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Our Ref: C.24.b/LWC/mo

13 June 2018

Subject: Access request to the technical minutes of the ADGPulse and WCPulse relative to the ICES advisory process answering the Special Request *"Comparison of the ecological and environmental effects of pulse trawls and traditional beam trawls when exploiting the North Sea sole TAC"*

Dear Dr. Colléter,

Thank you for letter to the ICES Secretariat requesting the technical minutes for the advice drafting group ADGPulse and the ACOM Web-Conference WCPulse. Please find both technical minutes included in this response letter.

Best regards,



Lotte Worsøe Clausen
Head of Advisory Support



ICES
CIEM

International Council for
the Exploration of the Sea
Conseil International pour
l'Exploration de la Mer

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Technical minutes of ADGPULSE (16-18 May)

ADGPULSE (advice drafting group on pulse fishing) began to discuss requested advice at 9.00 on May 16 2018 and finished at 1530 on May 18 2018 at ICES headquarters in Copenhagen, Denmark. The meeting was chaired by Mark Tasker (ACOM vice chair) and attended by Eskild Kirkegaard (ACOM chair), Jake C. Rice (RGPULSE), Christopher Zimmermann (Germany), Ole Ritzau Eigaard (Denmark), Adriaan Rijnsdorp (WGELECTRA), Stefán Áki Ragnarsson (WGEKO), Hans Polet* (Belgium), Youen Vermard (France), Didzis Ustups (Latvia) and Lara Salvany (ICES secretariat),
*By video

Christopher Zimmermann pointed a potential conflict of interest since he is a member of the steering committee of the Netherlands' electro-fishing project. The ADG considered there was not an actual conflict of interest.

The ADG noted that the pulse fishing is a very controversial topic with politics, NGOs and industry having opposed views and intentions. However, the scientific basis provided for the elaboration of the advice by WGELECTRA was very solid and a proof of that is the consensus reached by the three independent reviewers within RGPULSE. The ADG stated that will only focus on scientific evidence as the basis for the advice.

The ADG discussed the impact of natural events like storms in the mechanical disturbance of the seabed and noted that there is not enough research-data to consider this factor. Unpublished results point to a higher magnitude of disturbance of seabed by natural events than by trawling. The ADG suggested that WGEKO (or other relevant experts working group) consider translating this topic into terms of reference for future work.

The ADG discussed extensively the issues of size and catch selectivity, cod injuries and mortality, stock status of sole after 3-4 years of pulse fishing and implications for (and meaning of) sustainable exploitation. The results of these discussions were distilled into the advice.

The ADG discussed possible ecological consequences of increased selectivity on sole over plaice with pulse fishing. Less fishing of plaice would increase the stock biomass and potentially reduce food available for other fish stocks in the ecosystem. There was however little evidence one way or the other on this potential effect and therefore it was not included in the advice.

The ADG started a list of further research needs to include in the advice but then decided not to include such a list as a) it had not been asked for, and b) there was no coherent input from WGELECTRA.

The ADG discussed the evolution of the landings by different fishing methods and agreed to add a section in the draft additional information section, along with text on possible future prospects for pulse fishing and some descriptions of the fishing methods (the latter targeted at the lay reader).

The ADG thanked WGEKO, WGELECTRA and RGPULSE for their work and contribution to the advice.

Minutes of ACOM web-conference, 25 May 2018, to finalize advice on ecological and environmental effects of pulse trawling

Agenda

1. Welcome of members
2. Introduction of advice
3. Identification of issues (round-table)
4. Resolution of issues
5. Adjournment

