Proposal for pulse trawl research

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17-11-2014, IJmuiden

Background

In 2013, the new Common Fisheries Policy (CFP) was established for the coming years (EU regulation 1380/2013). One of the major elements of the new CFP is the landing obligation, which obligates fishermen to land all catches of species that are identified in the CFP. Consequently, part of the undersized fish that is discarded at the moment must be landed.

The Dutch demersal fishery traditionally fishes for flatfish using the beam trawl. Because this fishery is characterized by high by-catches, the landing obligation will have severe consequences for this fishery. For a number of years, the Dutch sector is looking for ways to decrease by-catches in the flatfish fishery. Currently, the pulse trawl technique is considered to be a promising alternative to the traditional beam trawl fishery by both the Ministry of Economic Affairs as well as the Dutch sector, due to its increased selectivity. The pulse technique uses small electrical currents to startle the fish, so that they detach from the seabed and land in the net.

Research aimed at the possible effects of the pulse fishery on the ecosystem started in 1998. This research was mainly focussed on the catches of target species, by-catch of undersized fish and benthos and bottom impact. Initially, this research was carried out with a 7m prototype pulse gear. Subsequently, this was replaced by the 12m prototype of the Verburg-Delmeco pulse trawl (Anonymous, 2002; van Marlen et al., 2001). In 2008, the pulse wing of HFK engineering was introduced. A catch comparison between both pulse gears and a traditional beam trawl was executed in 2011 (van Marlen et al., 2014). In addition, a pulse monitoring program was performed between December 2011 and March 2013 (Rasenberg et al., 2013), in which both type of pulse gears were represented. Both research showed that the pulse fishery has less by-catch than the traditional beam trawl fishery.

Fishing with electricity is prohibited (EU regulation 850/1998) in the EU and only permitted under a derogation. Initially, 5% of the beam trawl fleet was allowed to fish with the pulse trawl. However, this number was not sufficient to cover the interest for the pulse trawl in the Dutch fleet and consequently a waiting-list for pulse derogations was established. Eventually, the number of pulse derogations was increased in 2014, as part of the pilot project, based on article 14 of the new CFP. Consequently, 42 extra trawlers could switch to the pulse fishery.

Article 14 describes the following:
'In order to facilitate the introduction of the obligation to land all catches in the respective fishery in accordance with Article 15 ("the landing obligation"), Member States may conduct pilot projects, based on the best available scientific advice and taking into account the opinions of the relevant Advisory Councils, with the aim of fully exploring all practicable methods for the avoidance, minimisation and elimination of unwanted catches in a fishery.'

As part of the pilot project, a comprehensive research agenda was established, with the following objectives (Ministry of Economic Affairs, 2014):

1) Investigate how the pulse trawl, with or without certain adjustments to the design of the net, could contribute to a higher selectivity of the Dutch flatfish fleet, so that the consequences of the implementation of the landing obligation will be reduced to an acceptable level.
2) Collect key data and knowledge, which is needed for a broad acceptance and permission to use the pulse trawl in the North Sea. And taking into account the numerous issues and worries from different (international) stakeholders on the effects of the increase in pulse trawl licences for flatfish (but also other species like sharks, rays, lobster, spisula and shrimps).

Proposed research agenda

The research proposed in this document, serves both to comply with the conditions set for the pilot project pulse, as well as to address the issues and concerns of different (international) stakeholders. The following research areas can be identified in the research agenda:

1. Governance: mapping the processes and stakeholders perceptions concerning the introduction of a new fishing gear, the pulse trawl
2. Economy: gain insight into the economic performance of the pulse fishery
3. Control and enforcement of the pulse fishery
4. Ecology and technique: a total impact assessment of the Dutch flatfish pulse trawl fleet on a North Sea scale.

Area 1 and 2 are covered in current and future policy-supporting research. Area 3 is taken care of in the working group Control and Enforcement, where the fishing industry, NGO's, researchers, pulse-suppliers and policy makers work together.

This document covers area 4 (ecology and technique) and intents to inform on the proposed research projects and to explain the coherence between them.

