Modifying Nephrops trawl ground gear to reduce weight, maintain bottom contact and improve energy efficiency

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BIM Ireland's Seafood Development Agency

Modifying Nephrops trawl ground gear to reduce weight, maintain bottom contact and improve energy efficiency

Prepared by Daragh Browne and Matthew McHugh.

BIM, New Docks, Galway, Ireland.

Email: daragh.browne@bim.ie

Key findings

- We developed a Nephrops trawl skirt ground gear and carried out initial testing in the Western Irish Sea
- The skirt ground gear weighed substantially less than a standard chain ground gear
- Following major modifications, the skirt ground gear increased Nephrops catches. This indicates ground contact was at least maintained compared with the standard gear
- These results provide justification to carry out further work to optimise the configuration of the skirt ground gear for Nephrops and future work will also focus on testing effects on fish species

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Introduction

Nephrops norvegicus is Ireland's most valuable demersal species with landings worth €76 million 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.

Nephrops trawling is typically carried out on specific areas of muddy ground. Nephrops are not actively herded by trawl doors, sweeps or trawl wings unlike fish species. Instead, the width of the trawl bosom, the centre part of the trawls fishing line, largely determines its catching efficiency (Graham and Ferro, 2004). To optimise Nephrops catches the bosom of Nephrops trawls must contact the bottom and this is typically achieved by adding weight to the fishing line in the form of ground gear. A variety of different ground gears may be used, depending on bottom type. Rubber discs may be used where mud is interspersed with uneven, hard ground, chain may be used on clean, soft ground and grass or leaded rope may be used where the ground is very soft. In the western Irish Sea Nephrops trawls are often fitted with chain ground gear.

A new concept ground gear has been developed in Norway when fishing over sensitive habitats, see Grimaldo et al (2013). This 'skirt ground gear' is becoming increasing in popularity with Irish demersal seine netters as a replacement for heavy rubber discs when fishing over hard ground. There has been some interest from the Nephrops fleet to assess the skirt as an alternative ground gear. In this trial, we developed and tested a modified ground gear consisting of a "skirt" fitted forward of the fishing line of a standard multi-rigged Nephrops trawl. The aim of the trial was to reduce the weight of chain fitted to the ground gear while maintaining bottom contact and Nephrops catch rates.

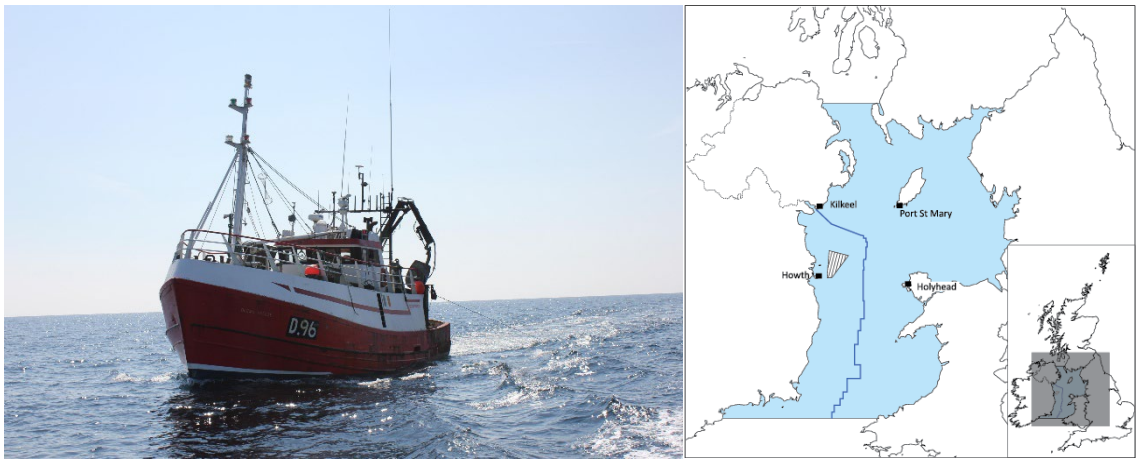

Figure 1. Trial vessel (left) and trial location (right)

Methods

This trial was carried out over six days during July 2025 on board MFV Ocean Breeze (D96), a 17 m 224 kW demersal trawler that targets *Nephrops norvegicus* in the western Irish Sea (Nephrops functional unit 15, ICES Division 7.a) (Figure1). Twin 36.6 m (20 ftm) footrope Nephrops trawls were deployed in half quad-rig configuration. The bosom area of each trawl measured 2.4 m. The upper and lower wingends of each trawl were attached to chain bridles measuring 4.6 m in length. The ends of the skirt footrope were attached to the lower bridle with a shortened split chain bridle. Both trawls were fitted with 300 mm square mesh SELTRA panels and codends.

