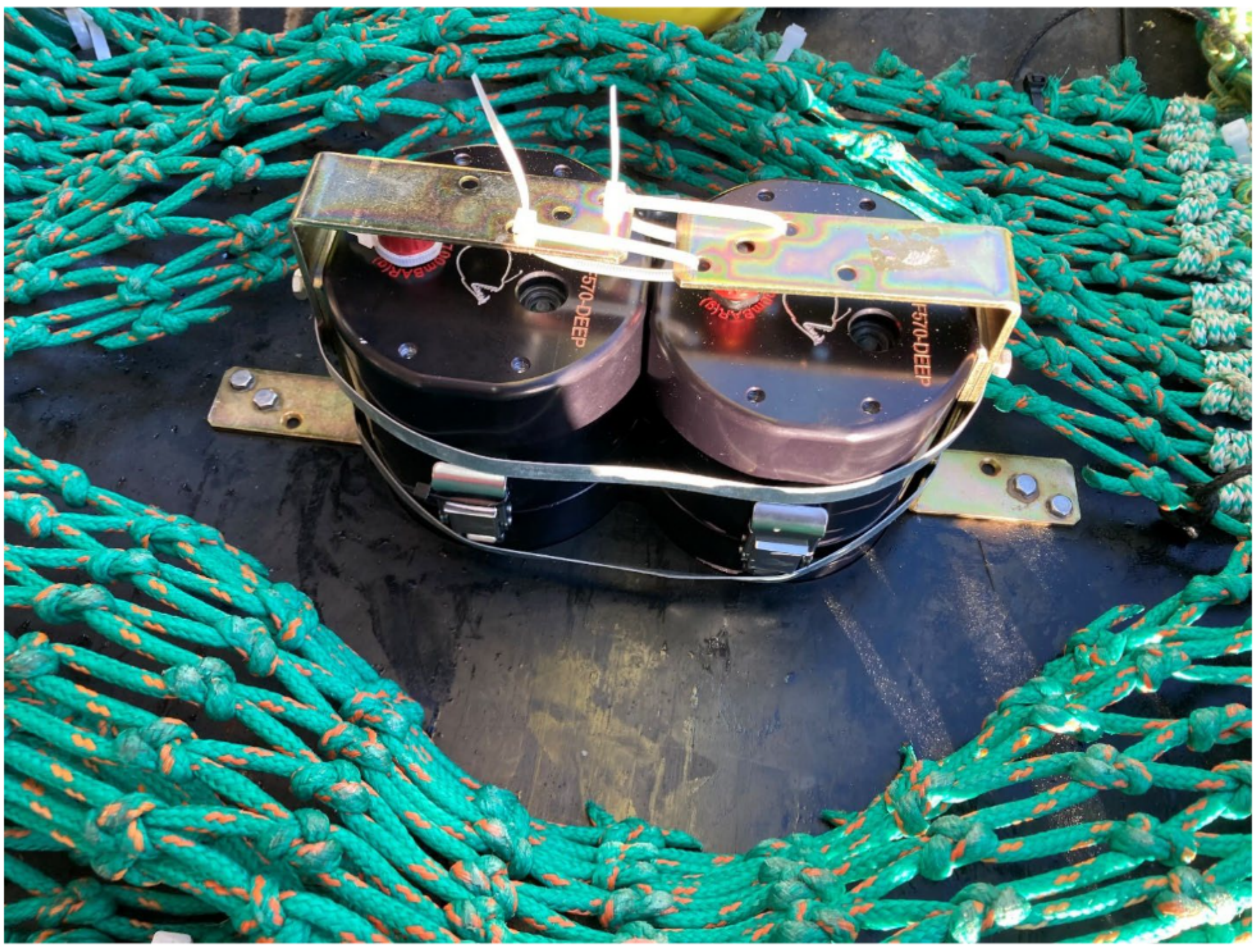
Assessment of image acquisition and sediment suppression systems in the Irish Nephrops fishery



Fisheries Conservation Report

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Assessment of sediment suppression and image acquisition systems in the Irish Nephrops fishery

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Key findings

- Image Acquisition System worked well and high-quality images obtained
- Sediment suppressed from ground gear appears to have entered the trawl aft of the sediment suppression system
- Further work on sediment suppression required to improve consistency of imagery

Rialtas na hÉireann
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Introduction

