Pulse fishing: scientific research and Research Agenda

What do we know, what do we not know?

2 July 2015, Adriaan D. Rijnsdorp

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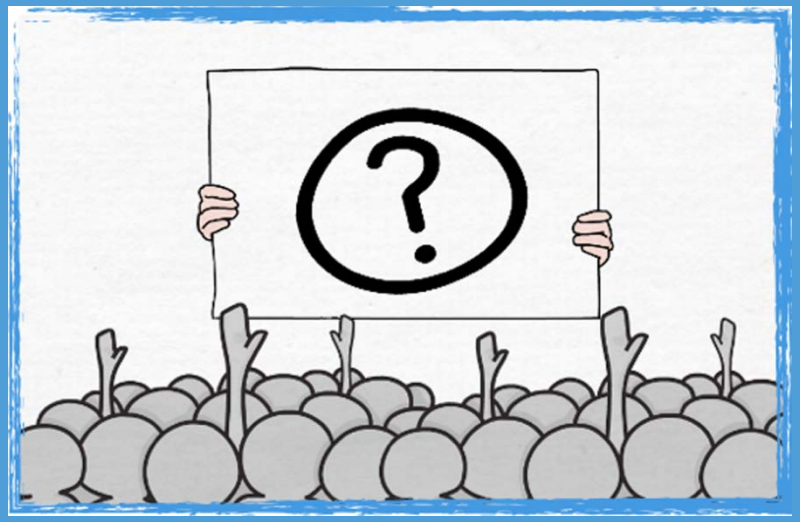
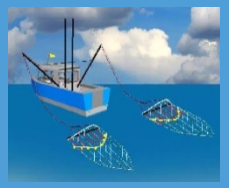
Why the research agenda?

Ices advice

Pilot project landing obligation

Concerns of stakeholders





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Overview

What do we know

1. Characteristics of electric field
2. Catch efficiency and selectivity
3. Effect of electricity on marine organisms
4. Ecosystem effects

What do we not know

5. Knowledge gaps (Research agenda)

What do we plan to do

6. Pulse trawl programme

1. Characteristics of electric field

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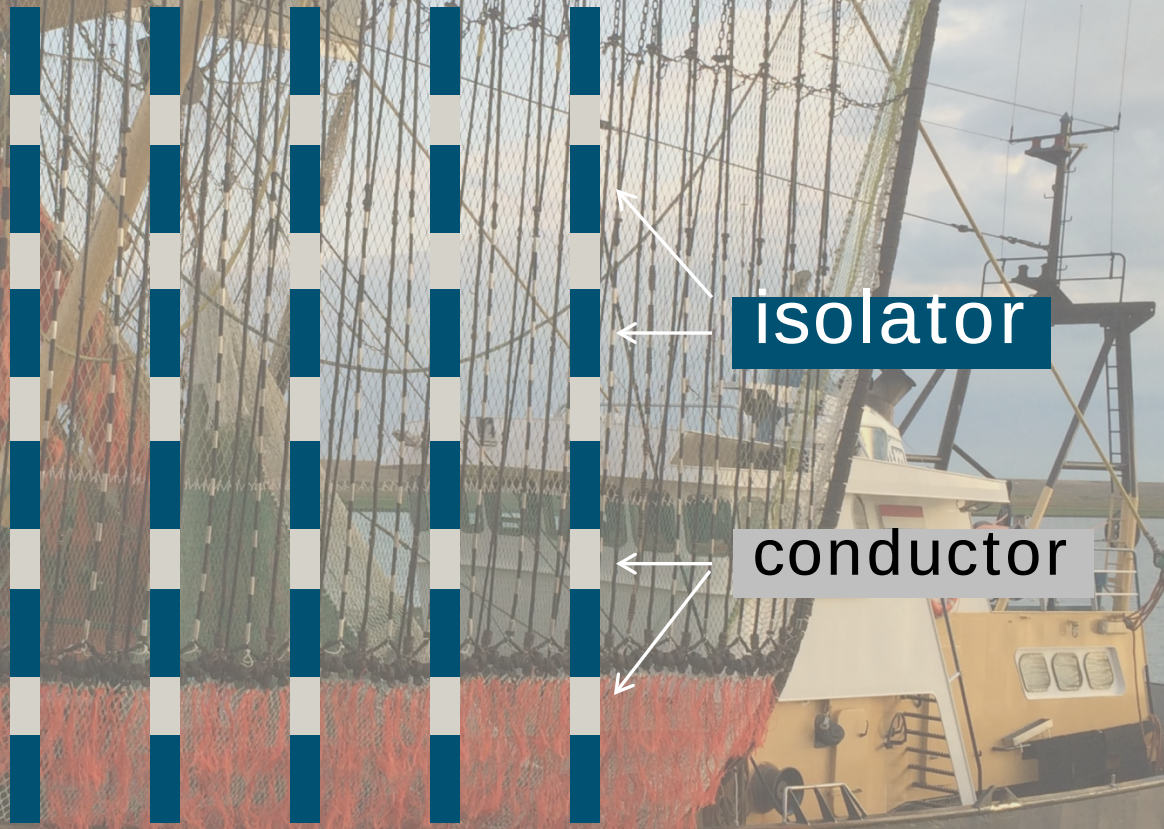
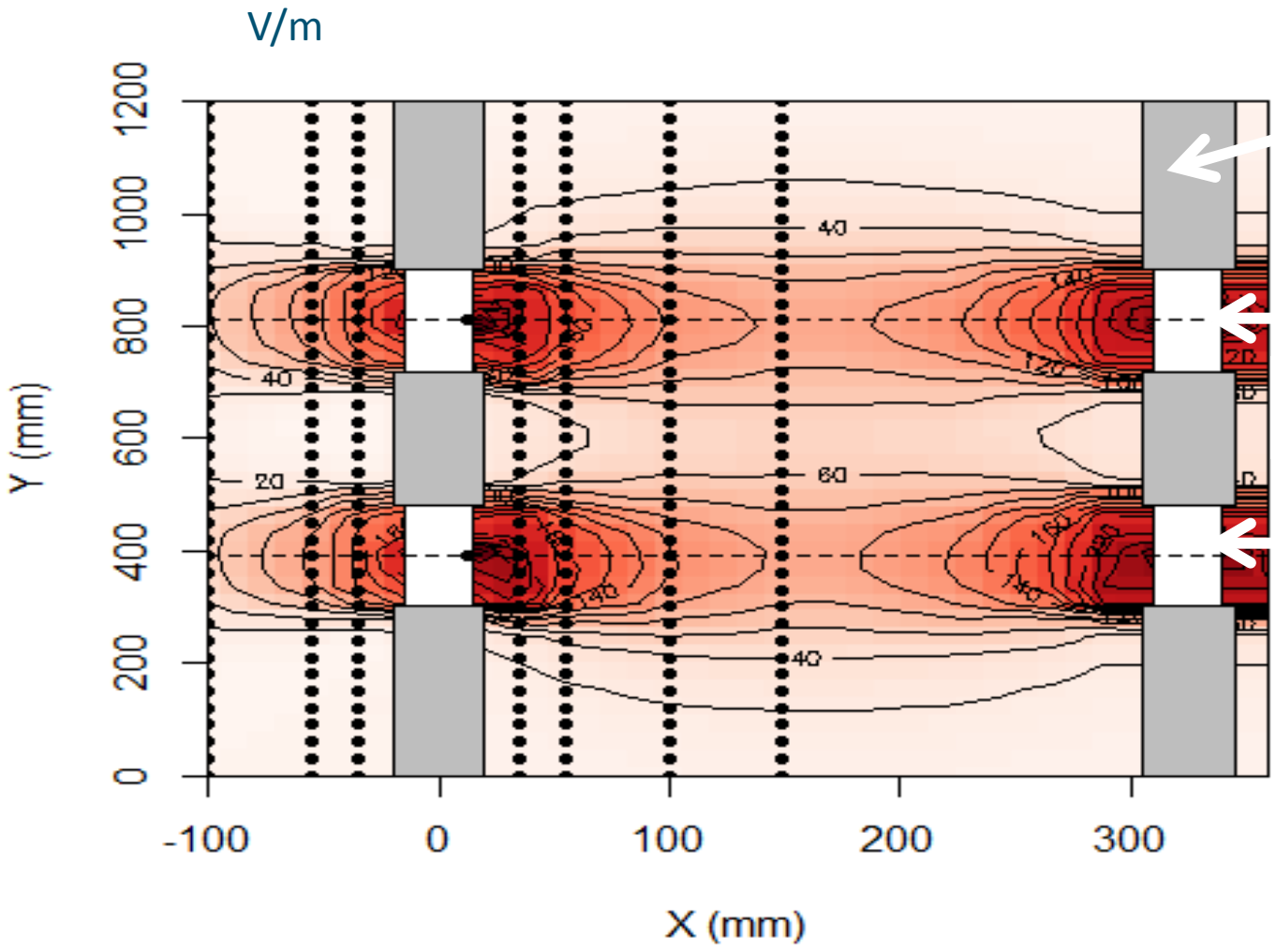