Ecology and technique: impact assessment

In the proposed impact assessment of the pulse fishery, three aspects are key:

1. The effect on the by-catch of undersized fish
2. The effect of the use of electricity on marine organisms and marine ecosystem
3. The development of the pulse technique

Appendix 1 gives an overview of the different subprojects that are part of the impact assessment. A synthesis will eventually combine the results of the different sub-projects to provide information on the impact of the flatfish pulse trawl on a North Sea scale.

Sub-project 1: By-catch of undersized fish

This sub-project is aimed at assessing how the by-catch of undersized fish will change when the sole and plaice quota are caught with a fleet of pulse trawl vessels, compared to a fleet of traditional beam trawl vessels. Currently, the sole and plaice quota of the Dutch fleet are caught with both pulse and beam trawl vessels. Both situations (100% pulse trawl and 100% beam trawl) are therefore theoretical and not measurable in reality. To assess the amount of by-catch in both scenario's, it is necessary to scale up discards data from current fishing practices. In addition to monitoring current practices, it is therefore necessary to gain more information on the technical selectivity, the fishery distribution and fishing intensity of both gears. The by-catch of a fleet is determined by (i) the technical selectivity of the fleet, (ii) the fishing grounds and (iii) the fishing season. The following research projects are proposed to deliver the data for this sub-project (see also figure 1):

1.1 Get more insight into the selectivity and efficiency of the beam trawl and the pulse trawl. Catch comparison trips will be arranged with both gears fishing in the same area at the same time. The aim of this research is to demonstrate the true difference in selectivity, while eliminating factors such as choice of fishing area and season. These data will be used to scale-up data from research 1.2.

1.2 Investigate by-catch as this occurs in current practice. To achieve this, a comprehensive discard monitoring program will be established. The data resulting from this research will be scaled-up (with data from the other research projects) to eventually assess by-catch levels in a 100% beam trawl and a 100% pulse trawl scenario.

1.3 Investigate the spatial and temporal distribution of the pulse and beam trawl fleet. For this purpose, VMS data will be collected. The data resulting from this research will be used to scale-up the data from research project 1.2.

<u>Expected results of sub-project 1:</u>

This research will deliver an estimate of the change in by-catch in the sole and plaice fishery, when the traditional beam trawl fleet is replaced by a pulse trawl fleet. It is assumed that if the remaining beam trawl vessels will be replaced by pulse trawl vessels, the spatial and temporal patterns of effort of the pulse trawl will remain the same.

The estimated change in by-catch is based on the following data:

i. The experimental fishery will deliver data on the proportional change in the by-catch of the pulse trawl per kg of marketable sole, in comparison to the beam trawl.
ii. The discards monitoring will deliver an estimate of the current by-catch in the pulse trawl fleet, which can be scaled up with data resulting from (i) en (iii)
iii. Registration of catches and VMS data will deliver information on marketable catches and the spatial and temporal patterns of the pulse fleet

It is important to realise that this is a rough estimate of the effects on by-catch of a total transition to the pulse trawl. In reality, spatial and temporal patterns of beam and pulse trawl vessels will differ. In PhD-3, a fleet dynamic model will be used to perform a more accurate up-scaling of current by-catch levels. In this research, spatial and temporal patterns of the pulse and beam trawl fleet will be modelled in interdependence of their specific selectivity and economic parameters.

