Research for PECH Committee - Landing Obligation and Choke Species in Multispecies and Mixed Fisheries - the North sea

Ulrich, Clara

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Research for PECH Committee - Landing Obligation and Choke Species in Multispecies and Mixed Fisheries - The North Sea

Abstract

The demersal fisheries in the North Sea are **highly mixed**. Several CFP tools and additional policy adjustments have been implemented since 2015. They have **helped deal with the landing obligation** but **have not incentivised discard reductions**.

Many potential choke issues are primarily **political**, linked to quota distribution rather than quota shortage. A few specific situations (including plaice, hake and elasmobranchs**) are considered difficult to address with the** current CFP tools.

Results-based approaches with full documentation of catches should be promoted.

This document was requested by the European Parliament's Committee on Fisheries.

AUTHORS
DTU Aqua, Denmark: Prof. Clara ULRICH

Research manager: Carmen-Paz Marti
Project and publication assistance: Virginija Kelmelytė
Policy Department for Structural and Cohesion Policies, European Parliament

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ABOUT THE PUBLISHER
To contact the Policy Department or to subscribe to updates on our work for PECH Committee please write to: Poldep-cohesion@ep.europa.eu

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CONTENTS

LIST OF ABBREVIATIONS

AER	Annual Economic Report
CFP	Common Fishery Policy
CMT	Choke Mitigation Tool
CQM	Catch Quota Management
DAS	Days at Sea
DCF	Data Collection Framework
EC	European Commission
FAO	Food and Agriculture Organisation of the United Nations
FDF	Fully Documented Fisheries
FDI	Fisheries-Dependent Information
F_{MSY}	Maximum Sustainable Yield exploitation rate
FU	Nephrops Functional Unit
ICES	International Council for the Exploration of the Sea
JRC	Joint Research Center
LO	Landing Obligation
MCRS	Minimum Conservation Reference Size
MS	Member State
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
MSY $B_{trigger}$	Biomass reference point that triggers a cautious response within the ICES MSY framework
NSAC	North Sea Advisory Council
NWWAC	North Western Waters Advisory Council
PO	Producents Organisation
REM	Remote Electronic Monitoring
SSB	Spawning Stock Biomass
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total Allowable Catch

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EXECUTIVE SUMMARY

Background

The European Parliament's Committee on PECH wishes to commission a research study on Landing obligation and choke species in multispecies and mixed fisheries. The topic is linked to three geographical areas: the South Western Waters, the North Western Waters and the North Sea. One of the study is: "Landing obligation and choke species in multispecies and choke species- the North Sea"

A key objective of the 2013 Common Fisheries Policy is to gradually eliminate discards, by 1st January 2019 at the latest.

The obligation to land all species in all fisheries introduced by the CFP, and hence progressively banning discarding, has led Member States to revise their approach to fisheries management according to their national allocations of quota. It is especially the case in multispecies and mixed fisheries impacted by the landing obligation. This new scenario on the one hand creates an incentive to develop more selective gears and landing all fish caught; while on the other hand, reducing the effect of the lack of quota for some species that will force the early closure of some fisheries i.e., the "choke effect".

Since 2014 progress has been made. This progress can be summarized in three phases:

First phase: renewal of fishing
1. Take advantage of all species inevitably captured: looking for other commercial outlets including those for non-direct human consumption;

2. Reduce discards through the establishment of temporary EU regional discards plans. To date, 15 of them have been adopted;

3. Investigating and adapting fishing gear to improve selectivity and reduce unwanted catches;

4. Reorienting the productive strategy of mixed fisheries, moving from single species to multispecies (spatial-temporal closures ....)

Second Phase: remedial measures
1. Using the tools provided for in the CFP to alleviate the lack of quotas for some species and reduce the risk of choke species: the high survivability exemption; the de minimis-exemption; adjustments of TACs: TAC top-ups, redistribution of national quotas, including a by-catch quota for choke species,inter-species and inter annual flexibility.

2. Carrying out quota exchanges (swaps of the same or distinct species) among countries for this purpose

Third phase: remaining problems and solutions
1. Assessing the feasibility of the available tools within the CFP and evaluating the effects of choke species, from a biological, economic and social point of view;

2. Find solutions: assess the current distribution of quota against catches and possible adjustments that could be made to re-balance this.

3. The role of regionalisation and the identification of responsible for implementation, follow-up and control of viable solutions.

Objectives and content

a) overall objective
Considering the background , to describe and assess the real problem of multispecies and mixed fisheries at regional level, in the current situation and under new scenarios (e.g. EU27 and a new CFP):identify choke species that have the potential to limit catches. Finally, assess whether the CFP contains effective and sufficient tools to deal with such issues and to allow implementation of the landing obligation.

b) Research objectives
In the North Sea:

A. Describe multispecies / mixed fisheries: the biology and ecology of the species concerned and the fishery itself;

B. Using representative fisheries case studies in each region, identify the species acting as choke, describing and assessing the use of all the CFP tools to mitigate the risks of these species choking fisheries; the community and international quota swaps and the productive and commercial strategies; identifying EU underutilized quotas of species acting as choke; and assessing whether traditional swaps help to reduce any deficits between catches and quotas;

C. to assess whether the tools in the CFP are technically adequate and sufficient to implement the landing obligation and the reasons why some are being currently underutilised;

D. Considering future scenarios after 2019 following full implementation of the landing obligation and the future of the EU with 27 Members States or any other likely scenario (i.e. Climate change), make predictions about the impact of the problems both biological, economic and social and the efficiency / sufficiency of EU actions and instruments to mitigate effects of the landing obligation. Identify alternative solutions: (e.g. redistribution of quotas underused; adjustments to the TAC and quota system; or any other viable solutions).

GENERAL INFORMATION

It is emphasised that this study **deals exclusively with the landing obligation and choke species in demersal fisheries** in the North Sea, and does not address the issues in the pelagic and industrial fisheries. The main findings are:

Regarding Objective A. Describe multispecies / mixed fisheries: the biology and ecology of the species concerned and the fishery itself, the chapter 2 starts with a brief theoretical and historical perspective on the **fundamental methodological challenges linked to accurately defining fisheries**, because of the **diversity in individual fishing strategies** resulting in great **variability in fishing patterns and catch composition**. Depending on the question asked, on the aggregation criteria and scale chosen, and on the dataset used, different categorisations of fisheries might be defined. In the recent years though, a **consensus on a standardised way to describe global North Sea demersal fisheries** has emerged in the aftermath of the cod recovery plan in 2008, and has also been the **cornerstone of the fisheries-based gradual phasing-in of the landing obligation** between 2016 and 2019. Some general description on these various fisheries is provided, together with information on the stocks they exploit either as target or as bycatch. **The state of the stocks has on average significantly improved** in the North Sea during the last decade, **largely related to better fisheries management and a decrease in fishing effort** rather than to an increase of biological productivity.

Regarding Objective B, identify the species acting as choke, the chapter 3 reviews a number of studies that have been performed on the topic, which has received **particularly strong focus in 2017** in various fora. **Real choke issues have not been really observed yet** in the North Sea, so analyses are only able to address **potential risks if and when the landing obligation is fully and strictly enforced**. The landing obligation has triggered the need to **characterise** the various potential choke situations and **assess the factors causing them**, in order to identify the **most appropriate mitigation strategies**. Importantly, different choke categories apply to various North Sea stocks, and **different situations may be experienced at EU, Member State, Fleet and Individual vessel** levels, depending on **access to quota and market**. The most serious potential risks of choke situations for the main commercial stocks are estimated to be with **Northern hake in trawl fisheries** and with **North Sea plaice in small-meshed beam trawl fisheries**, but for very different reasons. For hake, this is linked to **changes in the stock distribution**, with increasing abundance in the North Sea while Member States, and UK in particular, have low quota share. The issue is thus linked to **the historical relative stability key not being aligned with biological changes in the ecosystem, not least in relation to climate change**. For plaice, this is linked to the **large catches of undersized plaice in the sole fisheries**.

Regarding Objective C, assess whether the tools in the CFP are technically adequate and sufficient to implement the landing obligation, Chapter 4 reviews the various policy changes that have occurred since 2015 in the aftermath of the landing obligation. In the North Sea, **the landing obligation has been phased in on a fishery-by-fishery basis**. Several major stocks and fisheries were phased in in 2017, but the resulting outcomes in terms of estimated discards were not yet available at the time of writing this study. Beyond the discard plan foreseen by the CFP, **a number of other policy changes were implemented, includes TAC removals, reductions in minimum landing size and changes in prohibited species** among others. No major implementation issues have yet been reported by Member States, indicating that **these CFP tools have until now been sufficient to allow the fisheries to continue operating under the landing obligation**. However, it is also reported that **the landing obligation has so far had no significant impact on the way fishing is conducted**, and **the objective of reducing unwanted catches has not yet been met**. **By providing more flexibility, the policy changes may thus have also reduced the incentives to improve selectivity**. It is suggested that **better management actions need to be catalysed**, for example in the form of a top-down process whereby **failure to effectively implement at least some measures incentivising discard reduction would preclude MS from being able to apply for the use of other policy tools**.

Regarding Objective D, the future scenarios after 2019, Chapter 5 builds on most of the conclusions reached in chapters 3 and 4. In 2019, all regulated species will have to be phased-in, including the difficult cases mentioned in Chapter 3. Some reflections are given on the **possible options for undersized plaice catches** in the sole fishery. The current state of knowledge does not point to easy selectivity or avoidance options, and survival, while significant, is likely not "very high". Considering the high biomass and sustainable state of the stock, some level of flexibility might thus be considered against e.g. provision for fully documented fisheries and sustained efforts to increase selectivity. **For hake and other species showing distributional changes** in relation to **climate change**, the success of the landing obligation is highly dependent on Member States' voluntary quota swaps. **Stable political solutions should be sought to address this issue on a more permanent and long-term oriented basis,** especially in the context of Brexit. Considerations are also given on **management issues for sharks and rays**, which combine specific characteristics of being sensitive but valuable bycatches, and for which **no simple management option seem to offer an adequate balance between exploitation and conservation** in the landing obligation scheme. Secondly, alternative approaches to incentivise discard reductions are

discussed. The landing obligation as it now appears like a system that has "neither a stick nor a carrot". An effective implementation of a ban on discarding requires high levels of at-sea monitoring and effective control, and/or strong incentives to fish more selectively, neither of which currently apply. **Fully Documented Fisheries with Remote Electronic Monitoring**, together with **a smarter use of TAC top-ups** can be the fundament of a **results-based management system** focusing on **impact and controllability**, where fishers are fully accountable of their catch.

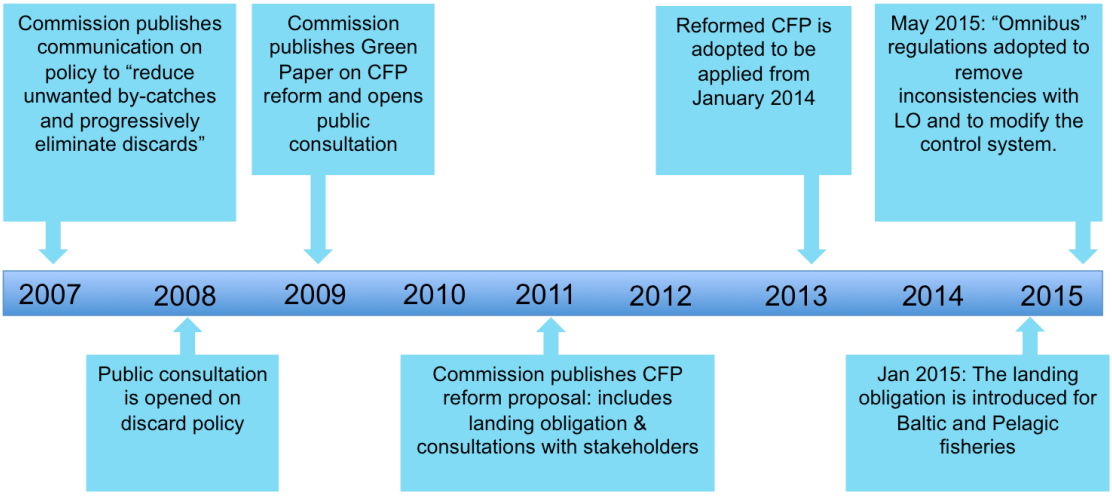
1. INTRODUCTION

The landing obligation (LO), the requirement to land all catches of certain fish species, was introduced as part of the EU's new Common Fisheries Policy (CFP) in 2014 (European Parliament and Council of the European Union, 2013). However, **the history of the EU discard policy started several years earlier**, when the Commission published in March 2007 a communication recognising the serious problem of discarding in European fisheries (Borges, 2015).

By many ways, the evolution of the EU discard policy has been **driven by the situation experienced in the North Sea demersal fisheries**. There has long been a **striking contrast** between the situation in the EU waters, where discards rates have historically been estimated to be **among the highest in the world** (Kelleher, 2005), and the situation in the Norwegian waters where a discard ban had been in place since 1987 (Diamond and Beukers-Stewart, 2011).

An incident involving a UK trawler in North Sea's Norwegian waters in 2008 generated public pressure to end discarding. Later in 2010, it is again in the North Sea that the public campaign of the UK celebrity chef known as "Hugh's Fish Fight" prompted a **very strong public reaction**. The campaign mainly **highlighted just one cause of discards**, the quotas, blaming the EU management system and its perceived draconian and ineffective measures. Ultimately, the EU landing obligation emerged out of this strong emotional context, but after having been in question for a long time (Borges, 2015; Fitzpatrick and Nielsen, 2016)(Figure 1).

Figure 1. Evolution of the EU's Landing Obligation 2007-2015



Source: (Fitzpatrick and Nielsen, 2016)

The landing obligation represents probably **the most important paradigm shift** in the history of the Common Fishery Policy. **When discarding is allowed, fishing is driven by maximising the value of the fraction of the catch that can be landed. When discarding is banned, fishing becomes also driven by minimising the quantity of the fraction of the catch that cannot be landed**. This means that fishers become **accountable for their entire catches** of regulated stocks, and not of their landings only. Changing this fundamental approach to the way fishers drive their business **requires a major change in mindset**, which can only take place if fishers supports its **legitimacy**.

Additionally, **the transition costs of this paradigm shift are real**. Discarding is an **invisible externality cost** for fishermen and society, which becomes internalised when discarding is banned. Even in a situation where fishermen would not be limited in their access to fishing quotas, **a landing obligation makes fishing less cost-effective** in the short-term, both by

increasing the costs (more trips back to harbour; more work for the crew; more infrastructures needed) and reducing the value of the catch (less valuable species and sizes; lower quality). But this situation worsens when limiting quotas add "choke issues" to this complex picture.

As a consequence of these two aspects, **banning discards is a difficult measure**. A number of countries have already implemented discards, including Canada, New Zealand, Norway, Iceland and Chile, and experiences with these countries have been reviewed (Condie *et al.*, 2014; Borges *et al.*, 2016). All cases show that **the implementation of discard bans requires high levels of at-sea monitoring and effective control, and/or strong incentives to fish more selectively,** neither of which applied in most cases examined. They also show that **progresses were slow**, with the Iceland taking 30 years to move into a mindset of full utilisation of all catches (Viðarsson *et al.*, 2015).

In spite of a **general improvement in the state of the stocks and in the economic viability of the fisheries in the North Sea** following a decade of strengthened fisheries management, it is obvious that these inherent difficulties also apply to the North Sea demersal fisheries. Since the early steps of establishing a knowledge baseline and defining roles and responsibilities in the new frame of the regionalised CFP in 2014 (Quirijns and Pastoors, 2014), many things have changed in the governance of the North Sea fisheries, although n**o effects on actual discards rates and fishing practices have yet been observed** (STECF, 2018).

The overall objective of the present study is thus to describe and assess the real problem of multispecies and mixed fisheries in the North Sea, now and after 2019. Based on an extensive literature review, we identify choke species that have the potential to limit catches, and discuss whether the CFP contains effective and sufficient tools to deal with such issues and to allow implementation of the landing obligation.

It is emphasised that this study **deals almost exclusively with the landing obligation and choke species in demersal fisheries** in the North Sea, and does not address in details the issues in the pelagic and industrial fisheries. There are some specific risks of demersal bycatch choking these fisheries, and care is indeed needed in the use of bycatch thresholds and interspecies flexibility to address these (STECF, 2017a). The problematics in these fisheries are however not directly comparable with those in the demersal ones, so a choice was made by the author to restrict the scope of this report to the demersal fisheries.

There is quite a lot of information available on the landing obligation in the North Sea, but it is largely dispersed across numerous sources. Beyond peer-reviewed scientific papers published in scientific journals, a lot of the information presented in the report is extracted from reports and grey literature including primarily:

- Reports and advice from the International Council for the Exploration of the Sea (ICES, www.ices.dk)
- Reports from the EU Scientific, Technical and Economic Committee for Fisheries (STECF, https://stecf.jrc.ec.europa.eu/reports)
- Deliverables from the EU Horizon 2020 Research Project DiscardLess (http://www.discardless.eu/).

Most of this information is publicly available, although it is not always straightforward to navigate into this amount of information and to know what to find where. Some reports mentioned in the text were however still unpublished at the time of writing this review, in particular the work by (Borges *et al.*, 2018) and by (Fitzpatrick and Nielsen, 2018). Their relevant results were however integrated after agreement with the authors. This agreement is gratefully acknowledged.

2. THE NORTH SEA DEMERSAL MIXED FISHERIES

KEY FINDINGS

- The North Sea is a large sea basin containing a **number of habitats and distinct regions**. This influences the range of species of fish that are present and their distributions, which in turns lead to a **great variety of activities** prosecuted by several countries.
- There are **numerous** studies and different sources of data providing qualitative and quantitative information on the North Sea demersal fisheries. Differences between them may occur according to **different criteria and scale used for classification**. A combination of **physical descriptors (gear, mesh size)** and **resulting outcomes (target species, catch composition)** can provide an accurate description.
- Different countries operate different fisheries with different catch composition, leading thus to **marked differences in targeting and discard rates**
- The **state of the main commercial stocks** has been **improving in the recent years** in the greater North Sea.

