International Stakeholder Dialogue on Pulse Fisheries

Report of the third dialogue meeting, Amsterdam, June 19, 2018

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Wageningen University &

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Contents

Summary

This document is a report of the Third International Pulse Stakeholder Dialogue Meeting hosted by the Dutch Ministry of Agriculture, Nature and Food Quality in Amsterdam on June 19, 2018. The report contains the minutes of the meeting. Hence, this document does not have the status of a research report. Participation and reporting was performed within the Policy Support Research programme (*Beleidsondersteunend Onderzoek*), theme 'Sustainable Fisheries (Project: Pulse Fisheries)' of the Ministry.

The dialogue meeting on pulse fisheries was organised in the context of the Dutch Ministry of Agriculture, Nature and Food Quality's approach to engage in a more transparent and inclusive process concerning the benefits, questions and concerns about the development of pulse fisheries. A multi-annual research programme into the impacts of flatfish pulse fishing started with the First International Pulse Stakeholder Dialogue Meeting in 2015. An International Science Advisory Committee (ISAC) was established to examine the research process and the quality of science produced (by peer review) and to assist both the scientists involved and the government to identify and address knowledge gaps in innovative ways.

A total of 70 participants from 6 different countries attended the dialogue meeting. They represented government bodies, politicians, fishers, processors and traders, NGOs, standards holders, media and scientists. The principle of Chatham House Rules, which allows the information of a meeting to be reported without identifying its source, was applied in this meeting. This report will therefore not attribute comments to participants, excluding presenters. However, the Chatham House Rules are compromised somewhat in this instance due to the presence of a camera. The decision to film the presentations and record the discussions was made by the Ministry, due to the public and political interest in the meeting. Footage can be made available on request to the Ministry.

During the meeting, researchers presented their work on pulse gear and answered follow-up questions from the audience. The first plenary began with an explanation of the advisory process of the International Council for the Exploration of the Sea (ICES). As an ICES member country, the Netherlands had requested ICES advice on pulse trawling. This advice was released in 2018 and compares the ecological and environmental effects of pulse trawls and traditional beam trawls when exploiting the North Sea total allowable catch (TAC) (ICES, 2018a). One of the co-chairs of the ICES working group on the subject (WGELECTRA) presented the results of five requested criteria of assessment and one additional criteria. The chair of the ICES Advisory Committee then explained the ICES advice based on the scientific results. A researcher from Wageningen Marine Research presented work on understanding the behaviour and movement of fish within the trawl nets, using camera monitoring. During the lunch break, participants were invited to participate in the information market with stands about control and enforcement, survivability of fish, underwater flatfish images, and shrimp fisheries. A test tank was also available so participants could experience the electrical pulse. The second plenary began with a presentation on the outcomes of the exercise the ISAC had undertaken, attempting to identify and prioritise stakeholder knowledge needs and evidence gaps. The day closed with more time for questions and some concluding reflections.

1 Introduction

This document is the report of the Third International Pulse Stakeholder Dialogue Meeting hosted by the Dutch Ministry of Agriculture, Nature Quality and Food (hereafter: the Ministry) in Amsterdam on June 19, 2018. On June 18, the day before the meeting, a trip on a pulse vessel was organised for participants who were interested to see a pulse vessel operating at sea. Most also came to the stakeholder meeting, some only joined the trip. Earlier meetings of a similar nature were held on 2 July, 2015 and 20 January, 2017. This report comprises elaborate minutes of the Third International Pulse Stakeholder Dialogue Meeting. Hence, this document is a record of proceedings and does not have the status of a research report.

As in the Second International Pulse Stakeholder Dialogue Meeting in 2017, the Wageningen Marine Research report format was selected for this report so that the dialogue results will be easily and transparently available for future use in the research and policy process.

The intention for the Third International Pulse Stakeholder Dialogue Meeting was to hold all discussions in accordance with so-called Chatham House Rules. However, this year the Ministry decided to have a camera present which meant that agreeing to Chatham House Rules was no longer strictly possible. The Ministry's rationale for filming the whole event was that there was a lot of interest from press and participating parties. The Ministry decided to film the presentations and record (without zooming in to those speaking) the discussions and to make the footage freely available for interested parties. In accordance with the Chatham House Rules principle, comments will not be attributed to individual names in this report. An exception has been made for the presenters (in relation to their own presentation) and scientists who are quoting their own work. Their names are disclosed in the report. There is no reference to participants' nationalities in the report, except when it concerns representatives from the Dutch government or Dutch fishing industry. This is done with their permission and in view of accountability and transparency considerations upheld by these parties.

Participation and reporting was performed within the Ministry's Policy Support Research Programme (*Beleidsondersteunend Onderzoek*), theme 'Sustainable Fisheries (Project: Pulse Fisheries)'.

2 Report of the Third International Pulse Stakeholder Dialogue Meeting

The agenda of this meeting was different to the Second International Pulse Stakeholder Dialogue Meeting in 2017 (see Table 1). This year all sessions were in plenary. The first session was organised around the ICES advice on the comparison of the ecological and environmental effects of pulse trawls and beam trawls when exploiting the North Sea sole TAC (ICES, 2018a) and the second session was about the stakeholder process. During the lunch break an information market was held for the participants to gather additional information. Stands were set up informing the participants on the following topics: control and enforcement, survivability of fish, and shrimp fisheries. The underwater images of flatfish in a pulse trawl shown in plenary were shown again and the researcher was present to answer questions.

Table 1 Agenda of the meeting

Time	What	Speaker
9.30-10.00	Reception and registration	
10.00-10.15	Opening of the Deputy Director General of Fisheries	Aldrik Gierveld, Ministry of Agriculture, Nature and Food Quality
	Welcome and outline of the day by the chair	Michel Kaiser, Bangor University
10.15-11.00	Plenary session I, outline by moderator	David Reid, Marine Institute
	ICES Advice	Eskild Kirkegaard, ACOM Chair ICES
	Report of WGELECTRA	Adriaan Rijnsdorp, WGELECTRA Chair
11.00-11.15	Coffee break	
11.15-11.50	Continuation of plenary session I	
11.50-12.00	Introduction to underwater flatfish images in a pulse trawl	Pieke Molenaar, Wageningen Marine Research
12.00-13.30	Lunch break and Information Market	
	a. Control and enforcement	
	b. Survivability research project	
	c. Underwater flatfish images	
	d. Shrimp fisheries	
13.30-14.30	Plenary session II, outline by chair	Michel Kaiser
	Stakeholder process, stakeholder survey and forecast	
14.30-15.00	Wrap up of the day	
	Concluding remarks and highlights of the day	Michel Kaiser
	Closing words	Aldrik Gierveld, Ministry of Agriculture, Nature and Food quality
15.00-16.30	Optional informal drinks	

2.1 Plenary session I

Aldrik Gierveld, deputy director general of fisheries at the Dutch Ministry of Agriculture, Nature and Food Quality (former Ministry of Economic Affairs) welcomed the participants. He emphasised the importance of the stakeholder dialogue meetings for the Ministry and explained how the Ministry is continuously seeking to strike the right balance between the different goals and interests. For this, the Ministry relies on science to answer questions such as what are the best fishing techniques available? This meeting is important in order to integrate all the interests at stake. Mr. Gierveld thanked the

international scientific advisory committee (ISAC) of the multi-annual pulse research programme and those presenting and expressed his wish for a good discussion.

Michel Kaiser from Bangor University (UK), chair of the ISAC, then took the floor and also welcomed the participants, announcing that he will chair the dialogue meeting. As pulse trawling is a sensitive and serious issue, he continued by stating that it is important to have open discussions. He explained that the camera present in the plenary room is from the Dutch government, and that the crew will film the presentations (not the participants as individuals) and record the discussions. He explained that the reason for this is to keep an accurate record of who said what. He therefore asked the participants to state who they are when asking a question or making a statement. The Ministry said that the film will be available to all, but the footage needs to be treated with respect and permission must be granted if it is to be used in any way. Michel Kaiser asked whether anyone present has objections to this and no one objected. He informed the participants that outside the room other cameras will be present and that they might be approached for an interview. Participants were notified that they then need to inform themselves about who the crews are and what the interview will be used for. Michel Kaiser continued by explaining the agenda for the day, in which adequate space will be allocated for questions and discussions. He then gave the floor to Dave Reid, who was the moderator of the first session.

Dave Reid from the Marine Institute Ireland introduced himself as a member of the ISAC and clarified that he is not at the meeting to represent the Marine Institute. He said he will moderate the first session and explained that he prefers questions to statements. If statements need to be made, participants were urged to keep it short. He asked the participants to keep questions to the end of the presentations, and for them to be polite and courteous, jokingly referring to the camera in the room.

2.1.1 Eskild Kirkegaard, chair of ACOM, presenting the ICES process

Eskild Kirkegaard is the Chair of the ICES Advisory Committee (ACOM). He thanked the organisers for inviting him to present the ICES advice (ICES, 2018). He began by explaining what ICES is for those not familiar with the organisation, describing it as an international science community and reading the organisation's mission. He said that ICES has 20 member countries, each with national representation in the advisory committee. While it has strategic partnerships, ICES is foremost a science community with more than 5000 scientists from 60 countries, of which 1600 are active on an annual basis in more than 100 expert groups. Advice is given by the Advisory Committee (ACOM) based on work done in these expert groups. In the ICES system, the term "advice" is only applied when the advice has been formulated through the ICES advisory process (expert groups, advice drafting group, peer-review, and finally approval by the ACOM). Therefore, ICES Expert Group reports are not advice. ICES gives both recurrent advice and on special request. He emphasised that ICES always gives advice on request. The organisation's main customers are the European Commission (DG MARE and DG ENVIRONMENT), OSPAR, HELCOM, NEAFC, NASCO, and ICES member countries. In 2017, there were 24 special requests on a wide range of topics (see presentation in Annex 2 for examples). The only way ICES can deal with these is through its community of scientists. Eskild Kirkegaard explained that when the Netherlands came with their special request on pulse, as is the case for any other special request, the ACOM Leadership and the ICES secretariat entered into a dialogue with the client (the Netherlands) on the understanding of the request. ACOM was informed of the request and the experts who were expected to work on the request were contacted. Based on the dialogue with the client and the feedback from experts, a proposal for a process to address the request was developed and approved by ACOM. When addressing a question, ICES uses six quality criteria to ensure a proper and consistent framework:

1) Best available knowledge: science and data from expert groups.
2) Quality assured: peer reviewed.
3) Transparent process: all steps are documented and several steps are open to observers.
4) Unbiased and non-political: that does not mean 'not politically relevant' but that the work is independent and only based on science.
5) Relevant: the advice meets the needs of the client.

6) Timely: most advice is on TAC and quota, so being timely is important.

The process involved WGECO (the working group on the ecosystem impact of fisheries), who proposed an outline to address the request. WGELECTRA (working group on electrical trawling) wrote a report addressing the request, which was reviewed by the RGPULSE (the review group pulse).The advice drafting group then drafted the advice, which was finally discussed and approved in consensus by ACOM. This illustrates that the ICES advisory process is a comprehensive, and sometimes bureaucratic, process. Eskild Kirkegaard, as chair of ACOM, emphasised that he mentioned this because there was a dispute in the press about it and he wanted to reiterate that ICES has a comprehensive process.

Eskild Kirkegaard informed the meeting that ICES has earlier provided advice about pulse fishing. The first was in 2006, by request of the European Commission. The second was in 2009 by request of the Netherlands. The third in 2012, by special request from France. The fourth report, published in 2016, was an update to the 2012 advice, by special request from France. The fifth advice, provided in 2018, was by special request from the Netherlands. The summary of this latest advice is presented in section 2.1.3 of this report.

2.1.1.1 Questions

A participant asked who filed the previous special requests to ICES about the pulse gear. Eskild Kirkegaard responded that this was the European Commission in 2006 and France in 2012 and 2016.

A representative from an NGO asked what the rules are on 'timely manner'. Eskild Kirkegaard responded that there are no clear rules, but that timely is interpreted in relation to the wishes of the clients and in relation to whether ICES has sufficient time to deal with the request. There is a minimum time period that is needed, which is set in consultation with the experts who have to do the research. Sometimes the experts need an extra year to complete some more work before they can report. There have been a few cases where they could not do it within the allocated time because it would jeopardise the quality of the work.

The representative from an NGO continued by stating that there was disagreement in the ACOM meeting related to this special request and that the proposal was made in order to delay the advice. Time was needed to reread the report yet it was rejected because of time constraints. The representative asked again how 'timely' is judged by ICES. Eskild Kirkegaard explained that ACOM works on consensus, which means full support. That does not always mean full agreement, but the process is to discuss the pros and cons and eventually reach a conclusion. In the case of this advice, some questions were raised and discussed in the ACOM meeting, but the final advice was approved by all members.

Dave Reid announced that Adriaan Rijnsdorp will present the report of ICES WGELECTRA.

2.1.2 Adriaan Rijnsdorp, chair of WGELECTRA, presenting the WGELECTRA report

Adriaan Rijnsdorp stated that it is nice to have the opportunity to explain the report here at the dialogue meeting. Some other members of WGELECTRA were present as well. Adriaan Rijnsdorp is co-chairing this working group with Maarten Soetaert. WGELECTRA is one of the expert groups in ICES. It consists mainly of scientists that study electrical or pulse fishing on the marine environment. They discuss the science, its application, and the societal debate. Every year the working group (WG) produces an update report. In this sense, the current WGELECTRA report is a 'living document', subject to revision upon new evidence. The WG discusses work on pulse fishing by the international institutes and tries to find ways to solve scientific questions. For its last meeting, WGELECTRA had an additional Terms of Reference in relation to the preparation of the special request by the Netherlands. In preparing for this task, the WG asked its colleagues from other institutes to send representatives to discuss these issues. In addition to the regular members of WGELECTRA, participants from the research institute IFREMER in France and from the research institute CEFAS and the Joint Nature

Conservation Committee (JNCC) in the UK joined the meeting. This gave strength to the debate. The WG's purpose is to provide the scientific basis for answering the request for advice.

