Centre for Environment Fisheries & Aquaculture Science

Cefas

CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE
LOWESTOFT LABORATORY, LOWESTOFT, SUFFOLK NR33 0HT

2023 RESEARCH VESSEL REPORT

REPORT: RV CEFAS ENDEAVOUR: CEND 19/23

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DURATION: December 13th to 20th (9 days).

LOCATION: North Sea (ICES areas 4b & c)

AIMS:

1. To carry out testing of a Jackson clean/fine ground otter trawl (JTS610) to enhance knowledge for scientists and ship's crew in deployment, fishing and recovery of the net in various water depths. This is in expectation that this net will replace that currently used as part of the internationally co-ordinated IBTS (International Bottom Trawl Surveys) survey series and catches will be compared to those seen in the IBTSQ3 survey completed in August 2023.

2. To use the catch to provide training opportunities for pelagic sampling, epi-benthic ID and stomach content ID skill development.

OPPORTUNISTIC AIMS

3. Tag and release specimens of starry smooth-hound *Mustelus asterias*, spurdog *Squalus acanthias*, tope *Galeorhinus galeus*, common skate *Dipturus batis* species-complex, blonde ray *Raja brachyura* and cuckoo ray *Leucoraja naevus,* in support of the ICES Working Group for Elasmobranch Fishes work to inform on stock units for demersal elasmobranchs (Jim Ellis).

4. To freeze any unusual fish species for subsequent identification / verification in the laboratory, including specimens of eelpout (*Zoarces, Lycodes* and *Lycenchelys*), sea scorpions (Cottidae, Division 4.a only), and any unusual fish species, which may also be used in otolith research (Jim Ellis/Gary Burt).

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5. To retain any dead specimens of tope (*Galeorhinus galeus*) and common skate (*Dipturus batis* species-complex) for biological studies (Jim Ellis).

6. Retain any dead specimens of shad and lamprey for biological studies (Teá Basic)

7. Cetacean observations will be recorded where possible and sent to the Sea Watch Foundation.

8. Record fisheries acoustic data throughout the survey using the new EK80 at 5 frequencies (38, 70, 120, 200 and 333 kHz) to map the pelagic fish community (Jeroen van der Kooij).

9. Use appropriate examples to develop an SOP for fish maturity photography for use on surveys in 2024 (Richard Humphreys/Samantha Barnett).

10. Testing for evidence of epiphytic dinoflagellates in macroalgae (Beth Bear).

Narrative

Scientists joined RV Cefas Endeavour on the morning of December 11 2023. Inductions were completed as the ship's crew rigged the JTS610 trawl. Unfortunately, the time needed to complete this task meant that early sailing on December 12th was not possible and sailing was delayed by 12 hours. The December Gear Trials Survey (henceforth referred to as CEnd 19/23) left Lowestoft approximate 18:15 December 13 and proceeded north-east. The first task of the survey was to recover the Dowsing wave-rider, which had broken free of its mooring and could become a danger to shipping. The GPS tracker on the buoy meant that it was found just before daylight on December 13 and recovered quickly (Figure 1). By 08:30 hr the ship was en route to Prime Station 8 to begin testing the net.

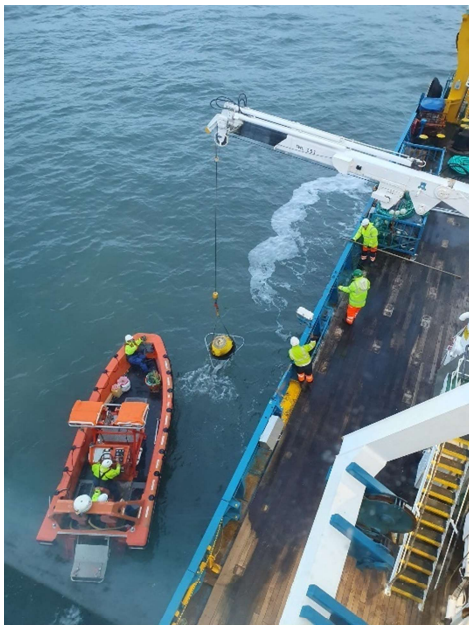

Figure 1: Recovery of the Dowsing wave-rider

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The JTS610 is a bottom trawl designed to replace the GOV (Grand Overture Verticale) trawl currently used by the IBTS in the Q1 and Q3 North Sea surveys. This net, but with a light hopper ground gear (300–250 mm disc diameter) was successfully used in the Celtic Sea/western English Channel in February 2023 as part of CEnd 3a/23. The "clean/fine" ground gear (250–200 mm disc diameter) had not been tested by Cefas, and as this was the expected design to be trialled for use during the North Sea IBTS, it was paramount to make sure the net delivered on a variety of expectations, and to record this testing throughout to inform the other member states of the IBTS.

This was especially important in the wake of issues highlighted in testing of the net by other IBTS members in September 2023. These included concerns over the ground contact at the quarters and bunt-ends of the ground gear, as well as at the triangle bridle split. The headline of the net was also very high, which would result in large pelagic catches for countries fishing in the Skagaraak and areas of shallow water. The other concern was with the ability to mend net damage, with crew noting the net's complexity and mesh construction.

Upon arriving on station weather had worsened to the point where fishing was not possible. With Prime Stations 7 and 8 having the shallowest water depth of the sites selected to survey, it was decided to remain in position overnight and begin work in the morning once the weather conditions had improved. Over the course of the next day five tows were completed. At prime station 7, the first attempt to fish was abandoned due to issues with the net geometric sensors. A 15-minute tow was completed soon after with a small catch of dab *Limanda limanda*, whiting *Merlangius merlangus* and haddock *Melanogrammus aeglefinus* (~20 kg in total). The third tow here was also invalidated as a low headline height throughout the fishing was found to be caused by the port wing and ground gear being entangled. Of note here was juvenile anchovy *Engraulis encrasicolus,* found much further north than having been recorded on previous North Sea surveys. Two tows were successfully completed at prime station 7, the first being only 20 minutes due to the presence of static gear. Whiting, haddock and dab were the most abundant with catch weights of ~90 kg, ~50 kg and ~17 kg recorded, respectively.

Much of the work the next day took place at prime station 23, also known as "Swallow Hole". The depth range at this station gave experience with the net at greater depths and also had a change in substrate, with the muddy ground home to *Nephrops norvegicus*. These were recorded in the first successful tow shallowing from 150 m deep, along with over 1 tonne of haddock and whiting. Another attempt at ~120 m saw another catch >500 kg abundant in these species, with also some long-rough dab *Hippoglossoides platessoides*. A tow between these catches had to be abandoned due to poor headline and door sensor readings. Further west, at prime station 22 a smaller catch of haddock, whiting and some herring *Clupea harengus* was successfully completed (~130 kg in total).

During the day, headline height was monitored after six floats were removed to try and target a ~5 m headline height in deeper waters. The ~8m headline height seen in the shallower waters (~35–40 m water depth) was found to be closer to 6.5 m in the deeper water at "Swallow Hole", although it is noted that deeper depths are expected to reduce the efficiency of the floats. The next day poor weather reduced operations to Prime Station 31 only and five tows were completed here, with one invalid due to poor headline sensor readings. A further six floats were removed, this time closer to the net opening and a small reduction in headline height was recorded on the following tow. Catches were very similar, as was expected, with haddock being the most abundant, recording over 200 kg each time.

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With the last attempt of the day ~50 kg of queen scallop *Aequipecten opercularis* were recorded in the catch. This was considered further evidence of the net's ground contact, seen with contact sensors since the start of the survey and through speed tests of up to 4.5 kts Speed Over Ground earlier in the day. With also the lower bridle chain up to the triangle showing wear ("shined"), it was agreed on board that issues over ground contact no longer needed investigating.

Figure 2: *Dipturus intermedius* from prime station 51 being tagged before release.

By 17/12/23 CEnd 19/23 had moved to prime station 52 but found the weather here too poor to be able to deploy the net. Transit was made westwards towards the Moray Firth and to prime station 51. Arriving in late morning, four fishing attempts were made over the course of the rest of the day, with focus on the headline. Firstly, the six floats removed from the wing-ends were re-instated to find there was no appreciable difference to having floats removed from the wing-ends or closer to the headline. A female flapper skate *Dipturus intermedius* was caught on the first tow, amongst ~500 kg of haddock and plaice *Pleuronectes platessa*. Another 18 floats were removed down the wings, which showed a drop in over 1 m in headline height from 7 m to 6 m in this water depth of ~60 m, closer to the target of ~6 m in shallow water (~30 m). Over 650 kg of haddock was caught this time.

Problems with communication from the wing-end sensors meant another attempt was made with the same net parameters, this time with the cod-end open. Unfortunately, this was no better, although fishing with a warp: water depth ratio of 4:1 was tried here, rather than the standard 3:1+30 m. This showed no difference other than an expected increase in door distance. A fourth attempt also lost communication with the door sensors, as well as the wing-end sensors and was declared invalid.