Participants

Country/ other	Participants	Comments sent to ACOM Forum	Advice approval before WebEx
Chair	Mark Tasker		
ACOM Chair	Eskild Kirkegaard		
ACOM Vice-Chair	Ghislain Chouinard		
Belgium	Els Torreele	X (by E. Torreele)	
Canada	<i>No participation</i>	X (by J. Morgan)	X (by J. Morgan)
Denmark	Morten Vinther		
Estonia	<i>No participation</i>		
Finland	<i>No participation</i>		X (by M. Salminen)
France	Pascal Lorange	X (by A. Biseau)	
Germany	Christopher Zimmermann		
Iceland	Steinunn H Olafsdottir		
Ireland	Maurice Clarke	X (by M. Clarke)	
Latvia	<i>No participation</i>		X (by D. Ustups)
Lithuania	<i>No participation</i>		
Netherlands	Nathalie Steins	X (by N. Steins)	
Norway	<i>No participation</i>		X (by H. Gjøsæter)
Poland	<i>No participation</i>		X (by J. Horbowy)
Portugal	Fatima Borges	X (by F. Borges)	
Russia	<i>No participation</i>		
Spain	<i>No participation</i>		X (by F. Velasco)
Sweden	<i>No participation</i>		X (by M. Cardinale)
UK	<i>No participation</i>		
USA	<i>No participation</i>		
EG participation	Adriaan Rijnsdorp (WGELECTRA) Stefan Aki Ragnarsson (WGECHO)		
ICES secretariat	Lara Salvany Michala Ovens		

Advice summary

ICES advises {concludes} that, given the available information, the ecological and environmental effects of using pulse trawls are less than using traditional beam trawls when exploiting the TAC of North Sea sole.

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

ii) The rate of injuries inflicted by mechanical impact on fish during the catch process is likely to be lower in pulse trawls than in traditional beam trawls. Cod suffer a relatively high injury rate when exposed to pulses, but the increase in the overall mortality of the North Sea cod stock caused by these injuries is negligible (as long as catches of cod in the southern North Sea are low). Flatfish (sole, plaice, dab), seabass and small-spotted catshark do not suffer pulse-induced injuries. More knowledge on the impact of pulse fishing on critical life stage (flatfish metamorphosis and early juvenile life, fish gametogenesis and spawning behaviour) is needed.

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

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

v) Incremental effects from repetitive exposure to pulse gear are not likely to occur unknown. [However much more information

is required on the effect on electro-magnetic sensory organs of elasmobranchs in general]
However, most of the uncertainties mentioned/listed in the 2012 ICES advice remain, and the previous conclusion ('ICES considered the available data are insufficient to recommend the large scale use of the electric pulse trawl in fisheries') is still valid.

Netherlands

Comment: "Concludes" rather than "advise"

France

Comment: Add "given the available information"

ACOM LS

Comment: Title too wide

France

i) Comment: Remove use of "sustainable" in Advice Summary
+/- MSY approach

ii) Include 42.5 % abnormality
"negligible" based distribution of cod stock in North Sea
"injuries"

"more knowledge ...is needed"

Portugal, France, Belgium agree
DK, GER, WGECHO chair, ACOM LS prefers "advise" and is consistent with previous advice.

Conclusion: Agreed to use "advise"

France: suggest to add "given the available information"

WGECHO suggest to remove,

Ghislain agrees to remove

Conclusion: not to add "given the available information"

Suggestion: to narrow it to requirement of request

FRA: wait until end of WC to redesign the title

Conclusion:

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

Agreed

Conclusion: Rejected comment by FRA

GER suggests add "presently negligible"

Suggestion to delete because not asked by the client

Conclusion: deletion

<p>Suggestion to add “mechanical”</p> <p>iv) expected,...However, need to be completed</p> <p>v) likelihood of repetition occurring are low so effects are low</p> <p>Last paragraph added by FRA</p>	<p>Conclusion: agreed</p> <p>Suggestion: include “<i>However, data needs to be completed</i>”</p> <p>Conclusion: taken out</p> <p>FRA suggest to explain better</p> <p>BEL: issues with unknown- suggests to change by low</p> <p>NL: maybe elaborate more to explain</p> <p>ICE: probability of repetitive exposure explainer</p> <p>ECO to end sentence right after.</p> <p>Conclusion: reduce sentence</p> <p>ICE: agrees with more precautionary touch</p> <p>ACOM LS: different question, 2016 advice was already different than 2012 advice.</p> <p>Considers irrelevant</p> <p>ACOM chair: agrees with ACOM LS. Not discussed in ADG so no basis to repeat</p> <p>DK: Out but some concluding sentence would be a good addition.</p> <p>The group agrees</p> <p>NL: remind the scope (not ecosystem impact assessment) of the request as final sentence</p> <p>ACOM LS: that’s implicit in the advice summary</p> <p>ACOM chair agrees with NL. Scientific basis for the advice is very solid for <u>comparison</u> and should not invent uncertainties.</p> <p>ICE: advice is too optimistic so narrowing of the scope could help.</p> <p>Conclusion: Reword and acknowledge information gaps.</p>
<p>Elaboration of the advice</p>	
<p>i Sustainable exploitation of the target species (species and size selectivity)</p> <p>ICES advises [concludes] that there is no difference in the feasibility of sustainable exploitation (maintaining $F \leq F_{msy}$) of the fishable biomass of the major stocks of flatfish when fishing using either traditional beam trawls or pulse trawls. Based on experience Over the past 6 years, the of exploitation by [an increasing number of] pulse and [a decreasing number of] traditional beam trawls does not prevent the, indicators of sustainability (Fishing Mortality, Stock</p>	