Demersal trawling for Nephrops is a valuable and socio economically important fishery both globally and in the Irish context where it accounts for €83 million worth of landings (BIM, 2023). Nephrops are mainly caught using demersal trawls but only when they emerge from their burrows and catch rates may not be consistent over the duration of a haul. The Skipper of a Nephrops trawler is typically only aware of the composition of the catch once the gear is hauled. Acoustic sensors can help to inform Skippers of catch rates of Nephrops in near real-time (McHugh et al., 2019) but require interpretation. Knowledge of where Nephrops catches are more consistent allows Skippers to fish more efficiently, potentially optimising fuel usage and reducing unnecessary time spent fishing. Video cameras mounted within trawls can also inform Skippers of catches of Nephrops and fish when outputs are relayed to the wheelhouse (Sokolova et al., 2022). This has major potential to improve catching efficiency for target species and avoidance of unwanted catches of low quota or non-target species.

A major impediment to the use of video cameras in Nephrops trawls is the sediment suspended by the ground contacting part of the gear which has been measured at heights of between 0.5 – 2 m behind the gear components (Sokolova et al., 2022). Nephrops trawls incorporate different ground gear depending on substrate type. In areas of soft mud lighter gear is used such as grass ropes which may comprise leaded rope or chain bites whereas in harder or more rocky areas foot ropes fitted with rubber discs may be utilised (Graham and Ferro, 2004; Montgomerie and Forbes, 2015).

This trial aimed to record clear video footage of Nephrops and fish from Irish Nephrops trawls fitted with a range of ground gear configurations and deployed over a range of substrate types.

Methods

Fishing Operations

The trial was carried out on board MFV Karen Mary (DA127), a demersal trawler targeting Nephrops in ICES Division 7.b, Nephrops functional unit 17 (Figure 1). The trial vessel deployed a single 23ftm Nephrops trawl throughout. Three different Nephrops trawls, with different ground gear and headline configurations (Table 1, Figure 2), were deployed during the trial. The aft untapered section of each of the trawls comprised a SELTRA, with 300 mm square mesh panel and a 90 mm 4-panel codend. The 4-panel construction of the SELTRA stabilises the distance between the top and bottom sheets of the extension piece and facilitates the use of the image acquisition system (IAT) described below. A range of bottom types, ranging from soft mud to harder substrates, was trawled within Galway Bay (Figure 1) to test the effect on sediment resuspension.

Table 1. Trawls and ground gears tested during the trial

Day	Gear
1	Heavy rubber ground gear
2	Heavy rubber ground gear
3	Looped lead rope ground gear (coverless trawl)
4	Looped lead rope ground gear (coverless trawl)
5	8 inch (203 mm) disc ground gear (changed to vertical cameras)
6	8 inch (203 mm) disc ground gear

