Perceptions of European stakeholders of pulse fishing

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Summary

This research project examines the concerns and questions of European stakeholders about pulse fishing, in order to assess to what extent the knowledge agenda on pulse fishing covers these issues. To get a first impression of the concerns about pulse fishing, and to get an idea of the stakeholders that express these concerns, an analysis was conducted of media items in the states bordering the southern North sea where pulse gear is used. In addition interviews were held with representatives from governments, NGOs, the fishing industry and scientists, and seven meetings were observed, national and international, where pulse fishing was discussed. An inventory was made of the substantive concerns that the stakeholders have about pulse fishing. It can be concluded that two thirds of the concerns are covered by the proposed knowledge agenda on pulse fishing (developed by IMARES and ILVO in 2014), or can serve as specifications of the research questions on the knowledge agenda. An overview of the remaining issues is presented in table 4.11 (p. 27-28). From these questions, some are examined in other current research projects. The remaining questions are in fact governance issues or are of an economic nature. It is thus important to approach pulse fishing research transdisciplinary as the questions and concerns stakeholders have do not only relate to the ecological consequences or the technique of the pulse but also to the governance and socio-economic functioning of the fishery within the wider context of North Sea fisheries. This research also found that stakeholders besides having substantive concerns about pulse fishing, also have concerns about the procedure through which the current number of pulse derogations have been obtained by the Dutch government and the transparency of this process. It is thus important for the Dutch government to not only address the technical knowledge gaps on pulse fishing but to also take the social context seriously and to develop strategies to deal with it. For instance by developing a vision on pulse fishing and to communicate about it.

Samenvatting

Dit project onderzoekt de zorgen en vragen die Europese belanghebbenden hebben met betrekking tot de pulsvisserij. Het doel van het onderzoek is om te kijken in hoeverre de huidige kennisagenda voor pulsvisserij deze kwesties dekt. Om een eerste indruk te krijgen van de vragen die er zijn en zicht te krijgen op wie de belangrijkste belanghebbenden zijn is een analyse uitgevoerd van media uitingen over de pulsvisserij in de landen die aan de zuidelijke Noordzee grenzen. Vervolgens zijn interviews gehouden met vertegenwoordigers van overheden, NGOs, de visserijindustrie en wetenschappers. Ook werden zeven internationale en nationale vergaderingen geobserveerd waarin pulsvisserij centraal stond of besproken werd. Hieruit is een inventarisatie gemaakt van de zorgen en vragen die bij betrokkenen leven. Tweederde van deze zorgen zijn gedekt door de huidige kennisagenda , of kunnen dienen als specificatie van reeds opgestelde onderzoeksvragen in de voorgestelde kennisagenda voor pulsvisserij (ontwikkeld door IMARES en ILVO in 2014). De overige vragen zijn gepresenteerd in tabel 4.11 (p. 27 - 28). Hiervan wordt een aantal vragen al onderzocht in reeds lopende projecten. De overige vragen zijn voornamelijk economische- en beheervraagstukken. Het is daarom van belang om het onderwerp pulsvisserij transdisciplinair te benaderen. De vragen en zorgen die belanghebbenden hebben richten zich immers niet alleen op de ecologische effecten of de technologische kenmerken van de pulsvisserij, maar hebben ook betrekking op beheervraagstukken en de sociaal-economische consequenties van de visserij in de bredere context van de visserij op de Noordzee. Uit het onderzoek blijkt dat belanghebbenden niet alleen inhoudelijke zorgen hebben over de pulsvisserij, maar ook hun ongenoegen uiten over het proces waardoor Nederland tot dit aantal ontheffingen voor pulsvisserij is gekomen en over de transparantie van dit proces. Daarmee is het dus belangrijk voor de Nederlandse overheid om niet alleen de technische kennishiaten te laten onderzoeken maar om ook de sociale context serieus te namen en strategieën te ontwikkelen om hiermee om te gaan. Bijvoorbeeld door het ontwikkelen van een visie voor de pulsvisserij en door erover te communiceren.

1. Introduction

This report presents the perceptions European stakeholders have about pulse fishing. The study was commissioned by the Ministry of Economic Affairs in the Netherlands. The pulse fishing technique is considered an important innovation for the future of the Dutch demersal fishing fleet. Therefore, the Ministry of Economic Affairs has committed itself to seek to expand the amount of pulse permits and finally to get a permanent authorization of the pulse fishing technique in the North Sea.

Fishing with electricity is currently prohibited under EU law, and the use of the pulse is regulated under a derogation and within pilot projects. Full authorization of the pulse fishing technique, or of electric fishing altogether, can only be accomplished in agreement with other EU member states as it requires an adjustment of the EU regulations. Over the years it has however become clear that not all member states are positive about the pulse fishing technique. Fishing industry representatives, fishers (also within the Netherlands) as well as NGOs have expressed concerns about electric fishing. Media articles have added to the debate about the pulse which has become a controversial technique, spurred by the increased amount of vessels using the technique in the last couple of years.

Much of the critique is linked to existing knowledge gaps on a number of topics. The Dutch ministry therefore has committed itself, together with the Dutch fishing sector and NGOs to develop a knowledge agenda, in which the knowledge gaps are identified guiding research to be undertaken. The ministry wants to be certain that the key concerns and questions held by stakeholders in Europe will be covered in the knowledge agenda and therefore asked IMARES to study the perceptions and issues/concerns of relevant stakeholders in Europe in pulse fishing. The ministry asked IMARES as well to facilitate and have discussions with these stakeholders on the knowledge agenda and monitoring program. A first knowledge agenda has already been developed by IMARES and ILVO (see Annex 6), in this report it will be assessed to what extent it needs to be expanded. This report provides an overview of the relevant stakeholders around the North Sea and their perceptions. Consequently these perceptions are linked to the existing knowledge agenda.

Pulse fishing

A large part of the Dutch fishing fleet targets sole (*Solea solea*) and plaice (*Pleuronectes platessa*). These flatfish species bury themselves in the seabed. Traditionally, a beam trawl with tickler chains was used to stimulate the fish to come up from the seabed and swim into the net. Since 2004, when the first trials were held on a commercial vessel, electric pulse fishing has gained importance in the Dutch fleet. The basis for the development of this method was already laid in the early 1970ies. It really gained momentum after 2008 in response to the decreased profitability of the Dutch demersal fleet and in the light of increasing criticism of the effects of the beam trawl on the ocean floor. Following a joint government-industry-NGO report about the troublesome situation of the fleet (Task Force Duurzame Noordzeevisserij, 2008), the government facilitated and stimulated innovation. The pulse technique was one of the preferred options (see Haasnoot 2015 for a detailed description of the transition to pulse fishing in the Netherlands).

The pulse technique is based on the beam trawl technique, but the tickler chains are replaced by electrodes. Pulses between the electrodes generate muscle contraction in the buried fish so that they come up from the seabed and get caught in the net. The pulse technique is a preferred fishing technique by many Dutch flatfish fishermen, mainly those fishing for sole, because of reduced fuel costs and improved catch quality.

Regulations

Electric fishing is prohibited by Council Regulation No 850/98. However, as research on pulse fishing showed promising results, since 2006 each Member State is by regulation Annex III(4) of Council Regulation (EC) No. 41/2006 allowed to grant pulse derogation permits for the Southern North Sea. Derogations can be granted to a maximum of 5% of the (beam trawl) fleet. The member states decide themselves on whether or not to allow pulse fishing. Denmark for instance has decided not to allow pulse fishing. Germany and the United Kingdom have allowed pulse fishing. Interestingly however, the two German pulse vessels and the four pulse vessels of the UK are Dutch owned, so pulse fishing currently remains mainly a Dutch practice. The Netherlands currently has 84 derogations for pulse fishing, far more than 22, which was 5% of the 440 Dutch cutters in 2010 (Haasnoot, 2015: 49). How was this accomplished?

In September 2010 when fishermen could apply for the first 22 derogations, the interest was much higher than the availability of derogations. Fishers' organisation VisNed, supported by NGOs WWF and the North Sea Foundation exerted pressure on the Ministry of Economic Affairs to expand the number of experimental licenses. At the Agriculture & Fisheries Council in December 2010 it was decided on the basis of article 43 of regulation 850/98 that the number of experimental licenses could be extended with another 20 derogations, but this time with the explicit condition that the pulse vessels would participate in research (Haasnoot, 2015: 56). The pressure on the Dutch government for more licences remained high and in 2012 the Dutch government managed to arrange extra licenses at the negotiations about the conditions for the European Maritime and Fisheries Fund for 2014-2021 (Ministry of Economic Affairs, 2012). However, the European Parliament still had to vote about the package of conditions and in January 2014 voted against the proposal. This came quite unexpectedly for the Dutch ministry (Ministry of Economic Affairs, 2014a). As fishers had already invested in the pulse gear, the Secretary of State scheduled meetings with the president of the European Fisheries Council Tsaftaris and with Euro commissioner Damanaki (ibid.). She managed to convince the EU officials in light of the upcoming landing obligation to allow for an increased number of derogations. Article 14.1 of the EU Regulation No. 1380/2013 explicitly states that member states can conduct pilot projects to explore methods for avoiding, minimising and eliminating discards. The permits were granted based on earlier research that confirmed the higher selectivity of pulse fishing (e.g. Marlen, van, et.al, 2011). As there is still a lot of uncertainty about the pulse, more research was needed so this group of pulse fishing vessels was to be fishing as part of a pilot (research) project (Ministry of Economic Affairs, 2014b).

While the additional derogations were perceived as a great achievement for the Dutch stakeholders involved in the transition to pulse fishing, many European stakeholders looked at it as a 'procedural scandal' (Haasnoot, 2015: 62). To illustrate this: the European parliament members disapproved of the extension of derogations, Belgian fishermen started a petition against the increase and European industry representatives expressed their dissatisfaction about it (ibid.). Thus, in order to work on the European acceptance of pulse fishing, it is not only relevant for the ministry and the Dutch government to address the substantive concerns that the stakeholders have and knowledge gaps, but also to ensure that procedural concerns and concerns about transparency are taken serious and are dealt with.

An overview of the pulse fishing dossier can be found in Annex 1.

2. Assignment

The assignment has two focus points:

1. To get insight in the perceptions and issues/concerns of relevant stakeholders in Europe of electric fishing (pulse fishing).
2. To facilitate and have discussions with these stakeholders on the knowledge agenda.