Biomass) have continued from continuing to improve, mostly due to an overall decrease in fishing effort. The catch is constrained by TACs and this has not changed with the introduction of pulse trawls. Differences in catch efficiency should not impact the total amount of fish removed as soon as the TAC is not overshoot. There is no evidence of additional mortality in the younger stages of flatfish caused by exposure to electrical pulses. One study that found fewer under-sized fish caught by the pulse trawl compared with traditional beam trawl could not be replicated.

Discard rates and species composition at present differs between gears, with lower discards of flatfish in pulse trawls, but both should change with the full introduction of the landing obligation in EU waters. ICES considers that pulse trawls could contribute [to] a technical solution to some problems emerging during the implementation of the landing obligation, as the catchability of sole is higher in this gear (the more valuable but rarer species) and that of plaice is lower (the less valuable but more abundant species). No catchability information is available for other flatfish species caught in either gear (turbot, brill), however [and] these stocks are currently considered to be harvested sustainably ($SSB > MSY$ trigger, $F < F_{msy}$).

“in the feasibility”

FRA

And add (maintaining ($F < F_{msy}$))

i) Paragraph too optimistic

Over the past 6 years...

Agreed to add maintaining $F < F_{msy}$

Conclusion: added

FRA no knowledge on some life stages and cannot be stated there is no evidence. WGELECTRA: agrees there is no data on metamorphosis of some sps.

Suggest to: density dependent process later in life doesn't scale up to population levels and any effect will be negligible.

WGECO suggest to delete

FRA either delete or use RGPULSE part

Conclusion: deleted

Add that both gears have been used ...

<p>“with lower discards of flatfish...”</p> <p>ii Target and non-target species that are exposed to the gear but are not retained (injuries and mortality)</p> <p>ICES infers that the rate of the injuries inflicted by mechanical impact during the catch process is likely to be lower in pulse trawls than in traditional beam trawls. Both gears expose organisms to mechanical impacts. There is no comparative information on the fate of organisms passing through the nets from traditional beam trawls or from pulse trawls. Pulse trawls are towed at a lower speed than traditional beam trawls and in addition there are no tickler chains in pulse trawl gear, so injuries due to collision with the gear are likely to be less frequent and less severe. The codends are identical between the two gears. Impacts on benthic communities are advised in section iv) below.</p> <p>Pulse trawls differ from traditional beam trawls in the exposure of organisms to electrical pulses. There is considerable variation in the ability of organisms to detect electrical stimulation and also in their responses to stimulation. There is insufficient information available on the detection threshold of organisms or on adverse response thresholds to be able to quantitatively assess the potential effect of electrical exposure at the population level.</p> <p>There is evidence that the exposure to pulses can result in spinal fractures and haemorrhages in cod and whiting, but not in flatfish (sole, plaice, dab), seabass and small-spotted catshark. Most injuries occurred in sizes of fish that would be retained by the gear and would be killed anyway. Of those that escape from the gear, it can be inferred that the injury rate would be substantially less than the overall average for cod examined (42%). [Moreover] the proportion</p>	<p>Improved stock status and fishing mortality for target stocks</p> <p>Total flatfish as catch rate (presented at WGELECTRA)</p> <p>Discard rate vs catch rate</p> <p>BEL: let’s not rewrite the whole advice</p> <p>Suggested: to postpone release and redo ADG but time limitations</p> <p>Conclusion: rewording of some of the paragraph but keep the main flow.</p> <p>Canada do not like “Infers”</p> <p>NL: think its ok; Conclusion: kept in</p>
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of cod caught in the pulse fishery is less than 1% of the overall catch of cod in the North Sea.

There is no information available on effects on early life history stages of any species after exposure to the sole pulse. However on ecological grounds, it is unlikely that any effects would have population level effects.