The pulse trawl is replacing beam trawl as the main method to catch sole. Adriaan Rijnsdorp said that this is the frame with which to approach the question of the special request. The group worked with 5 criteria:

1) Sustainable exploitation (of target species)
2) Impact on marine organisms (target and non-target species)
3) Mechanical disturbance of the seabed
4) Impact on the benthic ecosystem (structure and functioning)
5) Impact of repetitive exposure

As the WG only had a 3-day meeting, there was no time to write the report from scratch. The chairs therefore prepared for the meeting by writing the structure of the report and sharing a draft report with all members before the meeting. The WG then had three days to discuss the content and formulate conclusions. The WG made a review of the scientific information that was needed to give advice. It was necessary to qualify the strength of the scientific information and evidence available. To this end the WG created an assessment framework comprising four categories:

1) Proven
2) Indicative (there are still questions, but extrapolation is possible)
3) Inferred (there is no direct evidence, but it is possible to build a scientific argument)
4) Unknown (the WG does not know or there is conflicting information, either empirical or observation information)

The WG noted that a lot of information has been peer-reviewed, but there is also a lot of ongoing work.

Adriaan Rijnsdorp went on to explain the differences between beam trawl (BT) and pulse trawl (PT). Beam trawl uses heavy tickler chains and trawls at a speed of 6/7 knots, with sole being the main target species. Pulse trawl uses electrodes in place of tickler chains to create an electrical field that prompts fish to come out of the seabed and be scooped up by the nets. Pulse trawl has an efficiency advantage in that it trawls at only 5 knots and covers less ground while making its catch. The strength of the electrical field of the PT depends on where the strength measurement is taken relative to the node. This is due to dissipation, which means that the electricity quickly loses strength as it moves away from the conductor (i.e. to less than 17 V/meter if outside the net). Further, the soft sediment hardly affects the field strength.

On 1/1/2018 there were 78 sole pulse vessels in the Netherlands, 8 in Germany, and 3 in the UK. Seven vessels with pulse gear were being used to fish brown shrimp (5 Dutch, 2 Belgian). Sole fishing rights are transferable, so where pulse vessels landed 75% of the Dutch sole quota in 2009, this increased to 95% in 2016 as these vessels bought or rented quota from other vessels. There was also a shift in the distribution of the areas fished.

The application of the assessment framework led to the following results (WGELECTRA, 2018b):

Criteria 1: Sustainable exploitation of the target species using pulse gear:

- More efficient for catching sole (proven)
- Less efficient to catch plaice (proven)
- Size selectivity is unknown. Reduced catch efficiency for undersized flatfish (van Marlen et al. 2014) could not be corroborated
- Lower catch of discards for all flatfish, except for sole and other fish (indicative)
- Reduced catch rate of benthos (proven)
- Increased survival of discards due to cleaner catch and lower towing speed (inferred)

Criteria 2: Impact of pulse gear on marine organisms (methods: tank experiments and sampling commercial catch)

- Fish:

    - Injuries:
        - Fractures and haemorrhages due to cramp observed in cod (proven) and whiting (indicative), but not in sole, dab, seabass and small-spotted catshark (indicative)
        - Lower fracture probability in small and large cod (indicative)
    - Mortality:
        - No mortality observed in laboratory experiments. However, fish with fractures may have increased mortality risk (indicative)
        - Increased mortality in 2 out of 4 larval stages in cod, but not in sole larvae and sole eggs exposed to strong pulse stimulus (indicative)
    - Feeding:
        - No effect on food detection ability observed in one electro-sensitive fish species tested (indicative)
    - Reproduction:
        - Small-spotted catsharks laid eggs when kept for several months in the lab after exposure (inferred)
- Benthic invertebrates:
    - Mortality:
        - Lower mortality due to reduced mechanical disturbance of PT (50% lower penetration depth in sediment) (indicative)
        - No evidence for measurable additional mortality due to exposure to pulse in the few species studied (indicative)
    - Sub-lethal effects:
        - Few experimental studies do not show adverse effect on growth or risk of disease (inferred)
    - Reproduction:
        - Number of shrimps carrying eggs was not affected (indicative)
    - NOTE: The limited number of studies on benthic invertebrates implies that a possible adverse effect cannot be excluded

Criteria 3: Mechanical disturbance of the sea bed

- The average penetration of PT is 1.8cm (compared to 4.0cm with BT), in other words at least 50% reduction in mechanical disturbance (Depestele et al., 2018) (proven)

Criteria 4: Impact on the benthic ecosystem

- Benthic biomass impact:
    - Reduced benthic biomass impact (indicative)
    - Reduced benthic footprint (proven) and reduced benthic mechanical disturbance (proven)
- Bio-geochemistry:
    - The effect of pulse fishing on chlorophyll and oxygen dynamics is lower but more variable (few experiments) (indicative)

Criteria 5: Impact of repetitive exposure

- The group estimates the probability of an animal being exposed to PT more than once to be very, very low. The proportion of sea floor that is exposed multiple times within a day or week is negligible (inferred)
- Information on sensitivity threshold (V/m) is lacking, but the adverse effects only occurred at high field strength, observed in part of the trawl track
- Conclusion: Although repeated exposure has an effect in the lab, there is no indication that this will happen at sea. There is no indication for concern (inferred).

Additional criteria 6: Environment

- CO2 emissions reduced by ~50% due to reduced fuel consumption (proven)
- The reduced towing speed will reduce the wear of the gear, thereby reducing litter (inferred)
- No electrolysis was observed in a tank experiment with commercial pulse settings (alternating current) (indicative)

Adriaan Rijnsdorp concluded by saying that the impact assessment is ongoing, with experimental work still being done. The effects of pulse fishing on the population depend on sensitivity to exposure, exposure frequency, and the timing of the density-dependent regulation in the life cycle of the impacted species. Finally, the WG will be in a better position to answer these criteria when the Impact Assessment Pulse Fishery project results become available in 2019.

2.1.2.1 Questions

There were no questions after this presentation.

2.1.3 Eskild Kirkegaard, chair of ACOM, presenting ICES advice

Eskild Kirkegaard began by re-emphasising that part of Adriaan Rijnsdorp's presentation was peer-reviewed science and part was not. In order to keep the standard of the science high, the basis for the advice prepared by WGELECTRA was peer reviewed in an independent review process organised by ICES. The review went to the ICES advice drafting group and then to ACOM as part of finalisation of the advice. Because most existing evidence was about the absolute effects of pulse, WGELECTRA expressed that it was easier to come with firm conclusions through comparisons. The review group was asked to evaluate the scientific evidence and answer the question of whether the science is sufficient to make the comparison between the ecological and environmental effects of PT versus BT. The independent review group confirms the conclusions of WGELECTRA and confirms that the scientific evidence is sufficient to answer the questions in the special request.

Moving to advice, ACOM made the following conclusions on the five criteria:

Criteria 1: The sustainable exploitation of the target species

- Both PT and BT can sustainably harvest sole and plaice within MSY. Since the increase in use of pulse gear in 2009, fishing mortality has reduced and stock biomass has increased, mostly due to an overall decrease in effort
- There is no indication that the pulse fishery is not sustainable
- Bycatch of plaice decreased with pulse due to selectivity for sole, which is a better result for the ecological system
- Local increases in use of pulse (e.g., Thames estuary, Belgian coast, Northern France) may lead to a change to relative pressure on local components of the stock

Criteria 2: Target and non-target species that are exposed to the gear but are not retained (injuries and mortality)

- The evidence is clear: the impact has been reduced compared to BT due to the new design of PT
- Cod suffer relatively high injury rate, but these are animals that would be retained and killed anyway, so additional mortality is limited and the increase in the overall mortality of the North Sea cod stock is presently limited
- Flatfish, seabass, and small-spotted catshark do not suffer pulse-induced injuries
- There is no information available on the survival of fish at early life history stages after exposure to the pulse
- The population-level effect of possible reduced survivorship of larvae is considered to be low because of the low exposure rate and the strong compensatory density-dependent mortality in the life cycle of healthy stocks
- Exposure rate could be higher for eggs laid in sediment in the path of PTs, but egg-laying in sediment is rare in the North Sea

Criteria 3: Mechanical disturbance of the seabed

- Pulse trawls do not mechanically penetrate as deeply into sediment as BT and will therefore have a lesser mechanical effect on the benthos

Criteria 4: The structure and functioning of the benthic ecosystem

- Pulse trawl has a reduced footprint and mechanical impact on the benthos compared to BT

- The few studies indicate no incremental mortality from PT
- The effect on the structure and functioning of the benthic ecosystem is less for PT
- Because PT needs to catch 30% less fish overall to catch the same amount of sole (target species), pulse trawling leads to less fishing mortality

Criteria 5: The impact of repetitive exposure to the two gear types on marine organisms

- Incremental effects from repetitive exposure to pulse gear are expected to be low
- Little sensitivity to electrical stimulation has been found for any organism and the probability of repetitive disturbance is low.

The summary of the advice by ICES following the special request by the Netherlands is presented in Box 1.

Box 1: Advice summary of the Netherlands request on the comparison of the ecological and environmental effects of pulse trawls and traditional beam trawls when exploiting the North Sea sole TAC

"*ICES advises that there are fewer ecological and environmental effects of using pulse trawls than traditional beam trawls when exploiting the total allowable catch (TAC) of North Sea sole.*

i) *Both pulse and traditional beam trawls can be used to harvest the target flatfish stocks (sole and plaice) sustainably (at fishing mortalities in accordance with the MSY approach). Pulse trawls have been increasingly used in the North Sea flatfish fisheries since 2009. Over this period, the fishing mortality has reduced and stock biomass has increased, mostly due to an overall decrease in effort.*

ii) *The rate of injuries inflicted by mechanical impact on fish during the catch process is likely to be lower in pulse trawls than in traditional beam trawls. Cod suffer a relatively high injury rate when exposed to pulses, but the increase in the overall mortality of the North Sea cod stock caused by these injuries is presently negligible. Flatfish (sole, plaice, and dab), seabass, and small-spotted catshark do not suffer pulse-induced injuries.*

iii) *Pulse trawls do not mechanically penetrate as deeply into sediments as traditional beam trawl and will therefore have a lesser mechanical effect on the benthos.*

iv) *Pulse trawls have a reduced footprint and mechanical impact on the benthos compared with traditional beam trawls. The few studies of the effects of electrical pulses indicate no incremental mortality on benthos from the pulse trawls. It can therefore be expected that effect on the structure and functioning of the benthic ecosystem is less for pulse trawls.*

v) *Incremental effects from repetitive exposure to pulse gear are expected to be low.*

ICES recognizes that gaps exist in the knowledge of the potential effects of both gears; however there is considered to be sufficient information to compare the two gears."

Source: ICES (2018a, p.1).

2.1.3.1 Questions

A representative from an NGO commented that making a comparison between BT and PT in itself is a conclusion because it suggests they are the only two gear options, even though just looking at pulse is still difficult. Eskild Kirkegaard responded by explaining that, in terms of the knowledge available on the impacts of gears on the ecosystem, pulse is one of the best-investigated gears. This is because it has become a subject of political interest. He acknowledged that not all questions on the effect of pulse can be answered but for the pulse, compared to other gears, many questions can be answered.

A representative of fishers in Europe asked whether or not this research is missing answers about the social-economic effects of the gear such as its effects on small-scale fishing. The representative asked whether that is going to be a part of future research or whether the focus is only on the (environmental) impact of the pulse gear. Alyne Delaney (ISAC member) responded by acknowledging that the focus is indeed on technical and biological elements, as a result of how the Netherlands organised the research project, and that this is exactly the point she makes as member of the ISAC.

Eskild Kirkegaard responded that these aspects are indeed an issue that ICES would like to spend more time on.

A representative from an NGO asked why size selectivity, after 12 years of research, is still uncertain. The representative acknowledged the paper by Van Marlen (2014), but asked about other information and when the final opinion will be delivered. Adriaan Rijnsdorp responded that a follow-up comparing PT and BT has been carried out and it could not corroborate Van Marlen's (2014) work. In ongoing research, the aim is to underpin existing work with mechanistic insights into the size effect of the gear. Eskild Kirkegaard responded that spawning stock biomass was increasing for both stocks (plaice and sole) at the time of the switch to pulse gear so there is no indication of negative impacts at the population level.

A trader asked whether this research can bring pulse fishing closer to Marine Stewardship Council (MSC) certification. Adriaan Rijnsdorp responded that he does not know the MSC process very well, but from the evidence pulse is an improvement in sustainability. An employee of MSC responded that the effects of pulse on the ecosystem were previously unknown, but that some effects are now understood. If pulse would re-enter the assessment, the conformity assessment body (MSC certifier) can evaluate the outcome.

A representative of an NGO commented that there is a lack of information on the impact on species such as sharks for assessment purposes. The representative asked if more research was planned to rectify this. Adriaan Rijnsdorp responded that, while he hopes it will be possible, it is not guaranteed because choices have to be made because of time constraints. He re-emphasised that the aim is to develop a mechanistic understanding of the physiological impacts of the gear, which can then be extrapolated to other, similar animals. It is not possible with all species, of course, but for now this is the best approach.