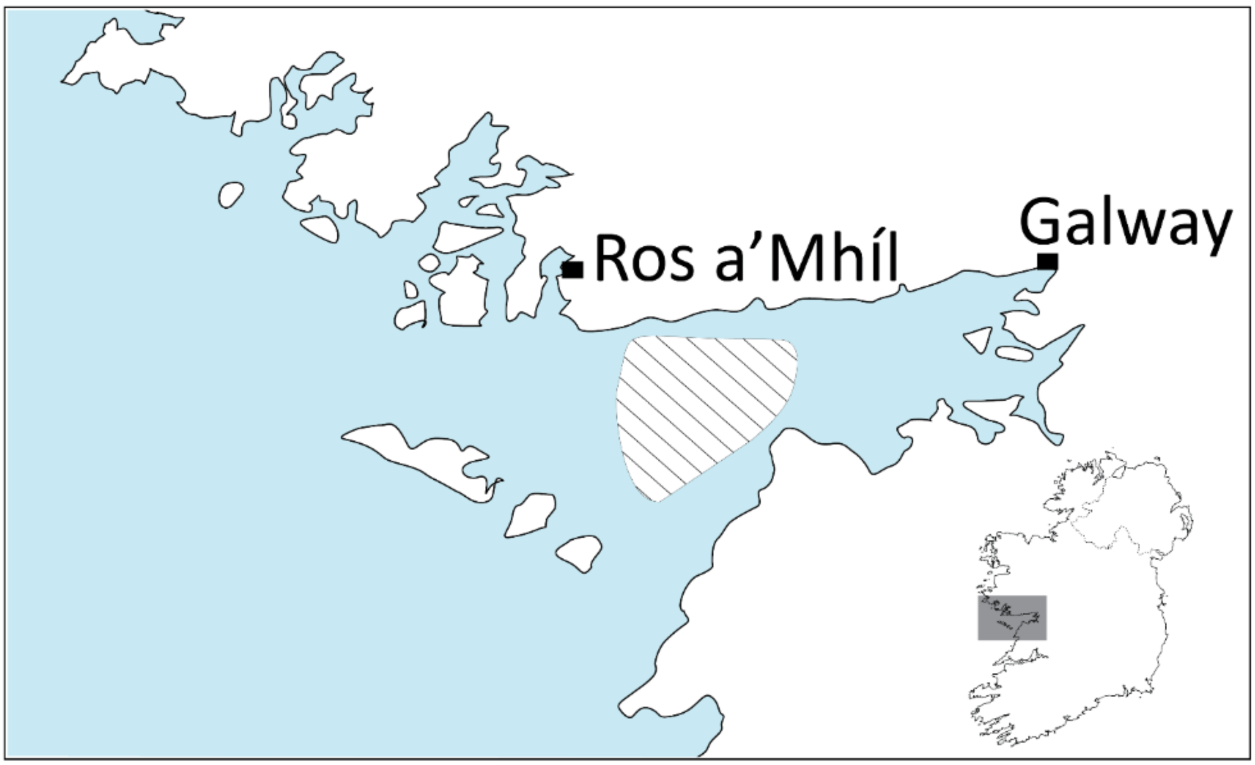

Figure 1. Trial location (hatched area)

Sediment suppression system

The sediment suppression system (SSS) consisted of a 3 m wide by 5 m long tarpaulin with eyelets fitted around the perimeter (Figure 2). The forward edge of the tarpaulin was securely fixed to the fishing line of the trawl and the centre was negatively offset by 20 cm to allow for the shape of the ground gear while fishing. The sides and rear edge of the tarpaulin were laced to the meshes of the trawl using bungie cord.

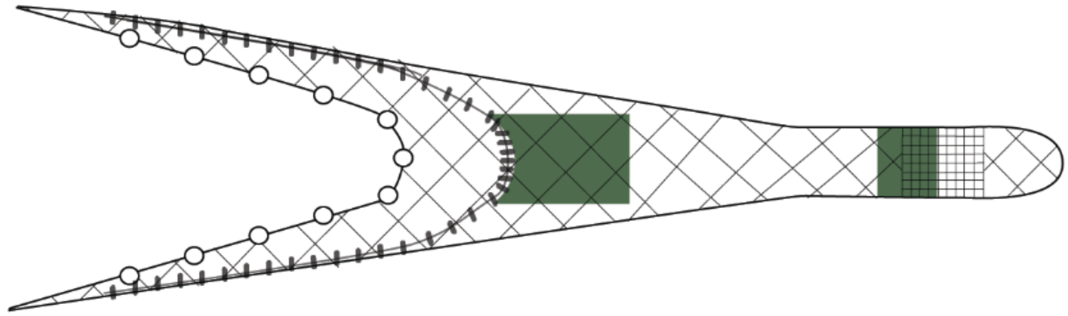

Figure 2. diagram of Nephrops trawl showing location (green rectangles) of: sediment suppression system (fwd); and image acquisition system (aft).

Image acquisition System

The image acquisition section (IAS) comprised a box shaped tarpaulin, stereo GoPro Hero10 cameras and underwater lights. The 2 m long tarpaulin was constructed of 4 tapering panels of tarpaulin measuring 0.5 m at the forward end and 0.4 m at the aft end. Twin GoPro cameras were mounted in underwater housings (www.anglerfishlighting.ca) which facilitate the use of external Sony NP-F750 type battery packs (Nitecore Li-ion 7.4V 5200mAh 38.5Wh) which extend GoPro battery life from 30-40 minutes to 5-6 hours. Camera housings were mounted to a rectangular nylon board in stereo configuration so that lenses faced inward through holes cut in the tarpaulin (Figure 4). The Nylon board was mounted on the port side panel of the tarpaulin on days 1-4 and on the top panel for days 5-6. The mounting configuration was changed to check if it was a contributing factor to sediment resuspension. Six SN Tech Pisces lights (https://sntech.co.uk/) were mounted on the side and top panels of the IAS facing inward. Mounting the stereo cameras on the side panel allows side on imaging of fish necessary for subsequent identification while vertical mounting still allows Nephrops imaging.

