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Preliminary assessment of a four-panel T90 codend with lastridge ropes in the Irish demersal seine net fishery

Fisheries Conservation Report

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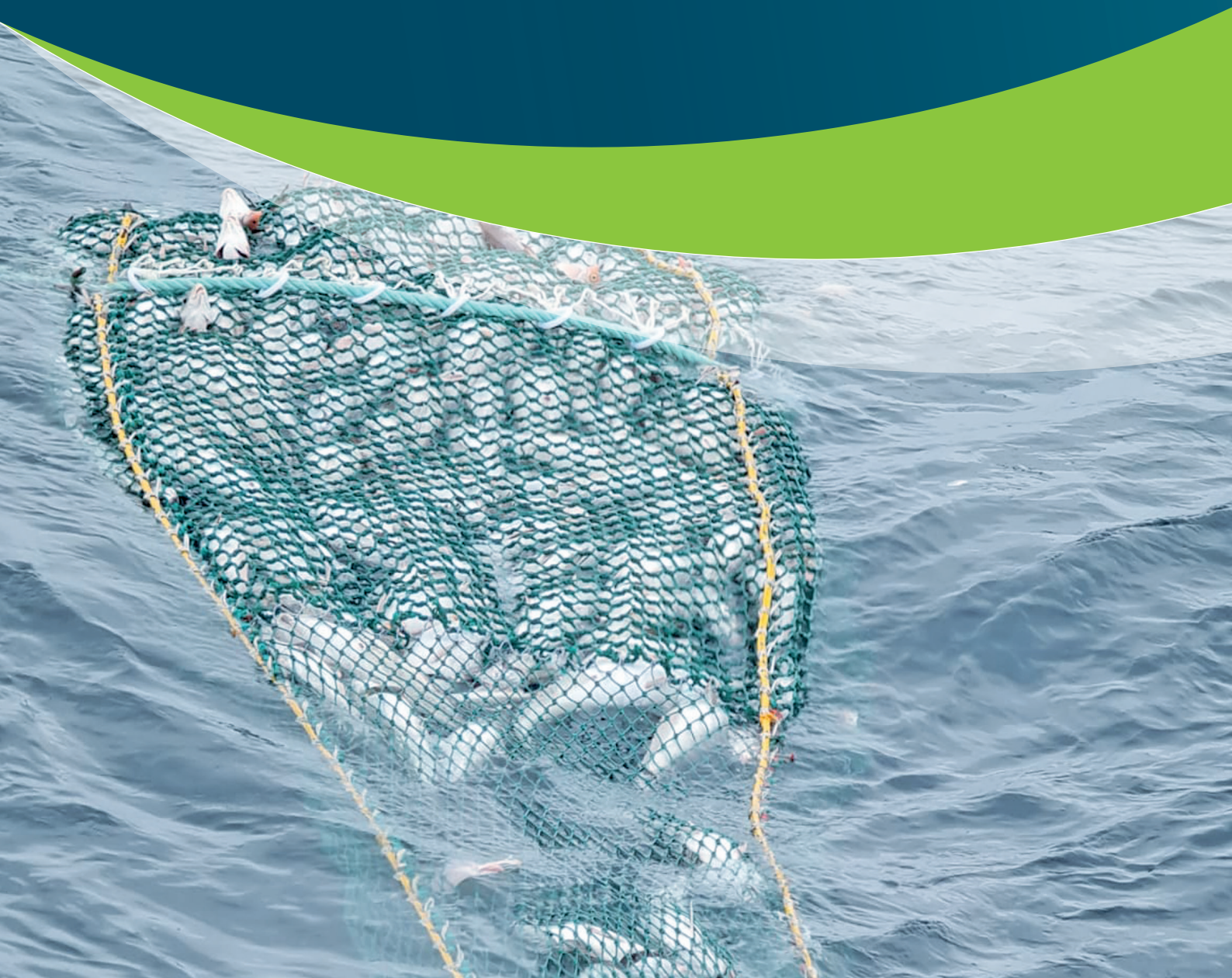

Key findings

70% reduction in small-grade haddock.