A representative from an NGO asked what kind of changes are expected between this interim assessment and the full results, and whether ICES will make another assessment. Adriaan Rijnsdorp responded that he expects that the WG will be in a better position to predict what electricity does to marine species and ecosystems. They will also have information on the geo-chemical processes. The ICES assessments will depend on the questions asked to ICES. Eskild Kirkegaard responded that the ICES WGELECTRA will continue and will present a new report in 2019. He repeated that if advice is given by ICES, it is on request. In addition, many peer-reviewed publications will come out soon. Dave Reid added that many presentations will be on the subject of pulse gear at the upcoming ICES Annual Science Conference (September 2018).

A representative of fishers in Europe asked how widely spread the voltage of pulse gear is and whether it could affect larger fish. The representative added that there is a lack of large fish in the North Sea, and so approving the gear in one environment may be risky. Adriaan Rijnsdorp responded that one component of the study is to model the field strength around the gear. Researchers have also measured this in the water column and in the sediment, and another study is solely focused on the question of how fish detect and respond to pulse gear. The results will be announced in 2019.

A representative from an NGO commented on studying exposure to pulse in experiments versus in practice, arguing that the probability of exposure increases with increased use of the gear. The representative also asked how an increased survival rate could be explained. Adriaan Rijnsdorp responded that trying to understand the effect of exposure is critical. From information on fishing effort, and repetition of effort on one location, we can quantify that there is no or limited repetitive exposure. Even if there is an effect of repeated exposure in theory (shown during experiments), it is necessary to know whether it applies in practice. It is also necessary to determine an exposure threshold for animals affected. Adriaan Rijnsdorp added that indeed it is not properly known what the effect of pulse is on the developmental processes of animals and invited Marieke Desender (CEFAS) to add to this. Marieke Desender added that the finding of an increased survival rate in one species is strange, suggesting species-dependent effects. It is not known what the effects are on larvae.

A representative of fishers commented that the skipper on yesterday's pulse trip claimed to have a 50% reduction in oil use and asked whether this was from new data? The representative also asked whether it was easier to fish with pulse than other gears. Adriaan Rijnsdorp responded that the figures in his presentation (46%) are from Wageningen Economic Research and that it should be kept in mind that there are differences between vessels. Some skippers focus on getting the best results, not all skippers are like that.

A Dutch fisher representative responded that pulse gear is easier, safer, and gives better quality fish. The total catch is equal to the BT gear because of the quota, but it disrupts fewer square meters of sea floor. The representative responded to an earlier comment about chefs being unwilling to work with fish from pulse gear as false, pointing to a trader in the room and asking him to comment. The trader stated that the problem was that French supermarkets want sole at the best quality, but are deterred by how fish caught by pulse is named *'peche electrique'* in France. He recalled a similar situation with flyshoot gear 20 years ago. It was initially rejected in France and is now gaining popularity; perhaps the same will happen with pulse.

Another trader comments that he feels confused as the claims made by science and NGOs are conflicting, giving examples such as 'the North sea is a desert' (from NGOs) conflicting with 'biomass is going up' (from science), and 'pulse is more efficient using less fuel' (from science) conflicting with 'pulse is not more efficient' (from NGOs). He urged them to enter a better dialogue, especially given the interest of the public. Adriaan Rijnsdorp responded that this suggestion was exactly the goal of the research. The ICES peer-review process has aimed to gather, specify, and review the evidence. He also commented that many claims that have been made in policy and campaigning are difficult to retract. He also pointed to the importance of knowing which methods are used and which definitions are employed.

A representative from an NGO responded by saying that the ratio of fish caught to fuel expended is roughly the same in the two gears (450 and 420 grams per unit of fuel). The difference between PT and BT gears is the type of fish that are caught (more sole – which is preferred on the market). However, the same mass is removed from the sea per unit of fuel compared to gill nets in France, which produce 2kg of fish per unit of fuel. The representative continued by stating that the perceived division between France and the Netherlands on this subject is not correct. Rather, fishers in the Netherlands, UK, France and Belgium are against pulse. The representative stated that chefs from 25 other countries do not want to work with pulse fish because of its status as an industrially caught fish. The representative concluded by urging for a cessation of the comparison of PT with BT (rather to compare with all gears) and to leave the narrative of France and the Netherlands having two different stances on the gear behind.

A trader commented that a more selective gear is a solution given the landing obligation and pressure from NGOs to be more selective. Frustration was expressed about the contradictory information and the way interest groups use it. Dave Reid responded that this is not the place for debate and continued by stating that the solution is to follow the processes of ICES. Many working in NGOs are scientists and fishers also want evidence, so it is the best way to reach consensus.

A representative of fishers in Europe asked whether research had be done to see what happens after the PT has passed along the sea bed. Adriaan Rijnsdorp responded that these trips are planned for this year.

A representative of fishers added that he would like to make the statement that the fishers who are using pulse are happy with the pulse gear, but the larger group of fishers are not.

Dave Reid announced that Pieke Molenaar will present flatfish behaviour and underwater imaging.

2.1.4 Pieke Molenaar, researcher Wageningen Marine Research, presenting the Flatfish in the Picture project

Pieke Molenaar began by explaining that his work aims to look at how the fish behave and what happens in the PT. With an 80mm mesh size it is difficult to avoid undersized plaice. The landing obligation is the background for this project. There is a history of 40 years to improve the selectivity of 80mm sole fisheries. With limited knowledge on fish behaviour in this fishery, the development of selective devices is frequently based on trial and error without understanding the mechanism behind these devices. These underwater video recordings are available online and provide fishers and scientists with fundamental knowledge of fish behaviour in PT. Filming in the net is easier with PT than with BT because of the lower disruption of the sediment. Gear technologists have always focused on how to get the small fish out of the net. Sole is a good swimmer, and fishermen already know that it tries to escape (as shown in the video, available online at https://www.youtube.com/watch?v=w5yx-rb5w3E). Sole and plaice behave differently in the net, but the question now is how to use this information. One option is to focus on catching sole in a separate section of the trawl and have a selective codend for plaice.

2.1.4.1 Questions

There were no questions after this presentation.

Before the lunch break, Michel Kaiser announced that there is a display tank at the lunch market in which attendees can feel the electrical stimulations of pulse gear themselves.

2.2 Plenary session II

Michel Kaiser introduced himself as chair of the second plenary session, which is to begin with his presentation about prioritising stakeholder knowledge and evidence gaps. The press present at this stakeholder dialogue meeting were not allowed in this session. They would be let in again at the closing part (2.3).

2.2.1 Michel Kaiser, chair of ISAC, presenting stakeholder knowledge needs and evidence gaps

Michel Kaiser began by explaining that the stakeholder engagement process he will present was implemented only after the research programme was put in place. There was a strategy for ongoing stakeholder engagement during the pulse trawl project (by organising dialogue meetings), but the International Science Advisory Committee (ISAC) identified a feeling amongst stakeholders that they were not being listened to. To rectify this, they set up a research question prioritisation exercise to identify the gaps in the science programme. This involved inviting the participants of the dialogue meetings (a group of approximately 80 stakeholders, similar to those present at this session) to participate and contribute. The process for the research question prioritisation exercise was as follows:

1) Invite all stakeholders to contribute to the compilation of key knowledge needs or evidence gaps
2) Compile list of knowledge needs
3) ISAC categorises all knowledge needs
4) Original questions are preserved and some clarification edits implemented
5) The entire list is sent to the stakeholder community to allocate votes to rank the questions according to importance

A weakness of the strategy is that stakeholders cannot be forced to contribute questions or votes, so the outcome may be biased by who participated. A total of 83 questions were submitted by 16 contributors in the stakeholder group. The contributors were commercial fishers, eNGOs, research scientists, process/retail, and government. The questions were compiled in a list, allocated to different themes, and then returned to the stakeholder group in the form of a survey, in which they were asked to prioritise the questions. Only 12 responded with votes, which Michel Kaiser admitted was low but

there is little that could be done to improve the response rate. The voters were recreational fishers, commercial fishers, eNGOs, research scientists, process/retail, and government. The following table shows the topics of the questions and the distribution of questions and votes by topic, and whether the voters thought the question was not a scientific one.

Table 2 Results of stakeholder survey about knowledge needs and evidence gaps

	Number of questions	*Number of votes*	*Response: not scientific question*
Bycatch	14	4	0
Ecosystem	38	11	2
Management	10	3	4
Socio-economic	11	3	0

The stakeholders were also asked whether the project met the knowledge needs of the topic. Michel Kaiser stated that a lot of the knowledge needs of the four topics had been (fully) met by the project. Bycatch and ecosystem topics were most commonly asked about. The socio-economic topics were popular with stakeholders but are missing in the programme.

Michel Kaiser offered several conclusions from this exercise. First, there is considerable similarity among stakeholder questions and concerns. Further, stakeholder concerns about bycatch and ecosystems are relatively well accounted for in the scientific programme. However, there are some gaps, even though pulse is one of the most heavily scientifically scrutinised gears. In addition, the management dimension of the topic often contains 'non-scientific' questions and the socio-economic issues are the least well-addressed topic in the scientific study. Finally, Michel Kaiser suggested that this exercise would have been more useful at the outset of the programme, when the contribution of stakeholders could be better integrated.

2.2.2 Alyne Delaney, member of ISAC, presenting the need for social data for management advice

Alyne Delaney introduced herself as the member of the ISAC who is an anthropologist by training. When the ISAC began, the project had already been planned. The ISAC group reflected on the stakeholder process, which resulted in what Mike presented. The socio-economic topics are currently not included, so this presentation is looking to the future to consider what can be done. Alyne Delaney said that the first question is why social data should be included in the first place. The answer to this is that managers don not manage fish but rather they manage people's access to fish. Allocation decisions involve and affect cultural, social, and economic patterns in society. There will always be winners and loser in these allocations, so it is important to look at the sub groups and ask how they will be affected. Conflict management requires social scientific information and analyses. The social part of social-ecological systems research requires information about context and rationales for behaviour. The issues that arose in this project are not unique, and there are many tools to engage and include stakeholders. This is necessary to gain support in the quest for sustainability and equity, which is also important. Alyne Delaney argued that a social impact assessment, which uses categories of social factors, would be valuable. Social science can be used to uncover the different segments or subgroups (in the Netherlands and elsewhere) that are impacted, either positively or negatively. Finally, with good social data, knowing and addressing the narratives about management can be achieved.

2.2.2.1 Questions

Michel Kaiser commented that the Dutch fishing industry would like to explain how they deal with fisher interactions and gave the floor to a representative of a Dutch fisher organisation. The representative commented that there have, for several years, been interactions between fishers both within and across borders. The Dutch organisation made an agreement with the NFFO, an English fisher organisation, that focused on the interaction of pulse gear with small scale fishers. This has been a difficult process, as the Dutch also hold historical rights. Yet they reached an agreement about where they would not fish, leaving these areas free for English small scale fishers, including gillnets for

sole and longlines for cod. The representative said that he sees this agreement as a good thing and an achievement in relations with the UK. There is a similar intention to do this sort of negotiation with fishers in other countries such as Belgium, France, and Denmark. The representative wished to offer it as a good example in this forum and reiterate that management is also about socio-economic impacts.

2.2.3 Adriaan Rijnsdorp, project leader of the pulse research, giving a forecast of the pulse research and responding to stakeholders in plenary

Michel Kaiser invites Adriaan Rijnsdorp to give a forecast of the pulse research.

Adriaan Rijnsdorp explained that the pulse research entails the 4-year pulse assessment project with other complementary projects such as the logbook programme (all vessels report catch per haul for detailed data), survival experiments, discard monitoring, and field strength measurement, among others. Making an impact assessment is the final goal, which should provide the fundamental basis on how electricity affects ecosystem processes and marine organisms. Two work packages are concerned with fundamental research and will eventually be brought together. Both a mechanistic and a predictive understanding is needed. In the mechanistic realm, the cramp response in the fish is the expected effect of the gear, but it is not yet clear whether there is collateral damage. Integration of the mechanistic understanding with predictions comes by modelling the distribution of the pulse fleet. It is also important to note that if fishers are not using pulse gear, they will likely go back to beam trawling, rather than other options such as static gears. The scientific work carried out by the various research institutes and universities in Europe will all be put together. Adriaan Rijnsdorp said that there are a lot of stakeholder questions about long-term effects but no long-term research, so the scientists will give our best answers based on inference.

A representative from the Ministry stated that the technical measures are now being reviewed. The beginning of the process is a proposal from the European Commission and pulse is part of that. This was then presented to the Council of Ministers and European Parliament. They can make amendments at this stage, which they did to a high degree. The report is 150 pages long and 1 is dedicated to pulse. The European Commission proposed to allow pulse fishing, the Council of Ministers said that PT should be restricted to 5% in May 2017, and the European Parliament said that a total ban on PT was appropriate. These three positions are all in consideration now in search of a compromise. The negotiations will concern many issues, including the use of pulse gear. Bulgaria's position as spokesperson for the Council will end on July 1, with Austria entering. This land-locked country will be leading a debate about TAC and quota, which is a difficult task. They would like the negotiations to end as soon as possible. In fact, all are interested in a smooth process because elections are coming up, but the three positions (i.e., allowing, restricting, or banning) have not been discussed yet.