With weather further north deteriorating, the survey moved south to prime station 41. Two attempts to fish were successfully completed here, with ~400 kg, and then ~750 kg of haddock, whiting and dab caught here. The second catch also saw ~45 kg of male spurdog *Squalus acanthias* (tagged and released). Net geometric readings showed a lower wing-end spread (~21 m, down from ~25 m) with the reduced flotation, with this potentially showing a change to the shape of the net beyond just headline height. However, another attempt with the floats re-instated at prime station 32 showed the wing-spread was still ~21 m. Whilst a 4:1 warp:water depth ratio was also attempted, this overspread the doors and the headline collapsed.

Fishing concluded on 19/12/23 back at prime station 8, with the weather forecast to prevent further work for the rest of the survey from that afternoon. Four attempts were made, with the latter two successful. The invalid tows were due to poor headline readings from a parted link on the headline height sensor unit. After this was fixed, a small catch of dab, whiting and haddock was caught, before changes in warp length were tested during the final fishing event. This showed that having a higher ratio in shallower water improved the net geometrics, something that was seen with the GOV net as well.

CEnd 19/23 then headed back to home port in Lowestoft, staying ahead of the encroaching weather front, docking at approximately 15:30 hr Wednesday December 20th.

Results

1. *To carry out testing of a Jackson clean/fine otter trawl (JTS610).*

As can be seen in Table 1, 24 deployments of the JTS610 were completed over eight different sampling stations (Figure 6). Six of these hauls were invalid, five due to loss of net geometric sensor readings and the sixth due to the port wing becoming twisted on deployment and not allowing the net to adopt its correct shape, resulting in a very low headline reading. Only eight of the 27 planned fishing stations across the survey grid could be completed due to the westerly gales throughout the survey, limiting the scope of the work to the most westerly sites that had some protection from the UK mainland.

Table 1. Number of and validity of deployments completed by CEnd 19/23

Validity	No. of Deployments
Valid	18
Invalid	6
Total	24

The net was used as specified in the IBTS gear group design (version 3) but modified before use, with a 50 kg, 16 mm traveller chain added to the ground gear bosom to provide additional weight to the trawl and improve ground contact. Changes were made through the survey to investigate net parameters, these are detailed in Appendix IV. The main areas of investigation were (a) ground contact, (b) headline height, (c) ease of use, and (d) catch comparison with GOV. Concerns raised by IBTS members over tensions in the upper and lower bridles could not be investigated due to the lack of tension meters available for testing.

Ground contact

Concern was raised by IBTS members from previous testing of the JTS610 with clean/fine ground gear, of sufficient ground contact at the quarters and further up towards the triangle bridle split. The impact of loss of ground contact could result in the trawl missing smaller flatfish species and epibenthos, biasing collecting a representative data set. Investigating this and potential changes to the net to improve ground contact was considered a key aim of CEnd 19/23.

As recommended by the IBTS gear group, six floats were removed, three from each wing-end. Marport Bottom Explorer sensors were also attached to the end of each ground gear bunt section, behind the chain to the bunt

extension piece (Figure 3). These were used for eight tows, with the position of the sensors changed, first to the other side of the ground gear inside the net after no readings were found in the position pictured. This worked intermittently but provided data showing between 0.1–0.3 m distance from the ground, with no change when speed over the ground was increased from the standard 3.4 kts to 4.5 kts, although this was only into 0.3 kts of tide. When one sensor was moved to the bosom of the net it was found to be covered in muddy substrate, indicating that the sensor had been in direct contact with the sea floor, and this is perhaps why the sensor data was only coming back intermittently. Figure 4 shows a good example of the data coming from the sensor, with the thin red line indicating the net going to the bottom and then back to the surface.

Figure 3: Marport Bottom Explorer rigged to the JTS610 ground gear

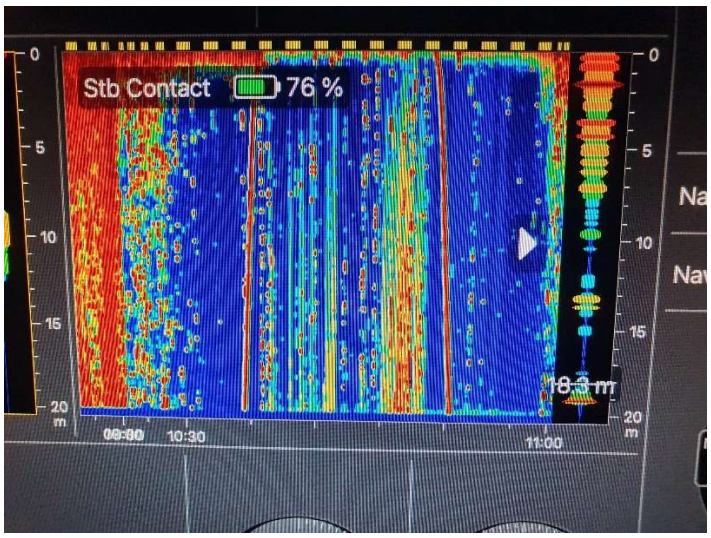


Figure 4: Marport Bottom Explorer output

With the sensors showing minimal lift from different positions and the evidence of the mud, it was decided that they could not provide any more information and were replaced with dangle chains (these being of lower mass than the sensors and housings). The abrasion of contact with the ground would give another type of indication that good ground contact was being achieved.

As can be seen in Figure 5, this abrasion was evident on the dangle chain at the bunt/bunt-extension and then up the wirework, along the ground gear extension chains to the hammerlock connecting the chains to the lower bridle and up to swivel joints and triangle where the bridles meet the sweeps.

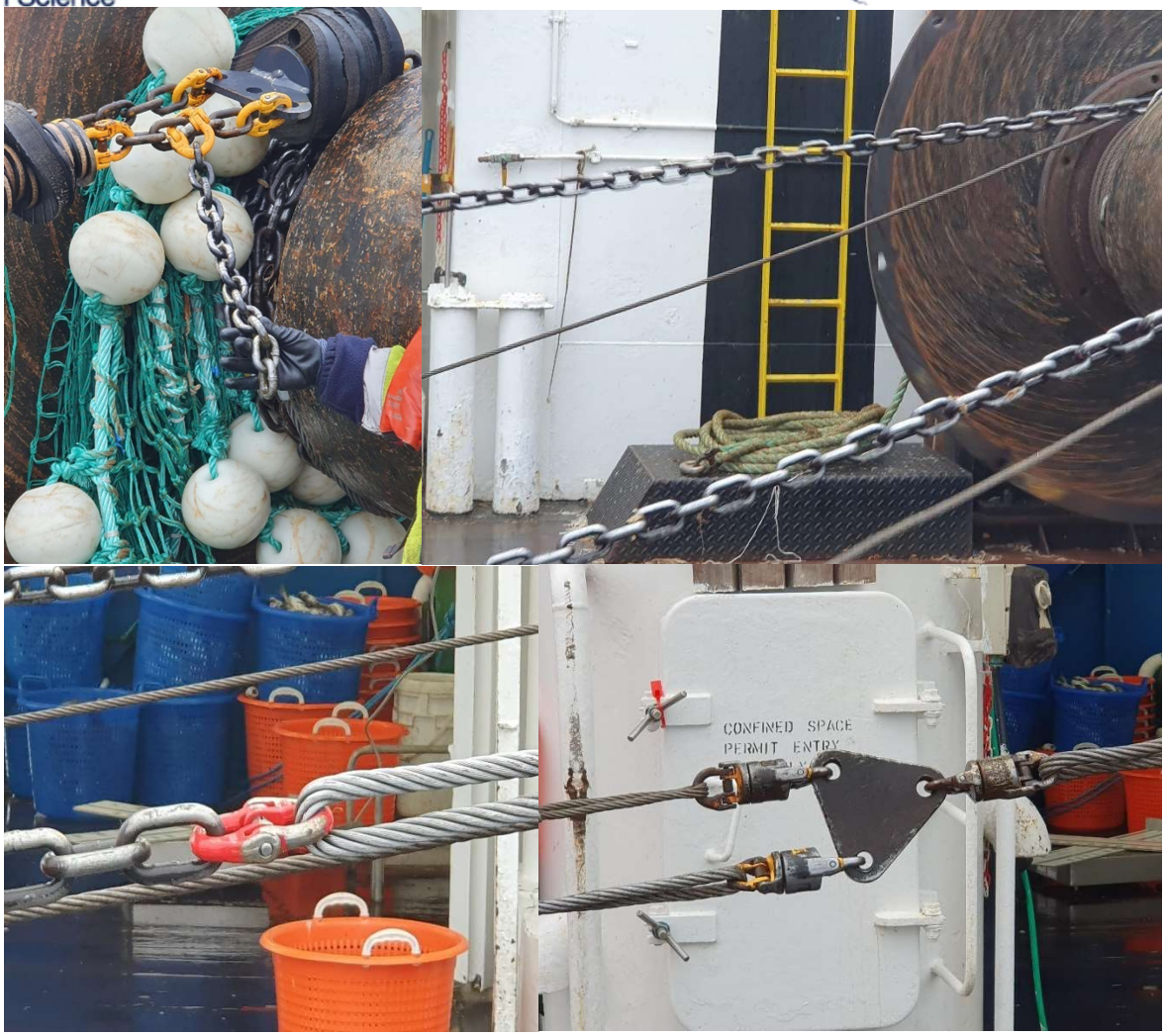


Figure 5: abrasion on dangle chain, ground extension chain, hammerlock between sweep and extension chain, and triangle split

With evidence of this abrasion up to the sweeps, and with minimal lift shown by the Bottom Explorer Sensors, after nine tows it was concluded that the net provided good ground contact, and with catch comparison supporting this (see below) this investigation was concluded.