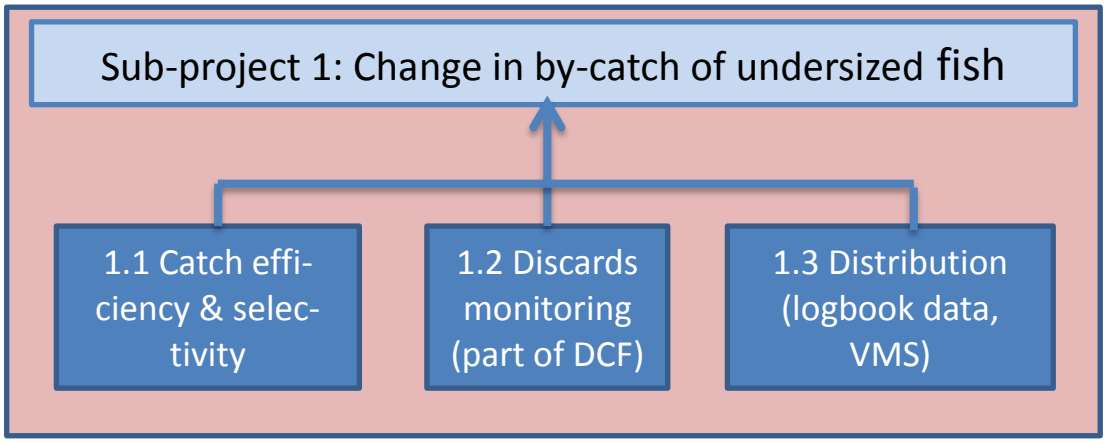

Figure 1: Overview of the coherence of the different research projects that will deliver the information for sub-project 1.

Sub-project 2: Impact of electricity on marine organisms and the ecosystem
The effects of electricity on marine organisms and the marine ecosystem are not yet well known. A large part of the pulse trawl research will therefore be aimed at this research area. It is proposed that data collection in this sub-project will be realized by a combination of research projects and PhD projects. The effect of electricity on fish and benthos will be investigated in the laboratory in research 2.1 (PhD-1) and the field in research 2.2 (PhD-2). The calculation of the effects on a North See scale will be performed with computer models in research project 2.3 (PhD-3). A particular wish (from NGO's) is to gain insight into the effects of the pulse fishery on the bottom ecosystem by performing field experiments with experimental fishing in closed areas (see research project 2.4). Additional research on the field intensity of the pulse trawl in practice will be carried out in support of the other projects in research project 2.5.

An overview of the proposed research projects on the effects of electricity on marine organisms and the marine ecosystem:

2.1 Laboratory experiments to investigate the degree of mortality, mechanical damage, physiological changes and behavioural changes of marine organisms, in response to pulse trawl exposure (PhD-1)
2.2 Laboratory and field experiments towards the effects on the ecosystem functioning (geochemical effects) (PhD-2)
2.3 Development and application of the fleet dynamics and ecosystem models that are necessary to estimate of the effects of the pulse trawl on a North Sea scale (PhD-3).
2.4 Field experiments aimed at comparing the effects of the pulse trawl fishery with the effects of the beam trawl fishery on the seabed of relevant fishing grounds. This research will involve closed areas, which will be split up in three sub-areas: 1) only pulse trawl fishery, 2) only beam trawl fishery, 3) control area: no fishing allowed.
2.5 Field strength measurements in situ (in, on and above the seabed). To determine the realistic exposure of marine organisms to the pulse trawl, it is important to investigate the spatial pattern in field strength (and the evolution of this) of the pulse trawl. This will provide insight into the distribution of the electrical voltage in, on or above the seabed in case of a pulse trawl passage.

Figure 2 shows how the different projects are connected and how their combination will provide the necessary insight into the impact of electricity on marine organisms and the ecosystem.

The computer models that will be developed by PhD-3 will be used to compare two scenario's. In scenario 1, the plaice and sole quota will be caught with a fleet of pulse trawl vessels. In scenario 2, the quota will be caught with a fleet of beam trawl vessels. It is expected that a 100% pulse trawl fleet will target slightly different areas with a different effort distribution, compared to the beam trawl fleet. These parameters will be incorporated into the models. The pulse and beam trawl fleet will be assessed on a number of indicators, like (i) by-catch of undersized fish, (ii) degree of damaged fish in the catch (spinal damage and ulcers), (iii) the impact on ETP species, (iv) the impact on the functioning of the bottom ecosystem. Data on i, ii and iii will be collected in sub-project 1 (by-catch). Element iv will follow from the field experiment with closed areas (research project 2.4).