A representative of an NGO asked about the agreement that the Dutch industry made with the NFFO, challenging how representative the meeting was and stating that issues have not been dealt with to the satisfaction of small scale fishers. Finally, the representative wished to draw attention to a complaint filed against the Netherlands about illegal licenses and an EU investigation into fraud. The representative from the Dutch fisher organisation responded that the collaboration meetings were open for non-members to join. The representative from the Dutch Ministry responded that they are open to questions about pulse and responded that pulse licenses are all within EU regulations, but welcomed more questions. As for the fraud speculation, the representative from the Dutch Ministry responded that there is no case, as the €6 million euros was spent on funding research and that investments were not paid in the past. In 2006, the national amount spent matched the state aid criteria. As for the EU Maritime and Fisheries Fund, information has only been available for some years because it fell under privacy laws related to funding from the Common Agricultural Policy (CAP). It has since been split from CAP funding. Finally, there has been no contact yet from the European Anti-Fraud Office. It will be answered if it arises, but the representative from the Dutch Ministry expressed full confidence that there is no case for fraud. A trader responded to the statement regarding the deal with the NFFO, stating that it all started at a meeting called by Seafish to look at pulse, with all parties (NFFO, LIFE, Lowestoft, Bloom and traders like himself) present. Following that meeting, the NFFO took the initiative to discuss and look at closures for pulse, and small scale fishers were part of that debate.

A representative of an NGO asked Adriaan Rijnsdorp about whether the mechanistic understanding was possible to achieve without studying all species in the system. The representative stated that they understand that it is not possible to study all, but suggested adding some species, to make the sample more representative of the ecosystem. Adriaan Rijnsdorp responded that doing so would be useful, but it is not possible for him to make promises as this requires trade-offs. That is perhaps not a satisfactory answer, but the reality. The representative of an NGO continued by saying that it had been mentioned several times that the pulse is the most studied gear, yet it is also an experimental gear, partly used on a scientific basis so the science could have happened sooner.

A trader asked what would happen to the Dutch fleet with a ban on pulse. Arie Mol, researcher from Wageningen Economic Research explained that if that would happen, and oil and fish prices would return to levels seen in 2013, it would spell the end for the larger part of the Dutch demersal fleet. Michel Kaiser asked whether gillnetters or other metiers could take over in the fishery, but Arie Mol said that gillnetters alone would struggle to catch the quota. The current gillnet fishers own a part of the sole quota and need to lease the rest. Their access is limited in time and space. Gillnetting is a seasonal fishery, and it would require very large amounts of nets to catch the sole quota, taking a lot of space in coastal waters, which is limited. With beam trawling there would be no problem catching the quota limit of fish, but the challenge would be economic efficiency. Michel Kaiser asked a representative of fishers what amount of sole the Dutch gill netting sub-sector could fish if there would be no pulse fishing. This representative responded that it was hard to answer such a question. Gill netters say that when a pulse vessel has passed along the seabed they cannot catch anything. That does not mean that it is caused by pulse fisher, but it could be the case.

A representative of an NGO asked which question Adriaan Rijnsdorp thought was critical to take up. Adriaan Rijnsdorp responded that, with the fundamental process already undertaken, there will be a strong basis for answering many other questions. What answers are needed should primarily come from the interest groups. His approach would be to do more fundamental research about what is affecting processes in organisms (such as their hormone or immune systems) in order to understand the long term effects of pulse gear. This would be a subject for another PhD project.

A scientist asked when the amount of research will be considered sufficient, referring to the presentation of Michel Kaiser with the research questions asked by stakeholders. The scientist asked whether there can be agreement on what the final aim of the research is. Adriaan Rijnsdorp responded by saying that the ICES process qualifies the strength of the evidence. There is already a lot of evidence about this fishery compared to other fisheries and there is sufficient information to give a clear answer. The research is ongoing, but the advice has been made very clear.

A fisher representative asked if IFREMER (the French marine research institute) could be a more active partner in the research. Adriaan Rijnsdorp responded that IFREMER had been present at WGELECTRA, and continued by saying that scientists enjoy international collaboration and that it returns the best results. He knows of an IFREMER project in the English channel on stock structures, which would be good for the Dutch institute to join, however there is a need to convince funders of international collaboration. Such inhibitions do not come from science but from the structures around it.

When questioned by a representative of an NGO about the cumulative impacts of pulse gear, such as the mixing of sound and electricity on the seabed, Adriaan Rijnsdorp said that he was open to hearing specific ideas on links within the system. Dave Reid concluded that the scientific 'holy grail' was an assessment of the ecosystem effects.

Michel Kaiser concluded the question session and announced that he will resign as chair from ISAC as he will become standards director of MSC, which might give a conflict of interest. He asked for reflections from some members and allowed the press in the room again.

2.3 Closing reflections

Alyne Delaney reflected that the session had been useful. She said that some criticism heard in the session is legitimate. The socio-economic issues related to pulse gear are not unique, but it will be useful to return to the project and see whether some socio-economic issues can be integrated in the research project. She also commented that making sure that this data is available will be useful for good governance.

Dave Reid reflected that there are multiple ways in which people gather information. This is a social problem, but nevertheless it would be good to have collaborative methods to bring all the information together in dialogue. He also reflected on the different perspectives on pulse fishing gear, whether it is being viewed comparatively or absolutely. When the process started, the key subject was the comparison with BT. Pulse fishing was not to make the world perfect, but to make it better by making small changes. He concluded by reflecting that he was impressed with the conversations of the day.

Michel Kaiser reflected that the socio-economic dimension of pulse research has been raised. He suggested that IFREMER contribute to that by putting work into the impacts on small scale fishers. He reflected that studying the impact of gears (pulse and others) in fact relates to the implementation of innovation. The aspiration should be to improve performance. The pulse project is about innovation and captures that aim. He reflected that the suppression of innovation would lead to a negative outcome, as we need to work towards more potential innovations. It is useful to reflect on what went wrong. Stakeholders were not engaged from the outset of the programme because it started as a purely engineering solution, Michel Kaiser added that, as a biologist, he knows that there are multiple complexities to be dealt with in research. He concluded by recommending a protocol with best practices, one of them being to include stakeholders from the beginning.

Marieke Pondman, from the Dutch Ministry of Agriculture, Nature and Food Quality, closed the meeting by thanking all researchers, contributors who helped with logistics, and participants who travelled from all parts of the EU. She thanked everyone for expressing their views on pulse fishing and finally reiterated the importance of this dialogue.

3 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. This certificate is valid until 15 December 2021. The organisation has been certified since 27 February 2001. The certification was issued by DNV GL.

Furthermore, the chemical laboratory at IJmuiden has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2021 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation. The chemical laboratory at IJmuiden has thus demonstrated its ability to provide valid results according a technically competent manner and to work according to the ISO 17025 standard. The scope (L097) of de accredited analytical methods can be found at the website of the Council for Accreditation (www.rva.nl).

On the basis of this accreditation, the quality characteristic Q is awarded to the results of those components which are incorporated in the scope, provided they comply with all quality requirements. The quality characteristic Q is stated in the tables with the results. If, the quality characteristic Q is not mentioned, the reason why is explained.

The quality of the test methods is ensured in various ways. The accuracy of the analysis is regularly assessed by participation in inter-laboratory performance studies including those organized by QUASIMEME. If no inter-laboratory study is available, a second-level control is performed. In addition, a first-level control is performed for each series of measurements.
In addition to the line controls the following general quality controls are carried out:

- Blank research.
- Recovery.
- Internal standard
- Injection standard.
- Sensitivity.

The above controls are described in Wageningen Marine Research working instruction ISW 2.10.2.105. If desired, information regarding the performance characteristics of the analytical methods is available at the chemical laboratory at IJmuiden.

If the quality cannot be guaranteed, appropriate measures are taken.

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Justification

Report C111/18
Project Number: 4318100207

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved:	Dr.ir. Nathalie Steins Program manager
Signature:	
Date:	21th December 2018

Approved:	Drs. J. Asjes Manager Integration
Signature:	
Date:	20th December 2018

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29		Huisman		NL
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31	samira	Irsane	French embassy	FR
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37	Günter	Klever		DE
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54	Adriaan	Rijnsdorp	Wageningen Marine Research	NL
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57	Lennert	Schrader	Netherlands Food and Consumer Product Safety Authority	NL
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Annex 2 Presentation Eskild Kirkegaard: The ICES Process

The Netherlands request on the comparison of the ecological and environmental effects of pulse trawls and traditional beam trawls when exploiting the North Sea sole TAC

Eskild Kirkegaard, ICES ACOM Chair

International Dialogue Meeting on Pulse Fishing, 19 June 2018

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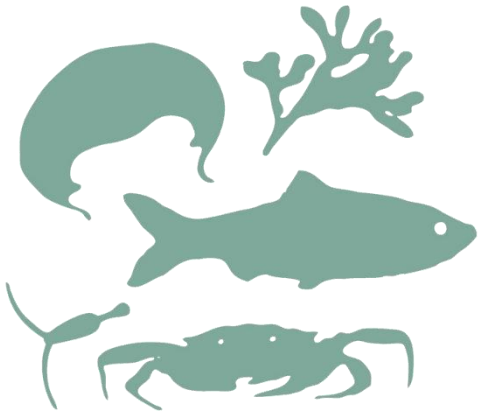

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Advice in 2017

- **Recurrent Advice:**
  - ✓ **Advice on fishing opportunities for 194 stocks;**
  - ✓ **3 advice on ecosystem impacts of fishing activities;**
  - ✓ **2 ecosystem and 2 fisheries overviews**

- **Special Requests:**
  - ✓ **24 special requests on impact of fisheries, in-year advice of fishing opportunities, Fmsy ranges, MSFD guidance, pressures and impact on seafloor, evaluation of fisheries management strategies, impacts of climate change on salmon;**

- **Advisory Services:**
  - ✓ **2 technical services.**

The Request for advice from the Netherlands

ICES is requested to compare the ecological and environmental effects of using traditional beam trawls or pulse trawls when exploiting the TAC of North Sea sole, on

(i) the sustainable exploitation of the target species (species and size selectivity);

(ii) target and non-target species that are exposed to the gear but are not retained (injuries and mortality);

(iii) the mechanical disturbance of the seabed;

(iv) the structure and functioning of the benthic ecosystem; and to assess

(v) the impact of repetitive exposure to the two gear types on marine organisms.

ICES quality criteria

Best available knowledge (data and science)

Quality assured

Transparent process: documented and open to observers

Unbiased and non-political: considered legitimate by governments and stakeholders

Relevant – meets the needs of the Client

Timely

ICES advisory process

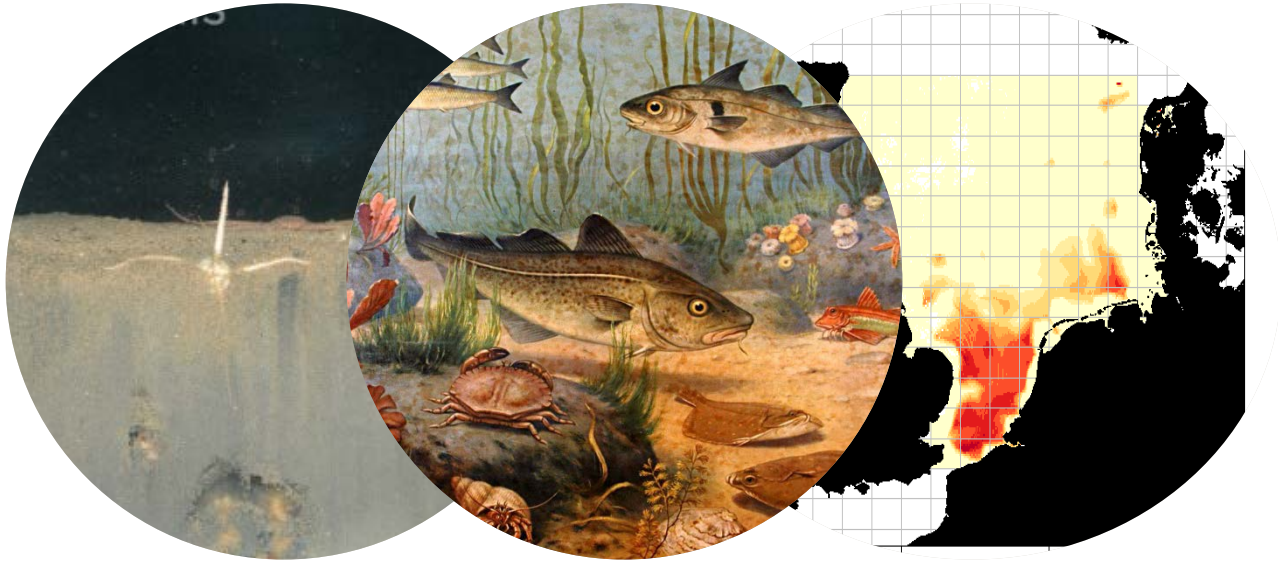
- WGECO proposes an outlines to address the request and selects 2 reviewers, 12 – 19 April.
- WGELECTRA drafts a response to the request, 17 – 19 April
- Review group (RGPULSE) review of WGELECTRA, 19 April – 8 May
- ADGPULSE, 16-18 May
- Web-conference (WCPULSE), 25th May
- Advice release 30th May

Advisory process

Annex 3 Presentation Adriaan Rijnsdorp: WGELECTRA 2018 Summary

WGELECTRA 2018: Summary

Adriaan Rijnsdorp & Maarten Soetaert (chairs)



International Pulse Dialogue Meeting, 19 June 2018, Amsterdam, Netherlands

WGELECTRA Terms of Reference

a. Produce a state-of-the-art review of all relevant studies on marine electrofishing. Yearly update it by evaluating and incorporating new research to it.
b. Compare ecological and environmental effects of beam trawls and pulse trawls when exploiting TAC – North Sea Sole.
c. Discuss and prioritise knowledge gaps, and discuss ongoing and upcoming research projects in the light of these knowledge gaps, including the experimental set up.

