Further assessment of four-panel T90 codends with shortened lastridge ropes in the Irish demersal seine-net fishery

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KEY FINDINGS

Three trials conducted to date generally demonstrate:

- Substantial increases in catches of larger more valuable round fish and flat fish
- Reduced catches of smaller less valuable round fish
- Almost no retention of undersize fish
- Increased catch quality and price differentials
- The gear has major potential to further improve the environmental and economic sustainability of the Irish demersal seine-net fishery

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INTRODUCTION

BIM is working with the Irish Fishing Industry to reduce unwanted catches, optimise quotas and improve operational and energy efficiency.

The 100 mm T90 (turned 90°) codend is a popular gear option (EU 2019/1241) with the Irish demersal seine net fishers operating in the Celtic Sea. Benefits include more stable mesh openings when compared with diamond (T0) mesh which likely leads to reduced catches of small round bodied fish (Cheng et al., 2022), greater catches of large fish and improved catch quality (Digre et al., 2010).

BIM previously conducted a preliminary assessment of a four-panel T90 codend with lastridge ropes (also called riblines) to further improve the performance of the T90 codend. The results were very positive with substantial increases in catches of large and medium grade haddock compared with a standard two-panel T90 codend (Browne et al., 2021b). The trial vessel continued using the four panel codend after the trial.

Here, we outline the results of two further trials of the four-panel T90 codends with lastridge ropes onboard demersal seine vessels. Previous BIM research on standard 100 mm T90 codends has demonstrated how juvenile or below minimum conservation reference size (MCRS) fish are effectively negated due to escapement through codend meshes (Browne et al., 2021b, 2024; McHugh et al., 2019). The main focus of these latest trials was to test the effectiveness of the four-panel codends in reducing catches of smaller less valuable round fish and increasing catches of larger more valuable fish.

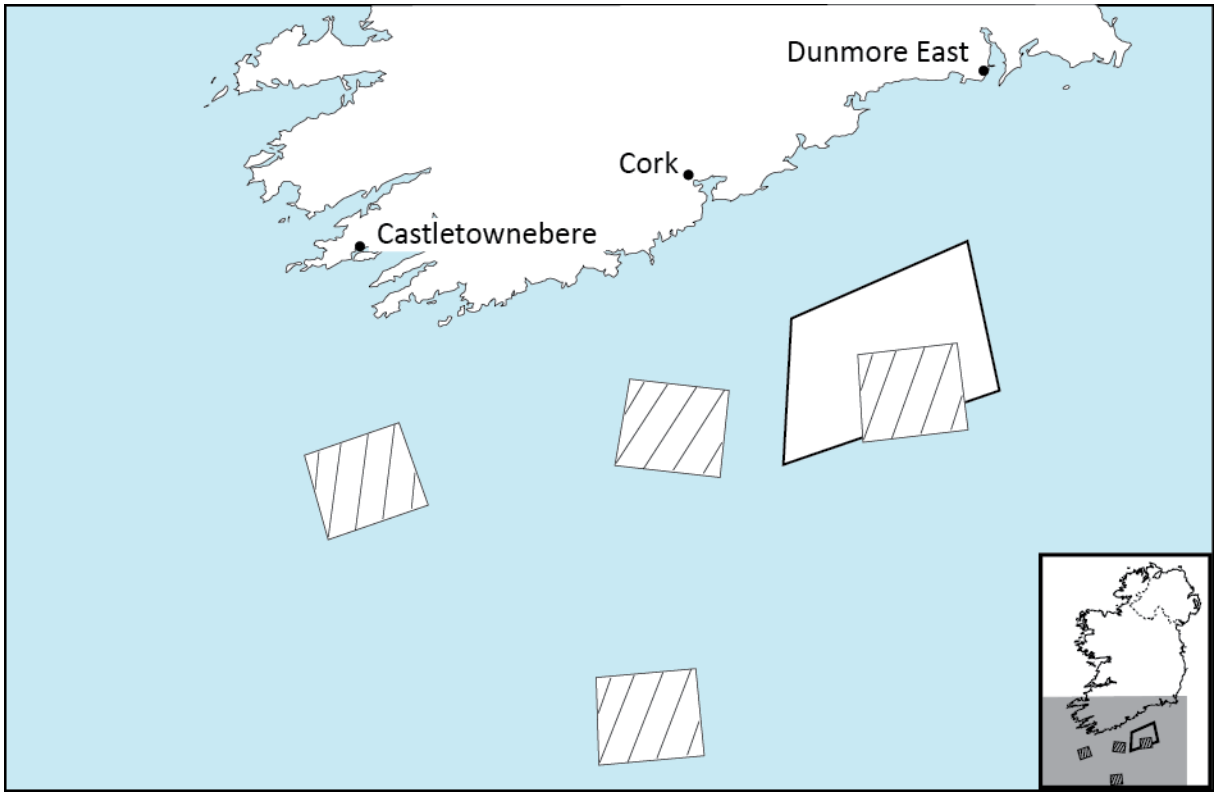

Figure 1. Locations of Trial 1 (hatched area) and Trial 2 (unhatched areas)

