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POSSIBILITIES FOR IMPROVING SELECTIVITY IN THE DUTCH DEMERSAL FISHERIES WITH THE LANDING OBLIGATION

How success factors of already implemented discard bans can support achieving the goal of the landing obligation to reach more selective Dutch demersal fisheries

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Possibilities for improving selectivity in the Dutch demersal fisheries with the landing obligation

How success and limiting factors in already implemented discard bans can support achieving the goal of the landing obligation to reach more selective Dutch demersal fisheries

A research report on a study into how success and limiting factors in already implemented discard bans can support achieving the goal of the landing obligation to reach more selective Dutch demersal fisheries, commissioned by Wageningen Marine Research for a bachelor thesis of the study Coastal and Marine Management.

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Fishing vessel: (Maritiemnieuws, 2017)



Preface

In front of you lies a research report addressing the question which success factors from already implemented discard bans can support achieving the goal of the landing obligation to reach more selective Dutch demersal fisheries. This study has been performed to fulfill the graduation requirements of the study Coastal Marine Management at Van Hall Larenstein in Leeuwarden. The study was conducted from the beginning of February until the end of June 2018.

We experienced a lot of difficulties performing this study. It was however possible to overcome all these difficulties with the supervision of Nathalie Steins and Ruben Verkempynck from Wageningen Marine Research (WMR) and David Goldsborough, Patrick Bron, and Peter Hofman from Van Hall Larenstein. Therefore, we would like to thank the supervisors for their excellent guidance and support during the process. We also want to thank all the stakeholders who were willing to participate in the interviews with us. Without the information from the interviews we would not have been able to perform this study.

We hope you enjoy reading this report!

Nils Kroon
Luc Roozendaal

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Abstract

While the landing obligation (LO) will be fully implemented on the 1st of January 2019, with the implementation in the Dutch demersal fisheries, it is still not clear if and how the European landing obligation and its goal can lead to more selective Dutch demersal fisheries. A qualitative approach has been applied through the performance of a literature review and conducted interviews with multiple interviewees who are involved in the Dutch fisheries policy. This approach was used to collect detailed descriptions for current limiting factors present in reaching the goal of the LO in Dutch demersal fisheries, success factors of already implemented discard bans present in reaching corresponding goals, and if and how these success factors can be applied to support achieving the goal of the LO in Dutch demersal fisheries. It has become apparent that multiple limiting factors are currently present in the situation of the LO in Dutch demersal fisheries. These limiting factors are present in the exemptions in the LO, the fisheries management system, the implementation process of the LO, the monitoring and enforcement of the LO, difficulties in selectivity innovations in fisheries, and the support in the fishing industry for the LO. To find ways to improve the possibility of reaching the goal of the LO, success factors were explored from already implemented discard bans in Canada, Chile, the Faroe Islands, Iceland, New Zealand, Norway, and the United States (Alaska). Encountered success factors from already implemented discard bans were based on collaboration between fishermen, monitoring and enforcement, fishery closures or restrictions, area closures or restrictions, net regulations, and quota regulations. According to multiple interviewees some of these success factors are applicable in the situation of the LO in Dutch demersal fisheries. Of these success factors, the most applicable success factors mentioned were Electronic Monitoring System with cameras, sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding, the possibility to land small quantities of fish that exceed quota without being penalized, collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch, and closing of fishing grounds for certain types of fishing gear. However, some considerations should be taken into account before applicable success factors could truly be implemented in the situation of the LO in Dutch demersal fisheries. All interviewees have also mentioned solutions to solve limiting factors, which in some cases were deemed to be more promising to improve the possibility of reaching the goal of the LO. These solutions were present in the form of exemptions in the LO, fisheries innovations to improve selectivity, facilitating development of selectivity by the government, collaboration to improve selectivity, monitoring and enforcement. Overall it can therefore be said that, through the implementation of applicable success factors from already implemented discard bans and self-named solutions of the interviewees, the possibility of reaching the goal of the LO can be improved.

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1. Introduction

When fisheries exploit certain areas at sea they do not only catch target and (commercial) bycatch species, but also unwanted species that are returned to the sea. This practice is commonly known as discarding, and there are several reasons for a fishery to discard this part of the catch. Some reasons could be that the catch is of little or no value, that the catch is damaged, or that the fishery has reached its quota for that species (Wageningen University & Research, N.D.). The practice of discarding is considered to be unsustainable and a waste of natural resources in fisheries. This has led to the implementation of discard bans in the fisheries management of Chile, the United States (Alaska), the Faroe Islands, Norway, Canada, New Zealand and Iceland (Condie *et al.*, 2014; Borges *et al.*, 2016).

European Union (EU) fisheries were the subject of a high-profile 'Fish Fight campaign' to end discarding in 2010. This campaign was based on the vision that discarding is a waste of natural resources (Hirst, 2015). The campaign and the accompanied societal pressure had a crucial effect on the reform of the Common Fisheries Policy (CFP) in 2013, when a landing obligation (LO) was introduced in EU fisheries management to gradually eliminate the practice of discarding. The LO states that it is mandatory to land all caught commercial species under quota management, with the goal that this will result in improved fishing behavior through adaptations to more selective fishing techniques (European Commission, 2018).

The Dutch demersal fisheries experience relatively high discard rates of 30 to 40% (Heath *et al.*, 2014). Reaching more selective fisheries is quite challenging because commercial and non-commercial demersal species of multiple sizes can be found near the sea floor. For example, the main target species in these fisheries is sole (*Solea solea*). These are caught with an 80 mm mesh size in areas where plaice (*Pleuronectes platessa*), which are caught with a mesh size of 120 mm, are abundant (Steins *et al.*, 2018.). A potential issue for fishermen that arises from these high discard rates in relation to the LO, when they are no longer allowed to discard the undersized species, is the high amount of storage that is needed for the discards and the effort it takes to sort all undersized fish in the catch (Rijksoverheid, 2015). It can be said that such issues are incentives for fishermen to fish more selective on target species, which is the goal of the LO.

These issues are subject to management and technical measures in the LO. Examples of technical measures from already implemented discard bans elsewhere in the world are increasing the mesh size of a fishing net and real-time closures of fishing grounds. Examples of management measures from already implemented discard bans are enforcing the discard ban by Electric Monitoring Systems (EMS) or onboard inspections and returning of species to sea which have a high survival rate (Borges *et al.*, 2016; Telesetsky, 2016). In those cases where these measures supported the effective introduction of a discard ban outside the EU, they could be considered success factors. On the other side, in the situation of the Dutch demersal fisheries, there are limiting factors which hinder achieving the goal of more selective fishing. Examples of these factors are absence of enforcement and present technical measures which incentivize discarding or the centralized decision-making process in the EU (Borges *et al.*, 2016; European Union, 2015).

The success factors from already implemented discard bans outside the EU might also apply to the Dutch demersal fisheries in making these fisheries more selective. However, with the LO for EU fisheries being fully implemented on the 1st of January in 2019 it is still insufficiently explored how the LO can lead to more selective fisheries and which success factors from already implemented discard bans can help achieve more selective Dutch demersal fisheries (Wageningen University & Research, N.D.).

1.1. Problem statement

It is not clear if and how the European landing obligation and its goal can lead to more selective Dutch demersal fisheries. Furthermore, it is not known what success factors in management and technical measures of already implemented discard bans can support Dutch demersal fisheries to achieve more selectivity.

1.2. Research goal

The goal of this study is to provide Wageningen Marine Research and governmental authorities, responsible for fisheries management, knowledge on management and technical measures present in already implemented discard bans which could support achieving more selective Dutch demersal fisheries.

1.3. Research questions

What limiting factors are currently present in reaching the goal of the landing obligation of more selective Dutch demersal fisheries and which success factors in management and technical measures of already implemented discard bans could apply to support achieving this goal?

- What limiting factors are currently present in reaching the goal of the landing obligation of more selective Dutch demersal fisheries?
- What are the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals?
- Which success factors of already implemented discard bans could apply to support achieving the goal of more selective Dutch demersal fisheries?

1.4. Thesis outline

Following this introduction, *Chapter 2* will describe the applied research methods. It discusses the design of the study and the methods applied to collect the eventual results that were needed to answer the research questions. These results are discussed in *Chapter 3*, which is divided into two sections concerning limiting factors of the LO in Dutch demersal fisheries and the applicability of encountered success factors of already implemented discard bans. The most notable results are summed up in the conclusions, which can be found in *Chapter 4*. In the conclusions the answer on the main research question will be addressed, (partly) resolving the problem discussed in the problem statement. The results presented in the conclusions are discussed in *Chapter 5*, which is where the discussion of the research results and a discussion of limitations in the study can be found. Recommendations based on the results and discussion are given in *Chapter 6* providing ways to improve the possibility of reaching more selective Dutch demersal fisheries.

2. Materials and methods

During the study certain materials and methods have been conducted to provide answers on the research questions. This chapter will describe the applied material and methods with an explanation on why and how they have been conducted.

2.1. General approach materials and methods

This study is based on qualitative research to provide answers on the previously described research questions. The qualitative approach has been applied as detailed descriptions were necessary to provide answers to these questions. Such detailed descriptions have been mainly explored for the current limiting factors present in reaching the goal of the LO in Dutch demersal fisheries, success factors of already implemented discard bans present in reaching corresponding goals, and if and how these success factors can be applied to support achieving the goal of the LO in Dutch demersal fisheries. In this study, limiting factors are defined as a situation, management or technical measure which hinders achieving the goal of the LO. Success factors are defined as a management or technical measure which improve the possibility of achieving the goal of the LO or have improved the possibility of achieving the goals of already implemented discard bans in this study.

To reach descriptions of these limiting factors and success factors, the study has been carried out by performing a literature review and conducting semi-structured interviews. A combination of these methods was chosen, as the results obtained from the literature review were supplemented and tested by the conducted interviews. The literature review has therefore been performed before the interviews were conducted. After the interviews were conducted the given answers were analyzed and processed in the results, together with the results of the literature review.

Consulted sources during the study were considered to be reliable when the author is an expert on the subject, the article is peer-reviewed or the author can be linked to a reliable (scientific) institute, the source is objective and references are used in the source. Furthermore, reports were consulted during this study, which are not peer-reviewed but can be linked to an author who is an expert on the subject or can be linked to a reliable (scientific) institute (The University of Adelaide, 2014)

An overview is given in *Table 1* with the conducted methods to answer each specific research question. The rest of this chapter will describe the processes and considerations of the literature review and of the interviews, and the conducted methods for every research questions and how the methods have made it possible to answer these questions.

Table 1: Research questions with corresponding methods

Research questions with corresponding methods		
Research questions	Literature review	Interviews
What limiting factors are currently present in reaching the goal of the landing obligation of more selective Dutch demersal fisheries?		
What are the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals?		
Which success factors of already implemented discard bans could apply to help achieve the goal of more selective Dutch demersal fisheries?		

2.2. Methods for literature review

The literature review was used to partially inventory the limiting factors which are currently present in reaching the goal of the LO of more selective Dutch demersal fisheries, and to inventory what success factors are present in management and technical measures of already implemented discard

bans for achieving corresponding goals. Sources used in this study were found using Google Scholar, have been obtained by people or have been found in the literature list from sources found in Google Scholar. Only the sources which were written in English or Dutch were used. The encountered success and limiting factors have been categorized in different inventories. The complete inventories of success and limiting factors can be found in *Appendix I: Limiting factors in Dutch demersal fisheries* and *Appendix II: Overview success factors in already implemented discard bans*. The different categories of success and limiting factors with examples have been described in *Chapter 3. Results*. After all success factors were collected, they were analyzed to see which success factors could be tested on applicability in the Dutch demersal fisheries during the interviews. A success factor used in the interviews needed to be present in at least two countries with an already implemented discard ban.

2.3. Methods for interviews

Interviews were conducted to further inventorize the limiting factors in the Dutch demersal fisheries, and for testing the applicability of success factors which were present in already implemented discard bans. Before the interviews were constructed a blueprint of the interview was made to ensure the interviews were sufficiently thought-out and constructed with a certain goal in mind. The blueprint is presented in *Appendix III: Blueprint achievability of the goal of the landing obligation*. The interview was semi-structured, which means questions for the interview were formulated up front and there was room to ask follow-up questions (Emans, 2002). Interview questions that were formulated up front have been constructed to ensure sufficient information was collected to answer the research questions, and can be found in *Appendix IV: Interview protocol*. The structure of the interview has been carefully considered so that answers given by the interviewees were not influenced. These considerations resulted in an interview structure where interviewees were firstly made aware of relevant matters for the interviews and the following steps that concerned the data-analysis, with for instance the question if the interviewee agreed with the interview being recorded. Furthermore, the interviewees were asked if they agreed with including their names in the list of stakeholders with corresponding organizations in the report. Finally, the interviewees were informed that the results in the report would refer in an anonymous way to the interviews. All interviewees agreed with these matters. After these matters were discussed, the first questions were asked, which have been focused on getting to know the interviewee and in what way the interviewee and the organization he or she represented were involved with the implementation of the LO. This information was not only valuable to create a context for the rest of the interview, but also to create a comfortable and relaxed environment as the interviewers also took the opportunity to introduce themselves. Following the first two introductory questions, interviewees were asked about their opinions on the LO and, whether and if the LO could lead to more selective Dutch demersal fisheries. After that, the interviewees were asked about limiting factors in Dutch demersal fisheries, and possible solutions for these limiting factors. All discussed questions up to now have been open questions, so the interviewee could relate their answers to any subject they found to be relevant. These questions were however followed by questions that needed answers on the applicability of success factors in Dutch demersal fisheries and whether they would improve the possibility of reaching the goal of the landing obligation. The conclusive question concerned the two most promising self-named solutions and applicable success factors that were discussed during an interview. This question was included, because even though a success factor would be applicable it was possible that an interviewee considered solving a limiting factor with a certain self-named solution as more promising to improve the possibility of reaching more selective Dutch demersal fisheries.

The stakeholder groups that were represented by the interviewees consists of NGO's, legislative bodies, fisheries organizations and research institutes. This was done to ensure that the perspectives of the main parties involved in fisheries management on limiting factors and potential success factors for more selective Dutch demersal fisheries, were included in the study. From every stakeholder group, three representatives were chosen, with the help of the supervisors from Wageningen Marine Research (WMR), based on their involvement in the implementation of the LO for the Dutch demersal fisheries. The number of chosen interviewees was based on the limited amount of time to perform the study, but with adequate coverage to lead to sufficient results. In *Table 2*, the specific stakeholder groups and the representatives who were interviewed are presented. Every stakeholder group has its own code which was used to refer to a quote mentioned by a stakeholder group in the research report.

Table 2: List of interviewees with represented organization and stakeholder group, and assigned group codes

List of interviewees			
Interviewee	Organization	Stakeholder group	Group code
Peter van Dalen	European Parliament	Legislative body	1
Kees Verbogt	Ministry of Economic Affairs and Climate Policy		
Geert Meun	VisNed	Fisheries organization	2
Durk van Tuinen	Dutch Fishermen's Association		
Martin Pastoors	Pelagic Freezer Trawler Association		
Frederieke Vlek	Our Fish	NGO	3
Lotte Huisman	The North Sea Foundation		
Irene Kingma	Dutch Elasmobranch Society		
Adriaan Rijnsdorp	Wageningen Marine Research	Research institute	4
Pieke Molenaar	Wageningen Marine Research		
Marloes Kraan	Wageningen Marine Research		

The interviewees were mostly (in some cases via phone or in person) approached via mail, where the focus of the interview was explained and asked if they wanted to cooperate. If an interviewee did not want to cooperate or did not respond, a new interviewee was chosen with the help of the supervisors from WMR. In the case of the interviewees from legislative bodies it was not possible to find a third interviewee. When an interviewee did want to cooperate, an appointment was made for the interview. The majority of the interviews has taken place in person, on a location chosen by the interviewee. One of the interviews did not take place in person, but via telephone. The table with success factors was send in advance and were discussed per factor during the interview.