Headline height

Headline height is an important consideration for the IBTS members. A higher headline height compared to commercial otter trawls allows the net to sample a better cross-section of the pelagic fish community, with herring *Clupea harengus* and sprat *Sprattus sprattus* key species to be monitored for the Q1 and Q3 IBTS surveys. The JTS610 net had shown a headline height of 6–7 m on its first use during the 2023 Q1SWOTTER survey (CEnd 3a/23), compared to the ~5 m seen with the currently used GOV trawl (see Figure 7). The impact of a higher headline would see more pelagic fish caught, especially in areas surveyed by IBTS members with large pelagic fish communities like the Skagaraak.

CEnd 19/23 investigated whether minor changes in the JTS610 could reduce the headline height enough to be more comparable to the headline height seen by the GOV trawl. Net geometrics comparing the two nets, and the JTS610 with light hopper ground gear used on CEnd 3a/23 can be found in Figure 7.

The JTS610 began CEnd 19/23 with 144 floats providing 352.8 kg of lift but this was reduced to 138 floats before fishing after recommendation from testing by other IBTS members. The first eight tows that produced usable headline height sensor data showed an average of 6.7 m (6.3–7.39 m), although the lower values were in deeper water, as expected. After this, an additional six floats were removed from the start of the wing, next to the headline for a total of 132 floats, this then only saw a reduction in headline height to 6.5 m. A further 18 floats were then removed, three sets of three on each side, down the wing, leaving a total of 114 floats. This reduced headline height to ~6 m in 60–80 m water depth.

It was concluded that a simple reduction in flotation did not definitively show that this reduced headline height without impacting the shape of the net. Further investigation should be conducted but the current recommendation from this survey, including comments from the crew as mentioned below, would be that a reduction in the fishing circle by shortening the headline would be the best option to reduce headline height.

Ease of use

The handling of the net is very much driven by the experience of the crew of RV Cefas Endeavour. Due to the lack of gear damage on the survey this side of the investigation was dealt exclusively by qualitative comment, following concerns that the net is difficult to mend from previous testing.

It was assumed that mending gear damage would be more difficult due to the use of compound twine in the net's construction, however, it was also understood that this harder wearing twine would also likely reduce the amount of mending required. The layout of the net also did not appear to be difficult to mend. The crew also acknowledged that the lack of middle bridle and kite (that provides dynamic lift for the GOV) made the net much easier to deploy and recover compared to the GOV.

In terms of suggested improvements, it was indicated that the cod-end sleeve could be reduced in length, by removing a mesh panel and the fishing circle should be reduced in size (for example, to 90% of the current configuration) in order to most effectively reduce headline height to the desired values.

Catch comparisons

As an intended replacement for the GOV net, comparing the catch with the JTS610 on the same sites surveyed with the GOV four months before would give some initial insight into the new nets suitability. When comparing catches, it is important to highlight that many species (especially pelagic fish such as herring) will see their distribution affected by the change in time of year (Knijn *et al.*, 1993[1]). For this preliminary report, catches are related to the survey, given that there are confounding factors of gear type and time of year. Eight different IBTSQ3 prime stations (7, 8, 22, 23, 31, 32, 41, and 51) were sampled on the survey, some of which were fished more times than on IBTSQ3. Valid station catches are averaged across number of deployments and compared to those recorded at the same sites in August during CEnd 12/23. Catch weights were standardised to 30 minute tow times for both surveys and due to the differences in sub-sample selection, raised numbers per length were also analysed here.

[1]Knijn, R.J., Boon, T.W., Heessen, H.J.L. and Hislop, J.R.G. (1993) Atlas of North Sea Fishes. ICES CRR 194.

Gadoid catches have been summarised by the four most commercially important species to the IBTS; cod *Gadus morhua*, haddock, whiting and Norway pout *Trisopterus esmarkii*.

Table 2. Catch weights (kg) for commercial gadoid species caught during CEnd 12/23 (August, IBTSQ3, GOV trawl) and CEnd 19/23 (December, gear trials, JTS610 trawl)

Prime Stn	Cod		Haddock		Norway Pout		Whiting	
	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23
7	-	-	0.57	49.00	-	0.22	500.98	92.21
8	-	0.17	0.80	14.83	-	-	201.02	26.96
22	0.53	-	358.20	117.47	6.06	0.84	289.17	13.33
23	1.16	2.27	508.33	1620.75	56.14	17.21	821.17	400.11
31	-	-	63.00	968.85	0.25	0.34	7.54	159.48
32	2.44	4.86	260.54	330.58	0.07	-	64.45	50.48
41	0.48	1.01	140.07	1109.97	0.09	0.14	33.82	179.35
51	-	0.36	305.74	1090.79	-	0.03	5.84	46.01
Total	**4.60**	**8.67**	**1637.24**	**5302.23**	**62.62**	**18.77**	**1923.97**	**967.91**

Only small amounts of cod were caught in both surveys, and only on three prime stations were they recorded on each so comparison between the nets is limited with this species. A similar number of cod were caught on both surveys (11 on CEnd 12/23; 10 on CEnd 19/23), mostly 25–46 cm in length (Appendix I), and with one 68 cm fish caught during CEnd 19/23, which would account for the difference in catch weight between the nets (Table 2).

CEnd 19/23 saw a much larger catch weight of haddock to that seen during CEnd 12/23 four months previously, with over three times that of CEnd 12/23. Much of this was seen at three of the eight stations sampled; prime stations 23, 41 and 51. The combined average catches at prime stations 41 and 51 were 1754 kg higher during CEnd 19/23 than observed during CEnd 12/23, with the largest catch being at prime station 23 for both surveys. The length distribution seen across both surveys was quite similar, however, with the abundance of fish recorded between 21 cm and 40 cm but raised numbers were much higher across this distribution during CEnd 19/23, contributing to the higher catch weights.

Similar to cod, average catch weights for Norway pout were small which limited comparisons, but both surveys showed catches at prime station 23 made up ~90% of total catch across these sites. As the length distribution of Norway pout was small, it is to be expected that this is very similar across both surveys (CEnd 12/24: 5–20 cm, CEnd 19/23: 9–21 cm) but the CEnd 12/23 recorded over five times more fish at these lengths compared to CEnd 19/23, which explained the higher catch weights.

Catch weights for whiting were found to be nearly twice as high during CEnd 12/23, than seen later in the year (CEnd 19/23). As with the haddock, the most abundant catches for both surveys were at prime station 23, with more whiting observed at all prime stations (except 31 and 41) during CEnd 12/23. The length distribution showed more smaller fish (15–20 cm) caught during CEnd 12/23, although by later in the year these classes

would have grown to be covering the lower part of the distribution recorded during CEnd 19/23. Much larger numbers were caught during CEnd 12/23, however, with over four times caught in the 20–24 cm range.

Pleuronectiformes

Due to the concerns before the survey about ground contact, comparisons on flatfish species were exended beyond the commercially important plaice and lemon sole *Microstomus kitt* to include dab and long-rough dab *Hippoglossoides platessoides*.

Table 3: Catch weights (kg) for selected flatfish species caught during CEnd 12/23 (August, IBTSQ3, GOV trawl) and CEnd 19/23 (December, gear trials, JTS610 trawl)

	Dab		Lemon sole		Long rough dab		Plaice	
Prime Stn	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23
7	38.37	17.09	0.54	0.56	-	1.21	2.97	0.19
8	12.86	36.01	0.36	-	-	-	4.19	1.27
22	0.31	0.13	2.06	0.11	1.74	3.14	-	0.14
23	2.05	0.84	5.10	2.12	29.14	24.41	-	0.76
31	17.51	50.17	3.29	10.47	4.53	11.81	26.92	11.67
32	14.52	26.38	1.04	2.31	2.86	18.17	18.08	21.56
41	11.52	76.78	3.67	11.74	9.61	29.86	23.40	29.71
51	18.62	87.65	26.55	21.87	0.25	1.65	25.36	157.86
Total	**115.75**	**295.04**	**42.60**	**49.17**	**48.13**	**90.23**	**100.92**	**223.15**

Plaice catch weights (Table 3) were relatively similar across most of the prime stations sampled but total catch weight during CEnd 19/23 was found to be twice that of CEnd 12/23, due to a larger catch of plaice on prime station 51, yielding over six times that seen in August. The length distributions (Appendix II) of plaice in both surveys were similar, with most specimens 16–32 cm, although the catches in CEnd 12/23 did see a broader overall length range (15–41 cm), while CEnd 19/23 saw larger numbers at length between these.