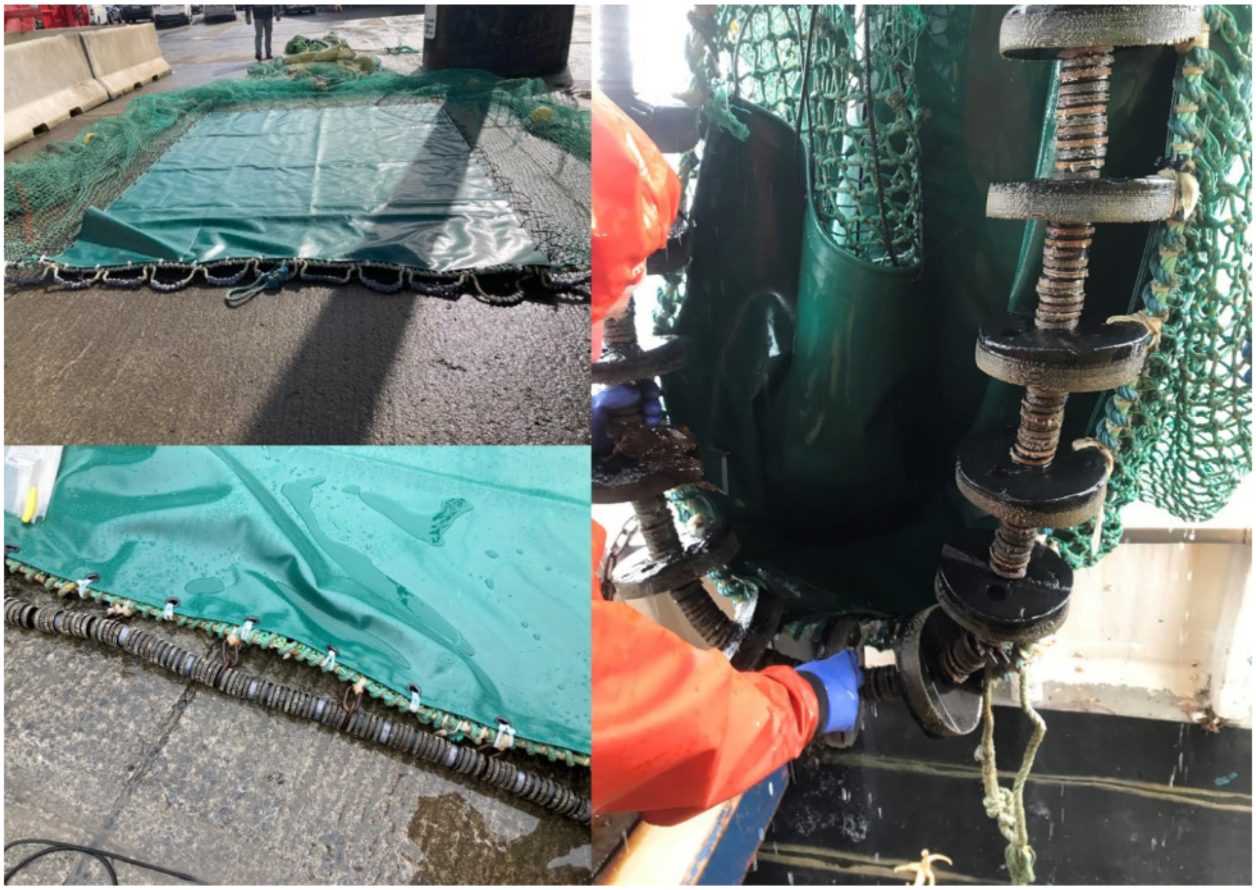

Figure 3. ground gear types deployed during trial (counterclockwise from top left): looped leaded rope, heavy rubbers and 8-inch rubber discs.

Ground gear observation camera and light

On the last day of the trial a Paralens underwater video camera and Anchor dive light was deployed on the headrope of the third gear tested (8 inch/ 20 cm discs) to investigate if sediment from the ground gear was passing over the SSS.