Once the interviews were conducted, the recorded interviews were labeled by date and the name of the interviewee. The recorded interviews were then summarized to text based on a 'content-only transcription'. This method of transcribing ignores everything that is irrelevant to the subject of the question and uses words that have not necessarily been used during the interview. As the perceptions were not the main focus of the interviews, but rather the gathering of information on current limiting factors and ways to improve the possibility of reaching the goal of the LO, this method of transcribing had been chosen. Because of this method it was however important to check if the answers were summarized in a correct way, therefore a draft of every interview summary was send back to the interviewees. They were asked to validate the summary and made it apparent if the

interview had been transcribed in a correct way, but also when it was not transcribed in a correct way and adjustments needed to be made. If this was the case the adjustments were made so they were taken into account during the data-analysis of the interviews.

The data-analysis was performed with the program AtlasTI. In AtlasTI the summaries of the interviews were opened and analyzed in three general steps:

1. Codes were given to fragments of text in the interview summaries to briefly explain what that piece of text is about. It was possible for fragment pieces of text to have multiple codes. These codes were constructed when all results from the interviews had been collected. An example of such a code was for instance the code 'Government should facilitate more' when fragments of text concerned views on the necessity that the government has to facilitate selective innovations more, and how. All codes were carefully appointed without interpretation of the text, and only focusing on what really had been said. The answers given on the applicability of success factors from already implemented discard bans were all coded in a different way than other fragments of text in the interview summary. Codes for answers on these questions would for instance either be 'EMS is applicable' or 'EMS is not applicable'. This was done to ensure every perspective of every interviewee (and stakeholder group) was represented in the results concerning the applicability of success factors. Answers given on the conclusive question were all coded with 'conclusive answer' so every perspective of every interviewee (and stakeholder group) on the most promising self-named solution or success factor (or both) were taken into account.
2. After all interview summaries had been coded. The codes were checked and certain codes which ended up sharing the same concepts were merged, or codes that ended up being irrelevant to the research subject were removed. The remaining codes were then assigned to a group related to the content of a code, an example of such a group is the group 'solutions' where all self-named solutions were collected.
3. Once all codes were assigned to a certain group, every group was used to describe the results found in *Chapter 3. Results*. Where the amount of times a certain concept (in the form of a code) had been shared became apparent.

2.4. Sub-question 1: Limiting factors in landing obligation

The literature review was performed to inventory the limiting factors which are currently present in the Dutch demersal fisheries for achieving the goal of the LO. Examples of search terms used are 'Limiting factors goal landing obligation' and 'Landing obligation in Dutch demersal fisheries'. The limiting factors were collected through the literature review before they were collected with the interviews, as during the start of the study it was thought that all limiting factors could have been collected with the literature review. This was however later realized not to be effective enough, as fisheries management is constantly developing and limiting factors therefore as well. As interviewees would be able to mention current limiting factors, the choice was made to also collect these factors during the interviews. Limiting factors found during the literature review were however not mentioned during the interviews to prevent influencing the answers of the interviewees.

The inventory with categorized limiting factors can be found in *Appendix I: Limiting factors in Dutch*

demersal fisheries. The inventory has been based on five headings for describing the factors. The first heading, 'type of limiting factor' has been used for globally categorizing the factors. The second, 'general limiting factor' has been used to describe the factor in a general way and make a first categorization. The third, 'specific limiting factor' has been used to describe the factor as it is. The fourth, 'consequence' has been used to describe the consequence of the factor. The last, 'number of times shared by interviewees' has been used to describe how many times a limiting factor was shared by interviewees and to which stakeholder group. It is possible that a limiting factor was present in the inventory but was not shared by interviewees when a factor was found in literature. In the report, the different types of limiting factors were described as separate headings. These were supported with examples of general and specific factors, corresponding consequences and by which stakeholder groups the factor was shared. These descriptions can be found in 3.1.1. *Limiting factors in Dutch demersal fisheries for achieving more selective fisheries*. The inventory and description gave an answer on which limiting factors are currently present in reaching the goal of the landing obligation of more selective Dutch demersal fisheries.

To create context for the results concerning the limiting factors and as the interviewees were provided with the chance to share their opinions on the LO, results were also collected that made current positive developments regarding selectivity induced by the LO apparent. The interviews have also made it possible to collect self-named solutions by the interviewees related to limiting factors that were mentioned. These solutions are therefore not solutions to directly improve the possibility of reaching the goal of the LO (like the success factors), but more in an indirect way as limiting factors could be solved. An inventory for self-named solutions was made with the same structure as the inventory of limiting factors. However, the word 'limiting' was replaced with the word 'solution' in the headings and the heading 'consequence' was not present. This inventory can be found in *Appendix V: Self-named possible solutions*. In the report, the different types of possible solutions were described as separate headings. These were supported with examples of general and specific solutions, and by which stakeholder groups the solution was shared. These descriptions can be found in 3.1.2. *Self-named possible solutions for achieving more selective Dutch demersal fisheries*.

2.5. Sub-question 2: Success factors already implemented discard bans

First, a literature review was performed to find out what countries have an already implemented discard ban and what the corresponding goals are. Examples of search terms for retrieving this information were 'countries with discard ban' and 'goals of discard ban'. After that, success factors which were present in already implemented discard bans of these countries were inventoried. Examples of search terms used are 'implementation process discard ban Norway' and 'management and technical measures present in discard ban Norway'. The inventory and descriptions of type of success factors in the research report are inventoried and described using the same methods as discussed for the limiting factors in 2.4. *Sub-question 1: Limiting factors*. The only differences in the inventory is that the heading 'country', replaced the heading 'number of times shared by interviewees', and general success factors which were encountered in two or more countries were highlighted in green. The inventory can be found in *Appendix II: Overview success factors in already implemented discard bans*. Descriptions of types of success factors can be found in 3.1.2. *Success factors from already implemented discard bans*. The inventory and descriptions gave answer to what the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals are.

2.6. Sub-question 3: Applicability of success factors

To find out which success factors that were encountered during the literature review, could apply to help achieve the goal of more selective Dutch demersal fisheries, certain success factors were tested during the interviews. As previously described, success factors which were tested during the interviews needed to be present in at least two or more countries with already implemented discard bans. This was done with the assumption that success factors that were present in multiple countries would be more effective to improve selectivity and would have a better chance of being applicable in the situation of the LO in Dutch demersal fisheries. During the interviews the applicability of every success factor was mentioned in the form of an answer that made it apparent if it was applicable or not, and the effect of the success factor in the situation of the LO in Dutch demersal fisheries. Once the interviews were conducted, data on the applicability of these success factors was coded in such a way that the results of the analysis made it apparent how many interviewees (and stakeholder groups) saw a success factor as applicable. Through this method it can be said that the more interviewees shared the idea that a success factor was applicable, the more applicable the factor is.

As previously mentioned, interviewees were also asked which two success factors or self-named solutions they saw as most promising in the situation of the LO in Dutch demersal fisheries. This question was included, because even though a success factor would be applicable it was possible that an interviewee considered solving a limiting factor with a certain self-named solution as more promising to improve the possibility of reaching more selective Dutch demersal fisheries.

3. Results

This chapter describes all the results from the literature review and interviews and is divided into two main sections. The first section is 3.1. *Limiting factors in Dutch demersal fisheries and self-named possible solutions*. This section describes the limiting factors present in the Dutch demersal fisheries for achieving the goal of more selectivity (section 3.1.1) and self-named possible solutions retrieved from the interviews (section 3.1.2). The second section is 3.2. *Applicability of success factors from already implemented discard bans*. This section describes the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals (section 3.2.1), the assessment of success factors from the literature review on applicability in the Dutch demersal fisheries (section 3.2.2) and the most promising self-named possible solutions and success factors (section 3.2.3). The different stakeholder groups are coded for referring to a piece of text mentioned by a stakeholder group (legislative body = (1), fisheries organization = (2), NGO = (3), research institute = (4)).

3.1. Limiting factors in Dutch demersal fisheries and self-named possible solutions

There are some developments induced by the LO that are positive. A fishery representative and NGO said that it is now more viable than before to start a conversation with fishermen about improving selectivity (2,3). A representative of a legislative body said that in the past it was sometimes not even possible to speak to fishermen about this subject (1). An NGO said that the LO also started a discussion on what to do with certain choke species (3). A fishery representative mentioned that the LO also pushed the fisheries to start developing techniques which improve selectivity, like the SepNep, as fishermen also want to catch less unwanted bycatch (2). An NGO said that there is an increase in investments and studies to improve selectivity and chances of survival of unwanted bycatch (3). The fishing industry also carries out survivability studies and how the chances of survival of undersized fish can be increased (1,2). A representative of a legislative body and researcher mentioned that the will to improve selectivity and to develop new selective gears has also been increased since the first implementation of the LO (1,4). Fishermen are starting to develop a different view on improving selectivity (1). It is a good thing that the LO has induced some positive effects on achieving more selective Dutch demersal fisheries. However, the goal of the LO is far from achieved. This becomes apparent in the next section when the limiting factors are described.

3.1.1. Limiting factors in Dutch demersal fisheries for achieving more selective fisheries

This section describes the limiting factors present in the Dutch demersal fisheries for achieving the goal of the LO that were encountered during the literature review and interviews. The inventoried limiting factors have been categorized and can be found in *Appendix I: Limiting factors in Dutch demersal fisheries*. The types of limiting factors are given in *Table 3* and were further described using examples from *Appendix I: Limiting factors in Dutch demersal fisheries*.

Table 3: Types of limiting factors

Types of limiting factors
Exemptions in the LO
EU Fisheries management system
Implementation process of the LO
Monitoring and enforcement
Selectivity innovations in fisheries
Support in fishing industry for LO

Exemptions in landing obligation

Due to problems in the implementation of the LO in certain fisheries, some fisheries can receive exemptions from the LO if they can prove the necessity for such an exemption. It has however become apparent that NGOs perceive exemptions in the LO as a limiting factor (3). Exemptions are for instance seen as a measure that dilutes the principle of the LO, as the problem of discards is still addressed, but little is being achieved when multiple species are excluded from directly reducing those discards (4).

In addition, providing fisheries with an exemption to discard certain species could result in an increased discard rate and higher fishing mortality, which is in contrast with the goal of the LO (3). An example was given with the situation of common dab (*Limanda limanda*). It was decided to remove common dab from the European quota regulations. As a result, this species can still be discarded during the full implementation of the LO (3).

Fisheries management system

During the interviews multiple limiting factors in the fisheries management have been named by interviewees. One of these factors, named by all stakeholder groups, concerns the top-down approach of the European fisheries management system, where regulations are mostly implemented top-down for multiple fisheries of multiple EU member states (1,2,3,4). This is perceived as an illogical approach as fisheries differ a lot from each other in the EU. (European Union, 2015). The consequence of such an approach is that it could lead to situations where a regulation (in this case the LO) does not fit a fishery but still needs to be implemented, which in turn can lead to problems in the compliance of fisheries with regulations.

Next to this, current catch composition measures were considered to be limiting factors (1,2,4). These measures reflect the specificity and species mix of a fishery, where fisheries are for instance obligated to discard fish to stay inside of permitted percentages of fish in the catch composition (European Union, 2015). As such measures oblige fishermen to have a maximum amount of a species onboard, this makes it very difficult for fishermen to comply with the LO.

The EU quota system also creates incentives to discard fish, and has therefore been identified as a limiting factor by most stakeholder groups (2,3,4). Due to the quota system fisheries may only land fish for which they own quota. If fisheries land fish of which they have exceeded quota, sanctions will follow. As fisheries rather avoid such sanctions, choices will most likely be made to discard fish instead of landing it. The NGOs and a fishery representative also had complaints about the facilitation of the Dutch government for selective innovations, as limiting factor for the goal of the LO (2,3). According to them, the government is not focusing enough on the mitigation of barriers for selective innovations. Such barriers for the development of selective innovations can be found in the administrative actions fisheries have to perform to develop such innovations. For example, a fisherman wanted an exemption to experiment with a new net. This exemption has not been given yet and it is unsure when the fishermen will get it (4).

Implementation process

Multiple factors in the implementation process of the LO have also been considered limiting for achieving the goal of the LO. The limiting factor in the implementation process that has been shared the most during the interviews, and by three stakeholder groups, is focused on the consideration that the LO has changed the situation of fisheries management too abruptly (1,2,4). Because of the LO, the quota system has changed from a principle of landings quota to a principle of catch quota. This has had the effect that fisheries were first obliged to discard undersized fish, while they are now obliged to land all these species. Due to this sudden change in fisheries management and the small time frame of implementation, fisheries do not have enough time to adapt to the new form of fisheries management and most of them will therefore not be compliant with the LO, as fishermen

do not have the tools to deal with the amount of discards which need to be landed. In addition, fishery organizations, NGOs and researchers made it clear that the goal of the LO is still differently interpreted, which results in the lack of a shared vision and therefore impairs collaboration on finding solutions to reach more selectivity (2,3,4).

Monitoring and enforcement

During the interviews, the insufficiency of monitoring an enforcement of the LO has been named by all stakeholder groups as the most limiting or one of the most limiting factors in the process of reaching the goal of the LO (1,2,3,4). This insufficiency is pointed out by the lack of concrete ideas on how compliance with the LO can effectively be monitored and enforced. The consequence is that this could lead to non-compliance of the LO as fishermen would not be penalized for illegally discarding (Walker *et al.*, 2015).

All stakeholder groups, except fishery representatives said that the difficulty of monitoring and enforcement can partly be blamed on the consideration that fishermen often seem to find ways to evade monitoring of their activities (1,3,4). This for example results in difficulties for the assignment of observer ships, onboard observers and the appliance of EMS with cameras. Fishermen could for instance stop illegal activities when an observer ship is spotted, bribe onboard observers, or mess with the onboard cameras so that illegal activities cannot be recorded.

A certain level of understanding for the evasion of monitoring has also been named by fisheries organizations and researchers during the interviews, as compliance with the LO results in socio-economic difficulties for fisheries. This is due to the concept that fisheries have to perform more work, catch less (valuable target species), have to pay for landed discards (and possibly for methods of monitoring), and fishermen could experience resistance from their crew as they will likely earn less money while performing more work as well (2,4).

Selective innovations in fisheries

Limiting factors for selective innovations have also been mentioned that arise from the situation of Dutch demersal fisheries in the North Sea. One of those limiting factors pointed out by all stakeholder groups concerns the concept that avoiding discards is difficult due to the high amount of mixed fish stocks in the North Sea (1,2,3,4). This is notable due to the fact there are few Dutch demersal fisheries where discards are absent. The consequence is that this natural situation of mixed fish stocks makes achieving complete selectivity very difficult in these fisheries.

Next to this, some species are considered to be too valuable to avoid catching them. While there are possibilities (like increasing minimum mesh sizes) to improve selectivity in some fisheries, this could also result in the loss of caught valuable species and therefore less income. Due to this loss in income through the appliance of selective innovations, fishermen are less likely to apply such innovations (1,2,4).

Support in fishing industry for landing obligation

Other limiting factors have been mentioned during the interviews that focus on the limited support in the fishing industry for the LO and the reasons for this limited support. The limited support in the fishing industry itself is considered to be a limiting factor by most stakeholder groups (2,3,4). This limited support is notable in the concept that fishermen are unwilling to land all fish as they do not comprehend why they should. Among other reasons, this confusion is caused by the feeling that the landing of undersized fish results in the absence of a chance for survival that was higher before the implementation. This is a limiting factor, because without support for the LO in fisheries, the enforcement cannot be effective as fishermen will most likely accept that they do not comply with the LO. The limited support for the LO in the fishing industry, mentioned by fishery representatives and researchers, is also partly the result of the concept that fishermen might understand that the

amount of discards should be reduced, but do not have the means to do so and therefore the majority of fisheries would not be able to comply if the LO would be fully enforced (2,4). Another reason for the limited support is the concept that the fishing industry does not collectively support the goal of the LO (3,4). This results in the limiting factor that without the collective support of the goal of the LO, reaching more collaboration with the fishing industry and more selective fisheries will be very difficult.