Lemon sole catch weights were the lowest of the four flatfish species compared, but in total were very similar (CEnd 12/23: 42.6 kg, CEnd 19/23: 49.17 kg). The largest differences was at prime stations 31 and 41, where over three times more was caught during CEnd 19/23 but weights by prime station were generally similar. The length distribution was seen to be comparable for both surveys, ranging from 14–24 cm, although CEnd 12/23 did see a small number of larger fish (up to 33 cm, compared to 28 cm during CEnd 19/23).

Catches of dab were found to be larger during CEnd 19/23 than observed during CEnd 12/23, especially at prime stations further north (31, 32, 41 and 51). In total, over twice as much dab was recorded on CEnd 19/23, compared to that seen earlier in the year. Despite this, the length distributions were similar, with most fish being 11–23 cm. The largest numbers were seen at 15 cm (CEnd 12/23) and 16–17 cm (CEnd 19/23), which will also contribute to the differences in catch weights.

Similar to lemon sole, catch weights of long-rough dab were small, although were found to be generally larger during CEnd 19/23, in particular on prime stations 31, 32 and 41. In total, this resulted in the nearly twice as much long-rough dab being observed during CEnd 19/23 than on CEnd 12/23. Comparing the length

distributions, the fish sampled during CEnd 12/23 contained more smaller fish (10–15 cm), where CEnd 19/23 recorded more fish towards the larger end of the length range (20–23 cm).

Pelagic fish

As can been seen in Table 4, catch weights for pelagic species could not be compared due to the minimal catches seen during CEnd 19/23. These species may move grounds over the year, with populations being in the UK coastal areas to spawn in August, but by December they have moved back further north and east, resulting in limited sampling. In terms of numbers, only 124 herring were caught during CEnd 19/23, compared to a raised 4598 on the same prime stations during CEnd 12/23. Four mackerel *Scomber scombrus* and 16 sprat were the other commercial pelagic species caught during CEnd 12/23.

Table 4: Catch weights (kg) for commercial pelagic species caught during CEnd 12/23 (August, IBTSQ3, GOV trawl) and CEnd 19/23 (December, gear trials, JTS610 trawl)

	Herring		Mackerel		Sprat	
Prime Stn	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23
7	-	3.22	8.11	-	-	0.04
8	4.18	1.31	1.88	-	269.21	0.21
22	200.44	5.10	119.90	-	-	0.05
23	237.58	7.72	19.42	0.16	-	-
31	53.72	-	3.84	-	0.57	-
32	24.17	0.18	136.42	-	0.08	-
41	2.27	0.38	1.31	0.36	-	-
51	-	0.09	250.96	-	-	-
Total	**522.36**	**18.00**	**541.84**	**0.51**	**269.86**	**0.30**

Elasmobranchs

Only small numbers of elasmobranchs were caught during both CEnd 12/23 and CEnd 19/23 at the selected prime stations, resulting in small catch weights (Table 5). More cuckoo ray *Leucoraja naevus* and starry smooth-hound *Mustelus asterias* were caught during CEnd 19/23, compared to that seen during CEnd 12/23, with similar amounts of lesser-spotted dogfish *Scyliorhinus canicula* and spurdog.

Length distribution data (Appendix III) were less accurate to compare to other species due to the lower numbers of individuals caught, but similar length ranges were observed for cuckoo ray (CEnd 12/23: 29–62 cm; CEnd 19/23: 25–53 cm) and lesser-spotted dogfish (CEnd 12/23: 13–68 cm; CEnd 19/23: 18–71 cm). However, for spurdog CEnd 19/23 caught larger individuals (80–98 cm) that were not observed in the late summer (potentially also due to seasonal migrations), and there were also differences in the length range of starry smooth-hound (CEnd 12/23: 81–104 cm; CEnd 19/23: 42–86 cm).

Table 5: Catch weights (kg) of selected elasmobranch species caught during CEnd 12/23 (August, IBTSQ3, GOV trawl) and CEnd 19/23 (December, gear trials, JTS610 trawl)

	Cuckoo ray		Lesser-spotted dogfish		Spurdog		Starry smooth-hound	
Prime Stn	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23	CEnd 12/23	CEnd 19/23
7	-	-	9.26	-	-	-	-	1.45
8	-	-	4.32	-	-	-	6.38	-
22	-	0.32	0.03	0.02	1.33	-	-	2.96
23	-	-	0.03	0.70	-	-	-	0.86
31	2.28	5.88	1.96	2.05	-	0.46	-	2.31
32	0.68	3.12	1.25	3.49	0.45	0.58	-	0.42
41	5.21	8.53	1.16	4.40	0.42	-	-	11.83
51	1.67	4.14	8.44	10.06	-	-	-	1.92
Total	**9.82**	**21.99**	**26.44**	**20.71**	**2.20**	**1.04**	**6.38**	**21.73**

Overall observations

A higher overall catch weight was recorded during CEnd 19/23 (7372 kg) than for CEnd 12/23 (5736 kg), although the number of fish, cephalopod and commercial shellfish species sampled was nearly identical (58 to 57, respectively). This could be attributed to the modern design of the JTS610; utlising new technology and materials used in the commercial industry will likely give the net an advantage over the GOV, which has not been used in the fishing industry for decades now.

It is encouraging to see that in the top 15 species ranked by catch weight (Table 6), only three species were caught by CEnd 12/23 in abundance and not by CEnd 19/23: mackerel, sprat and horse mackerel. As noted above, these species may have seasonal changes in behaviour and distribution, and were possibly not in the areas sampled at the time of year when this survey was operating.

Of note, was the presence of smaller, non-commercial species during CEnd 19/23, including pogge *Agonus cataphractus*, lumpsucker *Cyclopterus lumpus*, scaldfish *Arnoglossus laterna*, dragonets *Callionymus* spp., lesser weever *Echiichthys vipera,* and hagfish *Myxine glutinosa*.

A concern was noted with the representation of epibenthic fauna. While the number of species recorded on both surveys for these stations was similar (CEnd 12/23 = 61, CEnd 19/23 = 59), the catch weight was much higher during CEnd 12/23: (133 kg) than during CEnd 19/23 (27 kg). Such a pronounced decrease in this catch component is probably more associated with gear than seasonal effects. Unfortunately, as epibenthic catch was only weighed (total biomass) and the individual species observed on CEnd 12/23, it isn't known which species this additional weight may be attributed to.

Table 6: Top 15 species caught on selected CEnd 12/23 sites and CEnd 19/23, ranked by catch weight

CEnd 12/23:			CEnd 19/23		
Whiting	*Merlangius merlangus*	1923.97	Haddock	*Melanogrammus aeglefinus*	5302.23
Haddock	*Melanogrammus aeglefinus*	1637.23	Whiting	*Merlangius merlangus*	967.90
Mackerel	*Scomber scombrus*	541.83	Dab	*Limanda limanda*	295.03
Herring	*Clupea harengus*	522.35	Plaice	*Pleuronectes platessa*	223.15
Sprat	*Sprattus sprattus*	269.85	Long-rough dab	*Hippoglossoides platessoides*	90.22
Horse mackerel	*Trachurus trachurus*	213.62	Grey Gurnard	*Eutrigla gurnardus*	88.02
Dab	*Limanda limanda*	115.74	Spurdog	*Squalus acanthias*	76.59
Plaice	*Pleuronectes platessa*	101.26	Lemon sole	*Microstomus kitt*	49.15
Norway Pout	*Trisopterus esmarkii*	62.61	Northern squid	*Loligo forbesi*	37.50
Long-rough dab	*Hippoglossoides platessoides*	48.12	Norwegian lobster	*Nephrops norvegicus*	24.10
Lemon sole	*Microstomus kitt*	42.59	Cuckoo ray	*Leucoraja naevus*	21.99
Grey Gurnard	*Eutrigla gurnardus*	32.63	Starry smooth-hound	*Mustelus asterias*	21.73
Lesser-spotted dogfish	*Scyliorhinus canicula*	26.44	Lesser-spotted dogfish	*Scyliorhinus canicula*	20.70
Northern squid	*Loligo forbesi*	10.05	Norway Pout	*Trisopterus esmarkii*	18.76
Cuckoo ray	*Leucoraja naevus*	9.82	Herring	*Clupea harengus*	18.00

2. *To use the catch to provide training opportunities for pelagic sampling, epi-benthic ID and stomach content ID skill development.*

Three disciplines for training opportunties were identified before the survey which were in need to developing succession planning; epibenthic identification and processing, stomach sampling, and biological sampling of pelagic species. With this in mind, a trainer and two trainees were selected for each discipline. Each catch also provided opportunity for general fish sampling experience to be gained. The opportunity for trainees on this survey would then be followed up with positions in the 2024 Cefas fishing survey programme to reinforce the learning and start utilising these newly developed skills.

Epibenthic sampling was done on each station, with species identified, weighed and counted. Although on the IBTSQ3 surveys epibenthos is only observed, training for full epibenthic sampling would give good training for beam trawl surveys where species are weighed and counted as standard on selected sites.

509 fish stomachs were dissected and assessed for contents, covering 24 species (whiting and haddock being the most abundant, with 292 individuals assessed between them). This discipline is likely to become a required feature of future IBTS surveys so achieving dedicated effort to this aim is hugely important.

