2015 is summarised and supplied to the simulations from the data input framework for each PO fleet segment at the metier (gear and sea area) and stock level.
- 2015 discard rates from STECF FDI database are recalculated to home-nation, PO fleet segment and metier level. PO fleet segments using the same gear in the same area will have the same discard rates as discard information is not available from the FDI database at a vessel level. Where 100% discard rates are reported, but there are landings by a PO fleet segment, a 99.5% discard rate is used to ensure model operation. See Appendix B for information on the discard rates currently used in the model.
- Two different types of quota information are available in the data input framework. Initial quota allocation (IQA) to each PO fleet segment (includes quota held by vessels and on dummy licenses) and UK adjusted quota at year-end, i.e. after EU swaps, which is allocated to PO fleet segments according to FQAs.
- The rules for the implementation of the landing obligation reflect those agreed and proposed by Regional Groups in 2016. See Appendix C for information on how the model phases stocks into the landing obligation in 2016-2018.

2.2. Bioeconomic Simulations

The second element of the model is the engine of the model and is where different simulations are applied to the UK fleet to understand the impact of different conditions. The biological component of the model means that the quota allocated annually is adjusted to reflect the expected effect of each simulation on the biomass of each stock. Six simulations were developed for the model: four baseline simulations and two quota simulations. These are described below.

2.2.1 Baseline simulations

There are four baseline simulations (B1-B4) in the model. Each baseline simulation builds on the previous one (see Figure 2-1).

- **Baseline simulation B1** assumes that each PO fleet segment only has the initial quota allocation provided to its vessels and, by 2019, UK vessels cannot discard any demersal quota stocks. In this simulation, there are no mitigation measures from industry or government that could reduce negative impacts from the landing obligation. The year in which stocks become subject to the landing obligation in different fleet segments and metiers prior to 2019 is informed by existing and proposed management rules put forward by the North Sea and North Western Waters Regional Groups in 2016.
- In **baseline simulation B2** a catch allowance of 1.5% of a fleet segment's total catch (all quota stocks, all sea areas) can be applied to zero-TAC stocks. The scale of the allowance replicates an allowance in the previous version of the model. The figure of 1.5% was informed by current bycatch percentages. There is not yet any information on how zero-TAC stocks might be addressed under the landing obligation. The simulation does not exempt these stocks from the landing obligation but does significantly reduce the likelihood that these stocks will create a choke point in the model.
- In **baseline simulation B3**, in addition to the catch allowance, a fleet segment also benefits from quota uplift (also known as quota top-up or quota adjustment) when a particular metier and stock becomes subject to the landing obligation for the fleet segment. The methodology for applying quota uplift in the simulation during the transition period (2017-2019) is similar to the methodology currently recommended by STECF and used by the EU. The total amount of quota uplift calculated in 2019 is informed by ICES information on landings and catch TACs for each stock. See Appendix A for quota uplifts used in the model in 2016 and 2019. In 2017 and 2018, quota uplift is applied according to the proportion of the fishery that becomes subject to the landing obligation in each year.
- In **baseline simulation B4** the model actively extends fishing opportunity within a PO fleet segment by reallocating unused effort from one metier (created by a choke point) to another metier to delay a choke point. Baseline simulation B4 attempts to simulate decisions that vessel owners may make.

All further simulations that test the value of additional mitigation measures will be tested against or use the framework of baseline simulation B4.

2.2.2 Quota simulations

Two quota simulations have been developed to test to what extent the UK may have the capacity to address choke stocks with the quota available to the UK. Unlike the baseline simulations, the quota simulations are not cumulative i.e. simulation S1 is applied to B4 and simulation S2 is a new version of B4 with a different starting point for the quota held by the UK fleet.

- In **quota simulation S1**, in addition to the mitigation measures included in baseline simulation B4, unused quota (caused by choke points in simulation B4) is moved between PO fleet segments to enable best utilisation of UK quota stocks. This simulation assumes perfect distribution of information between PO fleets and home nations, easy quota movement and full compliance with the landing obligation. However, in reality some fleets may keep unused quota until the end of the year to minimise the risk of choke or to trade for their own purposes. The simulation is not intended to accurately reflect the decisions that individual vessel owners or PO quota managers might make, instead it is applied to indicate whether the UK has the capacity to solve its own quota challenges. This simulation uses the UK's initial quota allocation (IQA) plus quota uplift.
- In **quota simulation S2**, the IQA quota which is used to inform the baseline simulations is replaced with total UK quota held at year end after swaps with other EU Member States. The quota share that is allocated to each PO fleet segment is based on FQAs, not the PO quota at the end of 2015. This simulation assumes that the quota which comes into the UK during the year, through quota swaps between European POs, is distributed between all POs according to FQAs as no information on how UK quota is distributed between different PO fleet segments at the end of the year is available. The purpose of this simulation is to indicate that, if similar proportions of quota can be obtained by the UK as happened in the past, could the UK have the capacity to solve its own quota challenges. However, as the EU moves towards full implementation of the landing obligation, there is no guarantee that international swaps in the future will follow a similar pattern to those in 2015.

2.2.3 Key facts about the application of simulations in the model

The following points highlight key facts about how the simulations are applied in the model.

- The model operates at the lowest level of detail for each calculation, with results aggregated only in the results output framework. More detail on the approach and calculations is provided in the methodology report.
- Quota uplift (quota top-up, quota adjustment) is allocated to fleets based on the proportion of quota that they receive without adjustment. For the transition period (2016-18), quota uplift is only made available to fleet segments if the metiers that they fish are subject to the landing obligation in those years. This equates to no obligation to land a stock then no quota uplift for a stock.
- ICES stock assessment data for biomass is used in the model to simulate the impact of future fishing on stock biomass. The effect on biomass will vary from simulation to simulation and from year to year. Based on changes in biomass, quota is adjusted on an annual basis according to a harvest control rule that adjusts quota by up to 5%.
- Catchability is calculated for each of the 5,017 stock nodes (see Figure 2-2). Stock nodes are the number of stocks landed by each of the 412 PO fleet segment metiers in 2015, i.e. on average 12 different stocks were landed by the vessels in a PO fleet segment metier.
- Total effort in the model is restricted to the number of days fished by each PO fleet segment in 2015. In the report the focus is on choke points, but economic data is included in the model. If we proceed to consider economic impacts the maximum number of days could be extended to reflect the potential to increase fishing opportunity in some fleet segments.

2.3. Results Output Framework

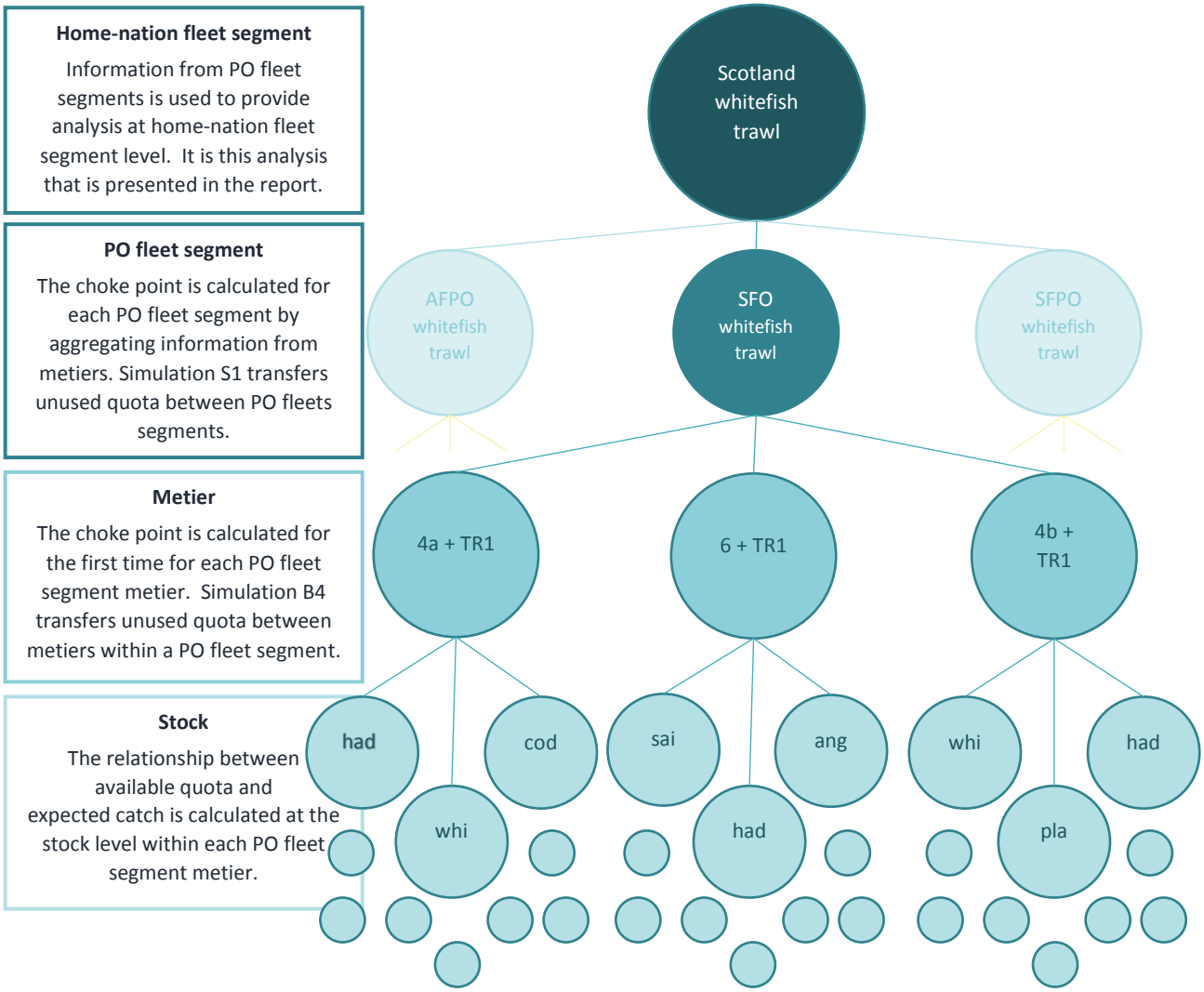
The is where the findings of the simulations are aggregated so that they can be reported at an appropriate level. In this report, the findings are aggregated to home-nation fleet segments. However, the aggregation

process could also provide information from the simulations for different levels, for example information could be provided for POs, gears, sea areas and stocks.

2.3.1 Aggregating the findings from the simulations

The results of model simulations are provided to the results output framework at the stock level in each PO fleet segment metier. The information is then aggregated in different ways to provide the answers to the questions that have been asked.

Figure 2-3: Aggregating the findings from the simulations to a home-nation fleet segment



2.3.2 Understanding the challenge

There are two main approaches used to answer the questions asked in this report: a choke point analysis which is calculated at a PO fleet segment level and aggregated to home-nation level for presentation, and a choke stock analysis, which identifies the most challenging stock for home-nation fleet segments.

- **A choke point analysis.** This approach to the analysis is focused on the point at which a fleet segment could run out of quota for any of the stocks that it catches. This analysis is undertaken at the lowest level in the model (i.e. PO fleet segment metier). The choke point is calculated as the fishing days possible up until a choke point is encountered. To present the choke point analysis in the report, PO fleet segment choke points are aggregated to identify a choke point for the home-

nation fleet segment. However, a different choke stock could be causing the choke points in each of the PO fleet segments. Therefore, the choke point analysis uses the minimum choke points which are determined by the characteristics of individual PO fleet segments (quota holdings, catch rates etc.).

- **A choke stock analysis.** To understand the choke characteristics of individual stocks, the choke stock analysis is designed to aggregate the results for each stock across multiple metiers. In the choke point analysis, described above, different stocks can impact the choke points identified at a PO fleet segment level so a clear understanding of the overall effect of individual stocks is difficult. In addition, some PO fleet segments within a home-nation fleet segment may not catch stocks that others catch in the same metier. In the choke stock analysis, unused effort per stock is calculated across all PO fleet segment metiers in the home-nation fleet segment and aggregated to indicate the scale of the challenge caused by each stock. Unused effort is the difference between 2015 days at sea in each metier and the days at sea estimated to catch the quota allocated to each metier. The stock with the largest unused effort is the stock identified as the most challenging stock. This stock may not always be the primary choke stock for different POs but, out of all the stocks caught, it is the stock that could cause the greatest choke challenge across the home-nation fleet segment. The choke stocks analysis can also be used to provide a UK view of challenging stocks.

Please see Figure 2-4 for a practical demonstration of the two approaches.

Figure 2-4: Example to demonstrate the choke point analysis and the most challenging stock analysis

The example presents a hypothetical home-nation fleet segment which contains three PO fleet segments. Each PO fleet segment has only two potential choke stocks. Prior to the landing obligation, each PO fleet segment fished for 2,000 days per annum, therefore, total days at sea for the home-nation fleet segment was 6,000 days. The data used to calculate the choke point and the most challenging stock for the home-nation fleet segment is in the table.

	Primary choke			Secondary choke		
PO fleet segment	Primary choke stock	Choke Point (days at sea)	Unused days (2,000 days minus choke point days)	Secondary choke stock	Choke Point (days at sea)	Unused days (2,000 days minus choke point days)
A	Saithe	1,200	800	Hake	1,300	700
B	Hake	900	1,100	Saithe	1,500	500
C	Cod	1,600	400	Hake	1,650	350

Choke Point Analysis

The home-nation choke point analysis sums the primary choke point for each PO fleet segment (1,200 + 900 + 1,600) to calculate the choke point of 3,700 days or 62% (3,700 as % of 6,000 days). This represents the days at sea possible before each PO fleet segment encounters its own primary choke stock. The analysis is not stock specific.

Most Challenging Stock Analysis

The most challenging stock analysis is stock specific. To identify the potential challenge caused by each stock the model calculates the number of unused days.

In the example hake is the most challenging stock because 2,150 potential days at sea could be unused (700 + 1,100 + 350). Saithe is only a potential choke stock for two POs and 1,300 days at sea could be unused. Cod is only a potential choke stock for one PO and only 400 days at sea could be unused. Once the most challenging stock is identified, the model quantifies the amount of quota for the most challenging stock that could be required to keep the home-nation fleet fishing for 6,000 days, assuming no other choke stock is encountered; and, as an alternative measure, the model also quantifies the improvement in selectivity that could be required to stop the stock from creating a choke.

2.3.3 Key facts about the results output framework

The following points highlight key facts about how the results output framework uses the information produced by the model simulations to provide appropriate analysis:

- The Results output framework allows us to update simulation results comparatively quickly. The processed data (we use R script created for this analysis) produced by the results output framework has a standard shape and all graphs and figures, presented in this report, are linked to it in an Excel file and use it as a source of information.
- The home-nation of each PO and fleet segment is identified in the data and this enables aggregation to home-nation level.
- In the choke point analysis, the choke point is calculated as the number of days at sea a fleet segment can fish before it encounters its first choke stock under each simulation. The choke point is then compared to the days at sea for the fleet segment in 2015. There is a presumption in this comparison that the number of days spent at sea in 2015 is a desirable outcome for each fleet segment.
- Although not presented in this report, the results output framework also receives information from the simulations on biomass and economic indicators. Biomass information is provided to the results output framework at a stock level and economic information is provided at a PO fleet segment level.