3.1.2. Self-named possible solutions for achieving more selective Dutch demersal fisheries

During the interviews, the interviewees were asked on what they thought were possible solutions for the present limiting factors. All self-named possible solutions with corresponding stakeholder group are given in *Appendix VI: Self-named possible solutions* and have been categorized. The types of self-named possible solutions are given in *Table 4* and were further described using examples from the appendix.

Table 4: Types of self-named possible solution

Types of self-named possible solutions
Exemptions in LO
Facilitating development of selectivity by government
Fisheries innovations to improve selectivity
Collaboration to improve selectivity
Monitoring and enforcement

Exemptions in LO

Exemptions in the LO are not necessarily a possible success factor which can stimulate more selective fisheries. However, fishery representatives and researchers said that these exemptions can help making the LO more workable for fishermen. One kind of exemption is in the form of species which have a quota but do not fall under the LO anymore (2,4). The species which are excluded from the LO need to prove they have a high survivability (1,2). An NGO and fishery representative said that clear conditions also need to be made when implementing an exemption (2,3). A representative of a legislative body thinks that it is a good idea to abolish the quota for some species (1). In this way they do not fall under the LO anymore as the LO only counts for species with a quota. A fishery representative mentioned that a possible solution is to create a full exemption for the 80 mm fishery (2).

Fisheries innovations to improve selectivity

More innovations need to take place in the fishing industry itself to improve selectivity. One topic mentioned were net innovations. Most stakeholder groups mentioned that the pulse trawl is a good example of an innovation which improves selectivity (1,2,4). According to all stakeholder groups more net innovations are needed to improve selectivity (1,2,3,4). Another topic mentioned by fisheries organizations and NGOs is that it is necessary to have independent research from the fishing industry to improve selectivity. A possible solution could be that the fishing industry starts collecting more data and draws their own conclusions on what needs to happen to fish more selective, instead of somebody else telling them what to do (2,3).

Facilitating development of selectivity by government

Selectivity needs to be more facilitated by the government. This can be done by creating more flexibility in the development of more selective fisheries. A possible solution pointed out by fishery representatives and researchers is to grant fishermen more space to develop new nets without having to take too much account of administrative actions (2,4). Another topic mentioned by NGOs

and researchers is that fishermen need to be compensated for their efforts to develop more selective fisheries. A possible solution is that fishermen who perform selectivity experiments are financially compensated (3,4). In relation to this last topic, an NGO felt that the government needs to show more initiative. A possible solution is that a structural innovation vision needs to be developed by the government, where space for innovation is offered (3).

Collaboration to improve selectivity

Collaboration was seen as a means to stimulate more selective fisheries. The first topic was more collaboration between stakeholders to reach a shared goal. A possible solution mentioned by a researcher is to first establish a shared vision between the different stakeholders, which is more selectivity in this case. When this vision is established it is possible to come up with solutions together. Such solutions mostly have more support from the fishing industry (4). A second topic was collaboration between fishermen to avoid unwanted bycatch. A possible solution would be that more communication between fishermen on catch composition in certain locations can help improve this collaboration (2,3). Another possible solution is a voluntary agreement between fishermen by closing an area in a certain time to avoid high percentages of unwanted bycatch (4).

Monitoring & Enforcement

Monitoring and enforcement is very important for controlling the LO. It had been mentioned by all stakeholder groups that EMS can be an effective tool to implement fully documented fisheries and control the LO (1,2,3,4). Another system mentioned by a fisheries organization and NGOs is where fishermen register and control everything, thus creating a fully documented fishery themselves and prove that they comply with the LO (2,3).

3.2. Applicability of success factors from already implemented discard bans

This section describes the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals, the assessment of success factors from the literature review on applicability in the Dutch demersal fisheries and the most promising self-named possible solutions and success factors.

3.2.1. Success factors in management and technical measures of already implemented discard bans

Success factors from already implemented discard bans in Canada, Chile, the Faroe Islands, Iceland, New Zealand, Norway, and the United States (Alaska) have been inventoried. Every country has a different goal in regard to a discard ban, due to the fact the fisheries and management differ from each other. In *Table 5* an overview is given of the countries with a discard ban and the corresponding goals. The inventoried success factors are categorized and can be found in *Appendix II: Overview success factors in already implemented discard bans*. These categories will be described using examples from *Appendix II*.

Table 5: Countries with discard bans and corresponding goals

Countries with discard bans and corresponding goals	
Location	Goal
Canada	Providing strong incentives to match catches to quotas while discouraging discarding (Branch & Hilborn, 2008).
Chile	Increase the biomass of target and non-target stocks by decreasing discards (Borges <i>et al.</i> , 2016).

Faroe islands	Recovery of cod (<i>Gadus morhua</i>), saithe (<i>Pollachius virens</i>) and haddock (<i>Melanogrammus aeglefinus</i>) stocks (Jákupsstovu <i>et al.</i> , 2007).
Iceland	Discourage discarding activity regardless of motivation (European Commission, 2008).
New Zealand	Reducing the wasteful practice of discarding and increase biomass of commercial stocks (Telesetsky, 2016).
Norway	Higher fisheries profitability based on improved exploitation patterns (Borges <i>et al.</i> , 2016).
United States (Alaska)	Reduce discarding (Graham <i>et al.</i> , 2007).

Collaboration between fishermen

Collaboration between fishermen is enacted in the discard bans of the United States (Alaska) and New Zealand. In both countries the goal is to collaborate to avoid areas with high percentages of unwanted bycatch. In New Zealand they plan to use a system in 2018 which automatically aggregates reports of catches and corresponding location from different fishermen, creating real-time bycatch maps (Telesetsky, 2016; Ministry for Primary Industries, 2018). In Alaska the government has enacted cooperation between different fishing sectors, where fishermen need to share catch composition data with corresponding locations. This data is used to create real-time unwanted bycatch maps (Karp *et al.*, 2005). Both countries have enacted different measures to cooperatively avoid unwanted bycatch by creating real time unwanted bycatch maps.

Monitoring and enforcement

Monitoring and enforcement is a factor for ensuring the discard ban is executed according to law. In the countries of Chile and New Zealand they use an EMS. This system uses cameras for monitoring if the discard ban and accompanying regulatory measures are followed (Borges *et al.*, 2016; Ministry for Primary Industries, 2018). Another measure used for monitoring fisheries, present in the discard bans of New Zealand, Iceland and Alaska, are onboard observers. These observers enforce the discard ban, reduces misreports of fishermen and register catch compositions, for example to effectuate real-time closures (European Commission, 2008; Ministry for Primary Industries, 2018; Karp *et al.*, 2005). If fishermen get caught breaking the law they will be penalized through fines, or the revoking of quota or fishing licenses (Gezelius, 2008; Ministry for Primary Industries, 2018; Condie *et al.*, 2014; European Commission, 2008).

Fisheries closure or restrictions

Fishery closure or restrictions are heavy measures which are mostly used as an incentive for fishermen to fish more selective for their target species. In the discard bans of Alaska and Canada the fishery has an annual bycatch limit. When this limit is exceeded the whole fishery will be closed for the rest of the year (Karp *et al.*, 2005; Condie *et al.*, 2014). Another reason for closing a fishery is present in the fisheries management of the Faroe Islands, where the cod fishery is closed from the 1st of March to the 1st of May due to the spawning season of cod (Jákupsstovu *et al.*, 2007).

Area closures or restrictions

Area closures or restrictions are usually used for protecting an area or for avoiding high percentages of unwanted bycatch. Area closures are present in the discard ban of the Faroe Islands, Norway and Iceland. These area closures are effectuated when a certain percentage of unwanted bycatch is present in the catch composition. Mostly these areas are accessible again for fishing activities after one or two weeks (Grétarsson & Danielsen, 2014; Jákupsstovu *et al.*, 2007; Gullestad *et al.*, 2015;

European Commission, 2008). In the discard bans of the Faroe Islands and Norway, area restrictions for certain gears are in place which can lead to reduction in fishing pressure (Grétarsson & Danielsen, 2014; Jákupsstovu *et al.*, 2007; Gullestad *et al.*, 2015). This also involves area restrictions for all gears except the most selective fishing method. The area restrictions incentivizes fishermen to fish with the more selective fishing method to get access to the area (Gullestad *et al.*, 2015).

Net regulations

The discard ban of the Faroe Islands was accompanied with legal minimum mesh sizes (Grétarsson & Danielsen, 2014; Jákupsstovu *et al.*, 2007). In the discard bans of Iceland and Norway a legal minimum mesh size was already present, but an increase in minimum mesh size was realized (European Commission, 2008; Gullestad *et al.*, 2015).

Quota regulations

Quota regulations are present in the discard ban of Norway, Canada and the Faroe Islands. In Norway and Canada fishermen have the possibility to land small quantities of fish that exceed quota without being penalized. This measure creates a certain flexibility in the quota system (Gullestad *et al.*, 2015; Condie *et al.*, 2014). Norway also has bycatch quota which sets a certain quota for unwanted bycatch. The quota can help reduce the incentive to discard unwanted bycatch as a quota is allocated for it (Gullestad *et al.*, 2015).

Success factors tested during interviews

From the different categories described above, some success factors were present in two or more countries. These success factors are listed below in *Table 6* and were tested during the interviews by the different stakeholders on the applicability of these success factors in the Dutch demersal fisheries.

Table 6: Success factors tested during interviews

Success factors tested during interviews	
Category	Success factor
Collaboration between fishermen	Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.
Monitoring and enforcement	Electronic Monitoring System (EMS) with cameras.
	Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.
	Onboard observers.
Fisheries closure or restrictions	Closing a fishery when an annual unwanted bycatch limit has been exceeded.
Area closures or restrictions	Closing fishing grounds when the percentage of unwanted bycatch of a specific species is exceeded in the catch composition of one haul.
	Closing of fishing grounds for certain types of fishing gear.
Net regulations	Increasing minimum mesh sizes.
Quota regulations	The possibility to land small quantities of fish that exceed quota without being penalized.

3.2.2 Applicability of success factors from already implemented discard bans

This section describes how the success factors that were tested during the interviews could apply in the Dutch demersal fisheries by using the data from the analyzed interviews.

3.2.2.1. Electronic Monitoring System (EMS) with cameras

A total of ten interviewees agreed and only one disagreed on the applicability of EMS with cameras in the LO of Dutch demersal fisheries. The distribution between stakeholder groups on applicability is given in *Figure 1*.

A representative of a legislative body and an NGO think that EMS with cameras can be implemented as part of fully documented fisheries which can be used to map the areas with high percentages of unwanted bycatch (1,3). This is complimented by a fishery representative who wants a pilot experiment with EMS to acquire data, improve knowledge and better documentation (2). Another representative of a legislative body and an NGO think that it is necessary to control and enforce what happens at sea (1,3). While another fishery organization thinks that this measure will only prove that the LO is not executable (2).

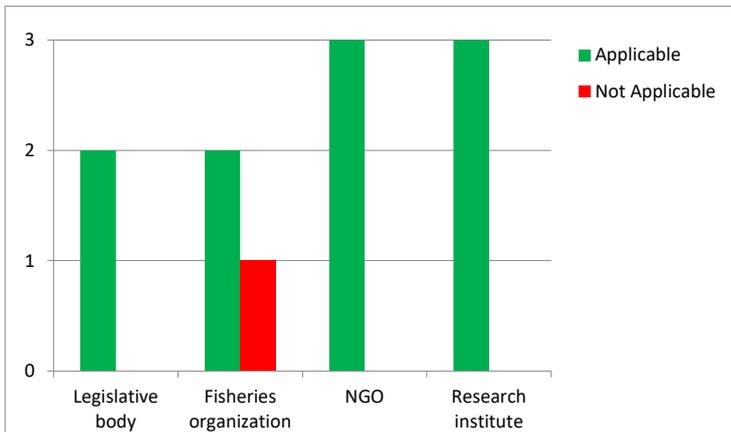


Figure 1: Applicability of EMS with cameras.

Privacy

One topic mentioned by most stakeholder groups was the issue of privacy which occurs when an EMS with cameras will be implemented on a fishing vessel (1,3,4). No concrete solutions were mentioned regarding the issue. However, according to an NGO it is very important that legislative bodies and fishermen work together to address this issue (3). An important part to discuss is the placement of the cameras to secure the privacy of the fishermen working on a vessel (1).

Assessing EMS images

Another topic mentioned were different ideas to effectively assess the images made by the EMS with cameras. A researcher came with the idea that EMS with cameras could be implemented by making it obligatory in an MSC certification. For creating transparency it is possible for consumers to see which ship caught the certified fish they bought. The consumer can check the fishing practices in an online live stream as a result of the EMS with cameras. When a consumer spots a violation made by the fishermen, they can alert the fisheries inspection in a central contact point (4). A representative of a legislative body came with another idea, that not every image has to be assessed for violations of the LO by first looking at abnormal catch compositions. The fisheries inspection

could only assess the images of fishing vessels which have abnormal catch compositions to reduce the workload (1). Another researcher had the idea that it is not necessary to check all images, but only sample-wise which could also work as a deterrent for illegal discarding (4).

Incentive for implementing EMS with cameras

The last topic in relation to EMS is that fishery representatives and a researcher mentioned that there is very low support from the fishery industry for implementing EMS with cameras (2,4). But also that it is very easy for fishermen to sabotage the camera in a way the fishing practices are out of sight (2,4). For avoiding the sabotage of cameras it is necessary to create an incentive for fishermen to make sure they also benefit from having cameras onboard (2,4). One possible incentive mentioned by a researcher is that cameras could be part of a MSC certification. In this way the fishermen could be incentivized for implementing EMS with cameras due to the fact they can sell their fish as sustainable (4). Another possible incentive mentioned by a fishery organization is rewarding fishermen with extra quota (2).

3.2.2.2. The possibility to land small quantities of fish that exceed quota without being penalized

A total of seven interviewees agreed and four disagreed on the applicability of the possibility to land small amounts of fish which exceed quota without being penalized. The distribution between stakeholder groups on applicability is given in Figure 2. Most stakeholder groups agreed that this measure can stimulate flexibility in the fishery management (1,3,4). An NGO mentioned that this measure is irrelevant, as it is expected that fishermen will also discard these small amounts of fish (3). A fishery representative also mentioned that this measure is irrelevant as the problems concerning choke species need to be solved first (2). A researcher pointed out that this measure will get out of hand in the Dutch demersal fisheries.

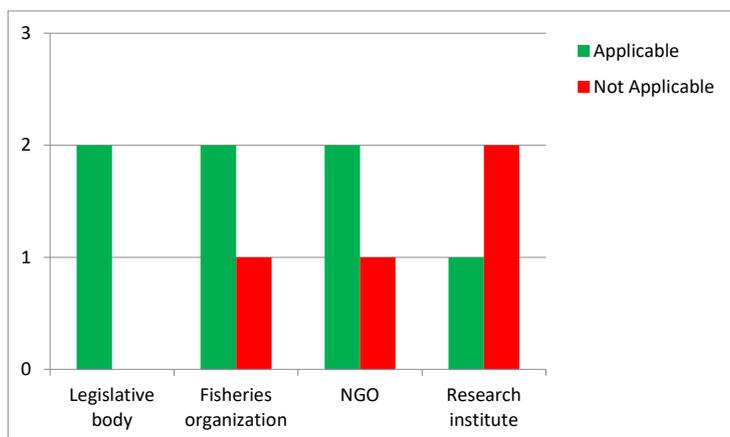


Figure 2: Applicability of the possibility to land small quantities of fish that exceed quota without being penalized.

Discussion landing amount

For implementing this measure a representative of legislative body and an NGO said that it is very important to make concrete agreements on how much can be landed per species without being penalized (1,3). It also takes a lot of work to negotiate the allowed amount of fish that exceeds quota. An NGO and researcher mentioned that the discussion on how much can be landed is a negative factor (3,4). A fishery organization and researcher mentioned that this is a good measure when the fish that exceeds quota needs to be deducted from the quota of the next year (2,4).

