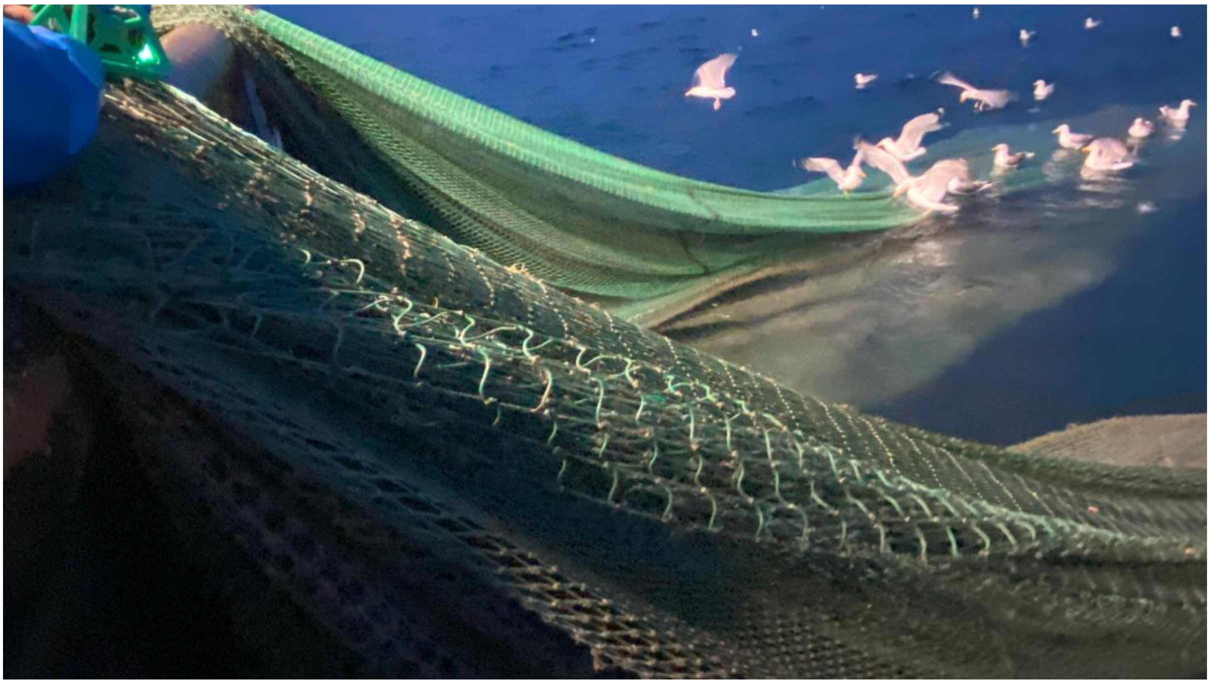
Further assessment of enlarged-mesh top sheets in Nephrops trawls



Fisheries Conservation Report **August 2025**

BIM Ireland's Seafood Development Agency

Further assessment of enlarged-mesh top sheets in Nephrops trawls

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Key Findings

- 160 mm mesh top sheets successfully tested in comparison with 80 mm top sheets in Nephrops trawls
- Significant reductions in small whiting and haddock
- Significant reductions in smaller Nephrops and increases in larger Nephrops
- Substantial reductions in twine area likely resulting in improved energy efficiency

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Introduction

Dublin Bay Prawns or Nephrops (*Nephrops norvegicus*) are one of Ireland's most important species and were the number two species by landings value in 2024 (BIM, 2025). BIM is working with the Irish Fishing Industry to help improve the Nephrops fishery in terms of energy and catch efficiency.

Most Irish vessels operate a quad or half-quad configuration. Nephrops trawls are traditionally constructed to target Nephrops and mixed demersal fish species and typically comprise an 80 mm diamond mesh trawl body and codend with an escape panel, usually a 300 mm square-mesh panel (SMP). The 300 mm SMP is to comply with EU legislation and has been shown to reduce fish bycatch by up to 70% for certain species and size classes (BIM, 2014; Tyndall et al., 2017).