3. Scotland Nephrops Trawl

3.1. Activity in 2015

There were 180 active vessels allocated to the Scotland nephrops trawl fleet in 2015. These vessels were members of five different POs or were non-sector vessels. The defining characteristics of the vessels in this fleet segment are that they: predominantly use TR2 gear, target nephrops, are over 10m in length, are members of a PO with more than five nephrops trawl vessels[1] and are registered to a port in Scotland.

In 2015, the fleet segment spent 64% of its time in Area 6 (16,404 days) and 34% in area 4 (8,838 days). A further 421 days were recorded in Area 7. In Area 4, although the primary catch was nephrops, the fleet caught a more diverse catch than caught in Area 6. In Area 4, cod, haddock and whiting were a notable proportion of catch (Figure 3-2).

Table 3-1: Scotland nephrops trawl fleet segment for the analysis, 2015

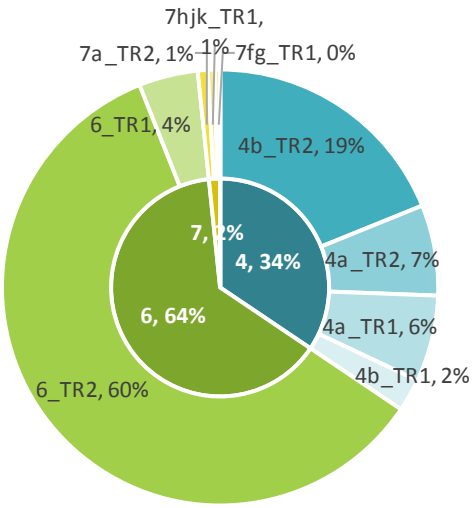
No. Vessels:	180
Main Gear:	TR2
PO Membership:	ASFPO, NPO, SFO, TFFPO, WoSFPO and non-sector

Table 3-2: Scotland nephrops trawl fleet landings and effort, 2015 (Areas 4,6,7)

	Total	Average per vessel
Landings (tonnes)	14,842	83
Effort (DAS)	25,663	143

Landings include non-quota stocks

Figure 3-1: Fleet segment effort (days at sea) by metier, 2015



Key for Figure 2-1

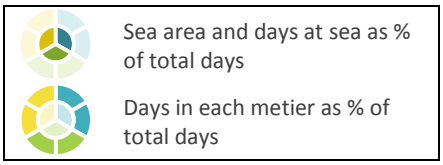
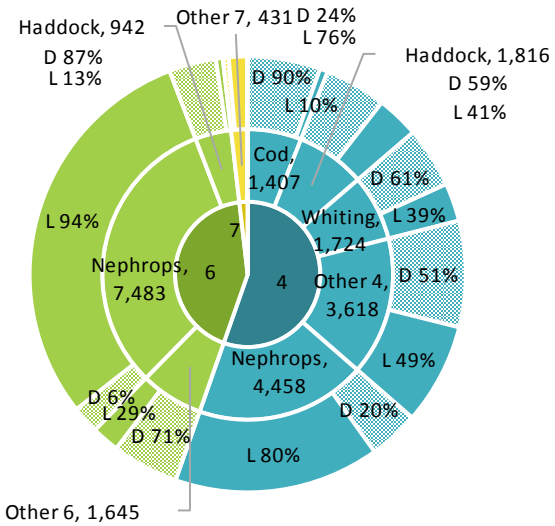
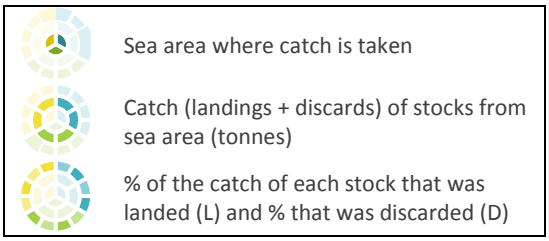


Figure 3-2: Fleet segment catch by sea area (landings + discards[2]), 2015



Key for Figure 2-2



Catch of individual stocks that represented more than 4% of total catch in 2015 is shown. All other catch (quota and non-quota) is grouped under 'other'.

[1] Vessels from one PO (five vessels) were excluded from the analysis. The exclusion of these vessels is due to the data confidentiality parameter in the analysis which excludes vessels from any PO fleet segment with five or fewer vessels.

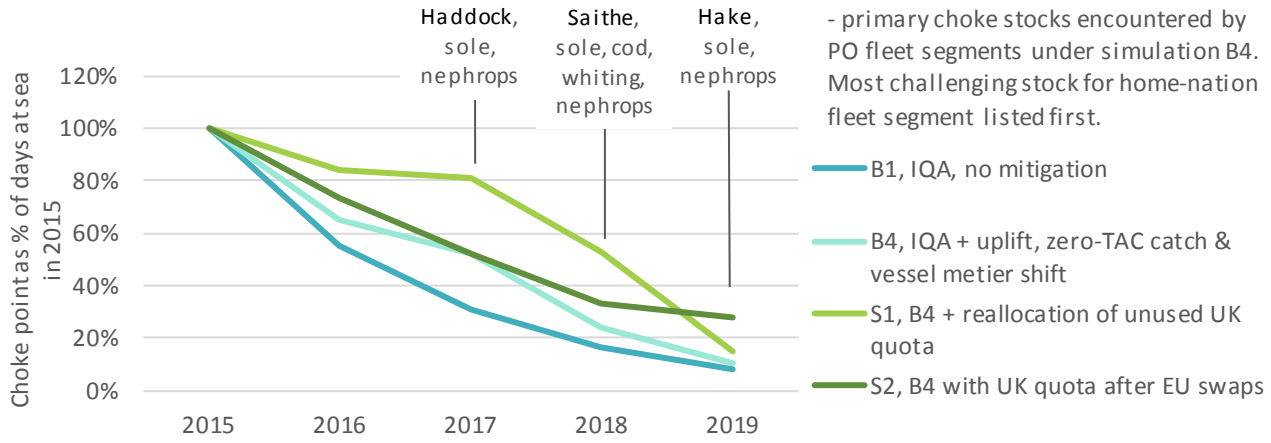
[2] Discard rate is taken from 2015 STECF FDI database and is specific to each fleet segment and metier where possible.

3.2. Findings from simulations in Area 4 (North Sea), 2017-2019

Figure 3-3 shows the choke points calculated for the Scotland nephrops trawl fleet segment under four simulations in Area 4 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown, with the most challenging stock listed first. The analysis shows that all five POs that operate in Area 4 are expected to encounter a choke stock between 2017 and 2019. In 2017, a choke most commonly occurs in sub-area 4b. Each primary choke stock contributes to the calculation of the choke point which, under simulation B4, is calculated to be 52% of 2015 days at sea (DAS) in 2017, 24% in 2018 and 10% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 3-3: Scotland nephrops trawl - Area 4 choke points under baseline and quota simulations, compared to 2015 DAS



3.2.1 Effect of quota simulations in Area 4

Under simulation B4, the most challenging choke stocks in Area 4 are identified as haddock in 2017, saithe in 2018 and hake in 2019. The amount of additional quota that the Scotland nephrops trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 133 tonnes of haddock quota in 2017;
- 140 tonnes of saithe quota in 2018; and
- 308 tonnes of hake quota in 2019 (Figure 2-4).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 3-5 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Compared to simulation B4, simulation S1, the reallocation of unused quota between UK POs, has a positive benefit to the estimated choke point of the Scotland nephrops fleet segment in 2017 and 2018, with a 29 and 28 percentage point improvement in the choke point (Figure 3-3). Although simulation S1 appears to offer no additional saithe quota in 2018 (Figure 3-5), the simulation is able to provide some benefit to POs that have a different primary choke stock. However, saithe remains a challenging stock. In 2019, when hake is the most challenging stock, simulation S1 has only a minimal benefit compared to simulation B4.

Compared to simulation B4, simulation S2, the allocation of UK quota after EU swaps, has no benefit to the fleet segment's choke point (Figure 3-3), despite the simulation estimating that haddock quota is available (Figure 3-5). Similarly in 2018, despite the simulation suggesting that more than half of the required quota for saithe is available, the choke point is only delayed by nine percentage points (Figure 3-3). In 2019, simulation S2 has more benefit on the choke point, a delay of 18 percentage points, through access to hake quota.

The reason why the impact on the choke point can appear disappointing under simulation S2 is that the simulation does not allow trade between POs and, as a result, the available quota may be allocated to a PO which does not have the greatest need for the quota. Further development of simulation S2 could be undertaken in the next iteration of the model.

Figure 3-4: Fleet segment's quota in baseline simulations plus quota required[3] to fish for 2015 DAS, compared to UK quota (tonnes)

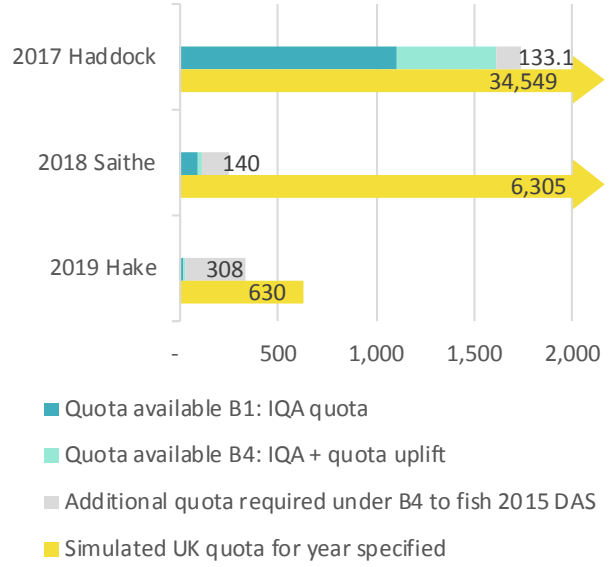


Figure 3-5: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

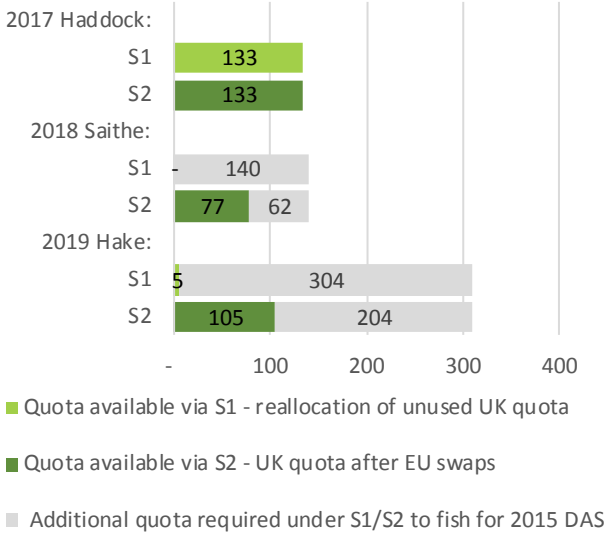


Table 3-3: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 4

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Haddock	7.5%	6.1%	✓✓✓	✓✓✓	✓✓✓	✗
2018	Saithe	1.1%	1.5%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2019	Hake	1.3%	3.6%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

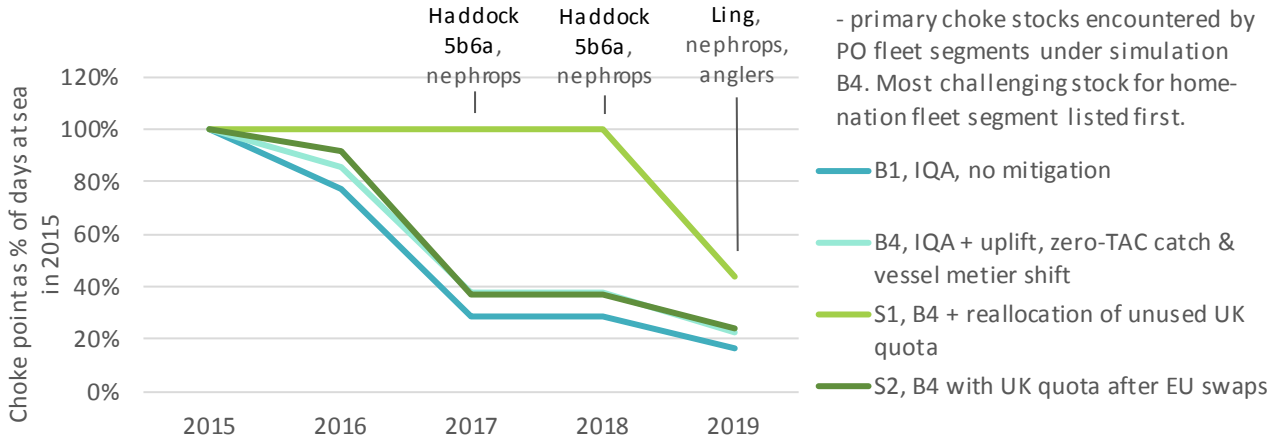
[3] More quota is not the only solution for choke stocks. The measure is used to understand the scale of the challenge.

3.3. Findings from simulations in Area 6 (West of Scotland), 2017-2019

Figure 3-6 shows the choke points calculated for the Scotland nephrops trawl fleet segment under four simulations in Area 6 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown, with the most challenging stock listed first. The analysis shows that three of the four POs that operate in Area 6 are expected to encounter a choke stock in 2017, 2018 and 2019. Each primary choke stock contributes to the calculation of the choke point which, under simulation B4, is calculated to be 38% of 2015 days at sea (DAS) in 2017 and 2018 and 23% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 3-6: Scotland nephrops trawl - Area 6 choke points under baseline and quota simulations, compared to 2015 DAS



3.3.1 Effect of quota simulations in Area 6

Under simulation B4, the most challenging choke stocks in Area 6 are identified as haddock 5b6a in 2017and 2018 and ling in 2019. The amount of additional quota that the Scotland nephrops trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 563 tonnes of haddock 5b6a quota in 2017 and 2018; and
- 123 tonnes of ling quota in 2019 (Figure 2-7).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 3-8 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

In 2017 and 2018, the reallocation of unused UK quota (simulation S1) fully addresses the quota requirement for haddock 5b6a quota and removes the potential choke point (Figure 3-6). The removal of a potential choke point under simulation S1, means that the simulation is also successfully addressing the need for nephrops quota which is another primary choke stock under simulation B4.

In 2019, simulation S1 also fully addresses the quota requirement for the most challenging stock identified under simulation B4 – ling (Figure 3-8). However, the benefit to the fleet segment's choke point is limited, a delay of 20 percentage points compared to simulation B4 (Figure 3-6), as anglerfish creates a secondary choke point that cannot be resolved through simulation S1.

Simulation S2, which includes the potential benefit of EU swaps, provides no benefit in Area 6.

