

FAST TRACK—Sustainable, cost effective and responsive gear solutions under the landing obligation

By Jordan P. Feekings et al.

DTU Aqua Report no. 342-2019





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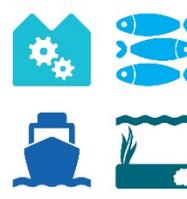
Jordan P. Feekings, Rikke P. Frandsen, Ludvig Krag, Henrik Lund, Tiago Veiga-Malta, Søren Qvist Eliassen, Rikke Becker Jacobsen, Hanne Bohnstedt, Valentina Melli, Marco Nalon, Lars O. Mortensen, Clara Ulrich and Mollie Brooks

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Title: FAST TRACK—Sustainable, cost effective and responsive gear solutions under the landing obligation

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DTU Aqua report no.: 344-2019

Year: Scientific work finalized March 2019. Report published June 2019

Reference: Feekings, J.P., Frandsen, R.P., Krag, L., Lund, H., Veiga-Malta, T., Eliassen, S.Q., Jacobsen, R.B., Bohnstedt, H., Melli, V., Nalon, M., Mortensen, L.O., Ulrich, C. & Brooks, M. (2019) FAST TRACK—Sustainable, cost effective and responsive gear solutions under the landing obligation. DTU Aqua Report no. 342-2019. National Institute of Aquatic Resources, Technical University of Denmark. 18 pp. + annexes.

Cover: Test codend with a size sorting grid tested in the Brown shrimp fishery is surfacing after a tow. To observe the performance of the grid, cameras and lights were used in the preliminary trials. Photo: Jordan Feekings.

Published by: National Institute of Aquatic Resources, Kemitorvet, 2800 Kgs. Lyngby, Denmark

Download: www.aqua.dtu.dk/publications

ISSN: 1395-8216

ISBN: 978-87-7481-265-4

Foreword

This is the final report for the project “FAST TRACK - Sustainable, cost effective and responsive fishing solutions under the Landing Obligation” under the scheme “Fælles indsatser på fiskeri” and is a collaboration between DTU Aqua, The Danish Fishermen’s Association and Aalborg University.

The objective of the project has been to establish a permanent interactive platform to facilitate the cooperation between fishers, net makers and scientists to identify challenges, collection and communication of knowledge and best practice, as well as cost efficient analyses of selective gears. The project was completed during the period 05-11-2015 until 21-12-2018 by DTU Aqua with participation from The Danish Fishermen’s Association, Aalborg University and SINTEF.

The project was carried out with financial support from the EU, the European Maritime and Fisheries Fund, the Ministry of Foreign Affairs' fisheries development program.

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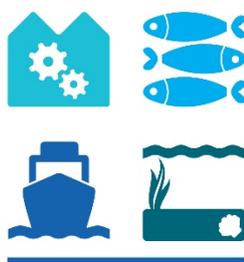
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This project is funded by the European Maritime and Fisheries Fund and the Danish Fisheries Agency.



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Executive Summary

The Fast-Track project set out to develop and implement a framework pertaining to the development of new and modified fishing gears which was more inclusive of all stakeholders, namely the fishing industry (fishermen, net makers and fisheries representatives), scientists and managers. The objective was to take each stakeholder group's specific competences and use these to more efficiently develop technical solutions which could alleviate some of the issues arising under the Landing Obligation.

During the project, a framework was developed to facilitate greater involvement of the industry and implemented throughout the Danish fisheries. In total, 13 vessels were involved in the project where a total of 19 gears were developed and tested. All gears developed pertained to the demersal trawl fisheries, namely the Baltic Sea cod trawl fishery, *Pandalus* trawl fishery, *Nephrops* trawl fishery, and the Brown shrimp beam trawl fishery. The gears tested either aimed at reducing catches of unwanted species and/or sizes. Of the 19 gears developed, 4 were taken through to scientific testing, and 2 of these presented to managers for possible implementation in regulations.

This report provides an overview of the work undertaken during the project and presents the results from the individual trials in the form of fact sheets. Furthermore, the report highlights some of the challenges which arose during the project and how these can be addressed in the future.

1. Introduction

With the reform of the Common Fisheries Policy and the introduction of a landing obligation, the ability of fishermen to adjust the selectivity of their gears to suit the quotas which are available to them becomes an important factor in determining the revenue and economy in the fisheries. As the combination of gear, fishing practice and quota shares differ between vessels, changes to the selectivity of the gears need to be implemented at the vessel level and based on the quotas which are available to the vessels at a given time. For this to be realised, simple and cost effective solutions which can be quickly coupled with existing gears are required. These solutions will need to be implemented quickly in order for them to solve the issues at hand without fishermen losing substantial income. Furthermore, these solutions will need to be scientifically tested to document their effect before being considered for implementation into the legislation.

Fast-Track aims to increase flexibility and ownership over the gears used while ensuring an effective introduction of the new EU Common Fisheries Policy. To achieve this, Fast-Track aims to facilitate the development of more selective gears by providing the industry with the possibility to take a more proactive role in the development and testing of new ideas. Here we try to facilitate a more bottom-up approach where the industry are responsible for coming up with the ideas they feel applicable for their fishery, as well as having an important role in the testing of the gear and the collection of the data. Furthermore, the project aimed to speed up the testing process and diversity of gears being tested by initially having the industry to define the idea and carry out a development/ pre-test to refine the gears performance before proceeding to a more rigorous scientific test.

The expected effects of the project were 1) the establishment of a permanent platform comprised of stakeholders (fishermen, net makers, producer organisations, managers and scientists) which could facilitate the development of ideas and solutions originating from the industry, 2) that the industry would become more proactive role in the development and testing of solutions for the effective implementation of the landing obligation, 3) that the close cooperation between industry and researchers would lead to greater ownership of the solutions developed, and 4) the speed with which innovative tools are developed, tested and approved would be reduced while profitability and sustainability improved.

2. Study Area and Description of Fishery

The project has no geographical limitations and the areas and fisheries covered reflect the incoming ideas from individual fishermen and fishermen's associations. In 2018, total revenue for the Danish commercial fisheries in Danish waters amounted to 3.1 billion Danish Kroner of which approximately 1/4 originated from industrial species, with sprat (*Sprattus sprattus*) and sand eel (*Ammodytes sp.*) being the most important (Figure 1).

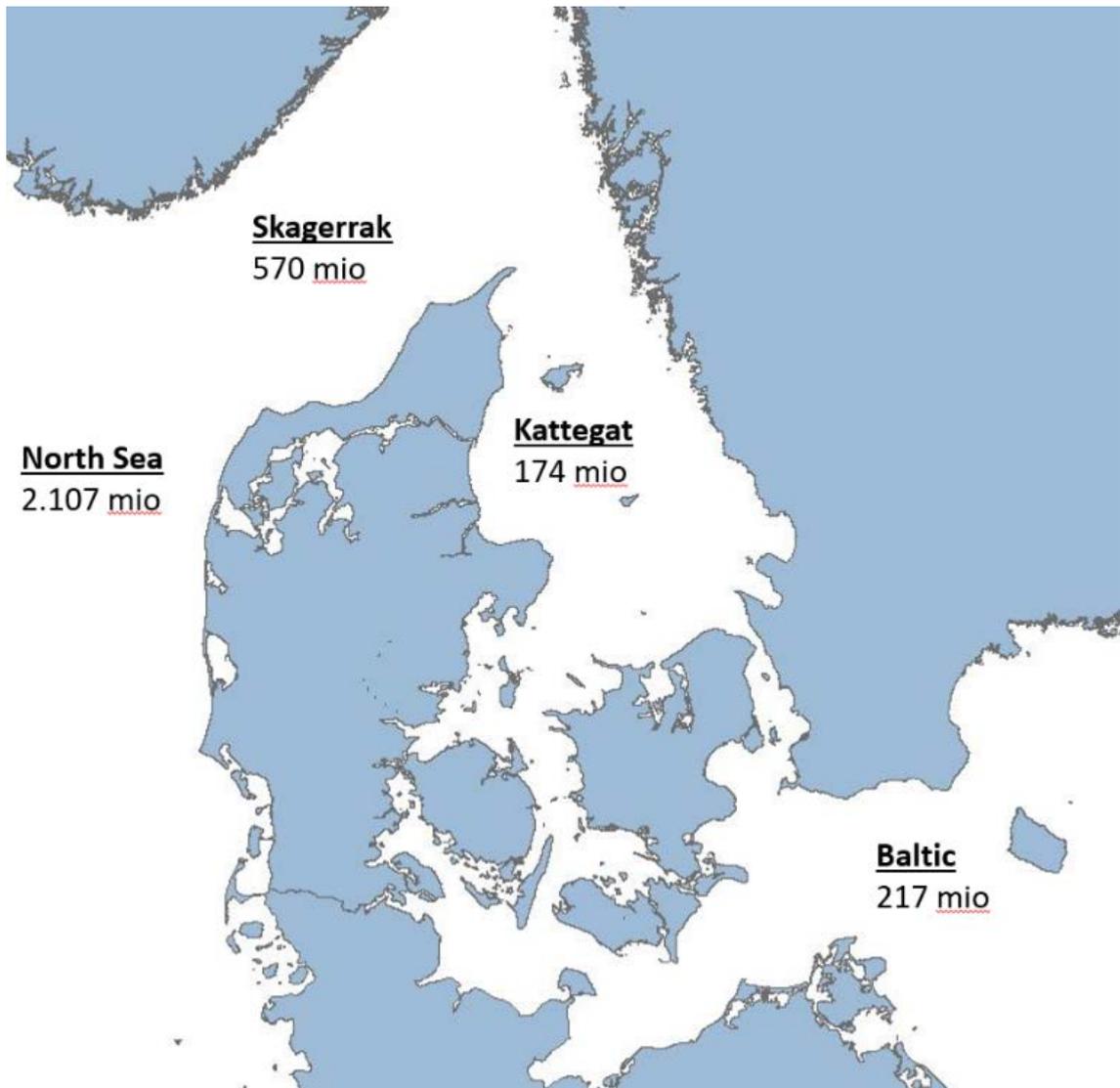


Figure 1. Value of landings from Danish fisheries in 2018. (Source: Danish Fisheries Agency).

