Staggering the fishing line: a key bycatch reduction option for whitefish trawlers

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Staggering the fishing line: a key bycatch reduction option for whitefish trawlers

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Key Findings

1. Substantial reductions in rays, flatfish, and dogfish with more moderate reductions in haddock and cod.

2. Substantial reduction in undersized whiting with no loss of market sized whiting.

3. Good option for vessels targeting whiting under the landing obligation.

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Introduction

The draft discard plan for North-Western waters from 2019 to 2021 (EC, 2018) contains lists of gear options for vessels targeting whitefish species in the Celtic and Irish Seas. These options are likely to be effective in reducing juvenile or below minimum conservation reference size (MCRS) catches. Challenges remain if low quota species such as cod and black sole are to be avoided, while viable catches of whiting, a key target species in the Celtic Sea, are maintained. Although not on the list of prescribed measures, separating or staggering the fishing line from the ground gear provides an additional option for vessels to reduce such unwanted catches which tend to enter the trawl close to the ground gear. A previous BIM trial demonstrated reductions in cod by 39%, flatfish by 57% and skates & rays by 80%, and an increase in whiting by 87% (McHugh et al., 2017). While the results were very encouraging, post-trial testing by the vessel owner revealed some issues with gear performance in rough weather and strong tides so further testing was required.

In collaboration with the Centre for Sustainable Aquatic Resources, BIM organised an Industry workshop at a flume tank facility in Newfoundland to address this issue (McHugh et al., 2018). The flume tank staff had lots of experience of ground gear alterations and a raised fishing line trawl is currently used in a New England (US) small-mesh trawl fishery to reduce unwanted groundfish species such as flatfish and rays (Carr and Milliken, 1998).

The principal gear adjustment consisted of altering the rigging from two single bridles to a split upper (V) bridle and lower bridle with detailed information on trawl performance parameters such as spread, opening, tension, and drag collected for future testing in Irish waters (McHugh et al., 2018). The current study aimed to transfer knowledge gained from the flume tank work by field testing the re-configured raised-fishing line trawl.

Figure 1. Location of raised fishing line trial (hatched area)

Figure 2. The trial vessel, MFV Northern Celt, SO 472

Methods

Fishing operations and gear

The trial was conducted on board the MFV Northern Celt (SO472) in ICES Divisions 7g and 7a in March and April 2019 (Figure 1 and 2). Two identical single rig otter trawls (Table 1) were used to compare catches from 24 alternate hauls. Each net was fitted with an 80 mm codend with a 120 square mesh panel (SMP) in compliance with current regulations in the Celtic Sea and under derogation from the Sea Fisheries Protection Authority (SFPA) in the Irish Sea. The test gear had 32 × 1 m droppers constructed from 14 mm polysteel rope attached between the fishing line and the ground gear (Figure 3a). An additional bridle was attached between the fishing line and the upper bridle to improve trawl stability (Figure 3b). The control gear was rigged as normal with two bridles. Headline height was estimated using the vessels own Scanmar and Marport headline sensors. The test and control gears were deployed as alternate hauls on a randomised paired basis with time and distance minimised between each pair of hauls.