Figure 3-7: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

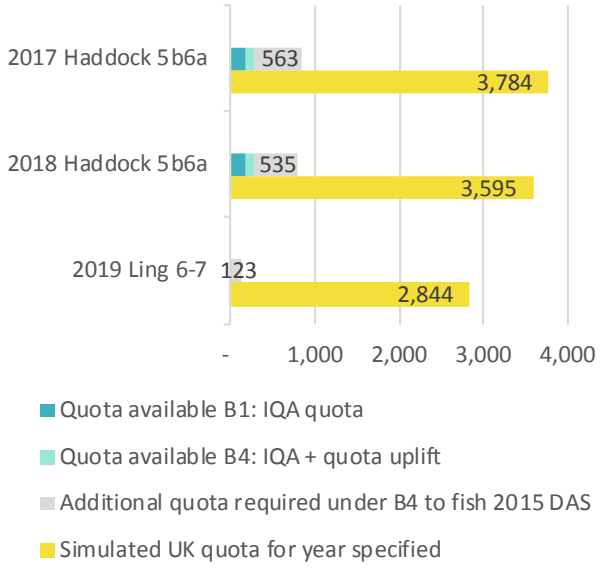


Figure 3-8: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

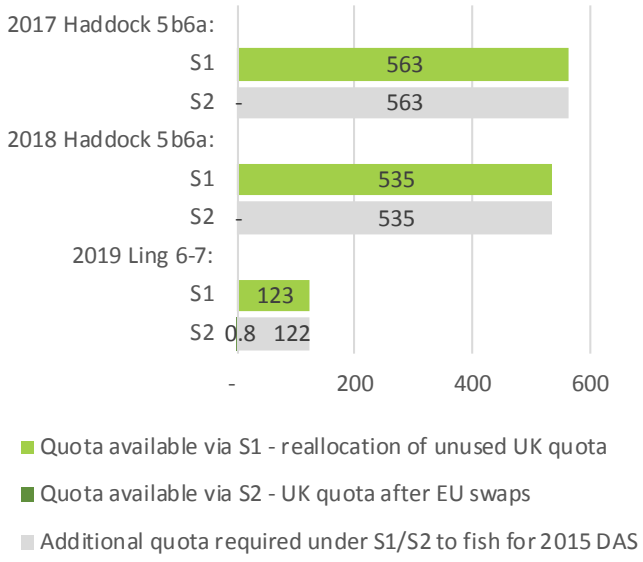


Table 3-4: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 6

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Haddock 5b6a	3.6%	5.7%	✓✓✓	✗	✓✓✓	✗
2018	Haddock 5b6a	3.6%	5.7%	✓✓✓	✗	✓✓✓	✗
2019	Ling 6-7	0.6%	0.2%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Table 3-5: Choke Point Analysis – Further detail on the choke points for the Scotland nephrops trawl fleet segment and the delay to the choke point that different simulations create

Sea Area	Average DAS per vessel in 2015	Year	Primary choke stocks for the different PO fleet segments included in the home-nation fleet segment	Baseline B4: Uplift, zero-TAC catch and vessel metier shift Aggregated choke point in home-nation fleet segment		Simulation S1: Reallocation of unused UK quota Potential delay to choke point, compared to baseline B4		Simulation S2: B4 with UK quota after EU swaps Potential delay to choke point, compared to baseline B4	
				% of 2015 DAS	Average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel
4	48	2017	Sole, haddock, nephrops	52%	25	29%	14	0%	0
		2018	Sole, saithe, whiting, nephrops, cod	24%	12	28%	14	9%	4
		2019	Hake, sole, nephrops	10%	5	4%	2	18%	8
6	89	2017	Nephrops, haddock 5B6A	38%	33	Removes choke	-	0%	0
		2018	Nephrops, haddock 5B6A	38%	33	Removes choke	-	0%	0
		2019	Nephrops, ling, anglerfish	23%	20	20%	18	1%	1

Table 3-6: Choke Stock Analysis – Further detail on the most challenging stocks for the Scotland nephrops trawl fleet segment and the quota required to avoid a choke on the stock

Sea Area	Year of analysis	Most challenging individual stock in year of analysis (Baseline B4)	Baseline B1: Fleet's IQA in year of analysis (tonnes)	Baseline B4: Fleet's IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: UK IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: Selectivity improvement required to avoid choke	Baseline B4: Additional quota required to avoid choke (tonnes)	Simulation S1: Additional quota available to fleet (tonnes)	Simulation S2: Additional quota available to fleet (tonnes)
4	2017	Haddock	1,106.4	1,607.9	34,549	-	133.07	133.1	154.71
	2018	Saithe	86	107	6,305	-70%	140	14	77
	2019	Hake	21	23	630	-90%	308	5	105
6	2017	Haddock 5b6a	185	282	3,784	-53%	563	563	-
	2018	Haddock 5b6a	176	268	3,595	-53%	535	535	-
	2019	Ling 6-7	6.2	6.8	2,844	-77%	123	123	0.8

Table 3-7: Five most challenging stocks by sea area in 2019 under baseline simulation B4

Sea Area	1st stock and choke point			2nd stock and choke point			3rd stock and choke point			4th stock and choke point			5th stock and choke point		
	Stock	%*	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel
4	Hake 4	17	8	Sole 4	70	34	Cod 4	80	39	Turbot 4	88	43	Plaice 4	89	44
6	Ling 6-7	29	27	Anglers 6	30	27	Plaice 6	38	35	Sole 6	41	37	Haddock 5b6a	46	42

**% shows choke point as a percentage of 2015 DAS in the sea area.*

4. Scotland Whitefish Trawl

4.1. Activity in 2015

There were 66 active vessels allocated to the Scotland whitefish trawl fleet. These vessels were members of four POs. The defining characteristics of the vessels in this fleet segment are that they: predominantly use TR1 gear, target cod, haddock, whiting and/or saithe, are over 10m in length, flatfish and other species such as anglerfish represented less than 50% of total value of landings in 2015, and are registered to a port in Scotland.

In 2015, the fleet segment spent the majority of its time in Area 4 (9,662 days) and 1,470 days in Area 6. The fleet segment landed 47,084 tonnes in 2015 from both areas.

Table 4-1: Scotland whitefish trawl fleet segment for the analysis, 2015

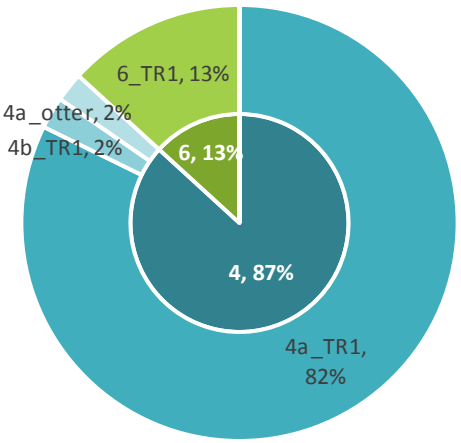
No. Vessels:	66
Main Gear:	TR1
PO Membership:	AFPO, NESFO, SFO, SFPO

Table 4-2: Scotland whitefish trawl fleet landings and effort, 2015 (Areas 4,6)

	Total	Average per vessel
Landings (tonnes)	47,084	713
Effort (DAS)	11,132	169

Landings include non-quota stocks

Figure 4-1: Fleet segment effort (days at sea) by metier, 2015

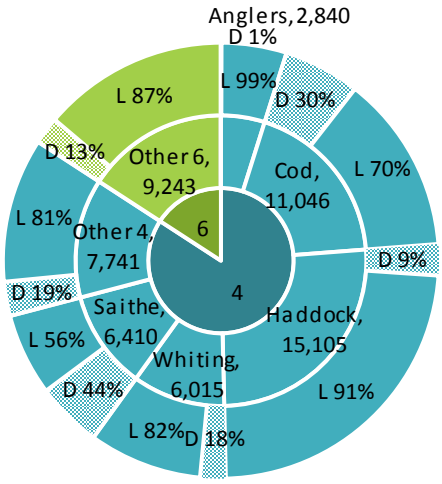


Key for Figure 3-1

Sea area and days at sea as % of total days

Days in each metier as % of total days

Figure 4-2: Fleet segment catch by sea area (landings + discards[4]), 2015



Key for Figure 3-2

Sea area where catch is taken

Catch (landings + discards) of stocks from sea area (tonnes)

% of the catch of each stock that was landed (L) and % that was discarded (D)

Catch of individual stocks that represented more than 4% of total catch in 2015 is shown. All other catch (quota and non-quota) is grouped under 'other'.

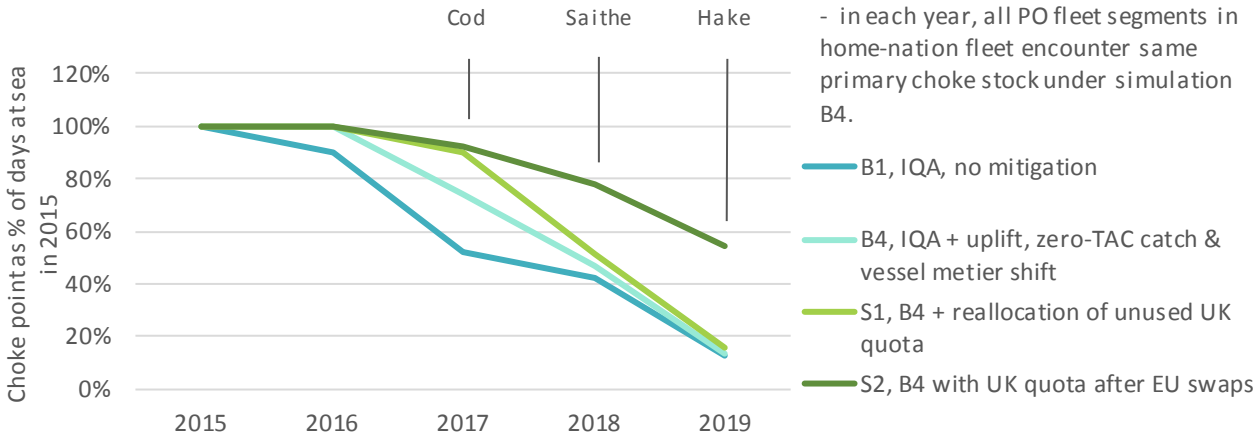
[4] Discard rate is taken from 2015 STECF FDI database and is specific to each fleet segment and metier where possible.

4.2. Findings from simulations in Area 4 (North Sea), 2017-2019

Figure 4-3 shows the choke points calculated for the Scotland whitefish trawl fleet segment under four simulations in Area 4 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown. The analysis shows that all four POs in the fleet segment are expected to encounter the same primary choke stock between 2017 and 2019. The choke point under simulation B4 is calculated to be 74% of 2015 days at sea (DAS) in 2017, 46% in 2018 and 13% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 4-3: Scotland whitefish trawl fleet - Area 4 choke points under baseline and quota simulations, compared to 2015 DAS



4.2.1 Effect of quota simulations in Area 4

Under simulation B4, the most challenging choke stocks in Area 4 are identified as cod in 2017, saithe in 2018 and hake in 2019. The amount of additional quota that the Scotland whitefish trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 2,686 tonnes of cod quota in 2017;
- 3,142 tonnes of saithe quota in 2018; and
- 1,919 tonnes of hake quota in 2019 (Figure 4-4).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 4-5 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Compared to simulation B4, simulation S1, the reallocation of unused quota between UK POs, has a positive benefit to the estimated cod choke point for the Scotland whitefish fleet segment in 2017, with a 16 percentage point improvement (Figure 4-3). However in 2018 and 2019, simulation S1 can only find a limited amount of unused saithe and hake quota in the UK and therefore the simulation has little effect on the choke point for the fleet.

Compared to simulation B4, simulation S2, which allocates UK quota after EU swaps, has a positive benefit on the estimated choke point of the Scotland whitefish fleet segment in 2018 and 2019, with a 31 and 41

percentage point improvement in the choke point (Figure 3-3). The Scotland whitefish fleet segment is the only one of the five home-nation fleet segments where simulation S2 consistently has a stronger benefit than simulation S1, which could be presumed to reflect the extent that international quota swaps support the activity of the fleet segment.

Figure 4-4: Fleet segment's baseline quota in year of analysis and quota required to fish for 2015 DAS compared to UK quota (tonnes)

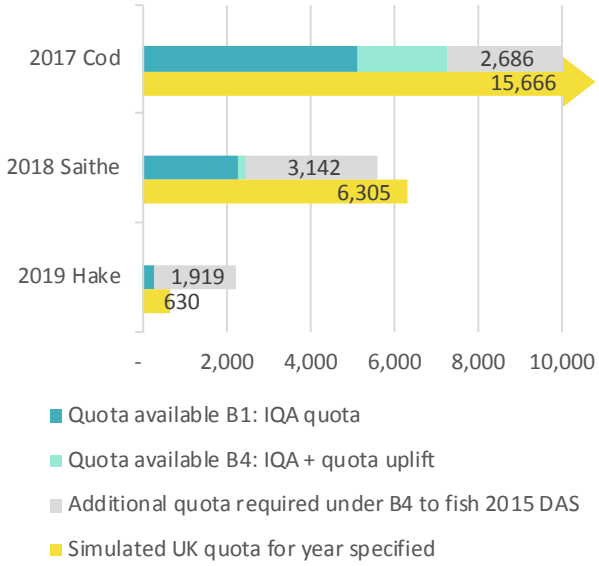


Figure 4-5: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

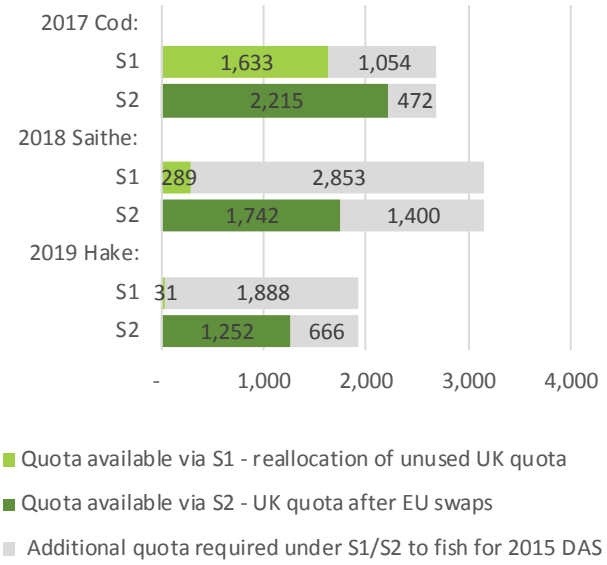


Table 4-3: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 4

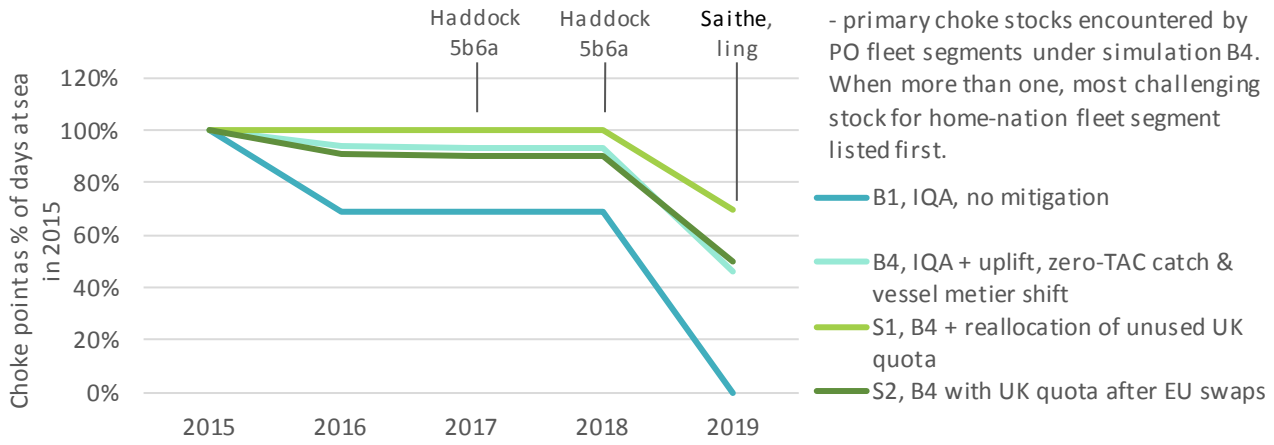
Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Cod	18.4%	46%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2018	Saithe	10.7%	39%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2019	Hake	3.7%	45%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

4.3. Findings from simulations in Area 6 (West of Scotland), 2017-2019

Figure 4-6 shows the choke points calculated for the Scotland whitefish trawl fleet segment under four simulations in Area 6 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown, with the most challenging stock listed first. Under simulation B4, two of the four PO fleet segments in the Scottish whitefish trawl segment are expected to encounter a choke stock in 2017, 2018 and 2019. The choke point under simulation B4 is calculated to be 94% of 2015 days at sea (DAS) in 2017 and 2018 and 46% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 4-6: Scotland whitefish trawl fleet - Area 6 choke points under baseline and quota simulations, compared to 2015 DAS



4.3.1 Effect of quota simulations in Area 6

Under simulation B4, the most challenging choke stocks in Area 6 are identified as haddock 5b6a in 2017 and 2018 and saithe in 2019. The amount of additional quota that the Scotland whitefish trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 0 tonnes of haddock 5b6a quota in 2017 and 2018; and
- 541 tonnes of saithe quota in 2019 (Figure 4-7).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 4-8 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Under simulation B4 in 2017 and 2018, haddock 5b6a is identified as the most challenging stock for the fleet. However, across the four PO fleet segments in the Scotland whitefish fleet segment, there is no requirement for quota. This occurs because although two POs are expected to experience a choke point caused by haddock 5b6a, two POs do not and are expected to have excess quota that could address the quota requirement for haddock 5b6a within the Scotland whitefish trawl fleet segment. Once the quota simulations are applied, simulation S1 moves quota between POs, and the choke points identified under simulation B4 in 2017 and 2018 are removed.