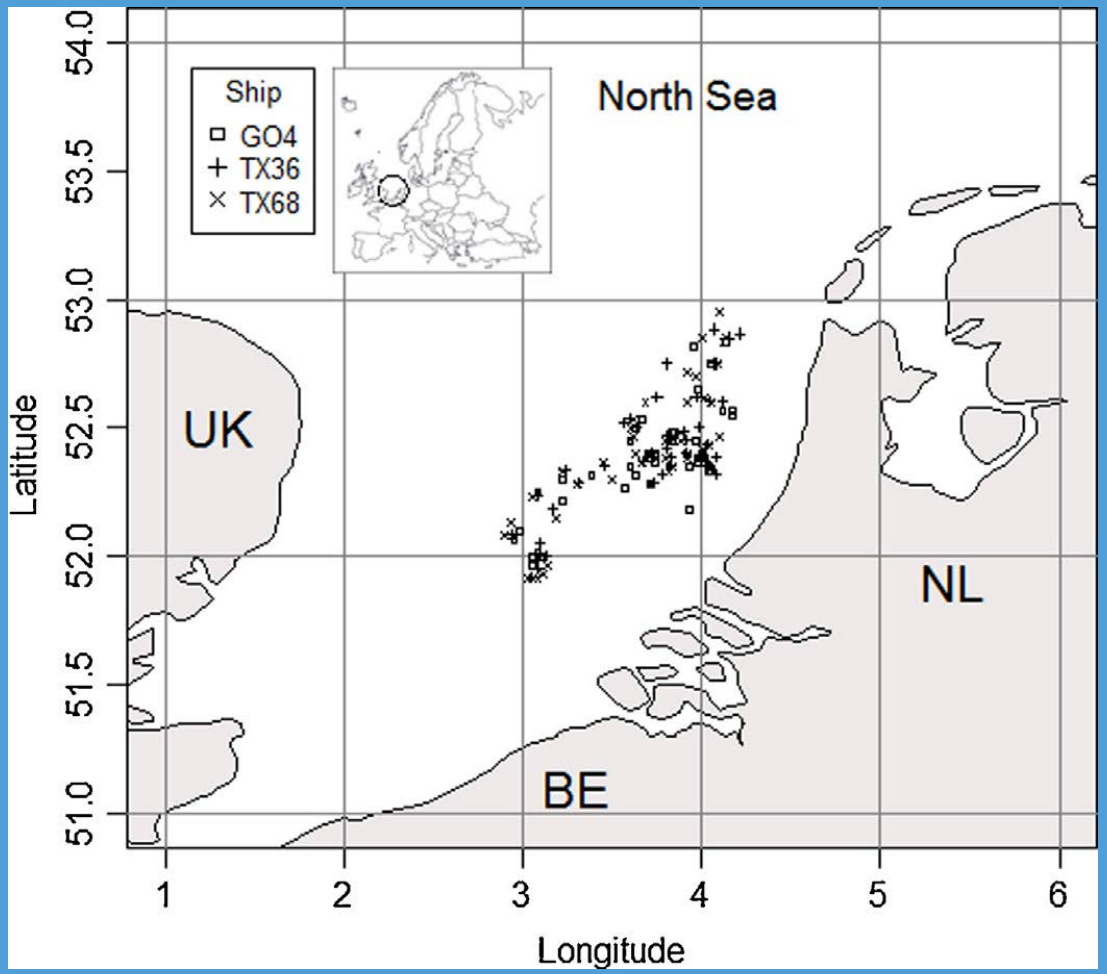
1. Electric field: non homogeneous



2. Catch efficiency and selectivity

2. Selectivity & Catch efficiency

Comparative fishing experiment in 2011: TX36 (HFK), TX68 (Delmeco), GO4 (tickler chain beam trawl)



Van Marlen et al. (2014)
Fisheries Research

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2. Catch efficiency

	Tickler chain n=33	Pulse n=2*33	Ratio Pulse / tickler	P
Landings (baskets / hectare)	0.10	0.08	81%	<0.001
Discards (fish & benthos) (baskets / hectare)	0.59	0.25	43%	<0.001