The following research questions are answered in this study:

- Who are the relevant European stakeholders in pulse fishing in the North sea?
- What are the perceptions of these European stakeholders of pulse fishing in the North Sea?
- What are the issues/concerns regarding pulse fishing in the North Sea?
- How do these issues/concerns relate to the knowledge agenda?

3. Materials and methods

The methods that were used in this research are a quick scan of media messages, interviews with stakeholders and (participant) observation in national en international meetings on pulse fishing.

Analysis of media items

An analysis of media items was used to get a first impression of the stakeholders involved in the pulse discussion per country and of the perceptions of the different stakeholders per country. The focus here was on messages in countries around the southern North Sea as that was of particular interest to the client. Those countries were Belgium, France, United Kingdom, Germany and Denmark. The messages were found on the internet and by consulting international colleague researchers and the pulse steering group pulse for articles. The steering group pulse is a national group established in 2011 by the Ministry of Economic Affairs (Haasnoot, 2015: 56), including the ministry representatives, industry representatives, an NGO, and IMARES and LEI, the latter is the Dutch agricultural economic institute. The group was intended as a platform to monitor the pulse derogations and coordinate research, to communicate about it and to control it. The search terms that were used for search on the internet can be found in Annex 2. Articles sent by Belgian, French and German colleagues were included in the analysis.

The media quick scan served as a first exploration of who the stakeholders are, how they assess pulse fishing and the issues brought up as reasons for concern. The information that was generated by this media analysis served as input for setting up the interview protocol and for selecting the first respondents for the interviews. The opinions of the stakeholders in the media items should not be considered as representative for their whole sector or their whole country, as it is likely that the strong opinionated appear in the media and not all the nuances. However, the media analysis does give an indication of the information about pulse fishing that reaches the wider public that is not particularly concerned with pulse fishing.

Interviews

The media analysis served as the first input for setting up the interview protocol and selecting the interview participants. Additional participants were selected as a result of snow ball sampling and on the basis of the people that were present at international meetings about pulse fishing. The interviews with the stakeholders served as a further elaboration of the media analysis, to hear about their concerns and questions about pulse fishing more in depth. The interviews where semi-structured in order to be able to identify new worries and questions that had not been found in the media analysis. Where possible a group interview was held in order to expand the coverage of relevant stakeholders in the time and means that were available. The interviewed participants where not selected randomly because the aim was to speak with a diverse group, including stakeholders from the different countries around the North Sea and from the various sectors involved in pulse fishing:

- Fishing industry
- Research community
- National policy makers and managers
- NGOs

The interview protocol is described in annex 3 and the list of interviews can be found in annex 5. The questions were related to both the perceptions and research needs for the knowledge agenda and monitoring program. The interviews where recorded and sent back to the respondents for a final check. It was agreed that the interviewees would be presented anonymously in the report.

Meeting observation

During 2014, seven meetings (national and international) were observed where pulse fishery was discussed. Detailed reports of the meeting were made in order to analyse the worries and questions that where raised during these meetings. The information obtained during the meetings served to extend the coverage of respondents. In Annex 5 a list of the observed meetings is presented.

Analysis

The data from the media analysis, the interviews and the meetings were analysed in order to get a systematic overview of the perceptions of stakeholders towards pulse fishing.

Media analysis

The media items have been analysed in two ways. First, an overview was made of the people that where quoted, from which country they are and to which sector they belong. Second, the content of the quotes was analysed by making use of a code list developed for this research (Annex 4; see section below). It was assessed whether the quote made a positive, a negative or a neutral statement about pulse-fishing. In addition an inventory was made of the issues of concern raised.

Interviews and meetings

For analysing the interview transcripts and the meeting reports, the qualitative data analysis program ATLAS.ti was used. In the program, the transcripts were coded in order to categorize and organize the concerns of the stakeholders. The codes were established in two ways. First, a list of codes was put together on the basis of the interview questions. Second, during the coding process new unforeseen codes where added on the basis of the content of the data. The list with codes can be found in Annex 4.

Limitations

Some limitations of the research and their implications will be discussed now. First, the media search was limited by the method – searching via google, which generated only *online* messages. In order to extend the search, colleagues from the countries that are within the scope of this research were approached, and members of the Dutch pulse steering group, were asked about media messages they had heard of. The yield in the end consisted of online articles and articles received from contacts. The media items are from a limited and mostly recent time period, this is a logical consequence of the fact that the wide introduction of the pulse gear is a recent event.

Secondly, all meetings that took place in the second half of 2014 to which IMARES researchers were invited in the Netherlands and beyond were observed in order to examine in what way participants spoke about the pulse. Some of these meetings discussed the pulse in relation to other research projects (such as in the GAP2 and BENTHIS projects) but most of these meetings were organised in relation to the new pilot project on pulse (linked to the extra admission of 42 pulse vessels to the pilot) and the development of the research agenda by ILVO and IMARES. This has two implications: First, the perception of stakeholders was studied in a particular setting, organised to discuss a research agenda in relation to the permitted growth of the pulse fleet. The results can therefore not be seen as the 'general' opinion of stakeholders in Europe. The same holds for the interviews, of which many where held alongside ongoing meetings in the Netherlands about the pulse. However, as the stakeholders spent time and resources to attend the meetings, it can be argued that for these stakeholders the issues are urgent and thus these persons are the most relevant to include in the research. Second, the stakeholder opinions about the pulse were observed in an arena in which the observers had two roles. While studying perceptions on the one hand, they had, at the same time, a role as (colleagues of) researchers from IMARES. Stakeholders

may have questions about the neutrality of the position of the observers and interviewers. Particularly as IMARES (largely in the form of its predecessor, the RIVO) has been an important actor in the development of the pulse gear. The neutrality is, however, secured as best as possible by the professional attitude of the observers and the interviewers and also because the colleagues conducting this research had not personally been involved in the development of the pulse gear.

Finally, it was not possible to organize interviews with all stakeholders that were aimed at. No interviews were held with stakeholders from France and Belgium (apart from the researchers at ILVO and Ghent University). With regards to Belgium, the main reason for this has been lack of time. Meetings were attended however together with fishers and NGOs from Belgium, the BENTHIS meeting and NSAC meetings, where pulse fishing was discussed and where Belgian attendees had the opportunity to raise questions and concerns about pulse fishing. In addition, informal conversations were held with Belgian fishermen and representatives. Regarding France, regular email contact was held with the NSAC representative, but it was not possible to arrange a face-to-face or a written interview. A possible interpretation is that this is due to the fact that pulse fisheries is perceived such a sensitive topic in France. Nevertheless this research has been able to include some of the French perspective on pulse fishing as information from other sources was available (media, NSAC contributions of France in the pulse NSAC focus group).

4. Results

This chapter first reports on the findings of the media analysis. Consequently on the analysis of the interview transcripts and the meeting reports and finally the issues and the concerns that have been found will be related to the research agenda on pulse fishing, in order to assess where the research agenda needs extension or specification in order to address the stakeholder questions.

Media analysis

The media analysis yielded 60 media items, consisting of articles, films, radio items. The items cover a time period from 1996 until 2014; most items stem from the time period 2011-2014. Table 4.1 shows the number of items found per country. This section reports on the results following the two ways in which the items were analysed, first looking at *who* is speaking, and secondly, at *what* is being said.

Table 4.1: number of media items per state

Belgium	France	United Kingdom	Denmark	Germany	**Total**
16	19	6	4	15	**60**

Stakeholder assessment

The 60 media items contained 65 quotes. Table 4.2 demonstrates the distribution of quotes per sector for each country. In the UK and Belgium (and Denmark) fishermen were most quoted in the media messages, whereas in France and Germany the shares are more even between the different roles. The quotes were evenly spread over the different countries, except for Denmark with only two quotes (see figure 4.1). 51% of the quotes were from the fishing industry, followed by government (25%), research (12%) and NGOs (11%), from one person expressing a quote the background was not traceable (other 1%) (see figure 4.2).

Table 4.2: distribution of quotes per sector for each state

	Belgium	France	United Kingdom	Denmark	Germany	**Total**
Government	6	3	4	0	3	16
Research	1	2	1	0	2	8
Fishing Industry	8	8	10	2	5	33
NGO	1	4	0	0	2	7
?	0	0	1	0	0	1
Total	16	17	16	2	14	65

Figure 4.1: % of comments per state

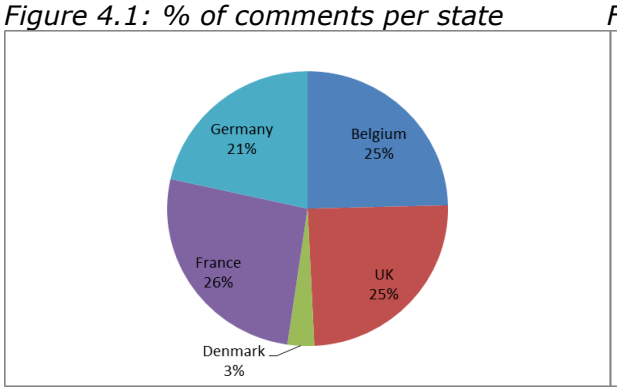
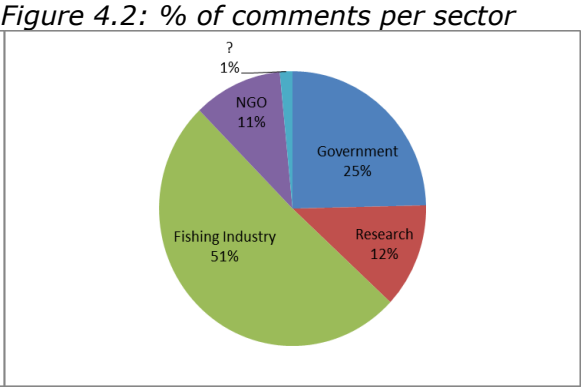


Figure 4.2: % of comments per sector



The research institutes referred to in the articles are: ILVO (Belgium), Ostseefisherei (Germany), ICES (EU), CEFAS (UK) and NOAA in the USA (in a French article). The NGOs that have been quoted in the articles are: Climaxi (Belgium), Aquabio (France), WWF (France and Germany), Greenpeace (France) and Robin des Bois (France). From this it appears that NGOs in France have picked up much more on the pulse than NGOs in the other countries. Another remarkable issue is that whereas WWF in France is quoted expressing concern about the pulse trawl (referring to the flatfish pulse), WWF in Germany is quoted neutral and positive on the pulse (referring to the shrimp pulse). Some stakeholders (most often researchers and fisher representatives) are quoted in more than 1 article (in France, UK and Germany). Partly this can be explained by the fact that some articles refer to the same news moment and quote the same people. Some fishermen from the UK are also quoted in media items in the UK as well as in Belgian media items.