Notwithstanding the 300 SMP benefits it has limited impact on smaller individuals, typically those < 20 cm (BIM, 2014; Tyndall et al., 2017). Increasing the mesh sizes in the trawl body, especially in the top sheets, offers individuals more surface area to potentially escape from the trawl. A Nephrops trawl is typically towed at ~3 kts (~1.5 m/s) which means that that the 3 m long 300 mm SMP is a relatively small target for escaping individuals and by enlarging the mesh in the top sheets there is more time and surface area (approx. 27 m+ between headline and SMP) available for fish to escape.

Increasing the mesh size in a trawl's top sheet is known to aid fish escapement (e.g., Fryer et al., 2016; Campbell et al., 2010; Kynoch et al., 2011). Conversely, increasing the mesh size in the top sheets is unlikely to lead to reduction in Nephrops catches because they are known to passively roll along the trawl's lower panel during the catching process (Main and Sangster, 1985, Newland and Chapman,1989; Briggs, 2010). Additionally, a trawl's top-sheet section offers a large section that can be modified with increased mesh size, which means less twine surface area and lower drag trawls that aim to improve fuel efficiency.

Here we compare Nephrops trawls with enlarged top sheets—160-mm diamond mesh between the headline and the square-mesh panel—against conventional trawls constructed with 80 mm mesh in the same section. This work follows on from earlier testing of trawls with modified top sheets (McHugh et al., 2021; 2022, and McHugh and Oliver, 2024).

Methods

The trial was conducted on board MFV Cisemair (S430), a 22.65 m (522 kW) demersal trawler targeting Nephrops in the western Irish Sea (ICES Division 7.a, Nephrops functional unit 15), towing four two-panel 42 m footrope Nephrops trawls (Figure 1; Table 1). The four trawls were deployed simultaneously in quad-rig configuration and the pair of trawls on each side were swapped to the opposite side (e.g., port to starboard) after seven hauls. Initially, the pair of trawls on the starboard side of the quad-rig (the test gear), incorporated: 160 mm mesh between the headline and the 300 mm square-mesh panel (Figures 2A; 3). The pair of trawls on the port side of the quad-rig (the control gear), incorporated: 80 mm mesh in the cover sheet up to the 300 mm square-mesh panel (Figures 2B; 3). Standard two-panel codends fitted with a 3 m long 300 mm square-mesh panel installed 9–12 m from the codline were deployed on each trawl.

Marport acoustic telemetry sensors were deployed on trawl wing-ends to monitor the spread. The vessels own Marport door sensors were utilised to record the overall trawl door spread. Additionally, loadcells were placed on each pair of trawls to record their drag. Also, for each trawl, twine surface area estimates are calculated to estimate potential differences in their drag.

The twine surface area (A) was estimated from: $A = (N_t + N_b)\, N_d\, Md$
where Nt is the number of meshes on the top row of a panel, Nb the number on the bottom row, Nd the number along the length of the panel, M the mesh size, and d the twine diameter (Ferro, 1981).

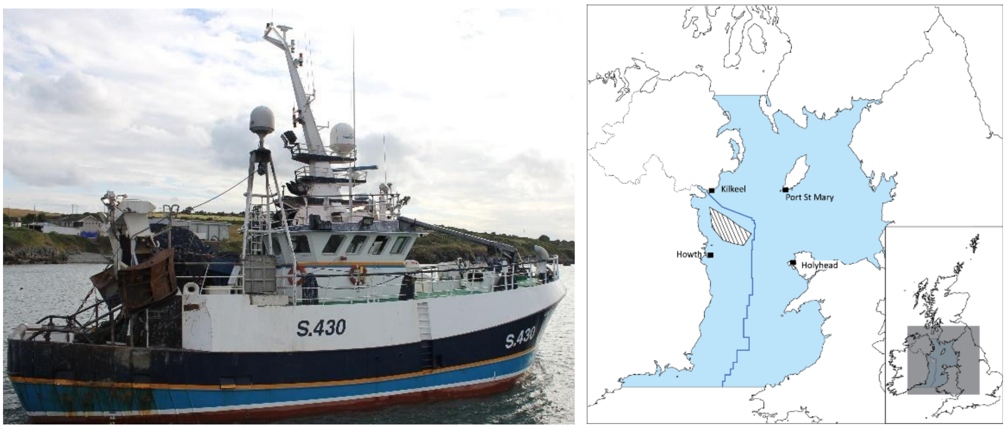

Figure 1. Trial vessel, and Location (hatched area)