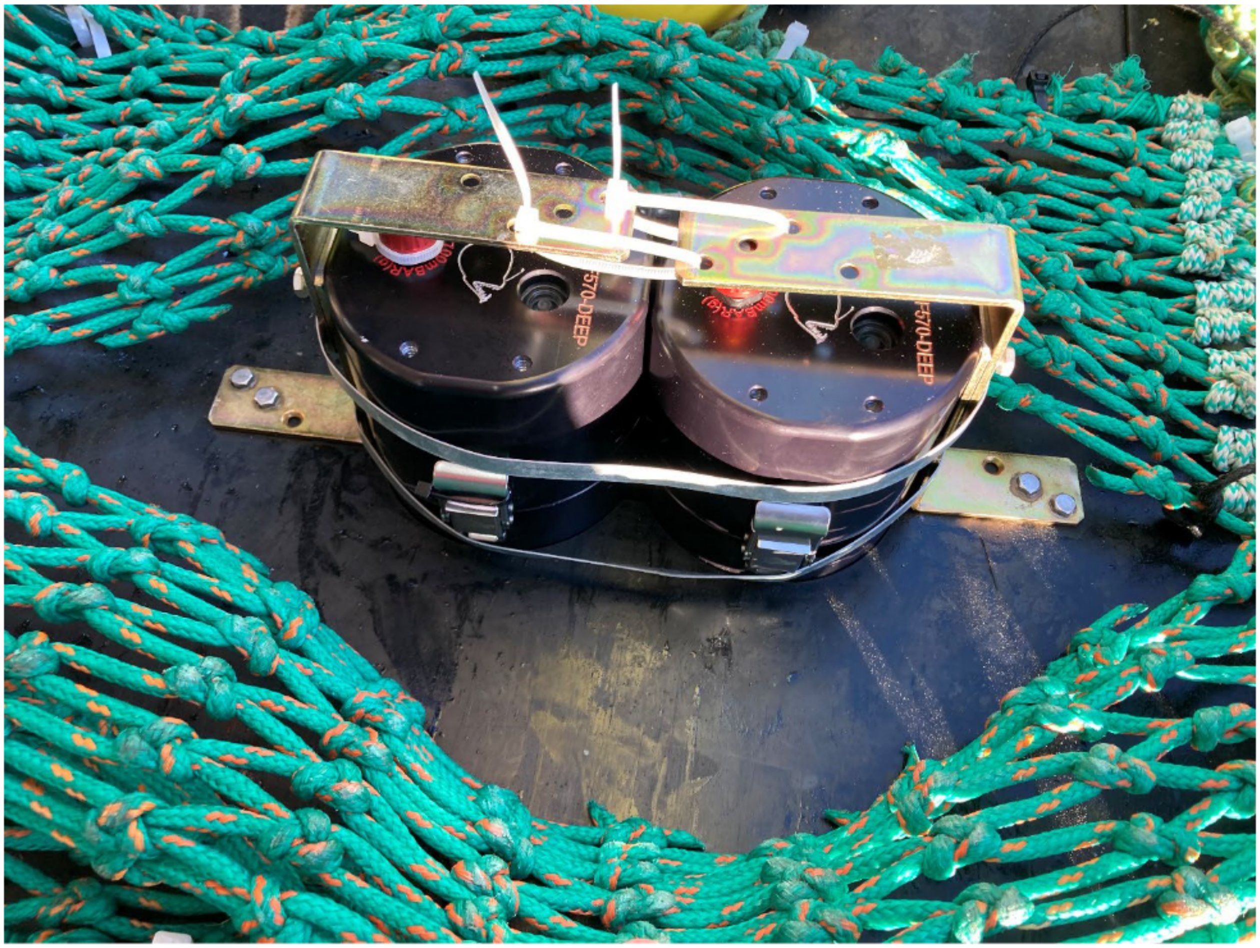
Figure 4. Nephrops trawl fitted with the Image Acquisition System (IAS) comprising: 4-panel tarpaulin; nylon mounting board; twin GoPro cameras in underwater housings; and SN Tech Pisces underwater lights.

Results

A total of 6 days, 2 with each gear, were completed during March and April 2023. Mean haul duration, speed and depth were 1:00 hr, 2.5 kts and 50 m.

The IAS functioned well during the trial. Video camera batteries lasted for at least 6 hours per day. The Nitecore battery recharging time was such that spare batteries were necessary for extended operation. The Pisces lights are rechargeable and estimated running time is 270 hours. The box shaped tarpaulin maintained its shape and imagery was of good quality where sediment was not present.