There is some evidence showing that the ability of small-spotted catshark to detect prey using their electro sensitive sensory system was not significantly affected after being exposed to a sole pulse stimulus, and feeding or reproductive behaviours were not altered in longer-term experiments.

No studies have been conducted to investigate the possible adverse effects of sub-lethal exposure on the maturation process, the quality of gametes and spawning behaviour of any fish species.

“Moreover, the proportion of cod...”

“However, on ecological grounds”

ACOM LS and chair: there is a major proposed change in the substance of the draft at this WC: Comments from FRA leads to major changes from draft at the ADG that spent a huge amount of time and effort ensuring consistence and integrity

“however, because there is a shift of trawling...”

FRANCE: **Caution:** this is not due to the pulse trawl and this low percentage cannot be taken as an evidence of the harmlessness of the pulse relative to cod. It is simply the result of the spatial distribution of cod (less present in the South of the North Sea...).

Even if this is a true statement it should be deleted since confusing or the whole story should be told

FRANCE: This comes from nowhere and is very speculative. Should be deleted.

FRANCE: Why this particular species? Most abundant electro-sensitive sp in the area, or the only species studied? If 2nd option, lack of info on other species should be mentioned

FRANCE: This is a very specific case and a very weak statement. I would suggest to delete. This result is based on only one observation. Need to be consolidated.

PORTUGAL: Electric pulse as normally used in sole

FRANCE: This is quite (!) important and should prevent us to be enthusiasts. This crucial point urgently needs evaluation, before concluding that effects on population levels are unlikely!

FRANCE: caution saying its harmless to cod

NETHERLANDS: delete moreover and state proportion of cod...

FRANCE: suggests to delete

DENMARK: agrees

WGELECTRA: central part of the reasoning. Density dependent instead of ecological

GERMANY: not redoing this, ADG was high quality and effort.

BELGIUM: political twist to be avoided

Suggested to postpone and repeat ADG

Conclusion: Agreed to carry on and focus on scientific comments only.

IRELAND: is confusing

Chair suggest some changes

Agreed

<p>“missing references”</p> <p>“the reduction”</p> <p>“an effect of electrical..”</p> <p>(v Assessment of the impact of repetitive exposure to the two gear types on marine organisms</p> <p>ICES advises [concludes] that incremental effects from repetitive exposure to pulse gear are not likely as little sensitivity has been found for any organism to electrical stimulation. The probability of repetitive disturbance is also low. Within the most intensively trawled ICES rectangles, the proportions of areas covering the same surface area as the gear may only be subject to repetitive trawling at intervals of less than one week are estimated at 0.3% (pulse) - 0.8% (beam trawl).</p>	<p>Comment by NETHERLANDS Chair responds there are no references in advice</p> <p>Comment: PORTUGAL: suggests to delete Suggestion: Chair explains and WGELECTRA supports Conclusion: Agreed to keep</p> <p>IRELAND: suggest to take out Concl: agreed to take out</p> <p>Comment: FRANCE suggest to change whole paragraph Conclusion: Change the last sentence FRANCE: This statement is not sound: We should distinguish juvenile/adult fish from near ripe or ripe broodstock (which supposes fishing during the reproductive period of target species). FRANCE: This is not clear at all... FRANCE: Even though these percentages appear to be very low, if all the sole are located in those areas, we cannot say that the (potential) impact will be low. All this section should have only one sentence saying : 'we do not know' We should not say so since this is not part of the question. What could be the effect on a maturing sole female (of sperming male), particularly in terms of eggs/sperm fertility and larvae viability? This aspect has never been taken into account so far.</p>
<p>Basis of the advice</p>	
<p>i Sustainable exploitation of the target species (species and size selectivity) – background information</p> <p>ICES considers the trawl fisheries targeting flatfish in the southern North Sea to be mixed fisheries. Catches of the defined primary target species, sole, cannot be taken without a significant bycatch of other species, namely plaice, but also brill, turbot, flounder and dab. For both beam and pulse trawl gears, the largest fraction of the catch (in terms of individuals and weight) consists of plaice. Flatfish stocks caught with these gears were assessed as harvested sustainably</p>	

($F \leq F_{MSY}$) when ICES last (2017) assessed each stock. A substantial fraction of the catch of these fisheries is discarded, but this should change with the introduction [implementation] of the EU landing obligation by January 2019. The extent of the change will depend upon the degree of compliance with the landing obligation or if there are exemptions from the landing obligation e.g. due to high survival of discarded fish.