Unfortunately, due to the limited number of pelagic species caught this discipline could not be developed as much as hoped. However, trainees made the most of the herring caught to improve otolith removal and get an appreciation for maturity state at this time of year.

Nearly 6500 fish were measured during the survey, and although collecting biological data was limited to elasmobranch species, many of the fish were used for traning on otolith removal and identifying maturity state.

3. *Tag and release specimens of starry smooth-hound, spurdog, tope, common skate, blonde ray and cuckoo ray.*

Table 7: Summary of tagged and released elasmobranchs on CEnd 19/23

Species	No.	M	F	length range (cm)	weight range (g)
Cuckoo ray	22	10	12	45–57	476 – 1065
Spurdog	31	29	2	70–98	1220–3995
Starry smooth-hound	5	1	4	70–91	1195–2805
Flapper skate	1		1	126	13560

As can be seen with Table 7, 59 selected species of elasmobranchs were tagged and released on the survey. These were fish that had been deemed in good condition and large enough to carry a tag without it interfering with the animal when released.

4. *To freeze any unusual fish species for subsequent identification / verification in the laboratory (Jim Ellis/Gary Burt).*

No species caught were deemed of suitable interest to be retained for further study after the survey.

5. *To retain any dead specimens of tope (Galeorhinus galeus) and common skate (Dipturus batis species-complex) for biological studies (Jim Ellis).*

No dead specimens of tope or common skate complex were caught or retained.

6. *Retain any dead specimens of shad and lamprey for biological studies (Teá Basic)*

No specimens of shad or lamprey were caught on the survey.

7. *Cetacean observations will be recorded where possible and sent to the Sea Watch Foundation.*

No cetacean sightings were noted during the survey.

8. *Record fisheries acoustic data throughout the survey using the new EK80 at 5 frequencies (38, 70, 120, 200 and 333 kHz) to map the pelagic fish community (Jeroen van der Kooij).*

This aim could not be completed due to the lack of appropriate storage equipment.

9. *Use appropriate examples to develop an SOP for fish maturity photography for use on surveys in 2024 (Richard Humphreys/Samantha Barnett).*

A draft SOP was reviewed on the survey and minor changes made. This will be sent to survey leads for 2024 fishing surveys.

10. Testing for evidence of epiphytic dinoflagellates in macroalgae (Beth Bear).

Four samples of macroalgae were fixed and brought back for analysis.

ACKNOWLEDGEMENTS

The survey team would like to acknowledge the outstanding work by the officers and crew of RV Cefas Endeavour in trialling a new survey gear and the accompanying issues with such work. Preparation for a non-standard survey such as this was also with its challenges and the hard work by the nets & gear team is also hugely appreciated.

Ben Hatton

Scientist in Charge

07/02/2024

DISTRIBUTION:

All survey participants;
Cefas Marine Operations;
Patsy Falconer – Portfolio Lead
David Pettengell – Project Manager
Ian Holmes – Cefas Fishing Surveys Manager;
Jim Ellis and Sally Songer – Directors of Cefas Fisheries International Centre of Excellence;
Daniel Evans - AWSM Head of Operations and Technical;
Brian Salter – AWSM Marine Consultant
Gary Burt – Fisheries Data Manager
Norwegian Government via Foreign, Commonwealth and Development Office

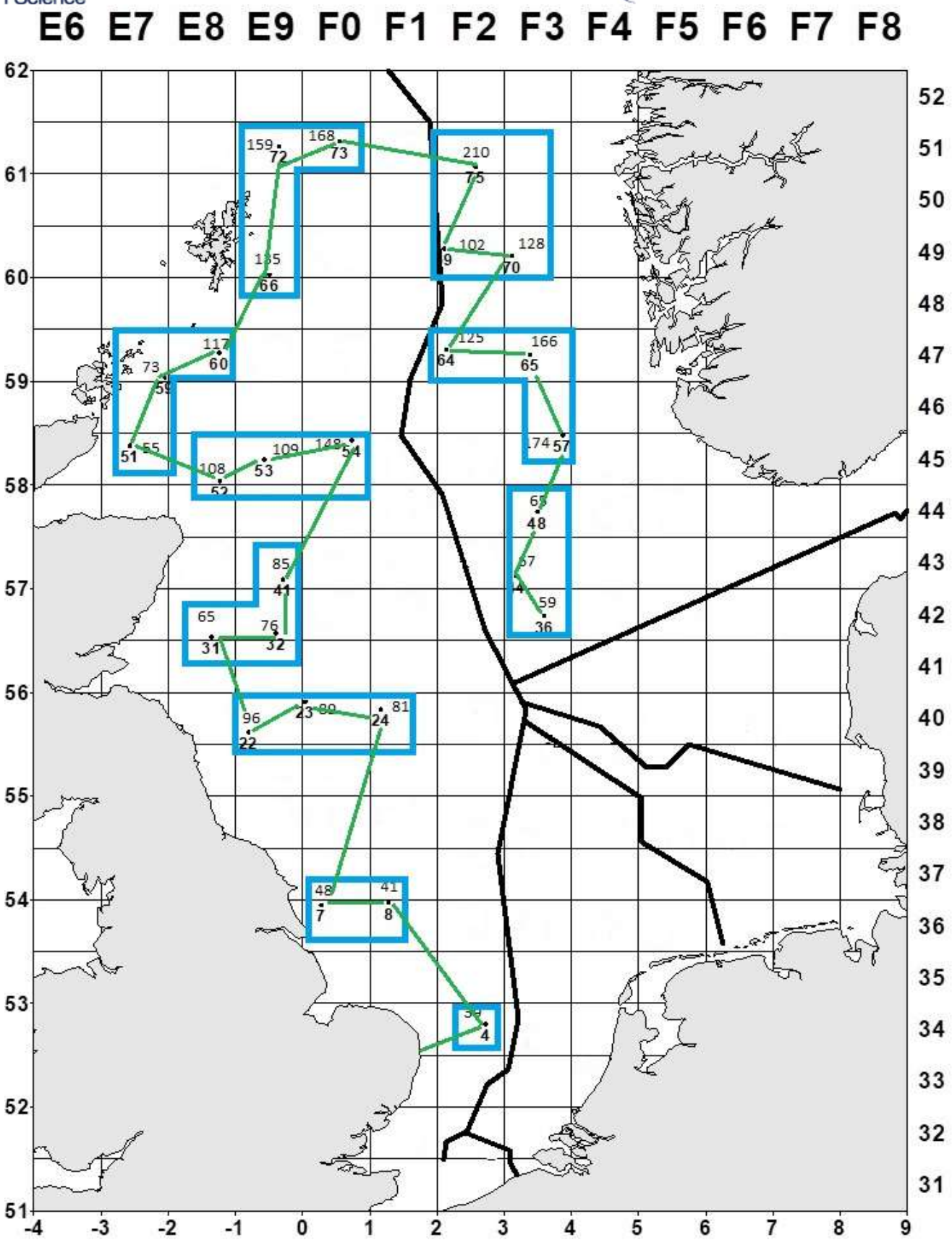
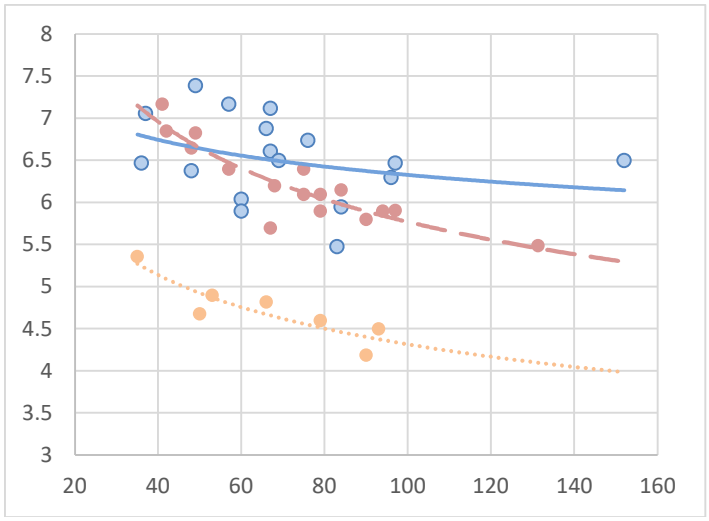
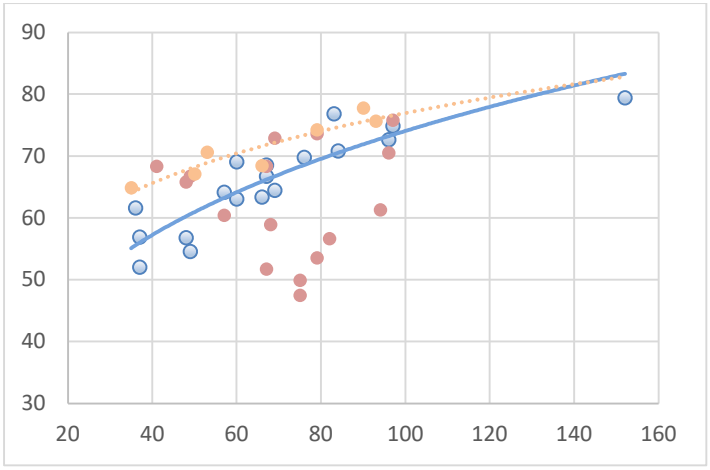