In 2019 and under simulation B4, the estimated quota required to avoid encountering a choke point for saithe is 541 tonnes. The reallocation of unused UK quota (S1) and the allocation by FQA of previous levels of international swaps for saithe (S2) each make additional quota available. Under S1, the estimated choke point is delayed by 23%, compared to simulation B4. However, there is only a delay of four percentage points to the estimated choke point under simulation S2 (Figure 4-6). Despite the potential under simulation S1 to access 271 tonnes of the estimated 541 tonnes of saithe quota required in 2019, the benefit to the fleet segment's choke point is relatively limited as ling is also identified as a primary choke stock and other secondary choke stocks also exist.

Figure 4-7: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

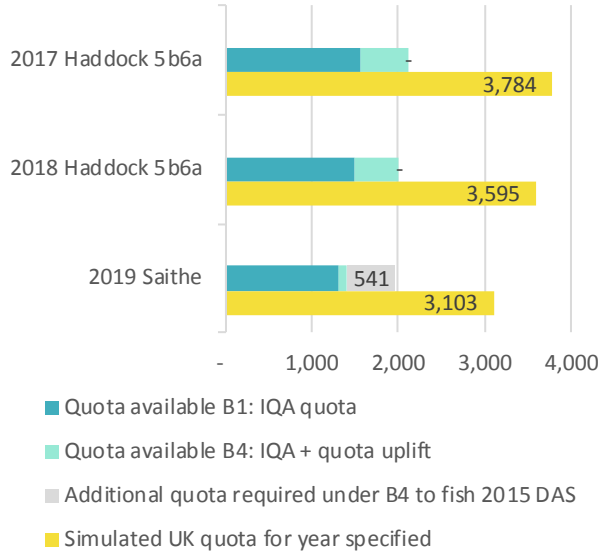


Figure 4-8: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

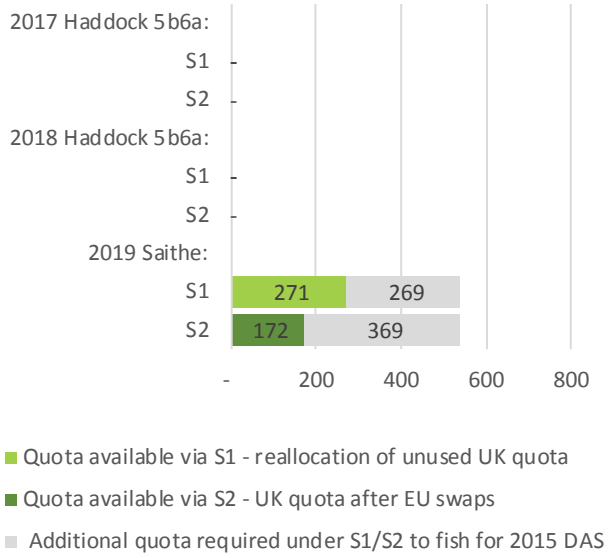


Table 4-4: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 6

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Haddock 5b6a	3.5%	56%	✓✓✓	✗	✓✓✓	✗
2018	Haddock 5b6a	3.5%	56%	✓✓✓	✗	✓✓✓	✗
2019	Saithe	3.5%	45%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Table 4-5: Choke Point Analysis – Further detail on the choke points for the Scotland whitefish trawl fleet segment and the delay to the choke point that different simulations create

Sea Area	Average DAS per vessel in 2015	Year	Primary choke stocks for the different PO fleet segments included in the home-nation fleet segment	Baseline B4: Uplift, zero-TAC catch and vessel metier shift Aggregated choke point in home-nation fleet segment		Simulation S1: Reallocation of unused UK quota Potential delay to choke point, compared to baseline B4		Simulation S2: B4 with UK quota after EU swaps Potential delay to choke point, compared to baseline B4	
				% of 2015 DAS	Average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel
4	146	2017	Cod	74%	108	16%	23	18%	27
		2018	Saithe	46%	68	5%	7	31%	46
		2019	Hake	13%	20	2%	3	41%	60
6	22	2017	Haddock 5b6a	94%	21	Removes choke	-	0%	0
		2018	Haddock 5b6a	94%	21	Removes choke	-	0%	0
		2019	Ling, saithe	46%	10	23%	5	4%	1

Table 4-6: Choke Stock Analysis – Further detail on the most challenging stocks for the Scotland whitefish trawl fleet segment and the quota required to avoid a choke on the stock

Sea Area	Year of analysis	Most challenging individual stock in year of analysis (Baseline B4)	Baseline B1: Fleet's IQA in year of analysis (tonnes)	Baseline B4: Fleet's IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: UK IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: Selectivity improvement required to avoid choke	Baseline B4: Additional quota required to avoid choke (tonnes)	Simulation S1: Additional quota available to fleet (tonnes)	Simulation S2: Additional quota available to fleet (tonnes)
4	2017	Cod	5,144	7,282	15,666	-26%	2,686	1,633	2,215
	2018	Saithe	2,258	2,450	6,305	-54%	3,142	295	1,742
	2019	Hake	262	282	630	-87%	1,919	31	1,252
6	2017	Haddock 5b6a	1,566	2,106	3,784	-	0	128	-
	2018	Haddock 5b6a	1,487	2,000	3,595	-	0	121	-
	2019	Saithe	1,314	1,405	3,103	-27%	541	386	172

Table 4-7: Five most challenging stocks in 2019 under baseline simulation B4

Sea Area	1st stock and choke point			2nd stock and choke point			3rd stock and choke point			4th stock and choke point			5th stock and choke point		
	Stock	%*	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel
4	Hake 4	14	20	Saithe 4	51	75	Ling 4	71	105	Cod 4	85	125	Anglers 4	91	133
6	Saithe 6	53	12	Anglers 6	57	13	Ling 6-7	71	16	Haddock 6b	84	19	Haddock 5b6a	89	20

**% shows choke point as a percentage of 2015 DAS in the sea area.*

5. Northern Ireland Nephrops Trawl

5.1. Activity in 2015

There were 98 active vessels allocated to the Northern Ireland nephrops trawl fleet in 2015. These vessels were members of two different POs. The defining characteristics of the vessels in this fleet segment are that they: predominantly use TR2 gear, target nephrops, are over 10m in length, are members of a PO with more than five nephrops trawl vessels and are registered to a port in Northern Ireland.

In 2015, the fleet segment spent 9,478 days in Area 7 and 2,558 days in Area 6. A further 942 days were recorded in Area 4. The fleet segment landed 9,387 tonnes in 2015 from Areas 4, 6 and 7.

Table 5-1: Northern Ireland nephrops trawl fleet segment for the analysis, 2015

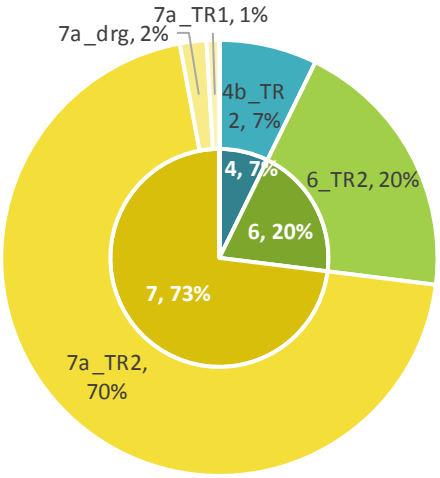
No. Vessels:	98
Main Gear:	TR2
PO Membership:	ANIFPO, NIFPO

Table 5-2: Northern Ireland nephrops trawl fleet landings and effort, 2015

	Total	Average per vessel
Landings (tonnes)	9,387	96
Effort (DAS)	12,978	132

Landings include non-quota stocks

Figure 5-1: Fleet segment effort (days at sea) by metier, 2015



Key for Figure 2-1

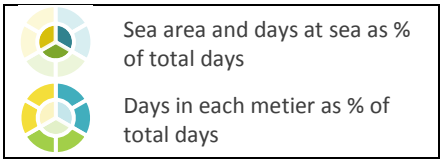
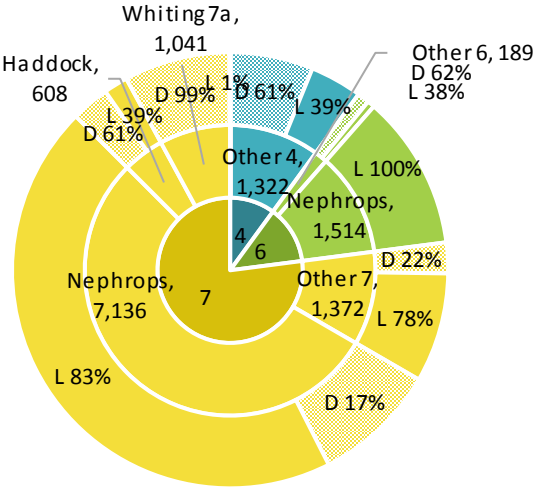
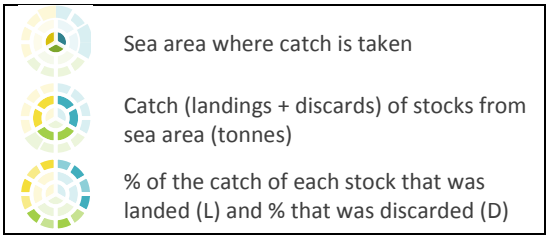


Figure 5-2: Fleet segment catch by sea area (landings + discards[5]), 2015



Key for Figure 2-2



Catch of individual stocks that represented more than 4% of total catch in 2015 is shown. All other catch (quota and non-quota) is grouped under 'other'.

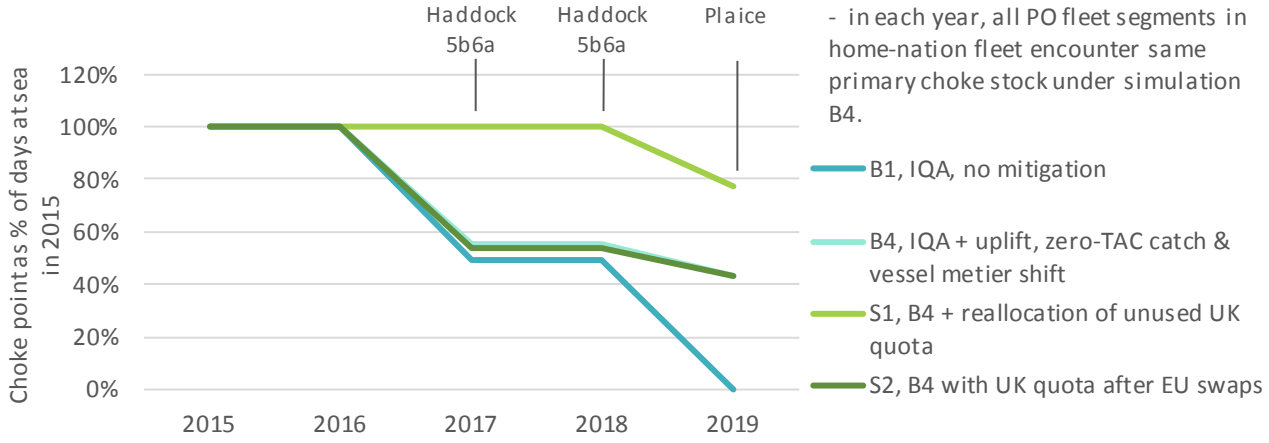
[5] Discard rate is taken from 2015 STECF FDI database and is specific to each fleet segment and metier where possible.

5.2. Findings from simulations in Area 6 (West of Scotland), 2017-2019

Figure 5-3 shows the choke points calculated for the Northern Ireland nephrops trawl fleet segment under four simulations in Area 4 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown, with the most challenging stock listed first. Under simulation B4, one of the two PO fleet segments in the Northern Ireland nephrops trawl segment is expected to encounter a choke stock in 2017, 2018 and 2019. The choke point under simulation B4 is calculated to be 56% of 2015 days at sea (DAS) in 2017 and 2018 and 43% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 5-3: Northern Ireland nephrops fleet - Area 6 choke points under baseline and quota simulations, compared to 2015 DAS



5.2.1 Effect of quota simulations in Area 6

Under simulation B4, the most challenging choke stocks in Area 6 are identified as haddock 5b6a in 2017 and 2018 and plaice in 2019. The amount of additional quota that the Northern Ireland nephrops trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 0 tonnes of haddock 5b6a quota in 2017 and 2018; and
- 6 tonnes of plaice quota in 2019 (Figure 5-4).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 5-5 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Under simulation B4 in 2017 and 2018, haddock 5b6a is identified as the most challenging stock for the fleet. However, only one PO is encountering it as a potential choke stock. Across the Northern Ireland nephrops trawl fleet segment, it is estimated that there is no requirement for quota under simulation B4. This occurs because the simulation expects excess quota to exist in the other PO that could be used to address the quota requirement for haddock 5b6a in the first PO. Hence, once simulation S1 is applied, quota is moved between POs, and the choke points caused by haddock 5b6a under simulation B4 in 2017 and 2018 are removed (Figure 4-3).

Under simulation B4 in 2019, the estimated quota required to avoid the fleet encountering a choke point for plaice is relatively small - 6 tonnes. The reallocation of unused UK quota (simulation S1) makes an additional 4 tonnes available to the fleet and this supports a delay to the estimated choke point of 35 percentage points (Figure 5-3).