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Van Marlen et al. 2014

2. Catch efficiency (flat)fish

	Tickler chain n=33	Pulse n=2*33	Ratio Puls /tickler	P
Plaice (kg/hectare)	1.34	1.26	94%	ns
Sole (kg/hectare)	0.59	0.61	103%	ns
Fish discards (#/hectare)	108.4	61.9	57%	<0.001

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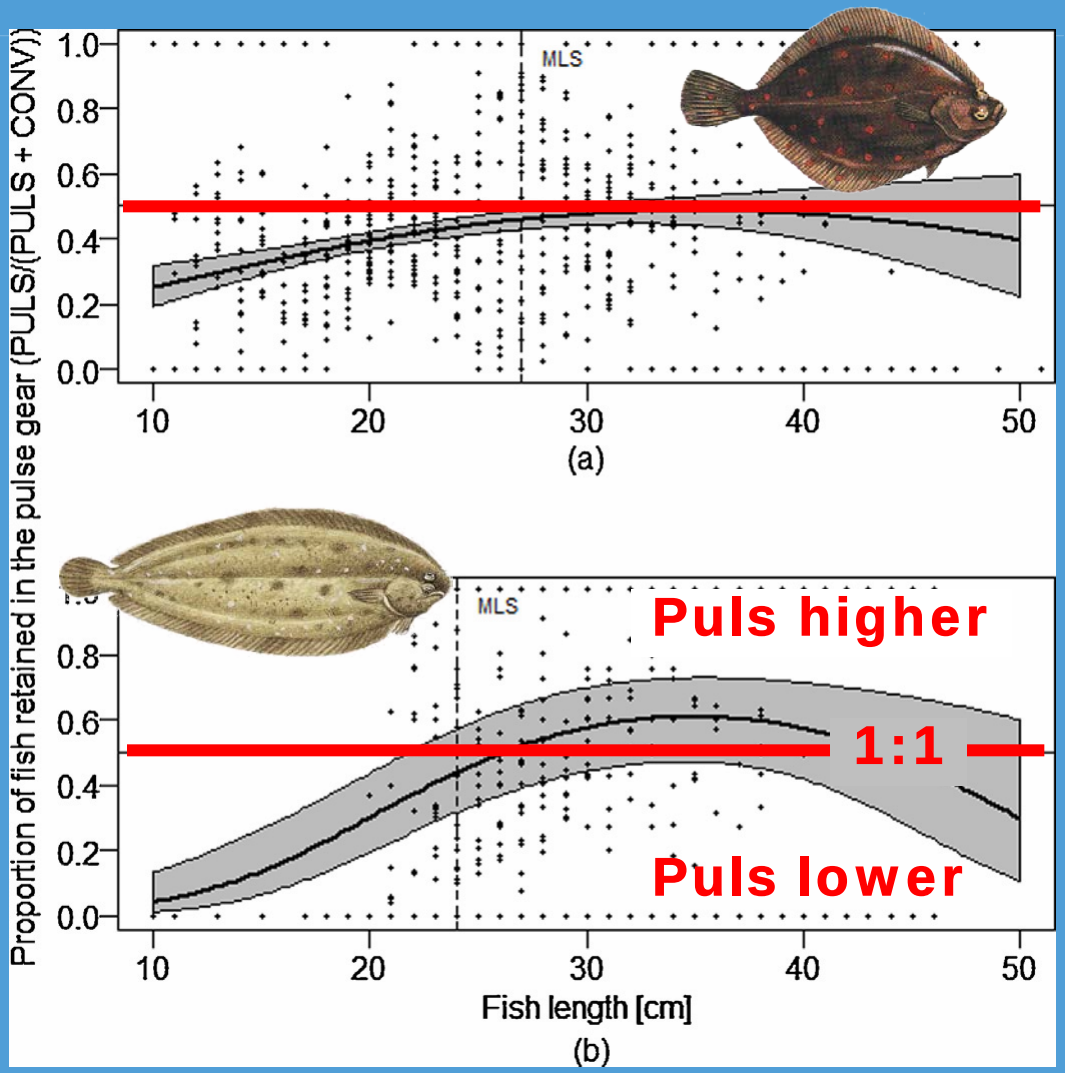
Van Marlen et al. 2014

2. Selectivity (plaice & sole): lower bycatch undersized flatfish

Catch
per unit area swept
Pulse / Tickler chain



Van Marlen et al. 2014

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3. Effect electricity on marine organisms

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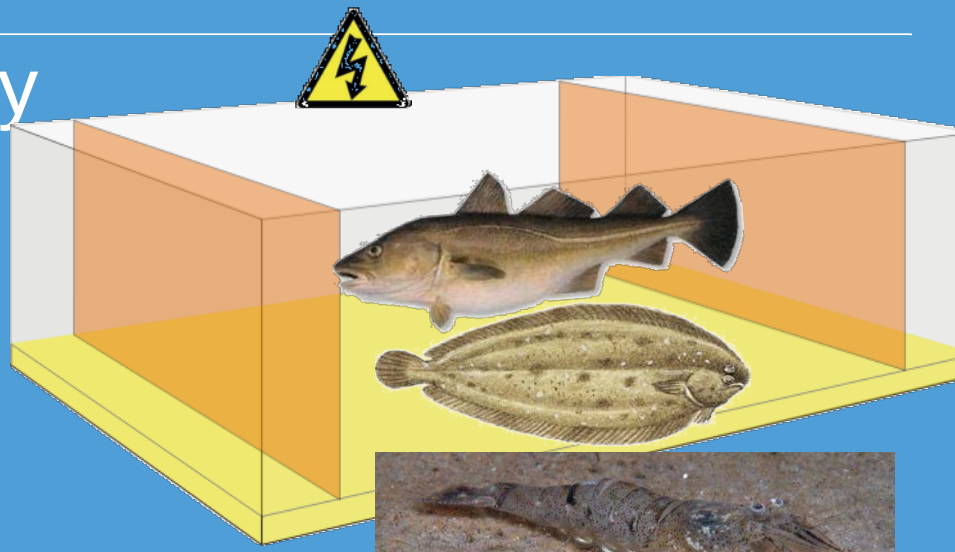
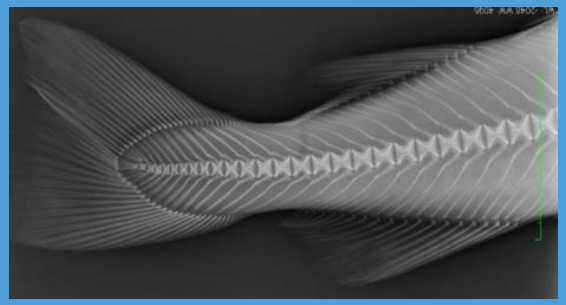
3. Effects of electricity