157% and 133% increases in medium and large-grade haddock.

94% increase in commercial value of haddock

34% increase in total catch value.

Major potential to optimise the value of available haddock quota.

Potential improvements in fish quality through stable four-panel codend and smaller lifts of fish aboard the vessel.

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Introduction

Haddock is a key target species for Irish seine net vessels with additional monthly quotas allocated to this fleet. A previous trial demonstrated the benefits of using 100 mm T90, or mesh turned 90°, compared to 120 mm standard diamond (T0) mesh in the codend on board a seiner targeting haddock. Very few undersize fish were caught in either gear but almost twice as much market sized haddock were caught in the T90 gear (McHugh et al., 2019). Hence, the T90 codend has become increasingly popular with Irish seine net vessels.

Further development of this gear has recently occurred in Canadian, Norwegian and Icelandic fisheries where shortened lastridge ropes were attached to four-panel T90 codends to further optimise species size selectivity (Cheng et al., 2020; Ingólfsson and Brinkhof, 2020; Einarsson et al., 2021).

During fishing traditional two-panel diamond mesh codends expand and take on a bulbous shape as water flow acts on the accumulated catch (Robertson and Stewart, 1988.). The meshes immediately forward of the catch are forced open and it is mainly through these meshes that fish escape. Drag causes the meshes further forward to be stretched laterally, i.e., mesh openings are reduced.

Lastridge ropes, attached shorter than the stretched-mesh length along codend selvedges, help increase and maintain mesh openings and optimise codend selectivity (Isaksen and Valdemarsen, 1990; Sistiaga et al., 2021). Four-panel codends are considered to maintain a more stable shape than two panel codends which may be the result of the square cross section and doubling of the number of selvedges.

Teaming up with an Irish seiner and Cathal Boyle and colleagues at Swan Net Gundry (SNG), this preliminary trial aimed to test a new four-panel 100 mm T90 codend design with shortened riblines or lastridge ropes along each of the selvedges.