The transition from traditional beam trawls to pulse trawls in the North Sea mixed flatfish fishery has considerably changed the species composition in the catch of the fishery. The amount of fish landed per hour of fishing (landings efficiency) for sole has increased by about 30%. Combined with the increase in sole discards per hour, this would imply a comparable increase in catch per hour of fishing (catch efficiency in numbers). The landings efficiency, in numbers, for plaice has decreased by about 40%. The difference in species selectivity between the two gears is attributed to differences in the cramp response between fish species. The pulse stimulus causes a cramp response that immobilises the fish, but sole will bend in a U-shape which makes sole also more accessible to the gear, whereas plaice lie flat and may be less accessible.

The higher catch efficiency of the pulse trawl for sole implies that the sole quota can be caught in less fishing time than with the traditional beam trawl. Considering only the pulse licence holders, their fishing effort (fishing hours) targeting sole decreased by 9% between 2009 and 2017, while their share of the Dutch quota increased by 27%. As the catch efficiency for other species is lower, the pulse trawl fishery can be classified as targeting sole alone. When targeting other demersal species these vessels are using other trawls. The reduced catch efficiency for plaice has potential implications for the level and geographical distribution of effort in plaice fisheries.

The analysis of the distribution patterns of the traditional beam trawl and the pulse trawl revealed that pulse trawl fishing has increased locally in some areas, such as off the Thames estuary and near to the the Belgian and the North of France coasts. The change in spatial distribution is related to the lighter weight of the pulse trawl which can be used on softer grounds than the traditional beam trawl. This

($F \leq F_{MSY}$): added

IRELAND: Recommends to remove

FRANCE: I am a bit surprised here that we talk about numbers instead of kg as we usually do when we refer to CPUE. In van Marlen et al, 2014, it is said that 'the catch rate per hour

(in kg/hour) in the pulse trawl was reduced by 21% and 28% for marketable size sole

and plaice. This is possibly not in contradiction with what is written here, but it gives a somewhat different message.

Van Marlen et al also show that the LPUE (kg/hectare) is slightly higher for sole in the pulse trawl.

PORTUGAL: Difficult to understand. It seems pulse increases discards and does not.

FRANCE: Caution: if the higher efficiency is only in terms of numbers, we cannot say that!

FRANCE: This is far too much! even though the sole proportion is higher than in the traditional beam, are we sure that sole is now the majority of the catch. Looking at van Marlen et al, the ratio plaice/sole is 2.07 for the pulse, while it was 2.26 for the traditional beam trawl. This conclusion should be deleted.

change in distribution of fishing effort may be changing the relative pressure on local components of the sole stock but there is insufficient information available on stock structure to enable analysis of the potential effect of these changes.

The change in distribution, and the subsequent increase in fishing intensity in areas where vessels holding pulse licences were not fishing has changed the areal fishing pattern of North Sea sole fisheries which may impact other fisheries that traditionally fished in these areas.

ICES notes that pulse trawls use 46% less fuel than traditional beam trawls per hour of fishing.

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

The comparison of the two fishing gears is done separately for exposure to mechanical disturbance and for exposure to electrical pulses. The area exposed to electrical pulses will be slightly larger because the electric field extends beyond the width of the gear. However the electric field strength decays exponentially and drops to just 1% of the strength at the electrode in about two metres.

Mechanical injury can be caused by fish encountering gear components such as the tickler chains, the codend and the warps. Because the pulse gear is towed at a lower speed and has no tickler chains, it is **inferred that mechanical injuries** are **less likely** to occur and are less serious with pulse trawls than traditional beam trawls. The cleaner catch (e.g. fewer stones, sand and other material) in pulse trawl codends further **suggests that fewer fish may be mechanically injured** in the catch process. All these factors support the conclusion that mechanical injuries **per unit of sole caught** are less common and less serious with pulse trawls than with traditional beam trawls.