The North Sea is a large sea basin containing a number of habitats and distinct regions resulting from its bathymetry, topographical features and hydrography. The variety of habitats and environmental conditions over the area influences the range of species of fish that are present and their distributions. This in turn has given rise to the development over time of a variety of fisheries prosecuted by fleets from a number of countries using a variety of gear types. The extent to which different countries participate in the various fisheries depends to a large extent on national quotas available to them (Quirijns and Pastoors, 2014).

There are **numerous ways to describe fisheries**, and **even defining what the wording "fisheries" means is not straightforward**. Before proceeding with the actual description of North Sea fisheries in section 2.2, I recall a number of **key concepts** and explain the **challenges** linked to their **characterisation** and their **quantification** in section 2.1.

2.1. Basic concepts and fundamental definition challenges

It is important to highlight the difficulties and challenges linked to using the word "*fisheries*" itself. Inherently, the idea of "fishery", "fleet" or "métiers" are concepts that one can **qualitatively** agree on, as it is obvious that different types of fishing activities performed by different types of fishing vessels using different types of gears will result in different types of impacts on the ecosystem and marine resources.

Nevertheless, issues arise when trying to **quantitatively define what these activities really are**, and to allocate fishing units to the various categories. There are indeed **many ways by which fishing activities can be considered alike or different from each other**. In short, two main issues arise when comparing fishing activities: 1) which **comparison criteria** to use and 2) **which scale.**

Here below we briefly recall the definitions of concepts and summarise the challenges linked to these two questions.

2.1.1. Concepts

"Fishery" is a rather **vague** wording. According to the definition of the Food and Agriculture Organisation of the United Nations (FAO), a fishery is: *"A unit determined by an authority or other entity that is engaged in raising and/or harvesting fish. Typically, the unit is defined in terms of some or all of the following: people involved, species or type of fish, area of water or seabed, method of fishing, class of boats and purpose of the activities."*

Other terms have thus been more clearly defined. The European Data Collection Framework (DCF, (EC, 2008a)) defined two concepts, which we adopt for this report:

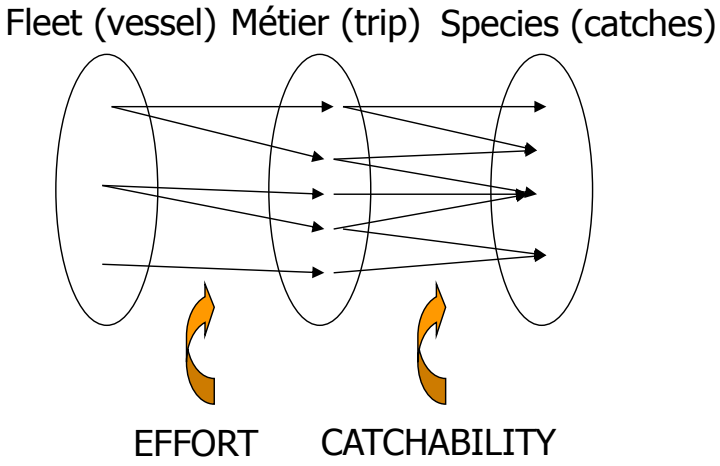
- **A fleet (or fleet segment)** is a **group of vessels** with the same length class and predominant fishing gear during the year. Vessels may have different fishing activities during the reference period, but might be classified in only one fleet segment.

- **A métier** is a **group of fishing operations** targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterized by a similar exploitation pattern.

In this report, we will thus use the specific word "fleet" or "fleet segment" when we refer to a group of vessels, and "métier" when we describe the fishing activity(ies) in which the fleet engages in. Fleets are linked to métiers through the fleets' **effort patterns**, and métiers are linked to species/stocks through the **catchability pattern** (Figure 2). The term "fishery", when used, will rather refer to a metier, unless otherwise specified.

Fleets and métiers are only **aggregations of multiple individual** operations and vessels operated by humans. As such, they are **not natural entities that are pre-defined** and for which is it easy and clear to know who belongs to which group. Under the type of simple stock-based TAC management that has long prevailed in the North Sea fisheries, **no unique pre-agreed classification exists** as this was not required for implementing management. The first fisheries-based management actions are rather recent, include the implementation of effort management in the last decade (see section 2.1.2), and the current discard plans for the gradual implementation of the landing obligation (see section 4.1). Another exception is the case of e.g. MSC certified "fisheries", or similar labelling, for which it is necessary to delineate which vessels and activities are allowed to use the label on their products. Already there the point is clear that different fisheries definitions might have been used across all these cases.
Fisheries-based approaches r**equire thus the definition of units** (fleets and/or métiers), as well as **of quantifiable rules** to populate fishing trips into métiers and fishing vessels into fleets.

Figure 2. Conceptual diagram of the links between fleets, métiers and species in a mixed-fishery context



Source: (Ulrich *et al.*, 2012)

2.1.2. Which criteria to define fleets and metiers?

A lot of scientific studies have been conducted over the last 25 years to provide robust definition analysis (Marchal, 2008; Deporte *et al.*, 2012). Fisheries can be defined according to either **trip inputs** (available records of the technical features of fishing trips, e.g. gear and mesh size used, fishing grounds visited, season etc) or **trip outputs** (empirical or statistical analyses of landings or catches composition in weight or in value, called "catch profiles"). Combined methods relate catch profiles (outputs) to fishing trip characteristics (inputs).

In the North Sea, both types of approaches have been used, for different purposes. **Inputs-based definitions** have been used in the **effort management regimes** in place during the period 2003-2008 (EC, 2004) and 2009-2016 (EC, 2008b; Kraak *et al.*, 2013). Categories (métiers) for days at sea limits were defined in terms of gear type and cod-end mesh size combinations, known as e.g. TR1, TR2, BT1, BT2 (see further below), together with several additional possible "*Special conditions*". Inputs-based definitions are also used in the Annual Economic Report (AER, (STECF, 2017b)), where fleet segments are defined according to **vessel size and main gear**, and these broad categories can include very different vessels and activities within a group.

Combined/output-based methods have been used in the **DCF for the scientific sampling of biological data**, where métiers have been defined according to a hierarchical structure using six nested levels of which level 5 relates to the "Target assemblage" based on main species type (e.g. Demersal fish vs. Crustaceans or Cephalopods). For example, the main bottom trawl fishery will be coded OTB_DEF_>=120_0_0, which means "*Bottom trawl with Otter boards_targeting demersal fish assemblage_with mesh size in cod end above 120 mm_no selective panel in trawl_no selective device in codend*."

Substantial difficulties are however linked with both approaches (Ulrich *et al.*, 2012). **Input information such as gear and area can link to very different types of fisheries**, and **mesh size is not always a good descriptor**, even when it is accurately recorded. In the North Sea, a good example of this is given by the vessels targeting almost exclusively saithe, in comparison with the more mixed roundfish fisheries were saithe is caught together with e.g. cod, haddock and whiting, although the same gear and mesh size are recorded in the logbooks (TR1, bottom trawl with >= 100 mm codend meshsize). Or similarly, bottom trawls with mesh size less than 100 mm (TR2) can target both Norway lobster or whiting. This lack or

relationships between the recorded mesh size and the catch composition is demonstrated to be even more problematic in the Celtic Sea than in the North Sea (ICES, 2017a)

Conversely, interpreting output information such as catch composition is further hampered by a number of recurrent questions such as: Should analyses be performed based on **tonnage or value**? **What defines a target or a by-catch species**, and are some species target for some fleets and bycatch for others? Are **catches different from the landings** and why, and is landings composition changing according to regulations and access to quota? Do catch composition reflect the true intention and perfect local knowledge from the fisher? Etc.

In summary, **there is not a unique and simple set of criteria that can be universally used to define fleets and fisheries**, and **the final choice of criteria is linked to the question asked and the availability of information**.

2.1.3. Which scale?

The question of scale is just as difficult to answer. In reality, **each vessel (and each trip or haul, respectively) is unique** in terms of catch rate, fishing type, profitability, incentives, fishing strategies etc.. Ultimately, two fishers from the same harbour fishing in the same way may have quite different catch composition. And two consecutive hauls from the same vessel can yield very different outcomes (Mortensen *et al.*, 2018).

As such, **fisheries will only be aggregations of these unique events**, and their average patterns will be dependent of the chosen scale of aggregation. Like a fractal or a snowflake, differences will appear when zooming in within a fishery, with catch composition varying according to e.g. season, fishing place, home harbour, vessel size, skipper etc. **Defining fisheries requires thus a trade-off to be made between the number of fisheries units defined and their internal consistency and homogeneity**.

2.2. Fisheries in the North Sea

2.2.1. Standard terminology

As explained above and later below, several definitions of North Sea fisheries have historically been used in different documents, for different purposes and a different scales. In the most recent years though, **a common approach has been to refer to the broad categories defined in the cod management plan** (Council Regulation 1342/2008, (EC, 2008b)). The greater North Sea is described as management area 3b in annual Annex IIa of the TAC and Quota Regulations (e.g. Council Regulation 40/2013). The greater North Sea can be further subdivided into:

- 3b1 - Skagerrak (ICES area IIIaN)
- 3b2 - North Sea (ICES area IV and EU waters of ICES area IIa)
- 3b3 - Eastern channel (ICES area VIId)[1]

The following definitions for regulated gears are used:

- Bottom trawls and seines (OTB, OTT, PTB, SDN, SSC, SPR) of mesh:
  TR1 equal to or larger than 100 mm,
  TR2 equal to or larger than 70 mm and less than 100 mm,
  TR3 equal to or larger than 16 mm and less than 32 mm;

[1] However the area VIId is now not included in the discard plan for the North Sea, but for the North-Western Waters.

- Beam trawls (TBB) of mesh:
  BT1 equal to or larger than 120 mm
  BT2 equal to or larger than 80 mm and less than 120 mm
- Gill nets, entangling nets (GN)
- Trammel nets (GT)
- Longlines (LL)

2.2.2. Datasets and sources of information available

In the frame of this report, **a number of datasets and sources of information** on North Sea mixed fisheries can be used. Given the quantity and complexity of fisheries data, a recurrent issue has been that the various databases and sources of information **might not be fully consistent and coherent with each other**. Even though they largely come from the same raw data (log-books, sale slips, harbor and onboard sampling programs), datasets are compiled and aggregated by different people in different institutions and for different purposes, and using different criteria and scales. As such, differences might occur, although increased collaboration and transparency in the data collection processes have significantly contributed to reducing these over the last decade.

Here we briefly present the key sources of scientific information available to describe North Sea fisheries.

2.2.2.1. STECF FDI data

The FDI[2] (Fisheries-Dependent Information) database has been established by STECF (Scientific, Technic and Economic Committee for Fisheries for the European Commission) and maintained by the JRC (Joint Research Center). It was **initially developed to monitor fishing effort in areas covered by fishing effort limitations**, and progressively extended. Data are collected through a data call. The most recent dataset includes catch (landings and discards) and effort data for all EU fleets between 2003 and 2016 (STECF, 2017c), disaggregated at the level of Member States and "Regulated Gear" according to the corresponding effort regime.

Additionally, data are also separated according to vessel size, distinguishing between vessels <10m, between 10 and 15m, and above 15m. A great number of species are included in the data call. Discard estimates are calculated automatically on the basis of the samples available, and their reliability can thus vary considerably (STECF, 2013).

This database is the **primary source of information** used in the Discard Atlas of the North Sea fisheries (Quirijns and Pastoors, 2014) as well as in all following studies emitted by e.g. STECF and NSAC.

2.2.2.2. STECF AER data

Catch and effort data are also available as the result of the DCF data call 2017 to support the analysis carried out during the STECF Expert Working Group on 'Annual Economic Report on the EU Fishing Fleet' (STECF, 2017b). The AER database also maintained by the JRC[3]. Catch data are landings in weight and in value (no discards data), by fleet segment (country, main gear and vessel size) and gear from 2008 to 2016. The vessel size classes are different from the FDI database above.

Over the years, significant efforts have been dedicated to **improve the coverage and quality of both JRC databases** (FDI and AER), and to **adapt them to the changing data needs**. In particular, management has moved from a focus on fishing effort in the context of the recovery plans to a focus on discards in the context of the EU landing obligation, and this

[2] https://stecf.jrc.ec.europa.eu/dd/effort
[3] https://stecf.jrc.ec.europa.eu/dd/fleet

requires a different breakdown of catch categories from the usual landings and discards. Also, there is a need to link the two databases in order to **combine economic data by fleet and catch data by métier** and standardize data by fishery/métier. From 2018 a new FDI database will be launched, reflecting these changes.

2.2.2.3. ICES MIXFISH data

ICES **has provided mixed-fisheries advice for the North Sea demersal fisheries since 2009**, focusing on the main target species cod, haddock, whiting, saithe, plaice, sole, and Norway lobster.

Catch and effort data for all North Sea countries (including Norway) are collected annually through a data call and compiled by the ICES WGMIXFISH Expert Group (ICES, 2017a). Fisheries definitions have been constructed empirically in a way that 1) distinguishes between fleet segments and métiers; 2) is consistent with both the DCF métiers definitions and Annex IIA of (EC, 2008b) regulated gears above; 3) uses aggregated fleet segments consistent with the AER definitions; and 4) provides catch composition (in species and size) fully consistent with the single-stock assessment. Discards by fleet and métier are estimated manually by the various stock assessors using the ICES DataBase InterCatch, on the basis of the sampled data provided by national data submitters.

The dataset represents an exhaustive source of information on fishing activities, but is not publicly available, and cannot be used for other purposes than those agreed with ICES. The data are however available to the author of this report as being a member of the expert Group.

2.2.3. Description of the mixed fisheries in the Greater North Sea Ecoregion

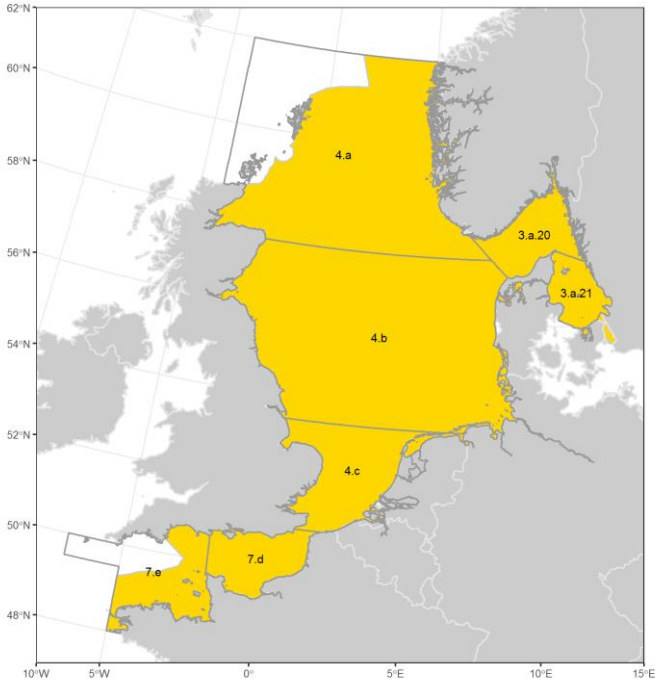
The previous chapters have explained **the complexity of defining what "mixed-fisheries" means**, and the multicity of the sources of information. They have underlined that describing mixed-fisheries in the North Sea is not an easy task, as it can be addressed in many different ways and at several scales.

ICES has recently engaged in a similar process of describing the main fisheries in the various ecoregions, summarizing a **vast knowledge** into a short and synthetic overview. Such a description has already been published for the North Sea (ICES, 2017b). The following chapter is thus largely extracted from this ICES overview, combined with elements extracted from other sources including the Discard Atlas (Quirijns and Pastoors, 2014).

2.2.3.1. General Overview

The definition of Greater North Sea is unclear and can vary according to documents. For (ICES, 2017b), The Greater North Sea ecoregion includes the North Sea, English Channel, Skagerrak, and Kattegat (Map 1), although most of the Kattegat stocks are actually assessed together with the Baltic Sea stocks and the Western Channel stocks are assessed together with the Celtic Sea ecoregion. This definition differs from the one used in the EC Mixed fisheries management plan (EC, 2016), the EC discard plan (EU, 2018), and the North Sea Advisory Council area, which includes only the Union waters of ICES zones IIa, IIIa and IV, but not the English Channel (area VIId-e) which belongs to the NorthWestern Waters.

Map 1: The Greater North Sea ecoregion (in yellow) as defined by ICES. The relevant ICES statistical areas are shown

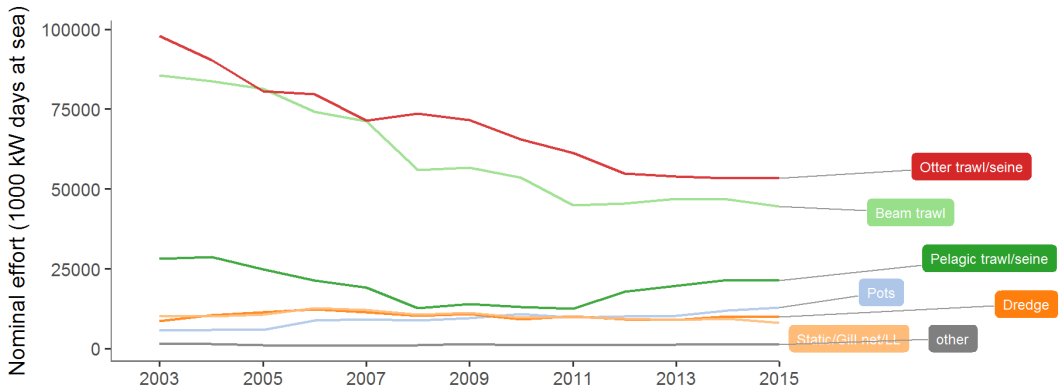


Source:(ICES, 2017b)
Note:ICES uses standard numbering (e.g. 3a, 4b) for area definitions with while most EU legal documents use Roman numbering (e.g. IIIa, IVb)

Around **6600 vessels from nine nations** operate in the Greater North Sea, with the largest numbers coming from UK, Norway, Denmark, the Netherlands, and France. Since 2003, **total fishing effort has declined** (Figure 3). Conversely, **the profitability of many of the commercial fleets has increased in recent years** (STECF, 2017b) due to the improved status of many fish stocks, reduced fleet sizes, lower fuel prices, and more efficient fishing gears.