The economically most important species in the whitefish fishery are herring (421 mio), plaice (315 mio), cod (295 mio), *Nephrops* (270 mio), mackerel (214 mio), and brown shrimp (117 mio). However, differences in salinity, bathymetry, and bottom type leads to large variations between waters (Figure 2). In the present study, we have covered fisheries in all major areas and with the exception of herring and mackerel, gears targeting all the dominant species have been included.

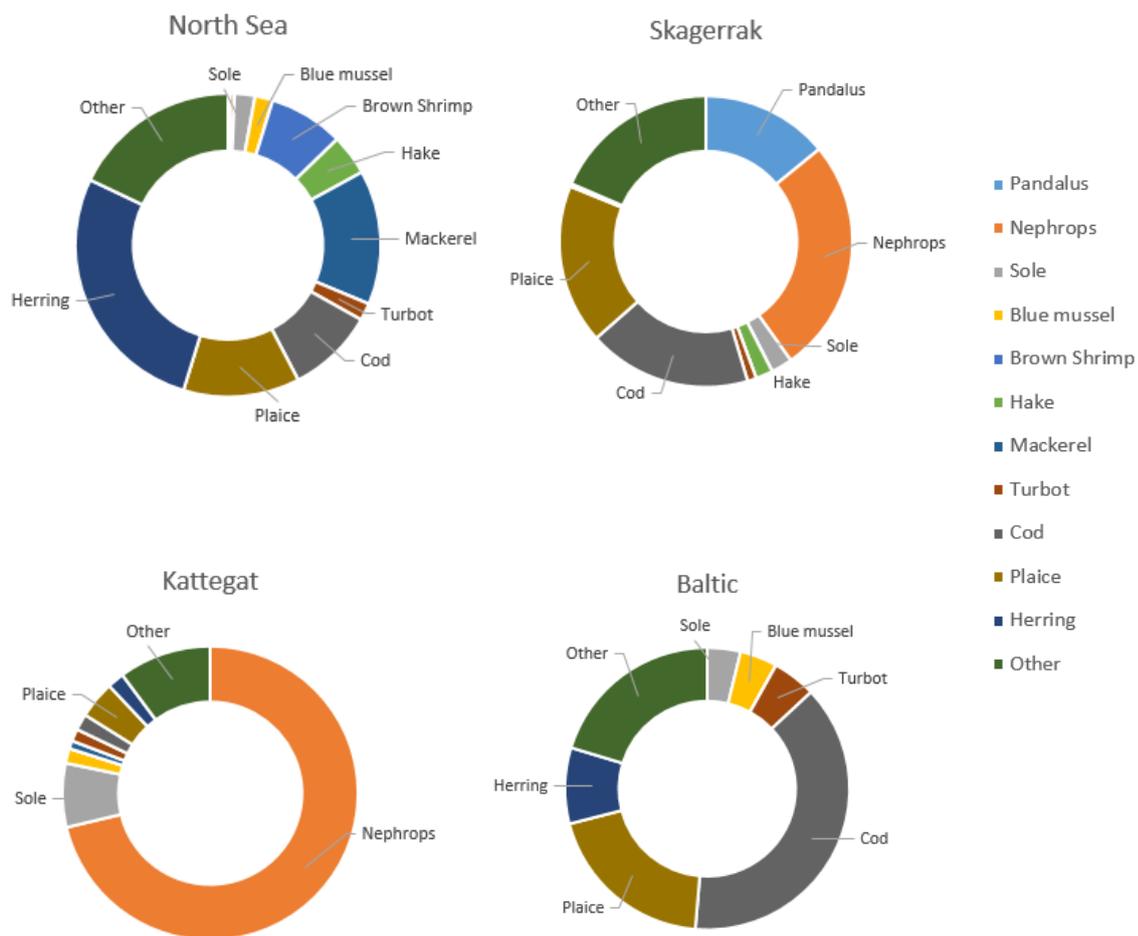


Figure 2. Distribution of value of white fish landings from Danish fisheries based on area and species (Source: Danish Fisheries Agency).

3. Stakeholder Engagement

The engagement of stakeholders throughout the project was recognised as a central and important aspect in the project. Therefore, to ensure that the fishing industry were kept up-to-date with what was going on in the project, regular articles were published in the Danish fisheries newspaper as well as regular harbour visits undertaken (Table 1). A project website, as well as a Facebook page, were constructed to further disseminate the project and its results. Furthermore, formal meetings with the industry were organised to discuss specific issues faced within certain fisheries.

Considerable effort was devoted to disseminating the results of the different trials and the objectives of the project to managers throughout Europe. This was primarily through presentations at regional and high-level group meetings. Furthermore, an ICES Workshop on Methods for Stakeholder Involvement in Gear Development (WKMSIGD) was organised together with the Baltic Sea Advisory Council (BSAC) to help understand how such types of initiatives can to help facilitate the landing obligation and the proposed reformed technical measures, as well as how such national industry-led initiatives can be coordinated at regional levels.

The engagement of scientists in the project was primarily through the publication of scientific articles, presentations held at international meetings and the coordination of the ICES Workshop on Methods for Stakeholder Involvement in Gear Development (WKMSIGD).

Table 1. Methods used to engage different stakeholder groups.

News articles	Formal Meetings (Industry)	Harbour Visits	Electronic	Formal meetings (Management/ science)	Publications
<ul style="list-style-type: none"> • 8 x Fiskeritidende • 2 x Fiskerforum • 1 x Bornholms Tidende • 1 x DTU Avisen 	<ul style="list-style-type: none"> • 2 x Strandby Fiskeriforening (Strandby) • 2 x Strandby and Skagen Fiskeriforeninger (Skagen) • Selectivity workshop (Hirtshals) • Fisker-Forsker workshop (Hirtshals) • Hestereje-udvalgmøde (Taulov) • 2 x Borholms Fiskeriforening (Rønne) 	<ul style="list-style-type: none"> • 4 x Bornholm (Rønne, Svaneke, Tejn) • 4 x Skagen • 12 x Hirtshals • 8 x Strandby • 3 x Hvide Sande • 5 x Esbjerg • 1 x Hanstholm 	<ul style="list-style-type: none"> • Social media (www.facebook.com/fiskeriteknologidtuqua/) • Website (http://www.fast-track.dk/) 	<ul style="list-style-type: none"> • Baltic Sea Advisory Council selectivity meeting (Gdansk) • BALTFISH (Copenhagen) • North Sea Advisory Council (Brussels) • North Western Waters Advisory Council (Dublin) • ICES ASC (Hamburg) • WGFTFB (Hirtshals) • DANFISH (Aalborg) • HELCOM (Copenhagen) • HELCOM (Copenhagen) • ICES/BSAC WKMSIGD (Copenhagen) 	<ul style="list-style-type: none"> • Veiga-Malta et.al. 2018. When is enough, enough? Quantifying trade-offs between information quality and sampling effort for fishing gear selectivity data • Eliassen et.al. 2019. The landing obligation calls for a more flexible technical gear regulation in EU waters– Greater industry • Feekings et.al. An evaluation of European initiatives established to encourage industry-led development of selective fishing gears. • Veiga-Malta et.al. 2019. Industry-led fishing gear development: Can it facilitate the process? • Veiga-Malta et.al. Testing a size sorting grid in a brown shrimp (<i>Crangon crangon</i>) fishery. • Mortensen et.al. European experiences on the use of Remote Electronic Monitoring. • Veiga-Malta et.al. Understanding the hydrodynamics of a size sorting grid in a crustacean fishery.

4. Problems that the Industry has Addressed during the Project

Table 2. The different fisheries, the problems and solutions tested.

Fishery	Problem	Solution	Number of vessels
<i>Nephrops</i> trawl fishery	Bycatch of fish	Grid, divided codend, scaring devices, scaring lines	5 vessels fishing in Kattegat and Skagerrak have been involved
Baltic cod fishery	Bycatch of small cod / loss of legal sized cod	Mesh size, lastride ropes, circumference	3 vessels from Bornholm were involved
Baltic cod fishery	Bycatch of flounder	Grid	2 vessels from Bornholm were involved
<i>Pandalus</i> trawl fishery	Bycatch of small shrimp	T90 codend, size sorting grid, square mesh panel	One vessel from Skagen
Brown shrimp beam trawl fishery	Bycatch of fish	Grid	One vessel from Thyborøn
Brown shrimp beam trawl fishery	Bycatch of small shrimp	Size sorting grid	One vessel from Esbjerg

4.1 *Nephrops* fishery

Nephrops are small and consequently small meshes are required to retain the species. This introduces the risk of retaining juveniles of other species living on the same grounds as *Nephrops*. Traditionally the *Nephrops* fishery is a mixed species fishery with a large fraction of the income originating from fish. However, restrictions of fish quota in combination with a landing obligation has highlighted a need of gears with very low retention of fish. Such a gear option will allow fishermen to decide where and when to spend fish quota.