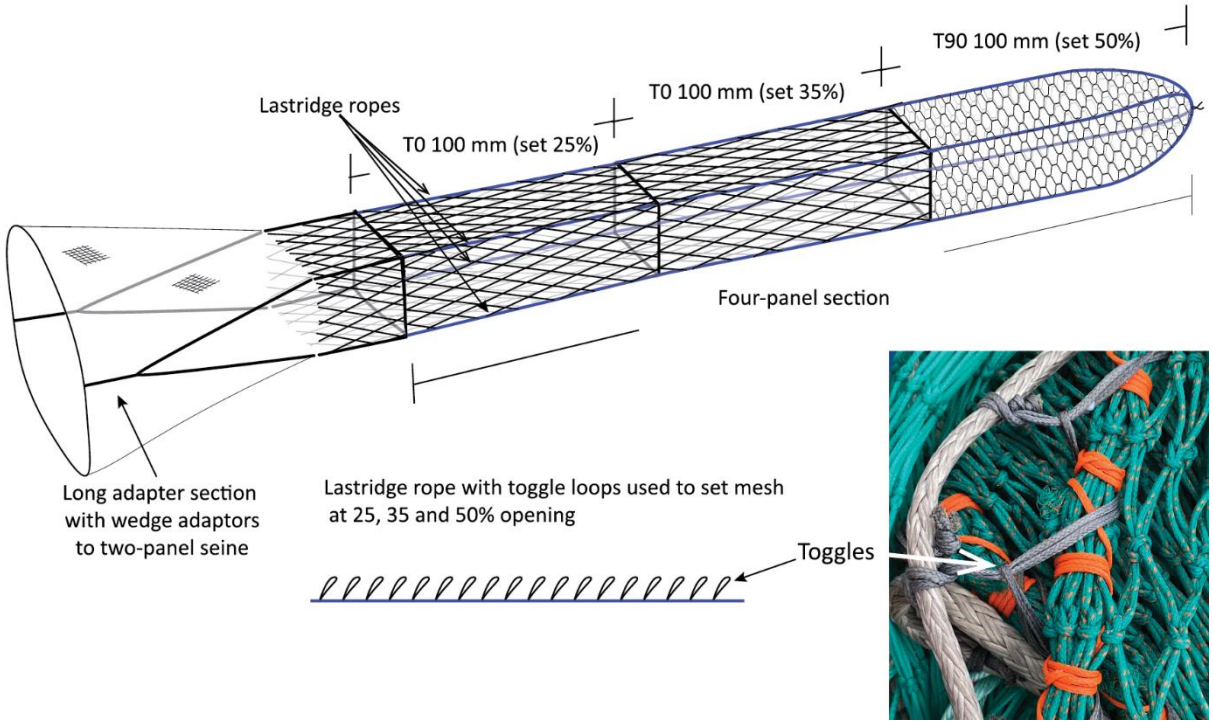

Figure 2. Diagram of four-panel codend used in the trials with closeup of toggles on lastridge ropes

METHODS

The trials were conducted onboard demersal seiners targeting whitefish in the Celtic Sea (ICES Division 7.j,g) using standard demersal seine configurations (Figure 1; Table 1). Trial

1 consisted of a full-scale catch comparison trial with two BIM scientists on board to provide technical assistance and conduct comprehensive catch sampling. Trial 2 was industry-led with information on graded catches provided by the vessel.

The names of the vessels have been excluded due to use of economic data. The standard gear comprised a standard 100 mm T90 codend and 100 mm diamond mesh (T0) extension in two-panel configuration (Table 1).

The four-panel codend comprised three sections: a 100 mm diamond (T0) mesh tapered extension section; a 100 mm diamond (T0) mesh extension section; a 100 mm T90 mesh codend. 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 were 3% and 6% shorter for both diamond mesh sections; 13.5% shorter than the T90 codend and 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 (Figure 2). The trial vessels each used two identical seine nets, one with a standard one with a four-panel codend.