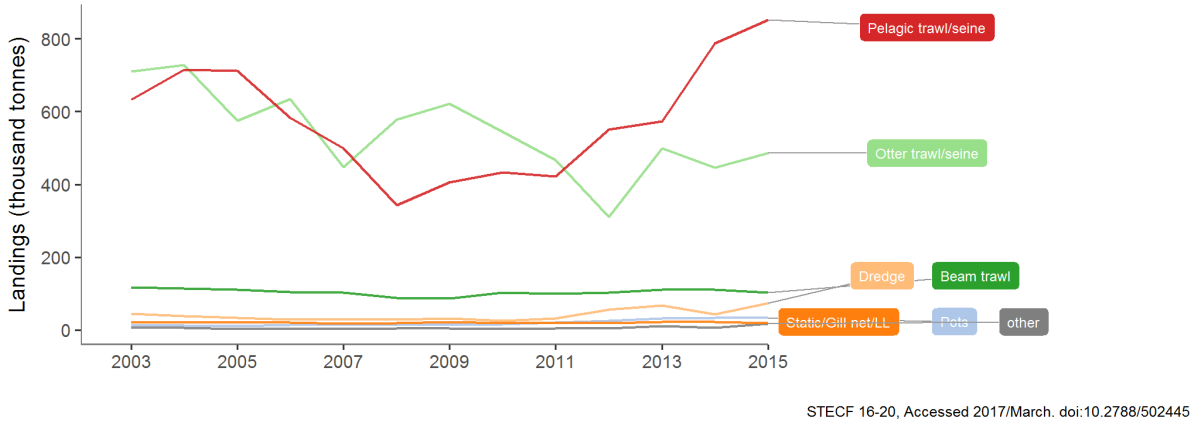
A few countries have important pelagic and industrial fisheries which account for the largest proportion of the total landings (Figure 4); however, these are usually **less mixed** that the demersal fisheries, although bycatch of demersal species occur. These bycatch can create important choke issues, but this is not dealt with in this report which focuses on demersal fisheries.

Figure 3 Greater North Sea fishing effort (thousand kW days at sea) in 2003–2015, by gear type (LL = longlines)



STECF 16-20, Accessed 2017/March. doi:10.2788/502445

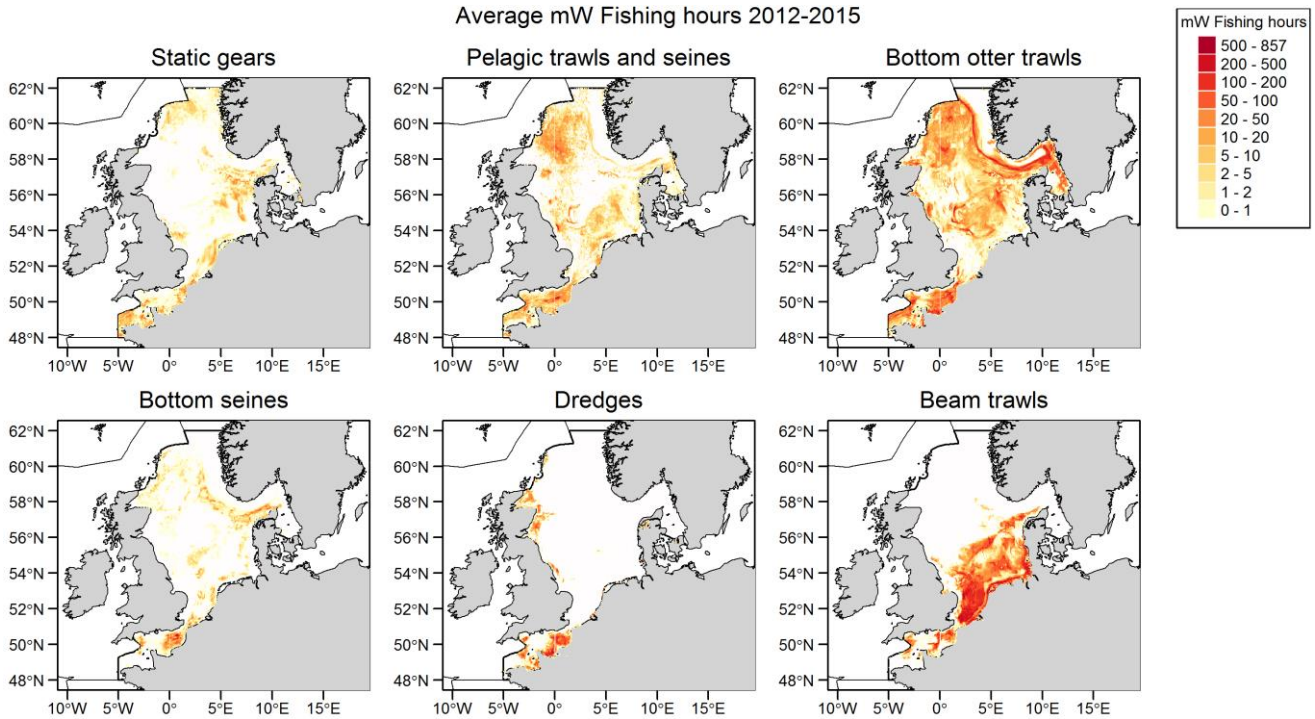
Figure 4 Commercial landings (thousand tonnes) from the Greater North Sea in 2003–2015, by gear type (LL = longline)



Source:(ICES, 2017b).
Note: The categories and data source for figures 3 and 4 are identical, but the colours are ordered by importance and differ thus across the two figures

The fisheries of the North Sea are highly complex. Vessels use a variety of fishing equipment and their catches consist of a mix of different species. **Otter trawl and beam trawls are the main gears used in the region's demersal fisheries, though with regional differences** (Figure 5). There is a dominance of flatfish beam trawl fisheries in the southern North Sea, and a dominance of gadoids and other demersal trawl fisheries in the Northern North Sea. There are also important shellfish fisheries in several areas, with Norway lobster (*Nephrops*) as the most important target species.

Figure 5. Spatial distribution of average annual fishing effort (mW fishing hours) in the Greater North Sea during 2012–2015, by gear type. Fishing effort data are only shown for vessels >12 m having vessel monitoring systems (VMS).



Source:(ICES, 2017b).

2.2.3.2. Description of the main mixed fisheries

This chapter provides a more detailed description of the various types of fisheries in the Greater North Sea, highlighting mixed-fisheries issues in relation with the landing obligation. This chapter combines text directly extracted from both (Quirijns and Pastoors, 2014) and (ICES, 2017b). The main countries involved in the named fisheries are mentioned.

Bottom otter trawl and seine fisheries

Otter trawls are the most common gear types in the Greater North Sea and are used intensively in most parts of the region, including the Skagerrak and the English Channel. Otter trawls typically catch gadoids, other groundfish, plaice, and Nephrops; however, **the species composition of the catch depends on the area and depth fished and the gear design, including codend mesh size.** Bottom seine fisheries operate mainly in the Skagerrak, central North Sea, and in the eastern English Channel, with limited effort in the northern North Sea. Mesh sizes and targeted species are largely similar to the otter trawl fisheries in these areas, and these two gears are thus also often considered and regulated together.

TR1 (mesh size >=100 mm)
In the northern North Sea and the Skagerrak, otter trawls operate primarily with mesh sizes greater than 100 mm. They target primarily roundfish, but **at least three different fisheries operate within this gear category**:

1. A mixed demersal fishery targeting cod and associated species (mainly haddock and whiting in the Western and Northern North Sea, mainly plaice in the South-eastern North Sea) with trawls and seines nets operates over much of the area indicated above. Of particular importance are the areas off Denmark, around Shetland and adjacent to the Norwegian Deeps. The main countries involved are Scotland, Denmark and Germany.

2. A mixed fishery that is characterised by a greater preponderance of 'groundfish' species targeting in particular anglerfish and megrim. The main area of operation for this fishery is along the shelf edge at depths around 200 m and this fishery is particularly important in Scotland.

3. A fishery for saithe, mainly to the far north of the North Sea area especially by French, German and Norwegian vessels.

In recent years, the increasing population of hake is seasonally abundant in the North Sea. Hake is regularly caught in TR1 fisheries, particularly by type 2 and 3. The proportion of Nephrops landings from mesh sizes greater than 100 mm has also recently been increasing.

TR2 (mesh size 70-100 mm)
TR2 gear is more widespread than the TR1 gear and associated mainly with **three fisheries**.

1. The fishery for Norway lobster (*Nephrops*). This species lives on areas of soft clay muds which are distributed patchily throughout the North Sea and Skagerrak. Bycatch limits for fish species apply in the smaller meshed (80-89 mm) *Nephrops* fishery. The bycatch limits do not create undue problems in inshore areas where fish abundance is low. In more northerly offshore areas where fish are more abundant, adhering to the bycatch limits is more challenging. The main nations involved are Scotland, England, Denmark and the Netherlands.

2. A mixed fishery taking place in the more southerly parts of the North Sea and centred on the eastern Channel in which whiting and non-quota species are important constituents. This is predominantly a French fishery.

3. A 90-99 mm mesh mixed demersal fishery centred on the Skagerrak and prosecuted by Denmark and Sweden. In the Skagerrak, also a directed *Nephrops* fishery with sorting grid (70-89 mm mesh size) is prosecuted by Swedish vessels.

Beam trawl fisheries

Two main beam-trawl categories operate in the North Sea, primarily in the shallow parts of the southern and central North Sea, with particularly intense activity off the southeast coast of England. Additionally, many small beam trawlers (< 24 m) target brown shrimp in the southern North Sea and coastal areas using a 20–25 mm codend mesh size.

BT1 (mesh size >120 mm)
The larger meshed BT1 beam-trawl gear is principally used in the plaice fishery of the Central and Eastern North Sea. Cod is also taken in this fishery. Denmark, Belgium and England mainly carry out this fishery.

BT2 (mesh size between 80 mm and 120 mm)
The BT2 gear (accounting for around 40% of all fishing effort in the North Sea) is mainly used in a fishery located in most Southerly parts of the North Sea and into the Channel. It is operated principally by the Netherlands, Belgium and Germany. The most important species for beam trawlers are sole and plaice in terms of value and volume, respectively and other flatfish (e.g. turbot and brill). Because of the small codend mesh size, this fishery catches significant quantities of fish below minimum sizes are caught, resulting in high discard rates. Part of this beam trawl fleet has changed its fishing practices in the recent years, shifting from conventional beam trawl to electric pulse trawl to reduce fuel costs, seabed impacts, and unwanted catches.

Static gear fisheries (gillnet and longline)

A number of fixed gears are employed in the North Sea, the most important being gill nets and trammel nets.

1. The main gillnet activity (GN1) is from a Danish fishery targeted mainly at cod and plaice. The importance of anglerfish in this fishery has risen in recent years and activity directed at this species has increased by Scottish vessels. Discard rates in gillnet fisheries with larger mesh sizes (>100 mm) are generally low; however, bycatch of marine mammals and seabirds occurs.

2. Trammel net fisheries (GT1) are operated by a number of countries and are particularly important in more coastal waters, for example off the English North Sea and Channel coasts for sole. Catches of plaice and cod are also important particularly in the fishery operated by Denmark.

3. Fairly small scale fisheries using longlines (LL) make catches of cod, hake and ling.

Pelagic trawl and pelagic seine fisheries

Pelagic trawl and seine fisheries operate throughout most parts of the North Sea, except in the eastern portion of the central North Sea. The small-meshed (< 32 mm codend) pelagic trawl fishery is prosecuted mainly by vessels >40 m from Denmark, Norway and targets sandeel, Norway pout, sprat, and blue whiting for reduction purposes. The pelagic trawl fishery for human consumption is operated by refrigerated seawater trawlers (>40 m) and freezer trawlers (>60 m) from the Netherlands, Denmark and Scotland and targets herring, mackerel, and horse mackerel. Some blue whiting is taken by these vessels in the northern North Sea. The pelagic

and industrial fisheries are more specialised typically targeting and catching predominantly one species at a time.

Dredge fisheries using other gears (dregdes, pots etc)

Most countries also have inshore fisheries prosecuted by under 10m vessels using a variety of gears (including pots, dredges etc.) for a variety of fish and shellfish species. Significant dredge fisheries for scallops occur in inshore areas along the east coasts of Scotland and England and throughout the English Channel. Dredges are also used to harvest blue mussels in the nearshore southern and eastern North Sea. These fisheries primarily occur on sand and gravel substrates and are affected by exclusion zones that protect sensitive habitats in some areas. Static gear pot fisheries, mainly for edible crab, lobster, and whelk operate in the inshore areas of several countries bordering the North Sea.

2.2.3.3. Discards

Discard data have been collected for some North Sea fisheries since the mid-1970s. Since 2000, discard data from North Sea commercial fisheries have been collected from various observers programmes implemented under the EU DCF. However, **complete discard data are only available from 2012 onwards**.

A detailed analysis of the North Sea discards data was performed prior to the implementation of the landing obligation (Quirijns and Pastoors, 2014), using STECF FDI data. The conclusions are reported in Table 1.

Table 1. Overview on the discards in different areas and fisheries, average 2010-2012

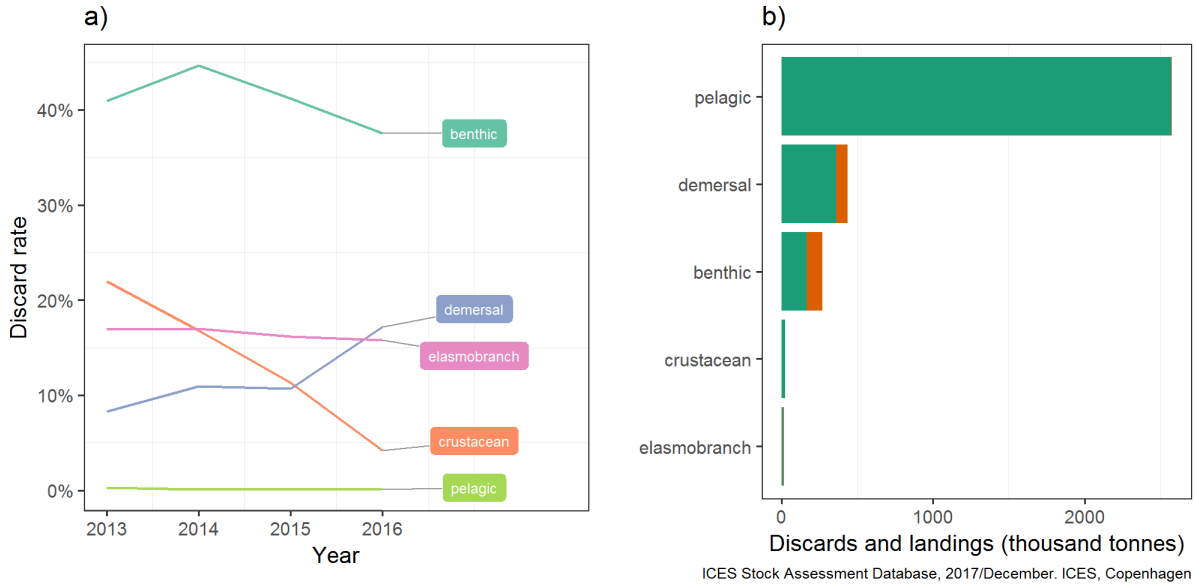
FISHERIES	COMMENTS
North Sea demersal fisheries	On average 40% of the catch in weight was discarded (i.e. discard ratio) in the North Sea between 2010 and 2012 with 78% of the discards coming from plaice and dab. Average discard ratios per species were highly variable, ranging from zero (e.g., megrim, blue ling) to over ninety percent (dab).
North Sea pelagic and industrial fisheries	Discard ratios are generally low for the pelagic fisheries and next to zero for industrial fisheries. However, no specific observer programmes are conducted on the pelagic and industrial fisheries in the North Sea. No information on slipping is available but can be substantial in certain seasons and areas.
Skagerrak demersal fisheries	The average discard ratio in the Skagerrak was 23% for the years 2010-2012. Discard ratios varied between species from very low percentages (i.e. anglerfish and turbot) to almost ninety percent (whiting). New gear regulations were introduced in national legislation 2013 by Denmark and Sweden, which can be expected to reduce the discard ratios in the future.
Skagerrak pelagic and industrial fisheries	Discard estimates are in general uncertain. No observer programmes are conducted on the pelagic and industrial fisheries. Slipping in pelagic fisheries is known and can in some season and areas be substantial.

Eastern Channel demersal fisheries	Whiting, plaice and sole dominate the catches. Between 10-40% of dab, plaice and lemon sole catches are being discarded. For many of the demersal species discard ratios varied by in some cases an order of magnitude between years. The quality of the discard information in the Eastern Channel is generally low.
Easter Channel pelagic fisheries	The main landings for pelagic species are herring and horse mackerel. For these species almost no discard information was available.

Source: (Quirijns and Pastoors, 2014)

Additional considerations on trends are found in (ICES, 2017b) (Figure 6). In 2012–2015, discard rates of demersal and crustacean species remained constant (7–10% and 15–20%, respectively, of the total catch of these species), while **discards of benthic species declined sharply between 2014 and 2015** (40% to 25%). Discard rates of pelagic species were close to zero during 2012–2015.