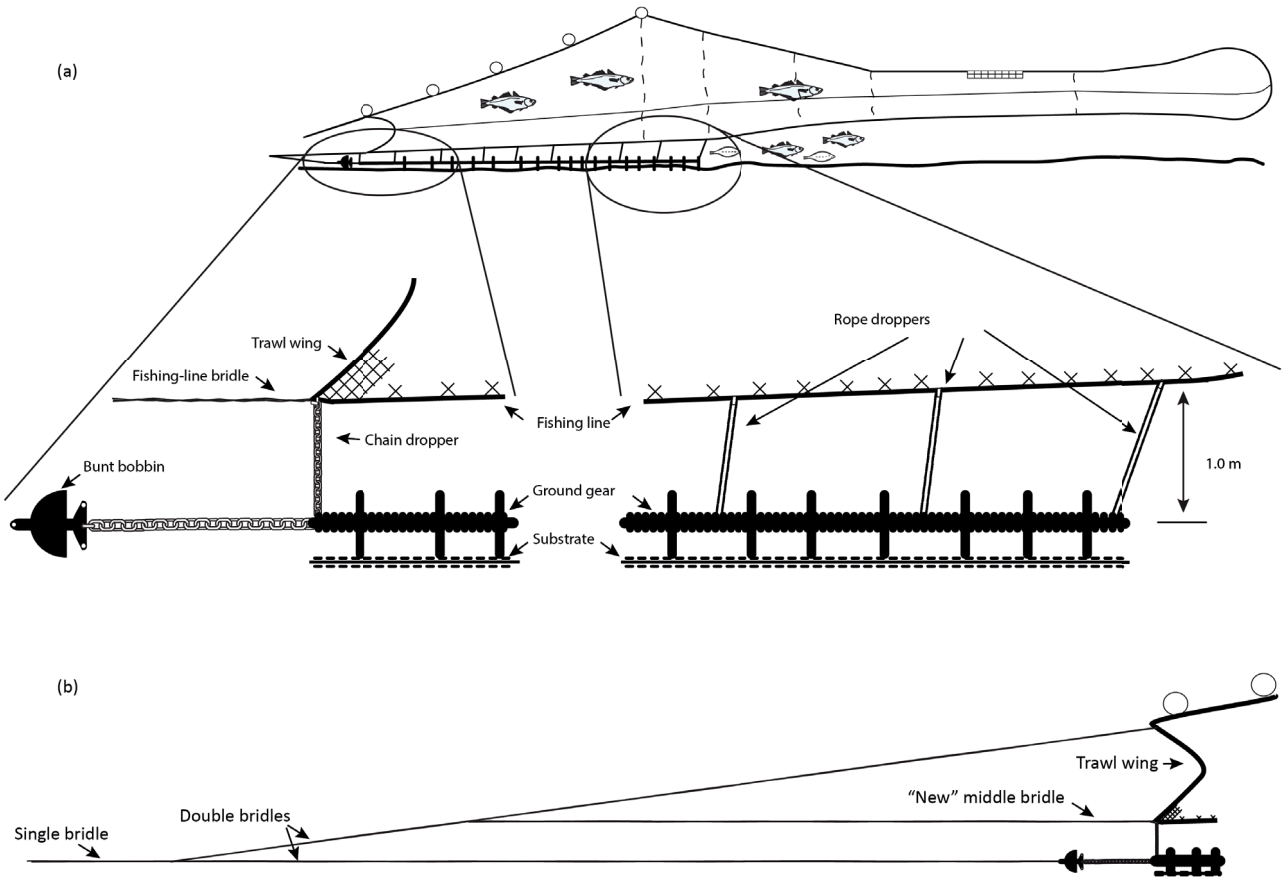

Figure 3. (a) the test gear with (b) the three-bridle configuration

Sampling and analysis

The total catches from each net were sorted to species level and weighed with random sub samples measured and weighed. Total lengths of commercial fish species were measured to the nearest cm below. Length-weight relationships (Silva et al., 2013) were applied to the measured fish to obtain estimated weights by length class for comparative purposes.

A generalised additive model (GAM) was used to statistically assess proportional differences in catch at length of key species, with length frequencies superimposed on the resulting graphs. Most of the hauls were conducted during day time so it was not possible to analyse differences in catches between day and night.

Table 1: Vessel and gear specification

Engine power (kW)	600
Warp diameter (mm)	22
Door manufacturer	Bison
Door weight (kg)	1050
Sweep length (m) - singles	109
Sweep length (m) - doubles	54
Trawl manufacturer	John Cavanagh
Trawl type	Single rig
Headline length (m)	26.2
Footrope length (m)	30
Fishing circle (meshes × mm)	720 × 120
Cod end and SMP nominal mesh size (mm)	80 and 120

Results

A total of 24 valid hauls (12 with each net) were completed over five days. Mean haul duration, towing speed, depth fished, and distance towed were 02:00hr, 3.2 kt, 82 m, and 6.32 nm, respectively. The weather was calm with wind speeds of 1 to 11 km/h or Beaufort 0 to 2. The main fish species caught were haddock, lesser spotted dogfish and whiting. Substantial reductions (> 60%) in catches of lesser spotted dogfish, flatfish species and rays, and smaller reductions (20 to 29%) of haddock, whiting and cod occurred in the test gear (Table 2).

Table 2. Total species catch weights

Species	Control (kg)	Test (kg)	Difference (%)
Haddock	3507	2783	-21
Lesser spotted dogfish	1480	180	-88
Whiting	974	704	-28
Plaice	356	114	-68
John Dory	268	200	-26
Hake	184	172	-7
Skates & Rays	160	35	-78
Lemon sole	143	43	-70
Monkfish	115	37	-68
Megrim	93	16	-83
Cod	83	59	-29
White Pollock	77	17	-78
Ling	40	24	-40
Mixed flats	17	15	-12
Others	1809	824	-54
Bulk catch	9307	5221	-44

Categorisation of species catches in relation to minimum sizes revealed major reductions (46 to 63%) in undersize whiting with minimal difference (- 9 to + 3%) difference in catches of larger whiting in the test gear. Overall, haddock were reduced by almost 40%. Cod ≥ MCRS were reduced by 32% while very few cod < MCRS were retained in either gear. Similar reductions in plaice occurred ≥ and < MCRS (Table 3).

