Bi-annual Scottish fishing Conference, St. Andrews

Review of innovations in selectivity

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FIS11A

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Project Context

- There are several ‘push factors’ on fishers to increase selectivity of their fishing practice.
- The EU landing obligation is probably the most cited factor driving the need for fishers to avoid unwanted, or previously discarded catch:
  - ‘Wrong species’ e.g. non-target or species / stock with no quota;
  - ‘Wrong size’ e.g. below the MLS (MCRS) or command too low a market price;
  - ‘Damaged fish’ e.g. through impact with the gear, predation, mis-handling;
  - ‘Too many fish’ e.g. lack of storage space may mean that certain fish take precedence.

Project Context

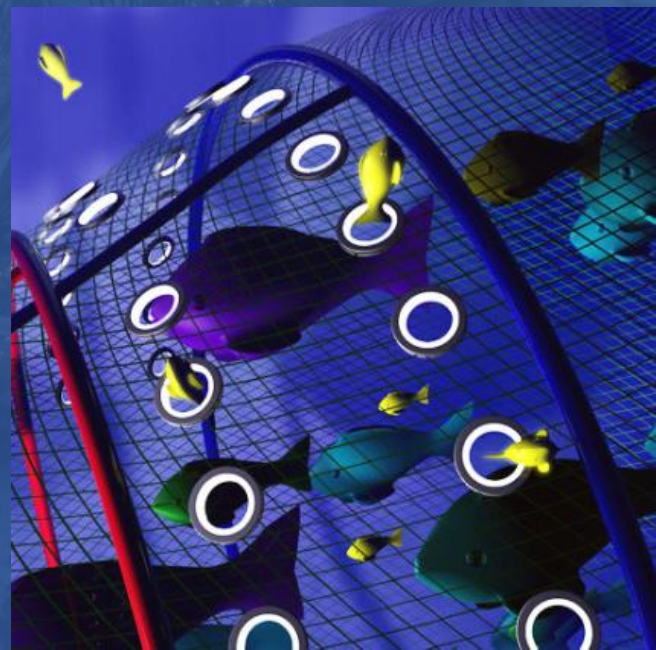
- The bulk of Scottish catches are made using only a few gear types, but variation in design, fishing practices and areas fished complicates ‘selectivity’ studies.
- Mixed fisheries in particular pose the greatest challenge.
- Since 1990s approaches to mitigate discards include:
  - TAC and quota; fishing effort and capacity; technical measures; social initiatives and market actions.
- Most relevant to selectivity, include:
  - Spatial restrictions; selective gears and methods; and increasing societal awareness of discard issues.
- Furthermore, knowledge sharing, awareness campaigns and fisher training have proved critical in increasing uptake of new approaches to selectivity.

Project Overview

- This study focused on the reduction of unwanted catch though improvement in selectivity of fishing gears and practices.
- It provided a framework for future work requirements - the products of which will support Scottish fishers to increase selectivity.
- The objectives were to:
  1. Develop a typology of selective gears, devices, practices;
  2. Identify & scope novel ideas and innovations to improve selectivity;
  3. Chart pathway and identify roadblocks to developing selective gears;
  4. Provide a strategic plan for future selectivity initiatives in Scotland; and
  5. Identify funding sources to support future selectivity research.

Typology of Gears and Practices (1/3)

- Generally speaking, the selectivity of fishing can be modified at three stages of the fishing operation:
  1. Unwanted fish can be avoided pre-capture, by adopting certain fishing behaviours, restricting where fishing is allowed, using deterrents or by modifying the profile of a gear.
  2. Unwanted fish can be allowed to escape from fishing gear post-capture
  3. Unwanted fish can be sorted and/or graded post-harvest and returned to the sea, using manual or automatic methods.