Figure 6. Left panel (a): Discard rates in 2013–2016 by fish category, shown as percentages (%) of the total annual catch in that category. Right panel (b): Landings (green) and discards (orange) in 2016 by fish category (in thousand tonnes)



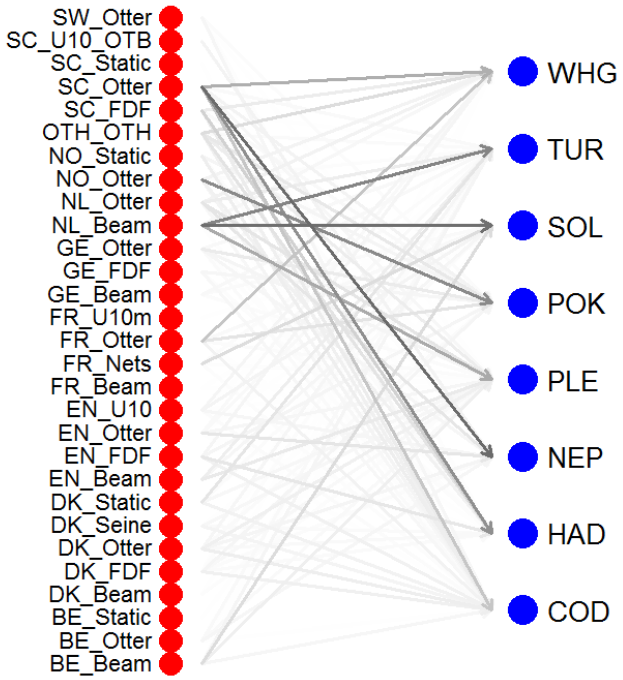
Source:(ICES, 2017b).

2.2.3.4. Summary

North Sea fisheries are **very diverse,** and often **very mixed** (i.e. métiers catch several different species). Vessels **may engage in several métiers** over one year. As the lowest level of vessels aggregation, ICES WGMIXFISH uses a segmentation by country (nine categories), gear type (four categories), vessel length class (four categories), and with additional provision for Fully Documented Fleets. This led to a total number of **42 fleet segments** in 2016 (ICES, 2017a). These fleets engaged in one to five different métiers (different mesh size) and/or areas (including North Sea, Skagerrak or Eastern Channel) each, resulting in **105 combinations of fleet*métier*area** targeting cod, haddock, whiting, saithe, plaice, sole and *Nephrops*, and catching also a great diversity of other **bycatch**. These numerous combinations can naturally be aggregated into **fewer categories** for easing the display and the interpretation of results.

The Figure 7 illustrates this diversity, emphasizing the number of target species caught by each fleet.

Figure 7. Technical interactions in the North Sea demersal fisheries for the main commercial stocks, based on 2014 catches by fleet aggregated over vessel length classes. The colour of arrows is proportional to the share of total catches by species taken by each fleet.



WHG: Whiting; TUR: Turbot; SOL: Sole; POK: Saithe; PLE: Plaice; NEP: Nephrops; HAD: Haddock; COD: Cod.
Source: (Ulrich, 2016), ICES WGMIXFISH data

2.2.4. Species exploited in the Greater North Sea

2.2.4.1. Primary and secondary species

As explained above, **it is difficult to define objectively and quantitatively whether a species is a target species, a by-catch or something in between** (target for some fleets, by-catch for some others). In reality, in the North Sea the main species are also largely those for which **analytical assessments and MSY reference points** usually exist, allowing for a rather straightforward dichotomy that is reflected in the regulations.

The 2013 CFP (European Parliament and Council of the European Union, 2013) Article 15 lists for the North Sea the following **nine species as "*defining the fisheries*"**: cod (*Gadus morhua*), haddock (*melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), saithe (*Pollachius virens*), Norway lobster (*Nephrops norvegicus*); common sole (*Solea solea*), plaice (*Pleuronectes platessa*); hake (*Merluccius merluccius*); Northern prawn (*Pandalus borealis*).

Similarly, the North Sea mixed-fisheries management plan (EC, 2016) refers to "Group 1" stocks including the main six species cod, haddock, plaice, sole, saithe and whiting. The European Parliament proposed to add anglerfish (*Lophius spp.*) and Northern prawn in that

list[4], although the anglerfish does not have any MSY reference point defined yet. "Group 2" comprises all the stocks of Norway lobster in the North Sea.

2.2.4.2. Biology, ecology and stock status

There are many species exploited in the Greater North Sea. **ICES assesses 120 stocks** from 72 species (ICES, 2017b). These species can be categorized according to their biology and ecology. These include:

- **Pelagic species**: species living in the water column away from the ground. In the Greater North Sea, this category includes only small pelagics: herring, mackerel, horse mackerel, sprat, Norway Pout, sardine, blue whiting. These are usually caught in targeted monospecific fisheries, but by-catch of demersal species can occur to some extent

- **Demersal species**: species living close to the ground. This is the largest category, with 23 species assessed by ICES. The most important are cod, haddock, saithe, whiting and sandeel, but a number of other species are also caught, often in mixed-fisheries: grey and red gurnard, ling, pollack etc. Striped red mullet and seabream are caught mainly in the Channel rather the North Sea. Finally a few other stocks defined as demersal in the ICES Greater North Sea overview are less considered into mixed-fisheries interactions: Alfonsinos, Greater silver smet, blue ling, seabass, eel, greater forkbeard, orange roughy, grenadier, tusk

- **Benthic species**: species living in direct contact with the ground. These include many important commercial species such as plaice, sole, anglerfish, megrim and four-spotted megrim, and many other species, some of them considered as important by-catches, such as brill, lemon sole, turbot, witch flounder, dab, flounder.

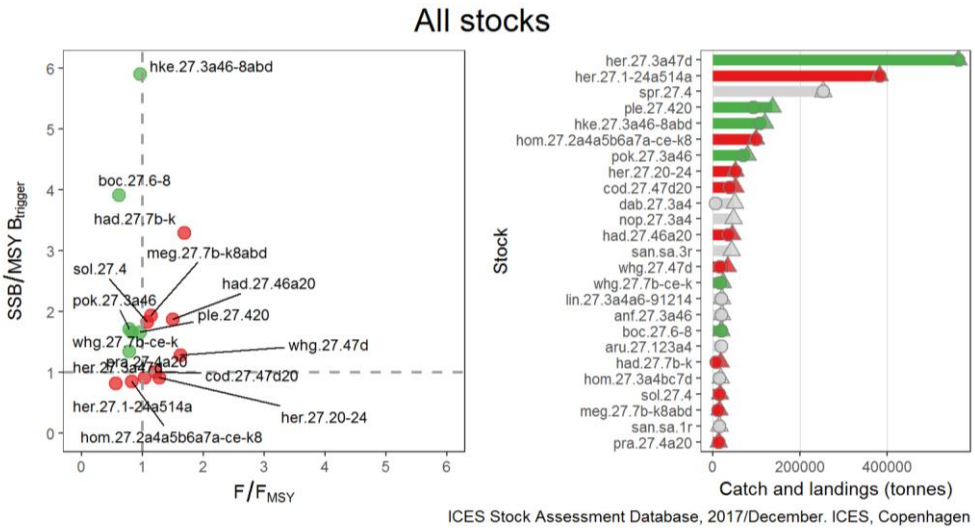
- **Crustaceans species**: In the Greater North Sea, the main species is Norway lobster (*Nephrops*), which is found in several fishing grounds and is thus divided in several populations called "Functional Units" (FU). There are also fisheries for Northern prawn (*Pandalus borealis*) and grey shrimp (*Crangon*). Crustacean fisheries are usually associated with some degrees of bycatch of demersal and benthic fish.

- **Elasmobranchs**. These include a variety of sharks (Angel shark, basking shark, dogfish, spurdog, tope shark, gulper shark, porbeagle) and skates/rays. There are many species of skates and rays, but these are not always well identified in the fisheries data (STECF, 2017d).

The status of many of the assessed stocks is globally improving in the Greater North Sea, with **average fishing mortality getting close to Fmsy, and biomass levels being above threshold levels** (ICES, 2017b; STECF, 2017e) (Figure 8). However, **great variations exist between the individual stocks**, and also from one year to the next. Additionally, it must be kept in mind that this positive development is almost exclusively due to the reductions in fishing effort following the cod plan (EC, 2008b), and not to an increase in the biological productivity in the North Sea since the recruitment of the main fish stocks has remained low.

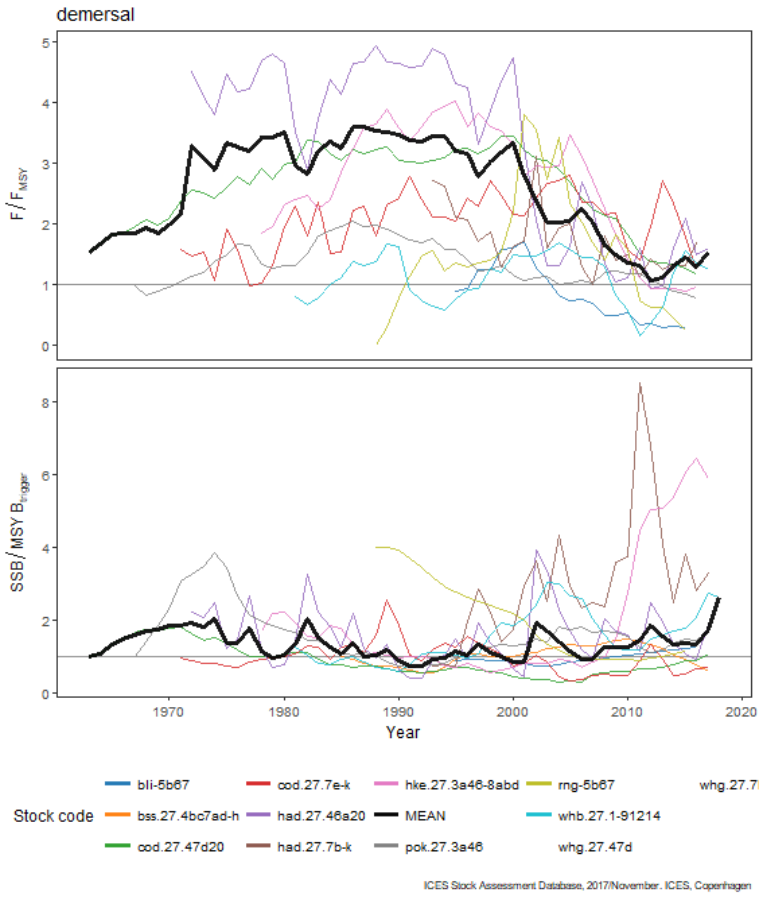
[4] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P8-TA-2017-0357

Figure 8. Status of North Sea stocks relative to the joint distribution of exploitation (F/FMSY) and stock size (SSB/ MSY Btrigger)



Note: [left panels, by individual stocks] and catches (triangles) / landings (circles) from these stocks in 2016 [right panels]**.**The left panels only include stocks for which MSY reference points have been defined (MSY where available). Stocks in green are exploited at or below FMSY while the stock size is also at or above MSY Btrigger. Stocks in red are either exploited above FMSY or the stock size is below MSY Btrigger, or both. Stocks in grey have unknown/undefined status in relation to reference points. For full stock names, see Table A in Annex 1. Note: for clarity, only stocks with catches greater than 10 000 tonnes are shown in the "all stocks" panel.
Source:(ICES, 2017b)**.**

Figure 9. Temporal trends in F/FMSY and SSB/MSY Btrigger for North Sea demersal stocks. Only stocks with defined MSY reference points are considered.



Source:(ICES, 2017b)**.**
Note: Equivalent detailed plots for pelagic, benthic and crustacean stocks are displayed in (ICES, 2017b)

2.3. Conclusions on Objective A

The North Sea demersal fisheries have been **extensively studied** and described in many documents, and there are many data available. The picture is complex, with many different nations, stocks and fisheries. **The recent development of the fisheries is globally positive**, with many stocks showing increased abundance and reduced mortality in the recent years, and fleets becoming increasingly profitable. However, **there are many variations from stock to stock and from year to year, making it difficult to manage mixed-fisheries** adequately. **Discard rates have remained important** in many fisheries.

3. CHOKE SPECIES IN THE NORTH SEA DEMERSAL FISHERIES

This chapter addresses Objective B, requesting that *"using representative fisheries case studies in each region, identify the species acting as choke, describing and assessing the use of all the CFP tools to mitigate the risks of these species choking fisheries; the community and international quota swaps and the productive and commercial strategies; identifying EU underutilized quotas of species acting as choke; and assessing whether traditional swaps help to reduce any deficits between catches and quotas"*.

KEY FINDINGS

- The landing obligation has **triggered** the need to **characterise the various potential choke situations** and **assess the factors** causing them, in order to **identify the most appropriate mitigation strategies**.
- **Different choke categories may apply** to various North Sea stocks, and **different** situations may be experienced **at EU, Member State, Fleet and Individual vessel** levels
- The **most serious risks of choke situations** for the main commercial stocks are estimated to be with **Northern hake in trawl fisheries** and **North Sea plaice in small-meshed beam trawl fisheries**, but for very different reasons. Issues with hake are linked with the **historical relative stability key not being aligned with biological changes** in the ecosystem, not least in relation to **climate change**. Issues with plaice are linked to the **large amount of small plaice** caught in the sole fishery.
- The potential choke effect of bycatch stocks has been less well studied so far.
- The discussion on possible chokes is still **speculative**, as these will **only be actually observed** under conditions of **full enforcement** of the landing obligation. **No such situation have yet been reported by Member States**.

The discussion about choke species in the North Sea is **not new** and the wording was already mentioned in the early days of the mixed-fisheries analyses (Ulrich *et al.*, 2011), but has taken a much wider importance in the last years in the frame of the landing obligation (Fitzpatrick and Nielsen, 2018).

A choke species is a species for which the available quota is exhausted (long) before the quotas are exhausted of (some of) the other species that are caught together in a (mixed) fishery (Zimmermann *et al.*, 2015).

In the North Western Waters, a lot of the most recent analyses and knowledge on choke issues have been centralized in the Choke Mitigation Tool (CMT) analyses[5] initiated by the NWW Advisory Council. In the North Sea, the knowledge situation is slightly different. **Much information is available about choke analyses, but in a rather dispersed form and in different places**. Choke analyses have e.g. been performed by the NSAC, ICES, STECF, but also in numerous publications and reports produced by national fisheries institutes and by large scale research projects like the H2020 project DiscardLess[6]. They typically use a similar approach as the CMT, contrasting total catches (landing + discards) with available quota. We

[5] http://www.nwwac.org/publications/north-western-waters-choke-species-analysis-2016.2448.html
[6] http://www.discardless.eu

summarise here the findings from several analyses operating at different scales, and assess whether they provide similar perceptions regarding potential choke issues.

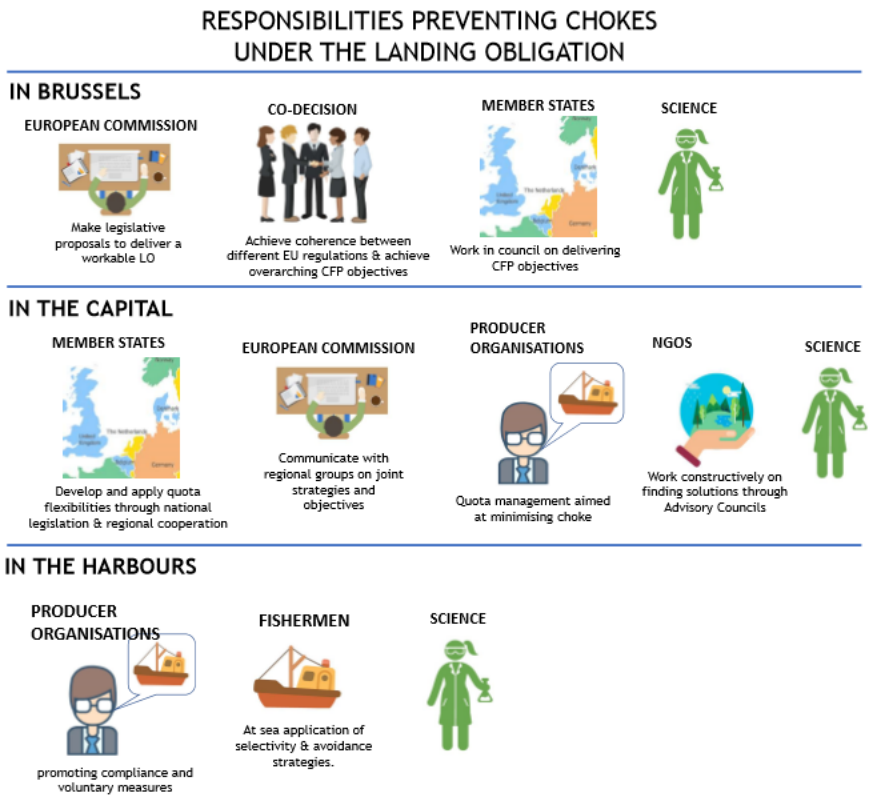
3.1. Levels of choke issues

An important milestone in the understanding of the problem has been **the need to identify the various types of possible choke situations**, and to **characterise their causes and responsibility**. It has been recognized that choke issues can potentially occur at various levels, depending whether the shortage of quota is due to a poor status of a stock or a poor distribution of fishing rights. The Advisory Councils (NSAC, 2017a) has developed a system for categorizing choke problems as follows:

- **Category 1**: Sufficient quota at Member State level—choke is due to distribution within the Member State such that a region, a fleet segment or an individual vessel does not have enough but this can be resolved by the Member State itself.
- **Category 2**: Sufficient quota at EU level, but insufficient quota at MS level—choke is due to a mis-match of catches and the distribution of quotas between Member States and can theoretically be resolved between themselves in a regional context.
- **Category 3**: Insufficient quota at EU level—choke is due to insufficient quota within the relevant sea basin to cover present catches or catch levels that can be realistically reduced, resulting in a total stop of fishing for a Member State or Member States.
- **Category 4**: Economic choking may occur at the vessel level when there is a considerable bycatch of a low value species and the boat is filled with fish that will not deliver a profit.

The (NSAC, 2017a) did also acknowledge that that all parties, from the deck and wheelhouse of each fishing vessel, to the Commission, Member States and the co-legislators, the European parliament and the Council, can contribute to prevent choke situations (Figure 10).

Figure 10. Responsibilities preventing choke under the landing obligation



Source:(NSAC, 2017a).