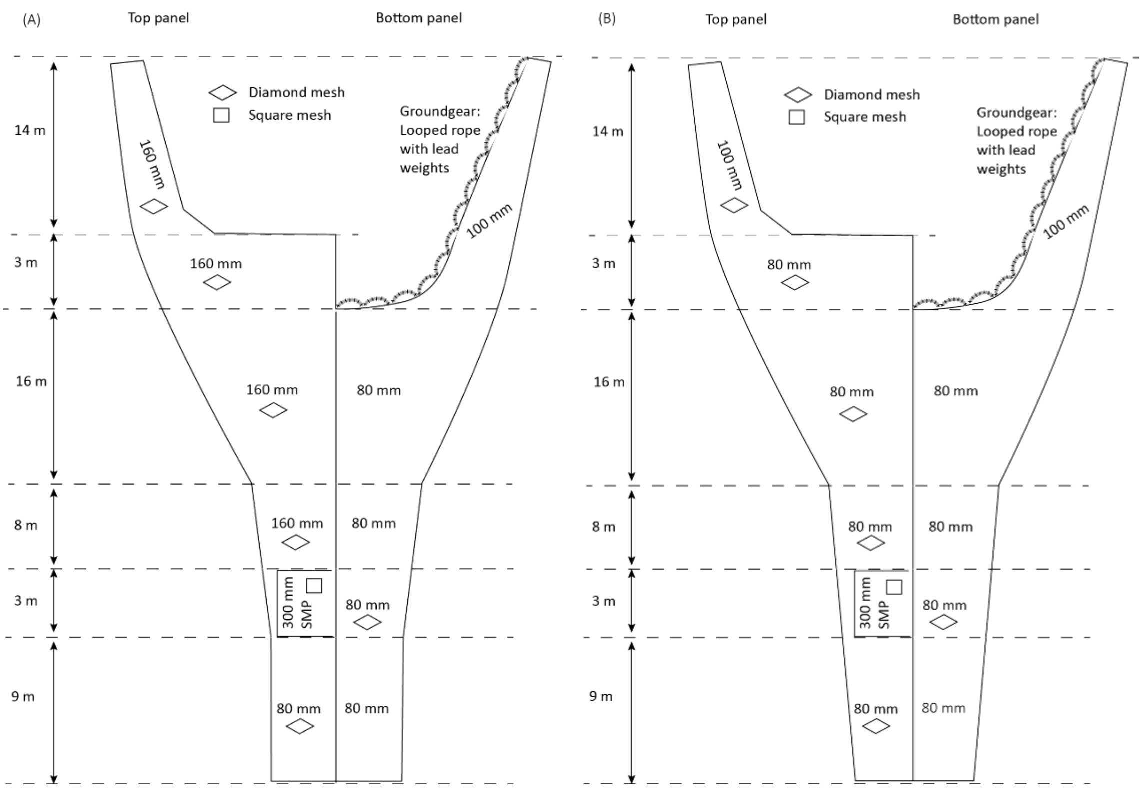

Figure 2. Trawl plans of (A)160 (Test) and (B) 80 (control) mm top-sheet trawls used in trial