Another way of reducing by-catch is to increase catch efficiency of the target species. A newly developed acoustic catch sensor has been developed for the Canadian *Pandalus* fishery. Adapting such a system to the *Nephrops* fishery would increase catch rates, while also reducing by-catch and benthic impacts.

4.2 Baltic cod fishery

The gears currently legislated in the Baltic Sea trawl fishery for cod have been developed to minimize the catches of undersized cod. However, since their implementation, the size distribution of cod has shifted towards smaller individuals. The length classes just above the minimum conservation reference size (MCRS; 35 cm) now constitute a larger fraction of the landings and are thus increasingly important economically. Therefore, a need for gears that effectively retain these sizes is presented by the fishermen. Furthermore, bycatches of flounder in the directed cod fishery are unwanted. High numbers of flounder in catches hamper codend selectivity and reduce

cod quality due to abrasion. A gear that retains round fish and sorts out flatfish is therefore required.

4.3 Brown shrimp fishery

Brown shrimps are caught with beam trawls in shallow waters. The fishery was MSC certified in 2016 based on a management plan implementing a gradual increase in mesh size from 20 to 26mm in 2021. Fishermen are concerned that the increase will lead to a high loss of marketable shrimp, therefore an alternative to the mesh size increase is investigated.

In periods and areas with large amounts of seaweed, the mandatory sieve net is often blocked, resulting in high losses of marketable shrimp. An alternative to the sieve net has therefore also been tested. Furthermore, a reduction in fish by-catch was desired.

4.4 Pandalus fishery

Pandalus are caught by trawls in deep water in the Skagerrak and North Sea. In some areas and season the fraction of small shrimp is high, resulting in a suboptimal length composition of catches. As part of the EU / Norway negotiations, there are plans to implement real time closures when catches of small shrimp are high. Only gears with documented low catches of small shrimp would be allowed in these areas. Therefore, technical solutions which reduce the catch of small shrimp were developed and tested.

5. Results

A total of 13 vessels were involved in the Fast-track project over the 3 years. Several of the vessels involved in the project developed and tested more than one idea, which led to a total of 19 different gears being tested. All 19 gears are presented in Table 3. The individual trials are grouped into four different fisheries: Baltic Sea cod (*Gadus morhua*) trawl fishery, Northern prawn (*Pandalus borealis*) trawl fishery, Norway lobster (*Nephrops norvegicus*) trawl fishery and the Brown shrimp (*Crangon crangon*) beam trawl fishery.

The results from each of the trials, as well their uptake by the industry, were evaluated. The results from each of the trials are assessed based on whether they were as intended (green), unclear or needing further development (yellow), or not as intended (red). Their uptake by the industry was scaled according to whether they are already in use (green), permitted but needing to be incentivized (yellow), or not permitted and management action needed (red). The details of each of the individual gear trials undertaken are presented in the form of fact sheets.

In total, the results from approximately half of the gears developed were as intended, while one (Annex1i) was deemed not as intended. Approximately half of the trials gave unclear results and was primarily due to the need for more data. Of the 19 gears developed, the majority (13) are not permitted to be used in the fisheries and require management action, 5 of the gears developed are already permitted to be used, while one requires management action to facilitate its uptake. Of the 13 gears developed which are not permitted to be used, 7 are not permitted due to the need for more data, while 4 have/are to be presented to managers. For 2 of the gears tested (Annex 1a and Annex 1b), there are no plans to present them to managers as they were developed to help understand the effects of specific design changes.

Table 3. Summary of the different individual trials carried out during the Fast-Track project.

Gear	Target species	Main topic	Project	Results	Uptake by industry	Factsheet
Baltic cod trawl	Cod	Size selectivity cod	Improved selectivity in T90 codends in the Baltic cod fishery - Phase I			Annex 1a-c
Baltic cod trawl	Cod	Size selectivity cod	Improved selectivity in T90 codends in the Baltic cod fishery - Phase II			Annex 1d
Baltic cod trawl	Cod	Size selectivity cod	Improved selectivity in T90 codends in the Baltic cod fishery - Phase II			Annex 1e
Baltic cod trawl	Cod	Species selectivity flounder	Species sorting grid to reduce catches of flounder	*		Annex 1f-h
Pandalus trawl	Pandalus	Size selectivity pandalus	Size selective sorting grid to reduce catches of small Pandalus			Annex 1i
Pandalus trawl	Pandalus	Size selectivity pandalus	T90 codend and square mesh panel to reduce catches of small Pandalus	*		Annex 1 j+k
Nephrops trawl	Nephrops	Species selectivity fish bycatch	Species sorting grid and dividend codend to reduce fish bycatch	*		Annex 1l
Nephrops trawl	Nephrops	Species selectivity fish bycatch	A modified Seltra panel & behaviour stimulators to reduce fish bycatch	*		Annex 1m
Nephrops trawl	Nephrops	Species selectivity fish bycatch	Species sorting grid and dividend codend to reduce fish bycatch	*		Annex 1n
Nephrops trawl	Nephrops	Species selectivity fish bycatch	Divided codend to reduce fish bycatch	*		Annex 1o
Nephrops trawl	Nephrops	Increase catch rates Nephrops	Real-time catch sensor to increase catch rates and reduce fish bycatch	*		Annex 1p
Nephrops trawl	Nephrops	Species selectivity fish bycatch	Scaring lines ahead of the trawl to reduce fish bycatch			Annex 1q
Beam trawl	Brown shrimp	Species selectivity fish bycatch	Species sorting grid as an alternative to a seive net	*		Annex 1r
Beam trawl	Brown shrimp	Size selectivity Brown shrimp	Size selective sorting grid to reduce catches of small Brown shrimp			Annex 1s

Results as intended			Already in use, no further actions needed
Unclear results, further development needed			Permitted, incentive needed
Results not as intended			Not permitted, management action needed

more data needed *

6. Discussion

6.1 The Fast-Track platform

The Fast-Track platform has facilitated the fast and efficient development and testing of new gears on an ad hoc basis. The number of incoming ideas from the industry has demonstrated an interest in participating in solving the discard challenges faced under the landing obligation. All the gears tested have addressed the demersal trawl fisheries, which reflects the importance of these fisheries as well as the focus on its discard challenges. Furthermore, the breadth of ideas put forward and developed under some fisheries shows that no single solution exists. AAU conducted a midterm and final evaluation of the project based on interviews of the participants (fishermen, netmakers, scientists and the Fishermens Association). Both evaluation revealed a high degree of satisfaction with the dynamics of the platform. All partners express that the ongoing dialogue between scientists, fishermen and netmakers ease the development of new gears on one hand and leads to a mutual understanding of the challenges and results on the other.

6.2 Gears developed

A series of ideas on how to reduce fish by-catch in the Kattegat and Skagerrak *Nephrops* fisheries were developed and tested. One of these aimed at guiding fish out of the path of the trawl with a rope arrangement and once adjusted, it can be deployed on a haul to haul basis. Sorting fish out at this early stage of the fishing process minimises the impact on the fish and can therefore increase the survival of the escapees. Four different gears aimed at separating fish from *Nephrops* in the aft end of the trawl, either by exploiting differences in size or differences in swimming performance between fish and *Nephrops*. The risk when guiding large individuals out of the codend is that a fraction of the small target species i.e. *Nephrops* is lost. In the gears tested, this risk was accounted for by introducing novel designs of both grids and panels, resulting in several promising designs. In Fast-Track II a workshop together with fishermen and net makers will seek to identify the design(s) which will be applicable to most vessels. Following this, scientific testing will be conducted. Finally, an acoustic catch sensor was tested to see if it could limit fishing to areas with high *Nephrops* catches and thus reduce by-catch and benthic impact. Further development is needed to adapt the system to the *Nephrops* fishery.

In the Baltic Sea, a series of trials were conducted to investigate ways to better match the selectivity of cod with its current size distribution and minimum conservation reference size of 35 cm. All trials were based on the legal T90 codend which was modified in relation to circumference, mesh size and netting material. A gear with a reduced mesh size was found applicable and a joint recommendation to implement the gear in the legislation was sent to scientific evaluation by STECF. Trials with gears that aimed at reducing catches of flounder and other flatfish were all based on a grid section in the extension. The construction of the grids varied, and due to increasing prices for flounder, the motivation to continue its development and testing vanished. Therefore, none of the gears which aimed at reducing catches of flounder were tested in scientific trials.

All gears tested in the Skagerrak *Pandalus* fishery aimed at releasing small shrimp with no loss of large individuals. Trials with a Swedish developed size sorting grid had no effect on the size

distribution but inspired the participating fishermen to continue to develop and test alternatives which could reduce the catch of small shrimp. These trials will continue in Fast-Track II.

In the North Sea Brown shrimp beam trawl fishery, the gears developed and tested have focused on reducing discards of both undersized shrimp and of non-target species. The gear seeking to reduce the fraction of small shrimps showed positive results during the industry-led development and testing phase, and will subsequently undergo scientific testing in Fast-Track II.

6.3 Incentives

During the initial development and testing phase, the economic costs associated with manufacturing the gears were covered by the project. During this period no economic support was provided to cover economic losses associated with catch loss due to the use of the new gear. This was on the premise that if the economic loss exceeded what was anticipated the use of the gear would not be warranted. If the initial development and testing phase showed promising results, the vessel was chartered and the gear's performance documented under scientific conditions. During the scientific trials, research quotas were used to reduce the economic costs associated with the scientific testing.