Content analysis

The analysis of the content of the statement started with an assessment whether the comments on pulse where negative, positive or neutral. Table 4.3 demonstrates an overview of how pulse is considered by stakeholders from different countries and table 4.4 demonstrates the perception of pulse by stakeholders from different sectors. For a visualization of the numbers, the figures 4.3 and 4.4 demonstrate the distribution of perceptions graphically.

Table 4.3: perception per country

COUNTRY	Pos	Neg	Neutr	Total
Belgium	4	9	3	16
UK	2	10	4	16
Denmark	0	1	1	2
France	3	14	0	17
Germany	9	4	1	14
Total	18	38	9	65

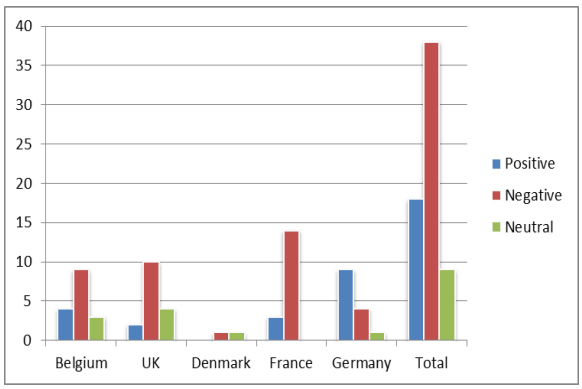
Table 4.4: perception per sector

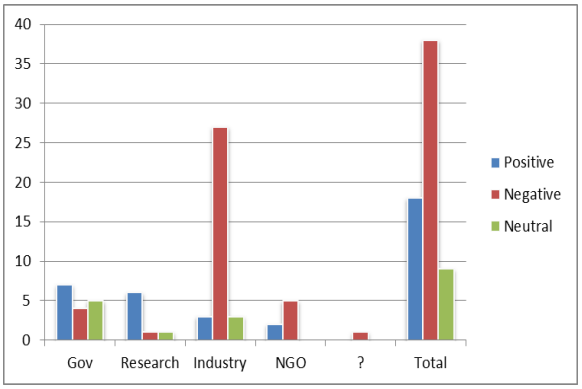
SECTOR	Pos	Neg	Neutr	Total
Government	7	4	5	16
Research	6	1	1	8
Fishing Industry	3	27	3	33
NGO	2	5	0	7
?	0	1	0	1
Total	18	38	9	65

Most people quoted in the articles give a negative comment (38), 18 comments were positive and 9 neutral. Research and government are more often quoted expressing positive comments, whereas people from the fishing industry and NGOs generally are quoted stating negative comments.

Figure 4.3: assessment per country

Figure 4.4: assessment per sector





The next step is to assess what has been said by these people. For a general assessment of the content of the quotes, quotes were coded with the same code list as we used for assessing the meetings and interviews (see annex 4). The codes that were used most when analysing the media messages of the five countries were: *ulcers, bycatch, competition, fuel reduction, overfishing, dead fish*, lack of information, research and ecology. The first five codes refer to effects of pulse fishing, ulcers on fish, reduced or not reduced bycatch, the changed competition among fishers with a new gear widely in use, the reduced fuel need for pulse compared to the beam trawl, overfishing is a (possible) consequence of pulse fishing and dead fish as a consequence of the pulse. The other three codes refer to the knowledge gaps about pulse, the second to the research that is done or that should be done and the later about the ecological effects of the pulse. When looking at whether there are differences between the countries, it can be seen that the *ulcers* are mentioned in media messages in Belgium, France (most) and Germany. For instance a Belgian ship owner in a Belgian media article of March 2014:

'We find more dead fish lately with ulcers. It is not normal that Dutch vessels, the same size, catch five times more fish than we do.'

The positive effect of the pulse that it reduces fuel consumption is mentioned in Belgium, France and Germany. Dead fish in Belgium, UK (most) and Germany. Ecology as topic (under the research agenda) in Belgium, UK and France (most). The others are mentioned in at least 4 of the countries and often in 5. Thus in different countries, different effects are most discussed but in all countries concerns are shared about effects of the pulse and comments are made about the lack of information available. In addition the competitive element is also important. A German industry representative for instance states in a German article from April 2012:

'What is caught with 500 cutters today, then [when pulse fishing is introduced widely] only needs 250, the rest needs to disappear (...). It is possible to catch enough with the old methods. If you deal with it wisely, many families and companies can live off it'.

Assessing per country what the most important topics are in the media messages gives the following results:

Table 4.5: most important issues mentioned per state

Belgium	UK	Denmark	France	Germany
-Competition *-Reduction catches own fleet (subcode under competition)* *-Overfishing* -Economy (subcode under research)	-Concerns *-Competition* *-Dead fish* -Research	-Concerns *-Competition* -Lack of information -Research -Licences / derogations -Size of the experiment	-Concerns -effect *-competition* *-overfishing* -ecology (subcode under research)	-Concerns *-Bycatch* -Lack of information -Research -Rules

What becomes clear from the analysis of the media items is that overall three main issues are discussed: the articles generally discuss concerns stakeholders have about the effects of pulse fishing, the lack of information that is available about pulse fishing and comments are made with regard to the underlying research.

Under the general code **effect**, referring to quotes in the text in which effects of pulse fishing are mentioned, 19 subcodes were developed for different kinds of effects. Of these 19 subcodes all countries at least 8 (with Denmark as an exception) and at most 10 different effects were mentioned in the various article, see table 4.6. The number in brackets displays how many times a certain effect was mentioned.

Table 4.6: all effects of pulse fishing mentioned per state

Belgium (10)	UK (8)	Denmark (1)	France (10)	Germany (9)
Ulcers (3) Discards (1) Bottom life (3) Electroreceptors (2) Competition (9) Reduction of catches of own fleet (5) Reduced fishing costs (1) Fuel reduction (3) Overfishing (8) Dead Fish (2)	Total catch (2) Bottom impact (1) Bottom life (3) Cod (1) Competition (20 Reduction of Catches of own fleet (2) Overfishing (4) Dead Fish (8)	Competition (1)	Ulcers (5) Total Catch (3) Bycatch (3) Discards (1) Bottom life (3) Electroreceptors (2) Competition (4) Reduction of catches of own fleet (2) Fuel reduction (3) Overfishing (5)	Ulcers (2) Total Catch (1) Bycatch (8) Bottom impact (4) Competition (1) Fuel reduction (5) Efficiency (1) Overfishing (1) Dead fish (2)

The media analysis served as a first scan of different possible opinions about pulse fishing in the Dutch neighbouring countries bordering the North Sea. The analysis shows that pulse fishing has been assessed negatively more often than positively in the media by the stakeholders that were quoted. In this sample, researchers and government representatives assessed the pulse more often positively, while industry and NGOs express more critical concerns. On a state level, Germany is the only country where pulse has been assessed more often positively than negatively in the media. The stakeholders do not only comment on the effects of the technology but also on the lack of information and on the quality of the research. As this analysis is only of opinions that appear in the media, and some opinions will not reach the media, this analysis does not show the representative opinions by the various sectors and in the coun-

tries. However, it provides a first indication of how the topic of pulse fishing has been brought in the media. The results from the interviews and the meeting observations will now be presented.

The interviews and meeting observation

This section presents the perceptions and worries that European stakeholders with regards to pulse gear have expressed in the interviews and in the observed meetings. A list of the meetings and of the interviews can be found in annex 5. This section starts with a list of the concerns expressed by the stakeholders. Secondly these concerns will be discussed more in detail. This section will conclude with an assessment of the research agenda on pulse fishing. The aim is to see to what extent the current research agenda reflects the concerns that are mentioned and if it does not cover them at all, where the research agenda can be specified or extended.

The list of concerns

The first step of the analysis of the interview and meeting transcripts consisted of coding the concerns that were expressed. This resulted in a list of possible effects of the pulse gear that stakeholders worry about. The list is presented in the first column of Table 4.7. The first number in brackets indicates how often a code occurred. The quantity may indicate that it is a widely shared concern but not necessarily. Namely, one person may for instance have visited more than one of the meetings, and expressed the same concern more than once or the same person may have raised the same concern more than once in an interview. The second number in brackets indicates the number of documents in which the concern was found. This at least means that the concern was not only raised in one interview but again, it is possible that it was raised by the same stakeholder at more than one occasion. Therefore it is relevant to discuss the content and the context of a quotation more in detail. This will be done in the next part of this section.

With regards to overlap, people quoted in more than one document, especially Dutch and Belgian scientists have been quoted in more than one document as there was always at least one of them present in the meetings that were analysed. Two NSAC meetings, one on demersal fisheries and one on pulse, brought many of the stakeholders together that have been interviewed or that attended other meetings on pulse. And other stakeholders have been interviewed adjacent to their participation to pulse meetings or exchange visits, so such overlap is likely to occur.

Besides looking at the content of the expressed concerns, attention was also paid to the form in which the worries were expressed. Some of the possible effects were based on observations by fishermen or scientists, some were effects heard of but most were expressed more as general worries or questions that need to be explored. This is also presented in Table 4.7.

Table 4.7: the possible effects of pulse gear that stakeholders worry about

	Observed effect (18)	Heard of (12)	Worry/question (108)
Damage to cod (15, 11)	1		15
Damage to fish/shrimp (17, 13)	1	5	18
Damage to the seabed (9, 6)	3	1	9
Competition (10, 5)	1	3	10
Displacement (15, 7)	1		16
Dead fish/shrimps (22, 14)		9	22
Electroreceptors (3, 3)			3
High discards (3, 3)	2		3
Impact on benthos (17, 8)			18
Impact on ecosystem (14, 11)			14
Impact on fish (13, 10)			14
Interaction with other fishing gear (14, 8)		3	11
Overexploitation (1, 1)			1
Survival (7)			7
Reduction catches own fishery (6, 5)	1	3	7
Catch difference (5, 4)			5
Increase catch efficiency (23, 12)		2	22
Increased chance disease (3, 3)	1		2
Ulcers on the fish (9, 8)		3	9

When comparing this list to the list of concerns in the media items, a few observations are striking. Firstly, the negative impact on cod has only appeared in one statement in the analysed media items, in the interviews and meetings it is an often mentioned concern, raised at various interviews and meetings. Secondly, overfishing does not appear as an important topic in the interviews and meetings while it is mentioned in the media in all countries in the media except for Denmark. Thirdly, while there is some overlap of negative concerns (impact on seabed/bottom and impact on bottom life), in the interviews and meetings a higher variation of possible negative impacts is mentioned than in the media messages. Displacement, impact on the ecosystem, damage to the fish/shrimp are for instance only mentioned in the former. Arguably these differences can be related to the different contexts in which the concerns are raised. As the media is directed towards the general public, that is not as informed as the people that participated in the meetings and in the interviews, the issues raised are less nuanced.