Figure 1. Trial location (hatched area) in the Celtic Sea

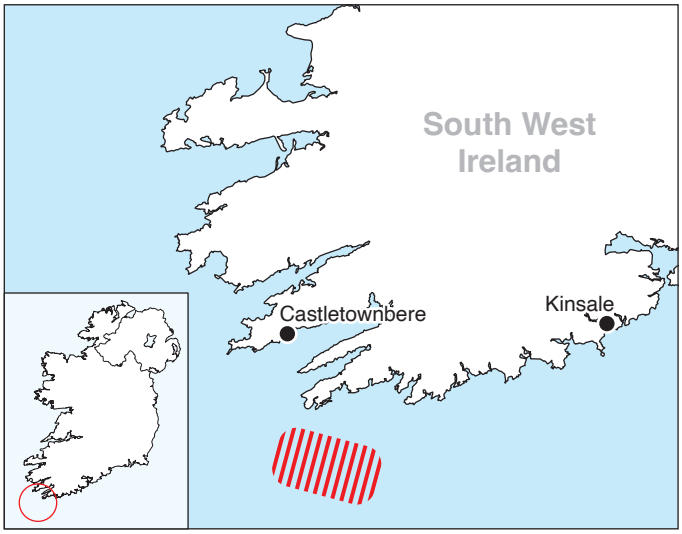
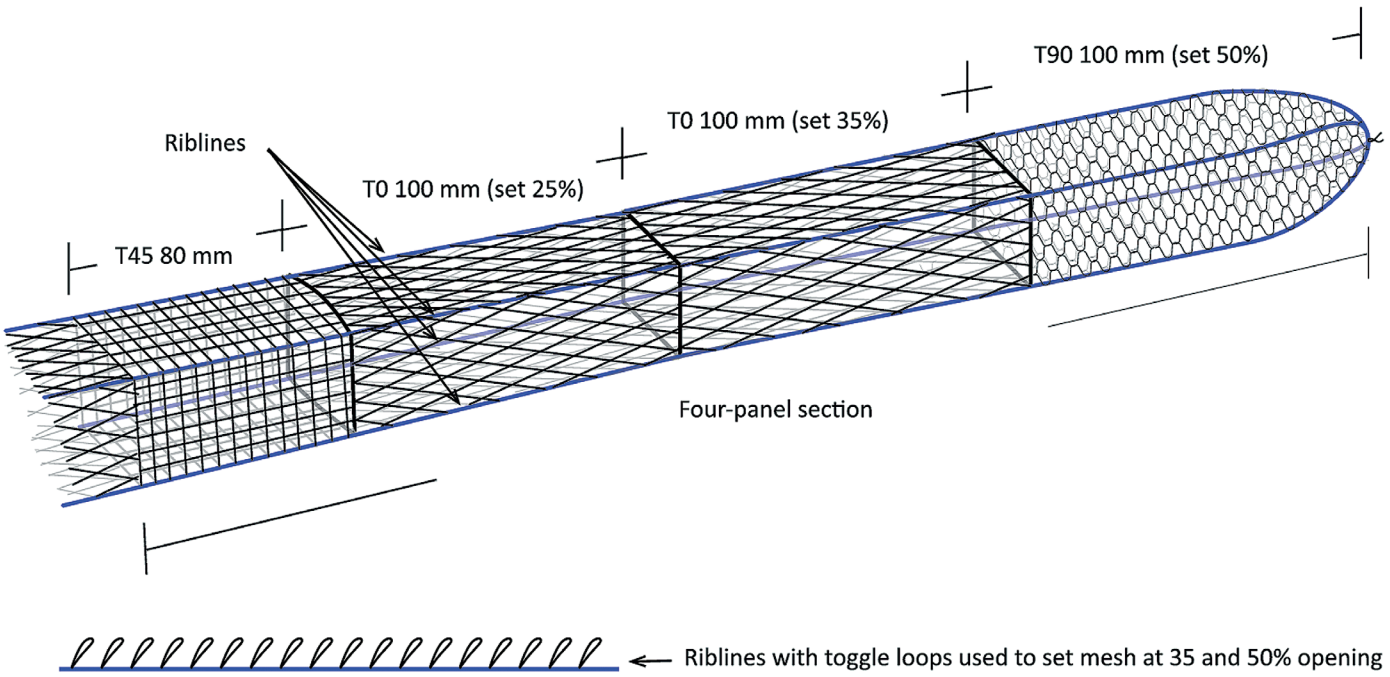


Figure 1. Diagram of test gear by Dr Matthew McHugh



Methods

The trial was carried out on board a 24 m Irish vessel targeting hake and haddock using the Scottish seine method in ICES divisions 7g and 7j of the Celtic Sea (Figure 1). The trip was carried out over four days from the 14th to the 17th of November 2021. The name of the vessel has been excluded due to use of economic data. The control gear comprised a standard 100 mm T90 codend and 100 mm diamond mesh (T0) extension in two-panel configuration.

The test gear comprised four sections in a four-panel configuration:

1. 80 mm Ultracoss knotless square (T45) mesh adaptor section;
2. 100 mm diamond (T0) mesh tapered extension section;
3. 100 mm diamond (T0) mesh extension section;
4. 100 mm T90 mesh codend.

The relatively small four-panel 80 mm square mesh section was used to adapt the four-panel codend to the two-panel net. 12 mm Dyneema lastridge ropes were attached to the selvedges of the test gear by knotting on in the forward two sections and toggling and lacing in the aft two sections (Figure 2).

Lastridge rope length was the same as the stretched mesh length in the forward square mesh section; 3% and 6% shorter for the two diamond mesh sections; 13.5% shorter than the T90 codend.