Source: https://oceangreatideas.com/2014/09/14/

Typology of Gears and Practices (2/3)

Sub-category	Fishery type	Examples
Pre-capture		
Alterations to the profile of the net	Trawl fisheries	Coverless trawl. Eliminator trawl.
Deterrents	Mainly gill & tangle nets, but also in pelagic trawl	Acoustic deterrents (pingers).
Fixed spatial closures (no-take areas)	All fishery types	Scotland's Nature Conservation MPA network.
Temporary moratoria and closures	All fishery types	Real time closures (RTCs).
Depth restrictions	Demersal trawl and bottom set gears	NAFO depth restrictions.
Behavioural practices	All fishery types	Avoidance of certain areas; Avoidance of specific species or size classes.

Typology of Gears and Practices (3/3)

Sub-category	Fishery type	Examples
Post-capture		
Alterations to mesh size, shape, orientation	Trawl fisheries, and some seine fisheries	Square mesh panels ; T90 cod end configuration.
Separator panels and devices	Applicable mainly in trawl fisheries	Inclined grid; 'Flip flap' netting grid trawl; LED light rings; Deep Vision automatic sorting system; The Fish Selector
Behavioural practices	All fishery types	Reduced setting time; Reduced vessel speed.
Post-harvest		
Sorting and grading living fish	All fisheries	Precision Seafood Harvesting; Vacuum pumping from the cod end

1. Automated post-haul selectivity system

Concept:

- Select fish after hauling; release unwanted fish. Hauled fish must be in a good condition with high chance of survival – thus applicability limited to certain species/methods.

Requirements:

- A low impact transport system: gear selection sea or storage (e.g. existing systems for Krill and Norwegian cod);
- Automated selection process and separator;
- The main technological components exist – pump transport systems and in-gear fish selectors but need adapting for this purpose

1. Automated post-haul selectivity system

- Fish pumps used in fisheries, aquaculture and fish passes.
- Technology well developed in aquaculture industry using pressure vacuums (large fish) or centrifuges (small fish) or to move fish between different heights an Archimedian screw design.
- Fish identification for selectivity purposes or fisheries research.
- Video systems for counting and measuring fish exist but need full automation;
- Prototype systems such as Deep Vision are not used to improve selectivity but the developers recognise this as a potential application.
- Automated fish separators would also be required

1. Next steps: Automated post-haul system

Considerations	Details
Goals and objectives	Develop a prototype post-haul selectivity system 1. Full feasibility study to determine candidate fisheries; 2. Research and development to design /adapt technologies; 3. Testing and refinement.
Size of project (duration / total cost)	Given technology currently available, it is considered that this research and development project might run between 24 and 48 months with an approximate budget > £150,000.
Technical expertise required	The components of the conceptual system require expertise in fish/low impact transportation, fish/product identification systems, engineering and automation. Collaboration with the fishing sector, e.g. undertaking at-sea trials.

2. Automated pre-capture avoidance system

Concept:

- Identify and track fish in the path of the net; manipulate the gear to avoid unwanted fish / increase target capture – feasible for Scottish trawl fishery

Requirements:

- Real time sensory system to provide information on fish (e.g. species, size) in the path of the net
- Gear that can be automatically or manually controlled to change shape and/or position in response to sensor derived information
- Some technological components exist –fish identification systems but their application is limited; commercial systems for gear manipulation exist some using sensors, but we are not aware of any automated systems.

2. Automated pre-capture avoidance system

Driver-less car technology – can it be adapted for fisheries?