Table 4.8: The number of concerns by sector and by nationality

	Government	Industry	NGO	Research
Belgium		2		12
Denmark		23		
Germany		6		1
United Kingdom		23	2	
France		2		
Italy		2		
Netherlands	1	24	4	3
Sweden		1		

In addition each text fragment containing a concern was coded providing information on the sector in which the speaker works and his/her nationality. Table 4.8 shows the co-occurrence of the nationality codes and the role codes. This table thus displays the approximate[1] number of expressions that were collected from a certain sector per country. It can be observed that most concerns were expressed by stakeholders from the industry and most of the expressions are of speakers with the Dutch nationality. The high number of quotes from industry stakeholders from Denmark and from the UK and Belgian scientists are explained by the fact that Danish and British fishermen and Belgian scientists were interviewed. The high number of Dutch quotes is explained by the fact that the observer notes of several national meetings were analysed. The empty fields in the table are explained by the fact that no statements from representatives from each sector in each country have been found. A complete picture of the concerns in each country by each sector can thus not be sketched. However, the stakeholders from whom quotes are included appear to be the ones for whom it is important to attend these meetings and express their opinions. It can thus be argued that data on the perceptions for stakeholders for whom this issue is relatively pressing have been included in this research. An elaboration on the various concerns mentioned will now be set forth.

The concerns about pulse gear in more detail

In this section the data behind each code will be discussed. Before doing that, the codes can be grouped in larger categories, see table 4.9. When in doubt about classifying a code (i.e. electroreceptors in the 1. Damage to commercial species or 2. Impact on ecosystem), a decision was made on the basis of the context (i.e. quotes about the electroreceptors of rays and sharks are referred to in the context of their ability to survive and not so much the damage as a loss to the fishermen and are thus coded under 2). This following section is structured in accordance with these categories. Sometimes the content of the codes largely overlapped. In that case codes are discussed together in one section.

[1] By approximation, because from 17 expressions it was not traceable in the reports who was speaking.

Table 4.9: categories of concerns and questions about pulse fishing

Category	1. Concerns about commercial stocks	2. Concerns about the ecosystem	3. Concerns with regards to other fisheries	4. Procedural concerns
Code	- Damage to cod - Damage to fish/shrimp - Dead fish/shrimp - Increased chance disease - Ulcers on the fish - Survival	- Damage to the seabed - Displacement - Electroreceptors - Impact on benthos - Impact on ecosystem - Overexploitation - High discards - Impact on fish	- Competition - Increased catch efficiency - Interaction with other fishing gears - Reduction catches own fishery - Catch difference	- Transparency - Derogations and the size of the experiment - Control

A. Concerns about commercial species

A.1 Damage to cod

The damage that the pulse gear brings to round fish, more specifically, to the spine of the cod is an often mentioned and widely shared concern. The concern is raised by researchers, fishers and NGO representatives. A more specific question is what percentage of cod gets injured. Other questions raised are whether the variation in distance between the electrodes matter for its effect on cod, whether the spinal injuries are attributed to the differential current distribution and whether the cod is unconscious when it breaks it's back. While a Danish fisherman worries that this might also happen to flatfish a British NGO-representative would like to know whether morphology can explain why it does not happen to flatfish:

British NGO representative: 'I would also be interested to know whether the spinal injuries to cod can be attributed to differential current distribution as we discussed and whether morphology explains why it doesn't happen in flat fish. For what it's worth, I did some work years ago which was published in Meat Science on the effect of downward hide pullers causing spinal fractures in cattle post mortem and there is the problem of fractured wishbones in broiler chickens, caused by electric water bath stunners. It's surprising how easily broken the spine can be when subjected to abnormal loads.'

Questions:

A.1a What is the effect of pulse on round fish, more specifically on the cod's spine and skin?

A.1b Which percentage of round fish/cod is affected by pulse?

A.1c Does the effect (on cod) differ when the distance between the electrode is varied?

A.1d Are the spinal injuries in cod attributed to the differential current?

A.1e Does the morphology of the fish explain why the effect of pulse on cod?

A.2 Damage to fish/shrimp, dead fish/shrimp and ulcers on the fish and survival

Various speakers, including Danish, Dutch, Belgian, German and English industry stakeholders, report to have heard of, or have observed, damaged fish, fish with burns, fish with ulcers, dead fish, a lack of small shrimps where they usually are found and broken shrimps. More specified concerns are the frequent exposure of shrimps to (sole) pulse as opposed to a one time exposure in a lab, the effect of pulse on mother shrimps and their spawning stock and the absence of shrimps in the trail of ships fishing with pulse gear. The latter is a worry of fishermen reported in the NSAC meeting. Ulcers are mainly mentioned in the context of dab and sole. Dutch fishermen say however, that the cold water temperature in winter and frost could also be a cause for this, a possible hypothesis for researches studying the reported ulcers on flatfish. Notable is that various British fishermen and fisheries representatives mention that many dead fish are caught at

the south east coast of the United Kingdom, more specifically in the Thames estuary up to Lowestoft and at the coast of Kent:

British fishermen: 'I think there is more work that needs to be done to look into it, to see what damage it does, to the seabed and is the small fish surviving, because you know, from reports of the Kent's coast, from the fishermen there, they're towing over grounds, and there is nothing there, all the fish there is dead.'

One British industry representative says that pollution and dredging in this area could also be a cause for the dead fish. Various stakeholders, fishermen from Great Britain and Denmark, a researcher and an NGO representative express the concern of the fish that are not caught in the net. They wonder whether the mortality occurs under water. An English fisherman argues that survivors that escape the net should be caught with a – to be invented – technique outside the net and not only be checked on the spine but also on the skin and on contusions. When during a presentation a Belgian scientist explains that if the strength of the pulse is set too high, the catches go down, fishermen react with the worry that the lower catches are due to the death of fish. In the data the worries about dead and injured fish and shrimp are mainly raised by industry stakeholders.

Questions:
A.2a What is the effect of the (frequent) exposure to pulse on fish, shrimps and the spawning stock of shrimps?
A.2b Are burns, ulcers, dead fish and broken shrimps a result of pulse?
A.2c Are ulcers on dab and sole the result of pulse or of frost?
A.2d Why are the catches lower when the electricity is set higher?
A.2e Is the pulse an explanation for the observed dead fish along the south east coast of the United Kingdom?
A.2f What is the survival rate of the fish that escape a net with pulse gear?

A.3 Increased chance disease

Another concern, not so widely shared, is about possible increased chances for diseases. A Belgian scientist shares preliminary results on a bacterial disease (*pangsit pancreas*) found by shrimp after exposure to pulse. In a meeting of the Common Language Group concerns are raised about the possibility of upwardly mobile disease and possible impact on the immune system of shrimps.

Questions:
A.3a Does pulse affect the immune system of shrimps and fish?

B. <u>Concerns about the ecosystem</u>

B.1 Damage to the seabed

Uncertainty about the level of seabed disturbance appears from the data. In a Dutch meeting it is determined by a Dutch fisherman that the pulse trawls digs less deep into the seabed in comparison to the beam trawl and that it affects a smaller area. A Belgian scientist argues however that the lack of seabed disturbance by the pulse trawl is overestimated, he has footage that shows how the pulse trawls still affects the seabed and in addition the sole still has to be collected from the bottom, so no disturbance is impossible:

Belgian scientist: 'It is a point of discussion what we understand as seabed disturbance. The way it is presented in the promotion movie[2] it seems as if it is a floating fishing gear, where the sole

[2] http://www.pulsefishing.eu/en/videos/video-about-pulse-fishing

comes loose from the ground and swims into the net. In practice the sole lies curled up on the seabed and you have to shovel it in the net in a quite invasive way.'

A Swedish industry representative would like to see a clear comparison of the seabed disturbance by the pulse trawl and the beam trawl. Dutch fishermen are even concerned about the lack of seabed disturbance, referring to the plaice box[3]. An English industry stakeholder on the other hand states that the seabed is dead after pulse fishing.

Questions:
B.1a To what extent is the pulse trawl less disturbing for the seabed than the beam trawl?

B.2 Displacement and electroreceptors
Stakeholders from various sectors are worried about the displacement of the Dutch fishing fleet with the introduction of the pulse gear. Some vessels changed fishing location because they can no longer fish North of the 55° North and in addition it is mentioned that pulse trawlers can fish in stony areas where the beam trawls could not fish. Worries about the consequences of this movement are both ecological and socio-economic. A Dutch NGO representative is concerned about the increased fishing in thornback spawning areas. A Dutch scientist suggests that the survival of thornback rays should be examined through a mark-recapture experiment. In addition the effect of pulse on the electroreceptors of elasmobranches needs research according to two scientists at different occasions. A British industry representative is worried about the increased fishing effort in the Thames area which is a spawning area for sole. The British fishermen used to have a gentlemen's agreement to avoid the area in the spawning season but the Dutch pulse trawlers go there year-round. Dutch fishermen are worried about the decrease of resting areas for the fish now that pulse trawlers fish in previously untouched areas. A Dutch NGO representative suggests to do research on the effects of displacement on coastal low impact (small-scale) fishermen:

Dutch NGO representative: 'What is the effect on the other metiers? The low impact fisheries are hereby negatively affected. For instance the increased fishing effort in the Dutch coastal areas and the effect on the gill net fishers in these coastal areas'.

Questions:
B.2a To what extent has displacement of the Dutch fishing fleet taken place since the increase of pulse trawlers?
B.2b How does displacement of the Dutch fishing fleet of the pulse fleet affect fishermen in coastal areas in the Netherlands and in the UK?
B.2c How does increased fishing effort in thornback ray spawning areas and in sole spawning areas affect these species?
B.2d What is the effect of teh pulse on the electroreceptors of elasmobranches?
B.2e To what extent does thornback ray survive a haul by pulse gear?
B.2f Has displacement of the Dutch fishing fleet of fisheries led to less resting areas for sole? If yes, what is the effect on sole?

