INTERNATIONAL BOTTOM TRAWL SURVEY WORKING GROUP (IBTSWG)

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Contents

i Executive summary

The International Bottom Trawl Survey Working Group (IBTSWG) coordinate fishery-independent bottom trawl surveys in the ICES Area (Northeast Atlantic and North Sea) providing an important platform for the collection of additional data such as sampling larval sprat, stomach contents and fish parasites. These long-term monitoring surveys provide data for stock assessments and facilitate analyses of the distributions and relative abundance of fish. IBTSWG promotes the standardization of fishing gears and methods. This report summarizes national contributions in 2022–2023 and plans for the 2023–2024 surveys.

In the North Sea, the surveys are performed in Quarter 1 and Q3. The Northeast Atlantic surveys are conducted mostly in Q1, Q3, and Q4 with a suite of 14 national surveys covering large areas of continental shelf extending from northern Scotland to the Gulf of Cádiz.

The 2023-Q1 North Sea IBTS was impacted slightly by mechanical issues on one vessel, resulting in some of the Rectangles in the central North Sea being sampled with a single haul instead of the planned two. The 2022-Q3 North Sea IBTS was broadly complete, with the overall number of hauls comparable to previous years, though some Rectangles close to shore or with obstructions may not have had full coverage.

The Northeast Atlantic surveys were mostly completed successfully, with the exception of the Scottish west coast groundfish survey in Q1 (cancelled due to vessel breakdown). There was incomplete survey coverage for some of the surveys, including the EVHOE survey (severe weather) and Portuguese groundfish survey (severe weather and mechanical problems). The Spanish surveys in the Gulf of Cádiz (cancelled in 2021) were undertaken in 2022.

Recent updates to DATRAS, where the trawl survey data are stored, were summarised and data quality, including catch weights and species identification, was reviewed.

IBTSWG met with members of various data users, including relevant stock assessment groups, such as WGNSSK, WGEF and HAWG, presenting summaries of relevant surveys.

A proposed new survey trawl, following on from earlier workshops and intersessional discussions, was reviewed. Several nations have conducted, or are planning, gear trials. Pending fine tuning required for the gear, the main aspects of the new trawl have been agreed. IBTSWG plan to hold an intersessional meeting to discuss implementation and to ensure communication and involvement of relevant experts on survey design and survey indices.

ii Expert group information

Expert group name	Internal Bottom Trawl Survey Working Group (IBTSWG)
Expert group cycle	Multiannual fixed term
Year cycle started	2022
Reporting year in cycle	2/3
Chair(s)	Pia Schuchert (Northern Ireland, UK)
	Jim Ellis (UK)
Meeting venue(s) and dates	27–31 March 2023, Lysekil, Sweden (58 participants)

1 Introduction

1.1 Background

ICES' International Bottom Trawl Survey Working Group (IBTSWG) has its origins in the North Sea (Subarea 4), and the Skagerrak and Kattegat (Division 3.a), where coordinated surveys have occurred since 1965. Whilst there have been surveys in various quarters, the coordinated surveys in the North Sea are currently conducted in Q1 (NS-IBTS-Q1) and Q3 (NS-IBTS-Q3), and these provide the best time-series data. The Q1 survey also extends into the eastern parts of the eastern Channel (Division 7.d; roundfish area 10). For more details of the history of the survey, see Heessen *et al.* (1997) and ICES (2020).

The IBTSWG assumed responsibility for coordinating trawl surveys in North-eastern Atlantic European seas (ICES Subareas 6–9) in 1994. The different ground types sampled in these areas has resulted in survey-specific trawl gears.

In addition to survey coordination and the annual meetings of IBTSWG, the group also edits the relevant survey manuals, which provide further information on the surveys, sampling protocols and history of the surveys. These manuals cover the North Sea IBTS (ICES, 2020) and the North-eastern Atlantic (ICES, 2017).