Table 1. Vessel and trawl gear characteristics for large mesh top sheets trial

	160 mm		80 mm
Vessel		Cisemair (S430)	
Length (m)		22.65	
Engine (kW)		522	
Trawl type		*Nephrops*	
Trawl manufacturer		Pepe Trawls	
Trawl configuration		Quad	
Headline length (m)		37	
Estimated headline height (m)		1	
Footrope length (m)		42	
Fishing-circle (meshes × mm)		400 × 80	
Number of panels		2	
Codend and SMP			
Number of panels		2	
SMP (mm)		300	
Mesh size (nominal) (mm)		80	
Mesh size (measured mean) (mm)	81.61		81.03

Table 2. Mean operational data for the large mesh top sheets with Standard Deviation (StdDev)

Parameter	mean	StdDev
Haul duration (Hr:min)	06:20	0.07
Fishing depth (m)	106.67	15.23
Warp shot (m)	292.07	7.61
Fuel (l/Hr)	83.93	9.94
Load engine (%)	47.30	4.44
Door spread Overall (m)	99.32	3.80
Wing spread 80 mm (m)	12.68	0.89
Wing spread 160 mm (m)	12.42	1.04
Load 80 mm (Kg)	1,086.96	311.99
Load 160 mm (Kg)	1,085.00	359.36
Speed Over Ground SOG (kts)	2.94	0.30