B.3 Impact on benthos, the ecosystem and fish
Danish, Dutch and British fishermen and also a Belgian scientist worry about the effect of the pulse on benthic species, microorganisms and on fish that escape the net.

[3] In the plaice box trawl fishing is prohibited for vessels with more than 300 HP. In the Netherlands it is an often heard complaint by fishermen that there is little plaice to be caught in the plaice box by fishermen that can still fish there. This example is often brought up as an argument against measures that close areas of the sea for fishing.

Danish fisherman: 'I think this is one of the main issues we have with the pulse fishery, that there could be a significant impact on in- and epifauna on the bottom. They are small animals, they don't get into the nets and you don't bring them to the surface, so we cannot see that.'

Specific species that are mentioned are sandeel, small crustaceans and worms. A German industry stakeholder argues that research should be done on 'avoidance effects of animals', referring to the possibility of organisms not returning to the same areas in the same numbers after having been frequently exposed to electricity. Dutch scientists mention firstly, the need to examine the effect of pulse on chemical reactions in the seabed and secondly, its long term effects on the growth and reproduction of species. A Belgian scientist and a Dutch NGO representative suggest that 50% of the North Sea should be closed to pulse fishing in order to have a reference area and to compare the impact of pulse on the ecosystem.

Questions
B.3a What is the effect of pulse gear on benthic species?
B.3b Does frequent exposure to electricity have the result that species do not return to the same areas in the same numbers?
B.3c What is the effect of pulse on chemical reactions in the seabed?
B.3d What is the long term effect of pulse on growth and reproduction?

B.4 Overexploitation
Overexploitation is only mentioned once by a Dutch scientist as an adverse consequence of pulse fishing. Overexploitation is not only the effect of the gear used but of many more factors (Polet, 2010), such as functional fisheries management, hence this issue can be considered covered by question 3.2c.

B.5 High discards
Discards in relation to pulse fishing is a rarely mentioned topic in the data. Two Danish fishermen mention that they observed a lot of discards when they went along on a Dutch vessel with pulse gear but they are used to the 120mm which catches less undersized fish, thus their concern is more related to mesh size than to pulse gear. One British representative of recreational fisheries questions the reduction of discards with pulse fishing, arguing, as already mentioned in section 1.2, that possibly the mortality is the same as with beam trawl fishing but that the dead species go under with pulse fishing. A Dutch NGO representative questions whether pulse gear has less discards and argues that more research should be done in how discards can be reduced by pulse gear. A French industry officer states in the NSAC meeting that discards should be examined in light of the total catch with pulse gear, thus not only absolute quantities of discards should be reported but also quantities relative to the total catch.

Questions
B.5a To what extent does pulse gear have less discards than other gears and how can discards be reduced? Looking at discards in relative (as a percentage of the catch) and absolute terms.

C. <u>Concerns with regards to other fisheries</u>

C.1 Competition and less fish/shrimps
Various stakeholders refer to the difficulty for especially Belgian and British fishermen to compete with the Dutch pulse fishers. According to a Belgian scientist, part of the arguments about the adverse effects of pulse are the result of this competition. In line with this a Dutch NGO-representative states that fishermen start using arguments that they would not use normally, for instance French fishermen using ecological arguments against pulse fishing. In a Dutch meeting fishermen raise the relevance to pay attention to the problems with fishermen from Belgium and the UK as they claim to have reduced catches since the introduction of the pulse. But also Dutch shrimp fishermen experience unfair competition, worried that only pulse cutters will get licenses to fish in N2000 areas and feeling disadvantaged that they cannot get a pulse licence while sole

fishers can use their pulse gear also for catching shrimps. This discussion at a Dutch meeting illustrates the many uncertainties that are expressed:

Dutch Fisherman 1: 'I have heard that the bad catches at the Thames are caused by sand mining in that area'.
Dutch Fisherman 2: 'That does not explain the problems of the Belgian fishermen where a lot of fish is caught, except by non-pulse fishers'.
Dutch Fisherman 3: 'Is this because the pulse catches everything? Or because the pulse chases the fish out of certain areas?'
Dutch Fisherman 4: 'Perhaps we have always estimated the sole stock wrongly, perhaps we always caught less sole with the beam trawl than there was available'.

Questions
C.1a How can the changed competition in fisheries since the introduction of the pulse be better understood? (taking into account Dutch and foreign fisheries and different aspects of competition, such as the access to the pulse gear and the impact of the displacement of the pulse fleet on other fisheries and informal management measures)

C.2 Increased catch efficiency
Worries are expressed in relation to the catch efficiency. An NGO representative and various industry representatives worry about the stocks when there is not sufficient adaptation of management to the new situation. Shrimp fishermen in particular worry about the price of the shrimp, which would drop if more shrimps are landed due to increased catch efficiency. A Belgian scientist notes that if catch efficiency is examined, it is important to take into account the different variations in pulse fishing gear.

Questions
C.2a to what extent is pulse fishing more efficient than tickler chains? (taking into account the variety of pulse gears)
C.2b To what extent has catch efficiency increased with pulse gear, to what extent does this pose a threat for the fish/shrimp stocks and does this have consequences for management?

C.3 Interaction with other fishing gears, reduction of own fisheries and catch difference
These issues largely overlap with the economic results of the displacement by pulse fishers as fishers who fish in an area where the number of pulse fishers have increased, catch less. This is stated by various stakeholders including a Belgian scientist, a Dutch NGO representative and fishermen from Denmark, England and the Netherlands. The Danish fishermen in addition express concern about the adverse effects on their cod fishery and about rumours that they heard about gill netters who only catch dead fish when they fish in an area where pulse trawlers have fished previously. A Dutch fisherman expresses his concern about the increased landing of small sole that he observes every year. His worry is that due to the increased catch efficiency with the pulse gear the sole does not get sufficient time to grow. Other Dutch fishermen in the same meeting say that the size of the sole could also depend on its year class.

Questions
C.3a What is the effect of pulse fishing on fishermen with other gears fishing nearby in terms of their catch and/or their revenues?
C.3b Has the percentage of small sole landings of the total sole landings increased? Can this be explained by increased fishing effort by pulse fishers?

D. Procedural concerns

D.1 Transparency
A lack of transparency is mentioned often and by many stakeholders as a source of frustration and distrust. Stakeholders argue that transparency is lacking in both the process through which

the number of derogations were granted as well as in the process of making knowledge that does and does not exist about the effect of pulse fishing available.

Questions:
D.1a How can transparency be improved for relevant stakeholders?

Belgian researcher: 'I think that one of the biggest problems of this moment is the feeling that it is not happening transparently.'

Danish fisherman: 'I don't think it is a right way to give 80 licenses just on an experimental level. That's more or less what has happened. And it is not a permanent permission to fish with this. But despite of that they have changed a lot of the vessels, maybe 40 or 50 vessels are fishing with the pulse and I don't know how much it costs to convert this, maybe several 100000 euros probably.'

Dutch NGO representative: 'We had the feeling that there is a too one-sided focus on the pulse and that is actually still the case. It remains the fact that it as a temporary status, against which there is a lot of resistance abroad. It is very legitimate that there is resistance. We are not against per definition, because we also see the benefits, also on an ecological level. But before you introduce, and especially when you want a license, there has to be evidence that the fishermen will use it during all times in a good way'.

D.2 Derogations and the size of the experiment
Many stakeholders, fishermen, industry representatives, NGO representatives and scientists, stress several times that they do not understand why 84 licences where needed for an experiment. Many of them state that the process should have been slower or smaller and only increased based on results.

Questions:
D.2a What are possible economic, ecological en social consequences when the time period for the derogations end? (possible research method: scenarios)

D.3 Control
One Belgian scientist argues that not the effects of pulse on fish is the biggest problem of the pulse gear but the management and, moreover, control. Another Belgian scientist adds that he observes that the Belgian control organisation makes little effort to get to know pulse gear and as they do not know how it works, they do not control. A Dutch NGO representative also refers to the lack of knowledge of controllers, stating that they do not know how to read the black boxes that have now been installed on pulse vessels. Danish and English fishermen wonder how the voltage is controlled, they argue that the voltage should be fixed so it cannot be tempered with.

Question:
D.3a How should control agencies adjust to increased fishing with pulse?

The research agenda

This inquiry above of the concerns about pulse fishing has resulted in the formulation of 32 questions. It was examined to what extent the current pulse fisheries research agenda addresses these questions. The original research agenda can be found in Annex 6. It was found that twenty of these questions are to a certain extent already covered by the current research agenda. Some of the stakeholder questions ask for specifications of the research agenda.

Table 4.10 below presents the adapted version of the research agenda. The first two columns on the left display the issue on the research agenda and the proposed research. In the third column the stakeholder questions that match the item on the research agenda are presented. In the fourth column specifications of the research and additions to the research that result from the stakeholder question are proposed. Twelve of the stakeholder questions are not covered by the research agenda. These questions are added in a separate table below, Table 4.11. The questions about round fish and cod more specifically are studied at IMARES at the moment of writing this report. A comparative study on the effects of tickler chains and pulse fishing on the seabed is conducted in the European research project BENTHIS[4]. The remaining questions mainly relate to economic and governance issues. It is thus important to not only approach pulse fishing through biological and ecological research but transdisciplinary.