Table 1. Vessel and trawl gear characteristics

Trial	**1**	**2**
Vessel length (m)	24	27
Engine power (kW)	188	354
Gear type	Seine	Seine
Manufacturer	Jackson Trawls	Jackson Trawls
Configuration	Single	Single
Headline length (m)	60	70
Estimated headline height (m)	10	15
Footrope length (m)	69	35
Footrope	Looped weighted rope	12” Discs
Fishing-circle (meshes × mm)	480 × 200	1,150 ×120
Number of panels	2	2
Seine rope per side (m)	2,860	3,400
Seine rope Ø (mm)	32	48
Standard Codend		
Mesh size (nominal) (mm)	100	100
Mesh Orientation	T90	T90
Number of panels	2	2
Four-panel Codend*		
Mesh size (nominal) (mm)	100	100
Mesh Orientation	T90	T90
Number of panels	4	4

*Four-panel codend for trial 2 was constructed by Swan Net Gundry

Sampling and analysis

Trial 1: Thee standard and four-panel codend nets were deployed on alternate hauls which were spatio-temporally matched as far as possible. (Browne et al. 2021a). Catches from each deployment were sorted to species level and weighed. Total length (TL) of commercial fish species were measured and recorded to the nearest cm below. Raising factors were applied where subsampling occurred. Length-weight relationships (Silva et al., 2013) were applied to the measured fish to obtain estimated weights by length class for comparative purposes.

Trial 2: The vessel fished each net for up to three consecutive rings with one net before swapping over to the other net and remained in a similar geographic area over the course of the trial. Commercial catches from each deployment were sorted to species level, graded, and weighed.

Mean catch weights of key species per ring were plotted using histograms with standard deviation included as a measure of variability. Price data from an on board weighing and data collation system onboard the vessel in Trial 2 were used to apply price data to species and size grades in both trials. Different numbers of rings were deployed with standard and four-panel codends in both trials, so the number of rings were standardised to facilitate effective comparison of commercial catch values across gears. The number of rings was raised to 10 in Trial 1 and 12 in Trial 2. Haddock and hake grades were standardised across both trials (Table 2), with conversion factors of 1.17 and 1.11 applied, respectively, to account for gutted individuals

Table 2. Grades used to standardised across trials

Size grade	Haddock weight (kg)	Hake weight (kg)
Small	0.5–0.7	<1.0
Medium	0.7–1.0	1.0–2.0
Large	1.0+	2.0+

Results

Trial 1

A total of 17 valid seine rings (10 with the four-panel and seven with the standard) were completed during October 2024. Mean ring duration (hr:min), towing speed (knots) and depth (meters) fished were 02:01, 1.2 kt, and 113 m. Haddock and Hake were the main commercial species landed accounting for 60% of the bulk catch.

Mean catches per ring for haddock and hake were lower in the four-panel codend for all grades except for the large hake which increased by 34% (Table 3; Figure 3). Overall, flatfish and monkfish catches were greater in the four-panel codend (Table 3; Figure 3).

Length frequencies for the top four species haddock, hake, megrim, and whiting showed that very few under MCRS fish were retained in either codend and that the four-panel codend retained fewer small fish (Figure 4).

The commercial value was reduced for haddock but increased for hake and flatfish in the four-panel codend. Overall, there was little difference in the value of catches between the two gears (Table 4). Large-grade hake were 3.6 times more valuable than small-grade fish while large haddock were 1.6 times more valuable than small-grade haddock.

Table 3. Mean catch weights (kg) of key species per ring for Trial 1

Species	Standard	Four panel	Difference
Haddock small	13.27	8.50	-36
Haddock medium	11.10	9.39	-15
Haddock large	20.55	12.28	-40
Hake small	9.48	2.62	-72
Hake medium	18.03	17.92	-1
Hake large	22.98	30.75	34
Megrim	7.37	11.44	55
Whiting	5.75	3.08	-46
Cod	2.52	3.75	49
Monkfish	1.80	11.11	×6.2
Plaice	1.79	3.68	×2.1
Lemon Sole	1.29	2.57	99
Witch	0.27	1.26	×4.6
Turbot	0.26	0.07	-73