Experiments and field observations have documented pulse induced injuries in cod and whiting. Some of these injuries are sufficiently severe to cause death. These injuries are only observed at pulse intensities that would only occur within the trawl track. Based on limited sampling and studies, the likelihood of spinal fractures, and spinal abnormalities in cod shows a dome-shaped relationship with body size **[i.e. lower injury rates with small and large sized individuals,**

IRELAND: Is this changing the fishing footprint into hitherto lightly fished habitats? Presumably pulse trawls also abrade the bottom, and if so, this could be a risk to soft bottom habitats?

FRANCE: 'inferred', 'less likely' do not sound as actual scientific evidence!

FRANCE 'suggests', 'may be' ... same comment: do not sound as actual scientific evidence!

FRANCE This is a very unusual way of presenting the result. Why don't we refer to hour fished or area swept instead. Are the results different ???

but higher injury rates with medium sized individuals]. Above 18 cm (the size of 50% retention in the codend used by both gears), injury rates can reach over 40% in intermediate sizes, with some evidence of lower injury rates of larger cod. However cod comprised less than 1% of the total fish catch in these fisheries, and few large cod were observed in the study. For cod smaller than 18 cm, the limited available evidence suggests the injury rate is much lower even with experimental pulses stronger than those used in the fishery.

The actual possible incremental mortality of the pulses, inflicted on individual cod and small enough to pass through the codend without being retained, is consequently inferred to be low, and well below 40%. Any injury or mortality inflicted by electrical pulses on fish of sizes that would be retained by the trawl gear would not be incremental mortality, because these species rarely survive capture by trawls, even if released when the gear is hauled.

There is no information available on the survival of early life history stages of fish after exposure to the sole pulse. Experiments with a pulse with a lower frequency than that used for sole (5Hz) suggest that certain larval stages of cod, but not of sole, show higher mortality when exposed to field strengths occurring in close range of the conductor. No effect was found for egg stages. The population level effects of a possible reduced survivorship of larvae due to pulse exposure is considered to be low, because of the low exposure rate and for healthy stocks there is strong compensatory density-dependent mortality later in their life cycle. The exposure rate could be higher for eggs laid directly in the sediments in the path of the pulse trawls, but few fish in the North Sea are known to lay eggs directly on sandy or muddy substrates. However, flatfish late stage larvae undergoing metamorphosis and juveniles, are close to the bottom.

There is limited experimental or field evidence of impacts of the electrical pulses on fish behaviour. Effects on feeding would be expected to be greatest on species use electro-sensitive foraging strategies, such as elasmobranchs. However, studies on small-spotted catshark have reported that feeding resumed normally after exposure to pulses in a tank experiment, the ability of the species to

FRANCE: Which species?

FRANCE: the only study that has examined the effect of electrical fields (Desender et al. 2018) on sole larvae has been stopped before metamorphosis...

In addition, the effect of repetitive exposure has never been evaluated on sole larvae, although intensive fishing could occur in coastal nurseries, with repetitive trawling events in small areas, where live very sensitive animals.

Desender et al. (In press, 2018). *Electrotrawling: The impact of pulsed direct current on early life stages of Sole (Solea solea)*. *North American Journal of Fisheries Management*.

FRANCE: are we talking about immediate mortality? If so, it needs to be said. Any evidence on any delayed effect? on the success of the metamorphosis??

detect prey using their electro-sensitive sensory system was not significantly affected after being exposed to a sole pulse stimulus.

iii The mechanical disturbance of the seabed - background

Total sediment penetration depth was estimated by adding a) the measured depth of sediment disturbance by the gear to b) the modelled depth of erosion due to sediment mobilisation in the wake of the gear. Depth of disturbance was measured with a sediment profile image camera to 3.4 and 1.0 cm for traditional beam and pulse trawl, respectively. The depth of the eroded sediment layer was modelled to 0.6 and 0.8 cm, respectively.

In the same experiments multi-beam echo sounder measurements showed that in traditional beam trawl tracks in/on the sediment was uniformly deepened following gear passage. The sediment in pulse trawl tracks was more heterogeneously deepened.