Table 4.10: research agenda with matching stakeholder concerns

Issue	**Proposed research**	***Matching stakeholder question***	***Specifications, insights and additions from stakeholder concerns***
Ecology			
Claims of damaged or dead fish and additional fish mortality from the industry.	Collect and log the 'anecdotes', discuss them with pulse fishers and others (if possible), try to understand a pattern if possible.	*A.2a Is the pulse an explanation for the observed dead fish along the south east coast of the United Kingdom?* *A.2b Are burns, ulcers, dead fish and broken shrimps a result of pulse?*	*A.2a Possible hint for a pattern. Are many anecdotes about dead fish from the south east coast of the UK?* *A.2b Include anecdotes on shrimps.*
Current research only focusses on limited number of species. More species come into contact with pulse trawl that are not captured. New fisheries with pulse are developing (e.g. nephrops, spisula)	Study effect of pulse on nephrops and on their burrows (since nephrops don't move). Underwater observation (Contacts with Scotia well advanced)		
	Behavioural study on the effects of electricity on nephrops. Contacts with CSIC Barcelona, Spain.		
	Develop monitoring approach for unaccounted mortality (e.g. by sampling on board of non-pulse vessels?)	*A.2f What is the survival rate of fish that escape a net with pulse gear?* *B.3a What is the effect of pulse gear on benthic species?*	*A.2f see suggestion in 1.1: Fish that escape the net should be caught with a – to be invented – technique outside the net and not only be checked on the spine but also on the skin and on contusions.* *B.3a examine benthic species in the trail of a pulse ship.*
	Compare Dutch and Belgian studies in a		

[4] More information on the BENTHIS research project: https://www.wageningenur.nl/en/show/Benthic-Ecosystem-Fisheries-Impact-Study-BENTHIS.htm

Issue	Proposed research	*Matching stakeholder question*	*Specifications, insights and additions from stakeholder concerns*
	repeated experiment.		
Sole and dab have blisters that are allegedly due to pulse fishing	Test in laboratory conditions on farmed sole and dab taken from North Sea. After testing observe for 3 months.	*A.2c Are ulcers on dab and sole the result of pulse or of frost?*	*A.2c Test the effect of frost on dab and sole.*
Thresholds of short and long-term effects of pulse characteristics are not known. Pulse used in flatfish gears may be too strong	Fundamental research on various species under pulse stimulation with varying pulse characteristics.	*A.2d Why are the catches lower when the electricity is set higher?* *B.3b Does frequent exposure to electricity have the result that species do not return to the same areas in the same numbers?*	*A.2d Find explanation for optimum voltage in pulse gear.* *B.3b examine if sole moves to different areas after (frequent) exposure to pulse.*
Effect on electroreceptor organs of elasmobranchs fish is not known. Stocks of these fish are in decline, and special conservation measures might be required.	Study elasmobranch prey detecting capabilities after exposure. Include rays.	*B.2e To what extent does thornback ray survive a haul by pulse gear?* *B.2d What is the effect of pulse on the electroreceptors of elasmobranches?* *B.2c How does increased fishing effort in thornback ray spawning areas and in sole spawning areas affect these species?*	*B.2e Test survival of rays after having been caught in a net with pulse gear.* *B.2c Include in the research the effects on spawning areas of rays.*
Long-term effects on populations (including mortality over longer time, reproduction, juvenile stadia and growth).	Studies on target and non-target biota in contact with gears: indirect mortality, growth, reproduction, of adult and juvenile stadia on longer term.	*A.2a What is the effect of the (frequent) exposure to pulse on fish, shrimps and the spawning stock of shrimps?* *A.3a Does pulse affect the immune system of shrimps and fish?* *B.3d What is the long term effect of pulse on growth and reproduction?* *B.2f Has displacement of fisheries led to less resting areas for sole? If yes, what is the effect on sole?*	*A.2a Include shrimps and the spawning stock of shrimps in the study.* *A.3a Take the immune system of shrimps and fish into account in the study.* *B.2f examine whether fish stocks need 'resting areas', if yes, what is the effect if they disappear.*
Effect on substrate (habitats) and chemical composition in water column from electrolysis.	Research into effect on sediments of electric pulses. Research into dissolution of chlorine compounds by electric pulses.	*B.3c What is the effect of pulse on chemical reactions in the seabed?*	
Technology			
Technology progresses beyond the current status. Pulse trawling will be developed for other gears than beam trawls, e.g. twin-	Monitor pulse technology development beyond the current status and the beam trawl applications.		

Issue	**Proposed research**	***Matching stakeholder question***	***Specifications, insights and additions from stakeholder concerns***
trawls, dredges,...			
Monitoring of spatial deployment of pulse gears	Monitor spatial deployment of pulse gears	*B.2a To what extent has displacement of the Dutch fishing fleet taken place since the increase of pulse trawlers?*	
Economy			
Economy of pulse trawling applications, and socio-economic aspects are not all known.	Monitor economic performance of more vessels (BENTHIS).	*C.1a How can the changed competition in fisheries since the introduction of the pulse be better understood? (taking into account Dutch and foreign fisheries and different aspects of competition, such as the access to the pulse gear and the impact of the displacement of the pulse fleet on other fisheries and informal management measures)* *D.2a to what extent is pulse fishing more efficient than tickler chains? (taking into account the variety of pulse gears)*	*C.1a analyse consequences of displacement and perceptions of non-pulse fishermen.* *C.2a compare economic performance to tickler chain fisheries.*
Governance			
Resistance to allow pulse trawling within other European member states (BE, DE, FR, UK). Problem perceived as a Dutch problem only.	Stakeholder analysis, interviews. Research on political aspects.		
Control and enforcement needs to be assured.	Do pilot study with newly suggested regulations and performance monitoring technology with inspection agencies.	*C.2b which management measures are required to cope with a possibly increased catch efficiency.* *D.3a How should control agencies adjust to increased fishing with pulse?*	*C.2b inquire whether increased catch efficiency forms a problem to the stocks and develop measures to cope with this.* *D.3a explore the effectiveness of possible control methods.*
Decision framework and models are not fully developed.	Extend ecosystem research and models.		
Most reports only in grey literature.	Finalize (x) papers in progress.		
Insufficient visibility of international research	Expand scope and outreach of SGELECTRA (an ICES working group studying electric trawling)		

Table 4.11: Additional research questions

Issue	**Proposed research**	***Matching stakeholder question***	***Specifications, insights and additions from stakeholder concerns***
Ecology			
Effect seabed		*B.1a To what extent is pulse trawl less disturbing for the seabed than tickler chains?*	*B.1a analyse effect of pulse trawl and tickler chains on seabed.*
Cod		*A.1a What is the effect of pulse on round fish, more specifically on the cod's spine and skin?* *A.1b Which percentage of round fish/cod is affected by pulse?* *A.1c Does the effect (on cod) differ when the distance between the electrode is varied?* *A.1d Are the spinal injuries attributed to the differential current?* *A.1e Does the morphology of the fish explain why the effect of pulse on cod?*	*A.1a/1.1b study effect pulse on cod* *A.1c/1.1d study the effect of pulse with varied current and varied distance between electrodes.* *A.1e study effect morphology of the fish on effect of pulse (on cod).*
Technology			
Discards		*C.2b To what extent does pulse gear produce less discards than other gears and how can discards be reduced? Looking at discards in relative (as a percentage of the catch) and absolute terms.*	*C.2b examine possible reduction of discards in comparison to other fishing gears and collect 'best practices' of discard reduction.*
Economy			
Displacement		*B.2b How does displacement of the Dutch fishing fleet affect fishermen in coastal areas in the Netherlands and the UK?*	*B.2b i.e. compare economic revenue data of British and Dutch fishermen before and after introduction of pulse fishing.*
Small sole landings		*C.3b Has the percentage of small sole landings of the total sole landings increased? Can this be explained by increased fishing effort by pulse fishers?*	*C.3b examine from landing data if landings of small sole have increased. If yes, examine which factors contribute to this.*
Effect on other gears		*C.3a What is the effect of pulse fishing on fishermen with other gears fishing nearby in terms of their catch and their revenues?*	*C.3a socio-economic study on perceptions and economic results of non-pulse fishermen fishing nearby pulse fishers.*
Governance			

Issue	**Proposed research**	***Matching stakeholder question***	***Specifications, insights and additions from stakeholder concerns***
Transparency		*D.1a 4.1a How can transparency be improved with relevant stakeholders?*	*D.1a Develop effective communication strategy to inform relevant stakeholders.*
End of derogation period		*D.2a What are possible economic, ecological en social consequences when the time period for the derogations end? (possible research method: scenarios)*	*D.2a Make possible scenarios when derogation period ends involving economic, ecological and social data.*

5. Conclusion and discussion

This research project discussed the perceptions of the relevant European stakeholders on pulse fishing in the North Sea and what their issues and concerns are. It was examined to what extent these are addressed in the knowledge agenda. Data were collected through an analysis of media items, through interviews with relevant stakeholders and through observing national and international meetings about or related to pulse fishing.

The relevant stakeholders in the pulse fishing debate, from various sectors, were found through the media analysis, snowball sampling and by observing meetings. Policy officers and politicians, researchers, fishing industry representatives and NGOs make statements in the media and engage in the discussion in the media. While some stakeholders do recognize the fact that less fuel is needed for pulse fishing than for beam trawl fishing, many concerns are expressed with regards to effects to commercial fish stocks, the ecosystem and to other fisheries. Also the Dutch industry is divided. Although a large part has made the transition to pulse fishing, others remain concerned about its consequences and also about unfair competition.

The stakeholder concerns were formulated into research questions and assessed to what extent these were covered by the research agenda on pulse fishing. This resulted in the finding that twenty of the 32 questions are either covered by the research agenda or can serve as a specification of the research agenda (see table 4.10). Of the remaining questions some are addressed in other research projects. Most questions that are not covered yet concern questions relating to the economy and governance issues (see table 4.11). It is thus important to not only approach the knowledge gaps with biological and ecological research, but in a transdisciplinary way, acknowledging also the underlying governance dilemma's and economic impact.

An important finding is that not only concerns have been found with regards to the lack of knowledge but also worries and discontent about the process through which the Dutch government obtained the increasing number of derogations and about the transparency of this process.

Haasnoot (2015) sets forth how the 'technology push' in the Dutch transition from a beam trawl fleet, to largely a pulse fleet, accounts for the worries and the discontent. In the transition all the attention of Dutch policymakers and the sector was focussed on the technological innovation of the pulse gear whilst no vision was developed on how this gear was going to be used and how it would be perceived. However, technology and society are interrelated and should be dealt with by policymakers as a socio-technical system. The introduction of new fishing gear impacts the fisheries management that is in place and management can influence how the gear is used. New fishing gears have in the past contributed to overexploitation but increasingly the development of new fishing gear is conservation oriented (Kennelly & Broadhurst, 2002). In other words, the effects of the introduction of new gears can have a diversity of outcomes, depending on how it is used. Thus, besides focussing on technological innovation policymakers and managers should also take into account the social practices, social relationships and social organization that are impacted by the technological change. 'This is of importance because social groups, ranging from engineers to manufacturers to users, political decisions, institutions, cultural preferences, and user behaviour etcetera have an influence on the conception, production, diffusion and use of technologies' (Haasnoot, 2015: 86).