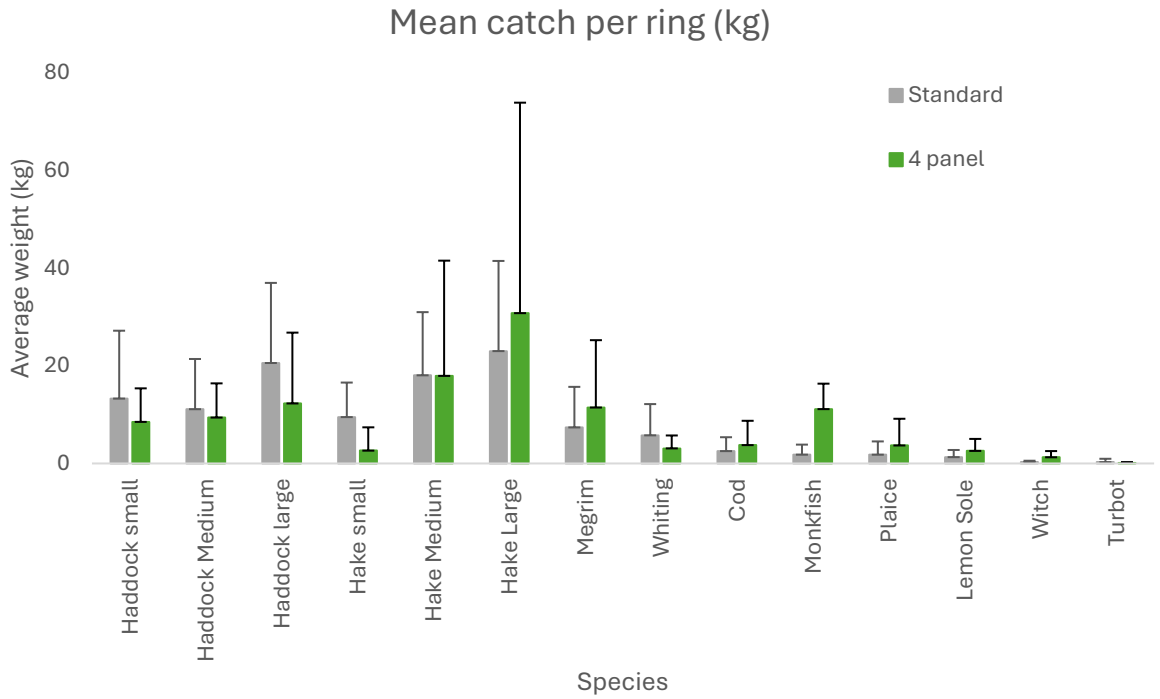

Figure 3. Histogram of mean catches per ring for Trial 1

Table 4. Catch value (€) Trial 1

Species	Standard (€)	Four panel (€)	Difference (%)
Haddock	2,159	1,310	-39
Hake	1,950	2,278	17
Megrim	162	252	55
Whiting	115	62	-46
Monkfish	81	500	>×6
Cod	70	123	75
Plaice	36	74	>×2
Turbot	37	9	-66
Lemon Sole	28	56	99
Witch	7	31	>×4
Total	4,645	4,694	1