Figure 5-4: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

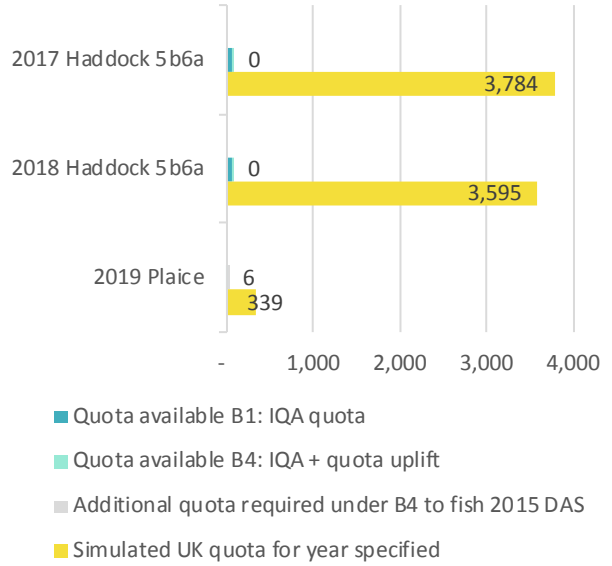


Figure 5-5: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

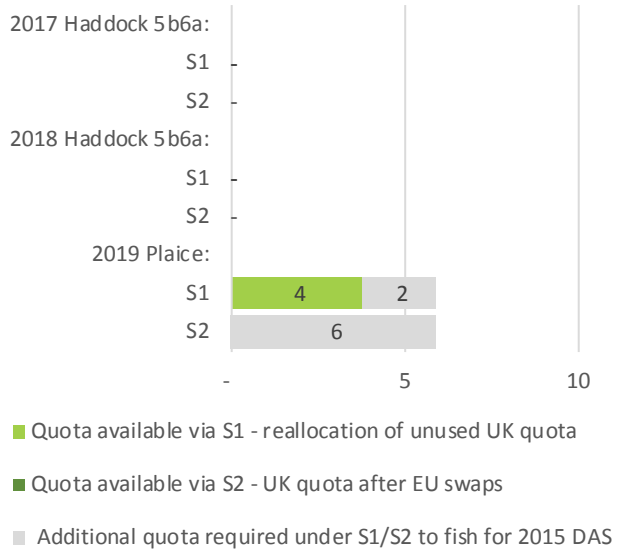


Table 5-3: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 6

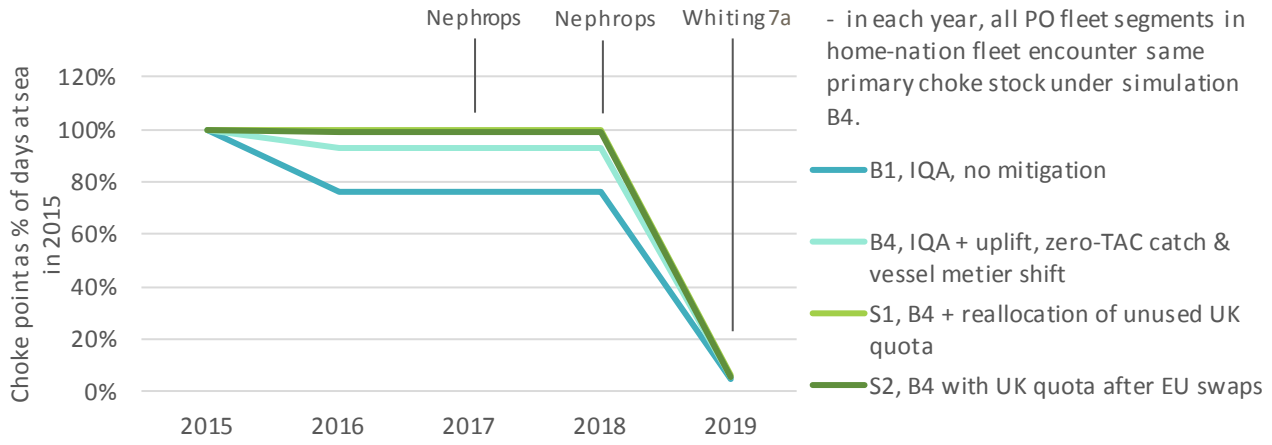
Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Haddock 5b6a	0.5%	1.8%	✓✓✓	✗	✓✓✓	✗
2018	Haddock 5b6a	0.5%	1.8%	✓✓✓	✗	✓✓✓	✗
2019	Plaice	0.1%	2.4%	✓✓✓	✗	✓✓✓	✗

5.3. Findings from simulations in Area 7, 2017-2019

Figure 5-6 shows the choke points calculated for the Northern Ireland nephrops trawl fleet segment under four simulations in Area 4 between 2016 and 2019. The primary choke stocks of PO fleet segments, which contribute to the choke point under simulation B4 are also shown. The analysis shows that both POs in the fleet segment are expected to encounter the same primary choke stock between 2017 and 2019. The choke point under simulation B4 is calculated to be 93% of 2015 days at sea (DAS) in 2017 and 2018 and 6% in 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 5-6: Northern Ireland nephrops fleet - Area 7 choke points under baseline and quota simulations, compared to 2015 DAS



5.3.1 Effect of quota simulations in Area 7

Under simulation B4, the most challenging choke stocks in Area 7 are identified as nephrops in 2017 and 2018 and whiting 7a in 2019. The amount of additional quota that the Northern Ireland nephrops trawl fleet requires to avoid encountering a choke point for the most challenging choke stocks is:

- 559 tonnes of nephrops quota in 2017;
- 559 tonnes of nephrops quota in 2018; and
- 1,022 tonnes of whiting 7a quota in 2019 (Figure 5-7).

The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 5-8 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Under simulation B4 in 2017 and 2018, the most challenging stock is expected to be nephrops, however, the estimated quota requirement of 559 tonnes is relatively small compared to the fleet segment's initial quota allocation, including quota uplift, of 8,489 tonnes (see Table 4-6). In 2017 and 2018, both the reallocation of unused UK quota (simulation S1) and the allocation by FQA of previous levels of international swaps for nephrops (simulation S2) effectively remove the potential for nephrops to create a choke point for the fleet segment in Area 7 (Figure 5-6).

Under simulation B4 in 2019, the estimated quota required to avoid encountering a choke point for whiting 7a is 1,022 tonnes. In 2015, whiting 7a is estimated to have represented 7.6% of the Northern Ireland nephrops trawl segment's total catch (all sea areas) and almost 100% of whiting 7a catch was discarded (Figure 4-2). With an estimated UK quota in 2019 of only 28 tonnes and an EU TAC in 2015 of 80 tonnes, quota simulations can have little effect on this choke stock.

Figure 5-7: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

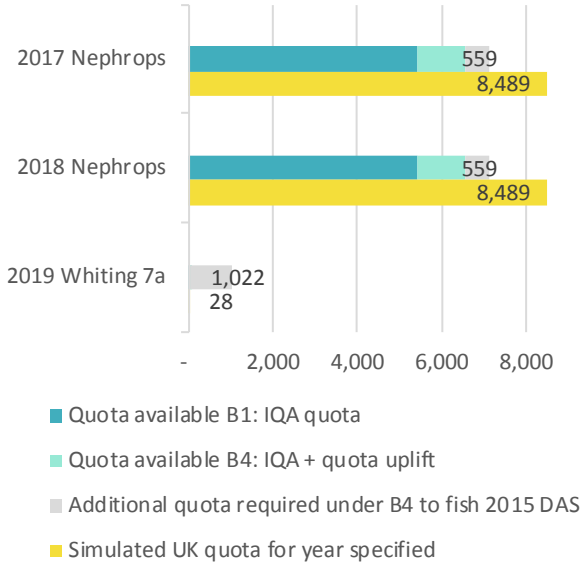


Figure 5-8: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

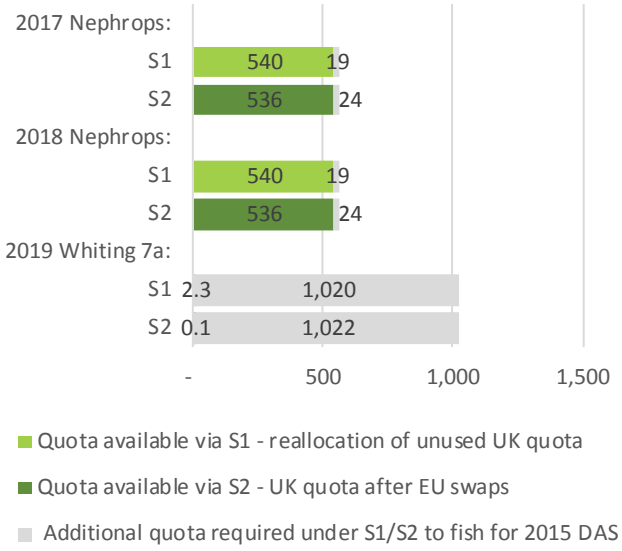


Table 5-4: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 7

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Nephrops	53%	77%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2018	Nephrops	53%	77%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2019	Whiting 7a	7.6%	65%	✗	✗	✗	✗

Table 5-5: Choke Point Analysis – Further detail on the choke points for the Northern Ireland nephrops trawl fleet segment and the delay to the choke point that different simulations create

Sea Area	Average DAS per vessel in 2015	Year	Primary choke stocks for the different PO fleet segments included in the home-nation fleet segment	Baseline B4: Uplift, zero-TAC catch and vessel metier shift Aggregated choke point in home-nation fleet segment		Simulation S1: Reallocation of unused UK quota Potential delay to choke point, compared to baseline B4		Simulation S2: B4 with UK quota after EU swaps Potential delay to choke point, compared to baseline B4	
				% of 2015 DAS	Average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel
6	26	2017	Haddock 5B6A	56%	15	Removes choke	-	0%	0
		2018	Haddock 5B6A	56%	15	Removes choke	-	0%	0
		2019	Plaice	43%	11	35%	9	0%	0
7	97	2017	Nephrops	93%	90	Removes choke	-	6%	6
		2018	Nephrops	93%	90	Removes choke	-	6%	6
		2019	Whiting 7A	6%	6	0%	0	0%	0

Table 5-6: Choke Stock Analysis – Further detail on the most challenging stocks for the Northern Ireland nephrops trawl fleet segment and the quota required to avoid a choke on the stock

Sea Area	Year of analysis	Most challenging individual stock in year of analysis (Baseline B4)	Baseline B1: Fleet's IQA in year of analysis (tonnes)	Baseline B4: Fleet's IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: UK IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: Selectivity improvement required to avoid choke	Baseline B4: Additional quota required to avoid choke (tonnes)	Simulation S1: Additional quota available to fleet (tonnes)	Simulation S2: Additional quota available to fleet (tonnes)
6	2017	Haddock 5b6a	67	72	3,784	-	0	-	-
	2018	Haddock 5b6a	64	68	3,595	-	0	-	-
	2019	Plaice	8	8	339	-55%	6	4	-
7	2017	Nephrops	5,402	6,576	8,489	-7%	559	552	536
	2018	Nephrops	5,402	6,576	8,489	-7%	559	552	536
	2019	Whiting 7a	18	19	28	-94%	1,022	3	0

Table 5-7: Five most challenging stocks in 2019 under baseline simulation B4

Sea Area	1st stock and choke point			2nd stock and choke point			3rd stock and choke point			4th stock and choke point			5th stock and choke point		
	Stock	%*	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel
6	Plaice 6	43	11	Haddock 5b6a	56	15	Anglers 6	69	18	-	-	-	-	-	-
7	Whiting 7a	6	6	Haddock 7a	32	31	Cod 7a	34	33	Nephrops 7	93	90	-	-	-

**% shows choke point as a percentage of 2015 DAS in the sea area.*

6. England Beam Trawl

6.1. Activity in 2015

There were 50 active vessels allocated to the England beam trawl fleet in 2015. These vessels were members of three different POs or in the non-sector group. The defining characteristics of the vessels in this fleet segment are that they: predominantly use BT gear, are over 10m in length, are members of a PO with more than five beam trawl vessels and are registered to a port in England.

Table 6-1: England beam trawl fleet segment for the analysis, 2015

No. Vessels:	50
Main Gear:	BT
PO Membership:	CFPO, LFPO, SWFPO and non-sector

In 2015, the fleet segment spent 7,553 days in Area 7 and a further 1,373 days in Area 4. Two of the PO fleet segments only operated in Area 4 and the other two only operated in Area 7. The fleet segment landed 14,853 tonnes in 2015 from Areas 4 and 7.

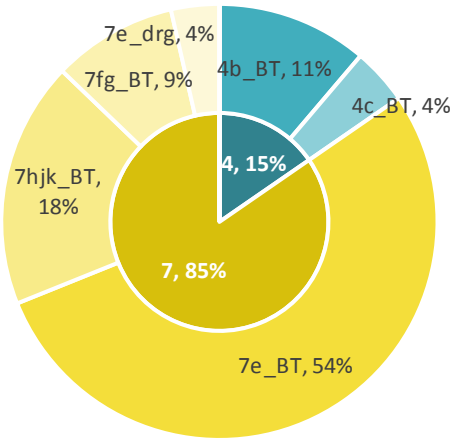
Table 6-2: England beam trawl fleet landings and effort, 2015 (Areas 4,7)

	Total	Average per vessel
Landings (tonnes)	14,853	297
Effort (DAS)	8,926	178

Landings include non-quota stocks

The analysis of the England beam trawl fleet segment is expected to be influenced by the limited amount of information on discards in Area 7 and estimates of plaice discard rates in Area 4 (Figure 6-2).

Figure 6-1: Fleet segment effort (days at sea) by metier, 2015

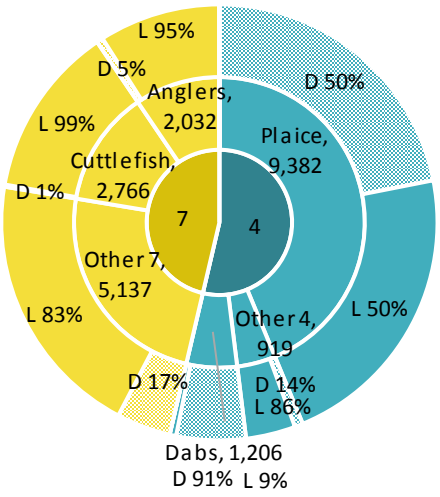


Key for Figure 2-1

Sea area and days at sea as % of total days

Days in each metier as % of total days

Figure 6-2: Fleet segment catch by sea area (landings + discards[6]), 2015



Key for Figure 2-2

Sea area where catch is taken

Catch (landings + discards) of stocks from sea area (tonnes)

% of the catch of each stock that was landed (L) and % that was discarded (D)

Catch of individual stocks that represented more than 4% of total catch in 2015 is shown. All other catch (quota and non-quota) is grouped under 'other'.