WGELECTRA Participation

- Belgium – ILVO, Gent University
- Netherlands – WMR, NIOZ, Wageningen University
- Germany – von Thuenen Institute
- Scotland – Marine Scotland
  - France – IFREMER
  - England – CEFAS, JNCC

ToR b: Request for Advice from the Netherlands

Compare ecological and environmental effects of beam trawls and pulse trawls when exploiting TAC - NSea Sole

Criteria:

1) Sustainable exploitation
   - target species
2) Impact on marine organisms
   - target and non-target species exposed but not retained
3) Mechanical disturbance seabed
4) Impact on benthic ecosystem
   - structure and functioning
5) Impact of repetitive exposure

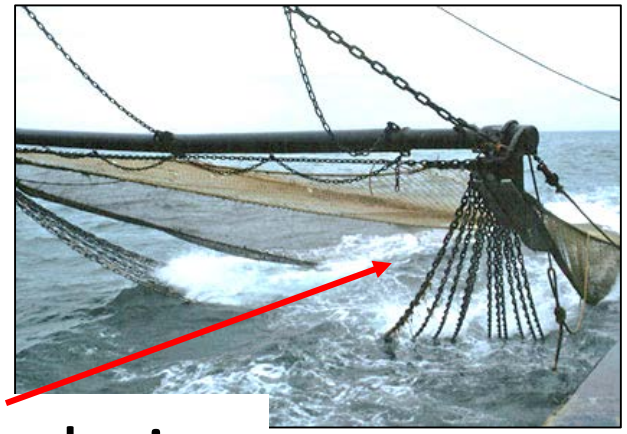
Approach

- Analysis of changes in Dutch fleet targeting sole and plaice
- Review scientific information on effects electrical stimulation on marine organisms
- Review results on-going research projects

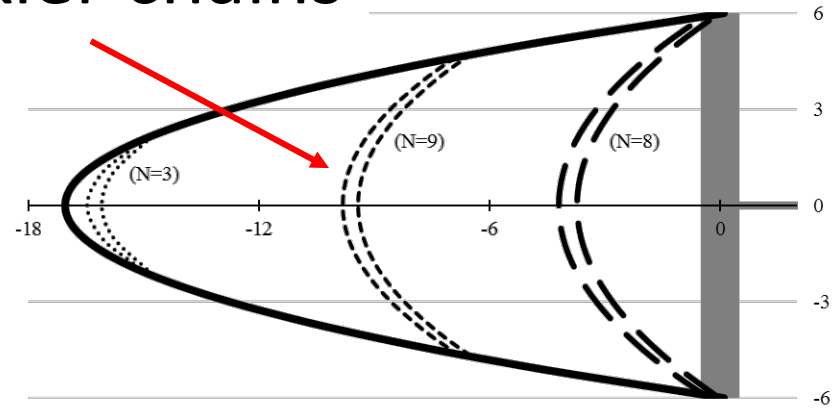
- Assessment of change in performance of pulse relative to traditional beam trawl according (sub-) criteria
  - Qualify strength of evidence as proven, indicative, inferred, unknown
  - Note: part of the evidence (recent studies) has not yet been peer-reviewed

Traditional beam trawl

- Towing speed: 6-7 knots



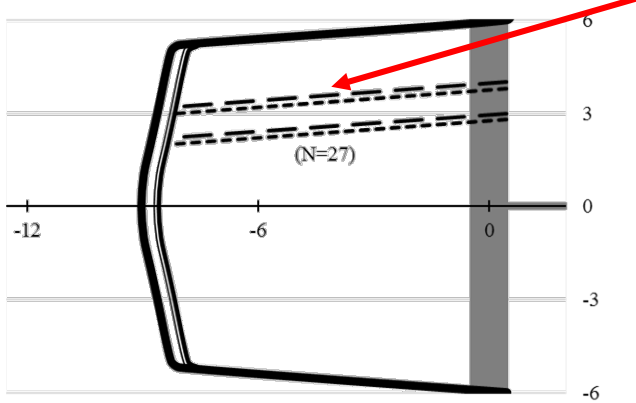
Tickler chains

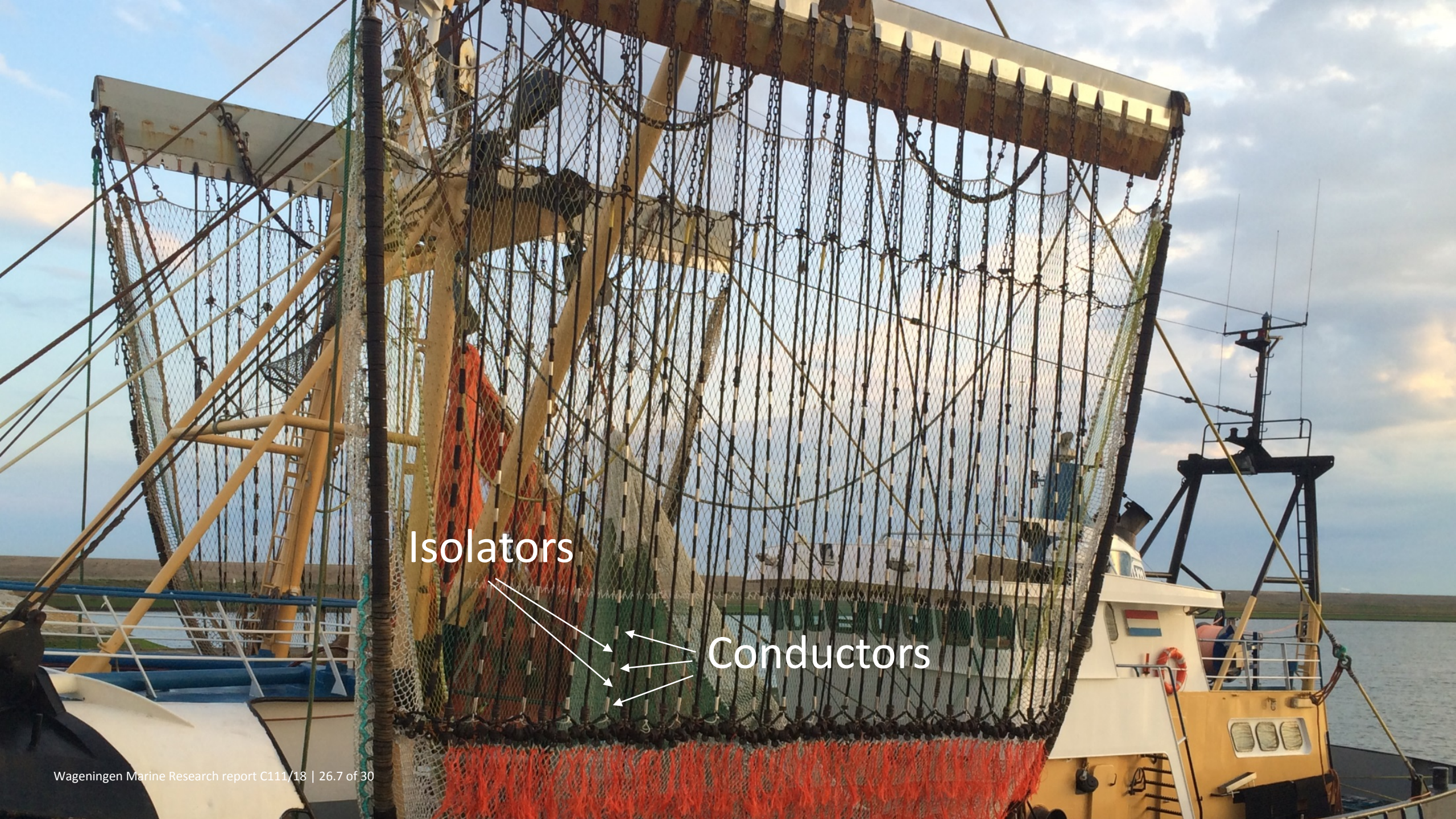


Pulse trawl

- Towing speed: 5 knots

Electrodes

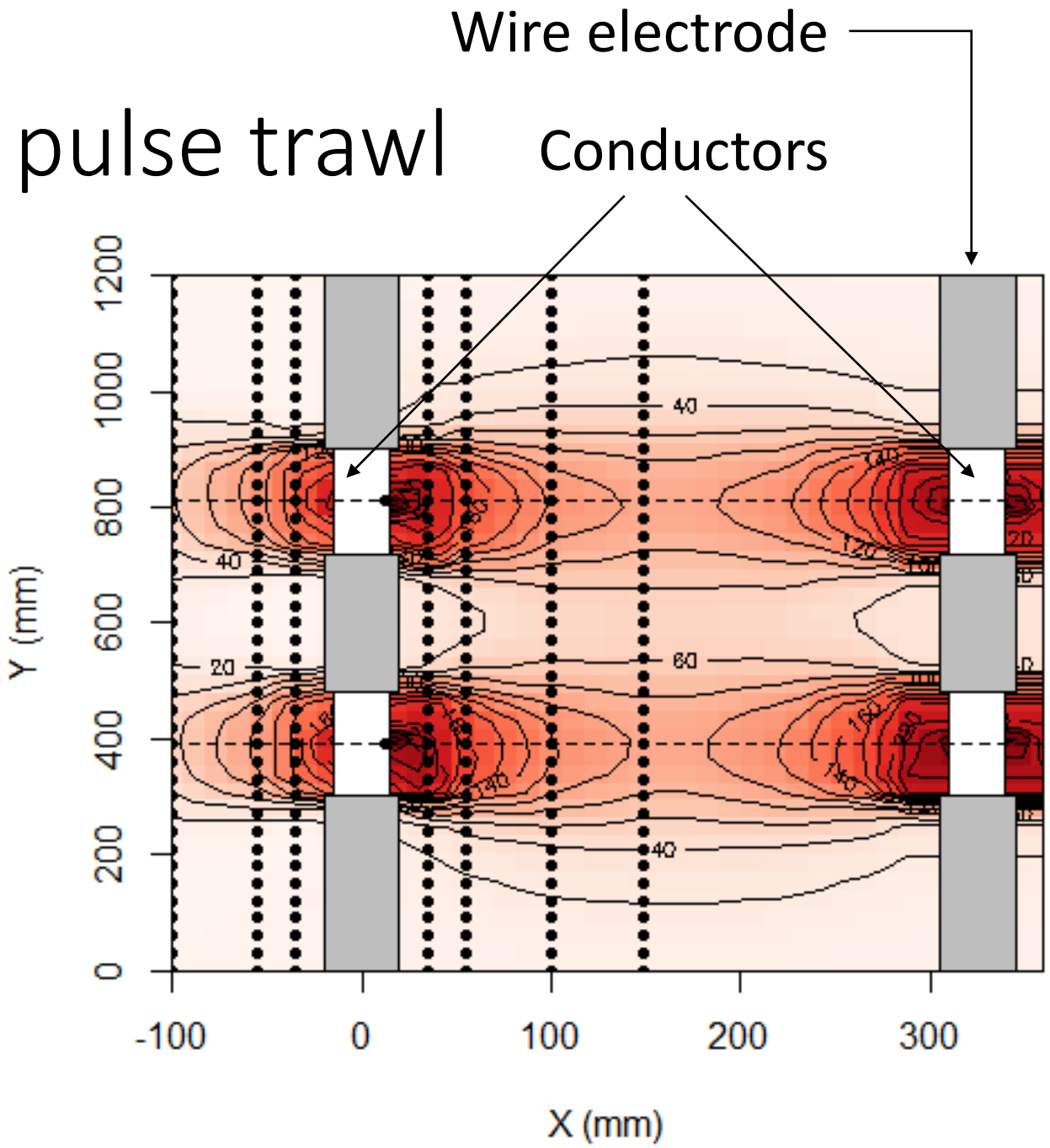



Isolators
Conductors

Electrical field of sole pulse trawl

- Alternating current
- Exposure duration: ~1.5 sec

- Field strength
  - Decrease exponentially with distance from conductor
  - < 17 V/m outside trawl
  - Soft sediment hardly affect field strength