The incentives offer to facilitate participation were structured in such a way which aimed to ensure that fishermen interested in developing and testing new gears would not be economically burdened. Furthermore, the incentive structure aimed to ensure involvement in the project would not lead to artificial participation, i.e. where participation would be for the immediate economic reward rather than for the longer term improvement of the fisheries.

While this incentive structure worked well throughout the duration of the project, it did lead to a number of gears being developed and insufficiently tested. This could be related to the motivations of why fishermen participated in the first place. For example, some fishermen were interested in developing a gear to optimise the catch composition for their specific quota composition and fishery, while others developed and tested a gear on behalf of the fishery. In the cases where a fishermen developed a gear on behalf of his colleagues it may be that a different incentive structure is needed to further facilitate the gear's development. Alternatively, the loss of interest from the industry may be due to the lax implementation of the landing obligation coupled with a rigid management system.

6.4 Management framework

From 2015 to 2019, the landing obligation was phased in across EU fisheries. The Fast-Track project was initiated in the beginning of this period with the objective of alleviating some of the problems arising due to its implementation. However, the lack of preparedness from fishermen and national administrations, coupled with insufficient enforcement, meant that there was a lack of motivation from the industry to adapt. The absence of clear incentives for the fishermen themselves to adapt meant that there were very few ideas coming forward from fishermen to increase gear selectivity in their fisheries. Additionally, the rigid management system which exists may have also deterred involvement from industry.

The lack of flexibility which still exists in the management system, even with the introduction of regional groups, means that despite the development process being more inclusive and quicker under the Fast-Track framework, the implementation of new gears in the fisheries are still delayed.

The rigid management framework, which is comprised of multiple input controls, leaves very little room for the industry to quickly develop and utilise new technical solutions which can help address issue as they arise. A system more structured around output controls would help facilitate such adaption from the industry.

This conclusion is also reached in the midterm and final evaluation of the project performed by AAU. They found that the highest degree of scepticism concerning the project is a doubt as to whether the developed and scientifically tested gears will be implemented in legislation.

7. Conclusions and Recommendations for Future Work

The Fast-Track project has established a well-structured and functioning platform which facilitates involvement from all stakeholders in identifying and resolving, through technical solutions, the issues arising under the landing obligation. The first gears have gone through the entire process, from their conception to their results being presented for managers at regional group meetings. The primary challenge now lies in whether the final approval process can effectively handle the larger number of gears needing evaluation or if it ends up being a bottleneck. It is central not only to the project but also to the success of the landing obligation that the process from idea to implementation is as fast as possible. A quick approval process will help the fishermen to adapt their fishing to the individual's quota composition as well as annual TAC variations without major economic losses.

To continue to strong collaborative work established under the Fast-Track project, a further 2 years of funding has been provided through the European Maritime and Fisheries Fund (EMFF). A key improvement made, which came from the results of the ICES WKMSIGD workshop, was the need for greater international collaboration. Therefore, under the new project, Fast-Track II, effort is being devoted toward creating regional and international networks that ensure the knowledge about selective devices in specific fisheries is shared, and that there is a broad acceptance of the results obtained. In addition, fisheries and gear-specific workshops will be organized with the participation of international experts who provide knowledge of selective gears from comparable fisheries.

The gears developed in Fast-Track, and subsequently implemented in the legislation or directly taken up by the fishermen, will always be available to the fishing industry. When the project is completed, it is expected that the collaboration platform is a natural part of gear development in Denmark.

Annex 1. Fact sheets describing the different gears and trials.

- Annex 1a. Effect of increasing circumference of T90 codends on Baltic cod selectivity.
- Annex 1b. Effect of codend material type on the selectivity of Baltic cod
- Annex 1c. Industry self-sampling to describe gear selectivity
- Annex 1d. Reducing circumference and mesh size in the Baltic cod trawl fishery – Trial 1
- Annex 1e. Reducing circumference and mesh size in the Baltic cod trawl fishery – Trial 2
- Annex 1f. Use of flexible grids to release flounder in the Baltic Sea cod trawl fishery
- Annex 1g. Use of an escape hole to release flatfish in the Baltic cod trawl fishery
- Annex 1h. Use of a grid to release flounder in the Baltic Sea cod trawl fishery
- Annex 1i. Use of an escape grid to optimise the size selectivity of *Pandalus borealis*
- Annex 1j. Use of a T90 codend to optimise the size selectivity of *Pandalus borealis*
- Annex 1k. Modifying the bottom panel ahead of a grid to optimise the size selectivity of *Pandalus borealis*
- Annex 1l. Testing a grid and divided codend in the *Nephrops* fishery
- Annex 1m. A modified SELTRA panel to reduce catches of fish in the *Nephrops* fishery
- Annex 1n. A sorting grid to minimise catches of fish in the *Nephrops* fishery
- Annex 1o. Testing a divided codend in the *Nephrops* trawl fishery
- Annex 1p. Testing of a real-time catch sensor in the *Nephrops* trawl fishery
- Annex 1q. Testing a counter-herding device (FLEXSELECT) in the *Nephrops* trawl fishery
- Annex 1r. Testing a grid as an alternative to a sieve net in the Brown shrimp beam trawl fishery
- Annex 1s. Developing a sorting grid to sort out small Brown shrimp in beam trawls

Effect of increasing circumference of T90 codends on Baltic cod selectivity

Annex 1a

AIM

To observe what effect increasing circumference in a T90 codend has on the selectivity of cod (*Gadus morhua*).

TARGET SPECIES

Cod (*Gadus morhua*)

AREA, VESSEL

Baltic Sea (ICES 24 and 25)
Twin trawler (26 m, 485 kW)

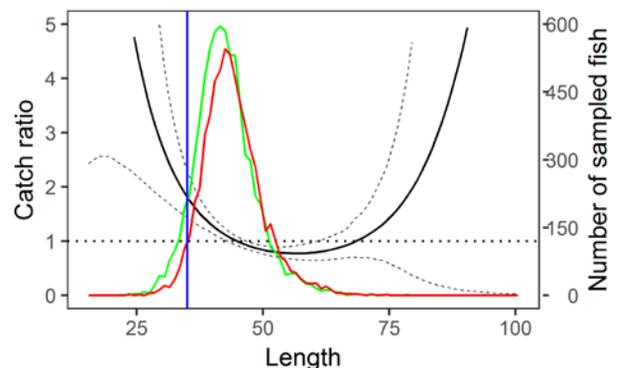


GEAR TRIALS

A 120 mm T90 codend with a circumference of 92 meshes was compared with a standard T90 120 mm codend with a circumference of 50 meshes

RESULTS

The codend with a larger circumference caught significantly more cod under 47 cm. Increasing the circumference is therefore not optimal as it results in significantly more cod under the MCRS (35 cm) being caught.



FURTHER INFORMATION

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DANMARKS FISKERIFORENING
Producent Organisation



Effect of codend material type on the selectivity of Baltic cod

Annex 1b

AIM

To observe what effect changing the codend material from polyethylene to polyester has on the selectivity of cod.

TARGET SPECIES

Cod (*Gadus morhua*)

AREA, VESSEL

Baltic Sea (ICES 24 and 25)

Twin trawler (26 m, 485 kW)

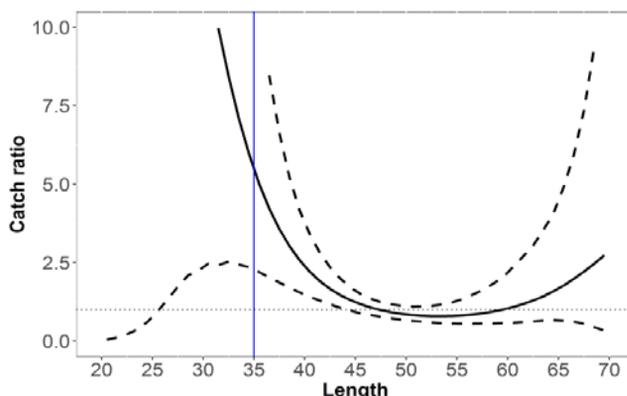


GEAR TRIALS

A 120 mm T90 codend made out of polyester was compared with a standard 120 mm T90 codend made out of polyethylene.

RESULTS

The codend constructed out of polyester caught significantly more cod under 44 cm. The use of polyester is therefore not optimal as it results in significantly more cod under the MCRS (35 cm) being caught.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Industry self-sampling to describe gear selectivity

Annex 1c

AIM

To determine whether it is possible for fishermen to collect data pertaining to the performance of fishing gears.

TARGET SPECIES

Cod (*Gadus morhua*)

AREA, VESSEL

Baltic Sea (ICES 24 and 25)

Twin trawler (26 m, 485 kW)



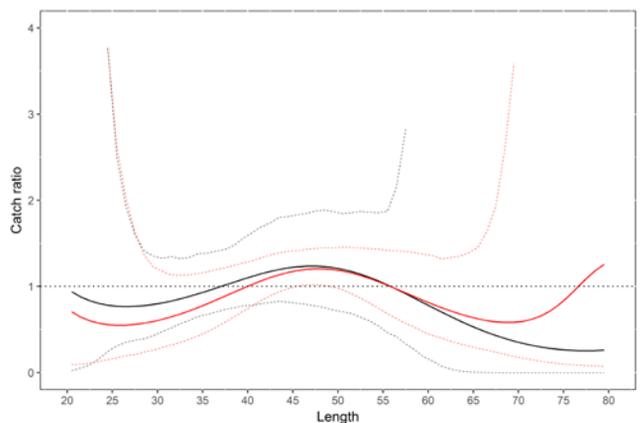
GEAR TRIALS

Fishermen were asked to measure 1 basket of cod per codend (80 individuals in total) from approximately 7 hauls (550 cod). These catch comparison data were compared to scientifically collected data from 6 hauls (5856 cod; no subsampling).