3.2. Initial considerations on quotas prior to landing obligation

During its early considerations on the landing obligation, (STECF, 2014) investigated for which species and stocks each Member State had catches (landings + discards) in 2012 in excess of its initial and final quota (including swaps/banking etc.). **Landings in excess of initial quota** but not of final quota illustrated the **dependency of MS on swaps** to cover their fisheries, while **catches in excess of final quota** illustrated potential risks of choke species at Member State level.

STECF underlined that the analysis presented was not predictive but was intended to flag potential issues to allow stakeholders to consider the tools available to reduce catch rates of these species so as to minimise risk of choking fisheries prematurely under the landing obligation.

For the North Sea countries and stocks in 2012, the main results were as follows

- **Belgium** No particular issues were observed for North Sea stocks; most problems were linked to stocks in NorthWest Waters
- **Germany**
  - Cod catches in IIIa were well in excess of initial and final quota
  - Nephrops catches in IV were well in excess of initial quota although the final quota was able to cover all catches although quota/catches were small
  - Hake catches in IV were well in excess of initial and final quota
- **Denmark**
  - Cod catches in IV and IIIa were in excess of initial quota and final quota
  - Megrim catches in IV were above the initial and final quota although catches were low
  - Hake catches in IV were in excess of initial and final quota and the initial quota is higher than the final quota
  - Haddock catches in IIIa were in excess of the initial and final quota
  - Saithe catches in IV were in excess of initial and final quota
- **France**
  - In many cases catches were broadly in line with initial quota
  - Catches of hake in IV were well in excess of the initial quota but aligned to the final quota
  - Other issues reported by STECF were in Western Waters
- **Great-Britain**
  - In many cases catches were broadly in line with initial quota
  - Catches of haddock in IV were in excess of initial quota but aligned with final quota
  - Catches of hake in IV were well in excess of initial and final quota
  - Catches of saithe in IV were in excess of initial and final quota
  - Other issues reported by STECF were in Western Waters
- **Netherlands**
  - Catches of haddock in IV were in excess of initial quota and broadly in line with final quota
  - Catches of hake in IV were in excess of initial quota
  - Catches of Nephrops in IV were well in excess of initial quota and in excess of final quota
  - Catches of plaice in IV were well in excess of initial and final quota
  - Catches of whiting in IV were well in excess of initial and final quota
- **Sweden**
  - Catches of anglerfish in IV were well in excess of initial and final quota although quota/catches were small
  - Catches of cod in IIIa were in excess of initial and final quota

- Catches of sole in IIIa were in excess of initial quota but broadly in line with final quota

(STECF, 2014) concluded that these preliminary analyses demonstrated that for all Member States and for a number of primary and secondary (by-catch) stocks, catches in 2012 were well in excess of the available quota, and for some stocks, this was the case even after quota swaps and banking and borrowing. That means that while in many cases the landings were aligned with the landings quotas, TACs increases (topups) might not necessarily be sufficient to cover the discards of all Member States.

3.3. Updated considerations on choke species by the North Sea Advisory Council and the Scheveningen Group

In March 2017, the NSAC conducted an updated analysis of this, comparing available quota with 2015 landings and discards data for the main species (NSAC, 2017b). The aim was to **classify the stocks according to the choke categories 1 to 4 above**. The analysis was hampered by concerns on the validity of the discard estimates, but provides a useful overview. The outcomes of this analysis can be summarized in Table 2.

Table 2. Summary of qualitative characterisation of potential choke effects

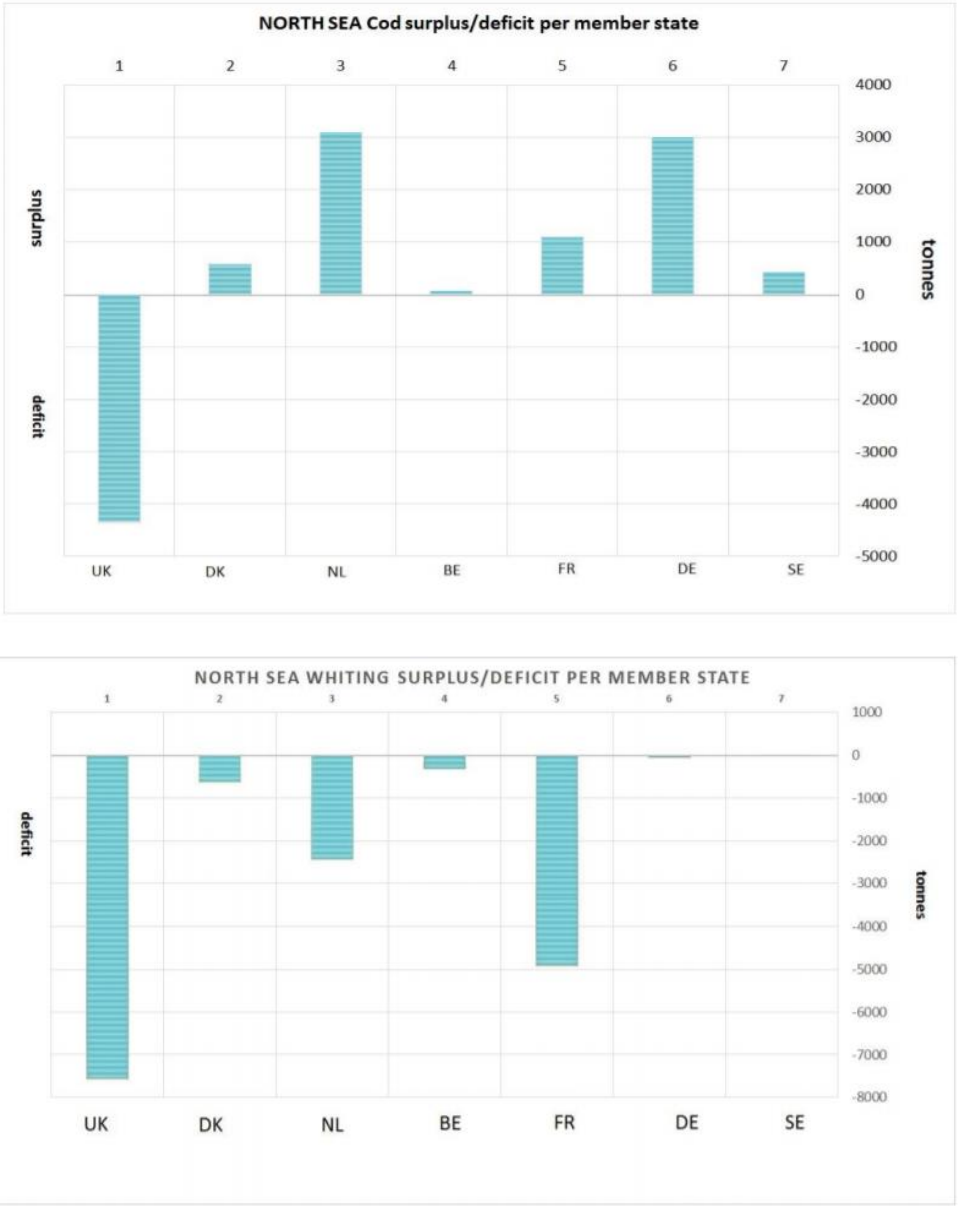
STOCK / AREA	CHOKE CATEGORY	MAIN COUNTRIES /FLEET AFFECTED	MITIGATION SUGGESTED / COMMENTS
North Sea Cod (cf Figure 11)	2	UK as a whole; Scotland	Enhanced leasing and swapping
North Sea Cod	1	France in TR2	De minimis
Cod in Skagerrak	2	Sweden, Germany	Improved selectivity
Cod in Kattegat	2 or 3	Germany, Sweden, Denmark	Improved selectivity. Levels of discards likely underestimated.
Plaice in North Sea	2/4	Netherlands, Belgium in BT2	little success in finding proper mitigation measures yet
Plaice in Kattegat	2	Germany	Choke risk considered low
Plaice in Skagerrak	2	Sweden	
*Saithe in North Sea**	*2*	*Scotland(UK), Denmark, Sweden*	*little success in finding proper mitigation measures yet.*
Whiting in North Sea (cf Figure 11)	3	All	Uncertainty in actual discard rates. little success in finding proper mitigation measures yet

Source:(NSAC, 2017b)

*** Note from the author :** For North Sea saithe, the concerns raised on the basis of the 2015 data do not apply anymore at the time of writing this report. A Significant TAC increase occurred in 2017, after an upward revision of the assessed stock status in 2016[7].

[7] http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/pok.27.3a46.pdf

Figure 11. Quota surplus/deficit per Member State compared to catches in 2015. Top: North Sea cod. Bottom: North Sea whiting



Source:(NSAC, 2017b)

Following this advice emitted by the NSAC, the Scheveningen Group of Member States agreed to postpone to 2019 the phasing-in of the landing obligation for North Sea plaice and Kattegat cod in some fisheries [8]

Northern hake is not considered to be a "species defining the fisheries" in the article 15 of (European Parliament and Council of the European Union, 2013), and is only to be phased-in in 2019. Hake was thus not included in this NSAC study. However, potential issues linked to the recovery of the stock and its expansion in northern waters have long been flagged (Baudron and Fernandes, 2015), and generalized quota shortage for that stock across the North Sea was noted by the NSAC in its following advice (NSAC, 2017a).

[8] https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/publicaties/2017/05/31/joint-recommendation-of-the-scheveningen-group-discard-plan-for-demersal-fisheries-in-the-north-sea/NS+JR+demersal++discard+plan+2018.pdf

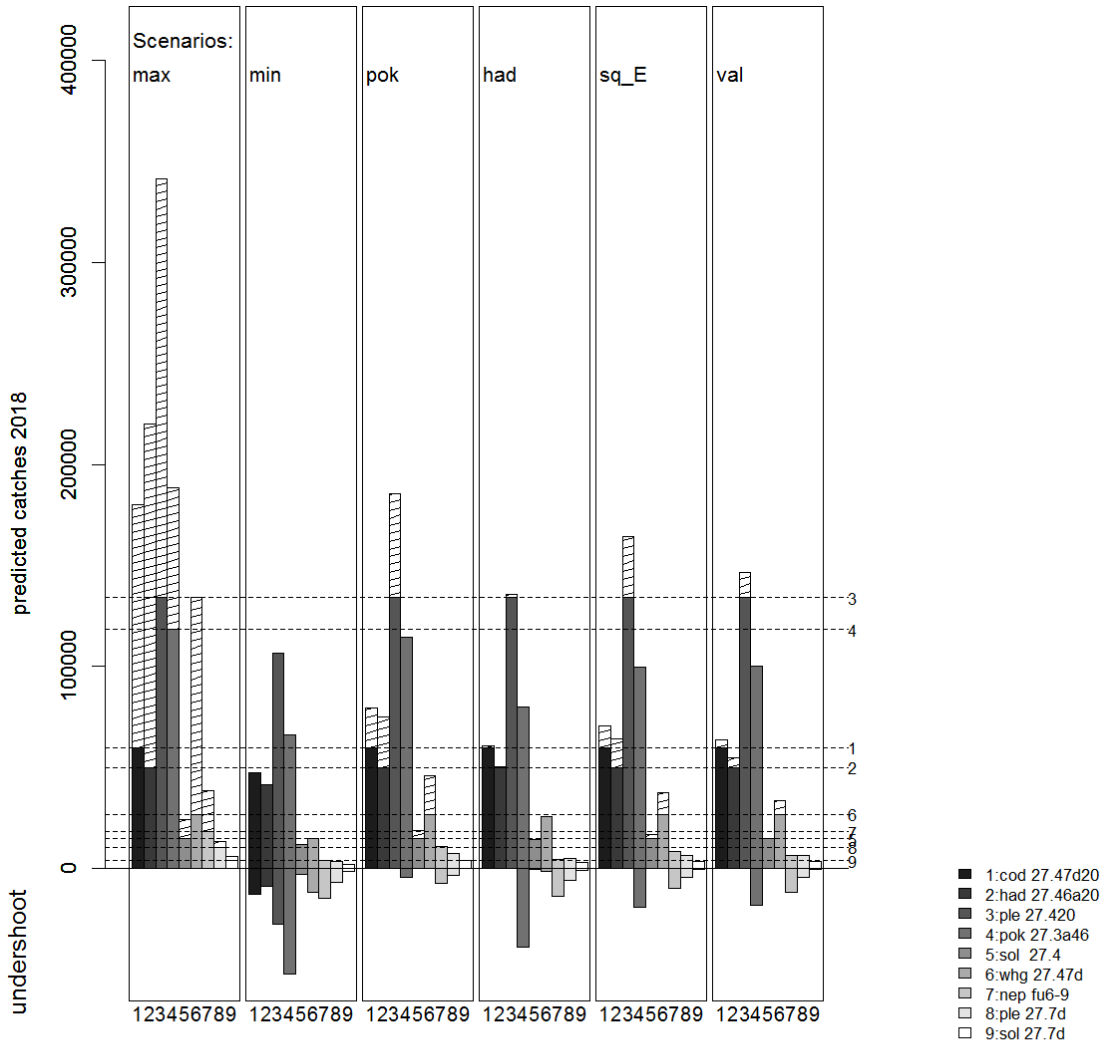
3.4. Scientific analyses identifying choke situations

3.4.1. Regional level: ICES Mixed-fisheries advice

ICES has pioneered the topic of choke analyses long before the landing obligation, having provided **annual mixed-fisheries advice on the risks of constraining TACs** and overquota discards since 2009 (ICES, 2017c). The analyses are performed using the data described in section 2.2.2.3 above, and the FCube methodology developed by (Ulrich *et al.*, 2011). The principle is simple: One estimates the amount of fishing effort by fleet corresponding to the advised fishing opportunities for each stock assuming unchanged catchability. Then discrepancies between stock-specific effort estimates are interpreted as being indicative of risk of choke. This is illustrated in the so-called "Minimum" scenario (Figure 12): For each fleet, fishing effort in following year is simulated to stop when the most limiting of the stock shares of that fleet would be been caught up. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks. This scenario corresponds to assuming a strictly implemented discard ban without flexible mechanisms.

From **2009 to 2015, the ICES mixed-fisheries choke analyses were strongly driven by North Sea cod**, which clearly had a very restrictive quota and relatively high catchability, being caught by most demersal fleets. However, the cod stock has increased over the last few years, and the TAC as well. Over the last three years, **fishing opportunities for North Sea whiting and haddock have then been estimated to be more constraining** than for cod for a number of fleets. For example, for the 2018 advice (ICES, 2017c), ICES estimated that whiting fishing opportunities may limit 24 out of 42 fleet segments.

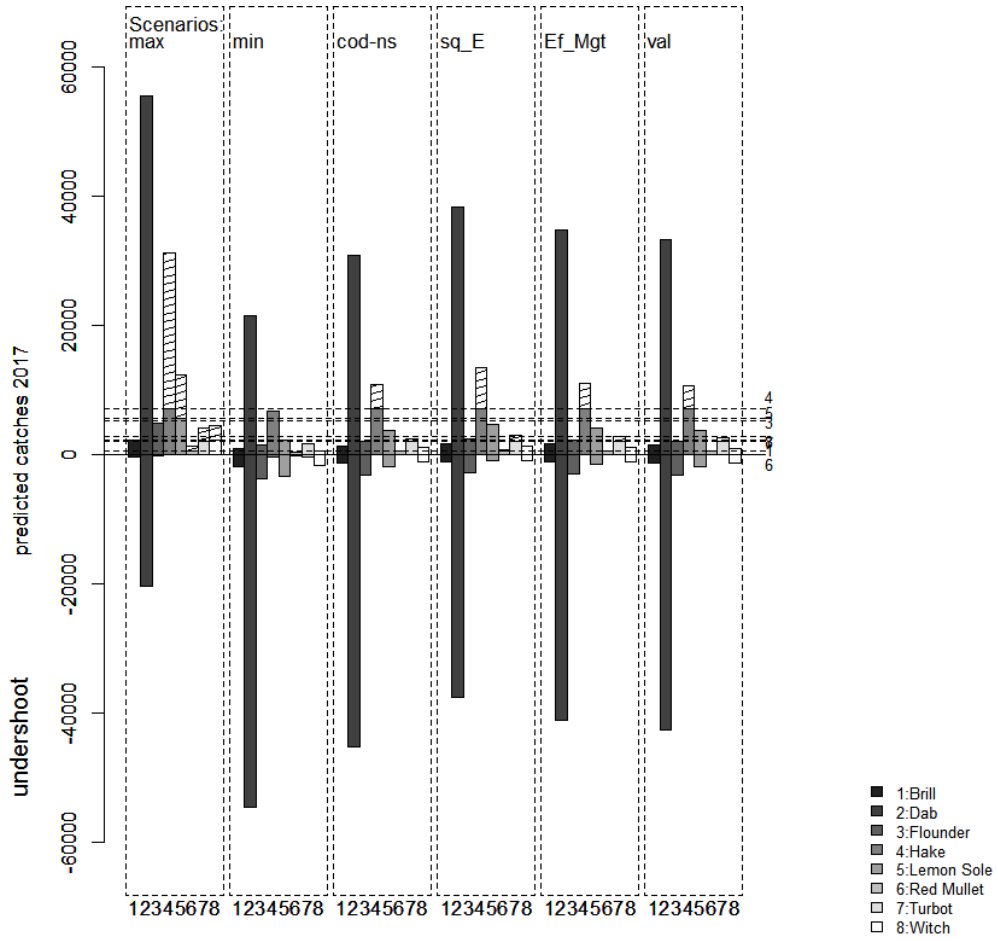
Figure 12. North Sea mixed-fisheries projections. Estimates of potential catches (in tonnes) by stock and by scenario.



Note: Horizontal lines correspond to the single-stock catch advice for 2018. Bars below the value of zero show undershoot (compared to single-stock advice) where catches are predicted to be lower when applying the scenario. Hatched columns represent catches that overshoot the single-stock advice
Source:(ICES, 2017c)

Because of the concerns on hake, (ICES, 2016) had also analysed the impact of mixed fisheries scenarios on eight secondary North Sea stocks; brill, dab, flounder, hake, lemon sole, red mullet, turbot and witch flounder (Figure 13). All TACs of these stocks except the North Sea component of the hake TAC and turbot were predicted to be underutilized under assumption of status quo effort, while hake quota was predicted to be fully utilised under the 'min' scenario, and overutilised in all other scenarios, highlighting its potential as a 'choke' species for the fisheries.