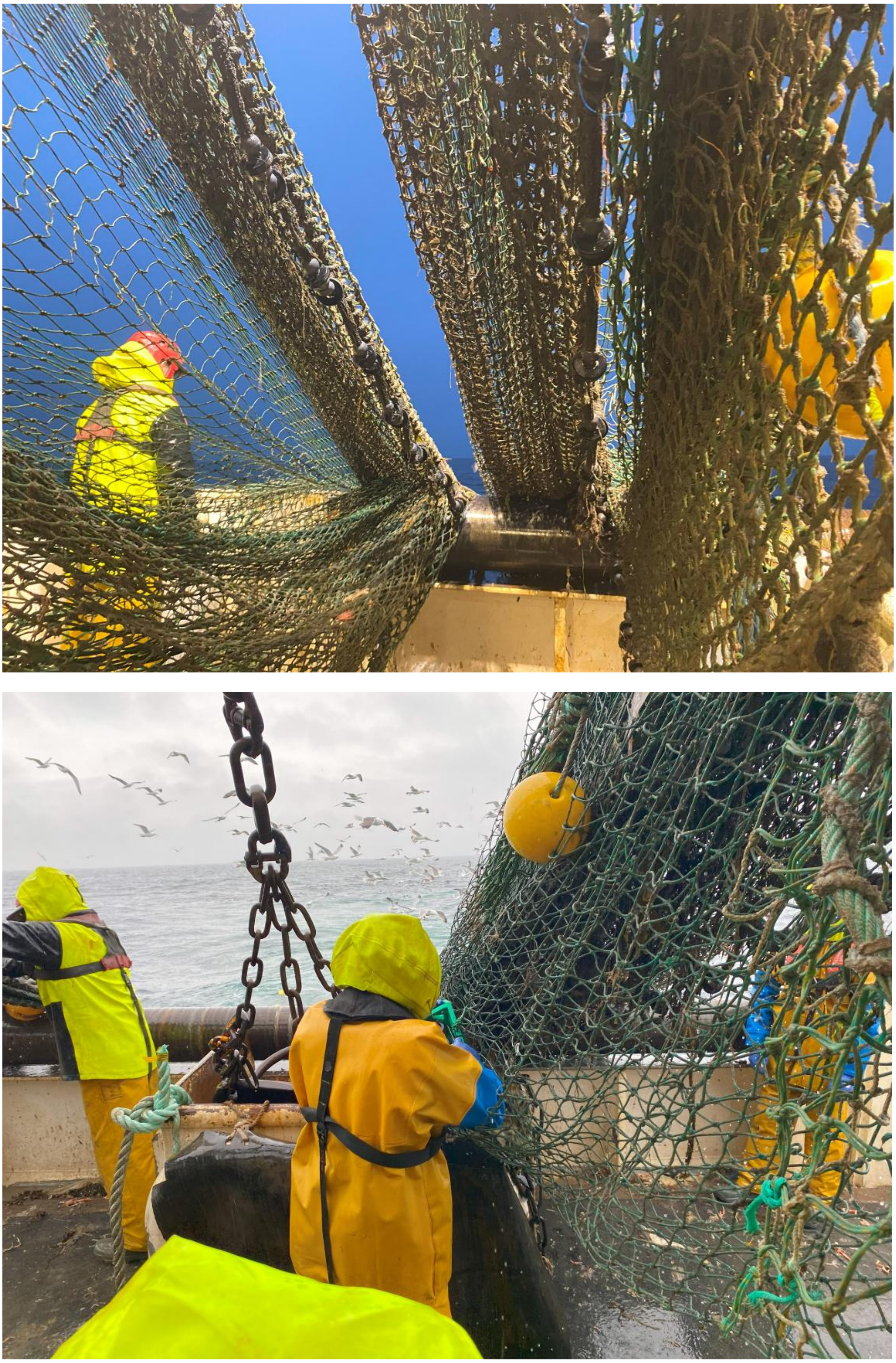

Figure 3. Photos from the trial of the 80 mm (top), and 160 mm (bottom) top-sheet trawls

Sampling and analysis
Paired nets were kept separate on boarding and their total bulk weighted. Total catches were sorted to species level. The total weight of commercial species, combined non-commercial species, and non-fish discards were recorded along with a random representative subsample where necessary. Total length (TL) of commercial fish species and carapace length (CL) of Nephrops were measured and recorded to the nearest cm or mm below. Raising factors were applied where subsampling occurred. Results are focused on three key species—Nephrops, haddock, and whiting. Length-weight relationships were applied to the measured fish (Silva et al., 2013) and Nephrops (Briggs et al., 1999) to obtain estimated weights by length class for comparative purposes.

Haul data including fishing position, environmental conditions and fishing depth were recorded by the skipper for every haul. The skipper also recorded the vessels fuel consumption (l/hr), and engine load (%) several time per haul.

Results

A total of 15 valid hauls were completed during June 2025. Mean haul duration, towing speed and depth fished were 06:20, 2.94kt and 106.67 m (Table 2). Nephrops were the main commercial species landed with 67% of total bulk caught or 87% of total commercial species caught. There was a significant decrease for smaller Nephrops with increased catches of larger individuals in the 160 mm top-sheet trawls (Figure 5). Overall, there was a 12% decrease in Nephrops catches in the trawl with the 160 mm mesh (Table 3). This decrease was mostly associated with the smaller and tailed grade Nephrops (20 –33 mm) (Table 4; Figure 5).

Whiting and haddock catches consisted mainly of fish below respective MCRS (Figures 4 and 5). There were significant reductions for smaller whiting and haddock (Figure 5). The 160 mm demonstrated reductions of 41 and 28% for whiting and haddock respectively. The other main commercial species landed were monkfish and mixed flatfish including black sole, megrim, witch, and plaice (Table 3).

Table 3. Total catch (kg) for160 (Test) and 80 (control) mm top-sheet trawls

Species	80 mm	160 mm	Difference
Nephrops	3,204	2,808	-12
Whiting	166	98	-41
Haddock	98	71	-28
Flatfish$	93	90	-3
Monkfish	62	119	92
Ray and skate	68	70	3
Other^	23	21	-9
Dogfish	16	2	-87
Non-commercial fish&	77	48	-38
Non-fish catch£	918	888	-3
Total bulk	4,725	4,215	-11

*Ray and dogfish
$ black sole, megrim, plaice, witch
^Cod, hake, ling
&Gurnards, dab, pouting
£Sea mouse, seaweed, whelks, jellyfish

Table 4. Estimated Nephrops catch (kg) by carapace length (CL, mm) for160 (Test) and 80 (control) mm top-sheet trawls