3.2.2.3. Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch

A total of seven interviewees agreed and four disagreed on the applicability of collaboration between fishermen to share catch composition in certain areas for avoiding catches with a certain percentage of unwanted bycatch. The distribution between stakeholder groups on applicability is given in Figure 3. All NGOs and most researchers agreed on this measure. However, most fishermen do not see this measure as applicable, while they are the ones who actually need to collaborate.

One opinion from a fishery representative and the NGOs is that this measure is important for realizing more transparency and sharing of data in fisheries (2,3). It is also important that fishermen take responsibility in managing the amounts of unwanted bycatch (3). A researcher thinks this is not possible in the 80 mm fishery due to the high diversity of demersal species. However, it could work in fisheries with a larger mesh size (4).

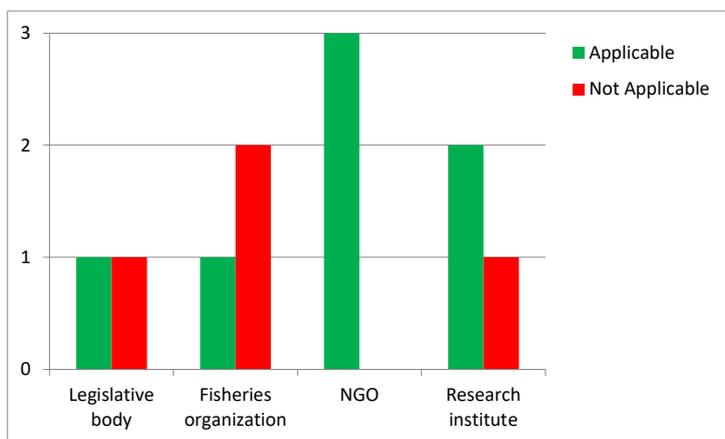


Figure 3: Applicability of collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.

Competition

The first topic mentioned by fishery representatives and researchers is that this measure will not work as fishermen are competitors in exploiting the natural resources of the same area (2,4), and will only work when fishermen share the same vision and actually want to implement it (4). Therefore, an NGO pointed out that it is important that there is more trust between fishermen (3). A representative of a legislative body and a fisheries organization mentioned that there is no support from the industry for this measure due to an accumulation of restrictive measures (1,2).

Registering of data

The next topic mentioned by researchers is that it is very important that fishermen register everything and can show results of their efforts to others (4). Fishermen are now getting used to registering catch data to their Producer Organization (PO) as result of the pulse trawl monitoring studies (4). A fishery representative and NGO mentioned that a system which automatically registers catch composition per haul and corresponding location is necessary for this measure to succeed (2,3). The data derived from this system needs to be shared anonymous and stimulated by the POs (2). Other fishery representatives think that fishermen and POs are already busy enough performing their normal work activities (2). But also that POs are not capable to facilitate this measure (2).

3.2.2.4. Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding

A total of nine interviewees agreed and two disagreed on the applicability of sanctions such as fines and the revoking of quota or fishing permit in response to illegal discarding. The distribution between stakeholder groups on applicability is given in Figure 4.

One opinion pointed out by NGOs is that this measure is important to show fishermen illegal discarding will be penalized (3). Not penalizing fishermen for illegal discarding is out of the question said a researcher (4). Another fishery representative said that penalizing illegal discarding will not have the desired effect (2). While another fishery representative and NGO mentioned that this kind of penalizing already happens when caught in the act (2,3). A system used in the Dutch demersal fisheries is the penalty point system which results in revoked fishing licenses when a certain amount of penalty points in a certain amount of time is exceeded (2).

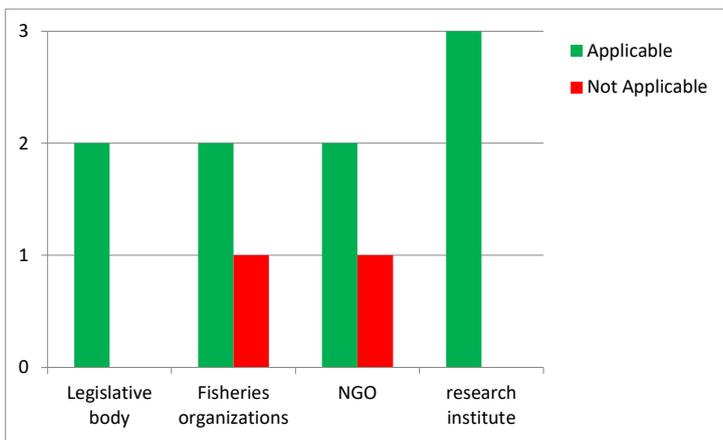


Figure 4: Applicability of sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.

Method for sanctioning

A fishery representative said that it is very hard to effectively sanction illegal discarding with the present monitoring system (2). A researcher does not know how it is possible to prove if a fishermen illegally discards fish (4), unless the monitoring and enforcement is done systematically in a correct way (4). This is complemented by a representative of a legislative body, saying that this measure is only possible when fully documented fisheries are present (1). An NGO pointed out that with fully documented fisheries it is possible to implement a bycatch limit, when this limit is exceeded, fishermen will be sanctioned. Furthermore, automated monitoring systems can effectively implement penalties for illegal discarding instead of inspection at sea (3).

Other things to consider

A researcher mentioned that it is important to first get everyone in agreement before implementing sanctions. In this way the measures have more support. After the agreement it is possible to implement sanctions where necessary (4). Another researcher mentioned that the process of implementing new sanctions is too slow. As a result there are sanctions in place which already do not fit the current situation in the fisheries anymore (4).

3.2.2.5. Closing fishing grounds when the percentage of unwanted bycatch of a specific species is exceeded in the catch composition of one haul

A total of three interviewees agreed and eight disagreed on the applicability of closing fishing areas when a certain percentage of unwanted bycatch from a particular species is exceeded in the catch composition of one haul. The distribution between stakeholder groups on applicability is given in Figure 5. It is mentioned by most stakeholder groups that this measure is not applicable as there is a large variation in demersal species in the North Sea. Furthermore, the catch composition is very variable per haul which means that closing a fishing area based on one haul is too short (2,3,4).

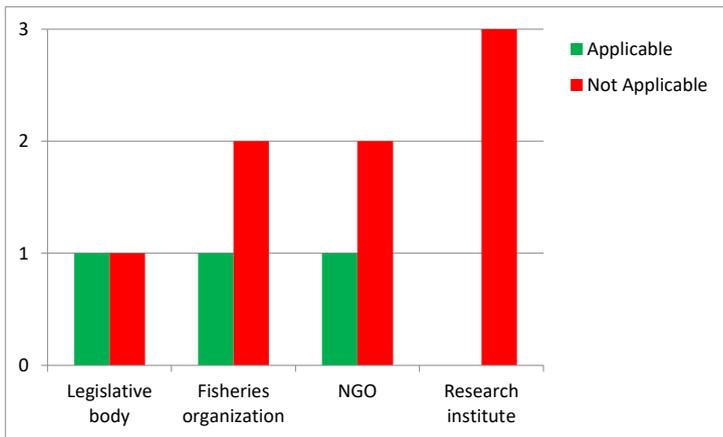


Figure 5: Applicability of closing fishing grounds when the percentage of unwanted bycatch of a specific species is exceeded in the catch composition of one haul.

Agreements

When implementing this measure a fishery representative and NGO said that it is very important to make agreements for which species this measure counts (2,3). A fishery representative pointed out that in these agreements it is also important to agree on the amount of different reports of high unwanted bycatch which induces the area closure. This is because fishermen are competitors and can lie about the amount of unwanted bycatch to close an area in where the competition is fishing (2). Another fishery representative and researcher are also wondering which and how areas need to be closed when this measure will be implemented (2,4). That is something to agree on as well.

Collaboration of fishermen

Almost all stakeholder groups, except fishery representatives agreed that this measure will only work when fishermen work together to avoid areas with high percentages of unwanted bycatch instead of being a top-down implemented measure (1,3,4). This is complimented by a representative of a legislative body mentioning that avoiding high amounts of unwanted bycatch is the responsibility of the fishermen (1).

3.2.2.6. Closing of fishing grounds for certain types of fishing gear

A total of four interviewees disagreed and seven agreed on the applicability of closing fishing areas for certain gears. The distribution between stakeholder groups on applicability is given in Figure 6. All NGOs agree with the applicability of closing of fishing grounds for certain types of fishing gear, as closing fishing areas could lead to a reduction in fishing pressure in certain areas as well. Most fishery representatives do not agree as this measure can reduce the areas in where they are allowed to fish.

It is mentioned by an NGO that it is not known if this measure can lead to a reduction of discards, therefore a lot of research is necessary (3). However, a representative of a legislative body said it could be useful for relieving pressure of vulnerable areas (1). Another fishery representative mentioned that the closed areas for certain gears is already at a maximum in the North Sea (2). A researcher also mentioned that this measure can only be useful when a new more selective gear is developed (4). Others mentioned that this measure is already present (1,2).

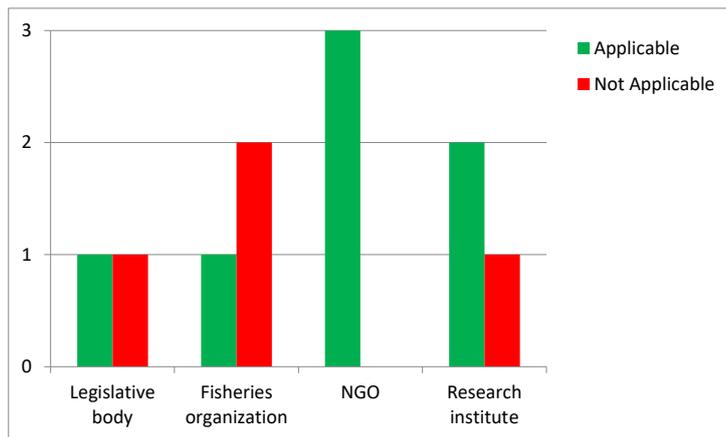


Figure 6: Applicability of closing of fishing grounds for certain types of fishing gear.

Policy process

Questions which arise from this measure by fishery representatives and researchers are: 'Which areas need to be closed? How large to these areas need to be? For what fisheries does this count? For what goal?' (2,4). An NGO said that this measure results in a very long policy process for implementing such areas (3).

Enforcement

A fishery representative and NGO mentioned that this measure needs a lot of enforcement (2,3). However, a researcher said that this can be done very easy through the usage of Vessel Monitoring Satellite (VMS) (4). Another researcher pointed out that closing areas for certain mesh sizes is applicable and very easy to control as fishermen are only allowed to have one mesh size onboard (4).

Other things to consider

A fishery representative mentioned that this measure will have regional effects as it is possible to prohibit certain gears used on fishing vessels from other countries who fish in the Dutch part of the North Sea (2).

3.2.2.7. Closing a fishery when an annual unwanted bycatch limit has been exceeded

A total of five interviewees agreed and six disagreed on the applicability of the closing of a fishery when an annual bycatch limit exceeded. The distribution between stakeholder groups on applicability is given in Figure 7. All NGOs agree on the applicability of this measure, while all fishery representatives disagree. From an NGO perspective an annual bycatch limit is favorable as it sets a clear line on how much unwanted bycatch can be landed and the premature closure of a fishery could lead to a reduction in fishing pressure. However, from a fishery perspective the closure of a fishery is not an option as fishermen are economically dependent on the fisheries. If a fishery closes prematurely, fishermen will have less profit.

An NGO mentioned that this measure is necessary when no action is undertaken by the fishing industry to fish more selective (3). In addition, the LO is fixed in the Common Fisheries Policy, and should therefore be executed (3). A fishery representative and NGO mentioned that this measure is theoretically applicable but can never be practically applicable (2,3). Another researcher said that it is theoretically applicable but not desirable (4). Furthermore, it has been mentioned that applicability differs per fishery by a fishery representative (2).

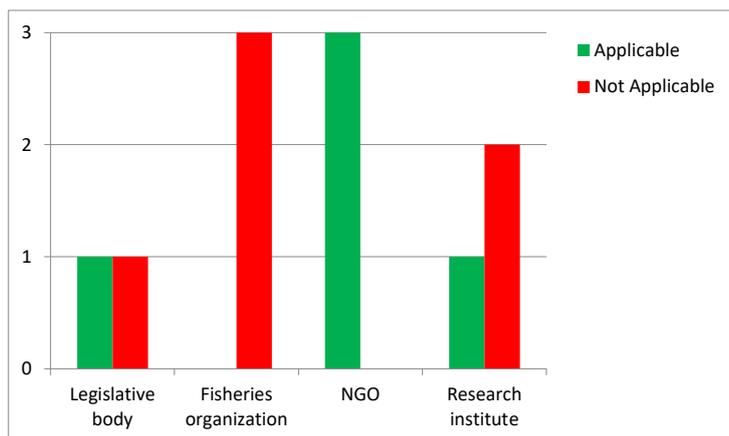


Figure 7: Applicability of closing a fishery when an annual unwanted bycatch limit has been exceeded.

Choke species

A researcher said that this measure will create large problems for fisheries which deal with choke species (4). Examples of species which can give problems as choke species are turbot (*Scophthalmus maximus*) and brill (*Scophthalmus rhombus*). A fishery representative and NGO pointed out that some species like rays can be excluded from the LO due to their high survivability when caught and released back into the sea (2,3). A researcher said that this measure will result in a large discussion on what the bycatch limit is for species (choke species) which are not excluded (4). When a fishery actually closes due to choke species, it is mentioned by an NGO that it is important to come up with different work activities for fishermen like tourism or culturing fish in windmill parks (3).

Enforcement

A researcher mentioned that the bycatch limit is very easy to control (4). However, another mentioned that this limit will incentivize fishermen to illegally discard as they will do anything to keep the fishery open (4).

Other things to consider

A fishery representative made it clear that fishermen rather fish in different areas or with different techniques than have this measure implemented (2). While a representative of a legislative body mentioned that this measure is very hard to manage as quota can be transferred when the bycatch limit is full (1).

3.2.2.8. Increasing minimum mesh sizes

A total of six interviewees agreed and five disagreed on the applicability of the increase of minimum mesh sizes. The distribution between stakeholder groups on applicability is given in *Figure 8*. The applicability of this measure strongly depends on the fishery (1,3). A representative of a legislative body and a researcher mentioned that this measure is not relevant due to the fact it has been discussed and tried so many times, but without success (1,4)

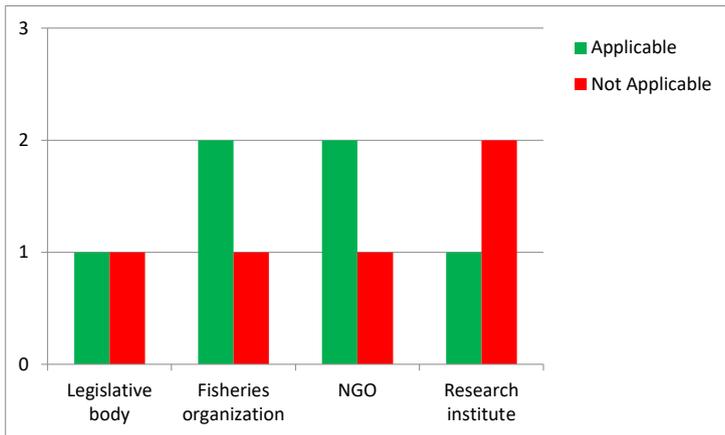


Figure 8: Applicability of increasing minimum mesh sizes.

80 mm fishery

The 80 mm sole fishery is the largest bottleneck in achieving more selectivity (2). All stakeholder groups pointed out an experiment in where the minimum mesh size was increased from 80 to 90 mm. This resulted in a loss of marketable sole but did not result in a reduction of discards (1,2,3,4). Therefore, fishery representatives said that is not possible for a fishery to target sole if the mesh sizes are increased (2). However, NGOs think there is still a lot to achieve in selectivity regarding the 80 mm fishery, but the fishermen do not want that (3). An NGO thinks scenario studies need to be performed to see how the 80 mm fishery can be improved regarding selectivity, instead of saying the fishery cannot be more selective up front (3). This shows a low ambition of the fishing industry to improve selectivity (3).