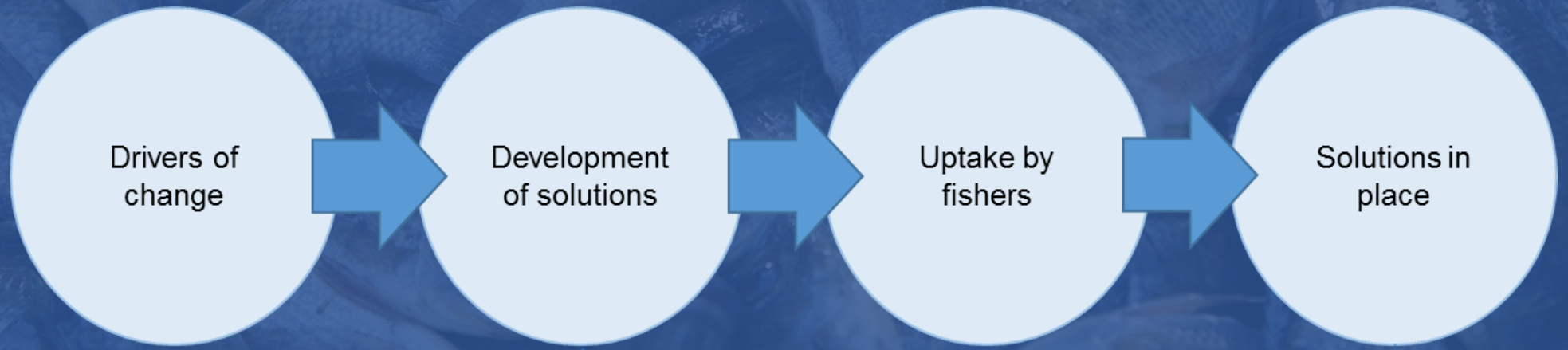
- Autonomous vehicles use a ‘sense-plan-act’ design
  - Sensors: lidar, radar, ultrasonic, infrared, GPS
  - Plan: Software algorithms can determine the best option from several possibilities
  - Act: The computer plans can be converted to actionable commands GPS, inertial navigation systems and telematics for transferring data to/from moving vehicles is used.
- UK based researchers are involved in the development of this technology and the UK Intelligent Mobility Fund has provided £20 million.

2. Next Steps: Automated pre-capture system

Considerations	Details
Goals and objectives	At least three work packages (WPs) should be established under a research framework to ensure coherence (e.g. objectives, timeframes) to develop a pre-capture selectivity system: To develop and trial (**WP1**) fish identification / tracking; and (**WP2**) gear control/manipulation; (**WP3**) combine these components into a complete working prototype.
Size of project (duration / total cost)	WP1: 24-48 months; > £500,000; WP2: 18-36 months; > £300,000; WP3: 12-18 months; > £100,000
Technical expertise required	WP1: Sensory systems; information technology; WP2: Engineering; automation; fishing gear design WP3: Gear trials; All WPs would require collaboration with the fishing sector, e.g. undertaking at-sea trials.

Pathway to Change

- Often barriers include lack of knowledge or sharing of knowledge on potential solutions and for the uptake phase fishers need to visualise the effect of a selectivity approach.
- Solutions include mechanisms for knowledge sharing (fisher-fisher, fisher-scientist); incentivising new ideas and sharing of ideas; improving linkages and collaboration between fishers and scientists; and practical means to observe the effects of new innovations



Pathway to Change

- FIS 11a identifies 4 new projects to address these barriers

Theme area	Work theme name
Cross cutting initiatives for improving development and uptake	Theme 1: Communication and exchange of knowledge
	Theme 2: Raising awareness and incentivising fishers
	Theme 3: Facilitating interdisciplinary collaboration
Specific initiatives to increase uptake	Theme 4: Visualising gear behaviour & fishing operations

- Possible sources of funding to support innovation are listed
- https://www.fiscot.org/media/1405/fis011a-revised.pdf

Fisheries Innovation Scotland

FIS011A - Developing and facilitating a range of possible future FIS projects in innovation in selectivity through on-net or alternative technologies

MRAG Ltd. 2017. Developing and facilitating a range of possible future FIS projects in innovation in selectivity through on-net or alternative technologies. A study commissioned by Fisheries Innovation Scotland (FIS) http://www.fiscot.org/ and supported by The European Maritime and Fisheries Fund and The Scottish Government.