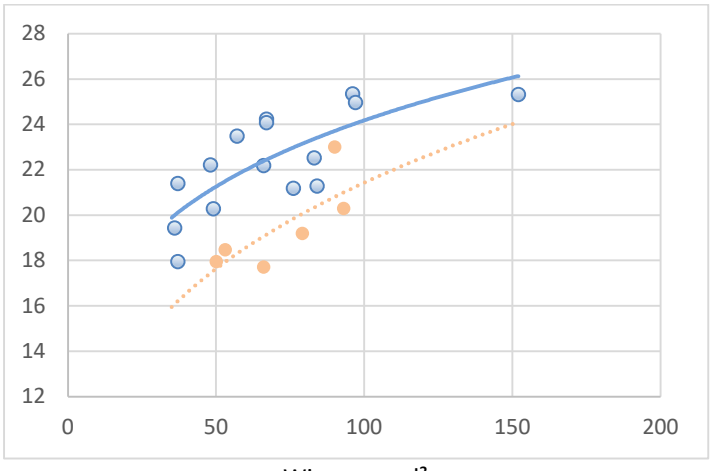
Figure 6: Survey map and planned route. Prime stations are in bold alongside water depths. Poor weather resulted in only prime stations 7, 8, 22, 23, 31, 32, 41 and 51 being surveyed.



Headline Height



Door Spread[1]



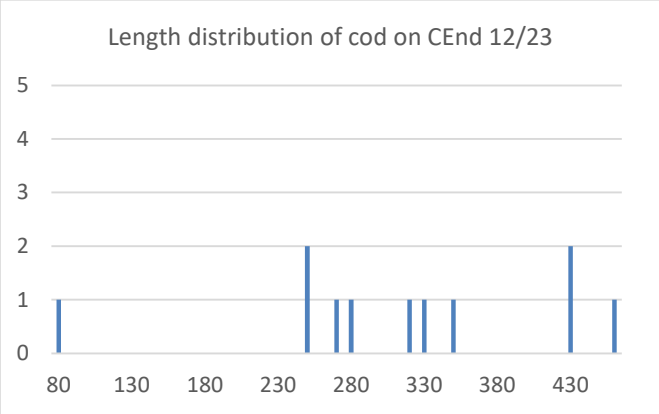
Wing spread[2]

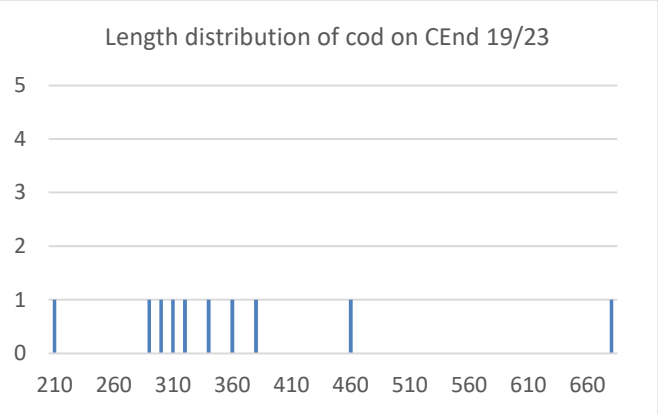
Figure 7: Net geometrics comparing JTS610 with clean/fine ground gear (Blue, solid trendline), JTS610 with light hopper ground gear (Red, dashed line) and GOV (orange, dotted line). Data taken from comparable water depths.

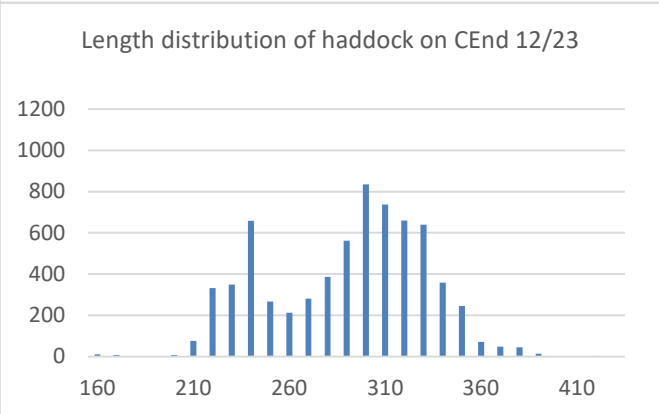
[1]Power trendline removed due to lack of comparable data at deeper water depths

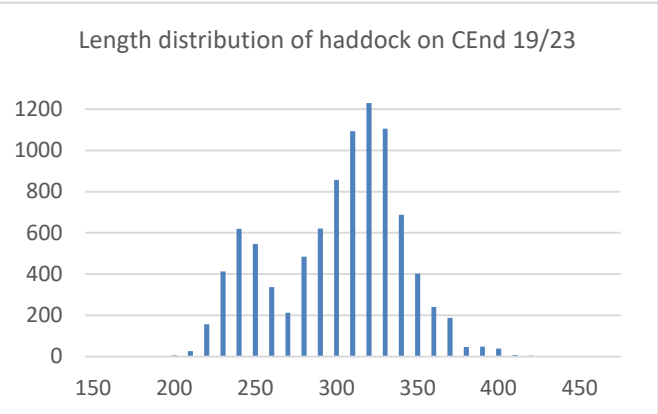
[2]No wing spread data available for JTS610 with light hopper ground gear

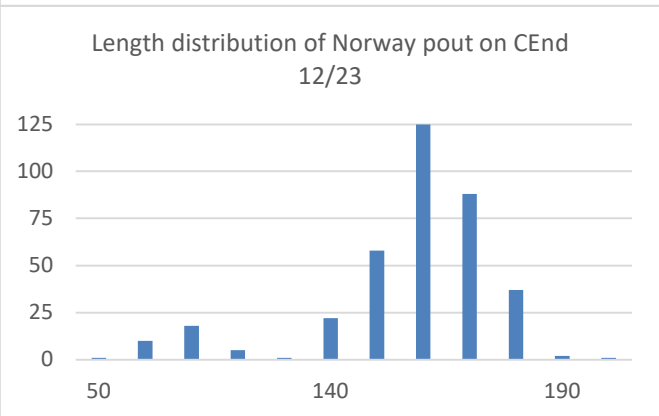
Appendix I: Length distributions for gadoid species caught on CEnd 12/23 and CEnd 19/23