Respondents in the interviews and stakeholders during meetings suggest various ways in which the transparency of the process could be improved: Danish and British fishermen recommend that footage should be shared from hauls with pulse gear. These fishermen had been invited on board of pulse vessels and they recommend to invite more fishermen on demonstration trips to see with their own eyes how

pulse fishing functions. A Belgian scientist argues that Europe should be more strict in monitoring the pulse derogations and provide more clarity about what can and what cannot be done. Dutch fishermen, a Dutch NGO representative and a Belgian scientist state that the Dutch ministry should communicate more about pulse and that they should answer to queries. Both a French Industry representative and a Dutch NGO representative argue that the NSAC should have been consulted about the high number of derogations in an earlier stage. British fishermen and a German industry representative voice the opinion that not only Dutch scientists should work on pulse gear but also scientists from other countries.

In addition, as is already suggested in the research agenda, it is important to publish research results not only in grey literature, as has been done in the past, but also in peer reviewed journals in order to increase the control and the credibility of the knowledge that is produced.

6. Recommendations

Based on this research we would like to give a number of recommendations. First, it has become clear that a topic as 'the impact of an innovative fishing gear' requires a transdisciplinary approach. Knowledge is needed from social science (including governance), economy, biology and ecology and in addition stakeholder knowledge needs to be incorporated as well. Secondly it is important to be transparent about the transition process and thereby to avoid a technological push. Much of the feedback of the stakeholders was not so much related to research *per se* but to the process undertaken by the Dutch government. But the transparency demand also holds true for the research, it is important that research reports can easily be found and are written in English. Thirdly the proposed knowledge agenda is quite extensive and it should be foreseen that it is not possible to undertake all the research. In that case choices need to be made as to which research will be undertaken first within the available budget. It is important that these choices are actively communicated and explained to the wider audience of stakeholders. It is considered good practice that by doing so priorities for research as expressed by stakeholders in multi-stakeholder settings (such as at the NSAC) are considered.

7. Acknowledgements

We would like to thank our colleagues Anneke Paaijmans and Sarah Smith for their work in this project, as well as our intern Tim Haasnoot.

8. Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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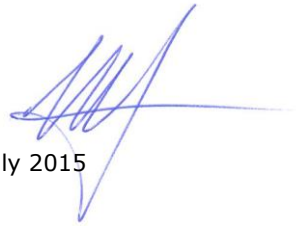
Justification

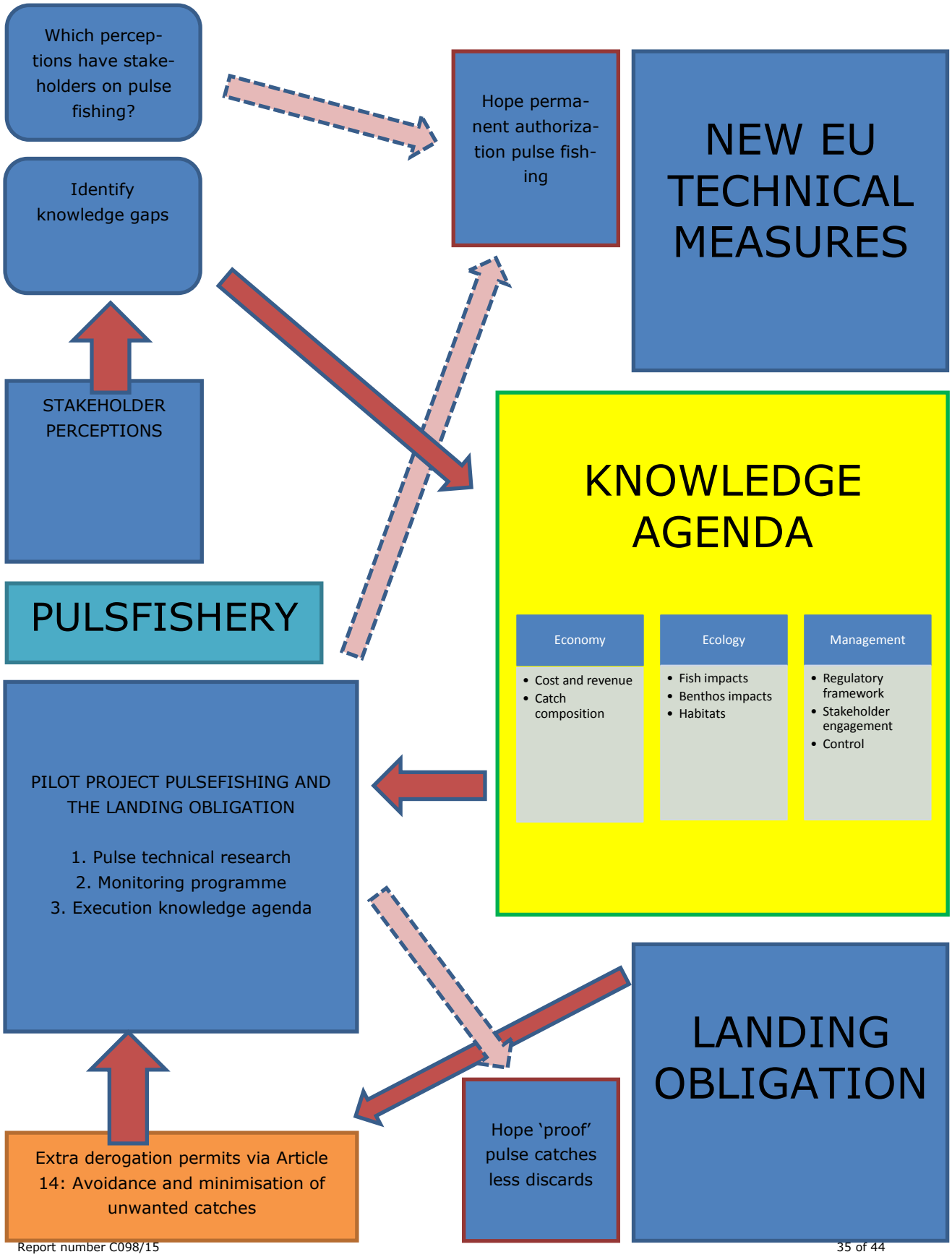
Rapport C098/15
Project number: 4308101079

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of IMARES.

Approved:	Luc van Hoof Senior researcher fisheries
Signature:	
Date:	8 July 2015

Approved:	Dr. ir. N.A. Steins Department Head fisheries
Signature:	
Date:	8 July 2015

Annex 1. Overview of pulse fishing dossier



Annex 2. Search terms for media messages on internet

Table 5.1: Search terms for media messages in Europe per country

Country	Search terms
Belgium	Google.be: pulsvisserij; pulsvisserij Belgie; pulsvisserij België platvis; pulsvisserij België media; pulsvisserij België politiek; pulsvisserij België garnaal
	Media messages were received from colleague scientists
Denmark	Google.dk: elektrisk bomtrawl; elektrisk bomtrawl fladfisk; eletrisk bom trawl fladfisk
France	Google.fr: Une pêche "électrique" dans le sud de la mer du Nord; Pêche électrique
	Media messages were received from colleague scientists
Germany	Google.de: elektro baumkurre; elektrofisherei; elektro baumkurre krabben; elektro baumkurre plattfisch; elektro baumkurre plattfisch fischerei; elektro baumkurre politik; elektro baumkurre medien
	Media messages were received from colleague scientists
United Kingdom	Google.co.uk: pulse trawl; pulse trawl flatfish; pulse trawl shrimp; pulse trawl politics; pulse trawl media
	Media messages received from Dutch fishers

Annex 3. Interview protocol

- Explain the reason for this interview.
    - **Context** (in orange box below)
    - Reason **why** we want to talk **to him / her** (SH are not random found, but are somehow selected; makes sense to refer to this; also to use this in the first part of the interview)

- How it will be used:
    - **Anonymity** (will be referred to as 'fisher representative from the UK' for instance. However some people will be 'known' in a smaller group – out of the context; for instance AC people.
    - Respondents are questioned about their ***personal*** **perceptions** / ideas / questions / knowledge – although we are aware that people will also reason from out of their 'occupation' – at least we are not looking for 'official statements' of their organisations but their thoughts.
    - Interview will be **recorded** (if permission), will be worked out and **sent back** for comments / additions.
    - Based on these interviews, media & literature analysis we will write a **report** (in English)
    - You can at any time **withdraw** from the research.

Context

Pulse fishing is still a relative new technique used in North Sea fisheries, predominantly by Dutch fishers. The pulse is operated under a derogation, as electric fishing is prohibited under EU law. The Dutch ministry has successfully requested an increase of pulse licences (in relation to the landing obligation) and seeks – on the long term - permission from the EU to lift the prohibition. In the meantime IMARES and ILVO have been requested to develop an extensive research program by the Dutch and Belgian fishing sectors & ministries to structure ongoing and new research on pulse fisheries.

IMARES has been asked by the Dutch Ministry of Economic Affairs (of which Fisheries is part) to conduct a research into stakeholder views on the pulse. We will talk to fishermen, policy officers, NGO's and scientists from all North Sea countries about pulse fishing. **The aim of the research is to understand what the perception is of various stakeholder groups around the North sea of pulse fishing, and to see where these perspectives are aligned and / or differ with the current pulse research program that has been set up.**

Date:
Name interviewer:

Background questions

- Name interviewee:
- Stakeholder group (encircle what the answer is):
  NGO / Policy / Fishing / Science
- Profession:
- Training / Education:
- Country (encircle what the answer is):
  The Netherlands / Belgium / France / Denmark / Germany / UK

Main questions [please use this as a topic list, no need to have a certain order]

1. What do you know about pulse-fishing[5]?

    a. In what way are you related to pulse-fishing?

2. What do you think of pulse-fishing; as a fishing gear / technique?

    [*positive points / negative points / effects / reason for it that it is used / what do we know / do we know enough / knowledge gaps*[6]]

3. What do you think of the fact that the Dutch are using the pulse for fishing & how it has been introduced / implemented?

    [*think about political process, licenses, getting more licences, knowledge base etc.*]

4. A number of research projects (ecological/economic) around pulse fishing have been carried out. Are you aware of these?

    a. What do you think of these studies?

    b. Do you think more research is needed?
        i. If so, elaborate... (which topics, issues should be addressed)?
        ii. If not, elaborate...?

5. How do you perceive the governance of pulse fishing?

    a. What do you think of the current regulation of the pulse – need for more / other rules?

    b. How do you see / value your role *vis à vis* the pulse fishing in the governance of fishing?