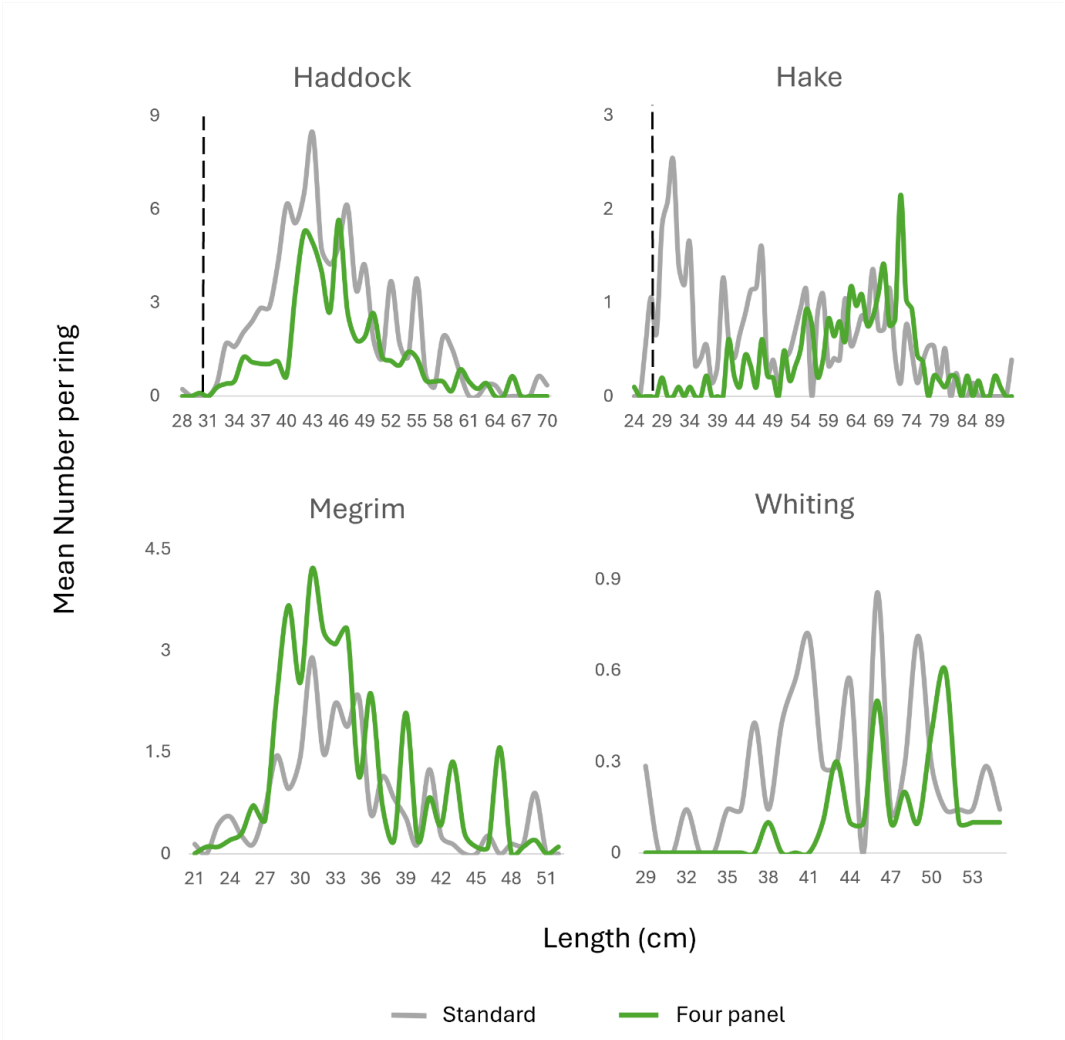

Figure 4. Length frequencies (mean per ring) with MCRS (where appropriate)

TRIAL 2

A total of 20 valid seine rings (12 with the four-panel and eight with the standard) were completed during October 2024. Mean ring duration (hr:min), towing speed (knots) and depth (meters) fished, were 01:59, 1.24 kt, and 81 m. Haddock and Hake were the main commercial species landed account for 83% of the retained catch (Table 5).

Mean catches per ring for haddock and hake were greater in the four-panel codend for all grades except for the smaller grades which decreased by 82% for haddock and 21% for hake (Table 5; Figure 5). Overall flatfish and monkfish were also greater in the four-panel codend (Table 5; Figure 5)

Overall, the commercial catch value increased by 23% for the four-panel codend (Table 6). The value of hake doubled while haddock decreased by 72% in the four-panel codend. Flatfish and monkfish also increased in value (Table 6).

Table 5. Mean catch weights (kg) of retained species per ring for Trial 2

Species	Standard	Four panel	Difference (%)
Haddock small	168	31	-82
Haddock medium	11	13	14
Haddock large	2	2	5
Hake small	16	13	-21
Hake medium	80	161	×2.02
Hake large	2	4	×2.24
Whiting mixed	8	6	-31
Whiting small	3	1	-66
Megrim	9	10	2
Plaice	9	10	14
Monkfish	7	9	20
Lemon sole	6	6	7
Gurnard	4	4	6
John dory	3	3	6