The overall mobilisation of sediment into the water column is inferred to be lower for pulse trawling compared to traditional beam trawling based on the lower hydrodynamic drag associated with the lower average towing speed of pulse trawling (speed reduction of 19% for the larger vessels above 221 kW and 14% for the smaller vessels). A shift of trawling effort from coarser to more fine sediments is inferred to increase sediment mobilisation.

iv The structure and functioning of the benthic ecosystem : background

There is a sound scientific basis that beam trawls cause significant mortality among benthic invertebrates and that mortality scales with the penetration depth of the gear. Three field studies on the impact of pulse trawls suggest a lower mortality as compared to traditional beam trawls that is consistent with the reduced penetration depth of the gear. The catch per hour of benthic invertebrates in pulse trawl is reduced by 38%-72% in large vessels in two comparative fishing experiments. In these larger vessels there was an average 62% reduction in discard rate of benthic invertebrates but in smaller vessels (≤ 221 kW) there was a 6% higher discard.

The increased catch efficiency for sole resulted in a reduced surface area swept after the transition from beam trawls to pulse trawls by 2017 Dutch-flagged licence holders between 2009 and 2017. The

FRANCE: How this species representative of all species concerned?
How many species?

One experiment with few individuals. Unsufficient to conclude.

FRANCE: This is obvious... and so what?

NETHERLANDS: What I miss in this section as is that as yet we cannot fully assess the impact of the pulse trawl on the structure and functioning of the ecosystem as a whole. The Impact Assessment Pulse Fisheries project is looking into this question and will be reporting in 2019. It should provide the results to make the impact assessment and ecosystem level.

A text along this lines should be included at the end of this section.

[But absolute assessment is NOT the request]

footprint – defined as the surface area fished during a year at least once – decreased by 18% and the total surface area swept reduced by slightly more than 30%.

Organisms that occur within the trawl path between the head rope and the penetration depth of the gear will be exposed to mechanical disturbance by both gears. The electrical pulse extends deeper into the sediment. Recent experiments have found no evidence that exposure to the electrical pulses results in measurable additional mortality in invertebrate species studied, although some early exploratory studies with small samples suggested that some impacts could occur. The available studies do not show that exposure to a pulse stimulus adversely affect growth or increase the risk of disease reflecting an impaired immune system. The limited number of studies, however, implies that a possible adverse effect cannot be excluded.

Electrolysis can cause the formation of chlorine gas (Cl_2) in saltwater. Currently, there is no evidence suggesting that sole pulses lead to electrolysis.

v Assessment of the impact of repetitive exposure to the two gear types on marine organisms - background

Some of the effects of repeated exposure to the two gear types are considered in the earlier sections of this advice. For example, the effects of both types of fishing gear on the target and non-target fish stocks (non-sessile species) are not just caused by one pass of the gear but are the cumulative effects of the gear over time and space.

The effects of repetitive exposure to traditional beam trawls or pulse trawls on organisms are mainly a result of sensitivity to the direct gear impact (mechanical or mechanical + electrical) and the intensity of the impact.

Within the four ICES rectangles most intensively trawled by this fishery, the proportions of unit areas the size of the gear (24m x 24m) subject to repetitive trawling at intervals of less than one week are estimated at 0.3% (pulse) - 0.8% (beam trawl). This also assumes that organisms occurring in the trawl track of the full width of the gear are exposed above their sensitivity threshold.

FRANCE: Tested on very few species : Arenicola marina for example, that mostly live in intertidal area (not subjected to pulse trawling). No sensitive/vulnerable benthic species were considered for studies.

FRANCE: as previously said, the request does not ask for the probability of repetitive exposure but explicitly for the impact of (possible) repetitive exposure. I do think that the whole section does not answer the question but focuses on the probability of repetitive exposure. This has to be modified.

In an ICES rectangle trawled at an annual intensity of five – the maximum intensity observed - about 35% of the unit areas the size of the gear will be trawled for a 2nd time within a month and about 70% will be trawled for a 2nd time within three months. If the ICES rectangle was being trawled seasonally and all trawling occurred during a period of six months, almost 60% of the unit areas the size of the gear would be trawled for a 2nd time within a month, and about 90% within three months.

The intensity calculations further assumed that all organisms are sessile. If organisms are attracted to the fishing grounds trawled by pulse trawlers, the estimated exposure probability will increase and the intervals between repetitive exposures would theoretically be shorter. Along the same lines, for animals that are repelled by the electric field the exposure will be less and the interval between repetitive exposures would theoretically be longer.

[Maurice: Further studies are required on the impact of electrical pulses to the electro-magnetic sensory reception in elasmobranchs.]

“landing obligations”

Addition of F Fmsy

Species selectivity over composition of the catch

“combines with the increase...”