- Lab experiments (ILVO, University Gent, IMARES)
- Exposure 2 sec
  - Cod & Sole & Dogfish
  - Brown shrimp & Nereis
- Measurements
  - Survival (2 weeks) & behaviour
  - Macroscopic
  - X-ray & Histology



Uni Gent: Marieke Depestele; Maarten Soetaert; Annemie Decostere;
ILVO: Hans Polet;
IMARES: Dick de Haan; Bob van Marlen

3. Overview single exposure experiments

	Behavioural response	Injuries	Mortality	Feeding
Cod	Escape (<20 Hz) Cramp (>20Hz) Epileptic (120V)	fractures haemor- rhages	no	resume normal feeding
Sole	Escape (<20 Hz) Cramp (>20Hz) Epileptic (extreme)	None	No	resume normal feeding
Dog-fish	Escape	None	no	Resume feeding; deposition viable eggs
Shrimp	Jump (<20 Hz) Cramp (>20Hz)	Increase virus infection	No	-
Nereis	movement	None	no	-

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Depestele et al (in prep); Soetaert et al (2015) ICES JMS; De Haan et al. (in prep)

3. Dab: single exposure experiment to study ulcers

- Three groups of 50 dab
- Maximal exposure
  - DELMECO (60V)
  - HFK (70V)
  - Reference group (not exposed)
- After 1week killed and examined for lesions, ulcers, wounds, parasites
- No ‘injuries’ observed

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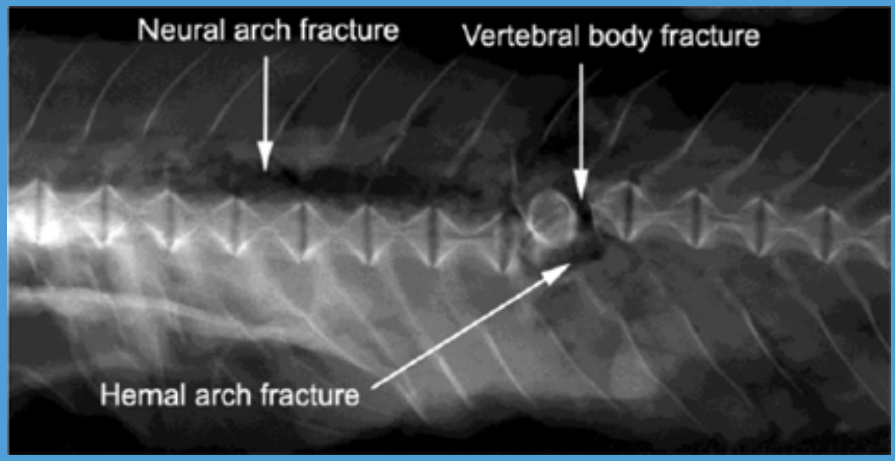
de Haan et al (in prep)

3. Experiments: Injuries in COD

- Wild cod
  - 4% (1/25)
- Aquaculture cod
  - 0% (0/145)
  - 2% (1/53)
  - 17% (5/29)
  - 48% (125/260) large cod
  - 0% (0/122) small cod



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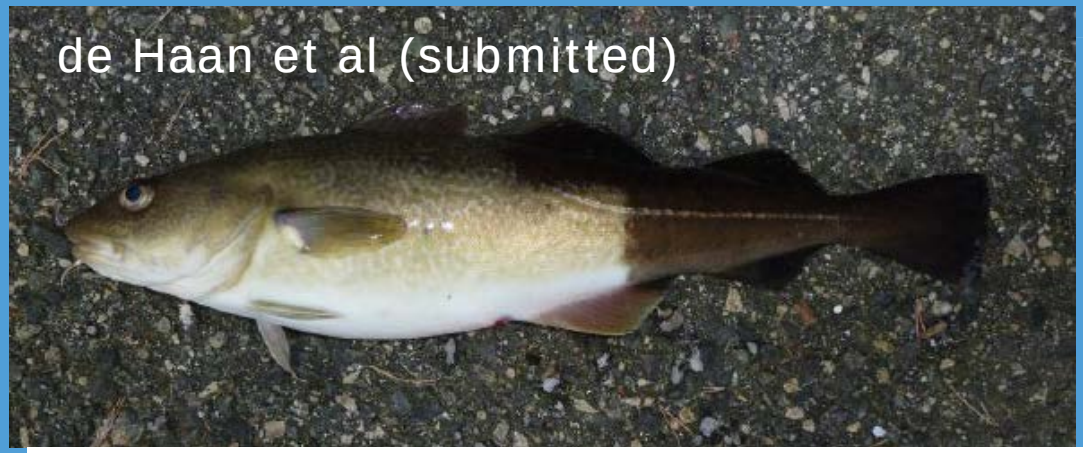
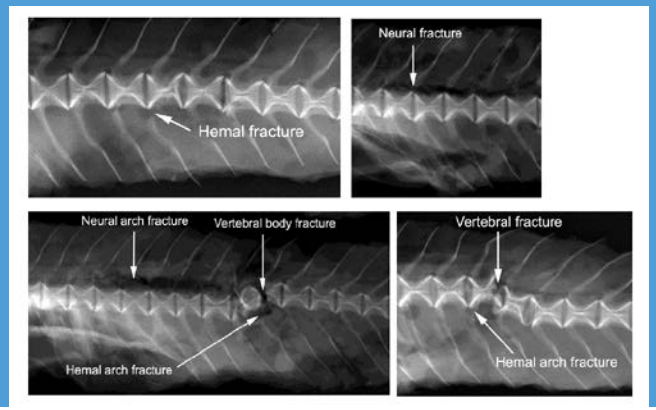
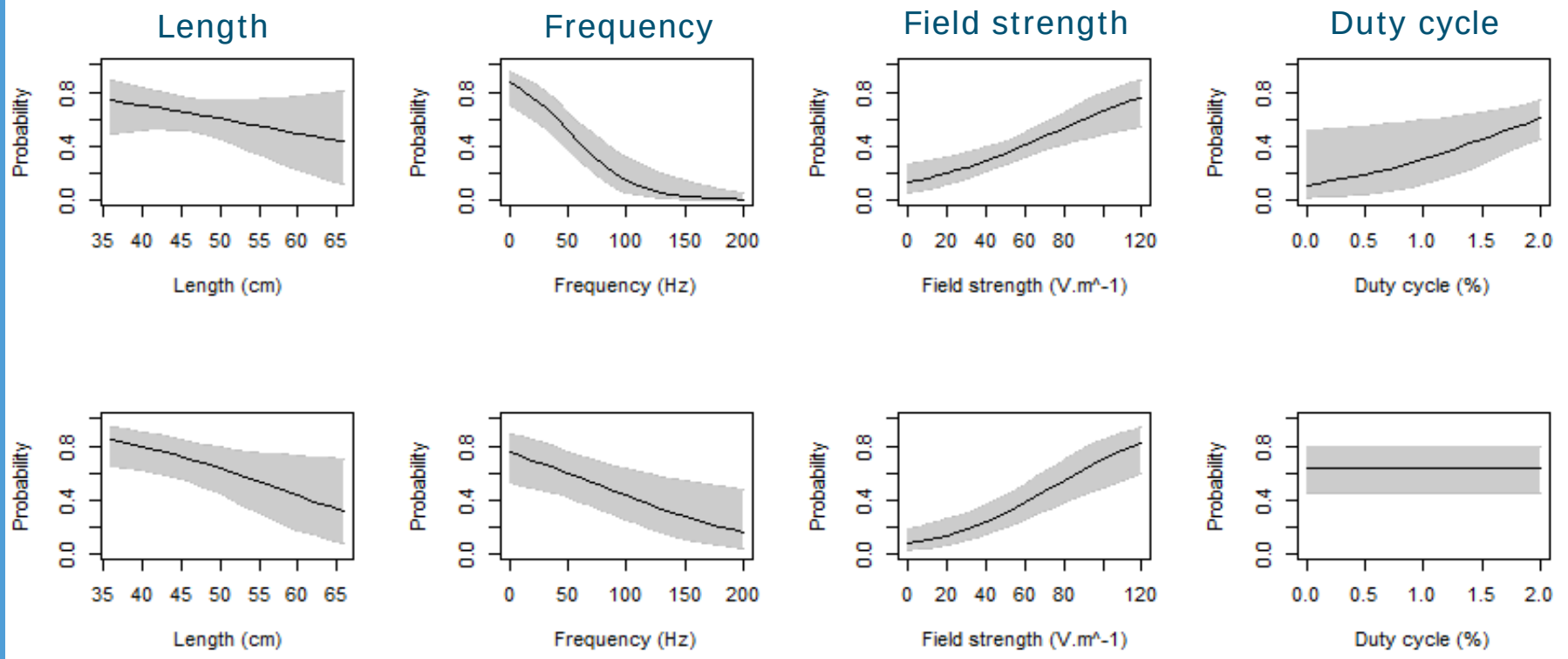
3. Effect pulse on injury probability