1.2 Terms of Reference (ToRs)

The ToRs for IBTSWG for the period 2022–2025 are:

(a) *Coordination and reporting of North Sea and North-eastern Atlantic bottom trawl surveys, including appropriate field sampling in accordance to the EU Data Collection Framework. Review and update (where necessary) IBTS survey manuals in order to achieve additional updates and improvements in survey design and standardization. (ACOM).*

(b) *Address DATRAS-related topics in cooperation with DGG: data quality checks and the progress in re-uploading corrected datasets, quality checks of indices calculated, and prioritizing further developments in DATRAS. (ACOM).*

(c) *Develop a new survey trawl gear package to replace the existing standard survey trawl GOV. (SCICOM)*

(d) *Evaluate the current survey design and explore modifications or alternative survey designs, identifying any potential benefits and drawbacks with respect to spatial distribution and frequency of sampling. Consider the effects of enforced changes in the distribution of survey stations (e.g. in relation to MPAs and offshore industries). Explore potential additional data collection, e.g. stomach sampling and tagging (SCICOM) and engage with the Workshop on Pilot North Sea Fisheries Independent Regional Observation (WKPilot NS-FIRMOG).*

(e) *Making data from IBTS available to be used by different ICES end-users, such as assessment groups, OSPAR and others. Establish a communication with end user groups as to the needs of the users and the data available within DATRAS. Collate a user document that outlines the important caveats in the data with regards to non-target species (e.g. when a non-target species was* *first recorded as a species, the confidence in sampling). Establish a continued working relationship between user groups and survey group.*

The participants list in provided in Annex 1, with full details of the resolutions provided in Annex 2. ICES have recently developed alpha-numeric codes for the various surveys used in ICES assessments and advice, and the relevant codes for those surveys conducted under the auspices of IBTSWG are provided in Annex 3.

This is the second report produced during the current triennium, following the information provided in ICES (2022).

1.3 Format of the report

The survey summaries and planning coordination (ToR a) are provided in Section 2, with more details on the surveys also provided for the North Sea IBTS Q1 (Annex 4), North Sea IBTS Q3 (Annex 5) and North-eastern Atlantic surveys (Annex 6).

DATRAS-related topics, including data quality (ToR b), are addressed in Section 3. Following on from the previous Workshop on the Further Development of the New IBTS Gear (WKFDNG), which was held in November 2021 (see ICES, 2022), additional discussions on the new trawl (including online meetings held inter-sessionally, and recent sea-going trials, the descriptions of the proposed new survey trawl are associated rigging are provided in Section 4 (Tor c).

Relevant aspects of survey design, including additional data collection (ToR d), are addressed in Section 5, with the communication with user groups (ToR e) summarised in Section 6.

1.4 Forward look

IBTSWG considered it appropriate to alternate between on-line and in-person annual meetings.

IBTSWG plan to meet next year during the week of 8–12 April 2024, with this being a fully on-line meeting.

In addition to the TORs, it was agreed that further plenary discussions should be held on the following topics: Fish welfare; oceanographic data (e.g., deadlines for submission, discussion on whether trawl-mounted CTD data are uploaded on DATRAS); benthic data; spatial squeeze (e.g., in relation to offshore infrastructure and Marine Protected Areas); haul duration (including acceptable ranges, and the appropriate rationales as to why hauls may be less than expected); and temporal changes of southern fish species). It would also be useful to have additional discussions on standard measurement dimensions.

IBTSWG will also need to agree for a new name for the proposed survey trawl, in order that the Data Centre can provide a gear code for the trawl, thus allowing data from upcoming trials to be stored on DATRAS.

IBTSWG also considered it appropriate to hold some intersessional work through relevant subgroups, including:

(a) New survey trawl and how to introduce the new gear (Sept/Oct) (see Section 4)

(b) MSS/OSPAR product – issues relating to data QA (see Section 3.4)

(c) DATRAS data: Data warnings and CatCatchWt (see Section 3.3)

(d) Temporal changes (distribution/abundance) of southern fish species (see Section 5.4)

(e) DATRAS data and mapping, including any further considerations of ShinyApps (data quality and applications) (see Sections 3.2 and 3.5).

1.5 References

Heessen, H.J.L., Dalskov, J., and Cook, R.M. 1997. The international bottom trawl survey in the North Sea, the Skagerrak and Kattegat. ICES CM 1997/Y:31; 25 pp.

ICES. 2020. Manual for the North Sea International Bottom Trawl Surveys. Series of ICES Survey Protocols SISP 10-IBTS 10, Revision 11. 102 pp. http://doi.org/10.17895/ices.pub.7562

ICES.2017. Manual of the IBTS North Eastern Atlantic Surveys. Series of ICES Survey Protocols SISP 15. 92 pp. http://doi.org/10.17895/ices.pub.3519

ICES. 2022a. Workshop on the Further Development of the New IBTS Gear (WKFDNG). ICES Scientific Reports. 4:18. 46 pp. http://doi.org/10.17895/ices.pub.10094

ICES. 2022b. International Bottom Trawl Survey Working Group (IBTSWG). ICES Scientific Reports. 04:65. 183pp. http://doi.org/10.17895/ices.pub.20502828

2 Coordination of North Sea and North-eastern Atlantic surveys

2.1 Introduction

This section of the report provides short summaries on the most recent surveys coordinated by IBTSWG, with more detailed information provided in the Annexes 4–6. This report section addresses ToR (a).