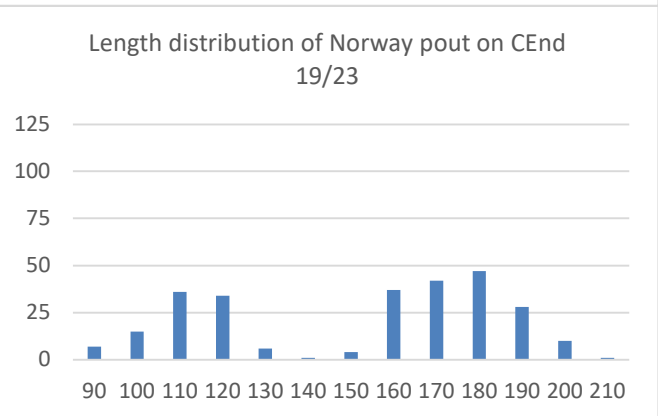


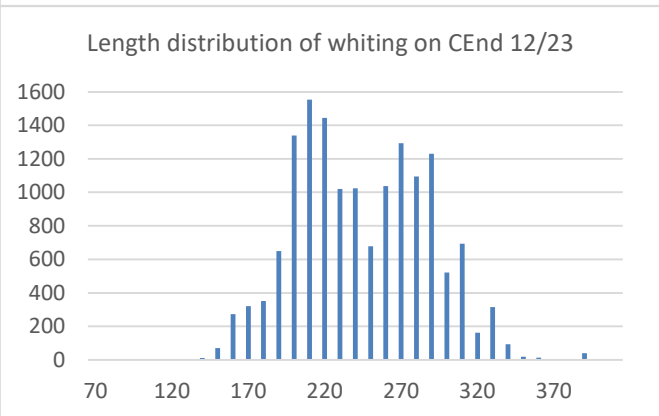


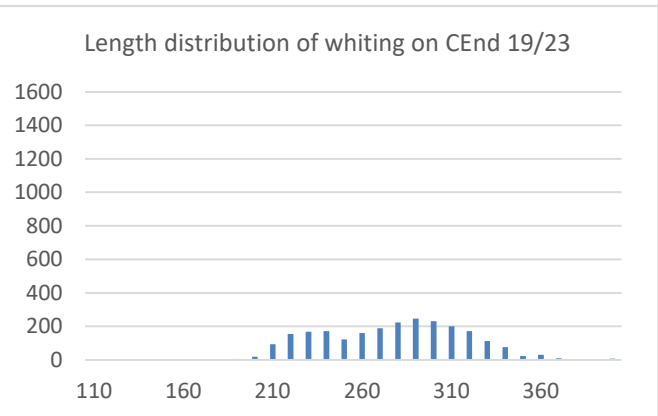




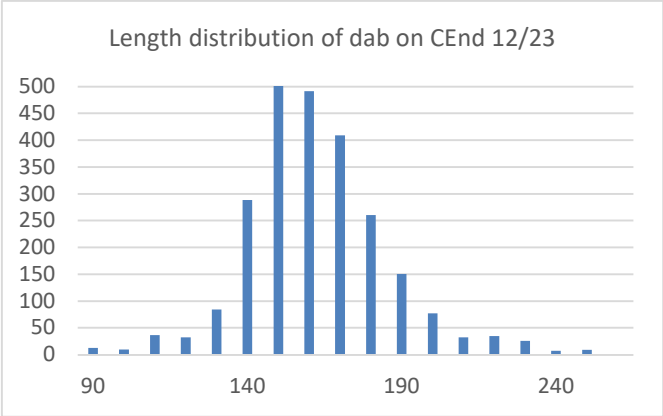


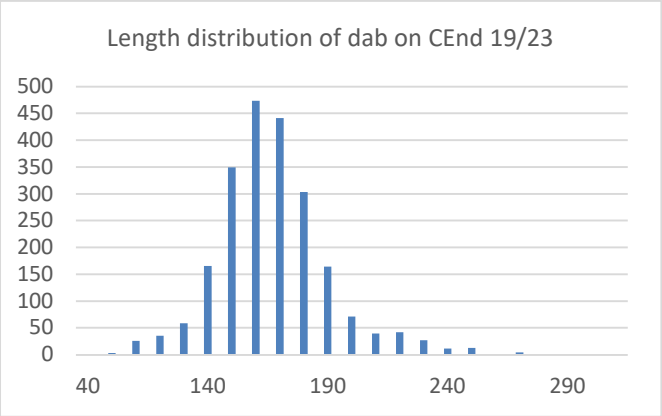


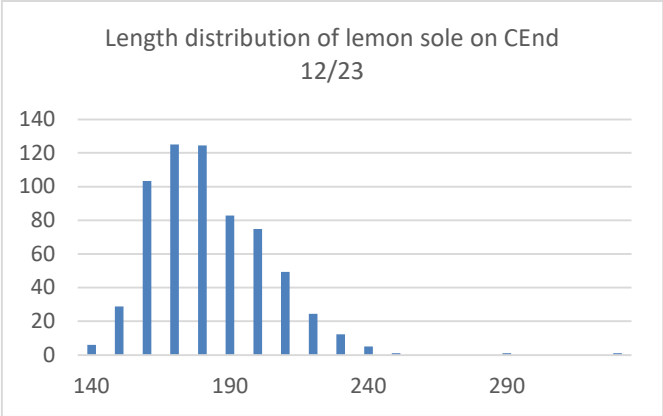


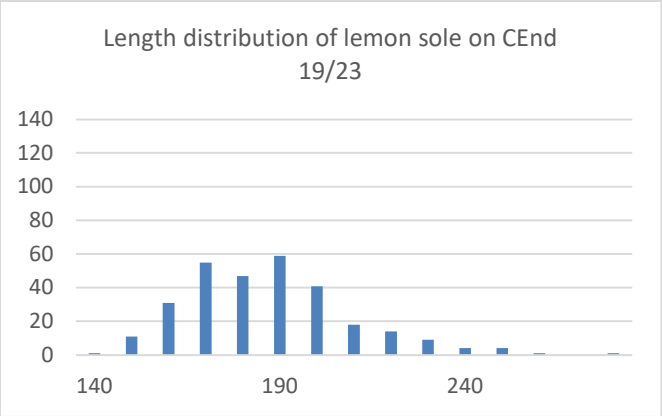


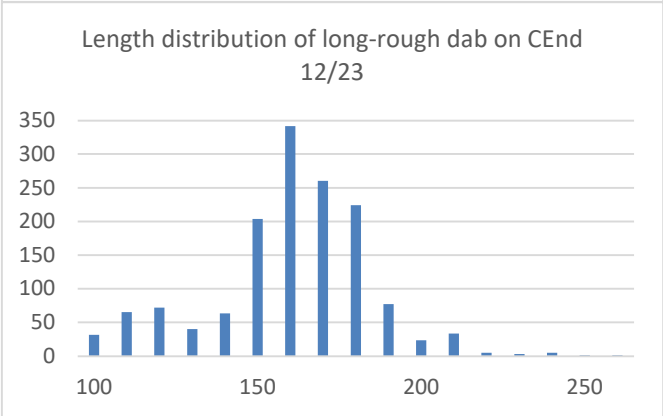
Appendix II: Length distributions for flatfish species caught on CEnd 12/23 and CEnd 19/23