4. Ecosystem effects

4. Ecosystem effects compared to traditional beam trawl

BENTHIS

- Reduction in
  - Bycatch of undersized fish
  - Bycatch of benthic invertebrates
  - Penetration depth
- Trawl path mortality
  - Under study
- Change in distribution pattern
  - Consequences to be studied

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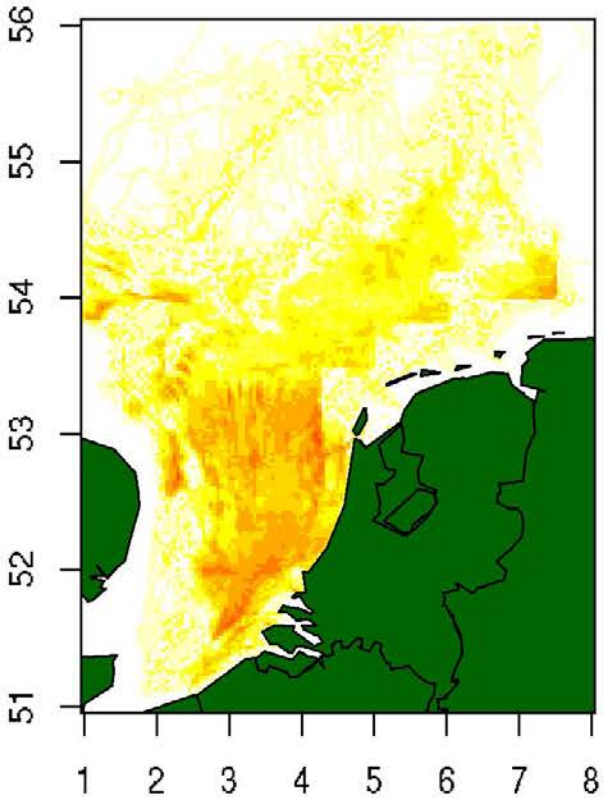
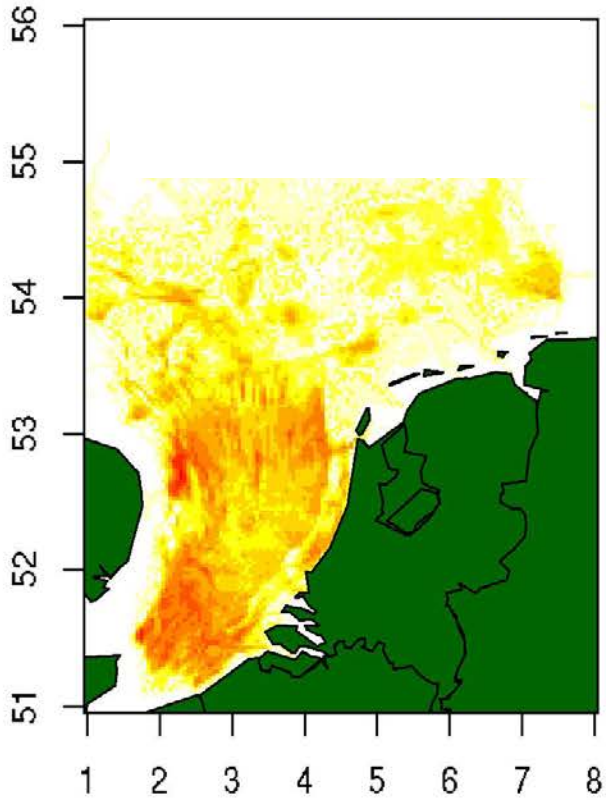
4. Change distribution pulse trawlers: consequences for ecosystem effects