RESULTS

The catch comparison data collected by the fishermen (black line) showed the same trend as the data collected during the scientific trial (red line), although with larger uncertainties. This shows that fishermen can and should be involved in the collection of gear selectivity data.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Reducing circumference and mesh size in the Baltic cod trawl fishery – Trial 1

Annex 1d

AIM

To reduce loss of cod (*Gadus morhua*) above the MCRS (35 cm) in the Baltic Sea cod trawl fishery.

TARGET SPECIES

Cod (*Gadus morhua*)

AREA, VESSEL

Baltic Sea (ICES subdivision 24 and 25)
Twin trawler (17 m, 219 kW)

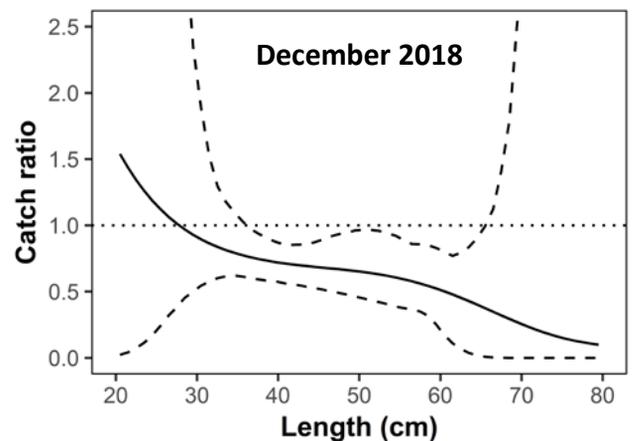
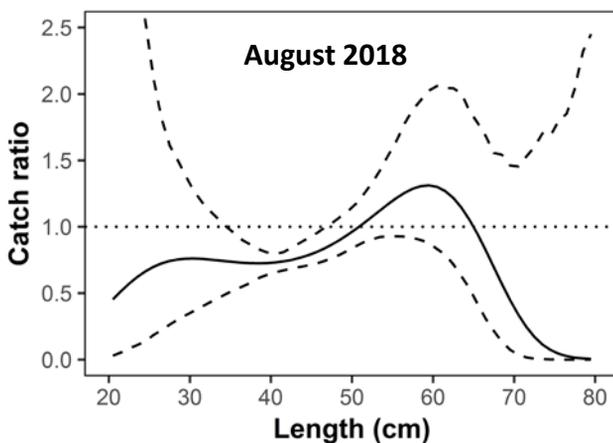
GEAR TRIALS

A T90 codend with a mesh size of 110 mm and a circumference of 40 meshes (test codend) was compared to a T90 codend with a mesh size of 115 mm and a circumference of 80 meshes (standard). The standard codend has been implemented in legislation since 1st Jan 2018 and the test codend was implemented in legislation until 2009, where it was replaced with a larger mesh size (120 mm).



RESULTS

2 trials were conducted in Aug (10 hauls) and Dec 2018 (10 hauls). Catch comparison results from the two trials were quite different. During the first trial, the test codend caught significantly less cod from 35-48 cm & indicated that catches of larger individuals may be higher, while in the second trial the test codend caught significantly less cod from 37-65 cm. The difference in results is possibly attributed to differences in catch sizes (1588 kg (719-3077) & 3385 kg (700-8400)).



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Reducing circumference and mesh size in the Baltic cod trawl fishery – Trial 2

Annex 1e

AIM

To reduce loss of cod (*Gadus morhua*) above the MCRS (35 cm) in the Baltic Sea cod trawl fishery.

TARGET SPECIES

Cod (*Gadus morhua*)

AREA, VESSEL

Baltic Sea (ICES subdivision 25)
Trawler (16 m, 270 kW)

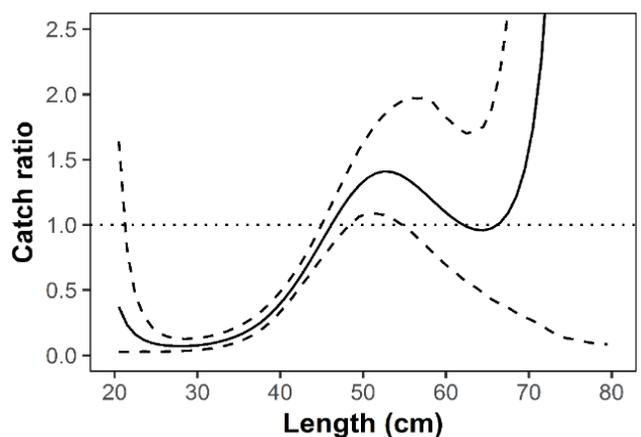
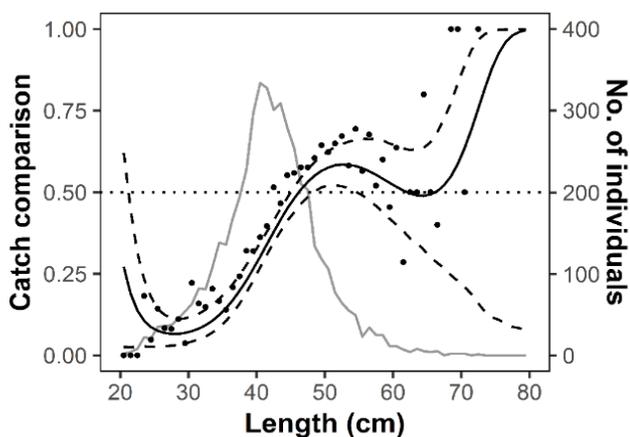


GEAR TRIALS

A T90 codend with a mesh size of 110 mm and a circumference of 40 meshes (test codend) was compared to a T90 codend with a mesh size of 115 mm and a circumference of 80 meshes (standard). The standard codend has been implemented in legislation since 1st Jan 2018 and the test codend was implemented in legislation until 2009, where it was replaced with a larger mesh size (120 mm).

RESULTS

9 hauls were carried out in the beginning of September 2018. Catch comparison results indicated that the test codend (110 mm codend) caught significantly less cod below 45 cm and significantly more cod between 48 and 54 cm than the standard codend (115 mm codend).



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Use of flexible grids to release flounder in the Baltic Sea cod trawl fishery

Annex 1f

AIM

To reduce catches of flounder (*Platichthys flesus*) in the Baltic Sea cod directed trawl fishery.

TARGET SPECIES

Cod (*Gadus morhua*)

Flounder (*Platichthys flesus*)

AREA, VESSEL

Baltic Sea (ICES subdivision 25)

Trawler (12 m, 99 kW)

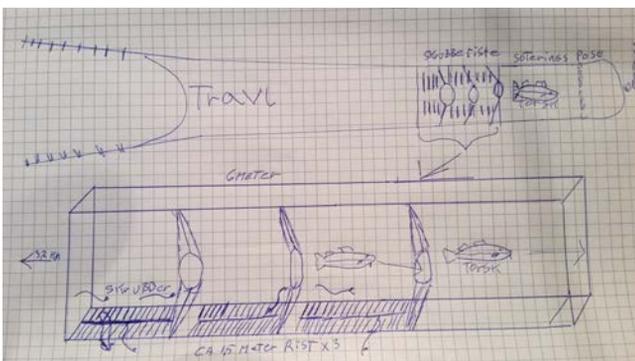


GEAR MODIFICATION

The fisherman designed a grid system consisting of three flexible grids (Vónin). Netting was placed behind each grid and held closed with elastic rope designed to slow or stop the catch and facilitate escape. If the catch became too large, the elastic rope could expand so that the catch could continue unobstructed either to the next sorting section or to the codend. Positioned in the bottom of the extension piece, the grid system was designed to guide out flatfish, in particular flounder.

RESULTS

Preliminary testing carried out by the fisherman showed mixed results. During some hauls good reductions of flounder were obtained, while others not. Furthermore, the efficiency of the grid was sensitive to the fitness of flounder. In the beginning of the year when fitness was good the catches of flounder were substantially reduced, while towards the end of the season when flounder had spawned the grid wasn't as effective. No data were collected.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Vi investerer i hav og fisk

Use of an escape hole to release flatfish in the Baltic cod trawl fishery

Annex 1g

AIM

To reduce catches of flounder (*Platichthys flesus*) in the Baltic Sea cod directed trawl fishery.