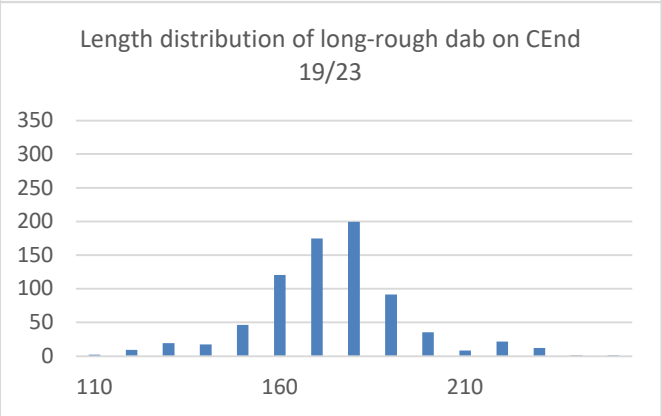


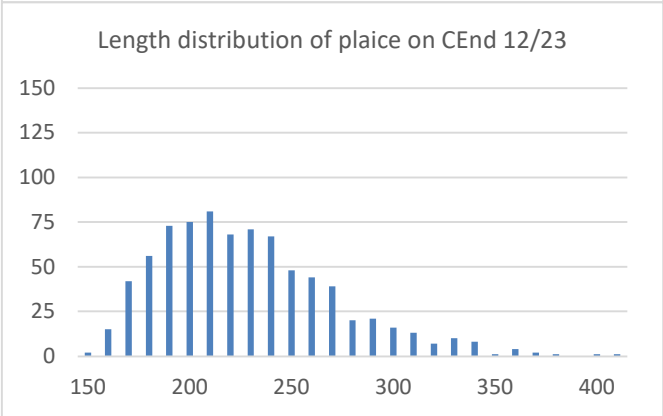


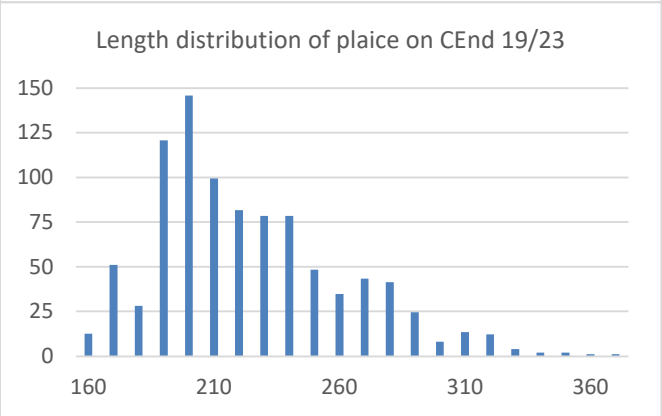




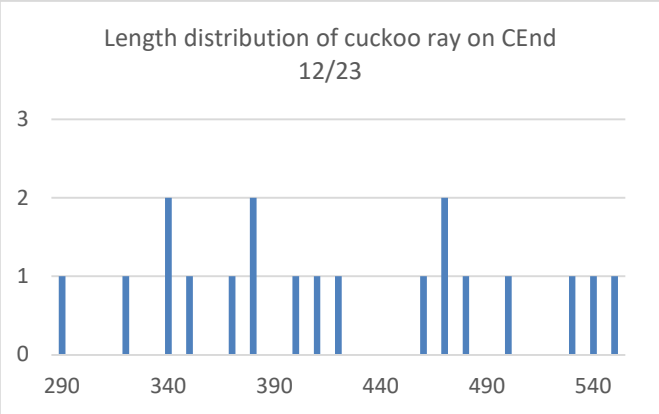


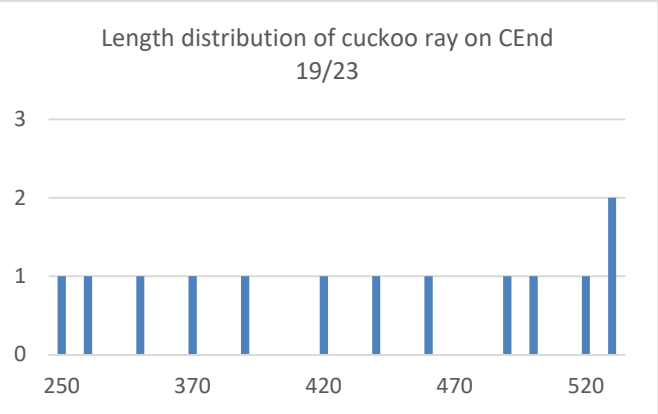


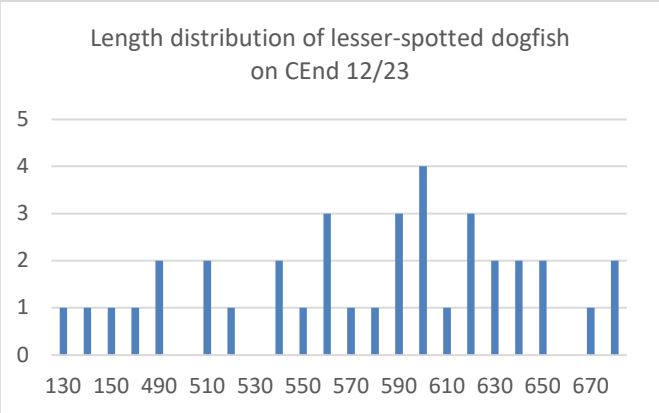


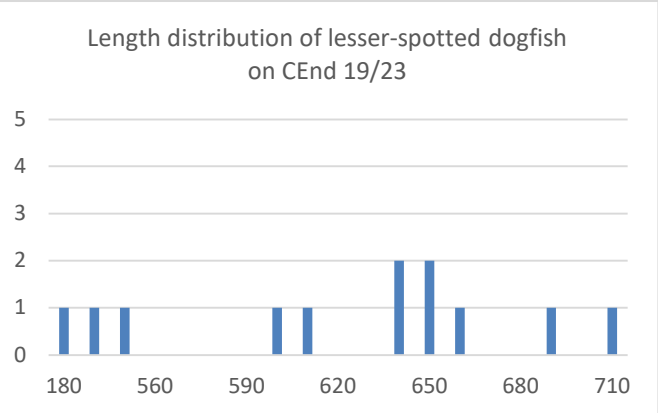


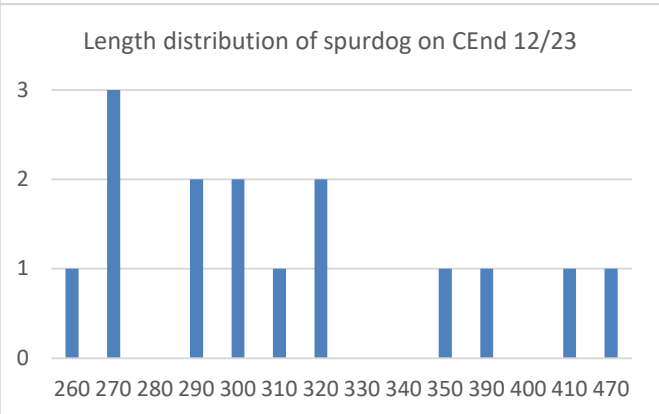
Appendix III: Length distributions for elasmobranch species caught on CEnd 12/23 and CEnd 19/23

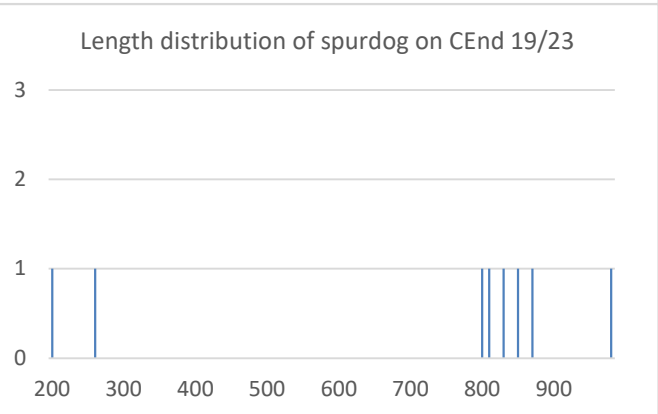


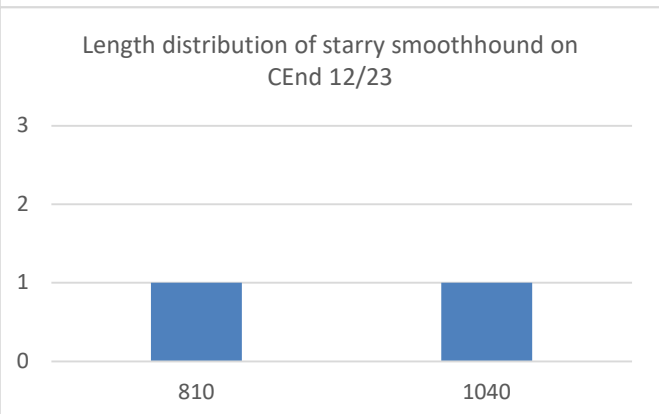


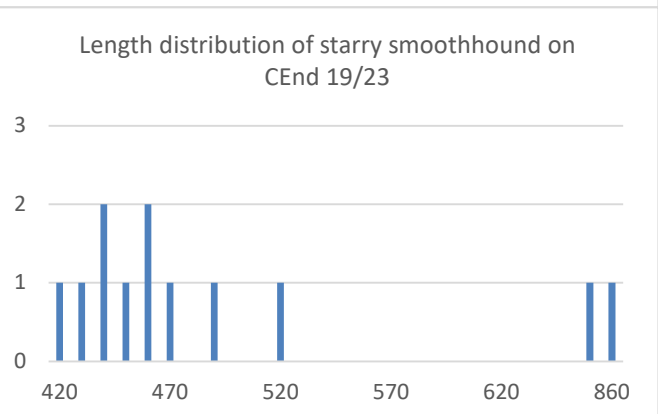












Appendix IV: Gear change log

#	Warp out (m)	Speed Over Ground (kts)	Changes	Comments
1	3:1+50	3.4–3.5	50 kg 16 mm chain added to fishing line along bosom, ground contact sensor pockets – port inside groundgear, starboard outside	Headline sensor upside down, no wing end readings, door readings very erratic. Abandoned after 5 mins.
2	3:1+50	3.4–3.5	Headline sensor swapped round	Headline sensor gave steady but inaccurate readings, bridle chains and ground sensor pockets shined up from ground contact.
3	3:1+10	3.4–3.5	Ground contact sensors added	Port wing and ground gear wrapped up - Invalid
4	3:1+30	3.4–3.5	Starboard ground contact pocket moved inside ground gear	Good readings from all sensors except port ground contact sensor
5	3:1+30	3.4–3.5	None	Door sensors gave erratic readings
6	3:1+30 – 3:1+45	3.4–3.5	3 floats removed from each wing-end	Mud on ground sensor (good ground contact)
7	3:1+30	3.4–3.5	Spare ground contact housing added to bosom. Starboard unit added to bosom, port turned upside down to check evidence of wing line being picked up by unit.	No headline or door sensor readings – abandoned after 6 mins
8	3:1+30	3.4–3.5	Port ground contact unit turned back to correct position, trawl sounder swapped in for headline unit	Ground contact sensors are intermittent but can see contact and landing and lift-off (photo taken).
9	3:1+30	3.4–3.5	Ground contact sensor – starboard moved from bosom back to wing. Port wing put in bosom.	
10	3:1+30	3.4–4.5	Starboard ground contact sensor moved to wing.	No change in ground contact when increasing speed to 4.5 kts into a 0.3 kts tide.
11	3:1+20	3.4–3.5	Contact sensors and housing removed, replaced with dangle chains.	Chains shined up, showing ground contact with less weight than the sensors and housings. Ground contact investigation complete.
12	3:1+30	3.4–3.5	Cod-end left open	Baseline change for cod-end open showed a slightly higher headline; 7.1m compared to 6.6 and 6.8 previously.
13	3:1+20	3.4–3.5	Six floats removed from start of wing next to headline	Very low headline height - invalid
14	3:1+30	3.4–3.5		Headline showed slightly lower readings; 6.5m
15	3:1+30	3.4–3.5	Six floats added back to wing-ends	Headline increased by 0.65 m
16	3:1+30	3.4–3.5	18 floats removed from headline, down the wing	Headline down by ~1 m, no wing-end sensors
17	4:1	3.4–3.5	Cod-end left open, wing-end sensors swapped out	No wing-end sensors, door spread increased by 6 m
18	3:1+30	3.4–3.5	Wing-end sensors angle to improve comms	No wing-end or door sensors - Invalid
19	3:1+30	3.4–3.5	Wing-end sensors swapped out	Wing-end spread decreased by 4 m
20	3:1+60	3.4–3.5		4:1 attempted but doors over spread and headline fell in. Reduced wire length by 20 m and saw large improvement. Headline down to ~5.5 m in 80 m water
21	3:1+30	3.4–3.5	18 floats re-attached on wings to make 138 in total	Wing-end spread still similar to previous attempt.
22	3:1+10	3.4–3.5		Poor headline readings – invalid
23	3:1+20	3.4–3.5		

24	4:1+30/+50	3.4–3.5	Increased warp halfway through tow	Stabilised well once extra warp was put out.