Table 3. Estimated species catch weights by minimum conservation reference (MCRS) and market* size

Species	Control (kg)	Test (kg)	Difference (%)
Haddock ≥ 30 cm	3650	2242	-39
Haddock < 30 cm	616	393	-36
Whiting ≥ 27 cm	810	736	-9
Whiting < 27 cm	191	71	-63
Whiting ≥ 31 cm*	545	562	3
Whiting < 31 cm*	455	246	-46
Plaice ≥ 27 cm	275	73	-74
Plaice < 27 cm	213	73	-66
Hake ≥ 27 cm	196	175	-11
Hake < 27 cm	2	1	-73
Cod ≥ 35 cm	81	55	-32
Cod < 35 cm	6	2	-70
Megrim ≥ 20 cm	104	17	-84

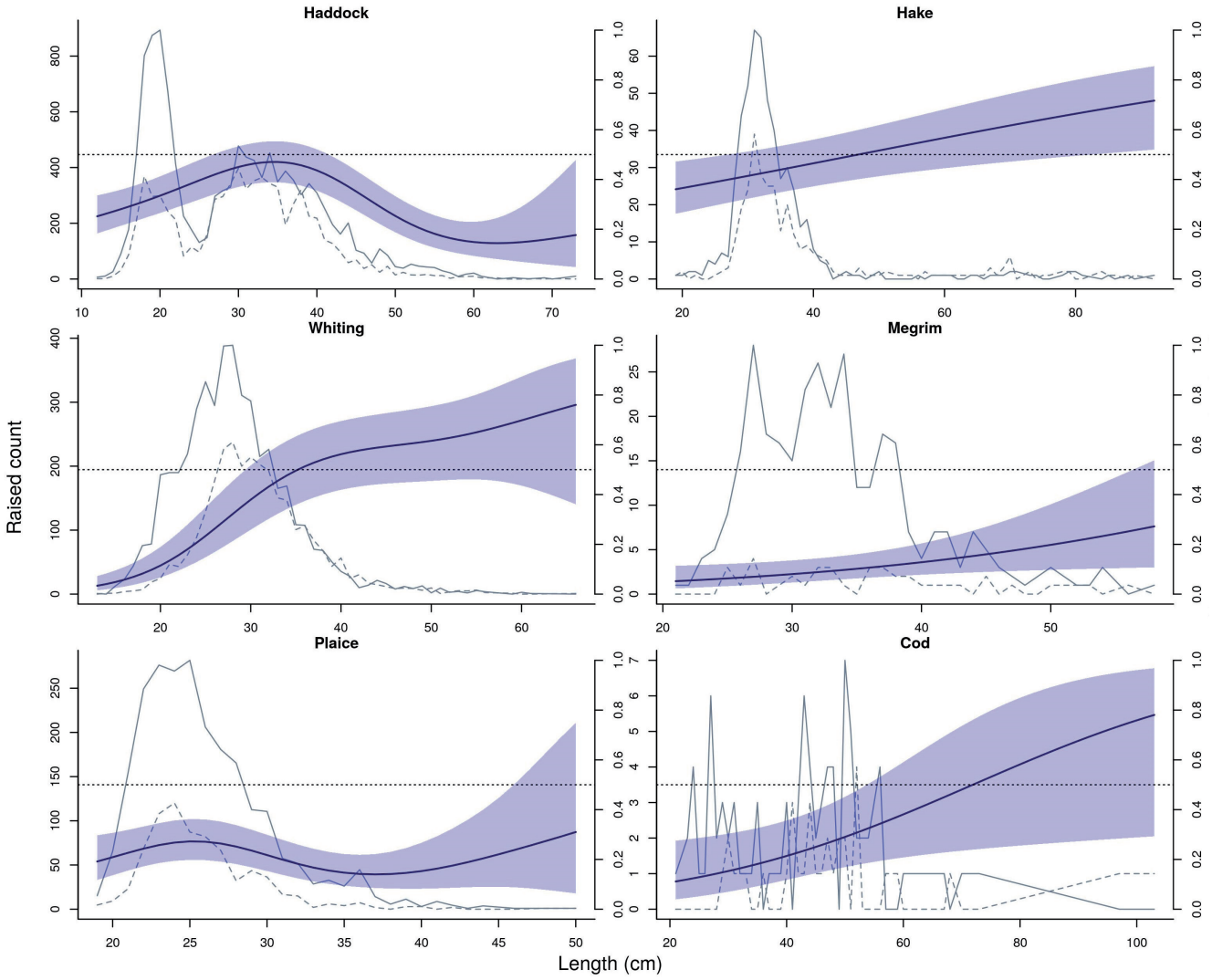

Figure 4. Proportional catch at length for key species in the staggered fishing line gear. Fitted average (solid) and 95% confidence intervals (shaded areas) come from the GAM model. Length frequencies are represented by grey dashed (Staggered gear) and grey (Control gear) lines.

Modelling of proportional catch at length in the two gears confirmed significantly lower catches of haddock < MCRS (30 cm) and ~ > 40 cm in the staggered gear. Whiting catches were significantly reduced ~ < 30 cm which is close to market size with no reduction in catches above that size. Plaice and megrim were reduced across all size classes, while significant reductions occurred in hake ~ < 27 cm (MCRS) and in cod across most of the observed size classes (Figure 4).

Discussion

Substantial reductions in haddock, cod, rays, flatfish and undersize whiting occurred while market sized whiting catches were maintained in the staggered fishing gear. This suggests that this gear can greatly assist Irish whitefish vessels in meeting landing obligation requirements when targeting whiting: whiting is least constrained by quotas in the Celtic Sea while quotas for these other species are more limited.

Minimal difference in headline height between the two gears suggest that the fishing line was staggered forward or aft rather than raised directly above the ground gear. This is corroborated by the absence of increased whiting and haddock catches in the test gear; McHugh et al. (2017) observed substantial increases in whiting and haddock catches in the test gear likely due to an observed difference in headline height of ~ 1 m.

Increased rigging weight associated with the extra bridles used to stabilise the trawl likely contributed to the comparatively lower headline height in the current study compared with McHugh et al. (2017). Lighter combination rope or dyneema bridles would lighten the rigging. Extra floats or kites on the headline could also contribute towards increased headline height. This would likely increase catches of whiting and haddock across all size classes. However, a prescribed gear option under the discard plan, the 90 mm T90 codend, should greatly reduce catches of < MCRS