Figure 13. Estimates of potential catch by secondary stock after applying Fcube scenarios.



Note: Horizontal lines correspond to the single-stock catch advice. Bars below the value of zero show the scale of undershoot (compared to the single species catch advice) in cases where catches are predicted to be lower when applying the scenario.
Source:(ICES, 2016)

Until now, little guidance or request has been provided to ICES on specific issues or particular choke scenarios to be investigated, and the mixed-fisheries advice has mainly been driven by the exploratory investigations of the scientific modelers. As such, the analyses are for now only performed at the stock and fleet level, not at the Member State, contributing thus to information on choke categories 1 and 3 but not 2. Similarly, no analyses of CFP tools or alternative quota swaps have been performed. But discussions are currently ongoing with EU Commission to include additional considerations at Member State level in 2018, which may provide new policy insights.

3.4.2. National level: choke analyses at fleet level within a Member State

Beyond the ICES results, similar analyses have been performed to analyse choke issues **within a Member State**, investigating differences in fishing opportunities between fleet segments or POs. We illustrate here the results of two of these analyses, one in UK and one in Denmark.

3.4.2.1. UK

The results below are extracted from (Russell *et al.*, 2017) from the UK institute SEAFISH. 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 quota movement studied are either a **redistribution of the unused quota** available in the UK (simulation S1) or a **fixed allocation of previous levels of EU quota swaps** (simulation S2).

The results (Table 3) highlight some points of concerns for the Scottish fleets that dependent of the North Sea stocks (Area 4). While the internal redistribution of unused UK quota can help for some stocks (e.g. haddock), it appears clearly that the Scottish fleet, and in particular the whitefish trawl fleet is **dependent of EU swaps** for hake because of the low UK share.

Table 3. North Sea UK fisheries: 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 when 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
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	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

Source: (Russell *et al.*, 2017)**,** as summarized in H2020 DiscardLess 2nd Periodic Technical Report (unpublished)

Incidentally, the SEAFISH model also show important choke effects in 2018 because of the predicted constraining effect of saithe TAC. The SEAFISH model is parameterized on 2015 data. However, as noted above in the footnote of Table 2, the ICES saithe assessment has been benchmarked in 2016, leading to a large increase in TAC in 2017. As such, saithe is no longer considered to be a potential choke stock (ICES, 2017c)

3.4.2.2. Denmark

Two bioeconomic impact assessments have been performed, one for the short-term (Andersen and Ståhl, 2016) and one for the long-term (Hoff and Frost, 2017) consequences of the landing obligation for the Danish demersal fisheries. The short-term economic impacts of the landing obligation are calculated as changes between a full landing obligation implementation against a baseline without a landing obligation in 2013, without changes in fishing patterns. Several scenarios are analysed, investigating the effects of various CFP tools (quota uplift, changes in MCRS). The long-term analysis investigate the consequences of additional factors, including the effect of Individual Transferable Quotas (ITQ – in the form of Vessel Quota Share).

A key finding of both analyses is that **Danish demersal fleets seem on average little affected by the landing obligation** if adequate top ups are provided. In the short-term scenarios (Andersen and Ståhl, 2016), the economic impact is almost neutral in these scenarios, or can even be a positive effect if MCRS for *Nephrops* is reduced (as it has happened in 2016). In the long-term scenarios (Hoff and Frost, 2017), the potential positive effects of the quota uplift are even larger (up to 5% increase in revenue) if a small de-minimis is allowed and when the vessels optimize their revenue by leasing extra quota, thus increasing the global quota uptake of the country.

Differences between fleets occur though, and small and medium-sized trawlers are more affected than larger vessels, which are more flexible. The situation is also more positive in the North Sea than in the Skagerrak-Kattegat (Area IIIa), where discard rates of cod, Norway lobster and plaice are high. But overall, as it also appeared in the analyses presented in sections 3.2 and 3.3, Denmark seems to have a better balance between its fishing opportunities and its catches in the North Sea (area 4) than many other Member States, and the risks of choke and severe negative economic impact seem limited. This positive situation can to a large extent be explained by the **efficient trading system of individual quotas** where unused quotas can easily be leased out within pools, although a part of the national quota still remain unfished for some species (Miljø- og Fødevareministeriet, 2016).

3.4.3. Individual level: effects of limiting quota on the daily fishing choices

The previous analyses have demonstrated how standard data and models can be used to predict the potential risk of chokes at the "broad brush" scale of a sea basin or a Member State. However, **understanding these mechanisms at the scale of the individual fisherman is a much more complex issue**. Skippers plan their daily tactics taking into account a large number of factors, including, but not only, their personal access to fishing quota. However the knowledge and data to perform analyses at that very fine spatio-temporal scale are largely missing. **So the understanding of the actual mechanisms by which a limiting TAC constrains the daily choices of a skipper remains largely speculative**. Some scientific models have tried to conceptualize these individual choke avoidance mechanisms. For example, (Batsleer *et al.*, 2013) modelled that fishers may reallocate their effort to areas and weeks in which the choke species (cod in Eastern Channel in their case) catches are low, at the expense of lower revenue, provided that the landing obligation is fully and coercively enforced. In their model, a high fine (>20 times the sale price) was necessary to create a sufficient economic incentive to change fishing ground.

To understand this more in-depth, (Mortensen *et al.*, 2018) conducted qualitative interviews and quantitative analyses of the perception of choke issues with the owner and the skipper of a single Danish demersal trawl in the North Sea. The analyses were performed between 2013 and 2015 at a time were the TAC for North Sea cod and North Sea saithe were very limiting. This study highlighted that saithe is distributed more patchily than cod, making it more difficult to predict its occurrence and avoid catching it. The fisher had thus to deploy a wide range of daily tactics to cope with its saithe catches, first by leasing additional quota if available and

affordable on the quota market, second by balancing the risks of saithe encounter with the gains of catching other valuable species distributed in the same areas as saithe, and in last resort, by changing target species and fishing areas away from saithe distribution grounds.

While this study provided very interesting insights on the choices made by that single vessel, it also highlighted that its findings could likely not be generalized, and that a different skipper owing a different set of individual quota would likely experience different constraints and would deploy other avoidance approaches.

This diversity of individual choke situations was investigated further as part of the H2020 DiscardLess project, where numerous interviews were performed in a lot of different European fisheries (Reid, 2017)[9]. **They highlighted some commonalities, but also some marked differences between fishers regarding their causes of discarding and the mitigation options they thought would work best for them**.

3.5. Conclusions on Objective B

3.5.1. Main choke situations in the North Sea demersal fisheries

Most available analyses of potential choke species issues have dealt with **the main commercial stocks**, and less with the effect of the secondary species that will enter the landing obligation in 2019. Out of the information gathered here, the most important cases appear to be:

- **Northern hake in TR1/TR2 fisheries**, because of its recent expansion in the North Sea where most Member States have only small historical quota shares;
- **North Sea plaice in BT2 fisheries**, because of the very large volume of undersized plaice caught in the sole targeted fishery;
- **North Sea whiting and Kattegat cod** in all fisheries, because of their high discards rates.

Noticeably, **the two first choke cases are linked to stocks that are in a very good state,** with high biomass levels and fishing mortality at Fmsy. **For these two cases, choke issues are thus not of biological nature.** But the issues for these two stocks are also diametrically different. For plaice, the problem is technical and economic; for hake, the problem is political, linked to **the historical relative stability key being no more aligned with the spatial distribution of fish stocks in relation to climate change**.

These two issues are **unlikely to be resolved by 2019**, and alternative political solutions are required as discussed more in depth in chapter 5 (Objective D). For whiting (and also haddock in that category), the issue is more traditionally linked to the annual fluctuations of stocks and recruitment, and may more likely be addressed by the established policy tools in the frame of Article 15 and of the mixed-fisheries management plan, discussed in Chapter 4 (Objective C). Other potential choke situations have been identified, but with less dramatic expected impact and affecting a limited number of Member States. As mentioned earlier, choke analyses performed with data prior to 2016 would likely identify saithe as a potential choke stock, but this can be considered as an outdated problem after the upwards revision of the stock assessment in 2016.

This summary combining qualitative and quantitative analyses is in line with the general perception of the NSAC, which stated in its latest advice (NSAC, 2017a) that "*the existing*

[9] http://www.discardless.eu/fishermen_story

toolbox is capable of dealing with most potential chokes for those species which are listed in Article 15 (1)(c) of the Basic Regulation. Two important exceptions appear to arise with:

• *Hake, where the stock development has out-stripped historic allocation arrangements, leading to a generalised shortage across the North Sea sea-basin;*

• *Where scientific stock assessments underestimate the size of incoming year classes, causing an imbalance between fishing opportunities and quantities of that species encountered on the fishing grounds.*

In this context, NSAC considers that in the North Sea demersal fisheries, most chokes will be associated with the species not listed in Article 15 and will require more consideration by fisheries managers to enable the effective implementation of the LO."

3.5.2. Expected vs. observed choke situations

This section has provided a fairly complete overview of the current state of knowledge regarding the occurrence of choke situation in the North Sea fisheries.

A fundamental aspect to keep in mind is though **the difference between "expected" and "observed" choke situations**. As of today, the discussion on choke issue still remain largely **speculative** and qualitative, and all the discussion above is about understanding whether, where and how choke situations could possibly impact negatively the fisheries if and when the landing obligation was fully enforced. But in reality, the landing obligation is not fully enforced yet and **no choke situation has been actually observed and reported by any North Sea Member State** as part of their legal obligation to report annually on their progresses and challenges regarding the implementation of the landing obligation (STECF, 2018). The actual extent of the problem remains thus unclear.

4. ASSESSMENT OF THE CFP TOOLS

This section addresses Objective C requesting to "*assess whether the tools in the CFP are technically adequate and sufficient to implement the landing obligation and the reasons why some are being currently underutilized*".

In this section, we review the various policy changes that have occurred since 2015 in the aftermath of the landing obligation. A lot of the considerations in this chapter are extracted from the work by (Borges *et al.*, 2018), including some of key findings highlighted below.

KEY FINDINGS

- The introduction of the landing obligation in the North Sea demersal fisheries has been **phased-in on a stock- and fishery- basis**. The current discard plan includes provisions for **several survival and de-minimis exemptions**.
- The landing obligation has also induced **several policy changes beyond those initially foreseen in the regulation**, in order to facilitate its implementation. This includes **TAC removals, reductions in minimum landing size and changes in prohibited species** among others.
- **No major implementation issues have yet been reported** by Member States**,** indicating that these **CFP tools have until now been sufficient to allow the fisheries to continue** operating under the landing obligation**.**
- However, **the LO has so far had no significant impact on the way fishing is conducted**, and the **LO objective of reducing unwanted catches has not yet been met**. By providing more flexibility, **the policy changes may thus have also reduced the incentives** to improve selectivity.
- It is suggested to **catalyse better management actions** in the form of a top-down process whereby **failure to effectively implement at least some measures incentivising discard reduction** would **preclude** MS from being able to **apply for the use of other policy tools**. This process could also link measures applied to discard reduction targets as currently **there is no obligation on MS to demonstrate such reductions**
- The few most difficult cases have not been phased-in yet, and **it remains uncertain whether the CFP tools will be adequate and sufficient** to deal with the landing obligation **in 2019**.

4.1. CFP Tools currently implemented in the North Sea Discard plan

The Scheveningen Group in collaboration with the NSAC has implemented a gradual implementation by stock and fishery of the landing obligation in the North Sea (Table 4), where the simplest cases were implemented earliest.

Table 4. Gradual phasing-in of the landing obligation in the North Sea demersal fisheries

Fishery	Cod	Haddock	Saithe	Whiting	N. lobster	Sole	Plaice	N. prawn	Hake
TR1	2017	2016	2016 /2018	2017	2017	2017	2016	2016	2019
TR2	2018	2016	2018	2018	2016	2016	2019	2016	2019
GN/GT	2017	2017	2018	2017	2017	2016	2019	2016	2019
LL	2017	2017	2018	2017	2017	2017	2019	2016	2016
BT1	2018	2017	2018	2017	2017	2017	2017	2016	2019
BT2	2018	2017	2018	2018	2017	2016	2019	2016	2019
TRAPS	2018	2017	2018	2017	2016	2017	2019	2016	2019
Trawl 32-69 mm	2018	2017	2018	2017	2017	2017	2019	2016	2019

Note: Cod in Kattegat in TR2 fisheries is only phased in in 2019. For saithe in TR1 fishery, only vessels which on average have landed more than 50% saithe over the years 2012-2014 have been phased-in in 2016. The rest is phased-in 2018.

Several important stocks and fisheries were phased in in 2017. However, data for that year were not yet available at the time of writing this study, neither from ICES nor STECF, and it is thus not yet possible to assess whether some discards reduction have taken place or not. ICES assessments for North Sea stocks including discard ratios for 2017 will be published end of June 2018. STECF FDI data will be compiled and published during the second half of the year.

The current North Sea Discard Plan (EU, 2018) applicable for 2018 includes provisions for the nine species defining the fisheries, albeit not in all fisheries yet

Table 5. Species for which the landing obligation applies in 2018.

Fishing gear [10]	Mesh size	Species subject to the landing obligation
Trawls: OTB, OTT, OT, PTB, PT, TBN, TBS, OTM, PTM, TMS, TM, TX, SDN, SSC, SPR, TB, SX, SV	≥ 100 mm (TR1)	All catches of cod, common sole, haddock, plaice, saithe, Northern prawn, and Norway lobster and whiting.
Trawls: OTB, OTT, OT, PTB, PT, TBN, TBS, OTM, PTM, TMS, TM, TX, SDN, SSC, SPR, TB, SX, SV	70-99 mm (TR2)	All catches of cod (3), common sole, haddock, saithe, Northern prawn, and Norway lobster and whiting.
Trawls: OTB, OTT, OT, PTB, PT, TBN, TBS, OTM, PTM, TMS, TM, TX, SDN, SSC, SPR, TB, SX, SV	32-69 mm	All catches of cod, common sole, haddock, plaice, saithe, Northern prawn, and Norway lobster and whiting.
Beam trawls: TBB	≥ 120 mm (BT1)	All catches of cod, common sole, haddock, plaice, saithe, Northern prawn, and Norway lobster and whiting.

[10] Gear codes used in this Regulation are as defined by the Food and Agriculture Organisation of the United Nations and can be found at http://www.fao.org/3/a-bt986e.pdf. Mesh size categories are described in section 2.2.1.

Beam trawls: TBB	80-119 mm (BT2)	All catches of cod, common sole, haddock, saithe, Northern prawn, and Norway lobster and whiting.
Gillnets, trammel nets and entangling nets:GN, GNS, GND, GNC, GTN, GTR, GEN, GNF		All catches of cod (3), common sole, haddock, saithe, Northern prawn, and Norway lobster and whiting.
Hooks and lines:LLS, LLD, LL, LTL, LX, LHP, LHM		All catches of cod, common sole, haddock, hake, plaice, saithe, Northern prawn, and Norway lobster and whiting.
Traps:FPO, FIX, FYK, FPN		All catches of cod, common sole, haddock, plaice, saithe, Northern prawn, and Norway lobster and whiting.

Source:(EU, 2018)

A number of exemptions are also defined, as shortly reported below

4.1.1. High survivability exemptions

4.1.1.1. Norway lobster

The survivability exemption apply to the following catches of Norway lobster:

- catches with pots (FPO (8));
- catches in ICES Division IIIa with bottom trawls (OTB, TBN) with a mesh size of at least 70 mm equipped with a species selective grid with bar spacing of maximum 35 mm;
- catches in ICES Division IIIa with bottom trawls (OTB, TBN) with a mesh size of at least 90 mm equipped with a seltra panel;
- in winter months (October to March), catches in the functional units Farn Deeps (FU6), Firth of Forth (FU8) and Moray Firth (FU9) with bottom trawls (OTB, TBN) with a mesh size of at least 80 mm equipped with a netgrid selectivity device.

4.1.1.2. Common sole

The survivability exemption applies to TR2 catches of common sole below MCRS made within 6 nautical miles of the coast in ICES area IVc and outside identified nursery areas. The exemption only applies to small vessels (<10 metres length, <221 kW engine power), when fishing in waters with a depth of 30 metres or less and with limited tow durations of no more than 1.30 hours.

4.1.1.3. fish by-catch in pots and fyke nets

The survivability exemption applies to catches of cod, haddock, whiting, plaice, sole, hake and saithe with pots and fyke nets (FPO, FYK).

4.1.2. De minimis exemptions

The following de minimis derogations apply

(a) in the fisheries by vessels using trammel nets and gill nets in ICES Division IIIa, ICES Subarea IV and Union waters of ICES Division IIa: a quantity of common sole which shall not exceed 3 % of the total annual catches of that species;

(b) in the fisheries by vessels using beam trawl BT2 with Flemish panel device, in ICES Subarea IV: a quantity of common sole below MCRS, which shall not exceed 6 % of the total annual catches of that species;

(c) in the fisheries by vessels using TR2 in ICES Subarea IV and Union waters of ICES Division IIa: a quantity of Norway lobster below MCRS, which shall not exceed 2 % of the total annual catches of that species;

(d) in the fishery for Norway lobster by vessels using bottom trawls equipped with a species-selective grid with bar spacing of maximum 35 mm in ICES Division IIIa: a combined quantity of common sole, haddock, whiting, cod and saithe below MCRS, which shall not exceed 4 % of the total annual catches of Norway lobster, common sole, haddock, whiting and Northern prawn, cod and saithe;

(e) in the fishery for Northern prawn by vessels using bottom trawls (OTB) with a mesh size equal to or larger than 35 mm equipped with a species selective grid with bar spacing of maximum 19 mm, with unblocked fish outlet, in ICES Division IIIa: a combined quantity of common sole, haddock, whiting, cod, plaice and saithe below MCRS, which shall not exceed 1 % of the total annual catches of Norway lobster, common sole, haddock, whiting, cod, saithe and plaice and Northern prawn;

(f) in the mixed fishery for sole, whiting, plaice and species without catch limits by vessels using bottom trawls (OTB, OTT, SDN, SSC) of mesh size 70-99 mm in ICES Division IVc: a combined quantity of whiting and cod below MCRS, which shall not exceed 6 % of the total annual catches of Norway lobster, haddock, sole, Northern prawn, whiting, plaice, saithe and cod; the maximum amount of cod that may be discarded shall be limited to 2 % of those total annual catches;

(g) in the fisheries by vessels using bottom trawls (OTB, OTT, TBN) with a mesh size of 90-119 mm, equipped with Seltra panel, or with a mesh size of 120 mm and above in ICES Division IIIa: a quantity of whiting below MCRS, up to a maximum of 2 % of the total annual catches of Nephrops, cod, haddock, whiting, saithe, common sole, plaice and hake.