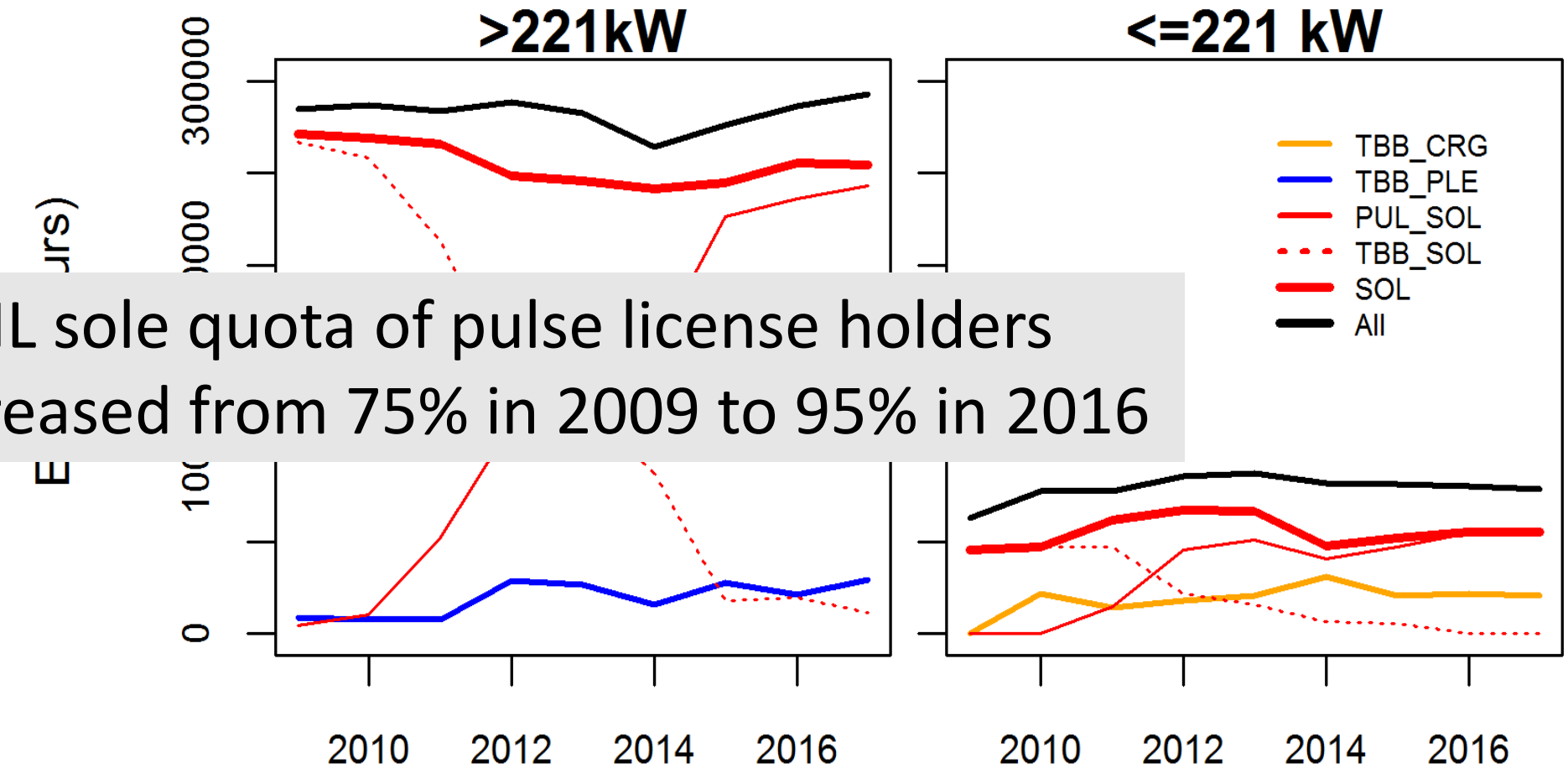
De Haan et al. 2016 IJMS 73(6): 1557–1569

1) Sustainable exploitation target species

Table 5.2.1. Number of active pulse vessels by country flag (1/1/2018) and fishery.

Country	Sole fishery	Brown shrimp fishery
Netherlands	78	4
Belgium	0	2
Germany	8	1
United Kingdom	3	0

Fishing effort of todays pulse license holders (n=78)



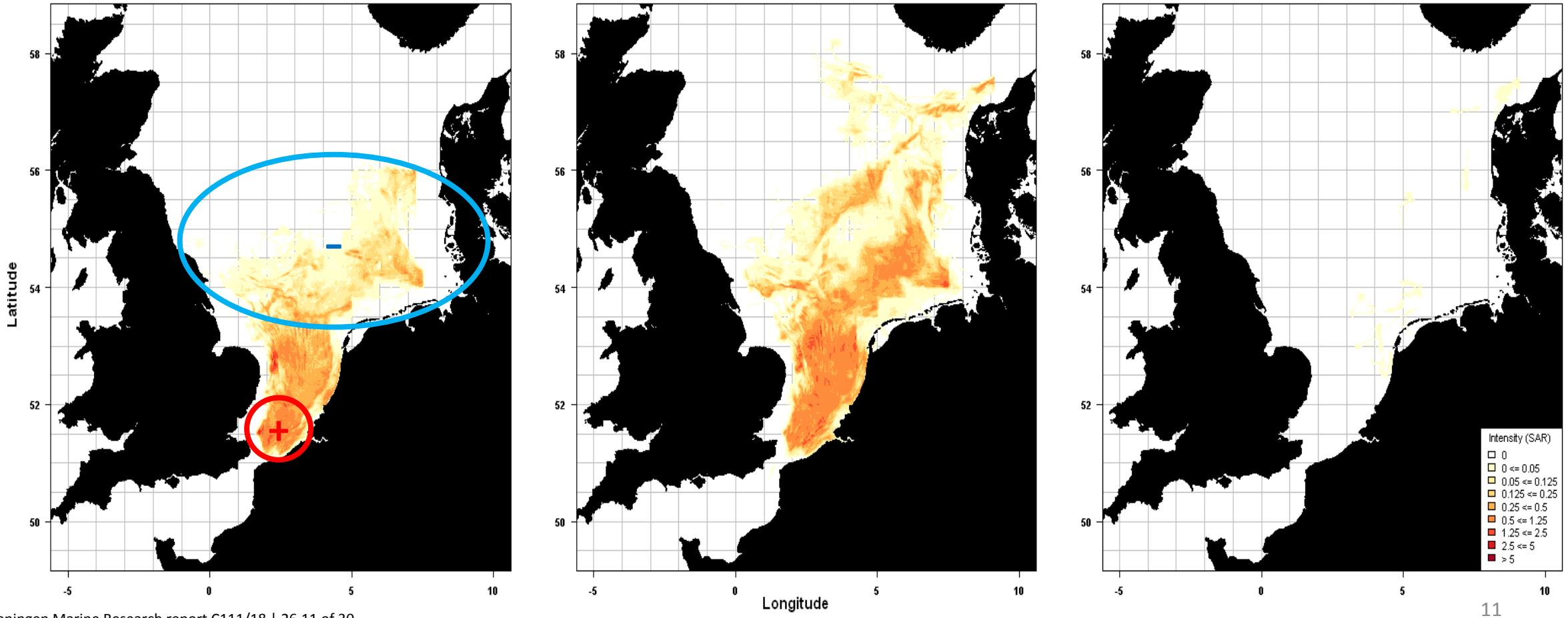
% NL sole quota of pulse license holders increased from 75% in 2009 to 95% in 2016

Shifts in spatial distribution (trawling intensity)

Pulse trawl (sole)

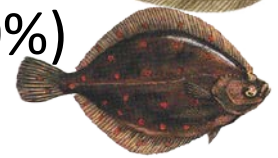
Beam trawl (sole)

Beam trawl (plaice)



Catch efficiency & selectivity pulse / beam trawlers

- Catch efficiency (proven)
  - Comparison commercial catch per hour by week / rectangle
    - Higher catch efficiency pulse for sole (+30%)
    - Lower catch efficiency pulse for plaice (-40%) and other species



- Size selectivity (unknown)
  - Comparative fishing experiments
    - Reduced catch efficiency for undersized flatfish (van Marlen et al. 2014) could not be corroborated

1) Sustainable exploitation target species

- Discards
  - Discard monitoring
    - Lower catch rate (N/hour) of discards pulse trawlers (indicative)
      - all fish (–16% to -24%)
      - flatfish (–22% to -27%)
      - but not for sole or other fish
  - Reduced catch rate of benthos (proven)

- Discard survival rate
  - Increased survival due to cleaner catch and lower towing speed (inferred)

2) Impact on marine organisms

2 PhD's Gent
Various experiments at ILVO, WMR
Large ongoing project 2016-2019

Methods

- 1. Tank experiments: exposure to commercial sole pulse (frequency, field strength)
  - Species
    - Fish (e.g cod, sole, dab, seabass) and Invertebrates (e.g. shrimp, ragworm)
  - Measurements
    - Behaviour (response)
    - Survival
    - Autopsy (X-ray, histology)
- 2. Sampling commercial catch

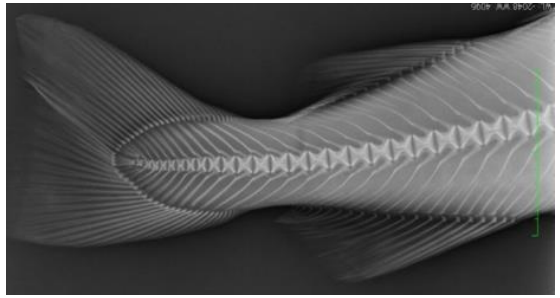
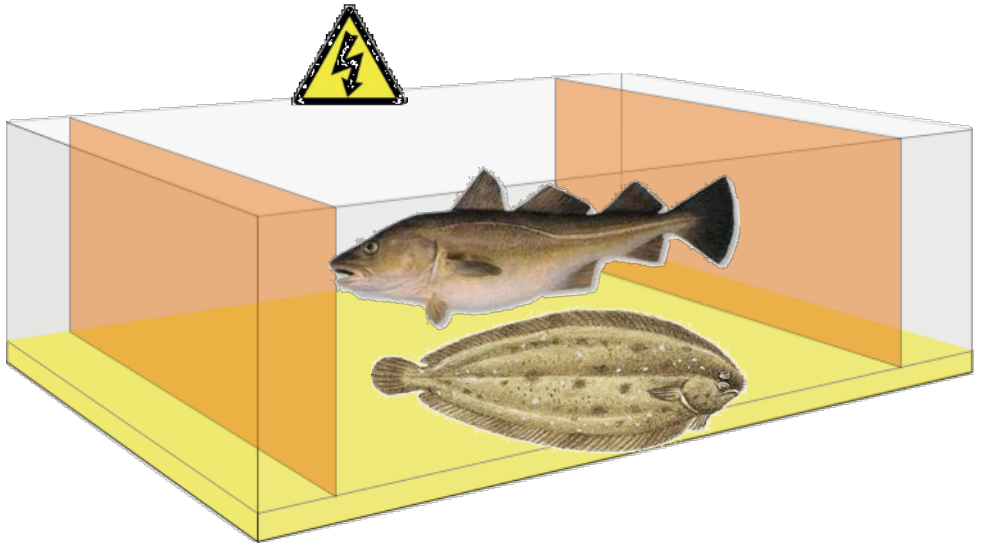


Plate or wire electrodes



2) Impact on marine organisms

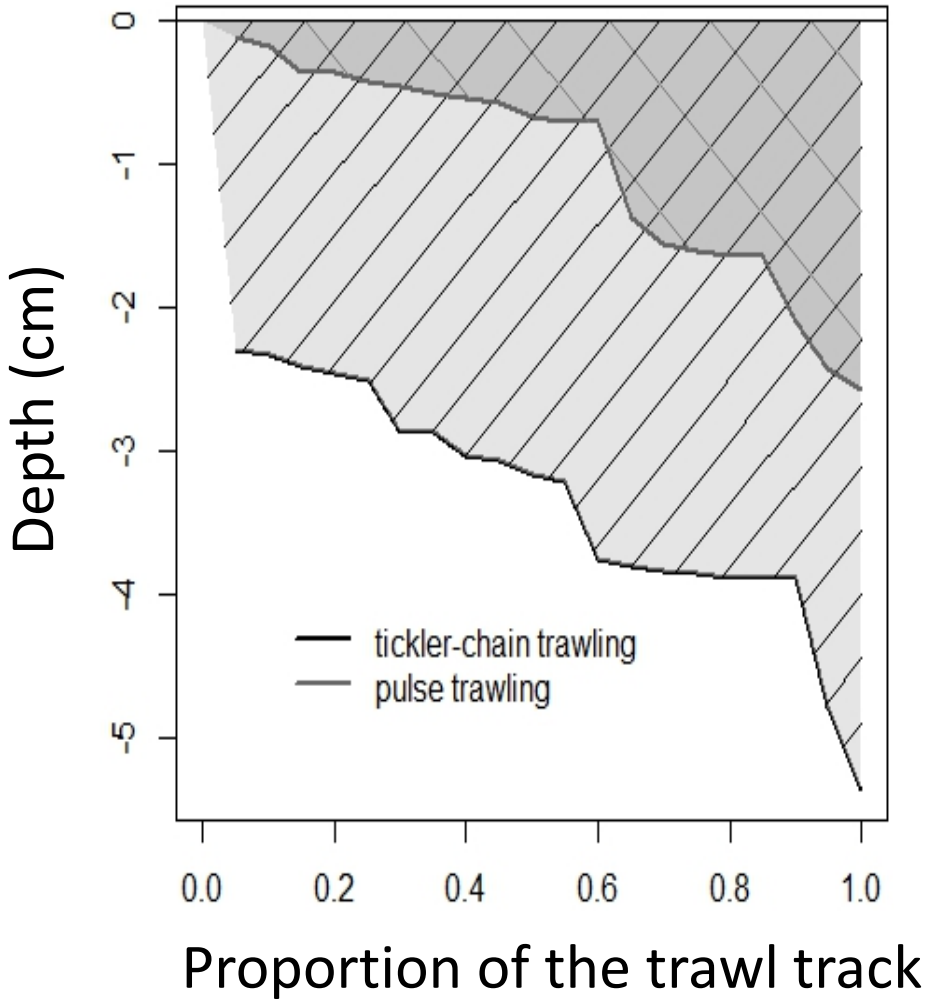
- Fish
  - Injuries
    - Fractures and haemorrhages due to cramp observed in cod (proven) and whiting, but not in flatfish (sole, dab), seabass and small-spotted catshark (indicative)
    - Lower fracture probability in small and large cod (indicative)
  - Mortality
    - No mortality observed in laboratory experiments, fish with fracture may have increased mortality risk (indicative)
    - Increased mortality in 2 out of 4 larval stages in cod, but not in sole larvae nor in egg stages exposed to strong pulse stimulus (indicative)
  - Feeding
    - No effect on food detection ability observed in one electro-sensitive fish species tested (indicative)
  - Reproduction
    - Small-spotted catshark layed eggs when kept for several month in the lab after exposure (inferred)