Market 80 mm fishery

A researcher pointed out that a large social discussion needs to be performed on what to do with the 80 mm fishery and if consumers still want to eat sole (4). But also that it is not fair only fishermen need to pay for the catch of sole while it is a social choice to consume this fish (4). An NGO and researcher pointed out that this measure can only succeed when a regulation is made in where the loss of marketable fish, due to the increase of mesh sizes, is compensated by the consumer or market (3,4). It is mentioned by an NGO that the fishery can have a more proactive attitude in searching market solutions (3).

120 mm fishery

Most stakeholder groups said that it is possible to slightly increase the minimum mesh size in 120 mm fishery (1,2,4). The downside is that fishermen will lose a part of the valuable bycatch of lemon sole (*Microstomus kitt*) (2,4).

Other things to consider

For reducing discards it is better to look at lowering the minimum legal size. If this would be implemented for plaice, a large part of the discard problem will be solved (1). Furthermore, more effort needs to be put in fishing net innovations instead of increasing the minimum mesh size (1).

3.2.2.9. Onboard observers

A total of six interviewees agreed and five disagreed on the applicability of onboard observers. The distribution between stakeholder groups on applicability is given in *Figure 9*.

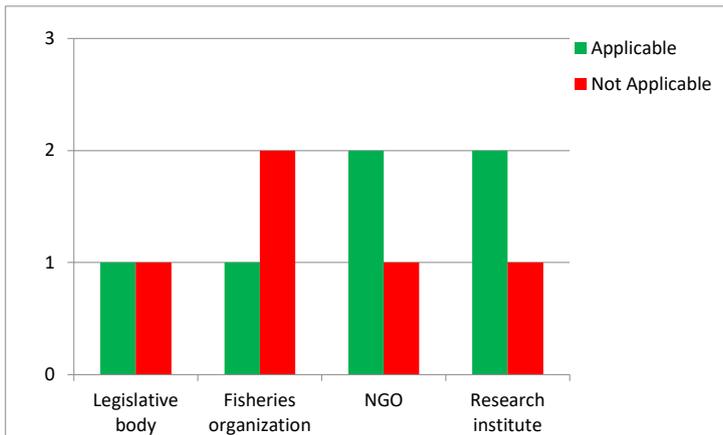


Figure 9: Applicability of onboard observers

Costs

Most stakeholder groups found onboard observers too expensive (2,3,4). Furthermore, the fisheries inspection does not have the amount of observers to man every vessel (1). It might be possible to perform such inspections with students for lower wages (1).

Objectivity of observer

An NGO said that fishermen and observers often know each other which can affect the objectivity of the observer (3). A researcher mentioned that onboard observers are bribable (4).

Other things to consider

An NGO thinks that fishermen are often smart enough to bypass the control of the onboard observers (3). A fishery representative said that more enforcement is unquestionable fishermen comply with regulations nowadays (2).

3.2.2.10. Overall view of applicability different success factors in Dutch demersal fisheries

This chapter gives an overview of the applicability of the different success factors which were used during the interviews. All success factors have been coded, as presented in *Table 7*, to make a clear

graph (Figure 10) which shows the most and least applicable success factors in the Dutch demersal fisheries.

Table 7: Success factors used during interviews with corresponding codes

Success factors tested during interviews with corresponding codes	
Success factor	Code
Electronic Monitoring System (EMS) with cameras.	1
Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.	2
The possibility to land small quantities of fish that are over quota without being penalized.	3
Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.	4
Closing of fishing grounds for certain types of fishing gear.	5
Increasing minimum mesh sizes.	6
Onboard observers.	7
Closing a fishery when an annual unwanted bycatch limit has been exceeded.	8
Closing fishing grounds when the percentage of unwanted bycatch of a specific species is exceeded in the catch composition of one haul.	9

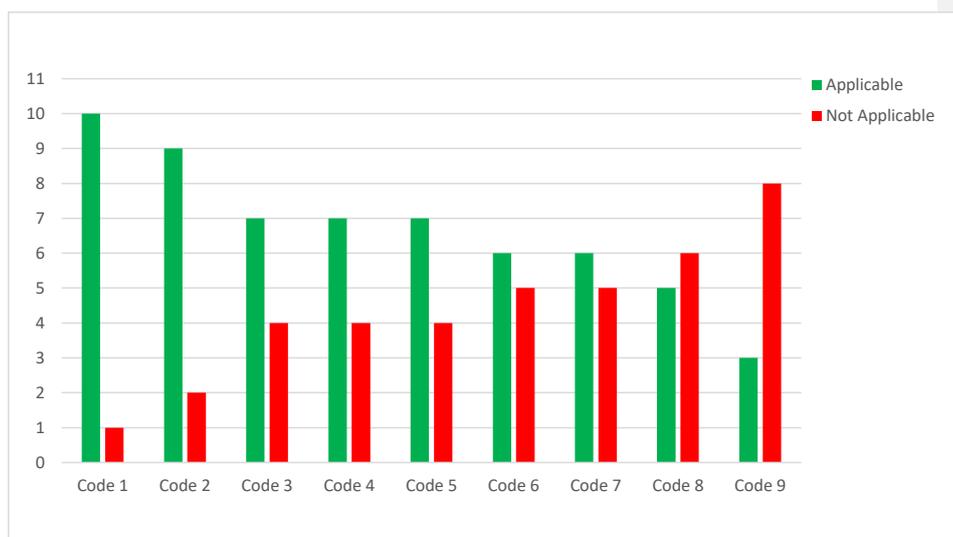


Figure 10: Applicability of multiple success factors in Dutch demersal fisheries

According to the interviewees, EMS with cameras (code 1) have the most potential to apply in the Dutch demersal fisheries. This is followed by sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding (code 2). The three third most applicable success factors are the possibility to land small quantities of fish that are over quota without being penalized (code 3), collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch (code 4) and closing of fishing grounds for certain types of fishing gear (code 5).

3.2.3. The most promising success factors from already implemented discard bans and self-named solutions

During the interview, the interviewees were asked which two of the success factors from already implemented discard bans and self-named solutions were most promising for reaching more selectivity in the Dutch demersal fisheries.

3.2.3.1. Different perspectives of stakeholder groups on most promising solutions and success factors

NGOs

One of the NGOs felt that it is important the government formulates a structural innovation vision, in where space for innovation is offered. Another pointed out that it is very important that fishermen work together by sharing catch compositions and corresponding locations to avoid high percentages of unwanted bycatch. The last one said that it is very important to keep innovating nets to reach more selectivity. The three NGOs agreed on one most promising solution which is EMS with cameras.

Fisheries organizations

One fishery representative said that the fisheries need more time to comply with the LO or to actually improve selectivity. This is complimented by the fact that exception arrangements for some species have been named as a very important measure. It is also very important that the fishery industry continues selectivity experiments. Furthermore, the LO needs to fit certain fisheries more instead of implementing a general LO for all fisheries in the EU. For making the LO more workable it is important that measures which determine the requirements of fishing gear and trip need to be abolished so that fishermen can make decisions on their own for improving selectivity. When this is implemented it is important that fishermen can show that they follow the rules by self-control. No most promising solutions were shared between fishery representatives.

Research institutes

Collaboration between fishermen researchers and government is necessary to improve selectivity. Problems which are present in certain fisheries should also be addressed with the help of the fishing industry. One most promising solution shared by two researchers was the implementation of a camera system. Of the researchers, one does not see any promising solutions.

Legislative bodies

One representative mentioned that net adaptations are very important for making the LO work. Another said that the possibility to land small quantities of fish which are over quota without being penalized is a very promising solution. One most promising solution shared by two representatives of a legislative body was the implementation of EMS with cameras.

3.2.3.2. Most promising success factors from already implemented discard bans and self-named possible solutions shared by different stakeholder groups

This section describes the most promising success factors from already implemented discard bans and self-named possible solutions that have been shared by different stakeholder groups during the interviews.

The EMS with cameras is named by almost every interviewee of the NGOs, researchers and legislative bodies. However, the fishery representatives did not see this as the most promising solution. Net innovations is shared as most promising solution by a representative of legislative bodies, NGO and fishery representative. A researcher and fishery representative mentioned that the LO needs to fit certain fisheries more as a most promising solution. Also more collaboration between fishermen and different stakeholders have been shared as a most promising solution by a researcher and an NGO.

4. Conclusions

4.1. Limiting factors present in the Dutch demersal fisheries for achieving the goal of more selectivity

The results in *section 3.1.1.* provided an answer on the first research question concerning the current limiting factors in the Dutch demersal fisheries for achieving the goal of more selective fisheries. It became clear that multiple limiting factors are currently present in the situation of the LO in Dutch demersal fisheries. An overview of the different limiting factors in the Dutch demersal fisheries are given in *Table 8.*

Table 8: Types of limiting factors in Dutch demersal fisheries

Types of limiting factors in Dutch demersal fisheries
Exemptions in the LO
Fisheries management system
Implementation process of the LO
Monitoring and enforcement
Selectivity innovations in fisheries
Support in fishing industry for LO

Exemptions in the LO can be seen as a limiting factor from mostly an NGO perspective as these exemptions dilute the idea of the LO. The EU fisheries management system is limiting as measures are often implemented top-down for all member states. This results in measures which do not fit a certain fishery. Furthermore, the facilitation of selective innovations is limiting as the government is not focusing enough on the mitigation of barriers for selective innovations and there are still measures present which incentivize discarding. The implementation process of the LO is also limiting as it changed the fisheries management too abruptly and the goal of the LO is still differently interpreted. The current monitoring and enforcement is one of the most limiting factors. The low support from the fishing industry results in non-compliance of the LO with the current form of enforcement. Another limiting factor is the high amount of mixed demersal fish stocks and the 80 mm fisheries in the North Sea. The last limiting factor is the low support from the fishing industry.

4.2. Success factors in management and technical measures from already implemented discard bans

The results in *section 3.2.1.* provided an answer on what the success factors in management and technical measures of already implemented discard bans for achieving corresponding goals are. It became apparent that there are multiple types of success factors. An overview of the different types of success factors is given in *Table 9.*

Table 9: Types of success factors from already implemented discard bans

Types of success factors from already implemented discard bans
Collaboration between fishermen
Monitoring and enforcement
Fishery closures or restrictions
Area closures or restrictions
Net regulations
Quota regulations

Collaboration between fishermen was present in the United States (Alaska) and New Zealand and was used to collectively avoid areas with high percentages of unwanted bycatch. Monitoring and enforcement was present in multiple countries to ensure the discard ban is executed according to law. EMS with cameras, onboard observers and sanctions were tools that were present. Fishery closure or restrictions are present in Alaska, Canada and the Faroe Islands. The closures are effectuated when an annual bycatch limit is exceeded or when it is the spawning season of vulnerable species. Area closures or restrictions are present in the Faroe Islands, Norway and Iceland. The closures are for avoiding large aggregations of unwanted bycatch. The restrictions can be used to incentivize fishermen to fish with more selective gear. Net regulations are present in the Faroe Islands, Iceland and Norway in the form of legal minimum mesh sizes and an increase of the mesh size. The last success factor concern quota regulations and are present in Norway, Canada and the Faroe Islands. This involves the possibility to land small quantities of fish that are over quota without being penalized and bycatch quota.

4.3. Applicability of success factors from already implemented discard bans

The results in *section 3.2.2.* gave answer to which success factors of already implemented discard bans could apply to support achieving the goal of more selective Dutch demersal fisheries. It became clear that five success factors were most applicable in the Dutch demersal fisheries. An overview of the five success factors are given in *Table 10.*

Table 10: Success factors which are most applicable in the Dutch demersal fisheries

Types of success factors from already implemented discard bans		
Success factor	Applicability	
Electronic Monitoring System (EMS) with cameras.	10	1
Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.	9	2
The possibility to land small quantities of fish that exceed quota without being penalized.	7	4
Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.	7	4
Closing of fishing grounds for certain types of fishing gear.	7	4

The most applicable success factor is EMS with cameras. This measure could allow effective enforcement of the LO when the privacy issue is solved and fishermen are incentivized to use this system. The second most applicable success factor are sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding. This measure can also be used to enforce the LO when penalizing happens systematically. Furthermore, the possibility to land small quantities of fish that exceed quota without being penalized can create flexibility in the quota system. However, agreements between stakeholders need to be made on the exact conditions of this measure. Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch could be possible when fishermen start to register all catches with corresponding locations. At last, closing of fishing grounds for certain types of fishing gear might be possible but could lead to a large amount of questions and a long policy process.

4.4. Self-named possible solutions for achieving more selective Dutch demersal fisheries

The results in *section 3.1.3* describes the self-named possible solutions of the limiting factors mentioned by the stakeholders. Five types of possible solutions were found. An overview of the types of self-named possible solutions are given in *Table 11*.

Table 11: Self-named possible solutions

Self-named possible solutions
Exemptions in LO
Fisheries innovations to improve selectivity
Facilitating development of selectivity by the government
Collaboration to improve selectivity
Monitoring and enforcement

Exemptions in the LO have been named by fishermen and researchers as a possible solution. The LO in its current form is not workable. The exemptions can give some room to fishermen to improve selectivity. The second possible solution are fisheries innovations to improve selectivity. More new selective fishing nets need to be developed by the fishing industry itself for fishing more selective. The third possible solution is more facilitating of development to more selectivity. This can be done by the development of a structural innovation vision by the government which allows space and compensation for the development of more selective new nets. The fourth possible solution is more collaboration to create a shared vision and come up with solutions together which could result in more support from the fishing industry. The last possible solution is effective monitoring and enforcement. All stakeholder groups found that EMS with cameras could be a good measure for enforcing the LO.

4.5. Most promising success factors from already implemented discard bans and self-named possible solutions

The results in *section 3.2.3* describes the most promising success factors from already implemented discard bans and self-named possible solutions. This information is useful to select the factors which the stakeholders found most important for reaching more selectivity. Four factors and solutions were shared between different stakeholder groups. An overview of the most promising factors and solutions is given in *Table 12*

Table 12: Most promising success factors from already implemented discard bans and self-named possible solutions

Most promising success factors from already implemented discard bans and self-named possible solutions	
Most promising factors and solutions	Amount of times shared
EMS with cameras	7
Net innovations	3
The LO needs to fit a certain fishery more instead of an overall LO for all fisheries in the EU	2
Collaboration between fishermen and different stakeholders	2

The most promising factor is EMS with cameras, shared by every stakeholder group, except fishermen. The second most promising factor are net innovations which is shared by a

representative of a legislative body, fishery representative and NGO. The third most promising factor is that the LO needs to fit a certain fishery more instead of an overall LO for all fisheries in the EU shared by a fishery representative and researcher. The fourth most promising factor is more collaboration between fishermen shared by a researcher and NGO.

4.6. Overall conclusion

Limiting factors in the Dutch demersal fisheries for achieving more selective fisheries are the exemptions in the LO, the current fisheries management system, the implementation process, the lack of monitoring and enforcement, the lack of selective innovations in fisheries and the low support of the fishing industry for the LO. According to multiple interviewees some success factors are applicable in the situation of the LO in Dutch demersal fisheries. Of these success factors, the most applicable success factors mentioned were Electronic Monitoring System with cameras, sanctions such as fines and the revoking of quota or fishing permit for illegal discarding, the possibility to land small quantities of fish that are over quota without being penalized, collaboration of fishermen by sharing catch compositions in certain areas to avoid catches with a high percentage of unwanted bycatch, closure of areas for certain gears. However, some considerations should be taken into account before applicable success factors could truly be implemented in the situation of the LO in Dutch demersal fisheries. All interviewees have also mentioned solutions to solve limiting factors, which in some cases were deemed to be more promising to improve the possibility of reaching the goal of the LO. These solutions were present in the form of exemptions in the LO, fisheries innovations to improve selectivity, facilitating development of selectivity by the government, collaboration to improve selectivity, monitoring and enforcement. Overall it can therefore be said that, through the implementation of applicable success factors from already implemented discard bans and self-named solutions of the interviewees, the possibility of achieving the goal of the LO can be improved.

5. Discussion

This chapter will discuss all the different results by linking them to each other.