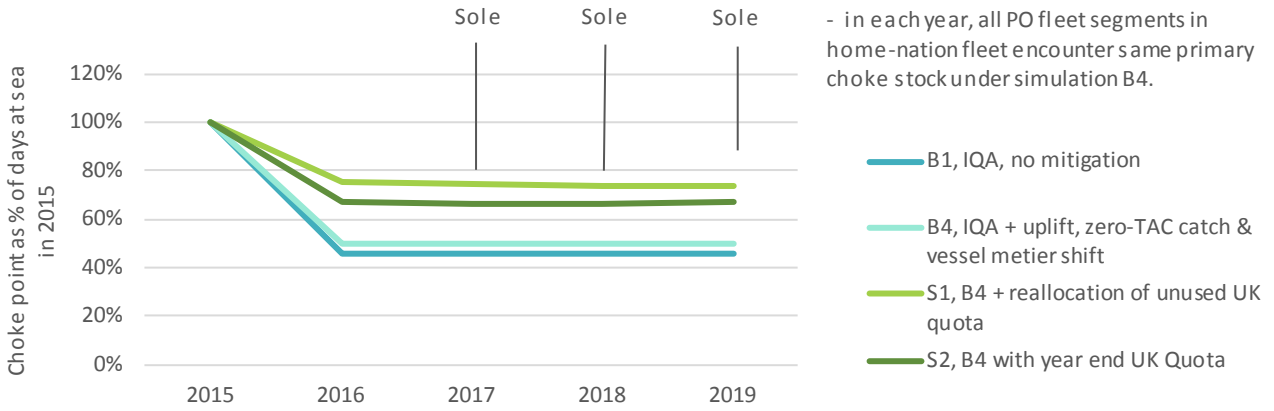
[6] Discard rate is taken from 2015 STECF FDI database and is specific to each fleet segment and metier where possible.

6.2. Findings from simulations in Area 4 (North Sea), 2017-2019

Figure 6-3 shows the choke points calculated for the England beam trawl fleet segment under four simulations in Area 4 between 2016 and 2019. The primary choke stock is sole for one of the two PO fleet segments active in Area 4 in each year between 2017 and 2019. The choke point under simulation B4 is calculated to be 50% of 2015 days at sea (DAS) in 2017, 2018 and 2019.

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 6-3: England beam trawl fleet - Area 4 choke points under baseline and quota simulations, compared to 2015 DAS



6.2.1 Effect of quota simulations in Area 4

Under simulation B4, the most challenging and only choke stock in Area 4 is sole in 2017, 2018 and 2019. The amount of additional quota that the England beam trawl fleet requires to avoid encountering a choke point for sole is 79 tonnes (Figure 6-4). The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 6-5 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

Both the reallocation of unused UK quota (simulation S1) and the allocation by FQA of previous levels of international swaps for sole (simulation S2) make an additional 55 and 59 tonnes available to the fleet segment respectively. Both quota simulations have a positive impact on the fleet segment's estimated choke point (Figure 6-3). The more limited benefit to the choke point from simulation S2, is because the quota is not allocated on the basis of need, so the PO encountering the choke point does not receive all of the additional quota, and in this simulation quota is not moved between POs.

Figure 6-4: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

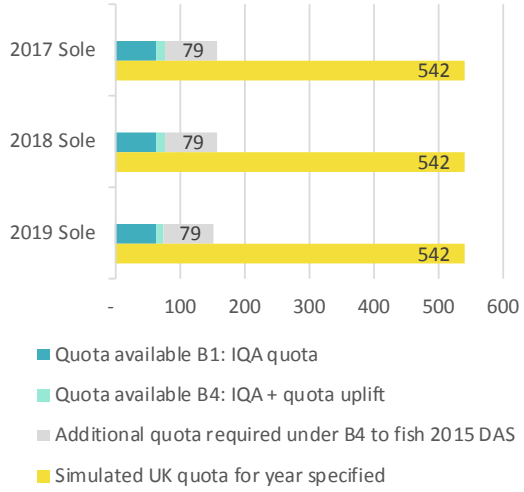


Figure 6-5: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

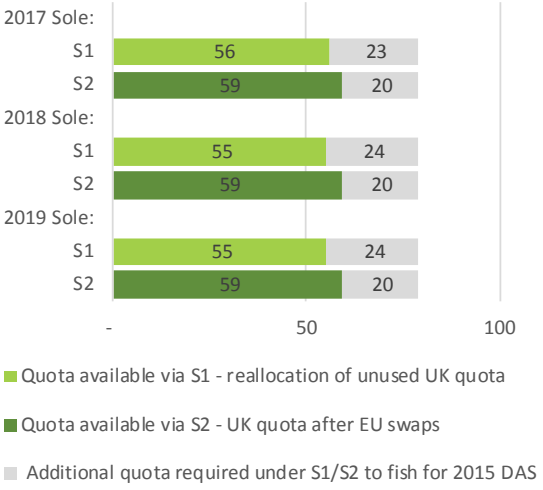


Table 6-3: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 4

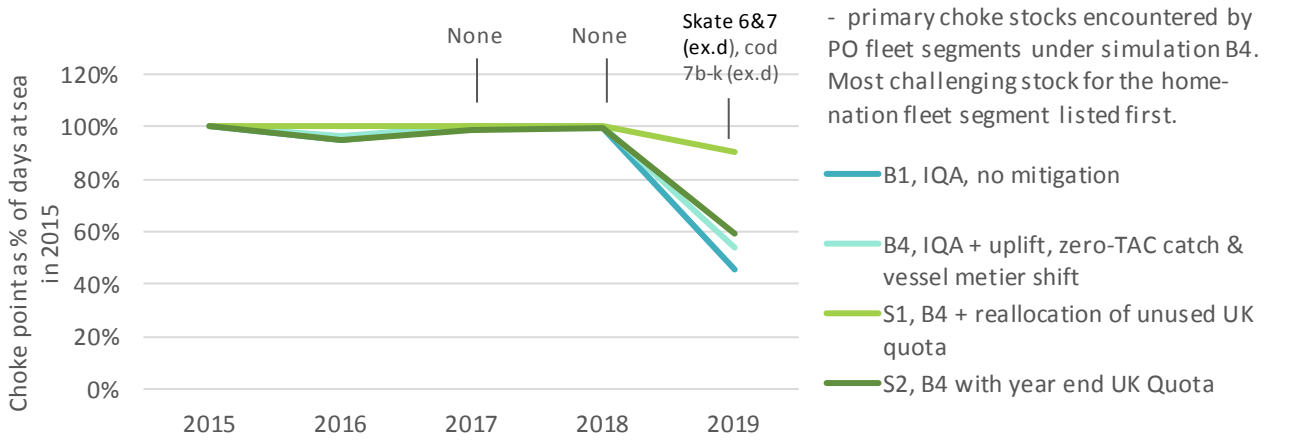
Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	Sole	0.9%	14%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2018	Sole	0.9%	14%	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2019	Sole	0.9%	14%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

6.3. Findings from simulations in Area 7, 2017-2019

Figure 6-6 shows the choke points calculated for the England beam trawl fleet segment under four simulations in Area 7 between 2016 and 2019. No choke stocks are identified for 2017 and 2018. Under simulation B4 in 2019, both PO fleet segments operating in Area 7 are expected to encounter choke stocks and the choke point is calculated to be 54% of 2015 days at sea (DAS).

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 6-6: England beam trawl fleet - Area 7 choke points under baseline and quota simulations, compared to 2015 DAS



6.3.1 Effect of quota simulations in Area 7

Under simulation B4, the most challenging choke stock in Area 7 is skate in 2019. The amount of additional quota that the England beam trawl fleet requires to avoid encountering a choke point for skate is 37 tonnes in 2019 (Figure 6-7). The quota simulations explore the extent to which the quota requirement could be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2). Figure 6-8 presents the amount of quota that is estimated to be available to the home-nation fleet segments under each quota simulation.

In 2019, the reallocation of unused UK quota (simulation S1) makes an additional 37 tonnes available to the fleet, and this supports a delay to the estimated choke point of 36 percentage points. Simulation S1 does not fully remove a choke point for the fleet segment because cod 7b-k is still expected to create a choke. The allocation by FQA of previous levels of international swaps for skate 6-7 (simulation S2) has no expected benefit to either primary choke stock.

Figure 6-7: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

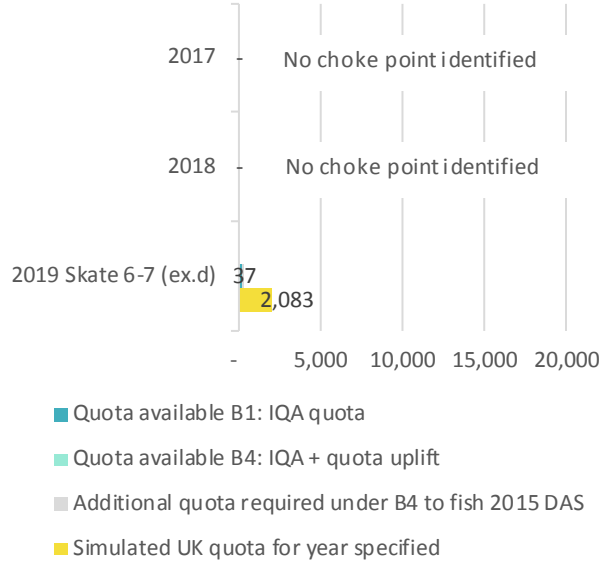


Figure 6-8: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

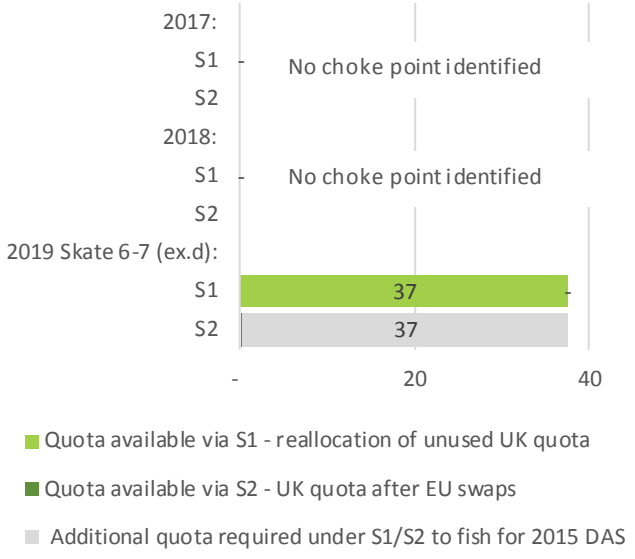


Table 6-4: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 7

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	No choke						
2018	No choke						
2019	Skate 6-7 (ex.d)	41%	11%	✓✓✓	✗	✓✓✓	✓✓✓

Table 6-5: Choke Point Analysis – Further detail on the choke points for the England beam trawl fleet segment and the delay to the choke point that different simulations create

Sea Area	Average DAS per vessel in 2015	Year	Primary choke stocks for the different PO fleet segments included in the home-nation fleet segment	Baseline B4: Uplift, zero-TAC catch and vessel metier shift Aggregated choke point in home-nation fleet segment		Simulation S1: Reallocation of unused UK quota Potential delay to choke point, compared to baseline B4		Simulation S2: B4 with UK quota after EU swaps Potential delay to choke point, compared to baseline B4	
				% of 2015 DAS	Average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel
4	25	2017	Sole	50%	14	25%	7	17%	5
		2018	Sole	50%	14	24%	7	17%	5
		2019	Sole	50%	14	24%	7	17%	5
7	137	2017	No choke						
		2018	No choke						
		2019	Skate 6-7 (ex.d), cod 7b-k (ex.d)	54%	81	36%	55	6%	9

Table 6-6: Choke Stock Analysis – Further detail on the most challenging stocks for the England beam trawl fleet segment and the quota required to avoid a choke on the stock

Sea Area	Year of analysis	Most challenging individual stock in year of analysis (Baseline B4)	Baseline B1: Fleet's IQA in year of analysis (tonnes)	Baseline B4: Fleet's IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: UK IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: Selectivity improvement required to avoid choke	Baseline B4: Additional quota required to avoid choke (tonnes)	Simulation S1: Additional quota available to fleet (tonnes)	Simulation S2: Additional quota available to fleet (tonnes)
4	2017	Sole	64	78	542	-50%	79	88	59
	2018	Sole	64	78	542	-50%	79	85	59
	2019	Sole	64	78	542	-50%	79	85	59
7	2017	No choke							
	2018	No choke							
	2019	Skate 6-7 (ex.d)	232	246	2,083	-34%	37	-	0

Table 6-7: Five most challenging stocks in 2019 under baseline simulation B4

Sea Area	1st stock and choke point			2nd stock and choke point			3rd stock and choke point			4th stock and choke point			5th stock and choke point		
	Stock	%*	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel
4	Sole 4	60	16	Skate 4	97	27	-	-	-	-	-	-	-	-	-
7	Skate 6-7 (ex.d)	71	108	Cod 7b-k(ex.d)	78	117	Anglers 7	90	137	Plaice 7hjk	92	138	Sole 7hjk	92	139

**% shows choke point as a percentage of 2015 DAS in the sea area.*

7. England Demersal Trawl

7.1. Activity in 2015

There were 80 active vessels allocated to the England demersal trawl fleet in 2015. These vessels were members of three different POs or were in the group of non-sector vessels. The defining characteristics of the vessels in this fleet segment are that they: predominantly use TR2 gear, operate only in Area 7, are over 10m in length, are members of a PO with more than five beam trawl vessels and are registered to a port in England.

In 2015, the fleet segment 9,210 days in Area 7 and landed landed 6,703 tonnes in 2015.

The analysis of the England demersal fleet segment is expected to be influenced by the limited amount of information on discards in the segment (Figure 7-2).

Table 7-1: England demersal trawl fleet segment for the analysis, 2015

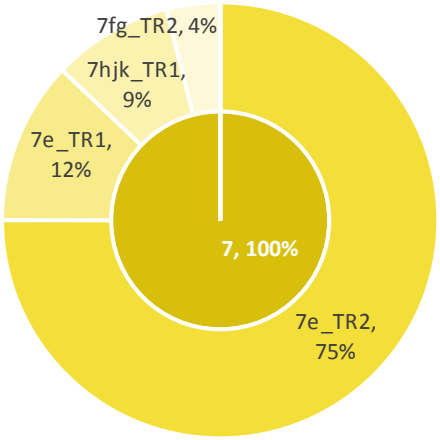
No. Vessels:	80
Main Gear:	TR2
PO Membership:	CFPO, SWFPO, WWCFPO and non-sector

Table 7-2: England demersal trawl fleet landings and effort, 2015 (Area 7)

	Total	Average per vessel
Landings (tonnes)	6,703	84
Effort (DAS)	9,210	115

Landings include non-quota stocks

Figure 7-1: Fleet segment effort (days at sea) by metier, 2015

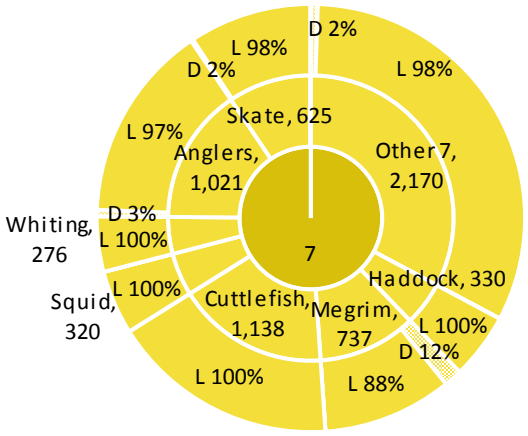


Key for Figure 6-1

Sea area and days at sea as % of total days

Days in each metier as % of total days

Figure 7-2: Fleet segment catch by sea area (landings + discards[7]), 2015



Key for Figure 6-2

Sea area where catch is taken

Catch (landings + discards) of stocks from sea area (tonnes)

% of the catch of each stock that was landed (L) and % that was discarded (D)

Catch of individual stocks that represented more than 4% of total catch in 2015 is shown. All other catch (quota and non-quota) is grouped under 'other'.