2) Impact on marine organisms

- Benthic invertebrates
  - Mortality
    - Lower mortality due to reduced mechanical disturbance of pulse trawl (50% lower penetration depth in sediment) (indicative)
    - No evidence for measurable additional mortality due to exposure to pulse in the few species studied (indicative)
  - Sub-lethal effects
    - Few experimental studies do not show adverse effect on growth or risk of disease (inferred)
  - Reproduction
    - Number of shrimps carrying eggs was not affected (indicative)

Limited number of studies implies that a possible adverse effect cannot be excluded

Disturbance depth by beam trawl and pulse trawl



Average penetration:

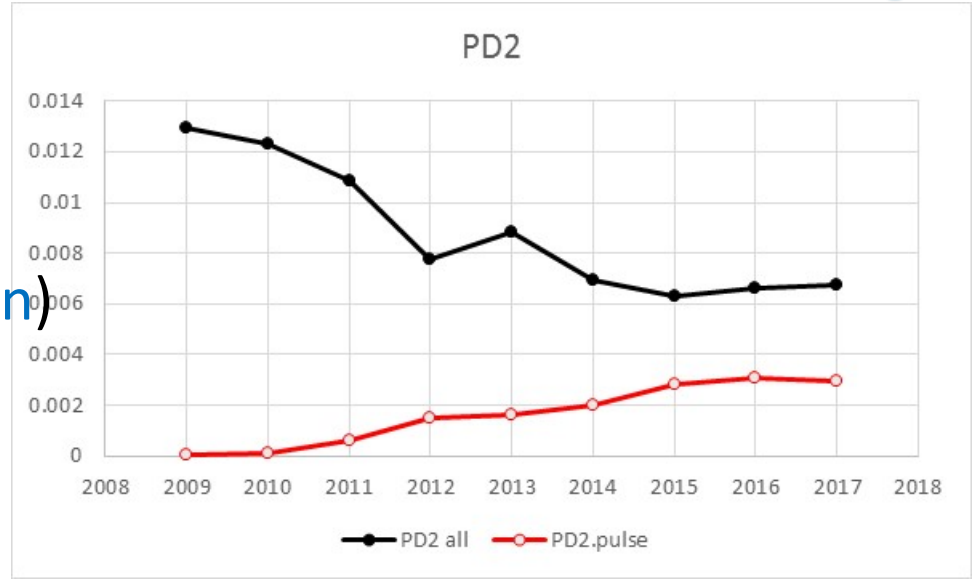
Beam trawl = 4.0 cm

Pulse trawl = 1.8 cm

50% reduction in mechanical disturbance

Depestele et al (submitted)

4) Impact on benthic ecosystem



- Impact on benthic biomass (indicative)
  - Reduced impact due to lower footprint (proven) and reduced mechanical disturbance (proven)
- Bio-geochemistry
  - Effect of pulse fishing on chlorophyll and oxygen dynamics is lower but more variable (few experiments) (indicative)

5) Impact of repetitive exposure

- Exposure frequency
  - 17% of sea floor trawled by pulse trawlers is exposed >=1 time per year (>17 V/m)

- Repetitive exposure
  - Proportion of sea floor that is exposed multiple times within a day or week is negligible (inferred)

- Information on sensitivity threshold (V/m) is lacking, but the adverse effects found occurred only at high field strength observed in part of the trawl track

6) Environment

- CO2 emissions
  - Reduction by ~50% due to reduced fuel consumption (proven)
- Litter
  - Reduced towing speed will reduce the wear of the gear (inferred)
- Electrolysis
  - No electrolysis observed in tank experiment with commercial pulse settings (alternating current) (indicative)

Impact assessment

- Population level effects depends on:
  - Sensitivity for exposure to pulse / beam trawl
  - Exposure frequency (overlap in spatial distribution)
  - Timing of the density-dependent regulation in the life cycle

- Population / Ecosystem level effects will be assessed when results of the ongoing research (Impact Assessment Pulse Fishery project) will become available in 2019

Annex 4 Presentation Eskild Kirkegaard: The ICES Advice

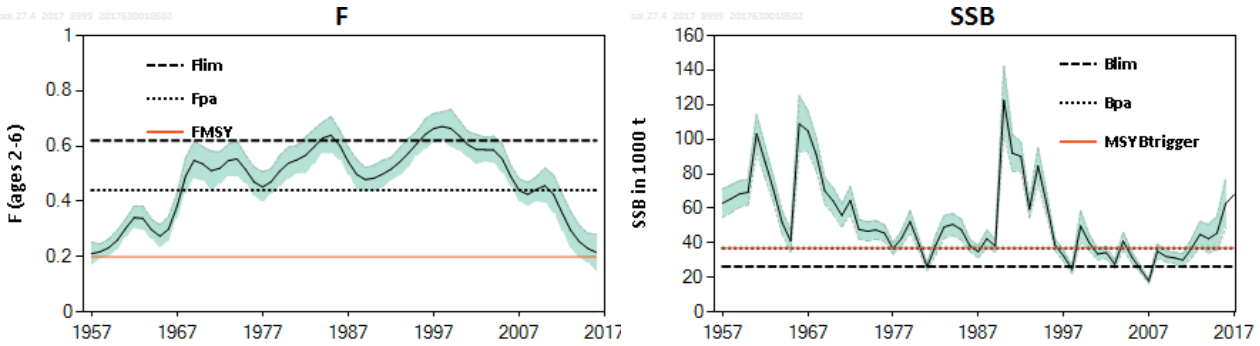
ICES Advice

The Netherlands request on the comparison of the ecological and environmental effects of pulse trawls (PT) and traditional beam trawls (TB) when exploiting the North Sea sole TAC

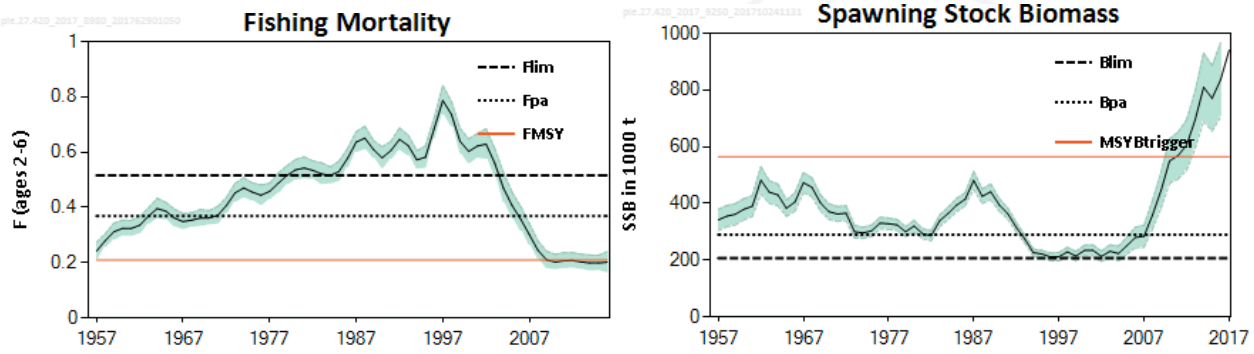
i) the sustainable exploitation of the target species (species and size selectivity);

Both pulse and traditional beam trawls can be used to harvest the target flatfish stocks (sole and plaice) sustainably (at fishing mortalities in accordance with the MSY approach). Pulse trawls have been increasingly used in the North Sea flatfish fisheries since 2009. Over this period, the fishing mortality has reduced and stock biomass has increased, mostly due to an overall decrease in effort.

Sole in the North Sea



Plaice in the North Sea



i) the sustainable exploitation of the target species (species and size selectivity);

Catch rates in pulse trawl relative to traditional beam trawl

Higher for sole

Lower for plaice

i) the sustainable exploitation of the target species (species and size selectivity);

Pulse trawl fishing has increased locally in some areas, such as off the Thames estuary and near to the Belgian and northern French coasts.

May change the relative pressure on local components of the sole stock and impact other fisheries that traditionally fished in these areas.

ii) target and non-target species that are exposed to the gear but are not retained (injuries and mortality)

The rate of injuries inflicted by mechanical impact on fish during the catch process is likely to be lower in pulse trawls than in traditional beam trawls.

Cod suffer a relatively high injury rate when exposed to pulses, but the increase in the overall mortality of the North Sea cod stock caused by these injuries is presently negligible.

Flatfish (sole, plaice, and dab), seabass, and small-spotted catshark do not suffer pulse-induced injuries.

ii) target and non-target species that are exposed to the gear but are not retained (injuries and mortality)

There is no information available on the survival of fish at early life history stages after exposure to the pulse.

The population level effects of a possible reduced survivorship of larvae is considered to be low because of the low exposure rate and the fact that for healthy stocks there is strong compensatory density-dependent mortality later in their life cycle.

The exposure rate could be higher for eggs laid directly in the sediments in the path of the pulse trawls, but few fish in the North Sea are known to lay eggs directly on sandy or muddy substrates.

Flatfish late stage larvae undergoing metamorphosis and juveniles are close to the bottom.

iii) the mechanical disturbance of the seabed

Pulse trawls do not mechanically penetrate as deeply into sediments as traditional beam trawl and will therefore have a lesser mechanical effect on the benthos.

iv) the structure and functioning of the benthic ecosystem

Pulse trawls have a reduced footprint and mechanical impact on the benthos compared with traditional beam trawls.

The few studies of the effects of electrical pulses indicate no incremental mortality on benthos from the pulse trawls. It can therefore be expected that effect on the structure and functioning of the benthic ecosystem is less for pulse trawls.

v) to assess the impact of repetitive exposure to the two gear types on marine organisms

Incremental effects from repetitive exposure to pulse gear are expected to be low.

Little sensitivity has been found for any organism to electrical stimulation and the probability of repetitive disturbance is low.

Thank you

www.ICES.dk

Annex 5 Presentation Pieke Molenaar: Flatfish in the Picture

Flatfish in the picture

Fish behaviour in pulse trawling

International Pulse Dialogue Meeting, June 19th 2018, Amsterdam

P. Molenaar

Electrified beam trawls -> Pulse trawling

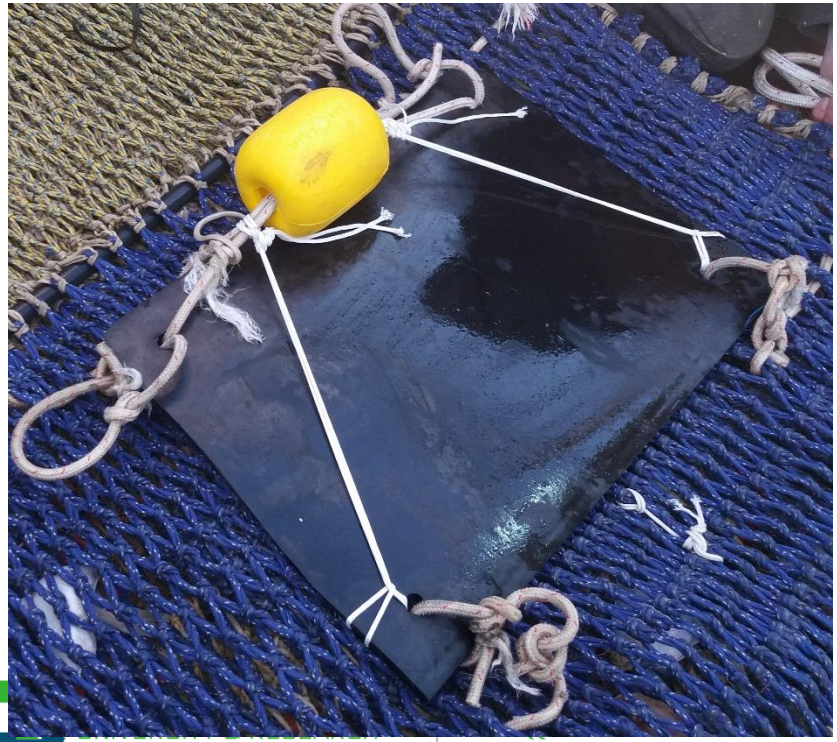
Background

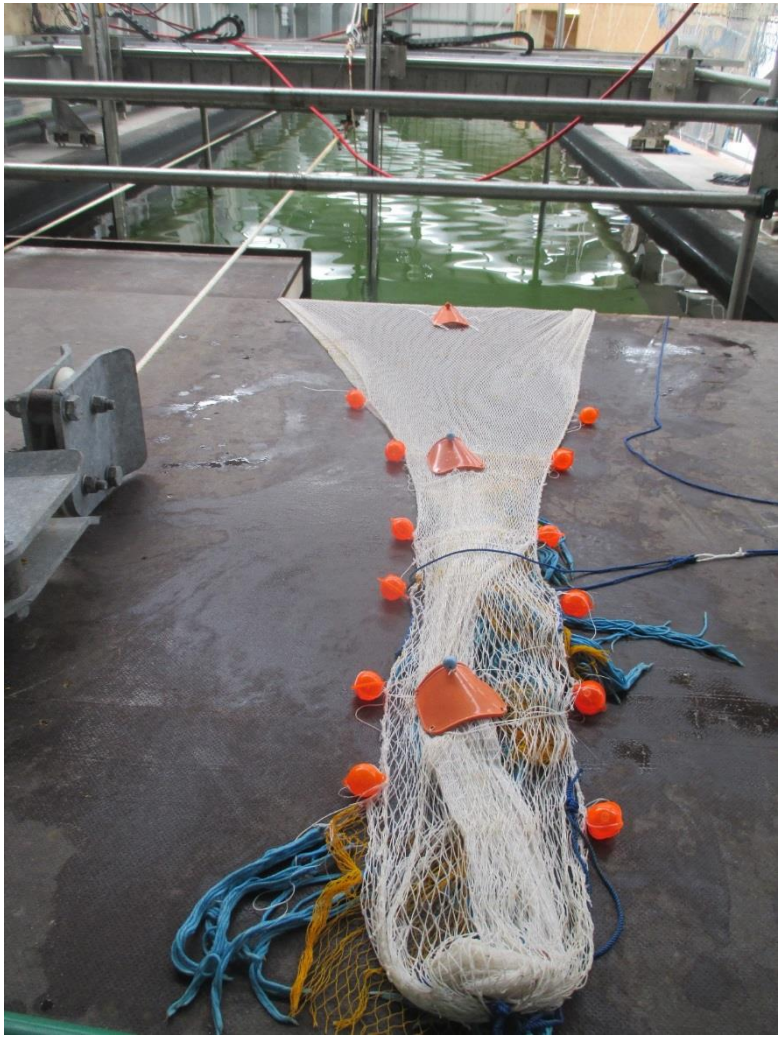
- **Knowledge on fish behaviour can inspire and motivate fishers to develop selective solutions**