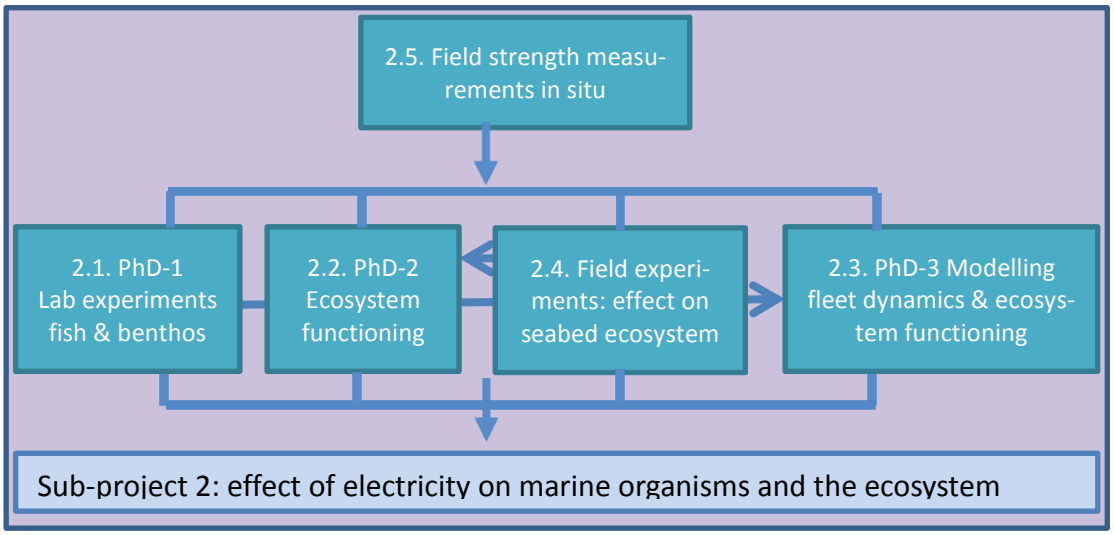

Figure 2. Overview of the different research projects under sub-project 2 and how their combination will provide the necessary insight into the impact of electricity on marine organisms and the ecosystem.

3. Development of the pulse technique.

To perform a realistic impact assessment, it is necessary to monitor changes in the pulse technique. Data collected in the control and enforcement process are essential in this respect. In addition, it is necessary to monitor the output of a number of pulse vessels at sea at a yearly basis.

Coherence between the sub projects

Figure 3 gives an overview of the coherence between all projects.