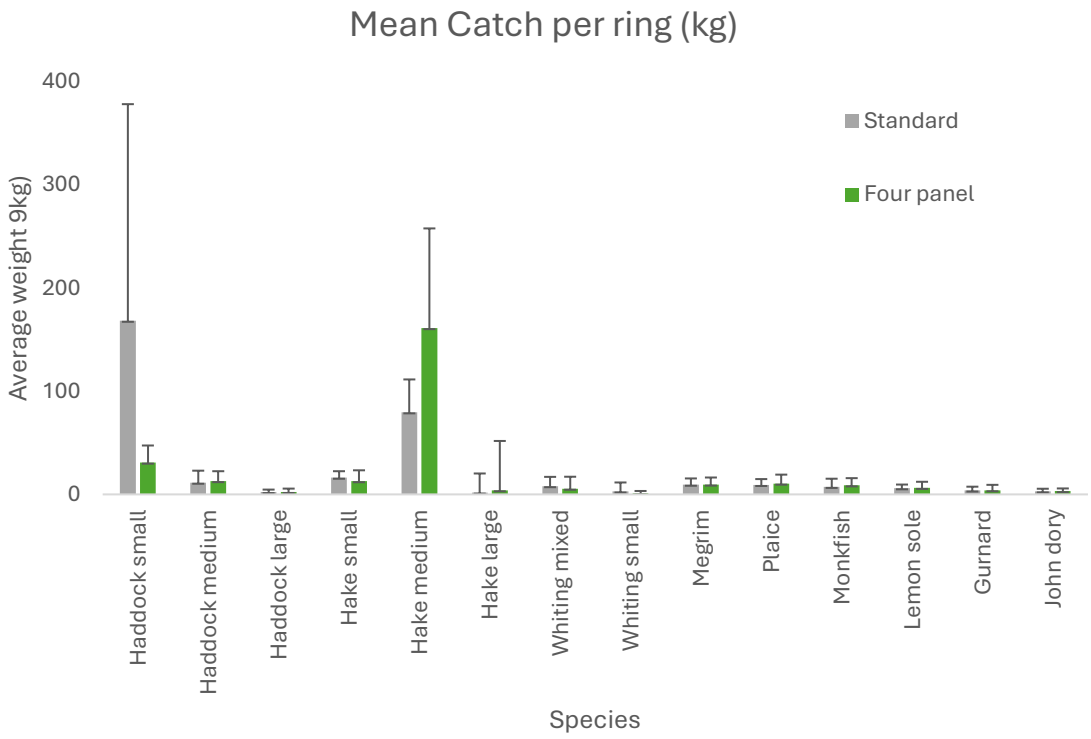

Figure 5. Mean catch weight (kg) per ring for Trial 2

Table 6. Catch value (€) Trial 2

Species	Standard (€)	Four panel (€)	Difference
Hake	4,106	8,263	>×2
Haddock	3,089	875	-72
Monkfish	323	387	20
Whiting	258	144	-44
Megrim	234	237	2
Plaice	209	239	14
Lemon sole	149	159	7
John dory	95	101	7
Gurnard	14	33	>×2
Total	8,475	10,437	23

DISCUSSION

Overall, the four-panel codends performed well but poor fishing at the times of the trials resulted in highly variable catches between rings, making it difficult to have accurate conclusions. Notwithstanding this variability, the substantial reductions in small-grade haddock and hake are consistent with previous four-panel T90 100 mm trials (Browne et al. 2021b, 2024). This reduction in smaller fish is encouraging for optimising haddock stock conservation and quota utilisation, whereby the smaller fish not captured will have time to grow larger and become more valuable before being caught.

Additionally, very few undersize fish from all species were retained in either standard or four-panel codends which follows previous assessments of 100 mm T90 codends (McHugh et al., 2019; Browne et al. 2021b). Cheng et al. (2022) showed that T90 meshes remain open when tension acts on the netting in the tow direction of the trawl, whereas T0 (diamond) meshes close; which allowed greater opportunity for small fish to escape even as the codend filled up. This coupled with T90 mesh being extensively used by the seining fleet is encouraging for the conservation of stocks with only the marketable catch being retained.

The addition of lastridge ropes provided the meshes with a fixed/stable mesh opening which is known to improve selectivity (Bak-Jensen et al. 2022). The more stable mesh openings likely contributed to retention of some species, especially flatfish; T90 mesh is known to retain more flatfish compared to diamond mesh (Madsen et al. 2012).

Increased fish quality has always been associated with T90 mesh codends (e.g., Digre et al., 2010) and the four panel with lastridge ropes are likely to further increase quality with more stable mesh openings and fewer small fish means less crowding potential. The vessel owner in Trial 1 reported a higher price by grade for hake caught in the four-panel codend which demonstrates this point.

The T90 four panel codend is the same circumference as a standard two-panel codend the addition of the extra two selvedges and the lastridge ropes means the overall cost is around double that of a standard two panel T90 codend. However, this extra cost would have been recouped in around one trip during Trial 2 in the current trial and one trip in a previous assessment of this gear (Browne et al. 2024).

The three trials conducted to date with the four-panel T90 codend with lastridge ropes on board seiners generally demonstrate substantial increases in catches of larger more valuable round fish and flat fish, reduced catches of smaller less valuable round fish, and almost no retention of undersize fish. In summary, this novel gear has major potential to improve the environmental and economic sustainability of Irish demersal seine fisheries.

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