The standard trawl's footrope comprised 36.6 m of 18 mm diameter combination rope and the ground gear consisted of 75 kg of chain mounted to the footrope in bites between wing ends (Figure 2a). The test gear was supplied by vessel owner Ciaran Powell and manufactured by Eamonn Howard. The chain was removed from the footrope of the test trawl and replaced with a skirt ground gear consisting of a 36.6 skirt footrope with mesh mounted between it and the trawls footrope. The skirts footrope was fitted with chain bites at the bosom and wingends only. The weight of chain used was approximately half that used on the standard trawl (~ 35 kg). The weight of the skirt was approximately 25 kg in air, the majority of which comprised the footrope which weighed slightly more than the trawls (Table 1). The overall weight of the skirt and chain ground gear was still substantially less than that of the standard trawl.

Table 1. Vessel and gear specifications

Vessel	Ocean Breeze (D96)	
Vessel length (m)	17	
Engine power (kW)	224	
Trawl door manufacturer/ model	Bison 8+	
Door weight (kg)	280	
Outer sweep length (m)	70	
Inner sweep length (m)	20	
Vee sweep length (m)	50	
Trawl supplier	Pepe Trawls Ltd.	
Trawl type	Twin Nephrops	
Towing configuration	Half quad-rig	
Trawl footrope type and ø (mm)	Combination rope 18 mm	
Trawl footrope length (m)	20/ 36.6	
	Standard trawl (port)	**Test trawl (starboard)**
Ground gear	Chain bites	Skirt + chain bites
Ground gear weight (kg)	75	25 + 35
Skirt footrope type and ø (mm)	na	Combination rope 20 mm
Skirt footrope length (m)	na	20/ 36.6
Skirt mesh size (nominal mm)	na	80

Initially the skirt mesh consisted of 80 mm (nominal mesh size) double 4 mm PE twine mounted 13 meshes deep between trawl and skirt footropes (Table 1). Skirt meshes were turned 45° and mounted on the square. This skirt configuration had the same mesh orientation from wing end to wing end, which resulted in opposing knot orientations in each wing. This is how Irish demersal seine netters rig a skirt ground gear to act as a replacement for heavy rubber discs when fishing over hard ground. The orientation of such a skirt ground gear would ideally be neutral as in vertical, or negative as in facing rearward relative to the direction of tow (Figure 2). A rearward facing skirt is likely to create some lifting force which would help the skirt to pass over obstacles on uneven ground. A forward-facing skirt would likely be more prone to snagging on uneven ground and would exert some downward force (Figure 2) (Grimaldo, et al., 2013). A forward-facing skirt would therefore be more beneficial on clean ground where bottom contact is required to catch species such as Nephrops (Figure 2).

Marport wingend distance sensors were fitted to provide data on trawl geometry. A CatchCam underwater video camera and lighting system were deployed on the test trawl behind the headline facing toward the ground gear to provide visual feedback on the shape of the skirt ground gear. Nephrops catches were sorted and weighed to provide an indication of the relative performance of standard and test trawls.

Skirt modifications

Following initial deployments of the skirt configuration, the Nephrops catches were less than in the standard trawl. CatchCam footage revealed that the shape of the skirt was not symmetrical relative to the trawls fishing line. One side of the skirt appeared to be lying behind the trawls fishing line. Despite multiple minor modifications to the skirt configuration the problem persisted. The orientation of the knots in the square mesh was eventually diagnosed as a likely cause of the problem. The meshes in the wing that was observed to have a forward angle of attack were left in place while the meshes in the opposite wing were reversed. Orienting the meshes in the same direction allowed both wings to adopt a similar shape, forward of the trawl's footrope.