5.1. Discussion of results

Exemptions in the LO were mentioned as a limiting factor by the NGOs and mentioned as a possible solution by fishery representatives and researchers. The NGOs feel that the goal of the LO of more selective fisheries is being diluted with the different exemptions. However, especially in the 80 mm fishery, fishermen are simply not ready to fully implement the LO without these exemptions. Moreover, the species which get an exemption need to have a proven high survivability (Steins *et al.*, 2018). Furthermore, it has also been mentioned by representatives of legislative bodies, fishery representatives and researchers that the LO has been implemented too abruptly with a total implementation timeframe of three years (European Commission, 2018). This is in stark contrast with Norway, where they started implementing the discard ban in 1987 until the present time, gradually increasing the amount of species which fall under the discard ban (Gullestad *et al.*, 2015). For these reasons, it can be said that fishermen would fish less selective when the LO is fully implemented, due to the fact they need to land all commercial species with quota now and there is no gear that is sufficiently selective. Currently, this would mean that the exemptions which have a proven high survivability result in more selectivity than when the LO is fully implemented. In the meantime it is necessary that more selective fishing methods are developed so that the LO could be fully implemented in the future. All stakeholder groups also agree that more net innovations need to be developed. Moreover, it is mentioned as a most promising factor by a fishery representative, representative of a legislative body and researcher. The gearing-up tool can help fishermen develop new innovative nettings as this tool shows a clear overview of around 450 net innovations and its effects performed in EU fisheries (Gearingup, 2018). However, the facilitating of more selective net innovations by the government is mentioned as limiting by NGOs and fishery representatives. A possible solution is that fishermen need to be granted space to develop more selective nettings and are compensated by the government for their efforts.

The top-down approach of the EU for implementing regulations has been mentioned by all stakeholder groups as limiting. In this case, an LO has been implemented for all fisheries in the EU, while these fisheries differ a lot from each other. The 80 mm fishery is a perfect example of a fishery in where the LO does not fit due to the high discard rates and the difficulty of improving selectivity in this fishery. A most promising factor mentioned by a fishery representative and researcher is that the LO needs to be adjusted to fit a certain fishery, so a more regional approach of the LO is favorable instead of the top-down approach which is currently present. One of the subjects of the reformed CFP was also to regionalize fisheries management in the EU (Christensen, 2009). With the current top-down implementation of the LO it can be said that they failed achieving that.

The EU quota system is also mentioned as limiting by fishery representatives, NGOs and researchers as it incentivizes discarding when the quota for a specie is exceeded. More flexibility is needed in the quota system. A fishery representative and NGO said that the EU needs to get rid of the historical distribution of quota as it does not fit in current EU fisheries anymore. They also said that this will not happen as no member state wants to touch this subject. The possibility to land small amounts of fish which are over quota without being penalized, which is the third most applicable success factor, can bring some flexibility in the quota system. This measure is also mentioned in the EU discard manual as deemed values for creating possible flexibility in the quota system and to discourage discarding (McIlwain, 2015). In the end, it is questionable if this measure can lead to more selective fisheries, but it can discourage discarding.

The limited support of the fishing industry for the LO is also a major limiting factor mentioned by fishery representatives, NGOs and researchers. Fishermen are unwilling to land all fish as they do not comprehend why, as they see the LO itself as a measure which stimulates the waste of natural resources (Kraan & Trapman, 2015). Moreover, NGOs and researchers mentioned that the goal of the LO is still differently interpreted. This and all the limiting factors mentioned above result in a very low support of the LO by the fishing industry. A researcher mentioned that collaboration between stakeholders is very important to first establish a shared vision between stakeholders, which is more selectivity in this case. When this vision is established it is possible to come up with solutions together which have more support from the fishing industry. More collaboration between stakeholders has also been named as a most promising factor by an NGO and researcher. The GAP2 project is a good example of effective collaboration between stakeholders and coming to solutions together (GAP2, N.D.). VisHack is also a good example of a project in where different stakeholders came together to think of options that could reduce the amount of discards (Farmhack, N.D.)

The implementation of the LO is exactly the opposite of effective collaboration. This leads to non-compliance of fishermen to the LO. Furthermore, there is no effective enforcement and monitoring in place which could mean that fishing practices can continue like before the implementation of the LO due to the fact the probability of getting caught is very low and fishermen do not support the LO. A possible solution mentioned by all stakeholder groups is to force fishermen to comply with the LO by implementing EMS with cameras. In New Zealand and Chile, EMS with cameras was implemented for the same reasons, as fishermen did not sufficiently comply to the discard ban (Ministry of Primary Industries, 2018; Borges *et al.*, 2016). It also became apparent that it was the most applicable success factor from the factors used in the interviews. Moreover, it has been named as most promising factor by all NGOs, all representatives of legislative bodies and two researchers, but not by the fishery representatives. An issue with the implementation of EMS with cameras is the impaired privacy of fishermen. An NGO stated that it is necessary to have good collaboration between the government and fishermen on the placement of these cameras. Literature also states that the implementation of EMS with cameras is most successful when it is part of a collaborative program between fishermen, inspection, government and researchers and everyone understands the perspectives of each other (Gil *et al.*, N.D.). However, this does not represent the current situation in the implementation process of the LO. Therefore, fishermen will always find a way to evade monitoring of their activities when they want to. Especially when there is a questionable management measure like the LO present which could lead to unprofitable fisheries (Gil *et al.*, N.D.). Study shows that 58% fishermen who already worked with an EMS system with cameras are positive. While only 10% of fishermen who did not already work with EMS with cameras found this measure positive. This also has to do with the fact that fishermen who worked with this system often are given an incentive to use this system (Plet-Hansen *et al.*, 2017). One possible incentive mentioned by a researcher is that cameras could be part of a MSC certification. A fishery representative mentioned that rewarding fishermen with extra quota is a good incentive. Study also shows that economically driven incentives work the best for implementing this measure (Plet-Hansen *et al.*, 2017). Another topic that is important regarding the implementation of EMS with cameras is the assessing of images on possible violations. It is almost impossible that the fishery inspection can check every image. Possible solutions mentioned during the interviews were making EMS with cameras part of an MSC certification, only assessing vessels with strange catch compositions or assessing the images sample-wise. In other fisheries they also use the sample-wise method for assessing the images (Plet-Hansen *et al.*, 2017; Gil *et al.*, N.D.). In the end, this measure could indirectly lead to more selective fisheries due to the fact an LO without enforcement will never stimulate fishermen to fish more selective and comply with the LO.

The second most applicable success factor were sanctions such as fines and the revoking of quota or fishing permit for illegal discarding. This is necessary for showing fishermen that illegal discarding will be penalized. However, it is very hard to effectively sanction fishermen due to the limited enforcement. Different stakeholder groups mentioned that systematic monitoring is necessary to implement this measure. EMS with cameras can offer this systematically monitoring (Plet-Hansen *et al.*, 2017). So it is necessary to first implement EMS with cameras and then implement a system which makes it possible to effectively sanction fishermen who do not comply with the LO. In the end, this measure could indirectly lead to more selective fisheries due to the fact the LO without enforcement with penalties will never stimulate fishermen to fish more selective and comply with the LO.

Another most applicable success factor was collaboration of fishermen by sharing catch compositions in certain areas to avoid catches with a high percentage of unwanted bycatch. All NGOs and most researchers agreed on this measure. However, most fishery representatives did not see this measure as applicable while they are the ones who need to collaborate. This is mainly due to the fact fishermen are competitors of natural resources in the same area. In this measure it is also important that there is a shared vision by fishermen that selectivity is something to strive for. Furthermore, it has been mentioned by fishery representatives and NGOs that this measure can only succeed when a system is present which automatically registers catch composition per haul and corresponding location, and the sharing of data is done anonymous. Again, EMS with cameras could facilitate in implementing this measure. When that measure is implemented it is possible to automatically and anonymously share the catch composition and corresponding location to a central point. Literature also states that this is a possibility when implementing EMS with cameras (WWF, 2015). This still leaves the question who will manage the aggregation of data. A researcher mentioned that POs are getting used to gathering data as a result of the pulse trawl monitoring studies. However, fishery representatives said that POs are already busy enough and that they are not capable to facilitate this measure. Nevertheless, it has been mentioned by a fishery representative and NGOs that for support by fishermen of this measure it would be favorable that the fishery organizations stimulate this and aggregate the data itself into a real-time unwanted bycatch map. However, this can only be implemented when a shared vision between stakeholders is achieved which means that the government needs to facilitate this and research institutes like WMR can help fishery organizations to develop an effective method for aggregating this data. In the end, this measure could lead to more selectivity when fishermen are actively avoiding areas with a high percentage of unwanted bycatch.

The last most applicable measure was the closing of fishing areas for certain gears. All NGOs agree with the applicability of closing areas for certain gears. This is not strange as closing fishing areas could lead to a reduction in fishing pressure in certain areas. Most fishery representatives do not agree as this measure will reduce the areas in where they can fish. In Norway, they used this measure for stimulating fishermen to fish with the more selective Nørdmore grid by closing fishing areas for all gears except that grid (Gullestad *et al.*, 2015). A researcher mentioned that there is no more selective measure present like the Nørdmore grid. This means that a more selective gear needs to be developed. Until a more selective gear is developed, it is not possible to improve selectivity with this measure. It can be merely be implemented to relieve fishing pressure in certain areas.

5.2. Limitations of this study

During this study, certain limitations in the research methods have been encountered. It was decided that the success factors which were present two times or more in already implemented discard bans were going to be used in the interviews. It could be very possible that a success factor that was mentioned one time in the literature review applies very well in the Dutch demersal fisheries. However, these were not analyzed on applicability and can be considered a shortcoming in this study. The original plan was to interview three persons from every stakeholder group. However, it proved very difficult to find a third representative of a legislative body who was willing to do an interview. This resulted in an unbalance of interviewees per stakeholder group which could have affected the results. Multiple interviewees have mentioned that it is not certain if the goal of the LO can actually be considered reaching more selective fisheries. As this study has been based on the interpretation that the goal of the LO is in fact reaching more selective fisheries, might therefore be unjust. During the interviews multiple interviewees have also mentioned that most of the success factors could only be applied in the theoretical sense, but did not know if such factors could also help to achieve more selective fisheries. Therefore it might have been beneficial for the research if the term 'applied' would have been explained during the interviews with the notion if these factors can or not help achieve the goal of the LO.

It is also possible that certain self-named solutions and limiting factors would have been agreed on by certain stakeholder groups or interviewees or both, but simply have not been able to state that they also see this as solutions, and success and limiting factors. Furthermore, individual fishermen or representatives from the seafood trade have not been interviewed, which might have been a limitation of the study as it could have been a valuable perspective as well. Moreover, the codes that have been used were made after the interviews. This could have led to some bias when making these codes. Furthermore, some success factors used in the interviews only differ a little from measures which were already present in the Dutch demersal fisheries. At last, all researchers which were interviewed originated from the same research institute. This could have led to a bias which could be present in that institute.

6. Recommendations

For reaching more selectivity we recommend that a shared vision is created between all stakeholders, that selectivity is something to strive for. For reaching a shared vision it is necessary that the low support from the fishing industry for the LO changes and the goal is not interpreted differently anymore. This could be facilitated by the government who can organize recurring meetings with all the different stakeholders. It is very important that the stakeholders listen to, and respect the vision each other on reaching more selectivity and from there on come up with solutions together. In these meetings it also needs to become apparent that not only the fishermen are the ones who need to innovate, but that every stakeholder needs to work together for developing more innovative selective fishing methods and gears. However, this is a long process as there are large differences in perspective. Further research can be performed to explore more possibilities that can increase a shared vision between stakeholders on the goal of the LO.

In the meantime, we recommend that the government facilitates the development of more selective fishing methods as much as possible to show good faith towards the fishing industry, which could help reduce the low support for the LO. This can be done by granting fishermen more space to develop new selective nettings. The word 'space' in this context means that the government needs to continue to give out exemptions of species for the LO when they have a proven high survivability. Furthermore, fishermen who perform selectivity experiments need to be financially compensated for their efforts. Fishermen mostly act out of economic reasons. Compensating them would make it more interesting for fishermen to experiment with new selective fishing methods and gears. It is also recommended, for creating more space, that a more regional approach for every fishery of the LO needs to be implemented. For some fisheries it is very easy to comply with the LO and for other fisheries it is very hard. These fisheries, like the 80 mm fishery, need to have more time to effectively implement the LO and achieve more selectivity. Further research can be performed on possibilities which could grant fishermen more space to develop selective gears/methods.

Even when a shared vision is present, there will always be fishermen who do not agree with the LO. Therefore, we recommend that effective monitoring and enforcement needs to be implemented in the form of EMS with cameras. For effectively implementing EMS, we recommend that fishermen are economically incentivized to use this measure. Making EMS part of a special MSC certification is a possible incentive as fishermen can sell their fish as more sustainable than others. Another incentive is rewarding fishermen with additional quota. We also advise to assess the images of the EMS in a sample-wise way as the fishery inspection does not have the capability to assess every image. It is expected that this method will have the same deterrent effect as when all images are assessed. Further research can be done to investigate more possibilities to incentivize fishermen to use EMS with cameras.

When EMS is successfully implemented, we recommend that sanctions for illegal discarding are implemented by the government. We expect that without these sanctions fishermen will continue to discard as there are no consequences. Further research is can be done on what fair sanctions are for the amount of fish a fishermen illegally discards

When EMS is successfully implemented we recommend to use EMS with cameras not only for monitoring and enforcement, but also for the automatically and anonymously sharing of catch composition with corresponding location for avoiding catches with a percentage of unwanted bycatch. The goal is to provide fishermen with a real-time unwanted bycatch map. When this is implemented, fishermen can make decisions on where to fish based on this map for avoiding large

amounts of discards, thus fishing more selective. Further research can be done on which stakeholder group will take responsibility for managing this system.

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Appendix I: Limiting factors in Dutch demersal fisheries

This appendix provides an overview of all limiting factors in Dutch demersal fisheries that were encountered during the literature review and the interviews. All limiting factors are given in different forms of specificity, the consequences they have and with the number of times the limiting factor was shared by a stakeholder group during the interviews.