CL (mm)	Size grade	80 mm	160 mm	Difference
< 20	< MCRS	2.43	1.03	-58
20 to 31	Tailed	1,325.52	929.81	-30
32 to 33	41 to 50	563.38	404.81	-28
34 to 36	31 to 40	627.62	557.19	-11
37 to 41	21 to 30	701.28	732.68	4
42 to 44	16 to 20	189.49	167.03	-12
45 to 49	11 to 15	67.66	104.61	55
50 to 52	06 to 10	6.58	3.05	-54
<20 to 52		3,483.95	2,900.21	-17

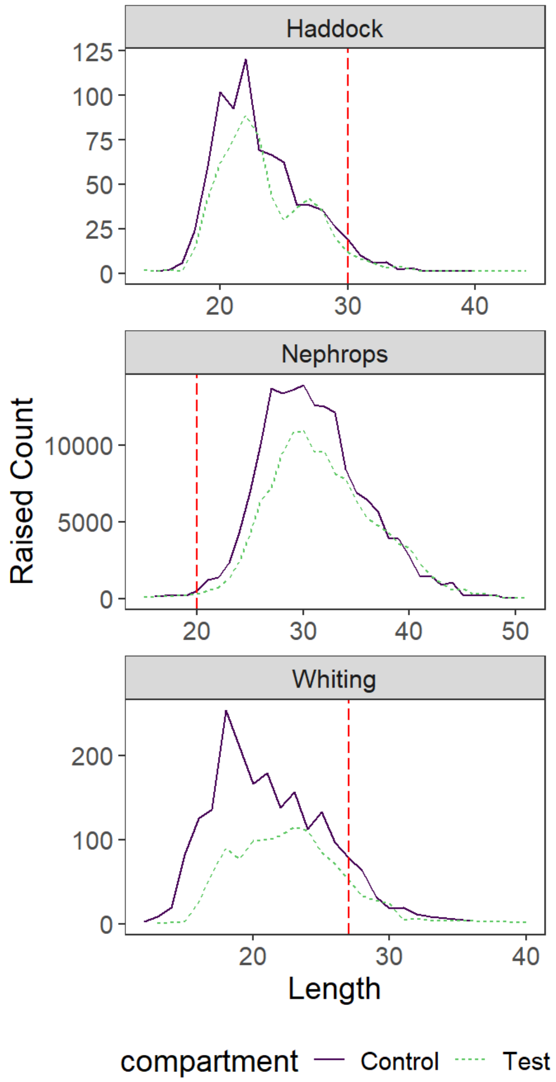

Figure 4. Length frequencies for haddock, Nephrops, and whiting caught in the 80- (control) and 160-mm (test) mesh trawls. Vertical dashed lines represent respective species MCRS.