whiting and haddock: Previous BIM research on this gear in a dual codend rig in the *Nephrops* fishery demonstrated reductions of 72 and 49% of < MCRS whiting and haddock compared with a standard 80 mm codend (Cosgrove et al., 2016). Further assessment of the 90 mm T90 codend in the whitefish fishery is planned.

This difference in the orientation of the gap between the fishing line and ground gear may explain differences in the size composition of whiting and haddock retained in the test gear between the two BIM studies. The raised fishing line retained more whiting and haddock across all size classes in the previous study, but the staggered fishing line retained substantially less < MCRS whiting and haddock in the current study. Size dependent reductions of cod and haddock at the ground gear in trawls with standard and raised fishing lines has previously been observed: smaller cod and/or haddock passed under the ground gear and fishing lines in greater numbers than larger individuals (Walsh, 1992; Krag et al., 2010). Fish reaction to fishing gear is based primarily on vision (Glass and Wardle, 1995). The staggered location and altered visibility of the fishing line in relation to the ground gear in the current study may have increased the propensity for smaller fish to swim closer to the ground gear, thus facilitating their escape.

Furthermore, although whiting and haddock have both been observed to rise vertically when they meet the ground gear, whiting have been observed to swim slightly higher off the seabed than haddock, between 1 and 2 m in front of the ground gear (Main and Sangster, 1981). Increased proximity of haddock to the gap between the ground gear and raised fishing line could explain reductions in larger haddock which were not evident for larger whiting in the current study. Direct observations of fish behaviour in relation to the test gear would assist in elucidating this issue but camera lights which would be required due to poor visibility could impact fish behaviour. Collecting bags below the fishing line could also assist but again, these may impact fish behaviour. Regardless of the underlying reasons behind variable catch composition, further industry-led testing and development of the gear is the best way to confirm performance of this gear in relation to different species. In addition to providing an effective bycatch reduction device in the whiting fishery, the gear has major potential to reduce trawl and catch damage on rough ground where stones and boulders can also pass through the gap rather than into the codend.

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