“north of France”

Lightly fished habitat”

IRELAND: suggest to delete
Conclusion: Soften to “may change”

Conclusion: delete

GERMANY: species selectivity
FRANCE composition of catch
Conclusion: composition of catch

Comment: Difficult to understand
Suggest to reword (ACOM chair): adding the increase

Comment: FRANCE: include coast of France
WGELECTRA: Yes, “Belgium coast” reference includes far north coast of France
Conclusion: accepted to include

IRELAND: changes in fishing footprint?

<p>(i.e. lower injury rates..."</p> <p>"these species"</p> <p>"but not of sole"</p> <p>"However, flatfish late stage larvae..."</p> <p>"iv: background</p> <p>V impact of repetitive exposure</p>	<p>Conclusion: not relevant</p> <p>Suggestion from ADG chair Conclusion: agree everyone</p> <p>Suggested to change by fish Conclusion: agree everyone</p> <p>Added by FRANCE WGELECTRA explains Agree on this last sentence</p> <p>NETHERLANDS: not a full assessment Conclusion: not addressed</p> <p>Conclusions: Not included</p>
Additional information	
<p>The beam trawl fishery in the North Sea</p> <p>The southern North Sea flatfish fishery is described in the ICES North Sea Fisheries Overview. Five countries (Germany Netherlands, Belgium, France and the UK) undertake the fishery using beam trawls, pulse trawls, otter trawls, gill nets and trammel nets. Sole represents the most important species in terms of the annual value to the beam trawl fishery, with plaice forming the greatest part of the landings by volume.</p> <p>Between 2010 and 2017 the use of pulse trawls in the Dutch flatfish fishery operating in the North Sea has increased to 78 vessels (of which 58 > 221 kW) and a handful of Dutch vessels operating with traditional beam trawls are now left.</p> <p>Sole in Subarea 4. Catch distribution by fleet in 2016 as estimated by ICES. "Other beam (incl. pulse)" are vessels flagged to Belgium, Germany and the UK.</p>	

Prospects of application of electricity to improve the sustainability of capture fisheries

The use of electrical pulse as a stimulator in fisheries has so far mainly been limited to the area in front of the footrope to replace conventional mechanical stimulation by tickler chains in the sole fishery, or bobbins in the fishery for shrimps, or to replace the hydraulic dredge to catch Ensis. However, electric pulses offer a wider range of possible applications to enhance the selectivity of trawls, for example to separate fish or steer behaviour in the aft end of the net. Electric cramp stimulus has been used to avoid the escape of sole through a benthos release panel. This led to an approximate 35% reduction of benthos, debris and certain undersized fish species without any loss of marketable fish.

This ICES Advice deals with the application of pulse stimulation in the fishery for sole only. Because the electrical characteristics differ between different applications, the conclusions on the ecological and environmental effects of the sole pulse cannot be applied to the other applications.

Equally, issues in other pulse fisheries may not be relevant in North Sea sole fisheries. In China, the introduction of an electrified trawl in the fisheries for shrimps increased the efficiency and resulted in an overexploitation of the shrimp stock. The pulse stimulus was similar in three main parameters to the one used in the North Sea brown shrimp fisheries (5 Hz, 0.3 ms pulse width and 60 V), but differed as the electrodes and therefore exposure time were more than 20 times longer. The fishery was also poorly regulated and this resulted in increased power output and reduced inter-electrode distance that increased the strength of the electric field, which in turn led to a poor size selectivity and high mortality of juvenile shrimp. There was a rapid increase in the number of vessels using electrified trawls and this further contributed to the overfishing of the resource. In 2001, this fishing method was banned.

BMS

PORT: BMS meaning?

Below minimum size. It's in all advice

Gear designs	Change in title: the general design of the two gears addressed in this advice.
Prospects of application of electricity...	<p>FRA: too advertising</p> <p>NL: suggest to remove 3rd paragraph</p> <p>ACOM chair suggest to delete all section since no added value and avoids distraction</p> <p>GER: useful background info for political negotiations</p> <p>BEL: does not belong to the reply of request</p> <p>FRA: agrees with BEL</p> <p>Conclusion: removed and consistent with previous decisions</p>

The meeting closed at 17:45 (CPH time); **Advice will be published on 30 May 2018 after usual style editing by ICES Secretariat.**