The square meshes that made up the approximately 2.4 m wide skirt bosom were also removed and replaced with a 2.4 m wide section of 80 mm 3 mm single PE mesh mounted on the diamond. The skirts footrope was initially the same length as the trawls footrope but to achieve a forward-facing orientation in the skirt bosom we shortened the centre of the skirts footrope by clamping the middle 0.60 m using bulldog clips. This was a temporary solution carried out at sea with limited time remaining in the trial.

The split chain bridle linking the skirt footrope to the trawls lower bridle was removed and replaced with a third chain bridle of similar length (Figure 2). The thought behind this modification was that it would allow more adjustability in the tension created in the skirt's footrope facilitating a forward-facing skirt.

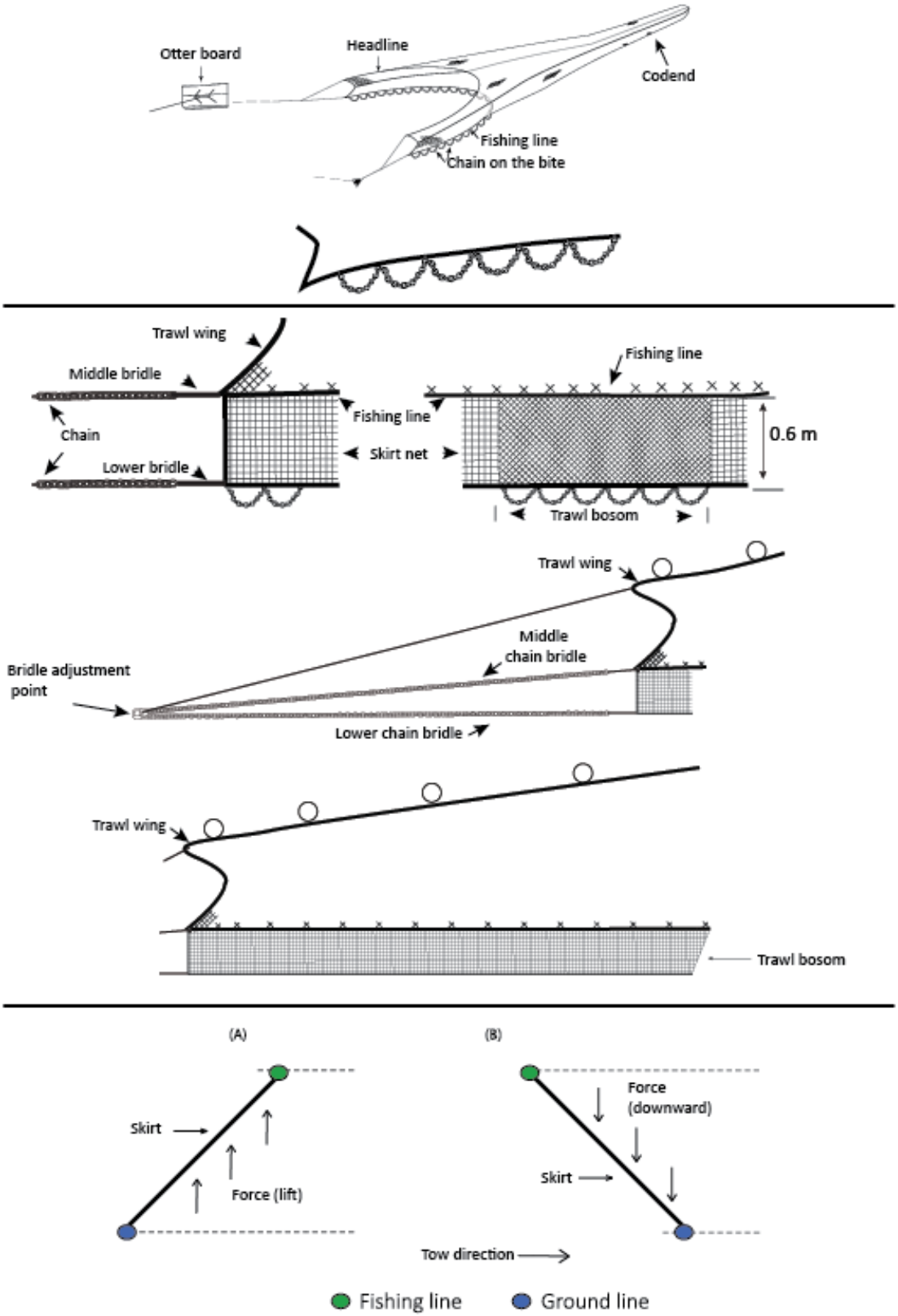

Figure 2. Standard trawl ground gear configuration showing chain bite ground gear (top); final configuration of skirt ground gear showing wing, bosom area and chain bridle (middle); illustration of skirt with a forward facing (left) and rearward facing (right) orientation in the bosom area of the trawl (bottom)