Tickler chain beam trawls



Pulse trawls



1-4. Conclusion: what do we know

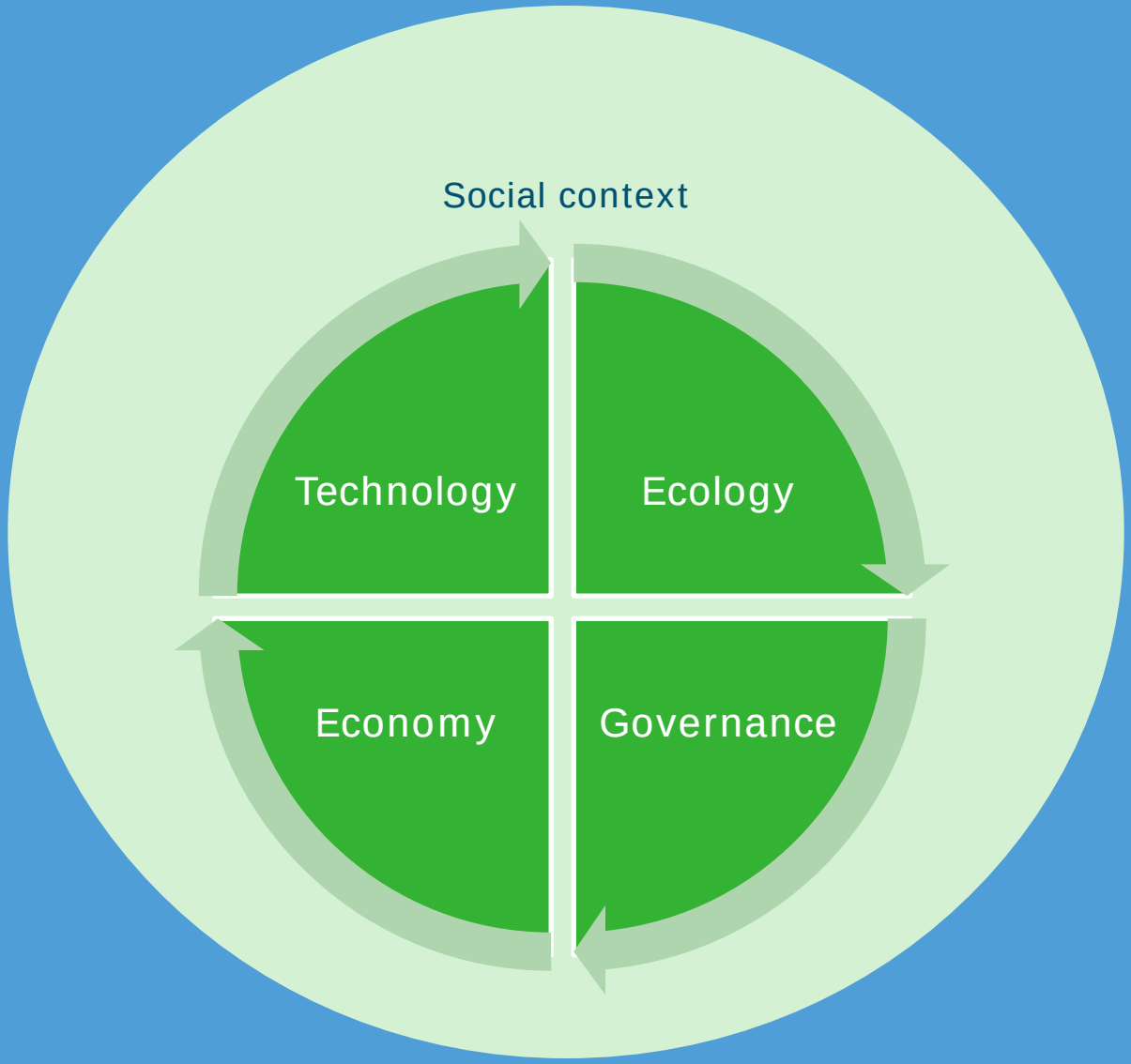
- Higher selectivity for sole
- Lower catch efficiency for undersized fish
- Lower catch efficiency for benthos
- Lower penetration depth of electrodes in sediment
- Change in spatial distribution
- Occurrence of injuries in cod and whiting (bone fractures, haemorrhages)
- No injuries detected in sole, dogfish, dab, shrimp, ragworm
- Shrimp exposed to 200 V/m revealed a higher severity of a virus infection

5. Research agenda

5. Research Agenda: process

- Ministry of Economic Affairs request to IMARES to report on **Knowledge Gaps**
- Research agenda
  - Quirijns *et al*., 2013 (updated in 2015)
  - Input from
    - ICES WGELECTRA
    - STECF
    - Review Soetaert et al (2013) Fish and Fisheries
- Consultations with NSAC (2014, 2015)
- Stakeholder perception study
  - Kraan *et al.,* (in prep)

Research agenda: topics



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5. Research Agenda: topics

- Ecology
  - Damaged or dead fish
  - Effect on electro-receptor organs
  - Thresholds of short and long term effects
  - Long-term effects on populations
  - Effect on substrate and chemistry (electrolysis)
- Technology
  - Technology progress (pulse settings, other fisheries)
  - Changes in spatial deployment pulse gear

5. Research Agenda: topics (cntd.)

- Economy
  - Economy and socio-economic aspects not all known
- Governance
  - Resistance from member states
  - Control and enforcement to be assured
  - Decision framework and models not fully developed
  - Most reports only in grey literature
  - Insufficient visibility of research in international fora

5. Stakeholder perception

- Approach
  - MSc thesis (Haasnoot, 2015) on innovation trajectory of the pulse in the Netherlands (15 interviews)
  - Perception Study (Kraan *et al*. in prep)
    - Quick scan media: Analysed 60 media messages (Belgium, France, UK, Germany, Denmark)
    - Interviews: 11 (Belgium, Denmark, UK, Germany)
    - Meetings observed in 2014: 7 (including NSAC)

NSAC

BENTHIS

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Kraan, Trapman, Rasenberg (2015) IMARES Report (in prep)

5. Stakeholder perception (cntd.)

- Findings
  - Worries and discontent about process through which the Dutch government obtained increasing number of derogations
  - Concerns about the transparency of the process
  - 32 research questions
    - Research agenda questions endorsed
    - Few additional questions (economy, governance)

Kraan, Trapman, Rasenberg (2015)
IMARES Report (in prep)

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6. Pulse trawl research programme

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6. Pulse trawl programme

- Objective: to provide a scientific basis to assess the consequences of the transition of beam trawling to pulse trawling the ecosystem (bycatch, benthos, ecosystem functioning)

- Approach
  - Monitoring
  - In-depth studies

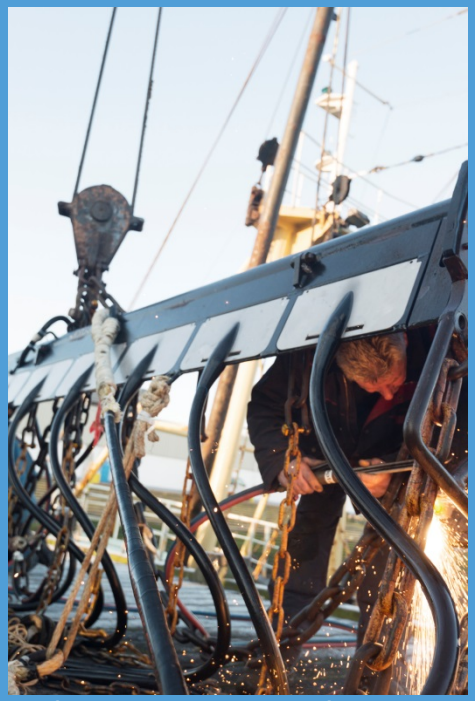

Photo: Hugo Schuitenmaker

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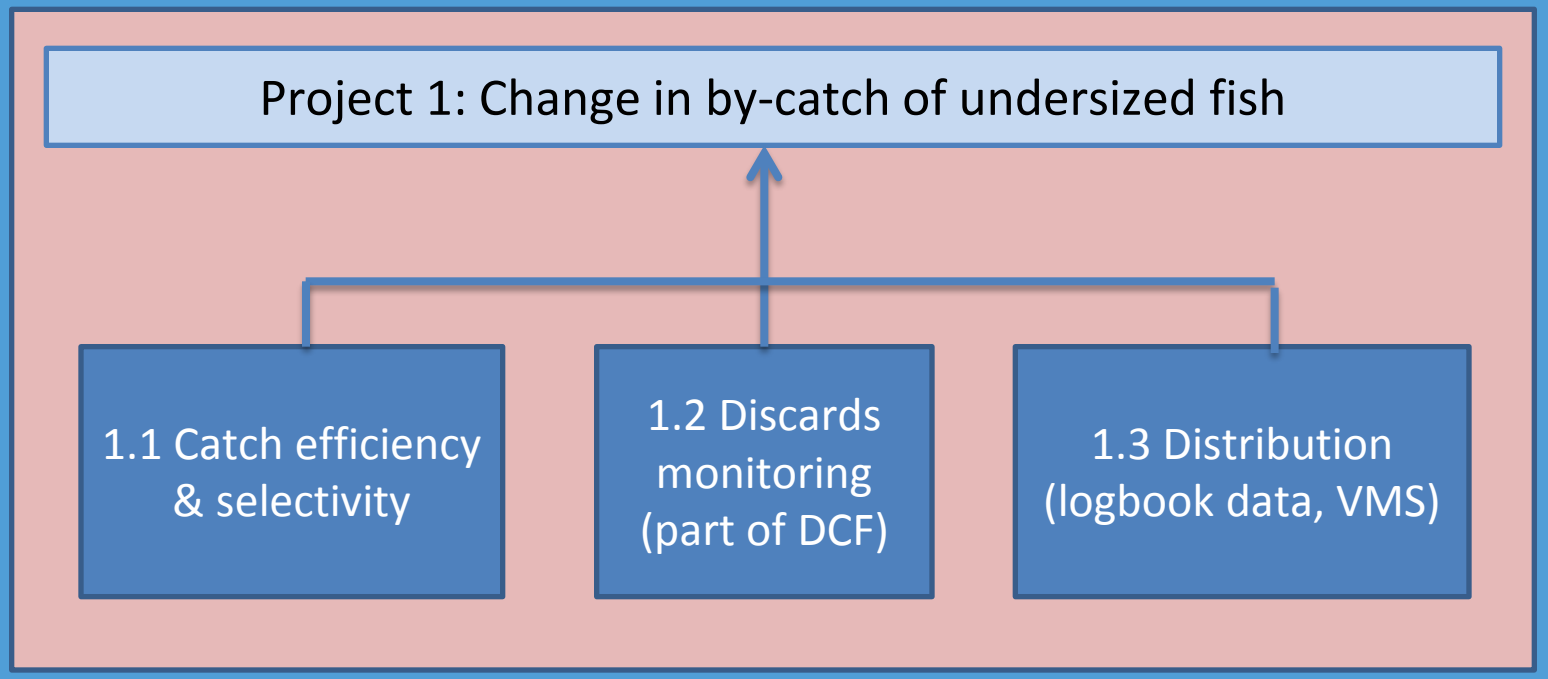
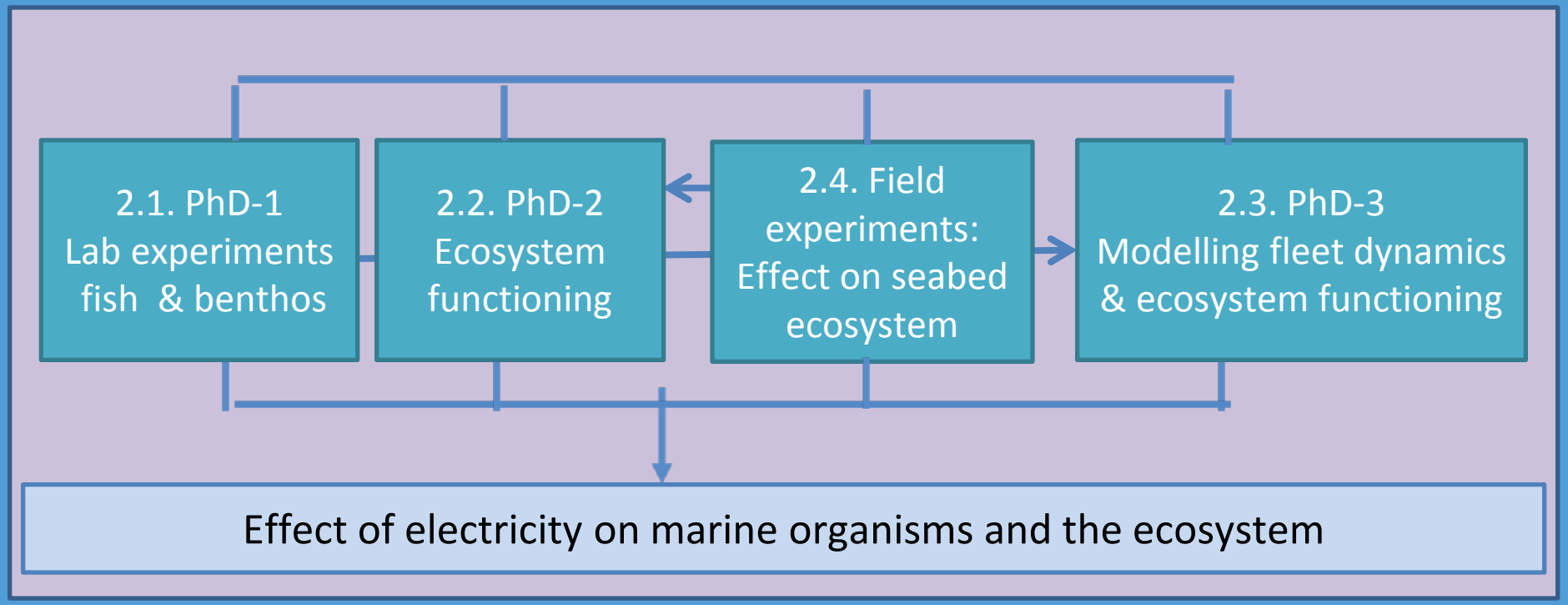
6. Monitoring



Project 2. Development of pulse trawl gear
Pulse settings, rigging of the gear

6. In-depth studies

- 3 PhD / Post doc projects (lab experiments, field experiments, modelling)
- Field experiment (effects of controlled chronic trawling on structure and functioning benthic ecosystem)



6. PhD1 - Effect on marine organisms

- Objective
  - To develop a predictive model on the distribution of the electrical field in various organisms and their effect on activity and survival
- Approach:
  - Lab experiments (fish, benthos)
  - Modelling
- Model species
  - Roundfish, flatfish, sharks and rays
  - Bivalves, crustaceans, polychaetes, sea urchin

6. PhD2 - Effect on the benthic ecosystem

- Objective
  - To develop a predictive model of the impact of electrical pulses on benthic ecosystem functioning in particular on the biogeochemistry
- Approach
  - Lab and Field experiments
  - Use of closed area (Oyster Grounds / Frisian Front)

6. PhD3 – Upscaling effects to fleet and ecosystem level

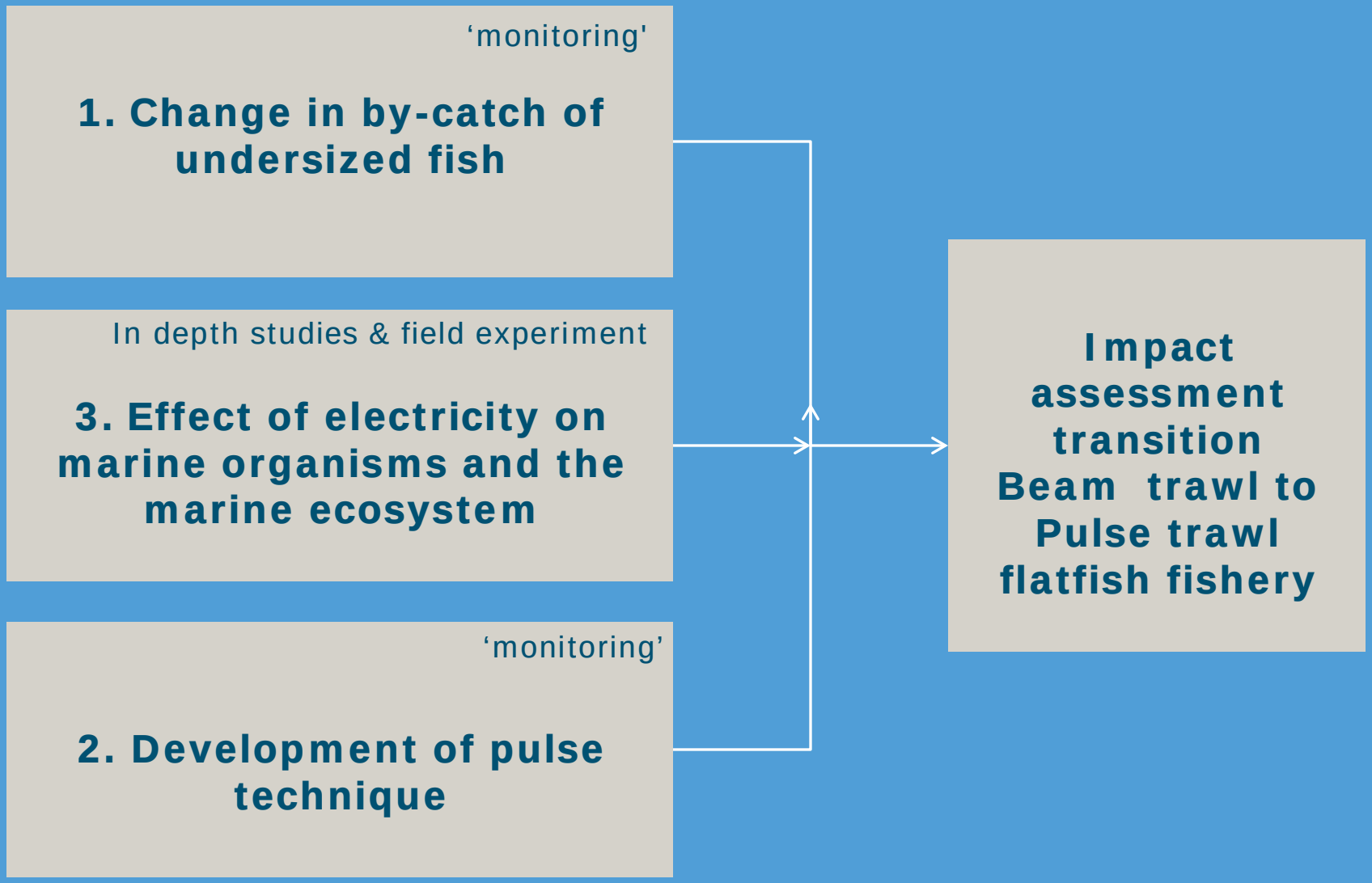
- Objective
  - To develop predictive models of the ecosystem effects (bycatch, proportion of injured fish, benthic ecosystem functioning) on the level of the fleet and North Sea

- Approach
  - Modelling spatial distribution pulse trawl fleet in relation to benthic habitats (high resolution)
  - Modelling effect pulse trawls on ecosystem functioning

6. Field study in closed area

- Objective
  - Comparative study of the effect of pulse trawling and beam trawling on the sea bed and benthic ecosystem structure and functioning
- Approach
  - Experimental fishing in study plots (pulse trawl, beam trawl, control)
  - Field sampling
  - Use of closed area (Oyster Grounds / Frisian Front)

6. Synthesis


'monitoring'
1. Change in by-catch of undersized fish
In depth studies & field experiment
3. Effect of electricity on marine organisms and the marine ecosystem
'monitoring'
2. Development of pulse technique
Impact assessment transition Beam trawl to Pulse trawl flatfish fishery

Conclusions

- Pulse Trawl Research Programme
  - Ambitious
  - Funding is not secured yet
  - Must have – Nice to Know
- Input from stakeholders welcome

Acknowledgement

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