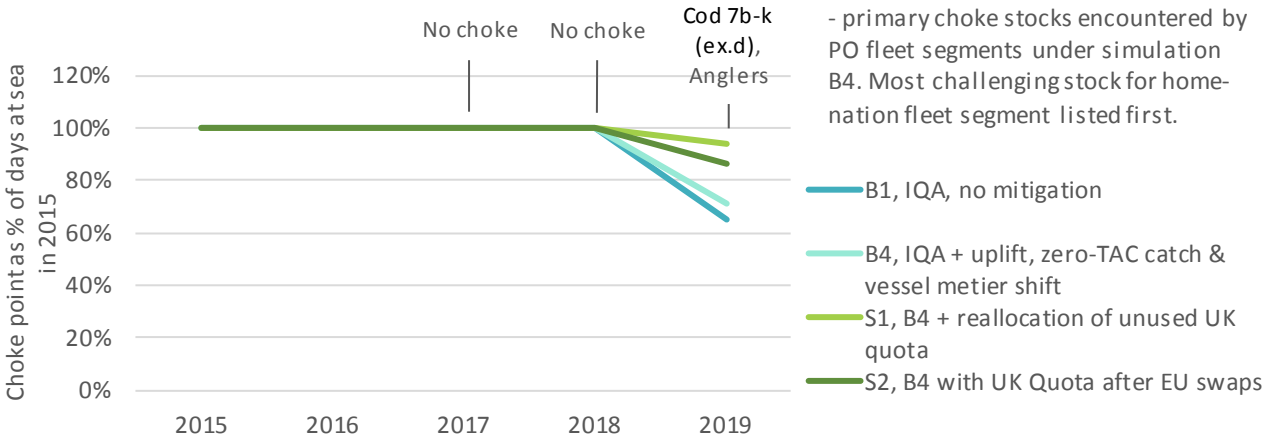
[7] Discard rate is taken from 2015 STECF FDI database and is specific to each fleet segment and metier where possible.

7.2. Findings from simulations in Area 7, 2017-2019

Figure 7-3 shows the choke points calculated for the England demersal trawl fleet segment under four simulations in Area 7 between 2016 and 2019. No choke stocks are identified for 2017 and 2018. Under simulation B4 in 2019, all four PO and non-sector fleet segments are expected to encounter choke stocks, three of these are expected to encounter cod 7b-k as their primary choke stock. Under simulation B4, the choke point is calculated to be 71% of 2015 days at sea (DAS).

The difference between simulations B1 and B4 indicates the expected benefit of quota uplift, the movement of quota between metiers within a PO fleet segment and, where relevant, a catch allowance for zero-TAC stocks. The results of simulation B4 provide the best baseline position against which other simulations can be tested. The quota simulations, S1 and S2, are discussed in more detail below.

Figure 7-3: England demersal trawl fleet - Area 7 choke points under baseline and quota simulations, compared to 2015 DAS



7.2.1 Effect of quota simulations in Area 7

Under simulation B4, the most challenging choke stock in Area 7 cod 7b-k in 2019. The amount of additional quota that the England demersal trawl fleet requires to avoid encountering a choke point for cod 7b-k is 15 tonnes (Figure 7-4).

Both the reallocation of unused UK quota (simulation S1) and the allocation by FQA of previous levels of international swaps for saithe (simulation S2) fully address the quota required in 2019 and remove cod 7b-k as a potential choke stock (Figure 7-5). However, anglerfish remains a potential choke stock and therefore restricts the benefit to the fleet segment's choke point (Figure 7-3).

Figure 7-4: Fleet segment's quota in baseline simulations plus quota required to fish for 2015 DAS, compared to UK quota (tonnes)

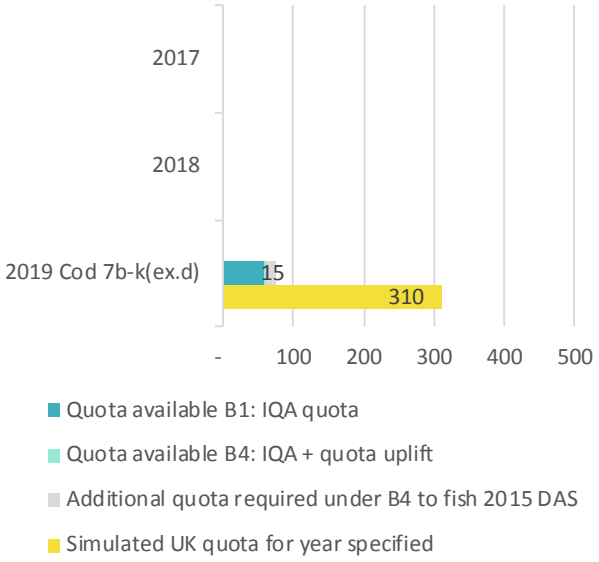


Figure 7-5: Additional quota available through quota simulations S1 & S2 and quota still required under each simulation to fish for 2015 DAS (tonnes)

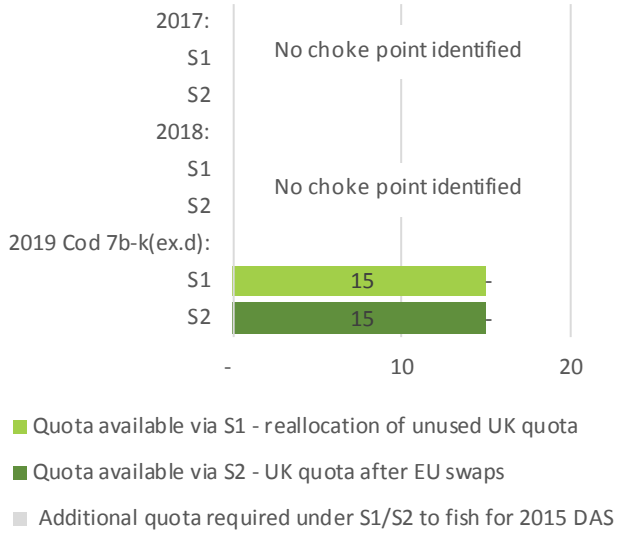


Table 7-3: Overview of most challenging choke stocks and potential benefit of quota simulations in Area 7

Year	Challenging stocks in area 6 (under B4)	Catch of stock as % of total fleet catch (all sea areas, 2015)	Fleet's share of UK quota for stock (after uplift)	Does S1 address most challenging choke stock?	Does S2 address most challenging choke stock?	Does S1 delay fleet's choke point	Does S2 delay fleet's choke point
2017	No choke						
2018	No choke						
2019	Cod 7b-k (ex.d)	0.4%	18%	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Table 7-4: Choke Point Analysis – Further detail on the choke points for the England demersal trawl fleet segment and the delay to the choke point that different simulations create

Sea Area	Average DAS per vessel in 2015	Year	Primary choke stocks for the different PO fleet segments included in the home-nation fleet segment	Baseline B4: Uplift, zero-TAC catch and vessel metier shift Aggregated choke point in home-nation fleet segment		Simulation S1: Reallocation of unused UK quota Potential delay to choke point, compared to baseline B4		Simulation S2: B4 with UK quota after EU swaps Potential delay to choke point, compared to baseline B4	
				% of 2015 DAS	Average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel	% point delay (2015 DAS)	Delay in average DAS per vessel
7	115	2017	No choke	No choke	-	-	-	-	-
		2018	No choke	No choke	-	-	-	-	-
		2019	Cod 7b-k(ex.d), Anglerfish	71%	82	23%	26	15%	17

Table 7-5: Choke Stock Analysis – Further detail on the most challenging stocks for the England demersal trawl fleet segment and the quota required to avoid a choke on the stock

Sea Area	Year of analysis	Most challenging individual stock in year of analysis (Baseline B4)	Baseline B1: Fleet's IQA in year of analysis (tonnes)	Baseline B4: Fleet's IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: UK IQA (incl. uplift) in year of analysis (tonnes)	Baseline B4: Selectivity improvement required to avoid choke	Baseline B4: Additional quota required to avoid choke (tonnes)	Simulation S1: Additional quota available to fleet (tonnes)	Simulation S2: Additional quota available to fleet (tonnes)
7	2017	No choke							
	2018	No choke							
	2019	Cod 7b-k(ex.d)	57	60	310	-24%	15	16	18

Table 7-6: Five most challenging stocks in 2019 under baseline simulation B4

Sea Area	1st stock and choke point			2nd stock and choke point			3rd stock and choke point			4th stock and choke point			5th stock and choke point		
	Stock	%*	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel	Stock	%	Avg. DAS per vessel
7	Cod 7b-k(ex.d)	81	94	Anglers 7	90	104	Sole 7e	91	105	Megrim 7	99	114	-	-	-

**% shows choke point as a percentage of 2015 DAS in the sea area.*

8. Overview and Best-case Simulations (of those tested)

8.1. Overview

The bioeconomic model that Seafish has developed can be asked a multitude of questions about the impact of policy on the UK fishing fleet. The focus to date is the potential impact of the landing obligation. The focus of the analysis presented in the report is on the likelihood that choke stocks could occur as a result of the landing obligation in five UK demersal fleet segments in 2017, 2018 and 2019 and whether the movement of quota could delay the choke points identified.

The bioeconomic model uses different simulations to estimate what could happen in future years. Unless otherwise stated all simulations assume that the initial quota allocation to the UK fleet, as calculated for each year, is the quota available, i.e. before international quota swaps. Four of the simulations are referred to as baseline simulations and explore the cumulative value of expected policy and industry mitigation measures. The final baseline simulation (B4) is considered to best indicate the challenge faced by UK fleet segments, and therefore the extent of change that could be required to keep fishing at similar levels of effort as fished in 2015. There are two further simulations which are applied to the B4 baseline simulation, these explore the extent to which choke stocks could potentially be addressed through unused quota available in the UK (simulation S1) and the allocation by FQA of previous levels of EU swaps (simulation S2).

There is a substantial amount of detail in the methodology and assumptions used to conduct the analysis. Key points are presented in Chapter 2 and a more detailed description can be found in the separate methodology report. The following points are highlighted for consideration when reviewing the findings from the analysis:

- Assumptions must be made to create an effective model, the diversity of quota holdings, method of operation and catch rate between individual vessels cannot be accurately replicated in such a large model. The model undertakes the analysis at the lowest feasible level which is metier level analysis within PO fleet segments. These findings are then aggregated to present the results for the home-nation fleet segments shown in the report. The aggregation process may obscure some localised challenges.
- Uncertainty exists in situations where decisions are still to be made, assumptions in the model are based on what has occurred so far and what is planned under the landing obligation. For example, estimates of future TAC/quota uplift reflect calculations by the EU so far, and rules during the transition period are informed by plans and proposals published by Regional Groups in 2016.
- Unlike the previous report by Seafish, the model does not consider the potential benefit of exemptions and derogations that may be available under the landing obligation, i.e. de minimis, survivability and interspecies flexibility. However, these could be incorporated in additional simulations.
- There is inherent uncertainty in available discard rates as they are based on a sample of fishing trips. Discard rates can vary year on year and the model is informed by discard rates recorded for 2015. Furthermore, if no discard rates are available for a gear and a metier, then an input of zero discards is provided to the model. The data source used for discard rates is the STECF FDI database which collates member state sampling data and provides the same data as that used by STECF working groups. Such holes in the data is a weakness as there are stocks, such as haddock 7e, which industry expects to be a challenging stock but for which discard sampling data is not available. For the UK this is more likely to exist for stocks in area 7 as North Sea and

West of Scotland are for the most part well-sampled. However, the input data can be amended in future should information become available from a source other than STECF FDI database.

- The model is informed by data from 2015 and is therefore influenced by any major events that affected catch or quota swaps and that were particular to 2015;
- The findings provide an understanding of the scale of the challenge that different UK fleet segments may face by quantifying what could be required to avoid a choke situation. The main measure used to quantify the challenge is the quota required to avoid choke. However, the tables at the end of each fleet segment's chapter provide an estimate of the selectivity improvement required to avoid choke. These are modelling outcomes and are therefore indicative and should not be treated as absolute targets. There are many variables that can influence the actual outcome, including natural, policy and industry led variables. Furthermore, quota and improved selectivity are not the only options to avoid a choke situation. Avoidance measures, new policy initiatives and new industry initiatives could all have a vital role to play.

The intention of the analysis is to:

- provide the best quantitative analysis possible at this time so as to support discussion on appropriate mitigation measures to reduce the impact of a potential choke stock; and
- demonstrate the type of analysis that is possible using the model developed by Seafish and the information reported by government in the UK and at the EU level. The hope is that as more information becomes available the analysis will be updated; and that the model can be used to test the potential value to the UK fleet of proposed mitigation measures.

8.2. Overview of findings

For the concluding chapter the summary of findings is focused on:

- the main sea area where the five fleet segments are active (Scotland nephrops trawl fleet segment is shown in two sea areas);
- the findings under the best-case quota simulation; and
- the choke stock(s) that are creating the choke points identified.

8.2.1 Quota simulations

The two quota simulations applied in the model, build on baseline simulation B4 which includes a catch allowance for zero-TAC stocks, quota uplift (also known as quota top-up or quota adjustment) and mobility of quota between metiers within a PO fleet segment.

Simulation S1 is the most complex quota simulation tested. The simulation moves unused quota between POs in the UK to mitigate the potential impact of choke stocks. The process by which the simulation does this is described in the methodology report. Simulation S1 does not include the potential benefit of international swaps but this is a development that could be considered in future simulations of the model. The unused quota may be available under simulation S1 because:

- a PO's vessels have encountered a choke stock that has stopped them from fully utilising a quota which is then made available through the simulation to other POs. An inherent assumption in this is that there will be full compliance with the landing obligation;
- the unused quota may be identified as unused in the simulation and made available to other POs but it could be quota that is traditionally traded in international swaps;

- the stock has little economic value so has been fully discarded. If no landings were ever recorded by a PO fleet segment, the model assumes that the fleet does not catch the stock. This is a limitation of available discard data. If the fleet holds quota for the stock, this will be made available to other POs in the simulation; or
- a PO fleet segment holds quota which it does not use.

For the majority of fleet segments, simulation S1 is the most beneficial quota simulation tested. However, for the Scotland whitefish trawl fleet, simulation S1 has limited benefit and simulation S2, is more positive.

Simulation S2 provides an indication of the potential value of historic levels of international quota swaps. Simulation S2 repeats baseline simulation B4 but instead of using the initial quota allocation to each fleet segment, as used in the baseline simulations, simulation S2 is informed by the quota held by the UK at the end of 2015. The end of year quota is distributed to PO fleet segments in the data input framework according to FQAs held.

8.2.2 Findings under the quota simulations

Figure 7-1 shows the choke points identified under the best-case quota simulation for each of the five fleet segments in their most active area (two sea areas are shown for Scotland nephrops trawl fleet segment).

The best-case simulation for the England demersal trawl and England beam trawl fleets in Area 7 is simulation S1, which moves unused quota between UK POs. Under simulation S1 there is no impact from choke stocks until 2019, and the expected impact in 2019 is relatively limited. However, this finding is caveated with concerns over a lack of discard information in 2015 for these fleet segments in Area 7. It is possible that the data available does not reflect the catch taken by these fleet segments in Area 7, and therefore potential choke stocks and their choke points could be obscured. The second figure on the first page of each analysis chapter shows the extent of discards recorded for a fleet segment.