4.1.3. Reduction of minimum sizes:

In the Skagerrak and Kattegat in 2016, *Nephrops* human consumption size was also reduced from 130 mm and 40 mm to 105 mm total and 32 mm carapace length, respectively. A minimum tail length of 59 mm was added in 2017, based on STECF's assessment which states that such tail length corresponds to the existing values for total length and carapace length

4.2. Other policy changes implemented in the North Sea since the beginning of the landing obligation

A study on the other policy tools implemented since the beginning of the phasing in of the landing obligation was performed by (Borges *et al.*, 2018) as part of the EU H2020 DiscardLess project. The chapter below is directly extracted from this document, with additional references where appropriate.

Beyond the discard plan and the exemptions described above **a number of other measures were adapted through 2015 till 2018** with the phased introduction of the landing obligation. These include:

4.2.1. Changes in TACs

TAC increases (also called "TAC top-ups", "quotas uplift" or "TACs adjustments")

Since 2015, catches by fisheries subject to the phased introduction of the LO (with some exemptions) should have been brought to shore and landed. To accommodate the predicted

increase in landed catch from the fisheries subject to the phased introduction of the LO, **the relevant 2015, 2016 and 2017 TACs were increased** in accordance with the estimated catch that formerly would have been discarded (Borges, 2018). According to the European Commission (2017) TAC adjustments are part of the overall package of measures to implement the landing obligation but they should nevertheless not jeopardise the F_{MSY} objective or increase fishing mortality.

According to Borges (2018) however, of the 40, 64 and 88 TACs under the landing obligation between 2015-2017, respectively; around 30%, the majority of which being TACs for demersal stocks, were increased in 2016-2017 to account for the landing obligation, and of these 10 TACs were set already above landings advice before any adjustments were made. Therefore, Borges (2018) concludes that the **landing obligation is likely to have contributed to TAC increases above maximum advised catch in 2016 and particularly in 2017**, and will continue to do so until 2019 when all EU TAC regulated stocks and fisheries in the Atlantic come under the LO.

Additionally, catches of fish below MCRS reported for 2016 and 2017 by most Member States are **extremely low** and do much likely not reflect the true quantities actually being caught (STECF, 2018). So even when set at the level of the scientific advice, **the TAC increases do induce an increase of fishing mortality if the adjustments are used to increase the landing of valuable catch** rather than land the unwanted catch.

TAC removal

Removing TACs from annual TAC regulations so that associated stocks are removed from the landing obligation has been put forward by several stakeholders as a way to deal with problematic stocks, i.e. where discarding are high due to low commercial value and/or where quotas are insufficient to cover catches. In 2017 the EC proposed, and Council agreed to delete the combined TAC for dab and flounder in the North Sea, after that ICES had assessed the sustainability risk of that removal to these two stocks to be low[11]. Several additional TACs removals are currently under discussion.

Prohibited species and zero TACs

The criteria for listing a species as prohibited, i.e. for which discarding remains compulsory, are not very clear, and this can be used to remove problematic species from the landing obligation. In the TAC 2017 regulation (European Union, 2017), picked dogfish (spurdog, *Squalus acanthias*) was as such listed as a prohibited species. (Borges *et al.*, 2018) notes however that listing a species will not necessarily lead to a decrease in mortality, **as it does not incentivise avoidance**. Without a post-release high survival, this measure adds thus little to the sustainability of the stock. The NSAC has expressed similar concerns (NSAC, 2017c), especially if the species has some non-negligible market value. The NSAC requires **more transparent procedures and eligibility criteria** under which a stock can be classified as prohibited or not.

Challenges with these approaches have been analysed in depth and discussed by (STECF, 2017d) about the management options for skates and rays, and also by (STECF, 2018), learning from the knowledge gained with the first avoidance programs launched in UK and Ireland (see further discussion in section 5.1.3).

4.2.2. Multiannual management plans

There has also been indirect effects of the LO in other fisheries management measures. The argument that the reality of mixed fisheries associated with the landing obligation and reaching

[11] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.04.pdf

Maximum Sustainable Levels (MSY) is incompatible has been gaining momentum at European level.

F_{MSY} upper range

The management plans in the reformed CFP have no explicit harvest control rules (HCRs) but include **F_{MSY} ranges** between which fishing opportunities can be set when pre-determined conditions are met (EC, 2016).

The use of the F_{MSY} upper range has been justified to allow for mixed fisheries to adapt to the landing obligation. Managers argued that extra flexibility is needed to cope with the landing obligation and avoid premature fisheries closures, while NGOs defend that the objective of "above MSY levels" enshrined in the CFP is not in line with any F value above F_{MSY} (Borges *et al.*, 2018). The harvest control provisions detailed in the multiannual plans already agreed and proposed, i.e. when F_{MSY} ranges and additional management measures are applicable, are not clear and leave many unanswered questions.

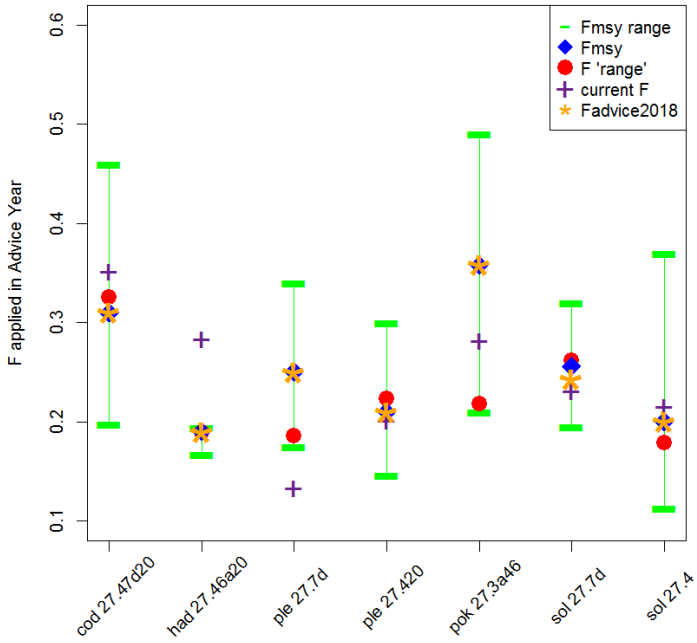
ICES has started investigating how a mixed-fisheries advice using the Fmsy ranges could work in practice, following the work by (Ulrich *et al.*, 2017). In 2017, an experimental **"range scenario"** was presented (ICES, 2017c) that minimizes the potential for TAC mismatches in 2018 within the F_{MSY} range. This scenario returns a fishing mortality by stock (

Figure 14) which, if used for setting single-stock fishing opportunities for 2018, may **reduce the gap between the most and the least restrictive TACs**, thus reducing the potential for quota over- and undershoot (

Figure 15). This "range" scenario suggests that the potential for mixed-fisheries mismatch would be lowered with a 2018 TAC in the lower part of the F_{MSY} range for Eastern English Channel plaice and saithe, and in the upper part of the range for cod and North Sea plaice.

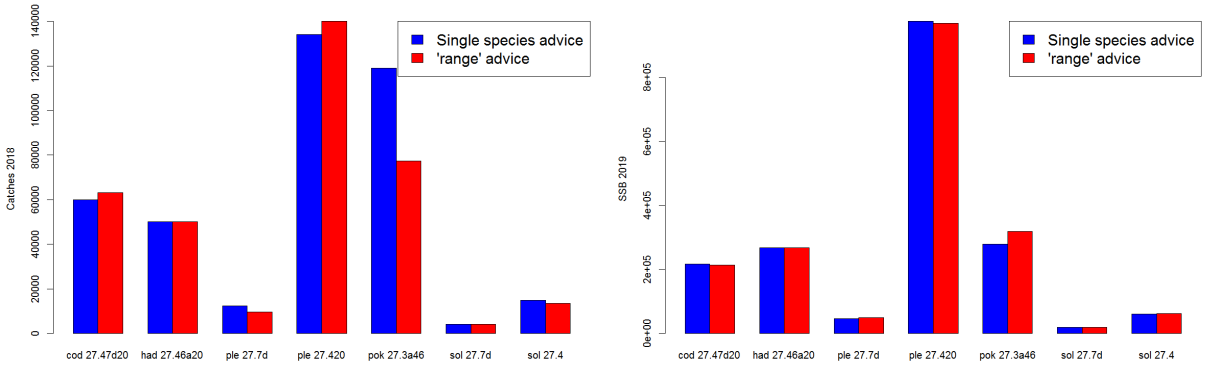
As mentioned above, discussions are now ongoing between the European Commission, ICES and STECF on how to move forward and what additional F_{MSY} ranges scenarios might be explored in the 2018 Mixed-fisheries advice.

Figure 14. North Sea mixed-fisheries 2018 "range" fishing mortality within the F_{MSY} range, compared with F_{MSY}, current F (F in 2016), and F in the single-stock advice for 2018. The "range" F is the one giving the lowest difference in tonnage between the "Max" and and the "Min" scenario across all stocks and fleets.



Source:(ICES, 2017c)

Figure 15. Comparison of the outcomes in terms of total catches in 2018 (left) and SSB in 2019 (right) between the F_{MSY}-based single-stock advice and the Frange-based forecast.



Source:(ICES, 2017c)

Target and bycatch species

The new multiannual management plan for the North Sea (EC, 2016) distinguished between several types of species: a) species that should be managed according to MSY (F_{MSY} by 2020), b) species that may be managed according to the precautionary approach if MSY scientific advice is not available, and c) other species not subject to catch limits to be managed based on the precautionary approach.

De facto, these new provisions establish a difference between target and bycatch species, **and to what level they should be managed under the CFP**. The argument that flexibility is needed from industry and managers is contra-balanced by NGOs that the CFP MSY objective is applicable to all species, regardless is they are commercial or not.

4.3. Conclusions on Objective C

The objective C requested to assess whether the tools in the CFP are technically adequate and sufficient to implement the landing obligation and the reasons why some are being currently underutilized. Answering this question is delicate, and involves also some degree of personal judgement and personal reflections.

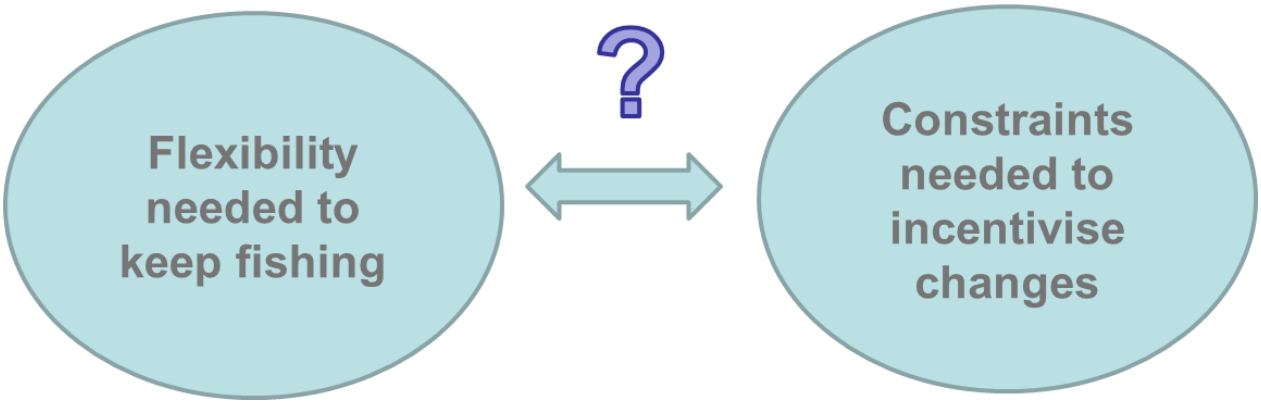
First of all, the landing obligation has certainly triggered major progresses in the awareness of the problems with discards, of the factors causing them, of the data and knowledge available and in the remaining gaps and challenges.

The landing obligation is now reaching an interesting paradox (Figure 16)**.** In the one hand, the review above have demonstrated that **numerous policy changes have been implemented** in the last three years in the aftermath of the landing obligation. These additional policy changes were not originally foreseen in the 2013 CFP (Borges *et al.*, 2018). No major implementation issues have yet been reported by Member States (STECF, 2018), indicating that **these CFP tools have until now been sufficient to allow the fisheries to continue** operating under the landing obligation.

On the other hand, it is obvious that by providing increased flexibility to deal with the landing obligation, **these changes have circumvented the primary objective of the landing obligation of reducing unwanted catch and changing fishing practices**. So the landing obligation has so far had no significant impact to date on the way fishing is conducted. Discarding continues and there is no indication yet that discard rates are reducing.

In that sense, one can consider that the tools in the CFP are so far been technically adequate and sufficient to implement the landing obligation for the fisheries already included; but they have not been technically adequate and sufficient to reduce discards.

Figure 16. The landing obligation dilemma



This paradox calls for reflections on how to proceed further, in order to **avoid watering down the objectives of the landing obligation without jeopardizing the economic viability** of the fisheries. Such discussions have taken place in the frame of the H2020 Project DiscardLess

(Fitzpatrick and Nielsen, 2018; Fitzpatrick *et al.*, 2018)[12]. A major policy challenge now is to **catalyse action** at the management level. These authors suggest that such a change could take the form of a **top-down process whereby failure to effectively implement at least some measures incentivizing discard reduction would preclude MS from being able to apply for the use of other policy tools** such as the removal of choke problem stocks from the TAC system. This process could also link measures applied to **establishing discard reduction targets** as currently there is no obligation on MS to demonstrate such reductions but merely to document what measures have been applied (STECF, 2018). In the same way, some NGOs have proposed specific cases where industry should only receive supports if they have implemented effective selectivity measures. A more general application of this approach could **incentivize progress while reducing industry fears** regarding bankruptcies,

To incentivize actual discards reductions in the fisheries already under the landing obligation, it could thus also be considered whether the **continued use of the current CFP tools already implemented** could be made **conditional on demonstrated evidence of changes in behavior towards more selective practices** and **increased volumes of unwanted catches brought to land and recorded**; failure to demonstrate this could trigger the abandoning of the CFP tool and the returning to the previous situation.

A second reflection is whether the current CFP tools can be considered to be technically adequate and sufficient for the most difficult cases described in Chapter 3 to be phased-in in 2019. This issue is the topic of the next chapter (Objective D).

[12] Unpublished at the time of writing.

5. FUTURE SCENARIOS IN 2019 AND AFTER

The Objective D requested *"considering future scenarios after 2019 following full implementation of the landing obligation and the future of the EU with 27 Members States or any other likely scenario (i.e. Climate change), make predictions about the impact of the problems both biological, economic and social and the efficiency / sufficiency of EU actions and instruments to mitigate effects of the landing obligation. Identify alternative solutions: (e.g. redistribution of quotas underused; adjustments to the TAC and quota system; or any other viable solutions)"*

KEY FINDINGS

- **Alternative policy options** could be considered to address the most difficult potential choke situations, provided that they also incentivise some changes in fishing practices.
- **Stable political solutions** should be sought to address the **recurring issue of climate-related changes in fish distribution** on a more permanent and long-term oriented basis.
- **no simple single management option seem to offer an adequate balance between exploitation and conservation** in the case of sensitive valuable bycatch like sharks and rays
- **Fully Documented Fisheries with Remote Electronic Monitoring** together with a **smarter use of TAC top-ups** can be the fundament of a **results-based management system focusing on impact and controllability**, where fishers are fully accountable of their catch.

At the time of writing this report, perspectives for 2019 for the North Sea demersal fisheries and beyond remain unclear. Concerning the future of EU with 27 Members States ("Brexit"), the decision taken in March 2018 to implement a 21 months transition period where EU law would still apply to UK fisheries has delayed the most difficult decisions, so the need for new institutional arrangements will not coincide with the end of the implementation period for the landing obligation. Whatsoever, it is obvious that the landing obligation can be a non-negligible aspect of the future relationships between UK and EU in terms of fisheries management. On the one hand, the landing obligation has been pushed in the CFP following strong public pressure primarily in UK, and it remains therefore unknown to which extent the commitment to ban discarding might be reduced in an EU without UK. On the other hand, a fully enforced and controlled landing obligation in UK waters would certainly significantly impact fisheries management in EU, as has long been the case in the Norwegian waters with regards to e.g. mesh size control. Either way, at this stage the situation is still too unclear and complex to be addressed in this present report, and we refer to other studies discussing the Brexit challenges more in depth cf. e.g. (European Parliament, 2017).

Without making predictions as such, in this part I further discuss some of the most important unresolved challenges described in Chapters 3 and 4. A disclaimer regarding this chapter is that it was written up in April 2018, a few weeks before the submission and evaluation of regional Joint Recommendations for 2019. It is evident that the issues discussed below are likely very similar to the issues currently faced by Member States regarding the 2019 implementation where all regulated species will be phased-in. The author of this present report has not been involved in the drafting of the North Sea discard plan by the Scheveningen Group, and the considerations given below are thus only personal reflections.

5.1. Specific choke situations

This paragraph discusses a number of specific cases of risks of choke, which cannot be easily approached with the current CFP Tools and would require alternative thinking.