Limiting factors in Dutch demersal fisheries				
Type of limiting factor	General limiting factor	Specific limiting factor	Consequence	Number of times shared by stakeholder group
Exemptions in the LO.	Common dab (<i>Limanda limanda</i>) should not have been exempted from the LO.	The entire quota of Common dab has been abolished, resulting in a species that can still be discarded during the full implementation of the LO. No additional safety measures have been appointed for this species.	European fisheries management left responsibility for common dab.	NGOs: 2 Legislative bodies: none Fisheries organizations: none Research institutes: none
	Exemptions dilute the principle of the LO.	Due to problems in the implementation of the LO in certain fisheries, some fisheries can receive exemptions from the LO. Such exemptions could however dilute the principle of the LO.	This results in a landing obligation where the problem of discards are still addressed, but little is being achieved.	NGOs: 2 Legislative bodies: none Fisheries organizations: none Research institutes: 1
Fisheries management.	Top-down approach of the European fisheries management system.	Regulations are often implemented top-down for multiple fisheries. However, fisheries differ a lot from each other in the European Union (European Union, 2015).	Could lead to situations where a regulation does not fit a fishery but still needs to be implemented.	NGOs: 1 Legislative bodies: 1 Fisheries organizations: 3 Research institutes: 2
		European fisheries management is very centralized and stakeholders do not have a lot of saying in the decision-making process (European Union, 2015).	Could lead to non-compliance of the fishing industry. Measures with stakeholder consultation mostly have more support from the stakeholders (European Union, 2015).	Has not been shared during the interviews
	Complicated regulations in	Catch-up rules in response to fisheries	Could lead to fishermen struggling to	NGOs: none Legislative bodies: 1

European fisheries management.	adaptations on implemented regulations (European Union, 2015).	understand all the regulations which also could lead to non-compliance (European Union, 2015).	Fisheries organizations: 1 Research institutes: none
Catch composition measures	Catch composition rules that reflect the specificity and species mix of a fishery. There is a legal obligation to discard fish to stay inside of permitted percentages of fish in the catch composition (European Union, 2015).	Catch composition rules often lead to discarding (European Union, 2015).	NGOs: none Legislative bodies: 1 Fisheries organizations: 3 Research institutes: 3
Different forms of enforcement in EU member states.	Other member states take European legislation less seriously. Fishermen might also notice that fisheries in other member states are not being controlled on their compliance with the LO.	This could result in less motivation in Dutch fisheries to comply with the LO.	NGOs: none Legislative bodies: 1 Fisheries organizations: 1 Research institutes: none
Fisheries have too much political power.	Fisheries have one of the most powerful lobbies in The Netherlands and the majority of the Dutch House of Representatives are defensive of the fishing industry. It is therefore difficult for the government to implement measures fisheries do not want.	The implementation of measures that are needed to enforce more selectivity might not be able to be implemented.	NGOs: 1 Legislative bodies: none Fisheries organizations: none Research institutes: none
Quota system.	Due to the quota system fisheries may only land fish for which they own quota. If fisheries land fish of which they have exceeded quota, sanctions will follow.	This results in discards when fisheries have exceeded quota.	NGOs: 1 Legislative bodies: none Fisheries organizations: 2 Research institutes: 1
Government is not facilitating innovations enough.	The government is not focusing enough on the mitigation of barriers for selective innovations. For instance the	This impairs the development of selective innovations.	NGOs: 3 Legislative bodies: none Fisheries organizations: 1 Research institutes: none

		development of selective innovations is impaired by administrative actions.		
Implementation process.	Collaboration between fishing industry and other stakeholders.	The LO has been implemented without true collaboration on deciding management options with the fishing industry.	Resulted in the absence of wanting to collaborate on fisheries management and an overall impaired collaboration.	NGOs: none Legislative bodies: none Fisheries organizations: none Research institutes: 1
	Effects of choke species have been underestimated.	The effects of choke species have barely been considered and underestimated during the implementation process of the LO.	As the LO is gradually fully implemented the problems with choke species become more apparent as they limit the effectiveness of the LO.	NGOs: none Legislative bodies: 1 Fisheries organizations: none Research institutes: none
	Implementation of LO is not sufficiently based on scientific and socio-economic knowledge.	During the implementation of the LO expert fishing biologists were not sufficiently involved. Next to this, an assessment of the socio-economic effects of the LO has been absent as well.	This has had negative effects on the effectiveness of the LO as a tool to reach more selectivity.	NGOs: none Legislative bodies: none Fisheries organizations: 1 Research institutes: 2
	The goal of the LO is still differently interpreted.	There is confusion on what the goal of the LO exactly is.	Results in the lack of a shared vision and therefore impairs collaboration.	NGOs: 2 Legislative bodies: none Fisheries organizations: 1 Research institutes: 1
	LO has changed the situation of fisheries management too abruptly.	Because of the LO the quota system has changed from a principle of landings quota to a principle of catch quota. This has for instance had the effect that fisheries were first obliged to discard undersized fish, while they are now obliged to land these species as well.	Fisheries do not have enough time to adapt to the new form of fisheries management and most of them will therefore not be compliant with the LO.	NGOs: none Legislative bodies: 2 Fisheries organizations: 3 Research institutes: 2
	Monitoring and enforcement.	Insufficient monitoring and enforcement of the LO.	No concrete ideas for enforcing and monitoring the LO (Borges <i>et al.</i> , 2016).	Could lead to non-compliance of the LO as fishermen would not be penalized for illegally

			discarding (Walker <i>et al.</i> , 2015).	
	Fishermen often find ways to evade monitoring of their activities	Monitoring and enforcement have limited effects as fishermen always find ways to evade monitoring. This for example results in difficulties for the assignment of onboard observer and the appliance of EMS.	As long as fishermen can evade monitoring illegal activities like discarding can continue, which in turn will make it difficult to reach more selectivity.	NGOs: 1 Legislative bodies: 1 Fisheries organizations: none Research institutes: 2
	Compliance with the LO results in socio-economic difficulties for fisheries	To comply with the LO would mean fisheries have to perform more work, catch less (valuable target species), have to pay for landed discards (and possibly for methods of monitoring), and fishermen could experience resistance from their crew as they will likely earn less money will performing more work as well.	This could result in non-compliance with the LO as complying with the LO would result in economic difficulties.	NGOs: none Legislative bodies: none Fisheries organizations: 2 Research institutes: 2
	Fishermen will not agree with sanctions on exceeding quota of choke species.	When the LO will be fully implemented choke species will become a major problem for fisheries, if sanctions on exceeding quota of choke species are truly applied.	Fishermen will most likely respond with full resistance on such sanctions.	NGOs: none Legislative bodies: none Fisheries organizations: 1 Research institutes: none
Selective innovations in fisheries.	Avoiding discards is difficult in the North Sea due to mixed fish stocks.	There are few Dutch demersal fisheries where discards are absent in one haul, due to the high amount of mixed fish stocks in the North Sea.	As avoiding discards in the North Sea is difficult due to the natural situation of mixed fish stocks, achieving complete selectivity is very difficult.	NGOs: 3 Legislative bodies: 1 Fisheries organizations: 1 Research institutes: 3

	Effective selective innovations are taking too long.	Effective selective innovations in the fishing industry are not being developed fast enough.	This results in the dilemma that innovations need to be enforced, while the fishing industry should still be able to continue fishing.	NGOs: 2 Legislative bodies: 1 Fisheries organizations: none Research institutes: none
	Some species are too valuable to avoid catching them.	There are possibilities (like enlarging minimum mesh sizes) to improve selectivity in some fisheries, but this could result in the loss of caught valuable species.	Due to possible loss of caught valuable species because of selective innovations, fishermen are less likely to apply such innovations.	NGOs: none Legislative bodies: 1 Fisheries organizations: 1 Research institutes: 1
Support in fishing industry for LO.	LO is practically impossible to execute.	Fishermen might understand that the amount of discards should be reduced, but do not have the means to do so.	If the LO would be fully enforced the majority of fisheries would not be able to comply.	NGOs: none Legislative bodies: none Fisheries organizations: 2 Research institutes: 3
	Very limited support in fishing industry for LO.	Fishermen are unwilling to land all fish as they do not comprehend why they should. Among other reasons, the confusion is caused by the feeling that the landing of undersized fish results in the absence of a chance for survival that was higher before the implementation.	Without support for the LO in fisheries, the enforcement cannot be effective as fishermen will most likely accept they do not comply with the LO.	NGOs: 1 Legislative bodies: none Fisheries organizations: 3 Research institutes: 2
	The fishing industry does not collectively support the goal of the LO.	Fishermen do not perceive selectivity the same way other fishermen might. For producer organizations it is very difficult to tell their members they should fish more selective as this might result in fishermen switching to other produce organizations. Due to different interests inside the POs it is also difficult to reach such a vision.	Without a collective support of the goal of the LO, reaching more collaboration with the fishing industry and more selective fisheries will be very difficult.	NGOs: 1 Legislative bodies: none Fisheries organizations: none Research institutes: 2
	Collaboration based on the sharing of data	Fishermen in general do not feel the need to	The lack of collaboration based on	NGOs: 1 Legislative bodies: none

	between fishermen is difficult due to competition.	collaborate, due to competition. Technology has allowed such collaboration, but as long as there is no mutual trust it will be very difficult.	the sharing of data between fishermen will make it difficult to avoid certain catch compositions in certain areas.	Fisheries organizations: 1 Research institutes: 1
	A lot of time is being spent on resistance towards the LO.	A lot of time is being spent on where and why exemptions should be made for the LO and resisting compliance to the LO in general.	Less time is being invested in finding suitable methods of reaching selectivity, as it is invested in the resistance.	NGOs: 3 Legislative bodies: 1 Fisheries organizations: none Research institutes: none
	Fishermen are not aware of the amount of their discards.	Due to onboard processing techniques, fishermen will not take the time to check the amount of discards. When they are confronted by research institutes with the amount of discards fishermen will often not believe it.	The absence of awareness on the amount of discards a fishermen catches makes it difficult for fishermen to understand why selectivity is necessary.	NGOs: none Legislative bodies: none Fisheries organizations: 1 Research institutes: 1

Appendix II: Overview success factors in already implemented discard bans

This appendix provides an overview of all success factors in already implemented discard bans that were encountered during the literature review. All success factors are given in different forms of specificity, the consequence they had and with the corresponding countries.

Success factors already implemented discard bans				
Type of success factor	General success factor	Specific success factor	Consequence	Country
Collaboration between fishermen.	Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.	Cooperation agreements between fishermen and sectors for communication on which places to avoid due to high percentages of unwanted bycatch (Karp <i>et al.</i> , 2005).	Can lead to better communication between fishermen on where high percentages of unwanted discards are present (Karp <i>et al.</i> , 2005).	United States (Alaska)
		A system which automatically aggregates reports of catches and corresponding location from different fishermen, creating real-time bycatch maps (Telesetsky, 2016).	Can lead to a real-time unwanted bycatch map which fishermen can use to avoid areas with high percentages of unwanted bycatch (Telesetsky, 2016).	New Zealand
Monitoring and enforcement.	Electronic Monitoring System (EMS) with cameras.	EMS for fully monitoring the fishing practices at sea (Borges <i>et al.</i> , 2016).	Can lead to compliance of the discard ban as fishermen could not hide fishing practices anymore (Borges <i>et al.</i> , 2016).	Chile
		EMS for fully monitoring the fishing practices at sea (Ministry of Primary Industries, 2018).	Can lead to full transparency in fisheries and a severe reduction of illegal discarding and misreporting (Ministry of Primary Industries, 2018).	New Zealand
	GPS tracking.	GPS tracking for monitoring if fishermen in an ITEQ system do not fish in restricted areas (Gezelius, 2008).	Can lead to enforcement of closed areas for fisheries (Gezelius, 2008).	Faroe Islands
	Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.	Penalties for fishing in closed areas and not reporting exceeded trip limits (Gezelius, 2008).	Can lead to an increase in compliance of reporting and avoidance of closed areas (Gezelius, 2008).	Faroe Islands
Illegally discarding and misreporting are penalized by fines or temporal withdrawal of fishing licenses and ITQs (Telesetsky, 2016).		Can lead to a decrease of illegally discarding and misreporting when sufficiently enforced (Ministry of Primary Industries, 2018).	New Zealand	

		Failure of non-mandated catch and non-compliance of area closures results in well-publicized revoking of fishing licences, fines or even goal sentences (Condie <i>et al.</i> , 2014; European Commission, 2008).	Well-publicized penalties can lead to more compliance of the discard ban and accompanying regulations (European Commission, 2008).	Iceland
	Onboard observers.	Onboard observers for monitoring the percentages of juvenile fish in a catch and enforcement of the discard ban (European Commission, 2008).	Can lead to the closure of fishing grounds when a certain percentage of juvenile fish was exceeded in the catch and reduction in discard rates (European Commission, 2008).	Iceland
		Onboard observers for enforcing the discard ban and reporting of catches of fishermen (Telesetsky, 2016).	Can lead to reduction of discards and misreports (Telesetsky, 2016).	New Zealand
		Onboard observers enforce the discard ban and corresponding regulatory measures (Karp <i>et al.</i> , 2005).	Can help reduce discards by enforcing the discard ban (Karp <i>et al.</i> , 2005).	United States (Alaska)
	Daily communicating catch reports to fisheries scientist for predicting area or fisheries closures.	Onboard observers communicate catch reports to the fishery science centre. They can make predictions on when a fishery exceeds the total bycatch limit if fishing practices continue in the same way (Karp <i>et al.</i> , 2005).	The information on when a fishery will be closed can lead to more selective fisheries as fishermen do not want the fisheries to be closed (Karp <i>et al.</i> , 2005; Graham <i>et al.</i> , 2007).	United States (Alaska)
Fisheries closure or restrictions.	Fishing ban during spawning season for a certain species.	Closure of cod fisheries during spawning season from 1 march to 1 may (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Can lead to protection of juvenile fish (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Faroe Islands
	Closing a fishery when an annual unwanted bycatch limit has been exceeded.	Every year a total bycatch limit is allocated to a fishery. If this limit is exceeded the whole fishery will be closed (Karp <i>et al.</i> , 2005).	Can lead to an encouragement for fishermen to avoid areas with high percentages of unwanted bycatch and to search for more selective fishing methods (Karp <i>et al.</i> , 2005).	United States (Alaska)
		Annual bycatch limits are set to stimulate the fishermen to fish more selective for their target species. If the limit is exceeded the fishery will close (Condie <i>et al.</i> , 2014).	Can lead to a reduction of 5% bycatch of the spiny dogfish and a reduction of 15% bycatch of halibut (Condie <i>et al.</i> , 2014).	Canada
Area closures or restrictions	Closing fishing grounds when the percentage of unwanted bycatch	Closing an area for 1-2 weeks when the percentage of juvenile cod, saithe and haddock exceeded 30% of the catch	Can lead to a reduction of fishing pressure in areas with a high percentage of juvenile fish (Grétarsson & Danielsen,	Faroe Islands

	of a specific species is exceeded in the catch composition of one haul.	(Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	2014; Jákupsstovu <i>et al.</i> , 2007).	Norway
		Closing an area when a percentage of juvenile cod and other species exceed 15% of the catch. A fisherman needs to move their fishing practices five miles (Gullestad <i>et al.</i> , 2015).	Can help reduce the capture of juvenile fish (Gullestad <i>et al.</i> , 2015).	
		Closing an area for two weeks by onboard observers when a percentage of undersized fish exceeds a certain limit in one haul (European Commission, 2008).	Can lead to a reduction in caught undersized fish (European Commission, 2008).	Iceland
	Closing of fishing grounds for certain types of fishing gear	Area restrictions for trawl and longline fisheries executed by larger vessels (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Can lead to a reduction in fishing pressure in some areas (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Faroe Islands
Area closures for all gears except when fishing with the more selective Nørdmore grid used in shrimp fisheries (Gullestad <i>et al.</i> , 2015).		Can lead to a stimulation to use more selective gears, thereby reducing discards (Gullestad <i>et al.</i> , 2015).	Norway	
Net regulations.	Increasing minimum mesh sizes.	Gradually increasing the minimum mesh size from 120 to 155 mm in the roundfish fisheries (European Commission, 2008).	Can lead to a reduction in discards of cod (27%) and haddock (European Commission, 2008).	Iceland
		Increase of minimum mesh size to 125 mm in the roundfish fisheries (Gullestad <i>et al.</i> , 2015).	Can lead to a reduction in undersized fish (Gullestad <i>et al.</i> , 2015).	Norway
	Legal minimum mesh sizes.	Legal minimum mesh sizes for certain target species (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Can lead to an escape of juvenile fish from the fishing net (Grétarsson & Danielsen, 2014; Jákupsstovu <i>et al.</i> , 2007).	Faroe Islands
Quota regulations.	Annual quotas	A change from weekly or trip quotas to annual quotas (Gullestad <i>et al.</i> , 2015).	Can reduce the incentive to weekly discard when exceeding the trip or weekly quota to once a year by only having one quota per year (Gullestad <i>et al.</i> , 2015).	Norway
	Bycatch quota	Bycatch quota have been allocated to cover expected unavoidable unwanted bycatch to vessels with specific target species (Gullestad <i>et al.</i> , 2015).	Can help reduce the incentive to discard unwanted bycatch as a quota is allocated for it (Gullestad <i>et al.</i> , 2015).	Norway
	The possibility to land small	Catches that exceed quotas may be landed without prosecution	Can lead to discouragement of discarding and targeting catch	Norway

	quantities of fish that exceed quota without being penalized.	or penalties. The value of the fish will be forfeited except in demersal fisheries where the fishermen receives 20% of the sale value (Gullestad <i>et al.</i> , 2015).	that exceeds quota (Gullestad <i>et al.</i> , 2015).	
		Overages for halibut (37.5%) and hake (15%) can be landed without being penalized. The overages will be subtracted from next year's quota and the value will be forfeited (Condie <i>et al.</i> , 2014).	Can help remove the incentive to target over quota catch and encourages fishermen to match catches to available quota (Condie <i>et al.</i> , 2014).	Canada
	Discarded catch with market value is counted against the quota.	It is allowed to discard catch of market value. However, they will be counted against the annual quota taking the discard survival rates in account (European Commission, 2008).	Can lead to a discouragement of the practice of high-grading (European Commission, 2008).	Canada
	Landing and selling fish in an Individual Transferable Effort Quota (ITEQ) system.	The opportunity to land and sell all fish which is caught in allocated fishing effort days (Jákupsstovu <i>et al.</i> , 2007).	Can lead to a large reduction in illegal discards and resulted in fully documented fisheries (Gezelius, 2008).	Faroe Islands
Other factors.	Exemptions for species in a discard ban.	Exemptions of species in a discard ban by executing a 2 year monitoring program to quantify and identify the causes of discards, and to develop and implement mitigation plans is performed (Borges <i>et al.</i> , 2016).	Can lead to more compliance of the discard ban by the fishing industry as some species can still be discarded (Borges <i>et al.</i> , 2016).	Chile
	Trip limit for a certain species.	A 5% trip limit for cod under 40 cm (Gezelius, 2008).	Can lead to an incentive to avoid areas with a high percentage of undersized cod (Gezelius, 2008).	Faroe Islands

Appendix III: Blueprint achievability of the goal of the landing obligation

While the landing obligation (LO) will be fully implemented on the 1st of January 2019, with the implementation in the Dutch demersal fisheries, it is still not clear if and how the European landing obligation to more selective Dutch demersal fisheries. As a literature review has already been performed on limiting factors of the LO in Dutch demersal fisheries and success factors from already implemented discard bans, interviews are needed to supplement these limiting factors and to test if and how these success factors can be applied to support achieving the goal of the LO in Dutch demersal fisheries. Apart from that, the interviews are also needed to get an insight into beneficial measures in relation to the goal of the landing obligation and to gather possible solutions for the limiting factors. All this, will be performed with semi-structured interviews in a way that does not influence the answers of the interviewees. This blueprint is constructed to ensure the interviews are sufficiently thought-out and constructed with a certain goal in mind.