The best-case simulation for the Scotland nephrops trawl fleet segment in Area 6 and the Northern Ireland nephrops fleet segment in Area 7 is simulation S1, which moves unused quota between UK POs. Under simulation S1, both fleets could be relatively unaffected by choke stocks until 2019. This is because they often require only a relatively small amount of quota to resolve choke points identified under baseline simulation B4. However, in 2019 the challenge for these fleets is notably greater as the estimated choke point dramatically drops (Figure 8-1). Under simulation S1 in 2019, the Scotland nephrops fleet is expected to encounter a choke point in 43% of 2015 days at sea in Area 6, an average of 38 days per vessel; and the Northern Ireland nephrops trawl fleet is expected to encounter a choke point in 6% of 2015 days at sea in Area 7, an average of six days per vessel. In 2019, neither quota simulation improves the estimated choke point for the Northern Ireland nephrops trawl fleet in Area 7.

The fleet segments and sea areas of more immediate concern are those that depend on Area 4: Scotland whitefish trawl fleet segment and the Scotland nephrops trawl fleet segment. Whilst some impact is expected in 2017, challenging choke points are estimated for these fleet segments in 2018, with a further decline in 2019. Uniquely, simulation S2 is consistently the best-case simulation for the Scotland whitefish trawl fleet in Area 4. For comparison, the choke points under simulation S1 are shown as a dotted line in Figure 7-1. In 2019, simulation S2 is also the best case simulation for the Scotland nephrops trawl fleet.

Figure 8-1: Choke point analysis under the best-case quota simulation for each fleet in its main sea area(s)

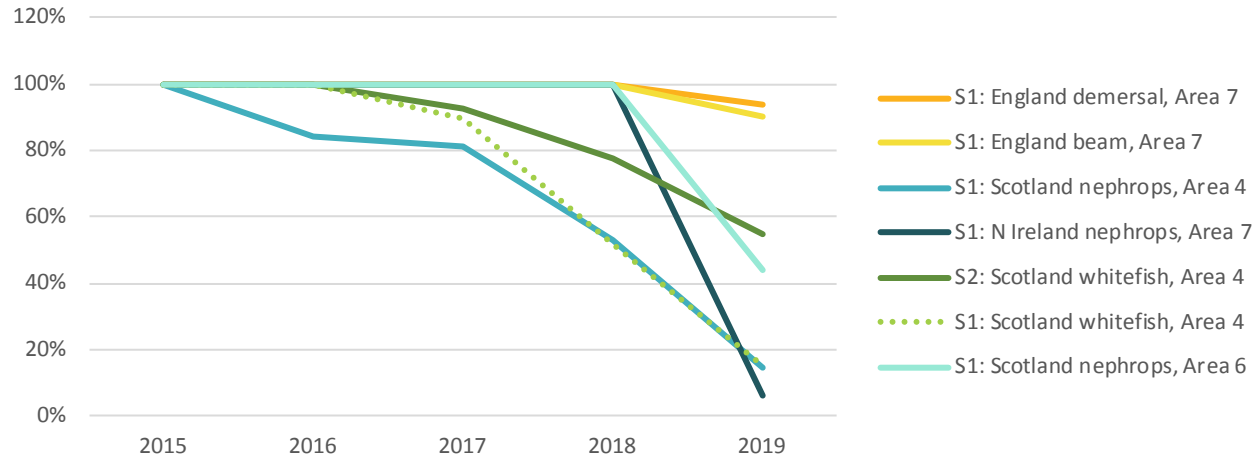


Table 8-1 identifies the primary choke stocks that cause the choke points identified above. The table highlights primary choke stocks only i.e. those stocks for which catch is expected to exceed available quota first. Secondary choke stocks are likely to exist in most cases, particularly in 2019 when all stocks become subject to the landing obligation. Further primary choke stocks also exist in other sea areas for most fleet segments (see fleet segment chapters for further detail).

Table 8-1: Choke situation for each fleet segment in its main area of activity under the best-case quota simulation

Home-nation fleet segment	Main Sea Area	2015 DAS in main sea area	Best case simulation	Under best-case simulation			
				Year that choke point occurs	Choke point as % of 2015 DAS	Primary choke stocks that cause the choke point	No of PO fleet segments in H-N fleet expected to encounter choke stocks[8]
England demersal trawl	7	12,508	S1	2019	94%	Cod 7b-k (ex.d)	4 out of 4
England beam trawl	7	7,553	S1	2019	90%	Cod 7b-k (ex.d) and plaice 7hjk	2 out of 2 that are active in Area 7
Northern Ireland nephrops trawl	7	9,478	B4	2019	6%	Whiting 7a	2 out of 2
Scotland nephrops trawl	6	16,404	S1	2019	43%	Anglerfish	3 out of 4 that are active in Area 6
	4	8,838	S1	2017	81%	Sole (only in 4b TR2)	4 out of 5 that are active in Area 4
				2018	52%	Sole (only in 4b TR2) and saithe	4 out of 5 that are active in Area 4
			S2 (not shown in Figure 7-1)	2019	28%	Hake	4 out of 5 that are active in Area 4
Scotland whitefish trawl	4	9,662	S2	2017	92%	Sole (only in 4b TR1) and cod	4 out of 4
				2018	77%	Saithe	4 out of 4
				2019	54%	Hake	4 out of 4

[8] It is understood that one PO in Scotland holds quota that is not fished by vessels in the PO. This detail is not currently picked up in the model and therefore potential choke stocks may be obscured for this PO.

Despite the diversity in the UK fleet there are similarities in the choke stocks identified in this summary analysis. In Area 4 saithe in 2018 and hake in 2019 are common problems. In this summary, Area 6 only appears once, and anglerfish is identified as the potential primary choke stock in 2019. In Area 7, cod 7b-k is identified as a common primary choke stock for the English fleets in 2019, and in Area 7a in 2019 the Northern Ireland fleet is expected to face a significant challenge from its catch of whiting 7a. The quota simulations have offered substantial mitigation to some fleets but, for other fleet segments, even the free movement of quota cannot fully address, and in at least one case does nothing to address, the challenge of choke stocks. Furthermore, the table above only highlights the primary choke stocks and even if these can be overcome, for some of the fleet segments, there are secondary choke stocks that could still create challenges.

TAC uplifts and quota trading are not the only potential solution to the challenges identified in the report. Solutions could also include gear selectivity improvements, avoidance and further policy initiatives such as interspecies flexibility, de minimis and survivability. These are not tested in the results of the model presented here.

If you have information that could be used by Seafish to improve the model, or you would like to explore the findings in more detail, or use the model to test the potential impact of a defined mitigation measure, please contact the Seafish Economics Team. The current work programme for the model includes updating the data input framework with 2016 data as soon as the information becomes available.

Appendix A: Quota Uplift used in Model

Quota uplift in 2016 and 2019 by stock code

Stock	2016	2019		Stock	2016	2019		Stock	2016	2019
ANGNS	-	+4%		HAKWS	+12%	+11%		PLANS	+25%	+30%
ANGWS	-	+4%		LEMWITNS	-	+35%		SAINS	+6%	+5%
BSFWS	-	+4%		MEG7	-	+17%		SAIWS	-	+5%
COD5B6A	-	+382%		MEGNS	-	+14%		SOL7A	-	+8%
COD7D	-	+26%		MEGWS	-	+14%		SOL7D	+9%	+10%
CODNS	-	+26%		NEP7	+11%	+18%		SOL7E	-	+2%
DABFLENS	-	+675%		NEPNS	+3%	+10%		SOL7FG	+1%	+3%
HAD5B6A	+11%	+21%		NEPWS	+2%	+7%		SOLNS	+1%	+7%
HAD7A	+27%	+89%		PLA7A	-	+242%		TURBNS	-	+4%
HAD7BK	-	+61%		PLA7DE	-	+73%		WHI7BK	+26%	+27%
HADNS	+17%	+21%		PLA7FG	-	+270%		WHINS	-	+86%
HADWS	-	+14%		PLA7HJK	-	+57%		WHIWS	-	+177%
HAKNS	+11%	+11%								

Stocks with no quota uplift are: ANG7, Bass, COD6B, COD7A, COD7BKXD, Cuttlefish, HER4C7D, HER7A, HER7EF, HERNS, HERWS, LIN4, LINWS, MACBOX, MACNS, MACWS, Pilchards, PLAWS, POL7, POLWS, Queen Scallops, SAI7, Scallops, SKA67XD, SKA7D, SKANS, SOL7BC, SOL7HJK, SOLWS, SPR7DE, SPRNS, Squid, USK4, USK567, WHI7A

Appendix B: Discard Rates used in Model

	TR1 (whitefish and demersal trawl)			TR2 (nephrops trawl)			BT (beam trawl)
	England	Scotland	Northern Ireland	England	Scotland	Northern Ireland	England
Anglers 7	1.3%	2.7%	0.0%	0.0%	0.0%	8.9%	3.3%
Anglers 4	0.6%	0.8%		4.6%	22.0%	21.6%	0.5%
Anglers 6		0.3%			52.7%	0.3%	
Boarfish 6		0.4%					
Cod 5b6a		83.0%			97.5%	0.0%	
Cod 6b		0.0%					
Cod 7a			32.4%		73.3%	67.0%	
Cod 7b-k(ex.d)	3.4%	8.7%		0.0%			7.7%
Cod 4	4.9%	27.9%		42.8%	98.3%	95.5%	3.8%
Dabs 4	61.6%	92.3%		94.0%	99.6%		91.5%
Haddock 5b6a		6.0%			95.6%	85.6%	
Haddock 7a			3.4%		80.0%	73.0%	
Haddock 7b-k	13.1%	20.8%		0.0%			21.6%
Haddock 4	2.9%	8.3%		88.4%	86.3%	86.8%	0.0%
Haddock 6b		6.0%					
Hake 4	6.7%	55.7%		81.8%	95.9%	93.8%	0.0%
Hake 6-7	4.4%	22.3%	0.0%	0.0%	47.3%	27.3%	13.8%
Lemon sole 4	90.6%	8.3%		78.7%	64.9%	68.4%	39.2%
Ling 4	2.3%	1.5%		65.6%	75.5%	75.0%	14.3%
Ling 6-7	2.9%	6.9%	0.0%	0.0%	64.6%	0.8%	10.6%
Megrim 7	3.5%	7.7%		0.0%	100.0%	50.0%	1.9%
Megrim 4	7.9%	3.3%			86.1%	85.7%	
Megrim 6		8.7%			67.7%	0.0%	
Nephrops 7	3.6%	3.3%			18.0%	16.9%	0.0%
Nephrops 4	3.6%	1.1%		1.4%	23.3%	17.5%	32.7%
Nephrops 6		7.1%			6.3%	0.0%	
Plaice 7a			12.6%		88.1%	91.9%	
Plaice 7de	0.0%			0.0%			44.4%
Plaice 7fg		0.0%		0.0%			0.0%
Plaice 7hjk		62.6%					45.9%
Plaice 4	10.3%	14.3%		54.5%	88.8%	88.5%	50.1%
Plaice 6		46.8%			98.6%	87.7%	
Pollack 7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Pollack 6		0.0%			0.0%	0.0%	
Saithe 7	0.0%		0.0%	0.0%		0.0%	0.0%
Saithe 4	1.7%	41.3%		0.0%	73.3%	73.3%	0.0%
Saithe 6		7.7%			91.2%	0.0%	
Skate 6-7 (ex.d)	2.4%	0.0%	0.0%	0.0%	0.5%	0.0%	32.5%
Skate 4	76.0%	0.0%		42.4%	21.6%	33.3%	17.9%
Sole 7a					0.0%	9.5%	
Sole 7e	0.0%			0.0%			0.5%
Sole 7fg		0.0%		0.0%			0.0%
Sole 7hjk		5.9%					2.0%
Sole 4	0.0%	1.1%		15.4%	67.6%	50.0%	13.3%
Sole 6		27.0%			91.0%	0.0%	
Sprat 7de				0.0%			
Sprat 4		0.0%					
Turbot 4	0.0%	2.7%		0.6%	15.3%	0.0%	5.9%
Tusk 4		0.0%			0.0%		
Tusk 5,6,7		13.7%					
Whiting 7a			38.9%		99.3%	99.4%	
Whiting 7b-k	4.8%	20.2%		0.0%			13.6%
Whiting 4	72.8%	18.4%		92.9%	82.7%	83.0%	95.3%
Whiting 6		45.7%			99.7%	99.1%	

Appendix C: Phasing of Stocks in 2016-2018, as included in the model

Table C-1: North Sea phasing, 2016-2018

	IVa_TR1			IVa_TR2			IVb_BT			IVb_TR1			IVb_TR2			IVc_BT			IVc_TR1			IVc_TR2		
Stock	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Sole		1	1	1	1	1	1	1	1		1	1	1	1	1					1	1	1	1	1
Plaice	1	1	1			1			1	1	1	1			1				1	1	1			1
Haddock	1	1	1		1	1		1	1	1	1	1		1	1								1	1
Cod		1	1			1			1		1	1			1					1	1			1
Nephrops		1	1	1	1	1		1	1		1	1	1	1	1									
Whiting		1	1			1			1		1	1			1					1	1			1
Saithe			1			1			1			1			1									

Table C-2: West of Scotland phasing, 2016-2018

	VI_TR1			VI_TR2		
Stock	2016	2017	2018	2016	2017	2018
Haddock 5B6A	1	1	1		1	1
Nephrops				1	1	1
Plaice		1	1			
Sole		1	1			
Megrim		1	1			

Table C-3: Other North-Western Waters phasing, 2016-2018

	VIIa_TR1			VIIa_TR2			VIId_TR1			VIId_TR2			VIIe_BT			VIIfg_BT			VIIfg_TR1		
Stock	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Sole 7D							1	1	1	1	1	1									
Nephrops				1	1	1													1	1	1
Haddock 7A	1	1	1																		
Sole 7FG																1	1	1			
Sole 7E													1	1	1						
Hake		1	1																		

Acronyms

DAS – Days at Sea

FDI – Fisheries Dependent Information

FPO – Fish Producers Organisation

FQA – Fixed Quota Allocation

ICES – International Council for the Exploration of the Sea

IQA – Initial Quota Allocation

PO – Producers Organisation

STECF – Scientific, Technical and Economic Committee for Fisheries

TAC – Total Allowable Catch

List of PO abbreviations

AFPO	Aberdeen FPO Ltd
ANIFPO	Anglo-North Irish FPO Ltd
ASFPO	Anglo-Scottish FPO Ltd
CFPO	Cornish FPO Ltd
EEFPO	Eastern England Fish Producers Organisation Ltd
FFPO	Fleetwood FPO Ltd
LFPO	Lowestoft FPO Ltd
NAFPO	North Atlantic Fish Producers Organisation Ltd
NESFO	North East of Scotland Fishermen's Organisation
NSFO	North Sea Fishermen's Organisation Ltd
NIFPO	Northern Ireland FPO Ltd
NPO	Northern Producers Organisation Ltd
OFPO	Orkney FPO Ltd
SFO	Scottish Fishermen's Organisation
SFPO	Shetland FPO Ltd
SWFPO	South Western FPO Ltd
TFFPO	The Fife FPO Ltd
TFPO	The FPO Ltd
WWCFPO	Wales and West Coast FPO Ltd
WoSFPO	West of Scotland FPO Ltd