Material and methods

Visserij-innovatiecentrum Zuidwest-Nederland

- Scale model experiments to lift cod-end
- Fisheries innovation centre South West Netherlands





Kite lifting capacity


WAGENINGEN
UNIVERSITY & RESEARCH

Flatfish behaviour

Sole

- Stays on trawl bottom panel for extended time intervals before entering cod-end
- Attempts to escape trough meshes bottom panel
- Strong swimming behaviour inside trawl

Plaice

- Limited swimming capacity and interactions with trawl

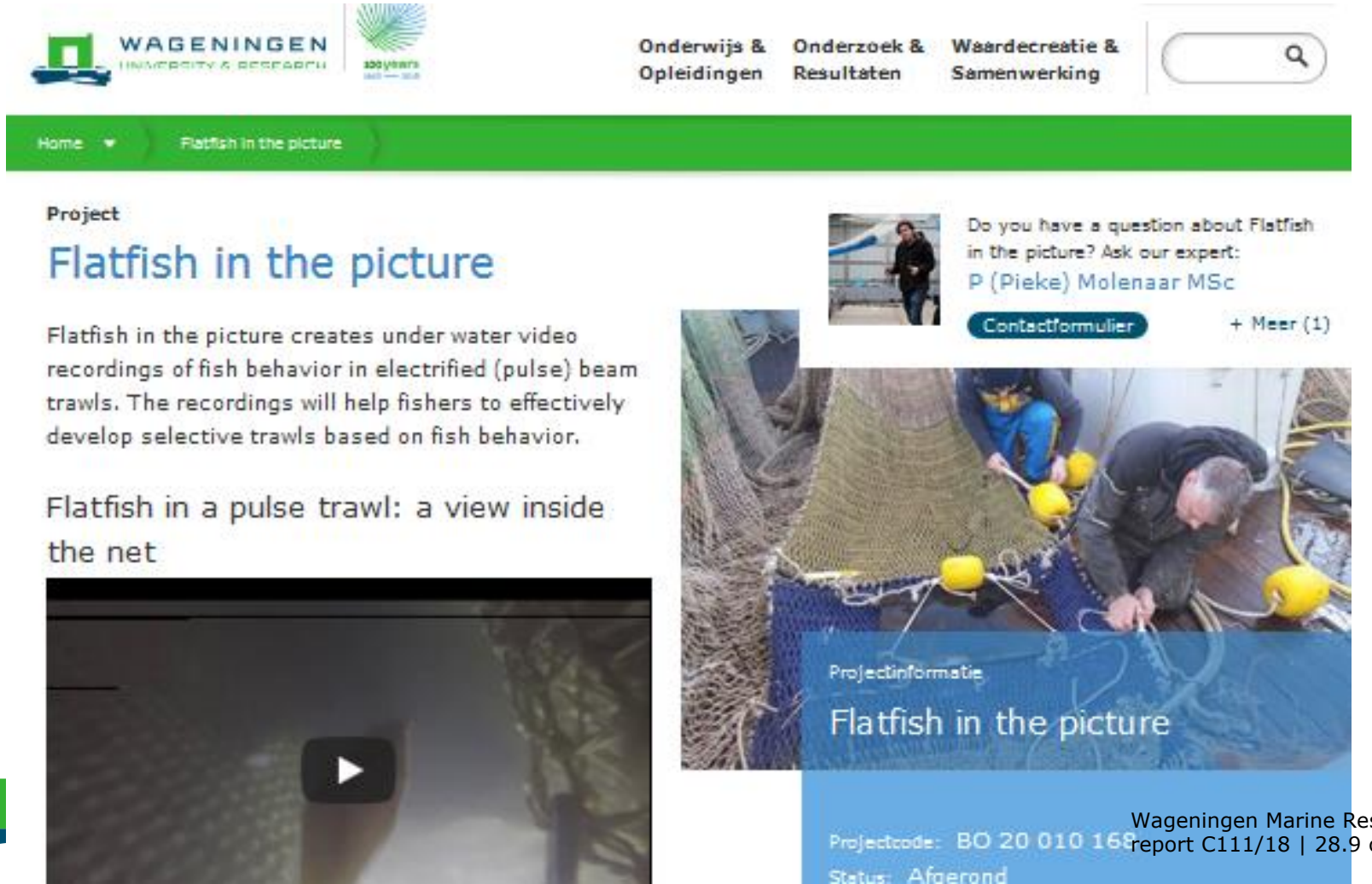
Future development selective devices

- Fish in the cod-end is exhausted after several minutes
- Focus on bottom panel, extension and tunnel for species separation
- Marketable sole separation based on behavioural and morphological characteristics

- Several new selective designs are proposed by the industry after analysing fish behaviour – first trials expected August 2018

Availability online

www.wur.nl/nl/project/Flatfish-in-the-picture-1.htm



Questions?

pieke.molenaar@wur.nl

Annex 6 Presentation Michel Kaiser: Stakeholder Knowledge Needs and Gaps in the Pulse Trawl Project

Pulse trawl project

Stakeholder knowledge needs and evidence gaps: prioritisation exercise

Michel Kaiser, David Reid, Alyne Delaney, Chris Zimmerman

The process:

1. Invite all stakeholders to contribute to compilation of key knowledge needs or evidence gaps
2. Compile list
3. ISAC categorises all knowledge needs
4. Original questions are preserved, some clarification edits implemented
5. Entire list sent to stakeholder community to allocate votes to rank the questions according to importance

Question contributors and voters

	Voters	Question setters
• Commercial fishers	4	[4]
• Recreational fishers	1	[0]
• eNGO	3	[4]
• Research Scientists	1	[4]
• Process/retail	1	[1]
• Government	2	[3]

Categories and distribution of questions

	Number of Qs	Number of votes
• Bycatch	14	4
• Ecosystem	38	11
• Management	10	3
• Socio-economic	11	3

Extent to which ‘Pulse project’ meets knowledge needs

	Fully met		Some gaps		Not met	Not science
• Bycatch	6	6	2	0	3	0
• Ecosystem	18	13	3	0	5	2
• Management	5	1	0	0	0	4
• Socio-economics	4	0	0	0	7	0

Bycatch questions

Q#	Vote#	Summary	Rephrased for clarity (by MJ Kaiser)	Main category	Fully met	Mostly met	Some gaps
26	8	Mortality of escapees	What is the mortality of the different target and by-catch species that have been in contact with the gear but have escaped, for either gear type?	Bycatch			
18	8	Direct effects on target and non-target species of fish	What are the effects on non-target, non-commercial fish species from all types of pulse trawling? (For example effects on sandeel, gobies, dragonets, elasmobranchs or other characteristic species in areas that are pulse fished?)	Bycatch		Extrapolation from observations and model results	
32	7	Mortality changes that occur with pulse characteristics	How does the mortality risk for target and non-target species change when the pulse characteristics are altered, what are the optimum characteristics of the pulse to enable commercial catches while minimising impacts?	Bycatch		inferred from lab experiments	
38	6	Immediate and long-term effects on individual fish escapees/contacts with pulse	What is the physiological impact on fishes caught by the Pulse trawl but that then escape the net? Is predation risk increased for these fish in the short to medium term and are their long-term effects of spawning potential?	Bycatch			inferred from lab experiments

Ecosystem

Q#	Vote#	Original question	Rephrased for clarity (by MJ Kaiser)	Main category	Fully met	Mostly met	Some gaps	Large gaps	Not met
64	7	Long term ecosystem effects of fishing on seabed fauna	What are the long-term effects on populations of plants and animals living in and on the seabed (including mortality over longer time, reproduction, juvenile stadia and growth) in areas that have a been exposed to pulse fishing for years?	Ecosystem		inferred from WP1 and WP2 results			
33	6	Long term exposure to DC on benthos, eggs and larvae of fish	Are there potential effects of cumulative exposure to pulse DC, and what are the effects of cumulative exposure specifically on benthos and on eggs/larvae (with initial focus on commercial fish species)?	Ecosystem	The likelihood of cumulative exposure can be estimated and combined with experimental results		Lab experiments to see effects of multiple pulses on benthos (no commercial fish/eggs)		
41	6	What is the effect of the electricity c.f. physical disturbance	What are the long-term effects of repetitive sub-lethal exposure to pulse trawling to benthic and (epi)benthic microbiota?Focused on the effects of the electric component of the pulse trawl (so not the physical disturbance)	Ecosystem	Repetitive exposure can be estimated		Lab experiments to see effects of multiple pulses on benthos and the respiration of the entire community (not specifically targeting microbiota)		

Management

Q#	Vote#	Original question	Rephrased for clarity (by MJ Kaiser)	Main category	Fully met	Mostly met	Some gaps	Large gaps	Not met	Not possible to answer scientifically or not a science question
63	6	Has changing the gear weight led to gear conflict	What is the effect of displacing pulse trawling into areas of the seabed where previously it did not fish?	Management	WP3+WP4					
9	5	How has the footprint of the fishery changed over time	How has the distribution and intensity of the beam trawl fishery changed since the advent of pulse fishing ?	Management	WP3+WP4					
14	5	How has effort responded with introduction of pulse	What are the trends in the distribution and frequency of use of this gear since its introduction? (For example has and will the swept area increase or decrease, how many more or fewer vessels will pulse fishing in the coming years, bearing in mind changes in efficiency and limitations of TACs?)	Management	WP3 / Benthis					
19	5	Should limits outside current EU legislation for electricity be examined	Does science indicate the need for specific controlled electric current frequency parameters outside of the original EU voltage limit?	Management						no

Socio-economic

Q#	Vote#	Original question	Rephrased for clarity (by MJ Kaiser)	Main category	Fully met	Mostly met	Some gaps	Large gaps	Not met
65	8	Define an experimental fishery and when is the evidence sufficient	How can experimental fisheries be regulated in such a way that a new fishery is truly experimental until it is proven to not have detrimental effects?	Socio-economic					not in our workplan
60	6	Socio-economic impact on other fishing sectors	How have different stakeholders been affected by the transition of the Dutch fleet to pulse fishing? (social and economic study on the relative losses and gains of different groups of European stakeholders, who lost something and who gained something, in other words: how did pulse fishing change the distribution of rights and resources?). (This question is useful in order to better understand why pulse fishing is such a politically sensitive topic and maybe this helps to think of solutions to also make the people benefit who feel they lost something).	Socio-economics					not in our workplan
15	4	Is the pulse fishery more efficient in terms of per kg of fish landed	How much more or less efficient is the pulse trawling than beam trawling? (For example has there been an increase or decrease in the 'hours fished : tonnes of target fish caught' ratio with pulse fishing)	Socio-economics	WP4				

Conclusions

- Considerable similarity among stakeholder questions and concerns
- Stakeholder concerns well – reasonably well accounted for by the scientific study for bycatch and ecosystems
- There are some gaps
- Management often poses 'non-scientific' questions
- Socio-economic issues are least well-addressed by the scientific study
- This exercise would have been more useful at the outset

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- Korringaweg 7, 4401 NT Yerseke
- Haringkade 1, 1976 CP IJmuiden

Wageningen Marine Research is the Netherlands research institute established to provide the scientific support that is essential for developing policies and innovation in respect of the marine environment, fishery activities, aquaculture and the maritime sector.

Wageningen University & Research:
is specialised in the domain of healthy food and living environment.

The Wageningen Marine Research vision
'To explore the potential of marine nature to improve the quality of life'

The Wageningen Marine Research mission
- To conduct research with the aim of acquiring knowledge and offering advice on the sustainable management and use of marine and coastal areas.
- Wageningen Marine Research is an independent, leading scientific research institute

Wageningen Marine Research is part of the international knowledge organisation Wageningen UR (University & Research centre). Within Wageningen UR, nine specialised research institutes of the Stichting Wageningen Research Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment.