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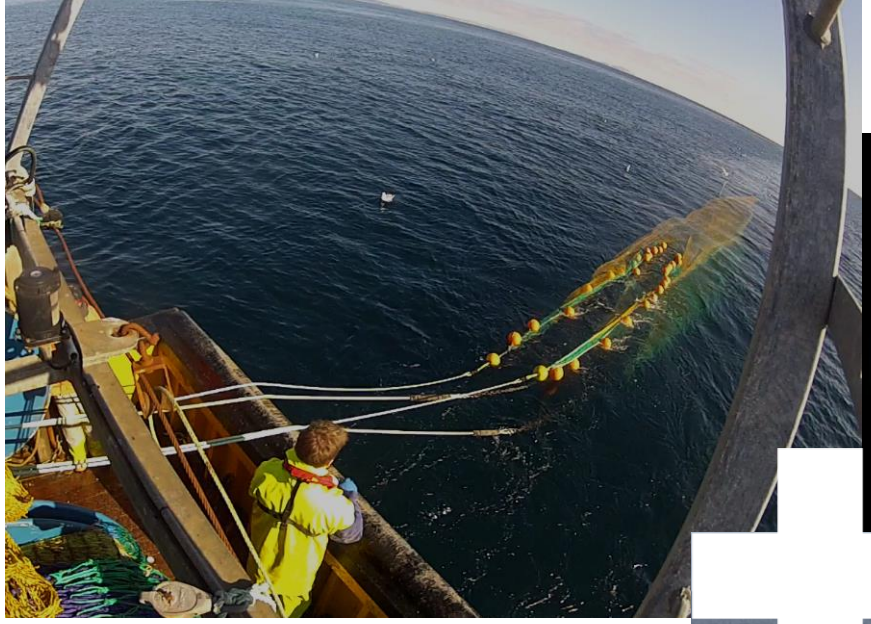

FMIG bite-size meeting:
Innovative gear selectivity – current state of play
17/04/24

Gear selectivity research at UHI Shetland

Dr Shaun Fraser
Senior Fisheries Scientist
shaun.fraser@uhi.ac.uk

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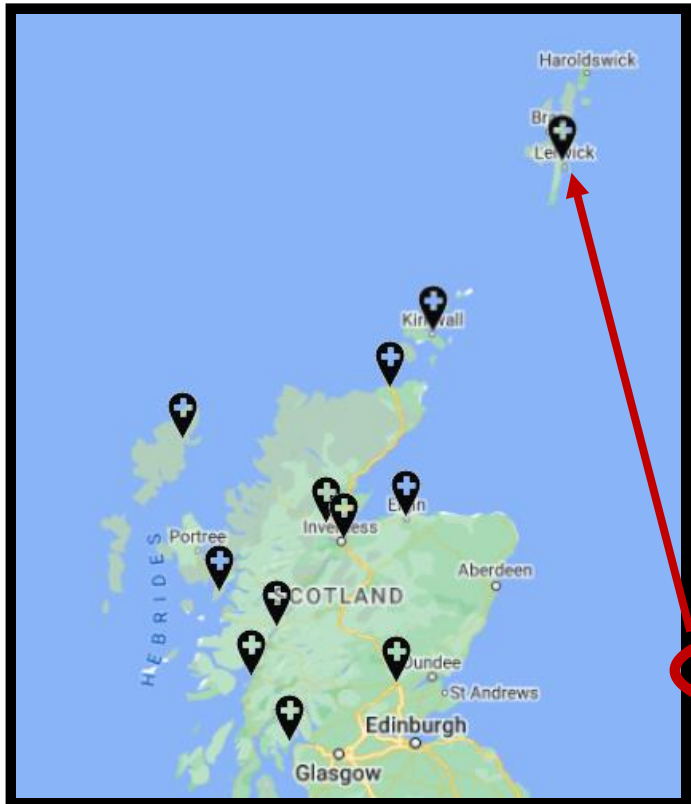
Who we are

shaun.fraser@uhi.ac.uk



UHI | ARGYLL

UHI | INVERNESS

UHI | MORAY MOIREIBH

UHI | NORTH HIGHLAND

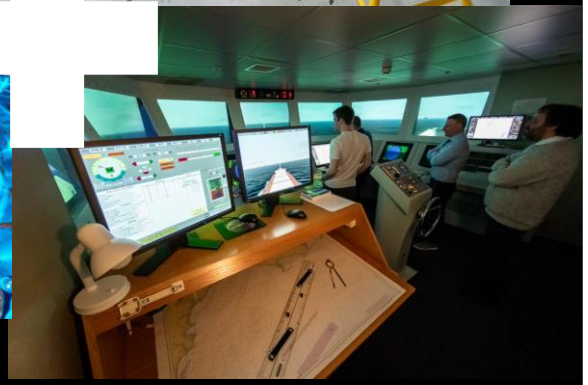
UHI | ORKNEY

UHI | PERTH

UHI | OUTER HEBRIDES INNSE GALL

UHI | SHETLAND

UHI | WEST HIGHLAND GÀIDHEALTACHD AN IAR



HTC | A partner of UHI

SABHAL MÒR OSTAIG | Com-pàirtiche de UHI

SAMS Scottish Association for Marine Science | A partner of UHI

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What we do

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Training:

- Engineering
- Nautical & Seamanship
- Aquaculture

Research:

- Demersal fisheries
- Pelagic fisheries
- Shellfish fisheries
- Fisheries policy and advice
- Marine spatial planning
- Aquaculture

- Close links to local industry

- Independent survey capabilities and research vessels

MRV Scotia, Length = 68 m, Crew = 17, Scientific Staff ≤ 12

source: https://blogs.gov.scot/marine-scotland/2020/01/27/demersal-trawling-survey-in-north-sea/

VS.

FV Atlantia II, Length = 12 m, Crew = 2, Scientific Staff ≤ 3

Background

shaun.fraser@uhi.ac.uk

Context: quota "mismatch" and "choke" species problem in mixed demersal fisheries

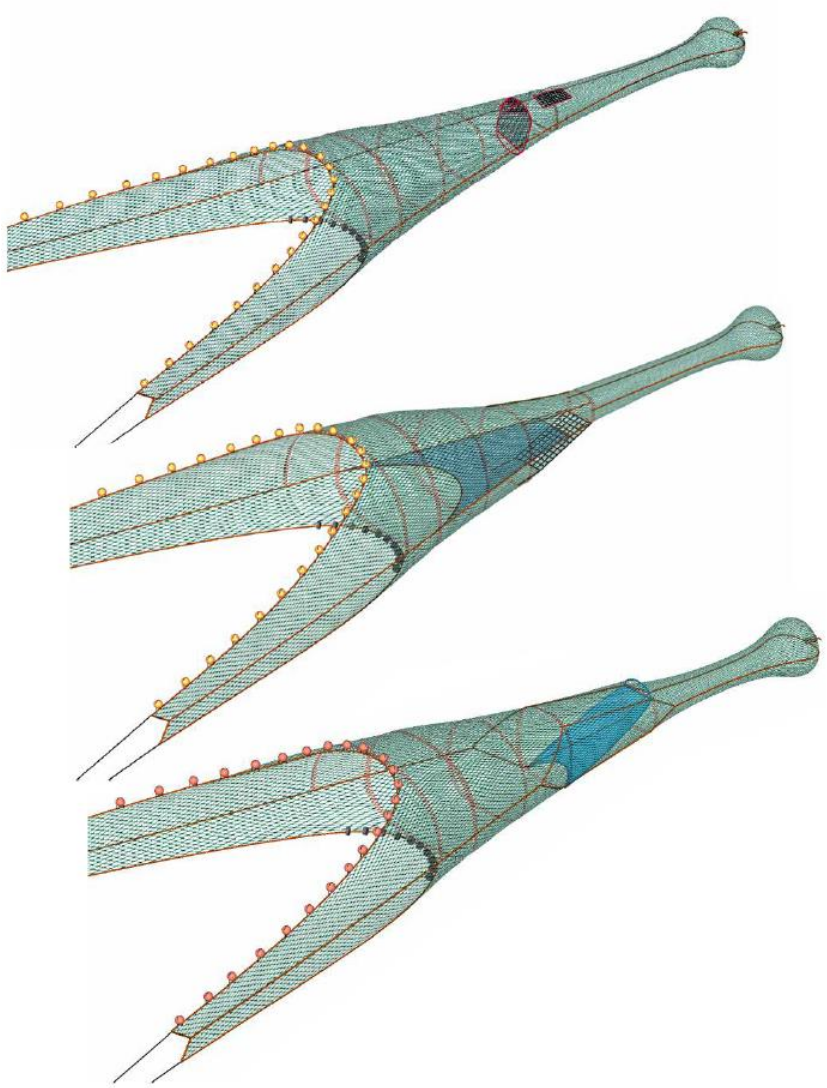
Potential gear modifications to improve selectivity?

1. Increased mesh sizes, mesh orientation, twine thickness…
2. Changing ground gear (chains/rubber hoppers/bobbins….)
3. Adjustment to headline height or coverless gears
4. Separator panels
5. Sorting grids and escape windows

…. lots of ideas tried before

Currently limited voluntary use of more "selective gears"

➔ Requirement for new technical solutions?



O'Neill, F.G. and Mutch, K., 2017. Selectivity in Trawl Fishing Gears. Scot. Mar. Freshw. Sci. 8, 1-85

Background

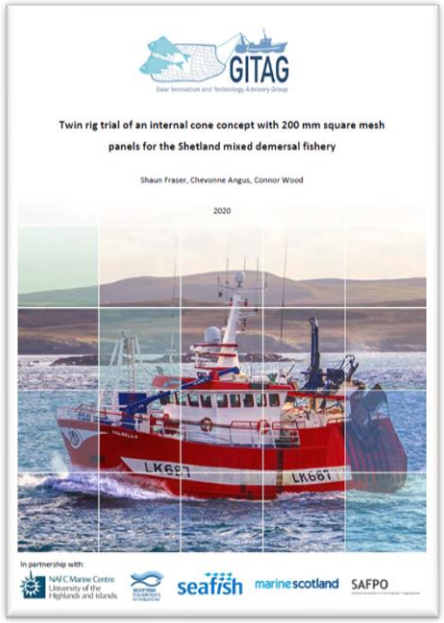
shaun.fraser@uhi.ac.uk

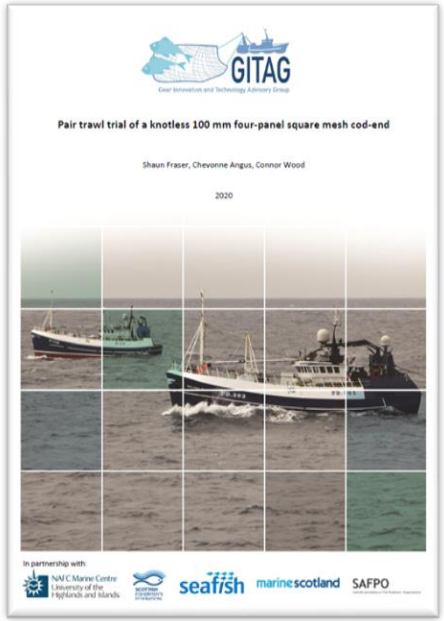
Involved in wide variety of projects testing ideas for Scottish mixed whitefish fishery and Scottish *Nephrops* trawl fishery

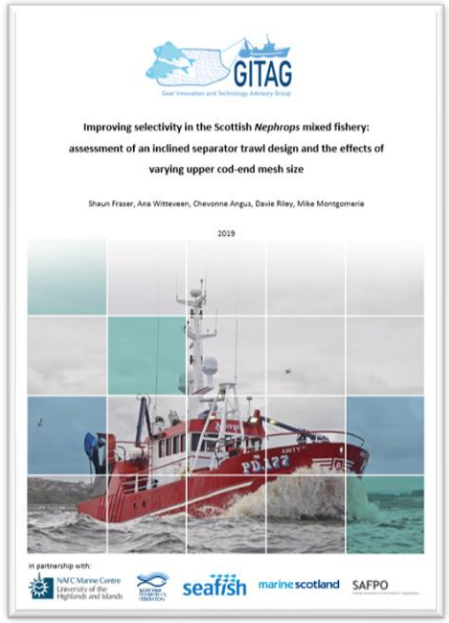
The Gear Innovation and Technology Advisory Group (GITAG)

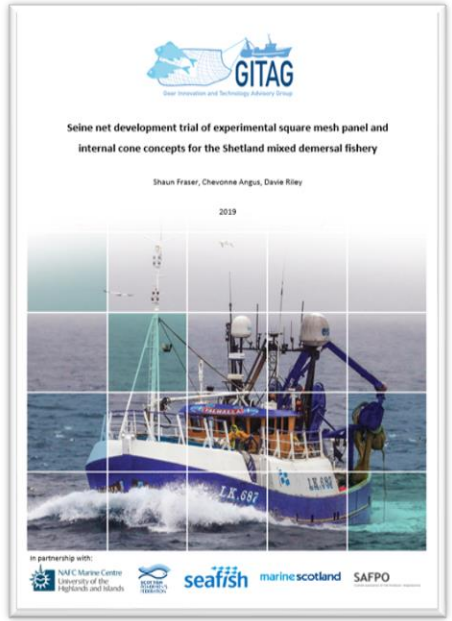
Ethos: *Voluntary uptake requires collaborative initiatives and an industry-led approach to gear development*

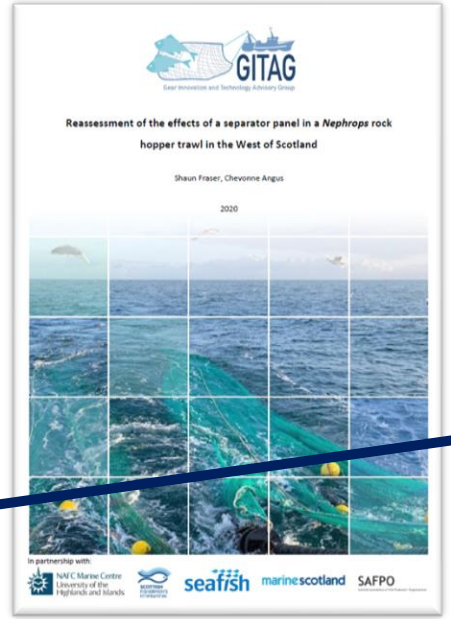
Focus on cod escape panel concept

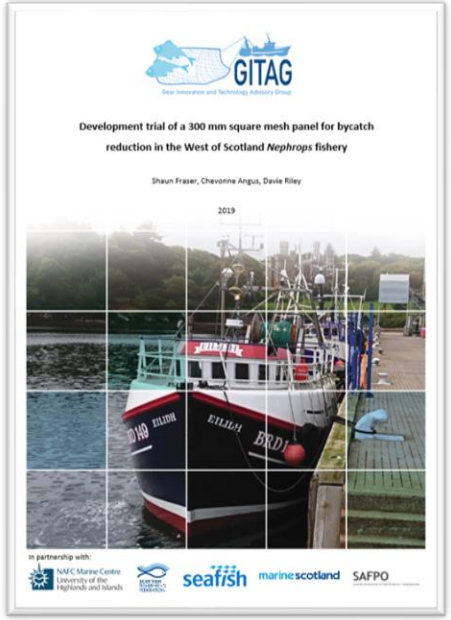


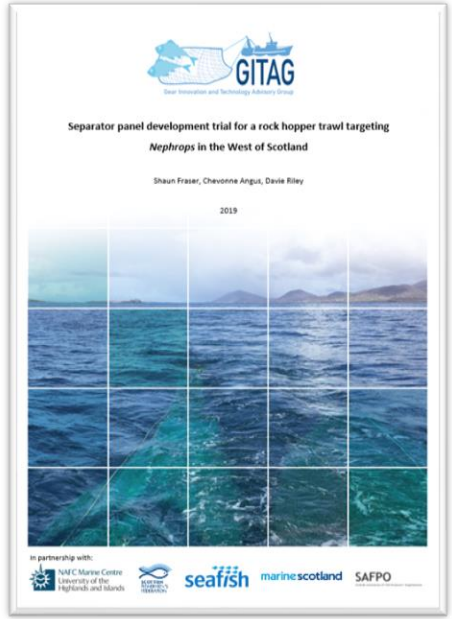












Cod escape panel

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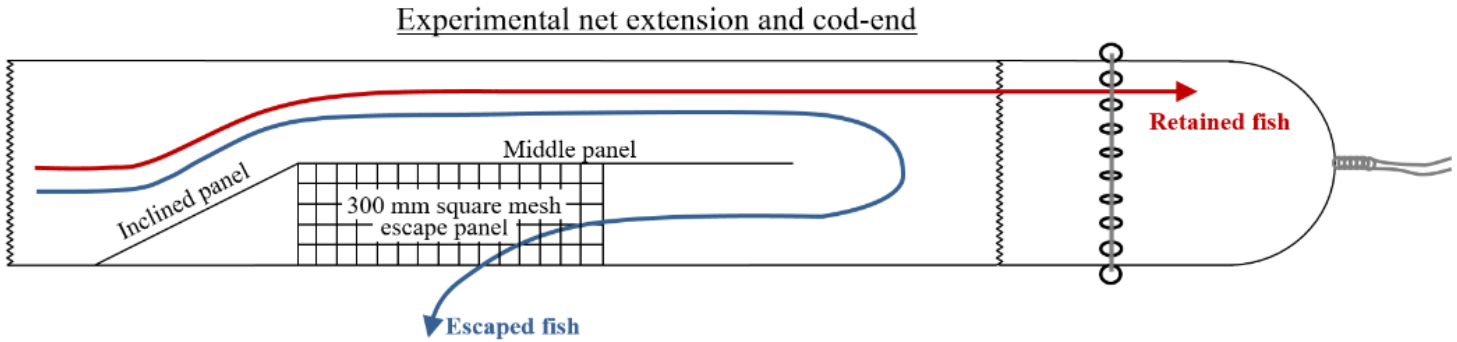
Utilising specific <u>behavioural</u> responses of cod in trawl gear

- Relatively powerful swimmers
- Tendency to swim downwards compared to other gadoids (haddock, whiting, etc.)



Fisheries Research 213 (2019) 212–218

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/fishres

Short Communication

Trial of a new escape panel concept to reduce cod catches in a mixed demersal fishery

Shaun Fraser*, Chevonne H. Angus

NAFC Marine Centre, Port Arthur, Scalloway, Shetland, UK

ARTICLE INFO

Handled by Bent Herrmann

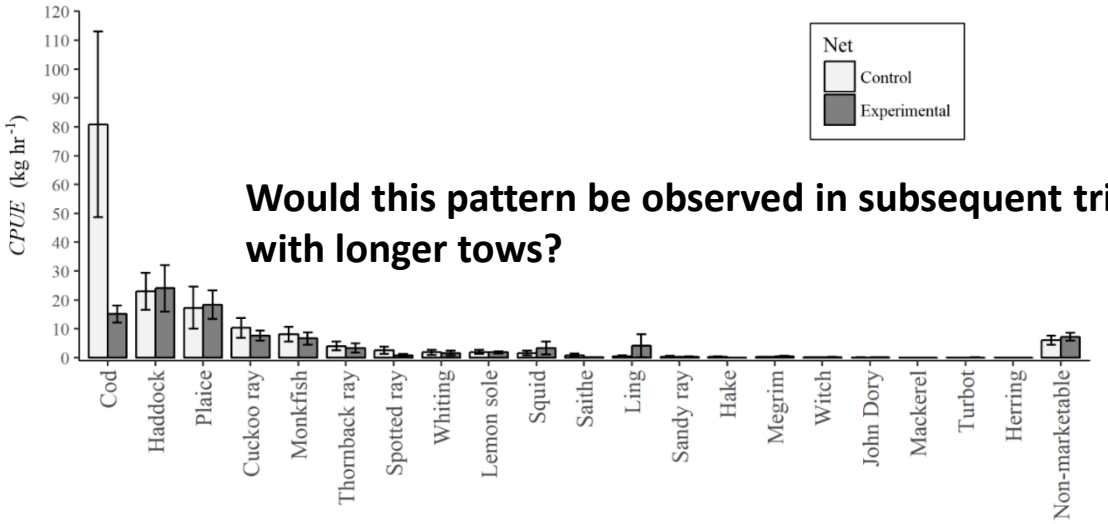
Keywords:
Gadus morhua
Gear selectivity
Bycatch reduction
Fish behaviour
Trawl

ABSTRACT

The species selectivity of demersal fishing gear in mixed whitefish fisheries needs to be improved for vessels with limited cod (*Gadus morhua*) quota which are encountering increasing abundances of cod in some areas of the North Sea, particularly around Shetland. Based on the known behavioural characteristics of cod within a demersal trawl, a new escape panel concept was designed and tested using an alternate haul methodology aboard a 12 m trawler. A modified (henceforth "experimental") net was made by incorporating an upwardly inclined panel connected to a horizontal middle panel that extends back over and beyond a large mesh escape panel in the lower side of the net extension. The results of 22 paired comparative hauls are presented which demonstrated the relative selectivity of the experimental net by reference to a control net. Catch rate data showed a significant reduction in cod in the experimental net by an estimated 81% ($p < 0.001$). Importantly, no significant differences in the catches of other main target species were recorded between the two nets. The results indicated that the escape probability of cod increased for larger fish, whereas no significant length effects were found for haddock (*Melanogrammus aeglefinus*) or plaice (*Pleuronectes platessa*). Further research and development is recommended to evaluate the escape panel concept in commercial conditions and to optimise this promising method for vessels in the mixed demersal fishery.

Initial sea trials (2018) with the MFV *Atlantia II* (LK 502)

- Indicated 81.3% reduction in cod catch rate
- No significant difference in all other cases
- Cod retention found to decrease with length



Would this pattern be observed in subsequent trial with longer tows?

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Cod escape panel

shaun.fraser@uhi.ac.uk

Subsequent development trials

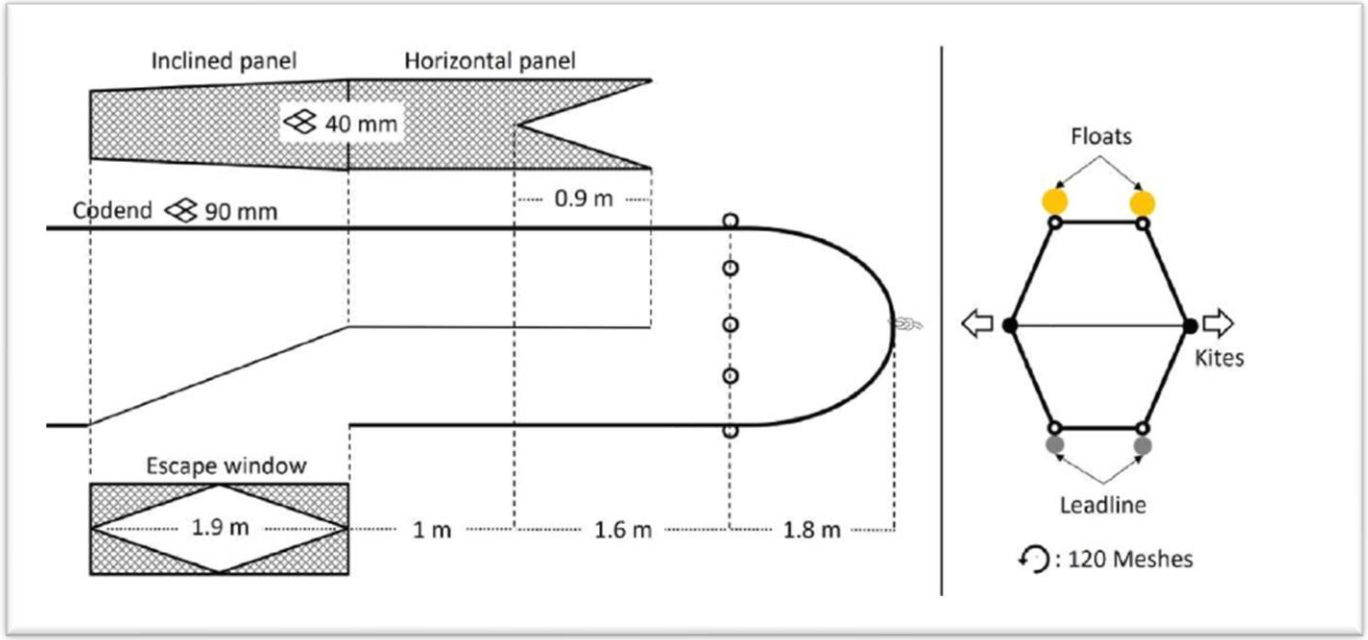
- Longer tows (> 4 h) aimed at matching local commercial practices
- Underwater camera systems for assessing fish behaviour and gear performance
- Improvements to geometry consistency and hydrodynamic stability

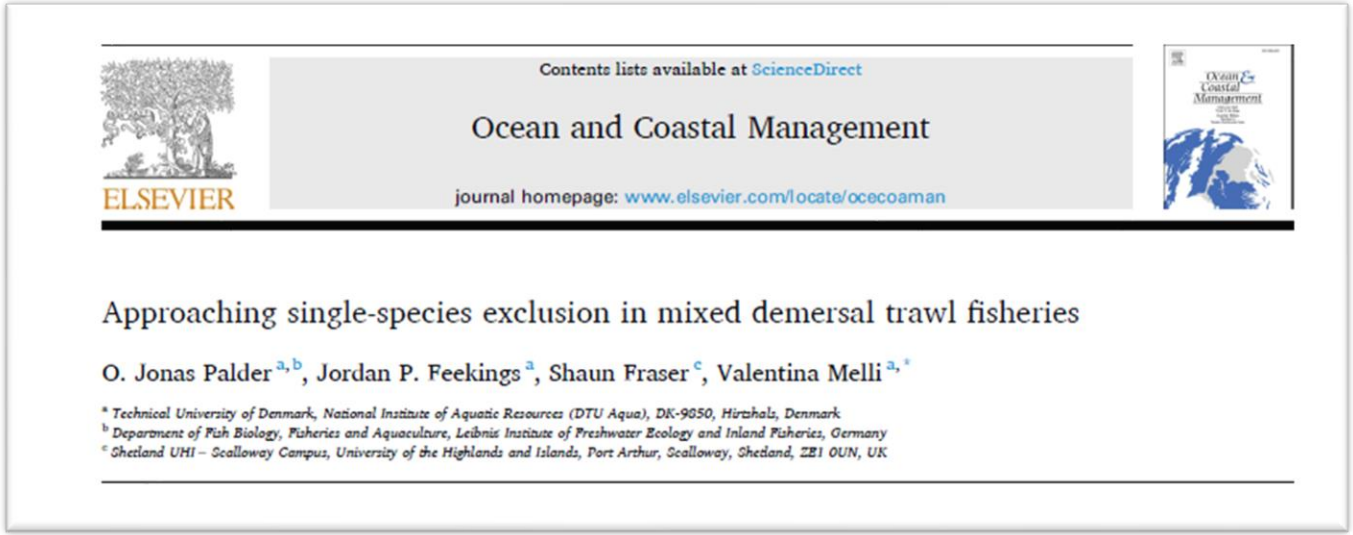
Cod escape panel

shaun.fraser@uhi.ac.uk

Further development by DTU Aqua

- Tested in Hirtshals flume tank
- Six panel configuration with floats, weights, and kites
- Field trails in Danish fishery aboard R/V Havfisken (17m) twin rig

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journal homepage: www.elsevier.com/locate/ocecoaman
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Approaching single-species exclusion in mixed demersal trawl fisheries

O. Jonas Palder [a,b], Jordan P. Feekings [a], Shaun Fraser [c], Valentina Melli [a,*]

[a] Technical University of Denmark, National Institute of Aquatic Resources (DTU Aqua), DK-9850, Hirtshals, Denmark
[b] Department of Fish Biology, Fisheries and Aquaculture, Leibniz Institute of Freshwater Ecology and Inland Fisheries, Germany
[c] Shetland UHI – Scalloway Campus, University of the Highlands and Islands, Port Arthur, Scalloway, Shetland, ZE1 0UN, UK

Results

- Low total retention of cod (33%)
- High retentions of commercial catches of Nephrops (89%), haddock (76%) and plaice (100%)

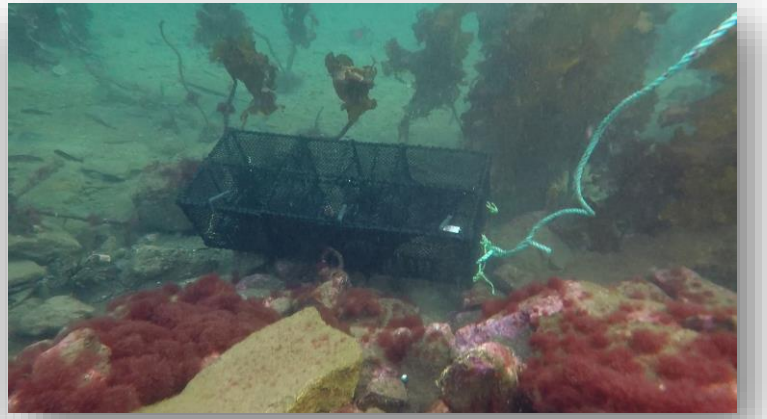
"The results demonstrate the unique ability of this design to specifically exclude cod, and in particular the commercially sized individuals, from a fish and crustacean demersal trawl, while maintaining most valuable catches."

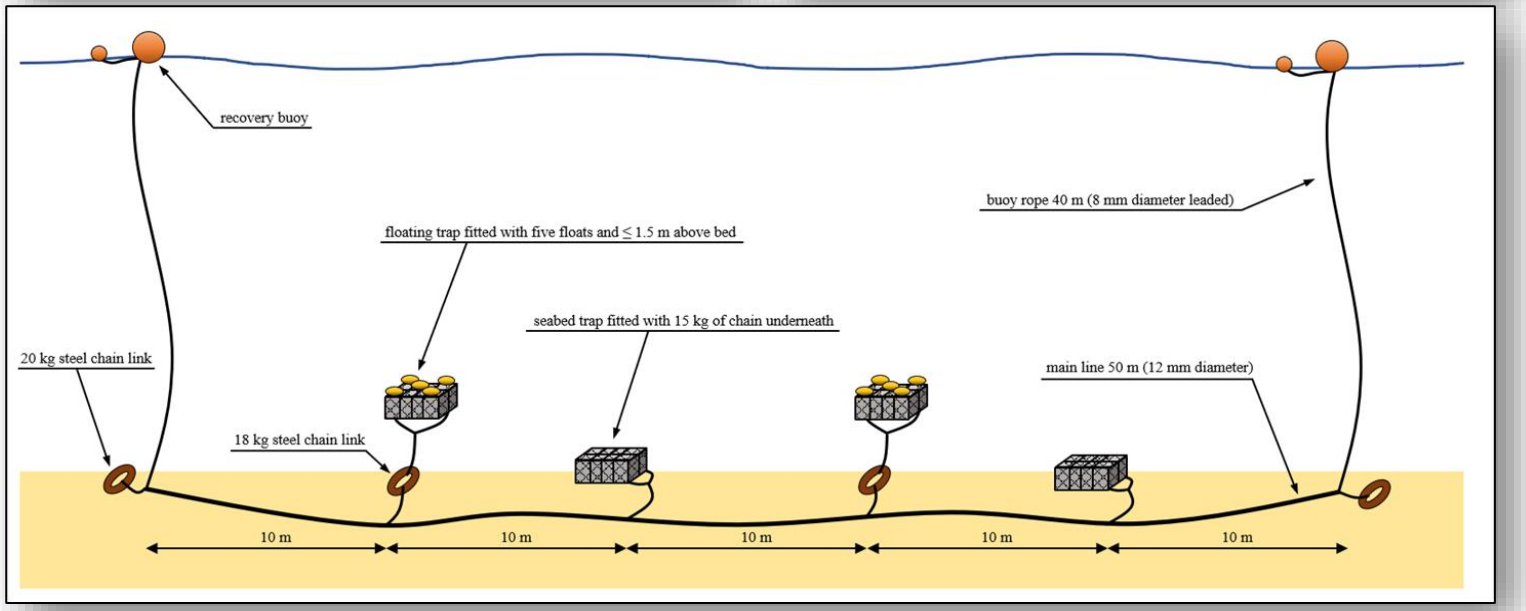
Static gear trials

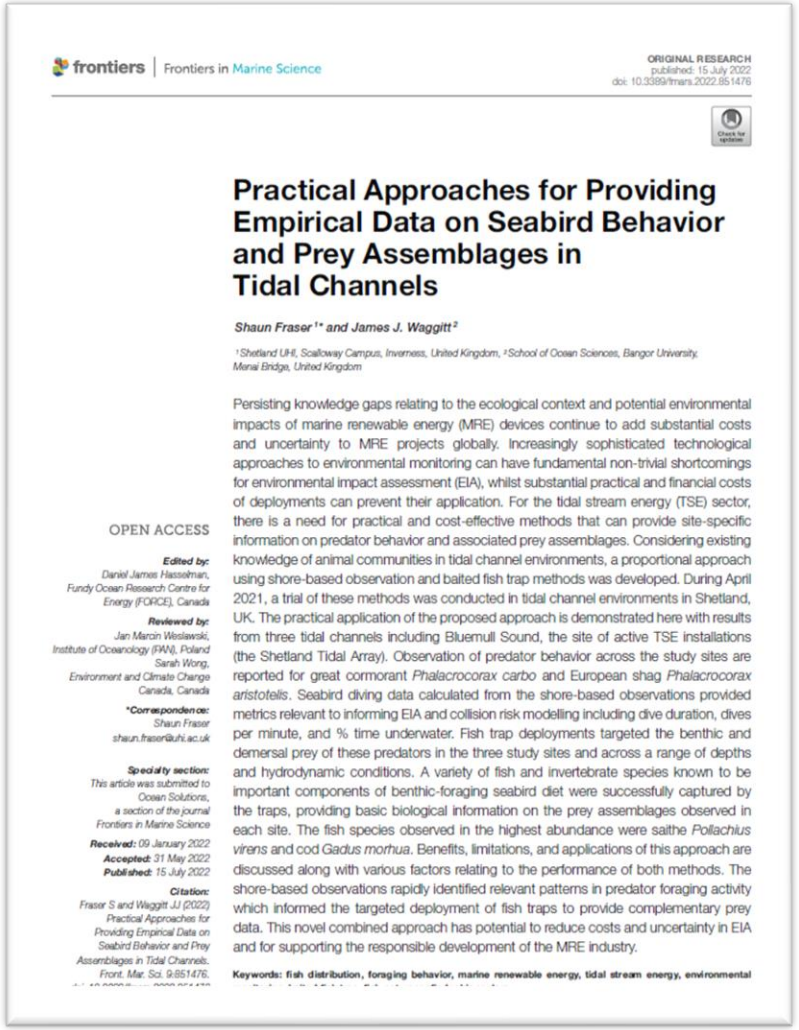
shaun.fraser@uhi.ac.uk

Various fish trap/pot designs trialled

- Most recent trial of wrasse traps in tidal environments







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ORIGINAL RESEARCH
published: 15 July 2022
doi: 10.3389/fmars.2022.851478

Practical Approaches for Providing Empirical Data on Seabird Behavior and Prey Assemblages in Tidal Channels

Shaun Fraser[1]* *and James J. Waggitt*[2]

[1]Shetland UHI, Scalloway Campus, Inverness, United Kingdom, [2]School of Ocean Sciences, Bangor University, Menai Bridge, United Kingdom

Persisting knowledge gaps relating to the ecological context and potential environmental impacts of marine renewable energy (MRE) devices continue to add substantial costs and uncertainty to MRE projects globally. Increasingly sophisticated technological approaches to environmental monitoring can have fundamental non-trivial shortcomings for environmental impact assessment (EIA), whilst substantial practical and financial costs of deployments can prevent their application. For the tidal stream energy (TSE) sector, there is a need for practical and cost-effective methods that can provide site-specific information on predator behavior and associated prey assemblages. Considering existing knowledge of animal communities in tidal channel environments, a proportional approach using shore-based observation and baited fish trap methods was developed. During April 2021, a trial of these methods was conducted in tidal channel environments in Shetland, UK. The practical application of the proposed approach is demonstrated here with results from three tidal channels including Bluemull Sound, the site of active TSE installations (the Shetland Tidal Array). Observation of predator behavior across the study sites are reported for great cormorant *Phalacrocorax carbo* and European shag *Phalacrocorax aristotelis*. Seabird diving data calculated from the shore-based observations provided metrics relevant to informing EIA and collision risk modelling including dive duration, dives per minute, and % time underwater. Fish trap deployments targeted the benthic and demersal prey of these predators in the three study sites and across a range of depths and hydrodynamic conditions. A variety of fish and invertebrate species known to be important components of benthic-foraging seabird diet were successfully captured by the traps, providing basic biological information on the prey assemblages observed in each site. The fish species observed in the highest abundance were saithe *Pollachius virens* and cod *Gadus morhua*. Benefits, limitations, and applications of this approach are discussed along with various factors relating to the performance of both methods. The shore-based observations rapidly identified relevant patterns in predator foraging activity which informed the targeted deployment of fish traps to provide complementary prey data. This novel combined approach has potential to reduce costs and uncertainty in EIA and for supporting the responsible development of the MRE industry.

Keywords: fish distribution, foraging behavior, marine renewable energy, tidal stream energy, environmental

OPEN ACCESS

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Jan Marcin Weslawski,
Institute of Oceanology (PAN), Poland
Sarah Wong,
Environment and Climate Change Canada, Canada

*Correspondence:
Shaun Fraser
shaun.fraser@uhi.ac.uk

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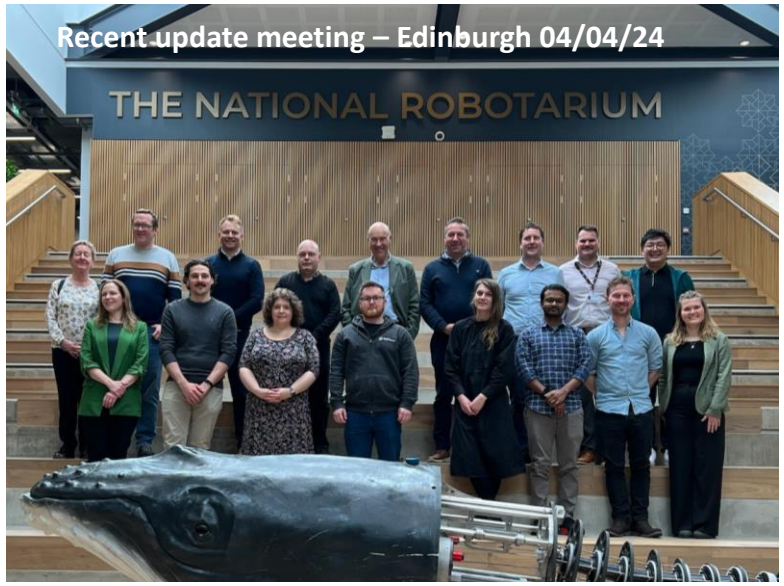
Smartrawl

shaun.fraser@uhi.ac.uk

Smartrawl
THE GATEWAY TO INTELLIGENT FISHING



Paul G Fernandes[1], Rosie Ashworth[1], David Morrison[1], Hari Lakshman[1], Thomas McGravie[1], Alex Sleat[1], Dewei Yi[2], Chris Moorhead[2] & Shaun Fraser[3]

UK SEAFOOD INNOVATION FUND
Department for Environment Food & Rural Affairs
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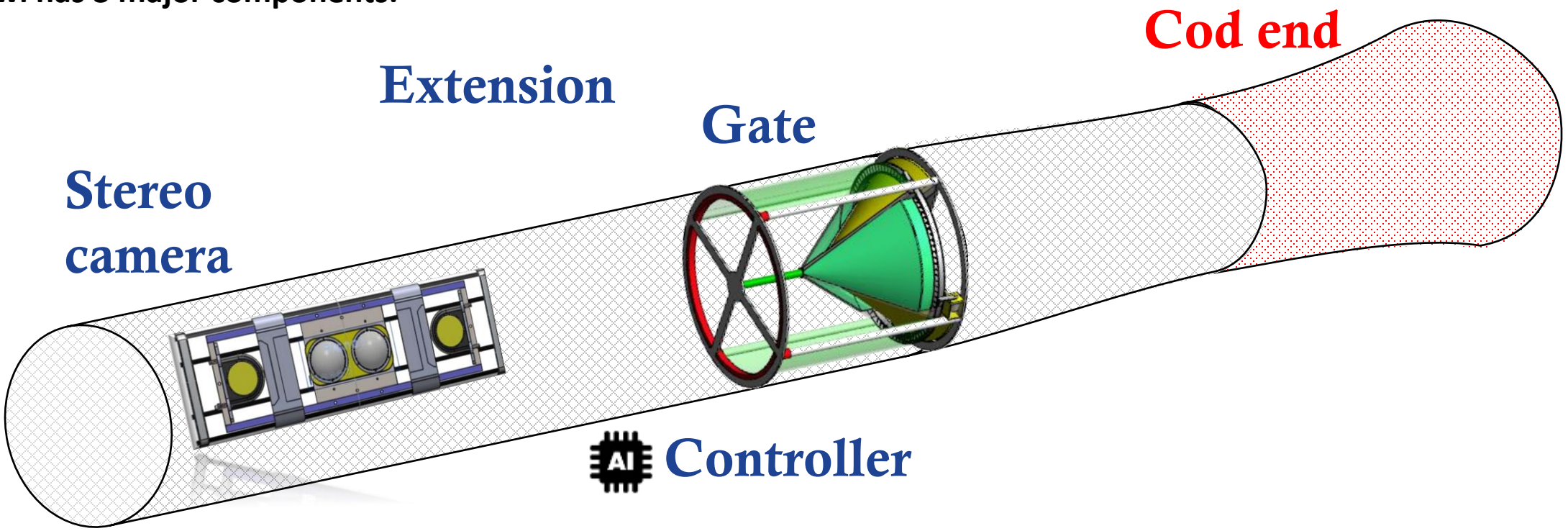
2 1495 UNIVERSITY OF ABERDEEN
3 UHI University of the Highlands and Islands Oilthigh na Gàidhealtachd agus nan Eilean
The Scottish Government

Smartrawl

shaun.fraser@uhi.ac.uk

Intelligent release of unwanted catches in-situ underwater in demersal or bottom trawl

Smartrawl has 3 major components:



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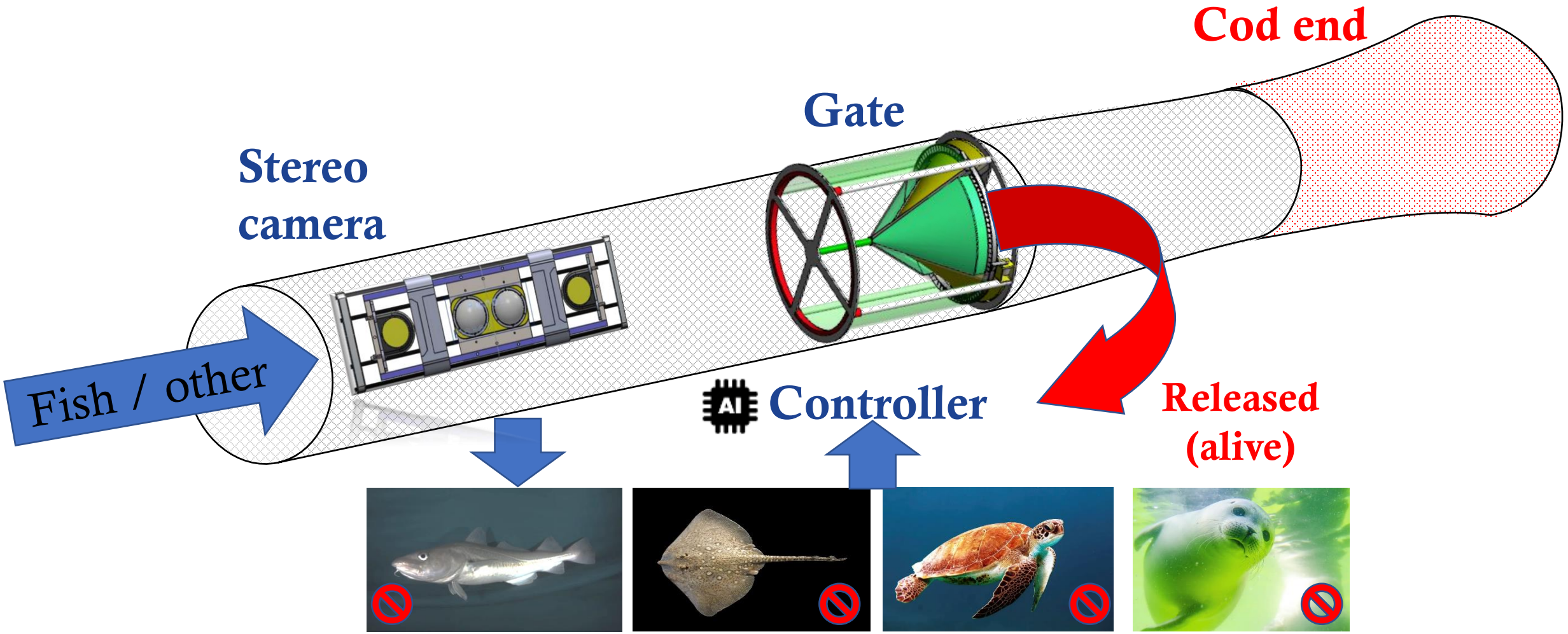
shaun.fraser@uhi.ac.uk

Smartrawl releases unwanted animals:



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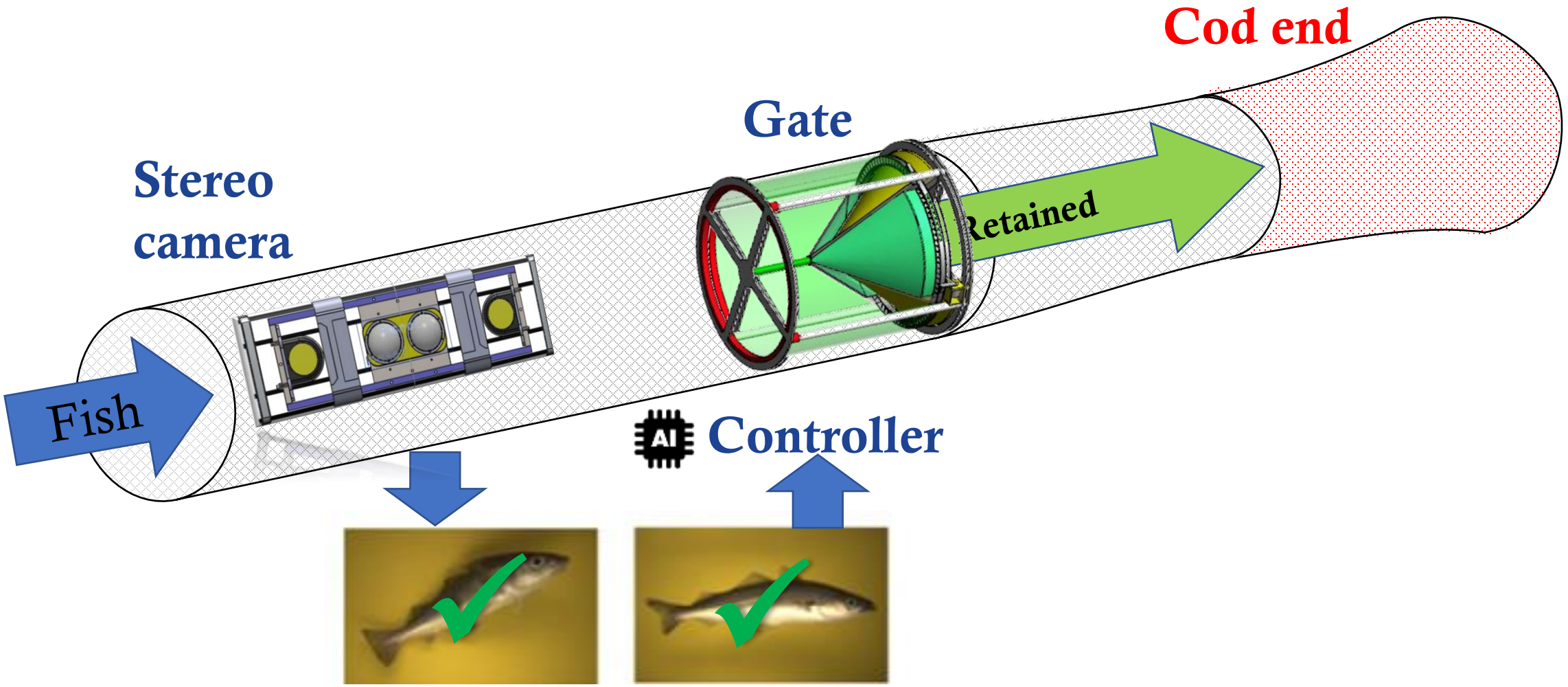
Smartrawl retains wanted animals:



Smartrawl

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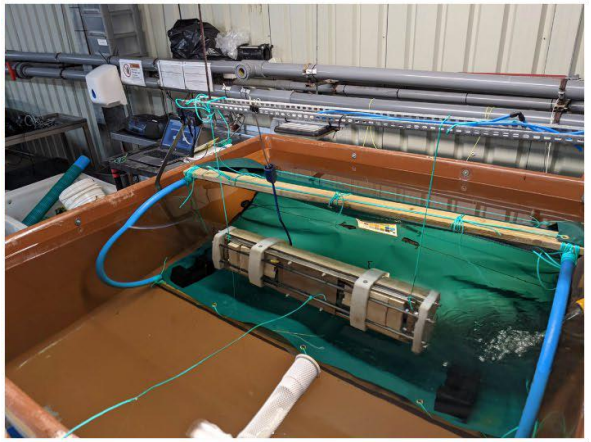
Stereo-Camera Field Trials

Initial challenges

#1 - Background material

#2 - Software optimisation

#3 - Turbidity



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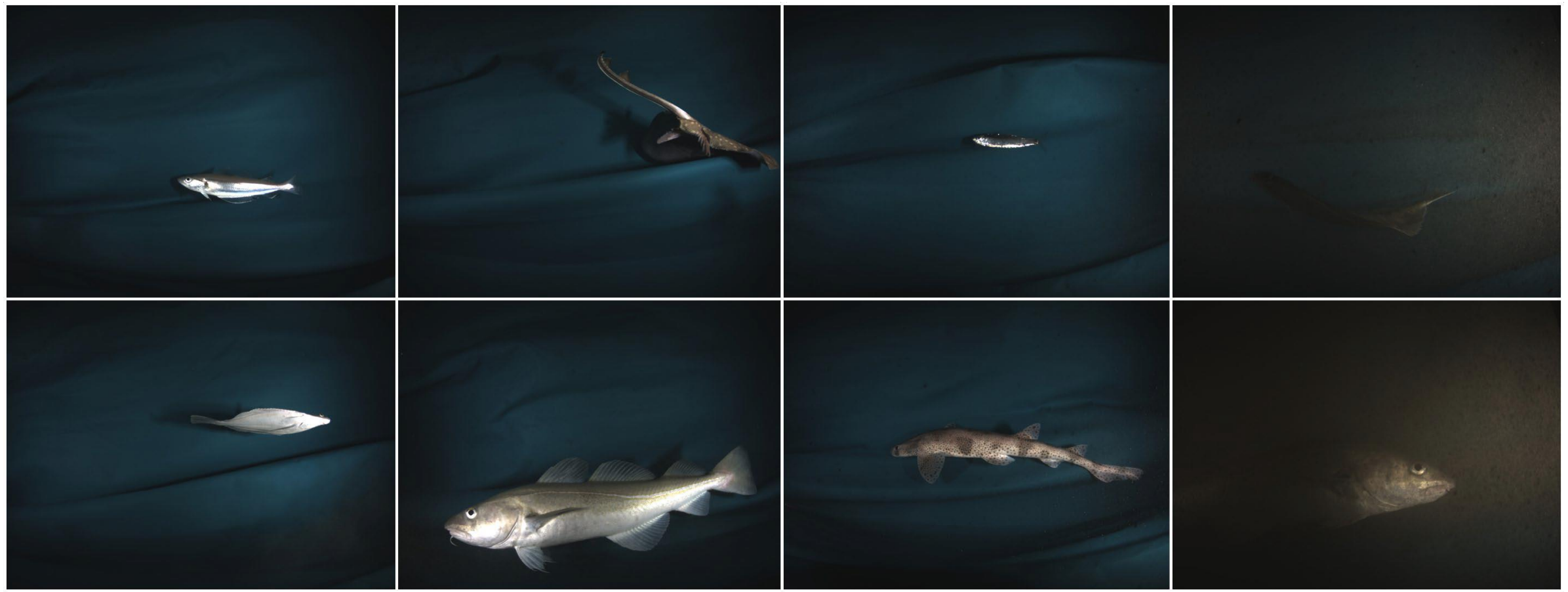
shaun.fraser@uhi.ac.uk

Stereo-Camera Field Trials



Possible to reduce impact of sediment on image quality?

2) Gear selectivity

shaun.fraser@uhi.ac.uk

Stereo-Camera Field Trials

Development of sediment suppression system
(following Sakolova et al., 2022)

Fisheries Research 251 (2022) 106323

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Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Test and development of a sediment suppressing system for catch monitoring in demersal trawls

Maria Sokolova *, Finbarr Gerard O'Neill, Esther Savina, Ludvig Ahm Krag

National Institute of Aquatic Resources, Technical University of Denmark (DTU Aqua), Willemoesvej 2, Hirtshals 9850, Denmark

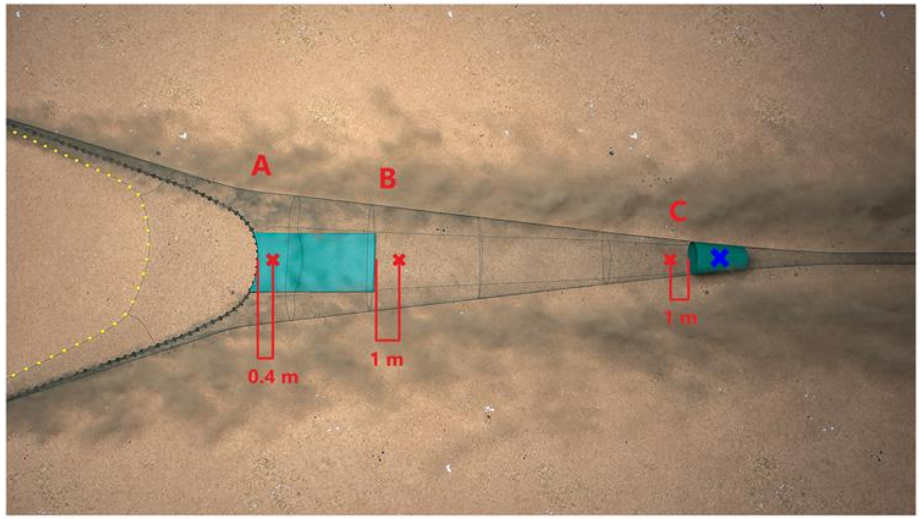
ARTICLE INFO

Handled by Dr Niels Madsen

Keywords:
In-trawl catch observation
Underwater image acquisition
Turbidity measurement
Innovation in fishing gear technology

ABSTRACT

Catch monitoring during demersal trawling is important to help fishers around the globe to cope with high bycatches. Information about catch composition during towing will allow fishers to identify and react to the presence of unwanted catch and undertake actions to avoid them during trawling. In demersal trawl fisheries, catch monitoring by the optical devices is typically challenged by the poor quality of underwater observations due to sediment mobilized during the towing process. In this study we develop, test and quantify the effect of a demersal trawl modification including sediment suppressing sheet and an in-trawl image acquisition system for catch monitoring during bottom trawling. The system is demonstrated on low-headline trawls that are typically used in mixed *Nephrops*-directed fisheries. We show that fitting a sediment suppressing sheet in the front part of the gear reduces the amount of mobilized sediment by half at three test positions inside the gear. When this sheet is used in combination with an in-trawl image acquisition system placed in the aft part of the trawl it is possible to obtain clear images of the catch during demersal trawling on the soft muddy grounds.



2) Gear selectivity

shaun.fraser@uhi.ac.uk

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2) Gear selectivity

shaun.fraser@uhi.ac.uk

31-03-22 D26 (top panel looking aft towards trailing edge of SSS)

Preliminary results indicate 49% improvement in images quality

Gate trials 2023

Objectives

1. Test new latch
2. Deploy gate 2
3. Obtain video evidence of gate turning
4. Obtain video evidence of release

Smartrawl

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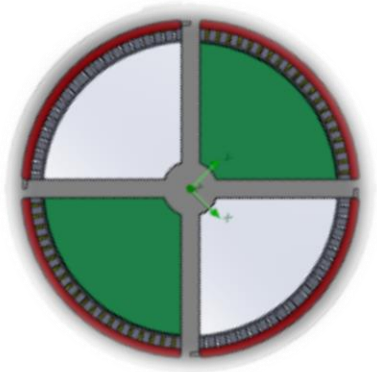
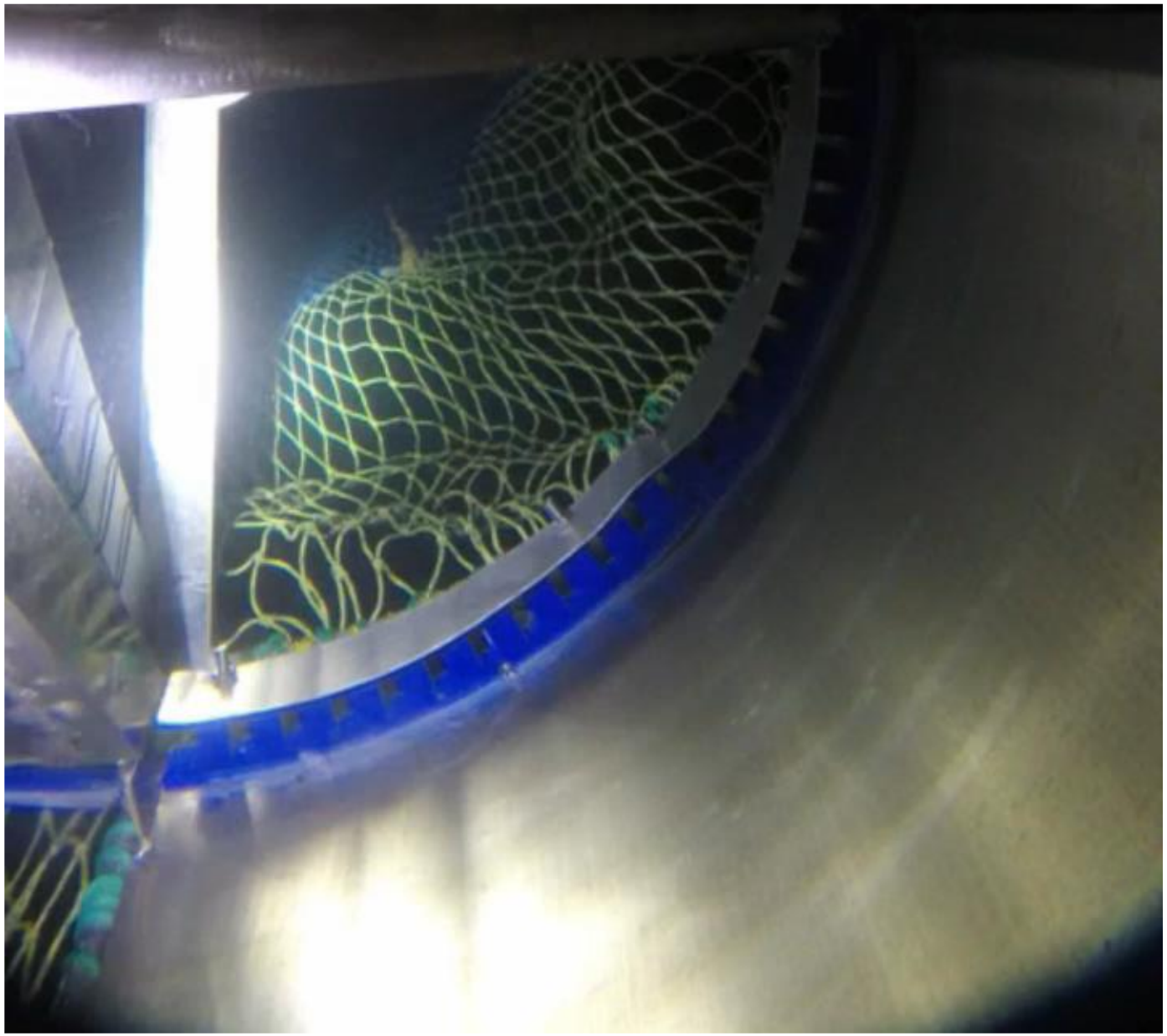
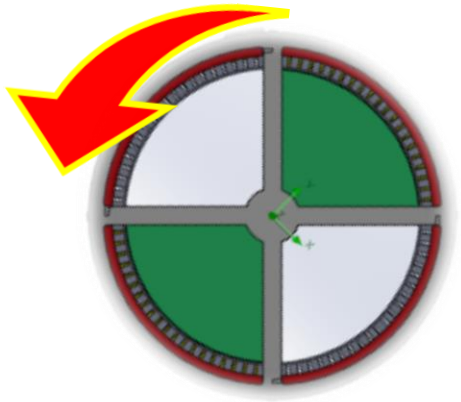
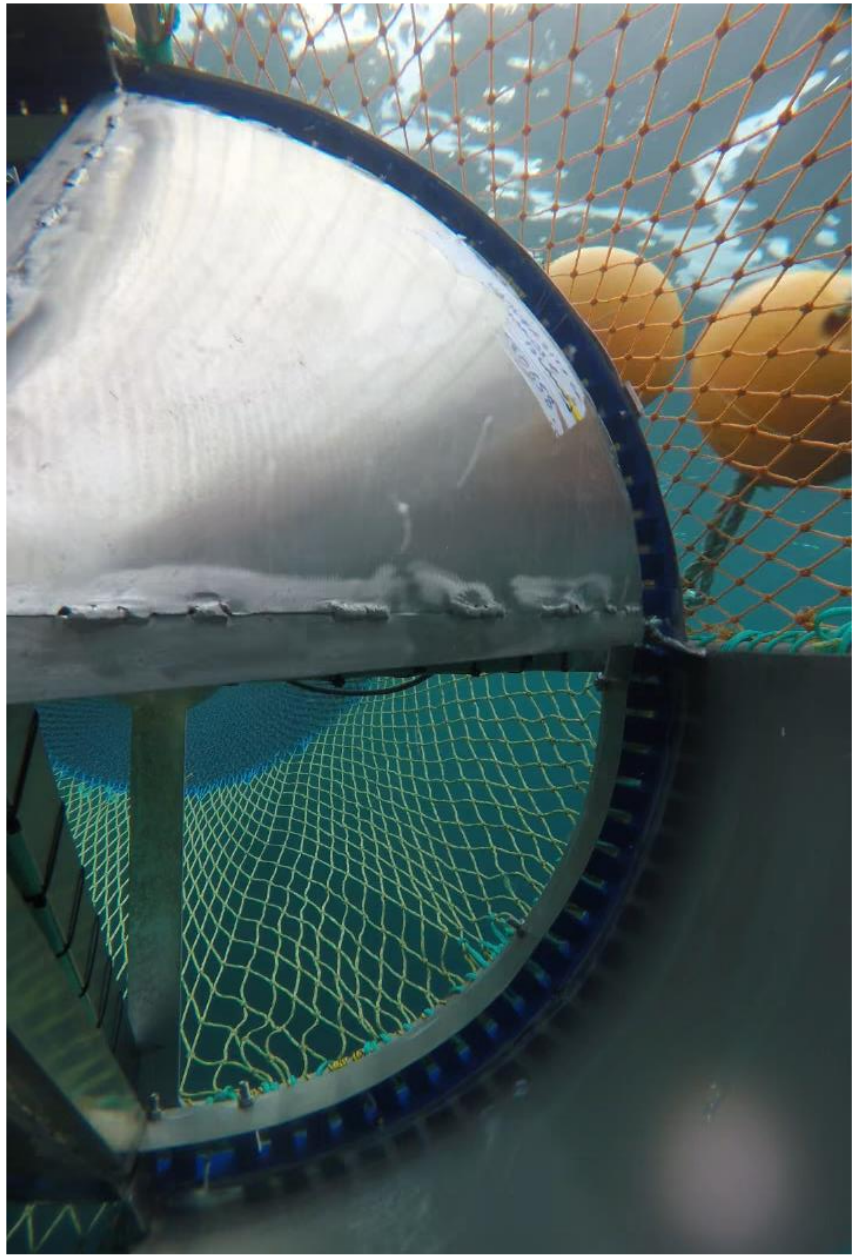
Catch footage





Rotation footage





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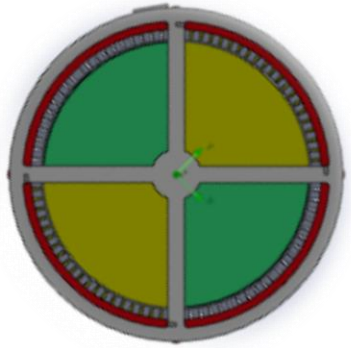
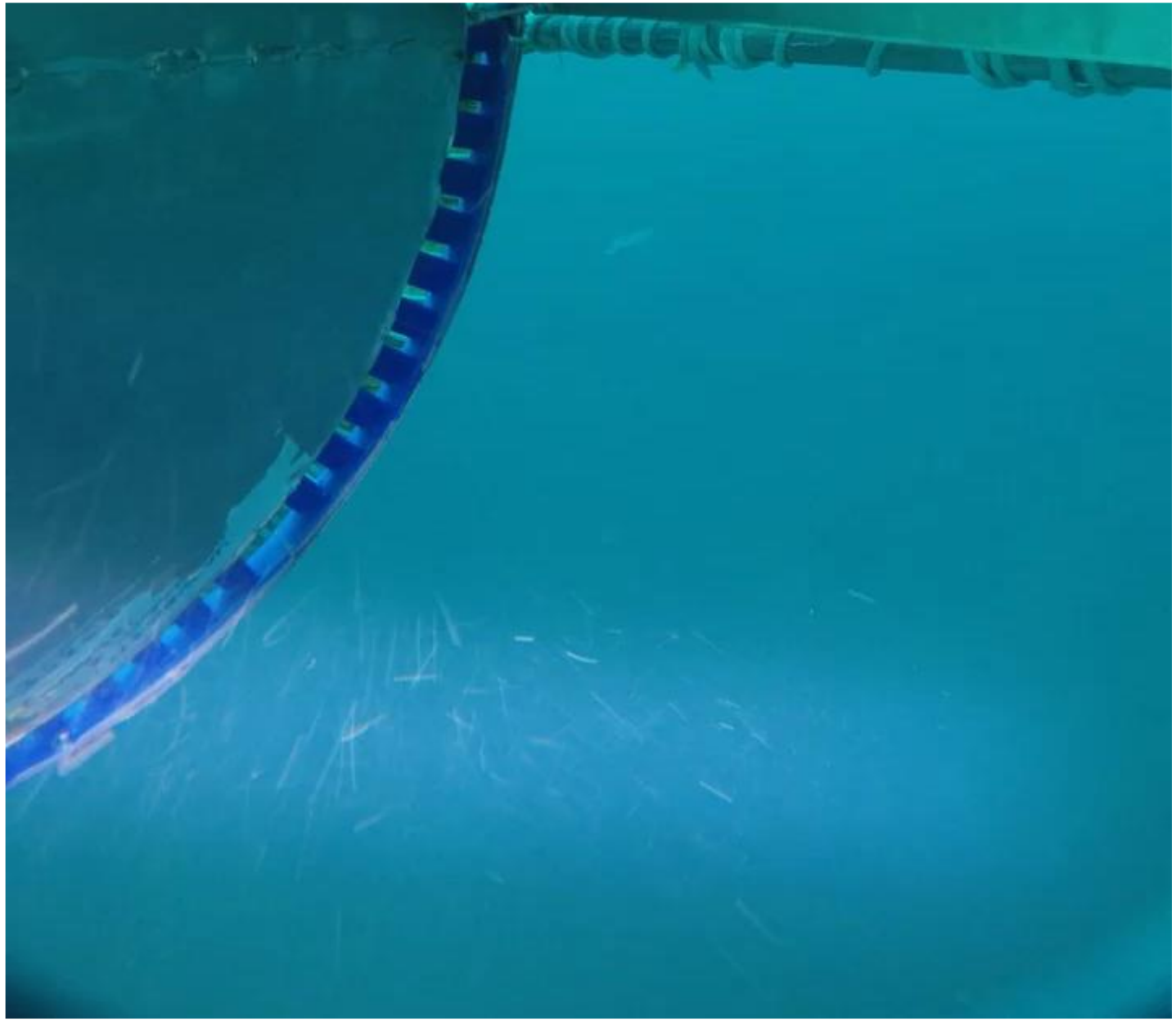
shaun.fraser@uhi.ac.uk

Release footage





Smartrawl

shaun.fraser@uhi.ac.uk

Current status

1. **Stereo camera**
   - Tried and tested ✓
   - > 1 million images collected ✓
2. **Gate [version 3]**
   - Evidence of catch & release ✓
   - Evidence of gate rotation ✓
   - Gate reconstruction in process [v4] ✓
3. **Artificial intelligence & control**
   - Algorithms developed for 8 species ✓
   - Integrated into new GPU µPC ✓
   - Logic programmed ✓
4. **Trials of integrated system planned for summer**

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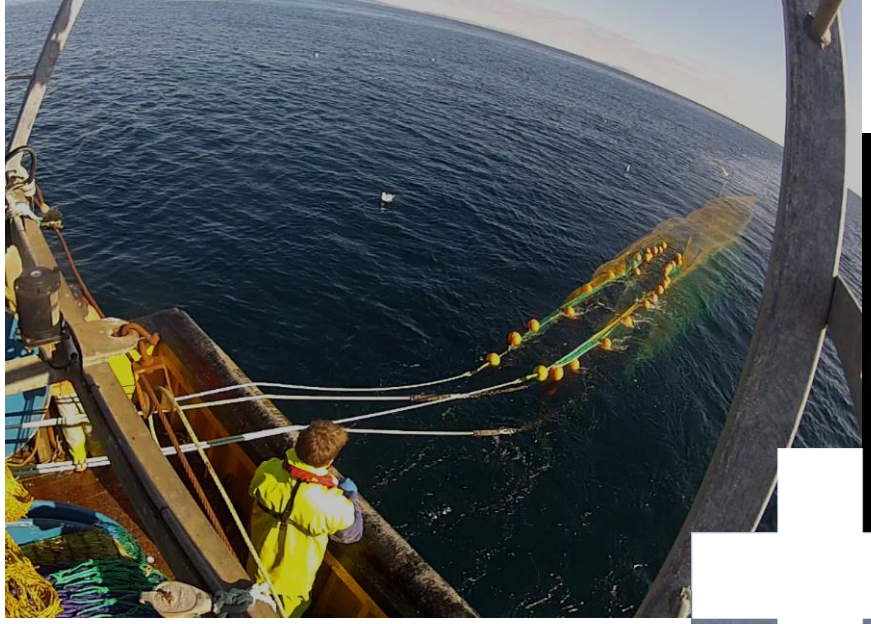

FMIG bite-size meeting:
Innovative gear selectivity – current state of play
17/04/24

Gear selectivity research at UHI Shetland

Dr Shaun Fraser
Senior Fisheries Scientist
shaun.fraser@uhi.ac.uk