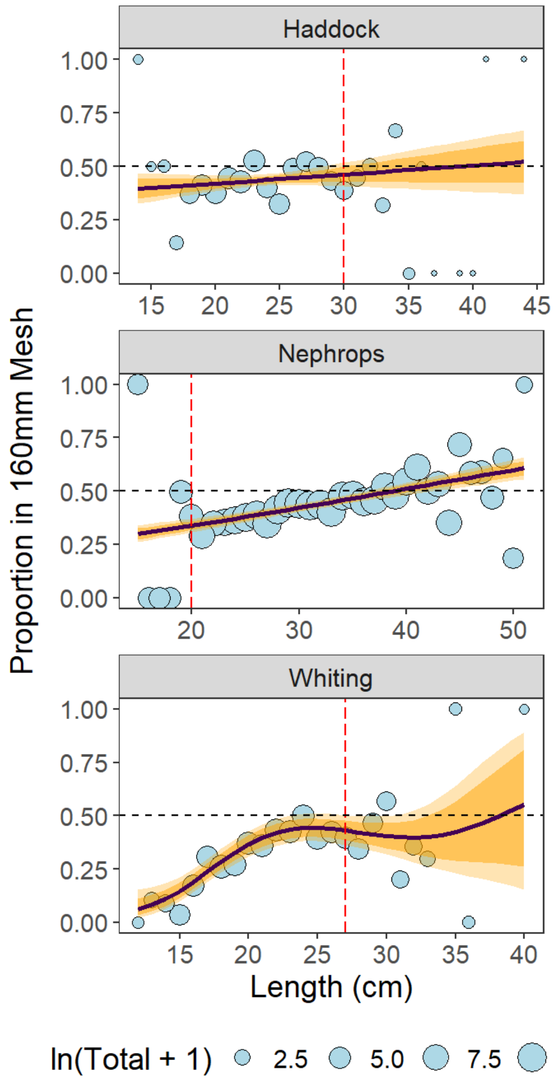

Figure 5. Proportions retained with GAM overlay for Haddock, Nephrops, and Whiting caught in the 160 mm top-sheet trawls. Vertical dashed lines represent the respective species MCRS.

Twine surface estimates showed that the trawls with 80 mm mesh had a surface area of 83 m^2 while the trawls with 160 mm mesh had a surface area of 67 m^2, a difference of 19%. Data from the loadcells showed that there was no difference in the force required to tow the 160- and 80-mm top-sheet trawls (Table 2).

Discussion

Overall, there were no operational observed issues with either of the 160- and 80-mm top-sheets trawls with the preferred door and wing end spread maintained throughout the trial. The reduction of whiting and haddock in the 160 mm top-sheet mesh trawl is encouraging, especially considering the reductions were for smaller <20 cm individuals. This contrasts with previous work using the 300 SMP where there was minimal loss of <20 cm whiting and haddock (BIM, 2014).

The large reductions of whiting and haddock in the 160 mm top-sheet trawl suggest they had the opportunity to escape earlier in the capture process before they enter the codend, where the risk of damage is highest. This bodes well for whiting and haddock stocks because fish escaping early in the capture process should have lower risk of damage and a better chance of survival (Broadhurst et al., 2006).

The 160 mm top-sheet trawls had fewer smaller Nephrops which was somewhat unexpected and difficult to understand and explain. In previous work with these trawls the 300 mm top sheets had increased Nephrops catches (McHugh and Oliver, 2024). Additionally, Dunlin and Reese (2003) assessed a trawl modified with a removed cover and 200 mm mesh section and observed a 20% increase in Nephrops catches. Further assessments with these trawls under more controlled conditions or with models in a flume tank might help understand the potential mechanisms like lower overall height that could have contributed to the reduced catches. Additionally, it is possible that there might have been a trawl effect; it was not practical to swap the top sheets on the trawls during the trial, and it is possible that the trawls did not all operate the same. Investigations will be made on how best to combat this potential bias for any future assessments.

The losses of Nephrops were mostly for the smaller <33 mm carapace length individuals of which will mostly end up tailed. Using Nephrops price data we estimated a total reduction in Nephrops catch value of 7%.

While any economic loss is unwanted, it is likely that this could be somewhat offset with lower fuel consumption because of the 19% reduction in netting surface area between the 160- and 80-mm mesh top-sheet trawls. While no reduction in drag was observed here, many fishers have increased the top sheets of their trawls to at least 160 mm and are reporting fuel savings of up to 13%. The results from industry are broadly consistent with what is expected since netting drag considered proportional to the twine surface area and reducing it is likely to result in a trawl that is easier to tow.

Having trawls that are easier to tow will be beneficial to the Irish fishing industry—reduced fuel consumption and CO2 emissions but also less plastic in the trawl construction. The lower drag trawls can be potentially modified further with high strength (thinner) twines (e.g. Dyneema) to further reduce drag. Additionally, as trawl drag decreases the trawl doors could be reduced in size further reducing the trawl configurations overall drag.

Moving from 80 to 160 mm top sheets is unlikely to cause operational issues and is an easy retrospective fit to any trawl to aid the release of unwanted catches and potentially reduce drag. Reports from industry suggest that the Nephrops vessels which have modified their trawls with 160 mm top sheets are satisfied with the results and observe no operational issues. Additionally, combining the larger mesh with other options like smaller trawl doors and thinner twine that lower fuel usage will likely offset any small losses in Nephrops catches, but detailed assessments are needed to fully understand these changes.

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