TARGET SPECIES

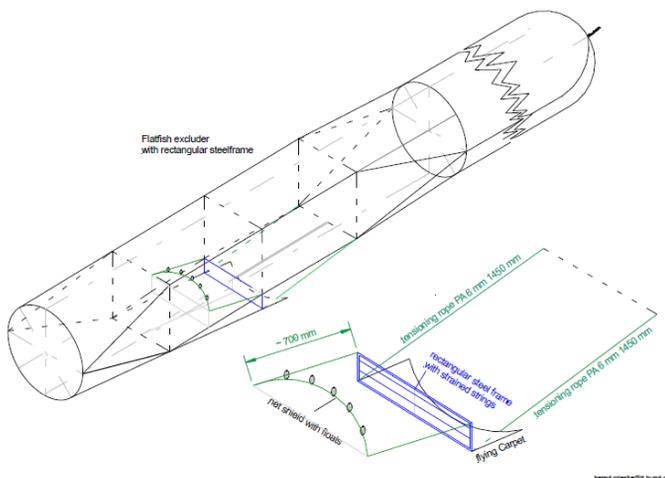
Cod (*Gadus morhua*)

Flounder (*Platichthys flesus*)

AREA, VESSEL

Baltic Sea (ICES subdivision 25)

Trawler (16 m, 270 kW)



GEAR MODIFICATION

Thünen institute has developed a gear (Flex tunnel) with a 25 cm high grid fixed in the lower section of the extension. Horizontal bars have a spacing of 80 mm. A section following this design was made for R3 Orion.

POTENTIAL

Trials on board a German research vessel have demonstrated a reduction in catches of flounder and plaice by 88% and 90% respectively, while no significant reduction for the target species, cod, was found.



STATUS

The experiments were postponed several times during 2018. The reason for this was relatively high flounder prices and failing catches of cod.

FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Use of a grid to release flounder in the Baltic Sea cod trawl fishery

Annex 1h

AIM

To reduce catches of flounder (*Platichthys flesus*) in the Baltic Sea cod directed trawl fishery.

TARGET SPECIES

Cod (*Gadus morhua*)

Flounder (*Platichthys flesus*)

AREA, VESSEL

Baltic Sea (ICES subdivision 25)

Trawler (16 m, 270 kW)

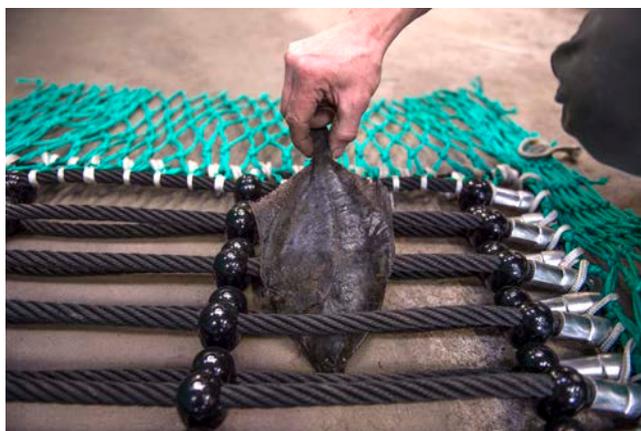


GEAR MODIFICATION

A net maker designed a grid consisting of parallel strings of wire rope. Positioned in the bottom of the extension piece, the grid was designed to guide out flatfish, in particular flounder.

RESULTS

The experiments were postponed several times during 2018. The reason for this was relatively high flounder prices and failing catches of cod. No data were collected.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



VI investerer i hav og fisk

Use of an escape grid to optimise the size selectivity of *Pandalus borealis*

Annex 1i

AIM

To reduce the capture of small Northern prawn (*Pandalus borealis*) in a shrimp trawl using an escape grid.

TARGET SPECIES

Northern prawn (*Pandalus borealis*)

AREA, VESSEL

Skagerrak (ICES IIIa)

Twin trawler (28 m, 746 kW)

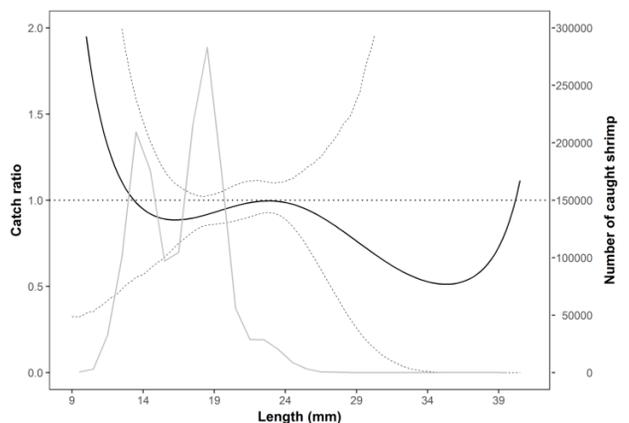
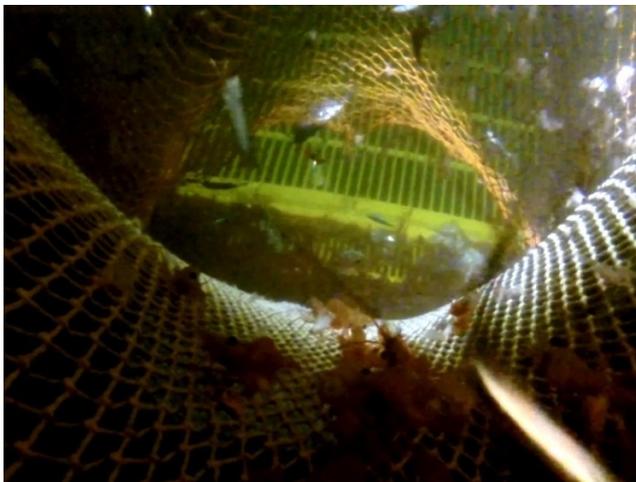


GEAR TRIALS

A gear with a grid consisting of two sections, a lower (10 mm bar spacing) and an upper section (19 mm bar spacing) was tested with a standard gear that had a grid with a 19 mm bar spacing.

RESULTS

Shrimp catches in the two gears were very similar. There was no significant difference in catches across all length classes. Underwater observations showed that there were large issues with clogging of the escape grid.



FURTHER INFORMATION

Jordan Feekings (jpf@aqu.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Use of a T90 codend to optimise the size selectivity of *Pandalus borealis*

Annex 1j

AIM

To reduce the capture of small Northern prawn (*Pandalus borealis*) in a shrimp trawl using a T90 codend.

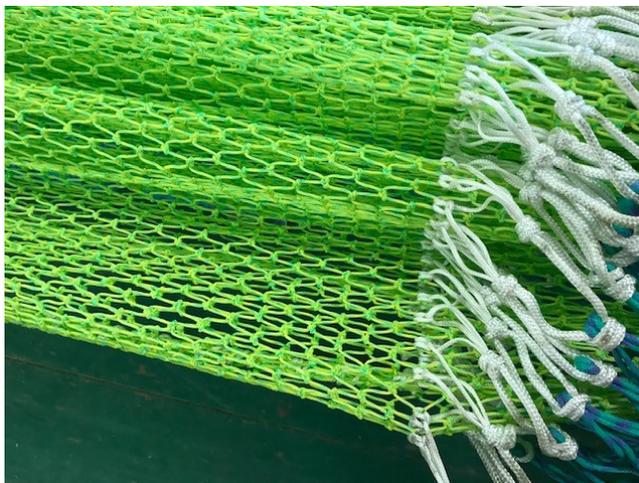
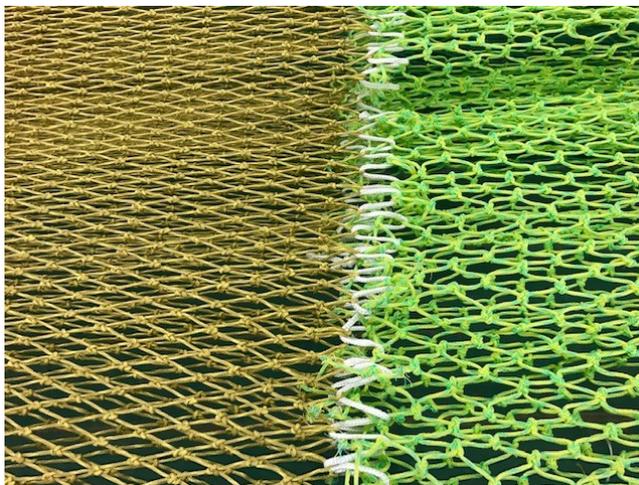
TARGET SPECIES

Northern prawn (*Pandalus borealis*)

AREA, VESSEL

Skagerrak (ICES IIIa)

Twin trawler (28 m, 746 kW)



GEAR TRIALS

A T90 codend was tested against a standard diamond mesh codend. Both codends had a nominal mesh size of 36 mm. Standard grids, with a bar spacing of 19 mm, were mounted in both gears.

RESULTS

Initial feedback from the skipper indicated that the catch of small shrimp was reduced. However, the perceived reduction became less apparent further into the development phase. A possible explanation is that the netting knot size and twine thickness may have been too small, resulting in the initial improvement being reduced once the netting lost its initial bending stiffness. Further development trials are planned for 2019 under Fast-Track II.

FURTHER INFORMATION

Jordan Feekings (jpfe@aqu.dtu.dk)

Modifying the bottom panel ahead of a grid to optimise the size selectivity of *Pandalus borealis*

Annex 1k

AIM

To reduce the capture of small Northern prawn (*Pandalus borealis*) in a shrimp trawl using a T90 codend.