6. Anything else you would like to add or ask us?

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5 When talking about pulse-fishing, we will only talk about sole-directed pulse fishing at the North Sea (Ices Area IVc)

6 If you make suggestions, please make sure to not ask leading questions.

Annex 4. Code list used in Atlas.ti

Table 5.2: overview of the codes used to analyze the transcripts

Code	Explanation
1. Context	When appointed in what context they were interviewed
2. Role	If one describes what his/her role is (part of the background information)
3. Relation towards pulse fishing	Answer to question 1a where is told how they are involved in het pulse fishing material
4. Value judgement	What do they think on pulse fishing ('normative' – good or bad, neutral)
4.1 Positive	If one names something positive about (effect of) pulse - if one makes a list of all terms of points, code every loose item separately
4.2 Negative	If one names something negative about (effect of) pulse - if one makes a list of all terms of points, code every loose item separately
5. Effect	If one appoint an effect; effect of pulse on ecosystem (impact=synonym)
5.1 Ulcers	When someone refers to ulcers on fish as a consequence of pulse fishing.
5.2 Bycatch	Bycatch = desirable bycatch, taken besides the target specie (for market)
5.3 Discards	Discards = unwanted catches, part that one throws overboard
5.4 Benthos as discards	When someone refers to benthos as discards in the catch
5.5 Seabed disturbance	Seabed disturbance as a consequence of pulse fishing
5.6 Benthos	All animals living in and on top of the seafloor
5.7 Cod	When someone refers to the effects of the pulse on cod
5.8 Electroreceptors	Related to sharks and rays
5.9 ETP species	Related to sharks and rays
5.10 Meshsize	When someone comments on the mesh size that pulse fishers use
5.11 Competition	When someone refers to the new competition that is established with pulse fishing
5.12 Reduction catches own fishery	When someone refers to a reduction of one's own catches as a result of other fishers fishing with pulse
5.13 Cost savings	When someone refers to the reduced costs that pulse fishing brings
5.14 Fuel reduction	When someone refers to the reduced fuel need in pulse fishing compared to the beam trawl
5.15 Efficiency	When someone refers to the increased catch efficiency of the pulse
5.16 Overexploitation	When someone refers to overexploitation as a (possible) consequence of pulse fishing
5.17 Dead fish	When someone refers to dead fish as a consequence of pulse
5.18 Survival of fish	When someone refers to the survival of fish/shrimps impacted by pulse
6. Catches	If one names something about the catches of the pulse vessels
7. Innovation	If one names something about innovation in relation to pulse
8. Pulse gear	All parts that relate to the pulse as fishing gear
9. Reason of use	If one names something on why one fishes with pulse

Code	Explanation
10. Interests	If one expresses interest in the pulse
11. Knowledge	Everything one says about knowledge / information / what-we do not know
11.1 Known knowledge	If one says something specific about what we know from research (not as one "general" says something about the effects / catch was only when one really named that we know from science)
11.2 Shortage of knowledge	If one specifically says something about what we do not know from research / no research has been done
12. Research agenda	If one says something about the research agenda (specific)
13. Research	If one says something about the research done / should be done
13.1 Ecology	If one says something about the ecology
13.2 Economy	If one says something about the economy
13.3 Social	If one says something about social implications / causes
13.4 Governance	If one says something about management
14. Process	All parts in the interviews that related to the process
15. Licenses/derogations	If one says something about licenses/derogations /permits
16. Politics	If one refers to the role of politics / political game
17. Regulations	If one says anything about regulations (licenses fall under there)
18. Control	If one says anything about control and enforcement
19. Participation	If one says something about the role of stakeholders in fisheries governance (relate to question 5b)
20. Transparency	If one says something about transparency of the process
21. Interaction with other gears	If one says something about interacting with other gears (in relation to pulse)

Annex 5. Interviews/meetings that took place

Table 5.3: list of respondents (interviews in individual or group interviews with max. 3 participants)

Country	Role	Number of respondents
Belgium	Scientists	3
Denmark	Fisheries	3
Germany	Fisheries	1
United Kingdom	Fisheries	3
United Kingdom	NGO	1
Total		**18**

Table 5.4: meetings that have been observed

Country	Date	Type of meeting
Netherlands	May 2014	Meeting with Dutch shrimp fishers on pulse fishing
Netherlands	11-7-2014	Meeting with pulse fishers (from southwest Netherlands) and scientists on pulse knowledge
Europe	8-7-2014	NSAC (North Sea Advice Committee; fisheries sector en NGO's around the North Sea were represented) meeting of the demersal working group where the pulse was discussed
Europe	17-11-2014	NSAC meeting with the pulse focus group (with fisheries representatives and NGO's around the North Sea) where the state of knowledge and research agenda were presented and discussed
Europe	11-10-2014	BENTHIS (EU project studies the impacts of fishing on benthic ecosystems including pulse) stakeholder meeting with Dutch and Belgium stakeholders on the results of the first field studies
Italy	3&4-7-2014	GAP-2 (EU exchange project related to fisheries) visit from Italian fishers to the Netherlands were the pulse technique was shown
United Kingdom	5-11-2014	On request, a Dutch scientist presented the state of knowledge on pulse fishing to the Common Language Group in London

Annex 6. Original research agenda

Table 5.5: Original research agenda

Issue	Need expressed	Existing knowledge	Knowledge gaps	Proposed research	Cost	Priority
Ecology						
Claims of damaged or dead fish and additional fish mortality from the industry.	Stakeholder analysis	Very little active monitoring of stakeholder claims	Claims are being presented of adverse effects due to pulse trawling without real evidence.	Collect and log the 'anecdotes', discuss them with pulse fishers and others (if possible), try to understand a pattern if possible.	BO project puls	1
Current research only focusses on limited number of species. More species come into contact with pulse trawl that are not captured. New fisheries with pulse are developing (e.g. nephrops, spisula)	STECF	Cat sharks, cod, six benthic species studied. Effect on cod can be prominent, other effects were limited.	Why did Dutch find spinal damage in cod, and Belgians not? Potential impacts on non-researched species	Study effect of pulse on nephrops and on their burrows (since nephrops don't move). Underwater observation (Contacts with Scotia well advanced)		1
				Behavioural study on the effects of electricity on nephrops. Contacts with CSIC Barcelona, Spain.	PhD1	1
				Develop monitoring approach for unaccounted mortality (e.g. by sampling on board of non-pulse vessels?)	Integrate with DCF discard monitoring?	2
				Compare Dutch and Belgian studies in a repeated experiment.		Done
Sole and dab have blisters that are allegedly due to pulse fishing	Popular media	ILVO has done research on occurence of blisters on dab and sole	Can we verify experimentally whether pulse could lead to blisters?	Test in laboratory conditions on farmed sole and dab taken from North Sea. After testing observe for 3 months.	Short study (12 kE)	In progress
Thresholds of short and long-term effects of pulse characteristics are not known. Pulse used in flatfish gears may be too strong	STECF, ICES	Optimal pulse for shrimps and sole developed	Can settings be reduced to decrease effects?	Fundamental research on various species under pulse stimulation with varying pulse characteristics.	PhD1	1
Effect on electro-receptor organs of elasmobranchs fish is not known.	ICES	Such organs are very sensitive to electric currents, and may get	Fish may not be able to detect prey after exposure to electric	Study elasmobranch prey detecting capabilities after exposure. Include rays.	PhD1	1

Issue	Need expressed	Existing knowledge	Knowledge gaps	Proposed research	Cost	Priority
Stocks of these fish are in decline, and special conservation measures might be required.		disturbed. Only cat sharks as indicator species studied.	fields of pulse trawls. What about rays?			
Long-term effects on populations (including mortality over longer time, reproduction, juvenile stadia and growth).	ICES/ Soetaert	Only short-term effects studied with limited pulse settings, and limited on direct mortality and larger sizes, only some indicator species.	Long-term effects (including mortality over longer time, reproduction, juvenile stadia and growth) on populations are not known.	Studies on target and non-target biota in contact with gears: indirect mortality, growth, reproduction, of adult and juvenile stadia on longer term.	PhD2 Pulse Monitoring proposal	1
Effect on substrate (habitats) and chemical composition in water column from electrolysis.	Soetaert et al.	Some claims of potential effects were given (e.g. Mike Breen on chlorine production).	Effect on substrate (habitats) and chemical composition in water column not known.	Research into effect on sediments of electric pulses. Research into dissolution of chlorine compounds by electric pulses.	PhD3	2
Technology						
Technology progresses beyond the current status. Pulse trawling will be developed for other gears than beam trawls, e.g. twin-trawls, dredges,...	ICES	DELMECO integrates shrimp and flatfish pulse.	What are the new pulse settings, what are effects?	Monitor pulse technology development beyond the current status and the beam trawl applications.	~ 5 kE	1
Monitoring of spatial deployment of pulse gears	Stakeholder analysis	VMS data available	Do pulse vessels explore different grounds?	Monitor spatial deployment of pulse gears	Pulse monitoring proposal	2
Economy						
Economy of pulse trawling applications, and socio-economic aspects are not all known.	STECF?	Some existing systems are evaluated. This shows economic potential. NL industry invests in the method as the best alternative to tickler chain.	Does this apply to all systems? Can this be extended to new technical developments?	Monitor economic performance of more vessels (BENTHIS).	Covered under BENTHIS project	3
Governance						
Resistance to allow pulse trawling within other European member states (BE, DE, FR, UK). Problem perceived as a Dutch problem	Dutch government	Some EU member states oppose the implementation of pulse trawling on a wider scale.	Perceptions? Interests? Fears? Hidden agendas?	Stakeholder analysis, interviews. Research on political aspects.	BO 2014 (&PhD 4)	1 (In progress)

Issue	Need expressed	Existing knowledge	Knowledge gaps	Proposed research	Cost	Priority
only.						
Control and enforcement needs to be assured.	STECF / ICES	Control and enforcement documents and technology defined.	Practical experience with the suggested rules and technology.	Do pilot study with newly suggested regulations and performance monitoring technology with inspection agencies.	IMARES begeleiding, ~85 K€	1
Decision framework and models are not fully developed.	IMARES	Crude models exist (e.g. Piet et al., 2009) and show potential in reducing discards in five target species.	Effects of new effort allocations, fishermen's response, effects on benthic species, definite ecosystem indicators.	Extend ecosystem research and models.	P.M.	3
Most reports only in grey literature.	ICES, STECF	Several papers in preparation, one published (van Marlen)		Finalize (x) papers in progress.	~15-20 k€	1
Insufficient visibility of international research	IMARES workshop	SGELECTRA platform for research	Need for more comprehensive expert groups on effects of electricity in marine environment	Expand scope and outreach of SGELECTRA	2 extra persons per year to SGELECTRA, ~55 k€ per year	1