5.1.1. North Sea plaice

Although this is not mentioned in the NSAC general overview (NSAC, 2017a), It has been clearly described in Chapter 3 that one of the most difficult challenges for the North Sea fisheries remains the issue of North Sea plaice in the mixed flatfish beam trawl fishery operated primarily by the Netherlands and Belgium. It is expected that the landing obligation of plaice will be a choke species that in the worst case would stop the BT2 sole fisheries, mainly related to the high costs of landing all catches. The North Sea plaice represents a **different situation that illustrates that discarding and sustainability are different issues not necessarily linked**: Discards represented around 35% of the catches of North Sea plaice in 2016, mainly constituted of small animals below MCRS. The stock has been exploited at Fmsy since 2009 and the biomass has been increasing to levels never observed before. The MSY-based TAC is not limiting the fisheries, with an uptake around 60% in 2016, and total catch representing 64% of the total advised catches[13].

To address this, the Netherlands have engaged in a number of scientific and technical projects in the recent years, but results have so far remained largely unconclusive (NSAC, 2017d). In particular:

- Because of the differences in body shape between plaice and sole, technical options for improved selectivity and enhanced escapement of plaice in the trawl are limited
- There are not many areas and seasons in the sole distribution area where plaice is not found (Rijnsdorp *et al.*, 2006).
- Survival studies so far have not given the expected evidence that plaice survival could be considered sufficiently high (around 16%), and the level is strongly dependent on fishing practices in the water and handling techniques on the deck of vessels.
- The current perspectives for developing new markets for unwanted plaice do not seem financially viable so far.

In reality, these reasoning may also apply to some extent to a lot of other stocks, but the quantities involved and the high abundance of the plaice stock make this case slightly different. As such, this stock has been classified as a **choke situation 4** ("Economic choke") (NSAC, 2017a), as the only one stock in this category. The main threat is thus not of biological nature, but of political and economic.

Additional research projects are still ongoing, including among others survival studies, selectivity trials and fine-scale discards mapping. Given this current state of knowledge, a possible scenario remain though that no viable technical solution is found in 2019, and none of the current CFP tools discussed in Chapter 4 is able to help significantly either. This will create a very difficult situation for the industry and the policy makers, and additional "out-of-the-box" decisions may have to be made, although the "out of the box" considerations listed by (NSAC, 2017a) seem neither fully adequate in this case.

As long as the stock remains in its very good current status with low fishing mortality, high biomass, non-negligible discard survival rates and catches way below the advised levels, biological risks are low and that there are little adverse incentives that could lead to unforeseen and unmonitored mortality. Under specific favorable circumstances such as these other policy arrangements could be imagined, for example some level of flexibility might be considered

[13] http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/ple.27.420.pdf

against e.g. provision for fully documented fisheries and sustained efforts to increase selectivity.

5.1.2. Northern Hake and other distributional issues linked to climate change

In the North Sea, hake will be phased-in in 2019. Hake is an emblematic case of choke level (Baudron and Fernandes, 2015), both at level 2 (with the historical allocation key of the relative stability no more in line with the current geographical distribution of the stock following its recent recovery and its expansion in the North Sea), but also to some extent at level 3, with total landings and catches well above the corresponding advised levels[14]. According to the CMT analyses performed in the North Western Waters, the issue of the hake quota problem appears less severe in the ICES Area VI and VII and hake is considered to be only at moderate choke risk (STECF, 2018).

The knowledge on possible avoidance and selectivity options for hake in the North Sea seems limited. Recent initiatives on the dissemination of gear trial results to fishermen such as the the gear trial factsheets of the H2020 Project DISCARDLESS (www.discardless.eu/selectivity_manual) and the Gearing Up initiative (https://gearingup.eu) include only limited information about hake. The author of this report is not aware of current selectivity programs dealing with this stock. As discussed earlier, the hake issue affects the UK more particularly, so political solutions to this issue will be intrinsically linked to the future impact of Brexit on the Common Fishery Policy.

Beyond the short-term options of continued voluntary swaps between Member States, this stock symbolizes the political difficulties that will be increasingly faced by Member States in the light of climate change. Changes in fish stocks distribution are occurring fast and wide, and ICES has identified distributional changes for 16 out of 21 species analysed[15]. The traditional target species disappear from their historical fishing grounds and become more abundant up north; and new species appear, for which Member States have no historical fishing quotas. The issue of hake has been described here, but similar stories have also happened for e.g. mackerel, cod, boarfish and, more recently, bluefin tuna which has returned into the North European waters. There is no doubt that these problems will not disappear and will rather accelerate, creating unbearable situation for the fishing industry in the frame of the landing obligation. Noticeably, the Brexit makes this situation even more complicated, because the TAC-regulated species become more abundant mainly in the waters around the British Isles. As long as the relative stability is not renegotiated, **stable political solutions should be sought to address this recurring issue on a more permanent and long-term oriented basis** (cf. section 5.2).

5.1.3. Elasmobranchs

Skates, rays and sharks are considered all together, while in reality they represent a variety of issues. Elasmobranchs include a number of species with marked differences in stock status and sensitiveness, and they usually fetch a fair market price making them attractive to be landed and sold once caught.

Skates and rays are currently managed under five regional TACs. Each is a general skate and ray TAC including several species. In 2019, these species will thus come under the landing obligation, which will have large implications.

STECF (STECF, 2017d) convened an Expert Working Group dedicated to the future management of skates and rays, which collated a vast amount of the knowledge available on

[14] http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/hke.27.3a46-8abd.pdf
[15] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.05.pdf

several important aspects including i) improved description of catch distribution across species, areas, seasons and métiers; ii) selectivity and avoidance measures; iii) survival after being caught and release. While a lot of useful information could be synthetized, this work also highlighted numerous knowledge gaps; in particular, it is evident that the knowledge available is often not enough distinguished between the various species.

In terms of discard survival, STECF highlighted the limited number and large variability of estimates of discard survival rates. It also shows that those estimates are not always comparable because of the diversity of approaches and methodologies followed. While **many studies report rather high to very high survival** rates (usually sensibly above 35-40%), **it remains difficult to extrapolate these estimates** across all species and métiers to support requests for exemption from the landing obligation.
In terms of selectivity, STECF noted that measures such as increased codend mesh sizes and square mesh panels are ineffective for skates and rays because their large, flattened body shape prevents escape once inside fishing gears. Conversely, STECF observes that improvements in the selectivity of trawls for skates may be achieved through modifications which utilise the difference in shape and size of skates and behaviour compared with other species in the catch. This includes e.g. grids and By-catch Reduction Devices (BRDs), escape panels and separator trawls. The knowledge here is insufficient and fragmented but preliminary results demonstrate good potential for these modifications to reduce catches of skates and rays.

STECF also analysed a long suite of possible management scenarios for skates and rays including:

- Splitting or lumping TACs across several species
- Landing trips limits
- Spatio-temporal closures
- Listing as prohibited species

A conclusion of this review was however that **no "silver bullet" solution could deliver the right balance between conservation and exploitation** in the frame of the landing obligation, and all options had pros and cons. These results are consistent with the first empirical experiences gained with the pilot avoidance programs for picked dogfish (*Squalus acanthia*, also called spurdog) in the Irish Sea launched by UK and Ireland (STECF, 2018), which demonstrated the challenges in encouraging avoidance while allowing a limited bycatch limit without choking the fishery at the same time.

5.1.4. Other potential risks of choke

As mentioned in Chapter 3, the analysis of potential choke situation has so far mainly focused on main commercial stocks, and little documentation is yet available on the potential risks of secondary species like turbot, brill or lemon sole, which will be phased in in 2019. Cod in Kattegat is also expected to pose serious issues in 2019.
The NSAC (NSAC, 2017a) has listed and discussed in generic terms a "ToolBox" of alternative policy changes that could be potentially used, but without investigating in more details which tool could be preferred in which situation. As was described in the previous chapter on elasmobranchs, all tools have advantages and drawbacks, and none of them can be considered as a unique and simple way forward.

As discussed in Chapter 4, we suggest that any such policy change should be conditional on the demonstrated implementation of some measures incentivizing discard reduction, to trigger changes in selectivity. This is further detailed in the next paragraph.

5.2. Alternative approaches to incentivize discards reduction

In this chapter, we explore a number of pragmatic ideas, which could potentially trigger positive changes in fishing practices and deliver effective discards reductions. These ideas are not out of scope of the current CFP setup, and could realistically and technically be implemented in European fisheries (in particular in the North Sea).

5.2.1. More efficient quota swaps

Improved quotas swaps are repeatedly pointed out as a way to reduce choke situations through better and fairer access to quota, both across and within Member States. However, history has largely proven that **the current system of voluntary bilateral swaps is quite inefficient, non-transparent and cumbersome**, and that there is often little incentives for countries who own a lot of quotas to give away to those who don't (Hoefnagel *et al.*, 2015). This is further reinforced when discarding is banned, and will be even more difficult when UK becomes a third country. The same is observed for the distribution of quotas within Member States (Carpenter and Kleinjans, 2017).

The landing obligation has also evidenced that the current system is flawed, when **most potential choke situations identified in the North Sea are of category 2 (or 1).** i.e. there is enough TAC in the system but it is not taken up because of distributional inequities, which indicates that the swaps are naturally not efficient enough to solve the problem. **The issues are political more than biological. Political will is thus needed to force these swaps in a more efficient manner.** One option would be to enforce stronger mechanisms in the spirit of "use it or lose it", but without undue increases of fishing effort and fishing mortality. Another option would be to a transparent market place for leasing unused quotas at EU level, following what can be seen at national level such as e.g. the Danish quota pools.

5.2.2. Smarter use of TAC adjustments ('top-ups')

For the stocks included in the landing obligation, the TAC is now given as a Catch TAC, intented to cover landings of both the wanted and the unwanted (previously discarded) catch. No specific provision has been made to use this additional TAC in a given way. It is thus distributed to Member States following the standard Relative Stability key and, within a Member State, following the standard procedures for national quota distribution. **As such, this approach fails completely in addressing the main cause of choke situation, for the choke categories 1 and 2,** because **it distributes the additional quota to those who proportionally have the largest share of it in the first place.**

It is urgent to recognize that **these TAC adjustments should not be treated as a standard landing TAC,** but could be used in a **much smarter way to incentivize discard reduction**. There are different ways by which this could be done, and we here only suggest a few ideas, which could be further developed if there is interest for.

Top-ups could be allocated proportionally to discards estimates rather than landings key. This option is mentioned but is probably not politically acceptable, as it would be perceived as a reward for those with worse discard patterns, and would also be perceived as a distortion of the relative stability.

More interestingly, top-ups could be **kept as a buffer to cover the discarding which is by default expected to continue**, and could be used for landings only against demonstrated evidence that the discards are less than assumed. The top-ups would not be distributed blindly to Member States and/or POs or individual vessels but would for example remain in a pool centrally administrated, considered to cover the assumed discards. Ultimately, if a MS, a fleet or a fisher would want to use their share for landings, they would need to provide reliable catch

records including landings of unwanted catches (below minimum size) and demonstrate that their ratio of unwanted catches is equal or less than the average estimate for that fleet. This practice would thus reward selectivity improvement, catch recording and the bringing to land of unwanted catches.

Ultimately, inspiration could be taken from New Zealand, where overquota landings is allowed but the landing value is not returned to the fisher (the so-called "deemed value"), removing thus some of the most obvious negative incentives (Marchal *et al.*, 2016; Hersoug, 2018).

This smart use of TAC top-up would be a way to transition to an actual results-based management with full accountability, which is further described in the next paragraph.

5.2.3. Control, monitoring and results-based management

This issue is not specific to the North Sea, but is a **generic well-known unresolved issue for the landing obligation**, which is systematically brought in discussions. The need for adequate control and monitoring is discussed in several reports and publications, and is well summarized in the publication by (Catchpole *et al.*, 2017) as follows: "One of the key challenges of the LO is the need for new regulatory and enforcement mechanisms, as the focus of monitoring and control shifts from landing activities to activities at sea. This shift **requires that fishing and discarding practices around the vessel are 100 per cent monitored during fishing** in order to detect what is caught and whether there is discarding. Currently, **traditional methods of monitoring**, which include dockside and fish market checking; the use of aircraft (including drones) to fly over fishing vessels; patrol vessels to carry out inspections at sea; vessel monitoring systems (VMS) using satellite positional data to plot the speed and location of vessels; observers on board vessels to record catches and other scientific data; and self- reported data (E-log, paper logbooks, sale notes, landing declarations), **can meet this need only to a limited extent**".

In recognition of this, increasing attention is being applied to Fully Documented Fisheries (FDF) with remote electronic monitoring (REM, or EM) systems as a means of attaining 100 per cent monitoring of fishing activities (this does not mean that 100% of the videos must actually be reviewed, but that **any haul can potentially be controlled at any time after it took place**). Several successful REM studies have been conducted over the last decade in North Sea countries (Denmark, Scotland, England, Netherlands and Germany), allowing a detailed understanding of the technical and operational aspects of REM systems, and triggering their technological developments in order to **reduce their costs** and **optimize their use and their acceptance** (Mortensen , van Helmond et al., subm.). Results have been largely positive and **REM are seen as the most cost-effective way to improve catch monitoring in the landing obligation** (Plet-Hansen *et al.*, 2017). Going some steps further, FDF is seen as a fundamental pillar of the design of a **results-based management** system where **fishers are fully accountable of their catch** and are incentivized to reduce their unwanted catches through a sensible balance between self-management and control (Ulrich *et al.*, 2015; Mortensen *et al.*, 2017). This system is further described in the document by (Schou, 2018) who suggests to relax REM vessels from most technical rules against the full documentation and monitoring of their catches, including:

- Full quota top-up for REM vessels and reduced or no top-up for non-REM vessels
- Free choice of gear for REM vessels - except for rules related to bottom impact and bycatches of protected species.
- Simplified exemptions for REM vessels. The main point is that catches are recorded and accounted for.

This combined approach is thought to be potentially the most adequate and cost-effective way to implement the objectives of the article 15, **moving the focus away from stringent technical rules** into a more flexible management system focusing on **impact and controllability**, which is the approach successfully tested in the Cod Catch Quota Management (CQM) trials (Mortensen , van Helmond et al., subm.). Quoting (Catchpole *et al.*, 2017), "of course, it could be argued that in such voluntary trials it is hard to disentangle incentives arising from additional quota from those arising from the REM, and it might be the case that the skippers of voluntary vessels are those already most likely to comply and keenest to collaborate with scientists. It is thus difficult to infer how REM would work if it became compulsory for all vessels. However, **experiences in Canada and USA demonstrated that larger discard reductions were achieved after REM became mandatory compared with the initial years when the system was voluntary**. This is because the system became more strictly enforced and included all vessel operators, including the less cooperative ones (McElderry, 2014)."

5.2.4. Prioritizing the objective of reducing discards over the objective of bringing to land

In the same line of thinking, a reflection could be conducted on the actual obligation to bring to land. The obligation to bring to land has an underlying idea that it is easier to monitor and control what is landed than what is discarded at sea. However, numerous scientific investigations have shown that **the actual requirement of bringing to land is among the most disputed elements of the landing obligation**, because of the repeated arguments among others that 1) capacity onboard vessels is limited, 2) bringing to land incurs extra costs by requiring more numerous returns to port and increase burden on crew, 3) most harbors and the value chain cannot logistically and financially deal with the unwanted catch brought to shore and 4) dead discards are probably better left in the ocean for the ecosystem food chain than brought to landfill (Sardà *et al.*, 2013; Veiga *et al.*, 2016; Catchpole *et al.*, 2017; Fitzpatrick *et al.*, 2017).

Additionally, as discussed in the section 5.2.3 above, monitoring at sea is becoming increasingly accessible and cost-effective via the use of electronic monitoring, and is widely used for bycatch monitoring in several world regions including South America and Pacific Islands, not necessarily in combination with an obligation to bring to land.

Building on the elements described in sections 5.2.2 and 5.2.3 above, it might therefore be reconsidered whether the two aspects could be disentangled, what sort of control is indeed most appropriate and achievable (Hedley *et al.*, 2015), and whether **effective discard reductions and selectivity improvements might first be achieved in some fisheries without the requirement to bring unwanted catches to land**. This requirement might still be implemented at a later stage, once the most difficult transition has been achieved.

5.3. Conclusions on Objective D

This chapter has developed some of the issues presented in Objectives B and C. A number of issues appears **fundamentally unresolved**. The CFP Article 15 has been designed to address the most well-known causes of discarding that had been heavily discussed during the reform of the CFP prior to 2013, and personified by the case of North Sea Cod overquota discards. However, some the cases discussed here **cannot be easily addressed** by the existing CFP tools and accompanying policy adjustments discussed in Objective C. These issues require thus considering alternative options that could allow pursuing the CFP objectives of sustainability and discards reduction without jeopardizing the future of the fishing industry. Such options would require efficient management actions that do not simply allow today's practices to continue, but **incentivize changes in a results-oriented approach focusing on impact and controllability**.

In conclusion, the landing obligation as it is now appears like a system that has "neither a stick nor a carrot". An effective implementation of a ban on discarding requires high levels of at-sea monitoring and effective control, and/or strong incentives to fish more selectively, neither of which currently apply.

To improve this situation, it is necessary to consider both the need for flexibility and policy adjustments in order allow fisheries to continue operating under the landing obligation, and the need to incentivize selectivity improvements. We suggest that any future policy change should be granted conditionally to the demonstrated implementation of measures effectively triggering discard reduction.

Fully Documented Fisheries with Remote Electronic Monitoring can be the fundament of a results-based management system focusing on impact and controllability, where fishers are fully accountable of their catch.

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The demersal fisheries in the North Sea are **highly mixed**. Several CFP tools and additional policy adjustments have been implemented since 2015. They have **helped deal with the landing obligation** but **have not incentivised discard reductions**.

Many potential choke issues are primarily **political**, linked to quota distribution rather than quota shortage. A few specific situations (including plaice, hake and elasmobranchs**) are considered difficult to address with the** current CFP tools.

Results-based approaches with full documentation of catches should be promoted.

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