TARGET SPECIES

Northern prawn (*Pandalus borealis*)

AREA, VESSEL

Skagerrak (ICES IIIa)

Twin trawler (28 m, 746 kW)

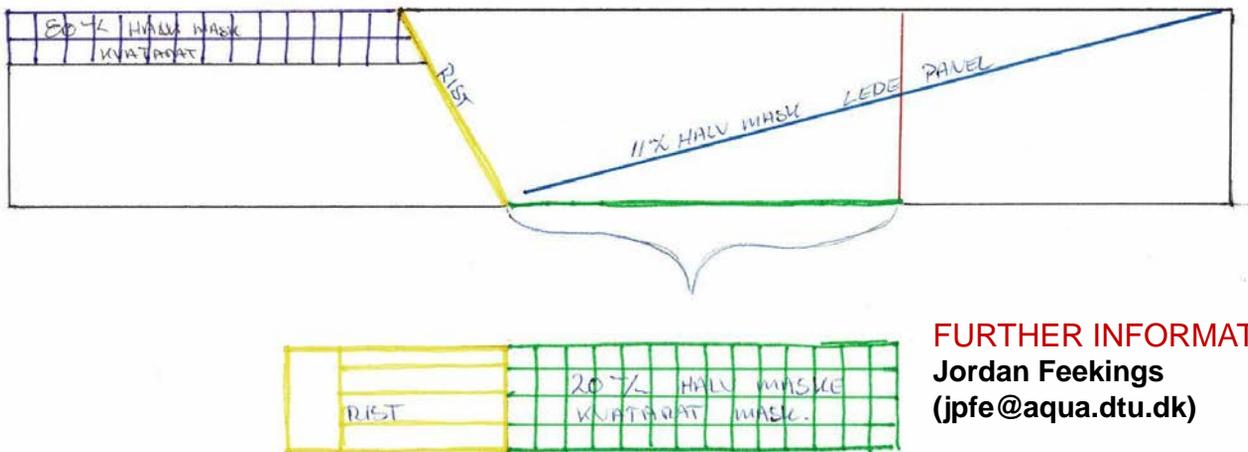


GEAR TRIALS

A square mesh panel (36 mm nominal mesh size) was inserted in the lower panel directly before the grid. Both codends had a nominal mesh size of 36 mm and were mounted with standard 19 mm grids.

RESULTS

Initial feedback from the skipper indicated that catches of small shrimp were similar to what was caught using the standard gear. Based on these preliminary results the trial was stopped.



FURTHER INFORMATION

Jordan Feekings
(jpfe@aqu.dtu.dk)

Testing a grid and divided codend in the *Nephrops* trawl fishery

Annex 1I

AIM

To reduce bycatches of fish in the Norway lobster (*Nephrops norvegicus*) trawl fishery.

TARGET SPECIES

Nephrops, cod, whiting, plaice, haddock

AREA, VESSEL

Skagerrak and Kattegat (ICES IIIa)
Twin trawler (15 m, 221 kW)



GEAR TRIALS

A grid with a bar spacing of 50 mm was tested in conjunction with a divided codend as an alternative to the legislated SELTRA codend. The lower codend had a mesh size of 74 mm diamond mesh and the upper codend had a mesh size of 125 mm square mesh.

RESULTS

Preliminary testing was carried out on two separate occasions. However, the fisherman lost interest in the project as he had sufficient fish quota and had come up with the design for those who don't. No data were collected.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



A modified SELTRA panel to reduce catches of fish in the *Nephrops* fishery

Annex 1m

AIM

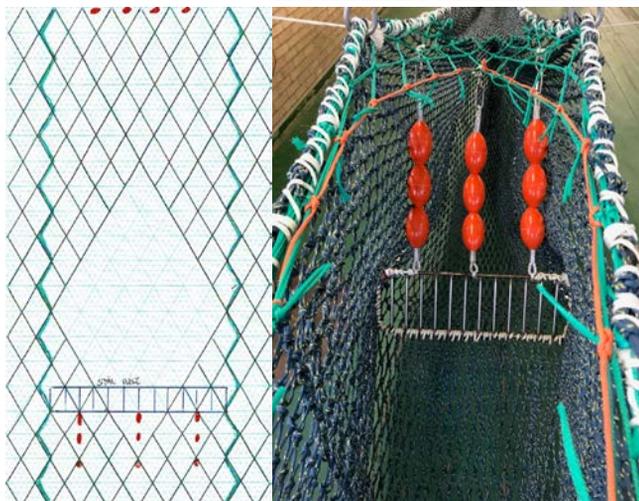
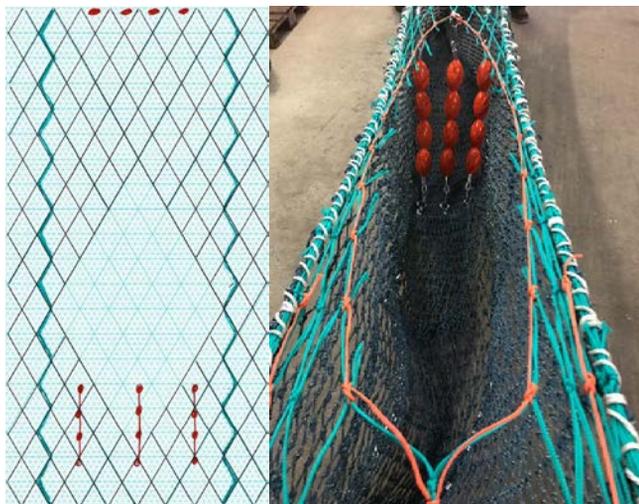
To reduce the capture of fish (E.g. cod, whiting, plaice) in the *Nephrops* trawl fishery.

TARGET SPECIES

Norway lobster (*Nephrops norvegicus*)

AREA, VESSEL

Kattegat and Skagerrak (ICES IIIa)
Twin trawler (15 m, 253 kW)



GEAR TRIALS

A modified SELTRA panel was tested in conjunction with two different devices to stimulate the escape of round and flatfish.

The first design consisted of three rows of floats, each with four floats. The second design consisted of three rows of floats, each with three floats, and a small grid mounted to the bottom panel to help stimulate the escape of flatfish.

RESULTS

Preliminary results indicate that catches of both round and flatfish are considerably reduced. In the few hauls worked up, catches of round and flatfish were reduced by approximately 60 %, while no reduction in *Nephrops* was observed. Scientific trials are planned under Fast-Track II.

FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)

A sorting grid to minimize catches of fish in the *Nephrops* fishery

Annex 1n

AIM

To minimize the capture of fish (E.g. cod, whiting, plaice) in the Norway lobster (*Nephrops norvegicus*) trawl fishery.

TARGET SPECIES

Norway lobster (*Nephrops norvegicus*)

AREA, VESSEL

Kattegat and Skagerrak (ICES IIIa)
Twin trawler (15 m, 253 kW)



GEAR TRIALS

As in *Pandalus* grids, the escape hole feeds into a large mesh fish codend (125 mm diamond mesh) allowing retention of high value fish by-catch. Bar spacing is 35 mm and the grid is divided and hinged into four off-set sections to ease handling and to reduce the risk of losing large *Nephrops*.

RESULTS

Nitrime has tested and adjusted the gear over a long period. According to the fisherman, good reductions in fish bycatch were obtained while there was no loss of *Nephrops*. The grid is sensitive to seaweed and plastic and the multi hinge construction induces an extra risk of bending. As for by-catch grids in general, minor changes in angle may cause severe loss of the target species.

FURTHER INFORMATION

Rikke P Frandsen (rif@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



VI investerer i hav og fisk

Testing a divided codend in the *Nephrops* trawl fishery

Annex 1o

AIM

To reduce bycatches of fish in the Norway lobster (*Nephrops norvegicus*) trawl fishery.

TARGET SPECIES

Nephrops, cod, whiting, plaice, haddock

AREA, VESSEL

Skagerrak and Kattegat (ICES IIIa)
Twin trawler (26 m, 550 kW)



GEAR TRIALS

A divided codend was tested as an alternative to the SELTRA codend. The divided codend consisted of a lower codend (90 mm diamond mesh), an upper codend (140 mm diamond mesh), and a 140 mm square mesh section to replace the SELTRA panel. The lower frame had a height of 300 mm and the upper 400 mm.

RESULTS

Preliminary testing was carried out on two separate occasions. However, the fisherman lost interest in the project which resulted in no data being collected.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Vi investerer i hav og fisk

Testing of a real-time catch sensor in the *Nephrops* trawl fishery

Annex 1p

AIM

To optimise catches of Norway lobster (*Nephrops norvegicus*) in the *Nephrops* trawl fishery.

TARGET SPECIES

Norway lobster (*Nephrops norvegicus*)

AREA, VESSEL

Skagerrak (ICES IIIa)

Twin trawler (17 m, 220 kW)

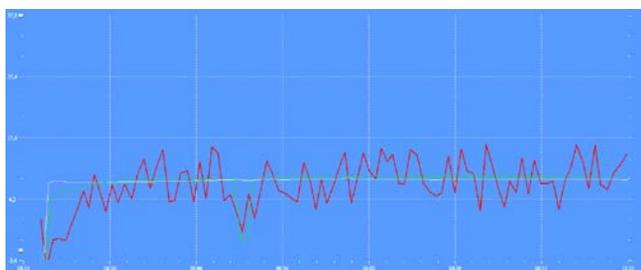
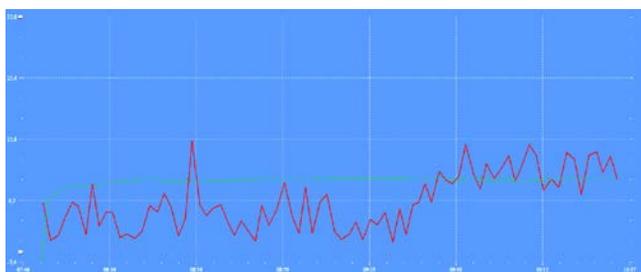


GEAR TRIALS

A real-time catch sensor (Notus ECHO) was mounted on a grid which covered the bottom half a SELTRA codend. The Notus ECHO was used to indicate, in real-time, when good catches of the target species, *Nephrops*, were obtained.