Based on SNG calculations, the mesh openings were fixed at 25% and 35% in the four-panel 100 mm diamond mesh sections and at 50% in the 100 mm T90 codend. The trial vessel used two identical seine nets made by Jackson Trawls with control and test gears attached for alternate-haul deployments (Table 1).

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Table 1. Gear characteristics

Seine Net	Manufacturer	Jackson Trawls
	Sweep length (m)	55
	Headline (m)	60
	Footrope (m)	68
	Seine rope length (m)	2860 × 2
	Seine rope diameter (mm)	32
Control gear codend	Mesh orientation	T90 mesh
	Nominal mesh size (mm)	100
	Measured mesh size (mm)	104
	Length (no. meshes)	49.5
	Circumference (no. meshes)	80
Control gear extension	Mesh orientation	Diamond mesh (T0)
	Measured mesh size (mm)	104
	Length (no. meshes)	100
	Circumference (no. meshes)	100
Test gear section 1	Mesh orientation	Square mesh (T45)
	Nominal mesh size (mm)	80
	Measured mesh size (mm)	82
	Circumference (meshes round)	88
	Length (no. Meshes)	50
Test gear section 2	Mesh orientation	Diamond mesh (T0)
	Nominal mesh size (mm)	100
	Measured mesh size (mm)	109
	Circumference (meshes round)	Tapering from 128 to 100
	Length (no. meshes)	49.5
Test gear section 3	Mesh orientation	Diamond mesh (T0)
	Nominal mesh size (mm)	100
	Measured mesh size (mm)	110
	Circumference (no. meshes)	102
	Length (no. Meshes)	49.5
Test gear section 4	Mesh orientation	T90 mesh
	Nominal mesh size (mm)	100
	Measured mesh size (mm)	110
	Circumference (no. meshes)	80
	Length (no. Meshes)	50

Work was conducted on a self-sampling basis in line with Covid restrictions. The skipper and crew followed an agreed protocol where wanted and unwanted catches were sorted by species, graded where appropriate, weighed, and recorded. Plaice, megrim, lemon sole and witch were combined as commercial flatfish species due to low catches. Other species such as John Dory, conger eel and rays were combined as other commercial species. Catches of non-commercial species were extremely low.

Mean catch weights of key species were plotted using a histogram with standard error bars included as a measure of variability. Sales notes were used to apply price data to species and grades. The number of hauls was standardised to 7 for each gear type to facilitate effective comparison of commercial catch values across gears.

Results

A total of 14 hauls were carried out, eight with the test and six with the control gear. Fishing was slack for the first six hauls but improved for the remainder of the trip. Haddock and hake were the main species caught.

The test gear caught 70% fewer small-grade haddock, and 157% and 133% more medium and large-grade haddock. Very few undersize fish occurred in either gear (Table 2, Figure 3). Flatfish and cod catches were sporadic during the trial. Monkfish catches were larger in the control gear, but this was more likely due to differences in abundance between hauls as differences in selectivity were unlikely due to monkfish size.