Results and discussion

Following major modifications to the initial skirt configuration, Nephrops catches from the last deployment of the trial revealed that the test trawl retained 20 % more Nephrops than the standard trawl. CatchCam footage also confirmed that the skirt footrope was now lying forward of the trawl footrope (Figure 3). Although pleased with this result the trial Skipper, net maker, and BIM scientists acknowledged that further work would be required to optimise the skirt configuration. This work would include remounting the skirt meshes to a footrope that is at least 60 cm shorter in length than the fishing line and optimising mesh configuration in the bosom area.

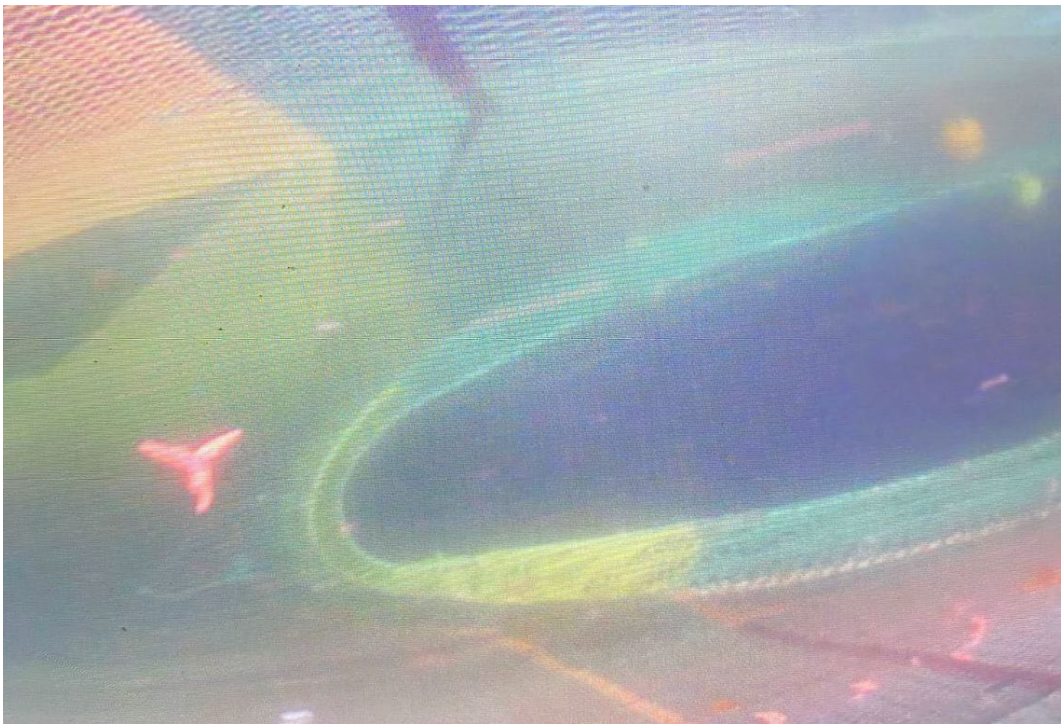

Figure 3. CatchCam screenshot of skirt footrope lying forward of trawl footrope during shooting.

It is noted that increased Nephrops catches with the skirt ground gear were only observed from the final haul of the trial and as such this result should be treated with caution. Notwithstanding this caveat, the aim of this trial was to reduce the weight of the ground gear of a Nephrops trawl while maintaining bottom contact and Nephrops catch rates. A reduction in weight was achieved and as the main indicator that bottom contact was maintained was parity of Nephrops catches with the standard gear these aims were also achieved. This result is a positive indication that with further development and testing the skirt could prove to be a viable alternative to traditional ground gears on clean, muddy Nephrops grounds found in the Western Irish Sea and other locations.

Future work could also focus on reducing the weight of the skirt ground gear to reduce drag, fuel usage, and increase the efficiency of Nephrops trawling which is a key aim of BIM's work in this sector of the Irish fishing Industry.

Acknowledgements

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