RESULTS

8 hauls were carried out in December 2018. There are indications that catch rates of the target species, *Nephrops*, can be detected in real-time when using the sensor. However, further testing is needed. Other hard shelled organisms, e.g. sea urchins, and hard objects such as stones may add noise to the results, making the results more inaccurate. Further testing is planned under Fast-Track II.



FURTHER INFORMATION

Jordan Feekings (jpfe@aqua.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



VI investerer i hav og fisk

Testing a counter-herding device (FLEXSELECT) in the *Nephrops* trawl fishery

Annex 1q

AIM

To determine if scaring lines could reduce fish catches in the *Nephrops* trawl fishery.

TARGET SPECIES

Norway lobster (*Nephrops norvegicus*), cod (*Gadus morhua*), saithe (*Pollachius virens*), and plaice (*Pleuronectes platessa*).

AREA, VESSEL

Skagerrak and Kattegat (ICES IIIa)
Twin trawler (22 m, 299 kW)

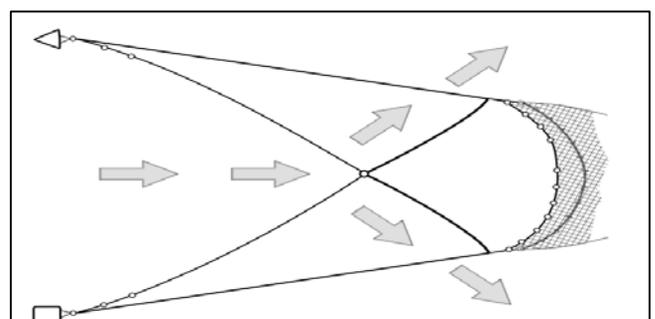
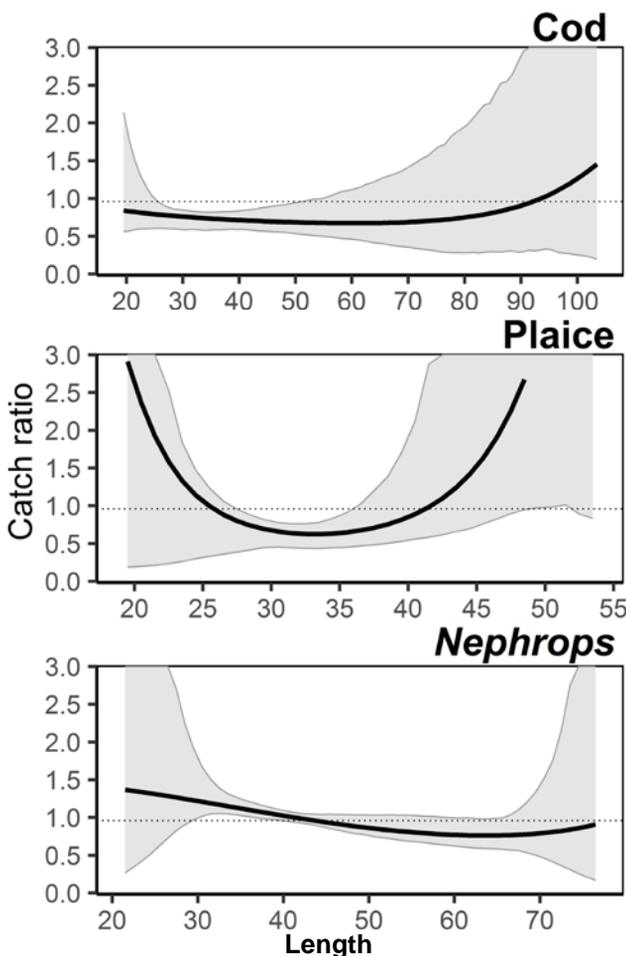


GEAR TRIALS

The counter-herding device (FlexSelect) was tested in a twin trawl design, where the scaring lines were mounted ahead of one of the trawls. In both trawls, the same codend (SELTRA) was used.

RESULTS

The scaring lines were found to significantly reduce the catch of fish, in particular cod (26-50 cm), plaice (27-35 cm), and saithe (48-59; 97-106 cm; figure not shown). With regard to the target species, *Nephrops*, catches of individuals between 30 and 39 mm (carapace length) were significantly higher in the trawl with scaring lines compared to the control (SELTRA).



FURTHER INFORMATION

Valentina Melli (vmel@aqu.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Testing a grid as an alternative to a sieve net in the Brown shrimp beam trawl fishery

Annex 1r

AIM

To reduce bycatches and clogging in the Brown shrimp (*Crangon crangon*) beam trawl fishery.

TARGET SPECIES

Brown shrimp (*Crangon crangon*)

AREA, VESSEL

North Sea (ICES IVb)

Beam trawler (21 m, 170 kW)



GEAR TRIALS

A grid with a 19 mm bar spacing was tested as an alternative to the legislated sieve net with a nominal mesh size of 70 mm.

RESULTS

Three rounds of testing took place in the development phase, where underwater observations were used to improve the design. However, the fisherman lost interest in the project and decided to stop. No data were collected.



FURTHER INFORMATION

Jordan Feekings (jpf@aqu.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Developing a sorting grid to sort out small Brown shrimp in beam trawls

Annex 1s

AIM

To improve size selection of Brown shrimp (*Crangon crangon*) in the single species beam trawl fishery.

TARGET SPECIES

Brown shrimp (*Crangon crangon*)

AREA, VESSEL

North Sea (ICES IVb)

Beam trawler (18 m, 125 kW)

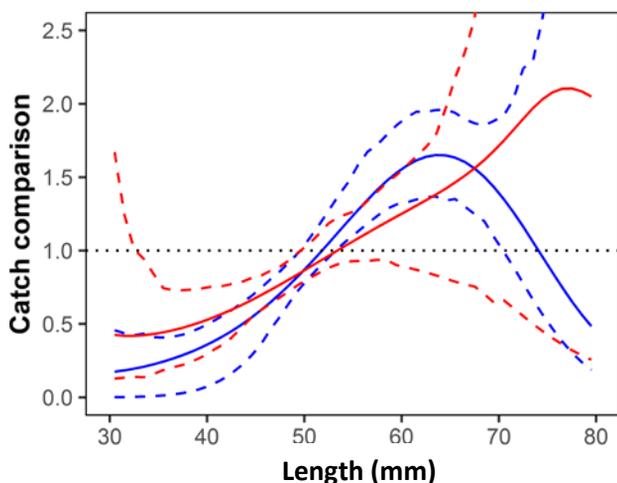


GEAR

A grid with a 6 mm bar spacing allowing small shrimp to escape. To ensure maximum water flow through the grid, special bars were constructed out of glass fiber which were drop formed and only 4 mm thick. Preliminary trials were conducted in Aug, Nov and Dec 2018 to test performance, grid angle, handling issues and potential blocking.

RESULTS

Based on preliminary testing, minor adjustments were needed to optimise performance, handling and robustness of the grid. During the preliminary trials, samples were taken to determine whether small shrimp were escaping. Catches of small shrimp under 48 mm were significantly reduced. Based on these results, scientific trials are to be conducted in Fast-Track II.



FURTHER INFORMATION

Jordan Feekings (jpf@aqu.dtu.dk)



DANMARKS FISKERIFORENING
Producent Organisation



Annex 2. Scientific publications

Veiga-Malta, T., Feekings, J., Herrmann, B. and Krag, L.A. 2018. When is enough, enough? Quantifying trade-offs between information quality and sampling effort for fishing gear selectivity data. *PloS one*, 13(6), p.e0199655.
<https://doi.org/10.1016/j.marpol.2018.10.020>; <http://kortlink.dk/ydkh>

Eliassen, S.Q., Feekings, J., Krag, L., Veiga-Malta, T., Mortensen, L.O. and Ulrich, C., 2019. The landing obligation calls for a more flexible technical gear regulation in EU waters—Greater industry involvement could support development of gear modifications. *Marine Policy*, 99, pp.173-180.
<https://doi.org/10.1016/j.marpol.2018.10.020>; <http://kortlink.dk/ydkg>

Feekings, J., O'Neill, F.G., Krag, L., Ulrich, C., Veiga Malta, T. 2019. An evaluation of European initiatives established to encourage industry-led development of selective fishing gears. *Fisheries Management and Ecology*.
<https://doi.org/10.1111/fme.12379>

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<https://doi.org/10.1016/j.ocecoaman.2019.05.009>; <http://kortlink.dk/ygpc>

Veiga-Malta, T., Breddermann, K., Feekings, J.P., Krag, L. A., Paschen, M. Understanding the hydrodynamics of a size sorting grid in a crustacean fishery. Under review.

*Mortensen, L.O., *van Helmond, A., Plet-Hansen, K.S., Ulrich, C., Bailey, N., Bergsson, H., Catchpole, T., Dalskov, J., Elson, J., Kindt-Larsen, L., Mangi, S., Needle, C.L., Oesterwind, D., Olesen, H.J., Zimmermann, C., Poos, JJ. European experiences on the use of Remote Electronic Monitoring. Under review.

Veiga-Malta, T., Feekings, J.P., Frandsen, R.P., Herrmann, B., Krag, L.A. Testing a size sorting grid in a brown shrimp (*Crangon crangon*) fishery. Manuscript.

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