Figure 3. Mean catch weight per haul

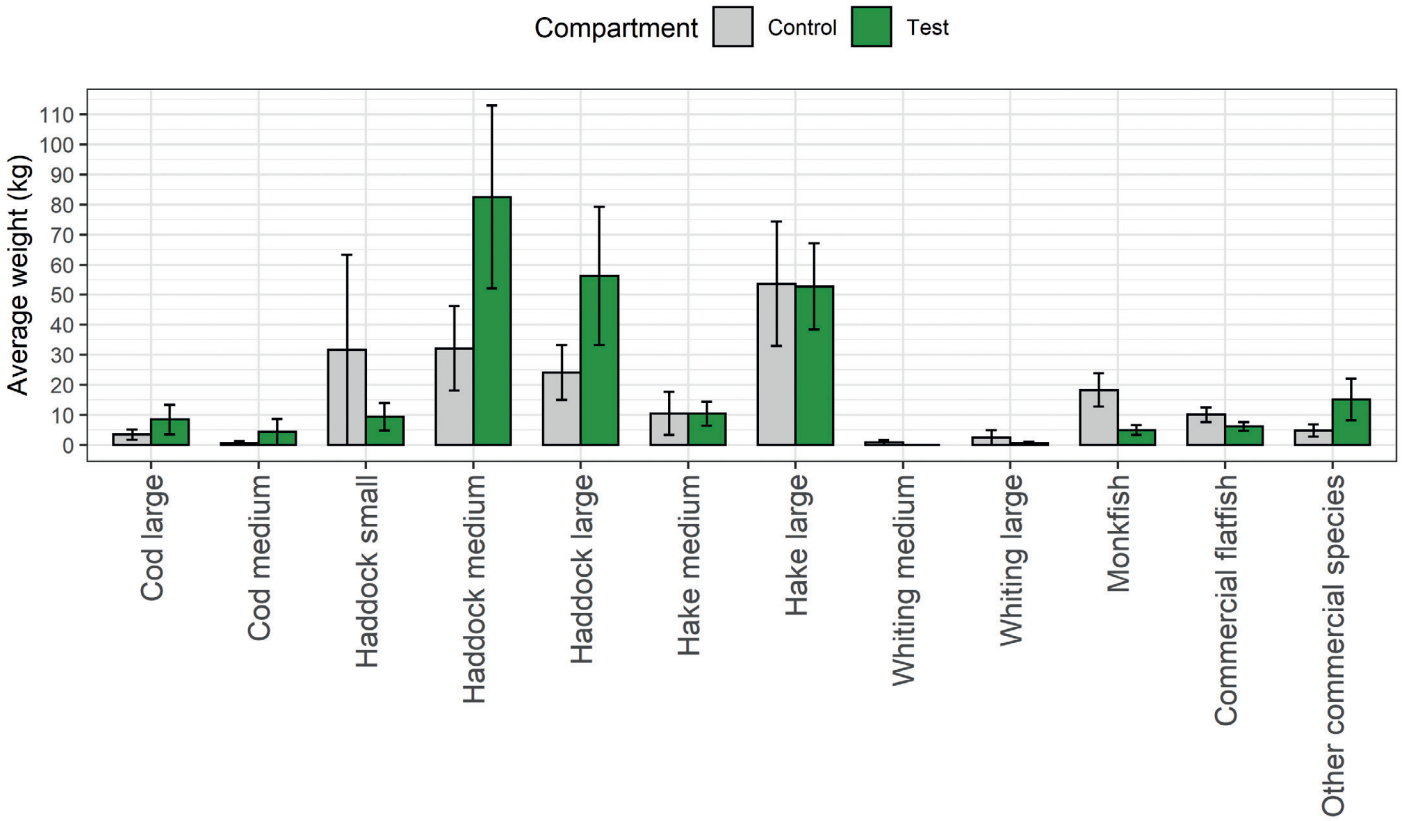

Table 2. Mean catches of key species per haul

Species	Control (kg)	Test (kg)	Difference (%)
Haddock small	31.7	9.4	-70
Haddock medium	32.2	82.5	157
Haddock large	24.2	56.3	133
Hake medium	10.5	10.5	0
Hake large	53.7	52.8	-2

Discussion

Results are preliminary due to the self-sampling nature of the trial. However, the new four-panel T90 coded with lastridge ropes was observed to catch substantially less small-grade and substantially more large-grade haddock compared with the conventional two-panel T90 codend. Hake catches were similar between gears possibly due to the relatively large size of this species in relation to the mesh sizes and orientations used. Very few undersize fish were caught in either test or control gears in line with previous assessments of 100 mm T90 codends (McHugh et al., 2019; Oliver et al., 2020a).