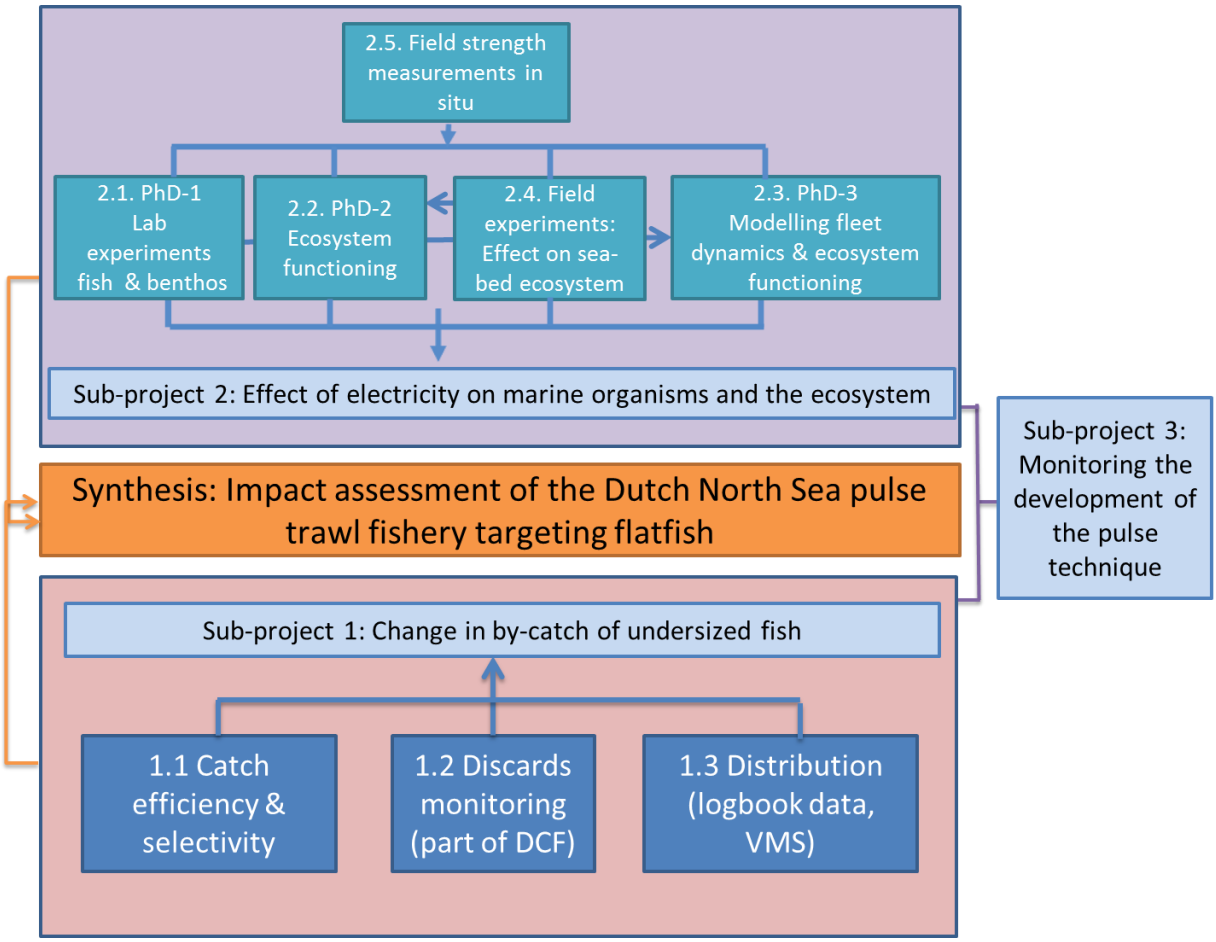

Figure 3. Overview of the coherence of the sub-projects for the impact assessment

Appendix 1. Overview of the proposed projects for the impact assessment

1.1	Catch selectivity and efficiency	Get more insight into the selectivity and efficiency of the beam trawl and the pulse trawl. Catch comparison trips will be arranged with both gears fishing in the same area at the same time. The aim of this research is to demonstrate the true difference in selectivity, while eliminating factors such as choice of fishing area and season. The data on technical selectivity will be used to scale-up data from research 1.2.
1.2	Discards monitoring	Investigate by-catch as this occurs in current practice. To achieve this, a comprehensive monitoring program will be established (extension of DCF). The data resulting from this research will be scaled-up (with data from the other research projects) to eventually assess by-catch levels in a 100% beam trawl and a 100% pulse trawl scenario.
1.3	Distribution	Investigate the spatial and temporal distribution of the pulse and beam trawl fleet. For this purpose, VMS data will be collected. The data resulting from this research will be used to scale-up the data from research project 1.2.
2.1	PhD 1	Laboratory experiments to investigate the degree of mortality, mechanical damage, physiological changes and behavioural changes of marine organisms, in response to pulse trawl exposure.
2.2	PhD 2	Laboratory and field experiments towards the effects on the ecosystem functioning (geochemical effects).
2.3	PhD 3	Development and application of the fleet dynamics and ecosystem models that are necessary for the calculation of the effects of the pulse trawl on a North Sea scale.
2.4	Effect on seabed ecosystem	Field experiments aimed at the comparison of the effects of the pulse fishery with the effects of the beam trawl fishery on the seabed ecosystem of relevant fishing grounds. This research will involve closed areas, which will be divided in the following areas: 1) only pulse trawl fishery allowed, 2) only beam trawl fishery allowed, 3) control area: no fishing allowed.
2.5	Field strength measurements	Field strength measurements in situ (in, on and above the seabed). To determine the realistic exposure of marine organisms to the pulse trawl, it is important to investigate the spatial pattern in field strength (and the evolution of this) of the pulse trawl. This will provide insight into the distribution of the electrical voltage in, on or above the seabed in case of a pulse trawl passage. The data resulting from this research will be used to extrapolate data from the laboratory to the effects at sea (PhD 1 and PhD 2) and to gain insight in the spatial patterns of the pulse trawl.
3	Monitoring the development of the pulse technique	Monitoring the developments of pulse technique in practice to perform a realistic impact assessment.
4	Synthesis	Report for Brussels on the effects of the pulse trawl fishery, resulting from an integration of all the above projects.