Goal of the interviews

The goal of the interviews is to provide an insight into the achievability of the goal of the landing obligation in the Dutch demersal fisheries, namely improving fishing behavior through improvements in selectivity. By making further inventory of limiting factors in the Dutch demersal fisheries, possible solutions for limiting factors, and to test the applicability of success factors which were present in already implemented discard bans outside the EU. It will also be useful to test whether interviewees see self-named solutions or applicable success factors as most promising in the situation of the LO in Dutch demersal fisheries.

Research questions

As the interviews serve as a method of reaching answers on the main research question of the bachelor thesis study on the achievability of the goal of the landing obligation, this same research question is used so results of the interviews can be used to answer the research questions of the bachelor thesis study. Therefore the interviews should provide an answer on the following research question:

What limiting factors are currently present in reaching the goal of the landing obligation of more selective Dutch demersal fisheries and which success factors in management and technical measures of already implemented discard bans outside the EU could apply to support achieving this goal?

To answer this research question and to support the results of this question, multiple sub-questions have been constructed. These sub-questions will be further divided and answered during the interview with the use of interview questions. The sub-questions of the interview are as follows:

- 1. How does the interviewee feel about the implementation of the landing obligation in Dutch demersal fisheries and the achievability of the goal?**
- 2. What limiting factors are currently present in reaching the goal of the landing obligation and what are possible solutions for such factors?**
- 3. What are current positive developments regarding selectivity that are induced by the landing obligations?**
- 4. Which success factors in management and technical measures of already implemented discard bans could apply to support achieving the goal of the landing obligation?**

5. Which two of the self-named solutions and the applicable success factors does the interviewee see as most promising in Dutch demersal fisheries?

Research population

The research population will consist of multiple representatives from multiple stakeholder groups. The stakeholder groups that will be represented by the interviewees consist of NGO's, legislative bodies, fisheries organizations and research institutes. From every stakeholder group, three representatives were chosen, with the help of the supervisors from Wageningen Marine Research (WMR), based on their involvement in the implementation of the LO for the Dutch demersal fisheries. The number of chosen interviewees was based on the limited amount of time to perform the study, but with adequate coverage to lead to sufficient results. In *Table 1* the specific stakeholder groups and their representatives who were interviewed are presented.

Table 2: List of interviewees

List of interviewees		
Interviewee	Organization	Stakeholder group
Peter van Dalen	European Parliament	Legislative body
Kees Verbogt	Ministry of Economic Affairs and Climate Policy	
Geert Meun	VisNed	Fisheries organization
Durk van Tuinen	Dutch Fishermen's Association	
Martin Pastoors	Pelagic Freezer Trawler Association	
Frederieke Vlek	Our Fish	NGO
Lotte Huisman	The North Sea Foundation	
Irene Kingma	Dutch Elasmobranch Society	
Adriaan Rijnsdorp	Wageningen Marine Research	Research institute
Pieke Molenaar	Wageningen Marine Research	
Marloes Kraan	Wageningen Marine Research	

Type of questions

Interview questions will be constructed to answer the previously discussed research questions. The first questions that are asked will be focused on getting to know the interviewee and in what way the interviewee and the organization he or her represented, were involved with the implementation of the LO. These questions are valuable to create a context for the rest of the interview, but also to create a comfortable and relaxed environment as the interviewers can also take the opportunity to introduce and tell a bit about themselves. Following these introductory questions, interviewees will be asked about their opinions on the LO and, whether and how the LO could lead to more selective Dutch demersal fisheries. These questions will be followed by questions concerning current positive developments regarding selectivity that are induced by the landing obligations, limiting factors in Dutch demersal fisheries, and possible solutions for these limiting factors. All discussed questions up to now have been open questions, so the interviewee can relate their answers to any subject they find to be relevant. These questions will however be followed by questions that need answers on the applicability of the previously discussed success factors in Dutch demersal fisheries and whether they would improve the possibility of reaching the goal of the landing obligation. The conclusive question concerns the two most promising self-named solutions and applicable success factors that will be mentioned during an interview. This question is included, because even though a success factor would be applicable it is possible that an interviewee considers solving a limiting factor with a

certain self-named solution as more promising to improve the possibility of reaching more selective Dutch demersal fisheries.

Possible practical difficulties

Most of the interviewees will have very busy schedules. Therefore, every interviewee must be contacted as soon as possible so that the interview can be planned in. In addition, some of the interviews will take place in a holiday season, which again emphasizes the need to contact the interviewees as soon as possible. Lastly, as the locations of the organizations represented by the interviewees are scattered throughout the Netherlands, trips to these locations need to be carefully considered to prevent tardiness.

Data-analysis

Once the interviews have been conducted, the recorded interviews will be labeled by date and the name of the interviewee. The recorded interviews will then be summarized to text based on a 'content-only transcription'. This method of transcribing ignores everything that is irrelevant to the subject of the question and the interview will thus be recorded with words that have not necessarily been used during the interview. As the perceptions are not the main focus of the interviews, but rather the gathering of information on current limiting factors and ways to improve the possibility of reaching the goal of the LO, this method of transcribing will be used. Because of this method it is however important to check if the answers were summarized in a correct way, therefore a draft of every interview summary will be send back to every interviewee. The interviewees will then be asked to validate the summary and make it apparent if the interview has been recorded in a correct way, but also when it is not recorded in a correct way and adjustments need to be made. If this is the case the adjustments will be made so they can be taken into account during the data-analysis of the interviews. The data-analysis will be performed with the program AtlasTI. In AtlasTI the summaries of the interviews will opened and analyzed in three general steps:

- Codes will be given to fragments of text in the interview summaries to briefly explain what that piece of text is about.
- After all interview summaries have been coded, all codes will be checked and certain codes that share the same concepts will be merged, or codes that might end up being irrelevant to the research subject will be removed. The remaining codes will then be assigned to a group related to the content of a code.

Once all codes have been assigned to a certain group, every group will be used to describe the eventual results of the interviews. Where the amount of times a certain concept (in the form of a code) has been shared, will become apparent.

Appendix IV: Interview protocol

Interview protocol achievability of the Landing obligation

Research: Bachelor thesis Coastal and Marine Management - *THE ACHIEVABILITY OF THE GOAL OF THE LANDING OBLIGATION TO REACH MORE SELECTIVE DUTCH DEMERSAL FISHERIES*

Researchers/interviewers: Nils Kroon and Luc Roozendaal

Interviewee: ...

Type interview: Semi-structured interview

While the landing obligation will be fully implemented on the 1st of January 2019, with the implementation in the Dutch demersal fisheries, it is still quite unclear how the goal of the landing obligation to reach more selective fisheries can be achieved. Therefore, this interview serves to provide an insight into the achievability of the goal of the landing obligation in the Dutch demersal fisheries, namely improving fishing behavior through improvements in selectivity. The assessment of this achievability will be performed by multiple interviewees who are involved in the Dutch fisheries policy, by looking at the applicability of success factors from already implemented discard bans in relation to current limiting factors in the Dutch demersal fisheries.

Relevant matters for the interview:

- The interviews will not take longer than an hour.
- We would like to record the interview.
- In the research results there will be anonymously referred to the interviews. Do you object to your name and organization being included in a list of interviewees in the report?
- We would like to send back the transcription of the interview so that you can assess whether we have correctly interpreted the answers or make adjustments where necessary.

General questions

- 1) What role do you and your organization play in the implementation of the landing obligation?
- 2) The implementation of the landing obligation is one of the results of the reform of the CFP. Were you involved with this reform? If so, how?
- 3) Were there any obstacles for the reduction of discards present in measures before the landing obligation was implemented? If so, which?
- 4) How do you feel about the implementation of the landing obligation in Dutch demersal fisheries?
- 5) Do you think the landing obligation in Dutch demersal fisheries will lead to more selective Dutch demersal fisheries?

Specific questions

You are probably already familiar with the fact that there is a discussion between several stakeholders about the introduction of the landing obligation and to what extent it contributes to more selective demersal fisheries. We will now ask a number of more specific questions about your opinion on this subject in relation to Dutch demersal fisheries.

- 6) The ultimate goal of the landing obligation is reaching more selective fisheries. In the case of the Dutch demersal fisheries, which current management and/or technical measures do you see as beneficial in relation to the goal of the landing obligation?
- 7) The ultimate goal of the landing obligation is reaching more selective fisheries. In the case of the Dutch demersal fisheries, which current management and/or technical measures do you see as limiting in relation to the goal of the landing obligation?
- 8) Do you think there are any solutions for these limiting factors? (discuss per limiting factor)

During our literature review, we encountered a number of factors that contributed to the successful implementation of discard bans in other countries. Such factors have been inventoried in the countries Canada, Chile, Faroe Islands, Iceland, New Zealand, Norway, and the United States (Alaska). These success factors have been encountered in management and/or technical measures and the impact these measures have had on the achievement of the objectives of these discard bans. We would like to present this table to you if you want to read it for a moment. You just mentioned the following limiting factors (fill in). If you look at this table, can you indicate which of these success factors from other countries might be able to provide a solution for the limitations you mentioned?

- 9) Looking at the applicable success factors from already implemented discard bans, how would you see the effect of these measures in relation to the goal of the landing obligation in Dutch demersal fisheries?
- 10) Looking at the non-applicable success factors from already implemented discard bans, can you explain why these measures would not be suitable in relation to the Dutch demersal fisheries?

Conclusive question

- 11) Which two of the self-named solutions and the applicable success factors from the table do you think are the most promising in Dutch demersal fisheries?

End of the interview. The interviewee has the opportunity to ask any questions and is thanked for his or her time.

Table with success factors

Measure	Applicable?
Collaboration between fishermen by sharing catch composition data from certain areas to prevent catch compositions with high percentages of unwanted bycatch.	
Electronic Monitoring System (EMS) with cameras.	
Sanctions such as fines and the revoking of quota or fishing licences in response to illegal discarding.	
Onboard observers.	
Closing a fishery when an annual unwanted bycatch limit has been exceeded.	
Closing fishing grounds when the percentage of unwanted bycatch of a specific species is excessive in the catch composition of one haul.	
Closing of fishing grounds for certain types of fishing gear.	
Increasing minimum mesh sizes.	
The possibility to land small quantities of fish that exceed quota without being penalized.	

Appendix V: Self-named possible solutions

Self-named possible solutions			
Type of solution	General solution	Specific solution	Shared by stakeholder group
Exemptions in LO.	Exemptions for different species in LO.	Exemptions for different species which fall under the LO.	2, 4
		Survivability studies for different species which fall under the LO.	1, 2
		Abolish the quota for some species.	1
		Clear conditions need to be met when implementing an exemption for a specie.	3, 2
	Exemption for fisheries in LO.	The 80 mm needs to have a full exemption from the LO.	2
Facilitating development of selectivity in fisheries by government.	Create flexibility in development of more selectivity by the government.	Fishermen need to be granted space to develop new nets without having to take too much account of administrative actions.	2, 4
		The government needs to give exemptions in the LO faster. This will make selectivity development faster.	4
	Compensation for development more selective fisheries.	Fishermen who do selectivity experiments need to be financially compensated.	4, 3
		More means to compensate fishermen for their effort to comply with the LO are necessary.	4
		The government needs to facilitate more selective fisheries by reserving more money.	3
	More initiative from the government is necessary to improve selectivity.	A structural innovation vision needs to be developed by the government, where space for innovation is offered.	3
		The government needs to start a conversation with the fishery industry on	3

		how to improve selectivity together.	
		The ambition of the government to improve selectivity needs to be higher.	3
	Other factors which could be facilitated by the government.	Rent a ship for testing new selective nets with researchers.	4
Fisheries innovations to improve selectivity.	Net innovations.	The pulse trawl is a good innovation which can improve selectivity.	1, 2, 4
		More net innovations need to be developed to improve selectivity.	1, 2, 3, 4
		Take the behaviour of the fish more in account, to separate marketable fish from unwanted bycatch, when developing new nets.	1
	Independent research from the fishing industry to improve selectivity.	The fishing industry needs to have their own special researchers which focus on improving selectivity.	2
		Fishermen need to have the capacity and possibility to innovate for themselves, like an R&D department.	3
		More collecting of data by the fishing industry and making their own conclusions.	2, 3
		Fishermen need to rent a ship together designed for testing new selective nets.	4
Collaboration.	Collaboration between stakeholders to reach a shared goal.	Start the collaboration between stakeholders with a shared vision. After that solutions can be found together which most of the time have more support from the industry.	4
		VisHack (A collaboration between different stakeholders to come up with ideas to improve selectivity).	3

		Create incentives for fishermen to work together and come up with solutions.	4
	Collaboration between fishermen to avoid unwanted bycatch.	More communication between fishermen about the location of high percentages unwanted bycatch.	2, 3
		Aggregating data of catch per haul and location and share it with other fishermen to avoid high percentages of unwanted bycatch.	3
		Voluntary agreement between fishermen by closing an area in a certain time to avoid high percentages of unwanted bycatch.	4
Monitoring & enforcement.	EMS with cameras.	EMS with cameras can be a good tool to implement fully documented fisheries.	1, 2, 3, 4
		Incentivize fishermen to use EMS with a MSC certification.	4
		Use consumers to monitor fishing activities with an online live stream made possible by EMS.	4
		More transparency needed in the fishing industry.	1
	System where fishermen register and control themselves.	A system where the fishing industry can prove for themselves that they comply with the rules by creating a fully documented fishery.	2, 3
Adaptation in fishing practices to improve selectivity.	Behavioural adaptations of a fishermen to fish more selective.	A fishermen needs to decide where to fish and how long a haul needs to be to improve selectivity.	2
		It is important for fishermen to see the amount of discards they produce in one fishing trip.	2, 4

Other possible solutions.	Change the distribution of quota in the EU.	Get rid of the historical distribution of quota as it does not fit in current EU fisheries anymore.	2,3
	Reducing MLS for species.	Reducing the MLS of plaice from 27 to 25 for increasing the amount of marketable fish and decreasing the amount of discards.	2