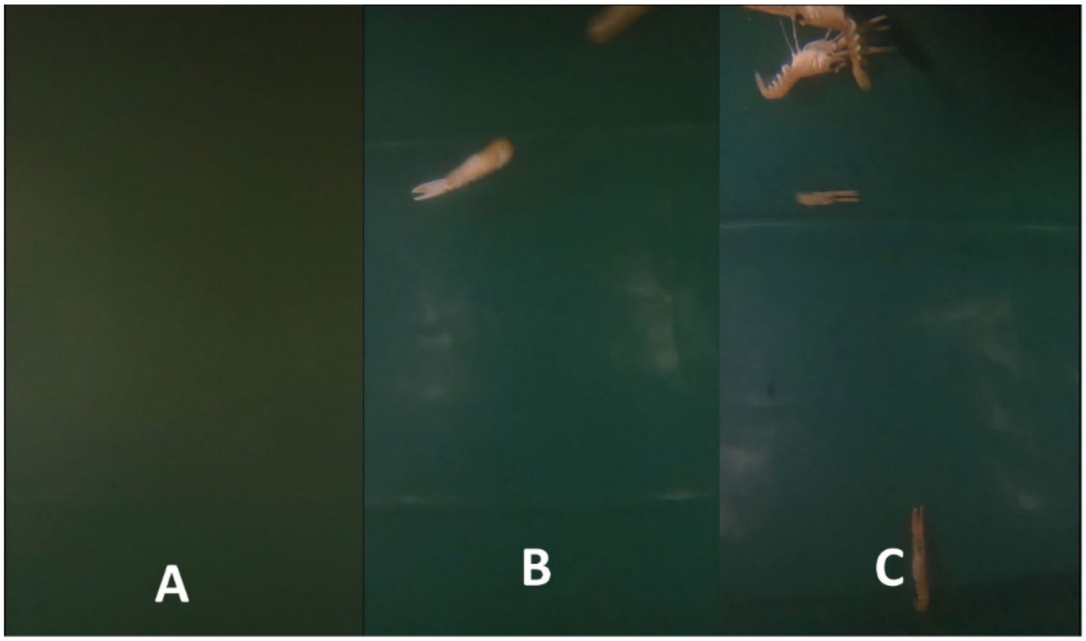

Figure 5. images taken from IAS video during one haul demonstrating: excessive suspended sediment (A); intermediate levels of suspended sediment (B); and low levels of suspended sediment (C).

All of the trawl configurations tested resulted in excessive suspended sediment within the IAS. The ground gear of the first two trawl configurations tested, heavy rubber foot rope and looped leaded rope, resulted in very little separation between the substrate and the fishing line and it is possible that sediment suspended by the ground gear entered the trawl over the SSS. The third ground gear tested comprising 8 inch (20.3 cm) rubber discs also resulted in suspended sediment within the IAS despite up to 20 cm of separation between the substrate and the fishing line. Examples of images captured under different levels of sediment suspension are displayed in Figure 5. In Figure 5B and 5C Nephrops are clearly identifiable but in Figure 5A suspended sediment makes identification impossible.

A Paralens underwater video camera and Anchor dive light deployed on the head rope of the trawl facing the ground gear revealed that sediment did not enter the trawl over the SSS. The suspended sediment visible at the IAS is therefore likely to have entered the trawl aft of the SSS.

Irish Nephrops trawls are commonly constructed so that there is more tension in the top sheet which results in slack bottom sheet meshes. Sediment may have entered the trawl aft of the SSS through trawl bottom sheet meshes contacting the substrate. Difference in trawl design may explain the difference in SSS performance in the Danish study (Sokolova et al., 2022). The 5 m length of the SSS could be extended aft to counter this issue. Alternatively, trawl designs that reduce bottom sheet contact, and potentially reduce drag, could be utilised with the disc ground gear to provide better quality video.

Discussion

Knowledge gained on trawl image acquisition in this trial will be of benefit to BIM in obtaining enhanced underwater imagery which will greatly assist in assessing trawl operations. Excellent images were captured when sediment was not present but excessive suspended sediment made it difficult to acquire clear images.

Deployment of a headline camera on the last day of the trial revealed that sediment passed below the SSS using the 8 inch disc ground gear. Yet the presence of sediment in the IAS during the same haul suggests that sediment entered through the meshes of the bottom sheet of the trawl possibly as a result of contact with the substrate. Increasing the length aft of the SSS could more effectively suppress sediment. Doing so effectively reduces the selectivity of the bottom sheet meshes of the trawl and is therefore only possible under derogation from the EU Technical Measures Regulation (EU) 1241/2019.

An alternative strategy would be to design novel or utilise extant Nephrops trawls that do not incorporate slack meshes in the bottom sheet thereby improving sediment suppression and potentially reducing bottom contact and drag. Another promising avenue for intermediate levels of suspended sediment is to enhance the images using dehazing techniques in post processing. Dehazing is a term used in digital image processing that describes methods such as deep learning that can be used to improve image visibility for instance where light is diffused underwater by suspended sediment (Hu et al., 2022).

Acknowledgements

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