Major reductions in small fish also potentially reduces fishing mortality likely leading to improved sustainability of the haddock stock. The reduction in small grade haddock was likely due to increased mesh opening in the tuned T90 codend. Greater catches of larger haddock could have been caused by increased water flow through the net due to greater mesh openings, and potentially increased headline height associated with reduced drag. Incorporating headline depth sensors in future work could help elucidate these potential effects.

Table 3. Standardised total catch values

Species	Control (€)	Test (€)
Cod	88	270
Conger eel	15	20
Haddock	1824	3531
Hake	1684	1661
John Dory large	65	110
Lemon sole large	0	31
Megrim	193	131
Monkfish large	526	126
Plaice	84	29
Skates/rays	12	91
Turbot	0	32
Whiting	46	9
Witch	0	47
Total	**4536**	**6087**

The total increase in value of haddock catches was 94% contributing to a total increase in catch value of all species of 34% (Table 3). Sales notes data showed that medium and large haddock were worth 75% more than small round haddock. This suggests that the new gear has major potential to optimise the value of haddock quota.

Monthly catch limits for haddock are likely to be reached sooner using the new gear which could lead to early cessation of fishing effort under the landing obligation. Fewer trips would be required to reach the haddock quota, however, which could lead to improved profitability through reduced operational costs associated with this more efficient fishing method.

Hake was the most commercially important part of the catch after haddock. Monthly quotas are similar for the two species but the vessel caught more than twice as much haddock compared with hake with the new gear. This suggests that early cessation of fishing effort might detract from optimal utilisation of the hake quota.

Caught in depths of up to 700 m on the edge of the continental shelf, hake are, however, more widely distributed throughout the Celtic Sea compared with haddock which are caught in depths less than 200 m (MI, 2021). Also, according to the skipper of the trial vessel, the two species are often caught together except in the Spring when hake can be targeted separately. Hence, some tactical targeting of hake and avoidance of haddock might help optimise quotas for both species.

Continued targeting of monkfish and flatfish species while avoiding haddock and low quota cod is possible using a modified seine. A Norwegian low-headline seine has been shown to reduce catches of haddock by 98% and cod – a low quota species in the Celtic Sea - by 94% compared with a conventional demersal seine while maintaining catches of flatfish species and monkfish (Ingólfsson et al., 2019). Plaice is also a quota limited species in the Celtic Sea but based on a previous BIM study (Oliver et al., 2020b), seiners can avail of a survivability exemption for this species.

Demersal seining is already considered to be a relatively fuel-efficient fishing method (Barange et al., 2018). Widespread adoption of the more operationally efficient test gear would further assist the seine net fleet in meeting economic and environmental challenges in relation to fossil fuel dependence and carbon emissions (Browne et al., 2021). Further field testing and bioeconomic analysis would greatly assist in determining the benefits of these novel seine gears.

Potential additional benefits of the modified T90 codend include improved fish quality due to the stable four-panel codend shape (see cover photo) and smaller quantities of fish lifted aboard; greater gear durability as the lastridge ropes relieve pressure on the codend meshes. Longer term monitoring of the gear performance is planned to assess the latter.

Previous BIM trials have used relatively long adaptor sections, between 7 and 9 m long, to facilitate the transition from two-panel trawls to four-panel selective gears such as the SELTRA and the dual codend (Tyndall et al., 2017; Cosgrove et al., 2016). In the current study, SNG's experience with pelagic trawls suggested that square mesh achieves a similar objective in a shorter section with the added benefit of increased water flow and less drag due to the fully open square meshes. This modification worked well although some smaller fish got stuck or 'meshed' in this section on occasion. Further assessment of the adaptor section is planned.

Preliminary testing of the new four-panel T90 codend with lastridge ropes suggests that it is a highly effective gear modification in the Irish demersal seine-net fishery. It has also been proven to be effective in bottom trawl fisheries in other countries (Cheng et al., 2020; Einarsson et al., 2021). Hence, this gear has major potential to improve the environmental and economic sustainability of Irish demersal seine and trawl fisheries.

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