2.2 Summary report of the North Sea IBTS Q1

(Coordinator: Ralf van Hal)

2.2.1 General overview

The North Sea IBTS Q1 survey aims to collect data on the distribution, relative abundance and biological information on a range of fish species in ICES Subarea 4 and Divisions 3.a and 7.d. During daytime, the GOV (Grand Ouverture Verticale) bottom trawl with standard groundgear A for normal bottom conditions or groundgear B for rough ground (Scotland in Division 4.a only) was used to sample fish, with age data collected for the target species (cod, haddock, whiting, saithe, Norway pout, herring, mackerel, and sprat) and a number of additional species. A CTD was deployed at most trawl stations to collect temperature and salinity profiles. Herring larvae were sampled with a MIK-net (Methot Isaac Kitt) during the night.

In 2023, there were seven participating vessels in the Q1 survey, namely “Dana” (26D4, Denmark), “GO Sars” (58G2, Norway), “Scotia” (748S, Scotland), “Thalassa” (35HT, France), “Walther Herwig III” (06NI, Germany), “Tridens II” (64T2, Netherlands) and “Svea” (77SE, Sweden). The survey covered the period 22 January to 27 February 2022.

A total of 325 GOV hauls (eight of which were invalid) were uploaded to DATRAS and 586 valid MIK hauls were deployed and data uploaded to the eggs and larvae database. Most Rectangles were fished at least once this year, the majority is fished with two hauls as planned. Rectangles 46E6, 47E6, 48E6 and 49E6 were not covered at all. The “Walther Herwig III” had mechanical issues and consequently had to halt their survey activities after 22 of their planned 67 hauls (see Figure A4.1), Norway took over some of these hauls, but it resulted in some Rectangles only being sampled once.

More details of the 2023 surveys are given in Annex 4.

2.2.2 Highlights and issues

- The “Walther Herwig III” experienced mechanical issues (steering gear) which delayed the start of the survey for seven days, and this was followed by a broken winch that forced them to cancel the GOV-part of the survey after 22 of the 67 planned GOV-stations.
- The Dutch had two hauls with significant amounts of bryozoans in those stations directly north of the Dutch island. Despite the quantity of bryozoans, the hauls could be processed normally.

- The low net-opening observed in the German survey in recent years was corrected by modifying the kite rigging and the length of the headline extensions.
- For the third year in a row, a number of participants collected information on gill parasites of haddock. Some participants also reported these parasites in other gadoid species. For the second year, a number of participants also collected information on liver weight and liver parasites of cod.
- Diet data (stomachs) following the updated-five-year rolling scheme have been collected as part of the EU-map obligations by the EU. These were also collected by the non-EU countries Norway and Scotland.
- Scotland additionally undertook three non-programmed stations with the new survey net BT238 for catch comparison purposes, and a further deployment of BT238 was made to collect fishing gear geometry data only (open codend).
- The Netherlands was not able to use the Seabird CTD for downcast on each GOV, instead a Valeport CTD was used with a lower detail.
- 82% of the MIK stations were conducted, the missed stations were mainly in the northern area. The herring 0-ringer index (90.8) corresponds to an average index value, and is a bit below the long-term average of 100.7 (in the time-series since 1992).
- As in last year, sardine larvae were found in the MIK samples. This year they were not just found in the southern samples, but also in the northern samples.

2.2.3 Planning and coordination

For 2024, all participants indicate to be part of the survey again and as the situation currently is they all plan to use their own national vessel. The start dates of the national surveys are therefore likely to be very similar as in Q1 2023.

For a third successive year, weather, Covid and/or mechanical issues caused a serious reduction of effort in at least one of the countries. Again, this resulted in difficulties covering the area in the middle of the North Sea north of the Dogger Bank. This is considered an important area, as in the latest reallocation of Rectangles, some of the Rectangles located here were allocated to a single country. To reduce the risk of missing these Rectangles a new reallocation of some Rectangles has taken place. This includes shift in locations between the Netherlands, Germany, Norway, Denmark and Sweden. The new allocation map is shown in Figure 2.1.

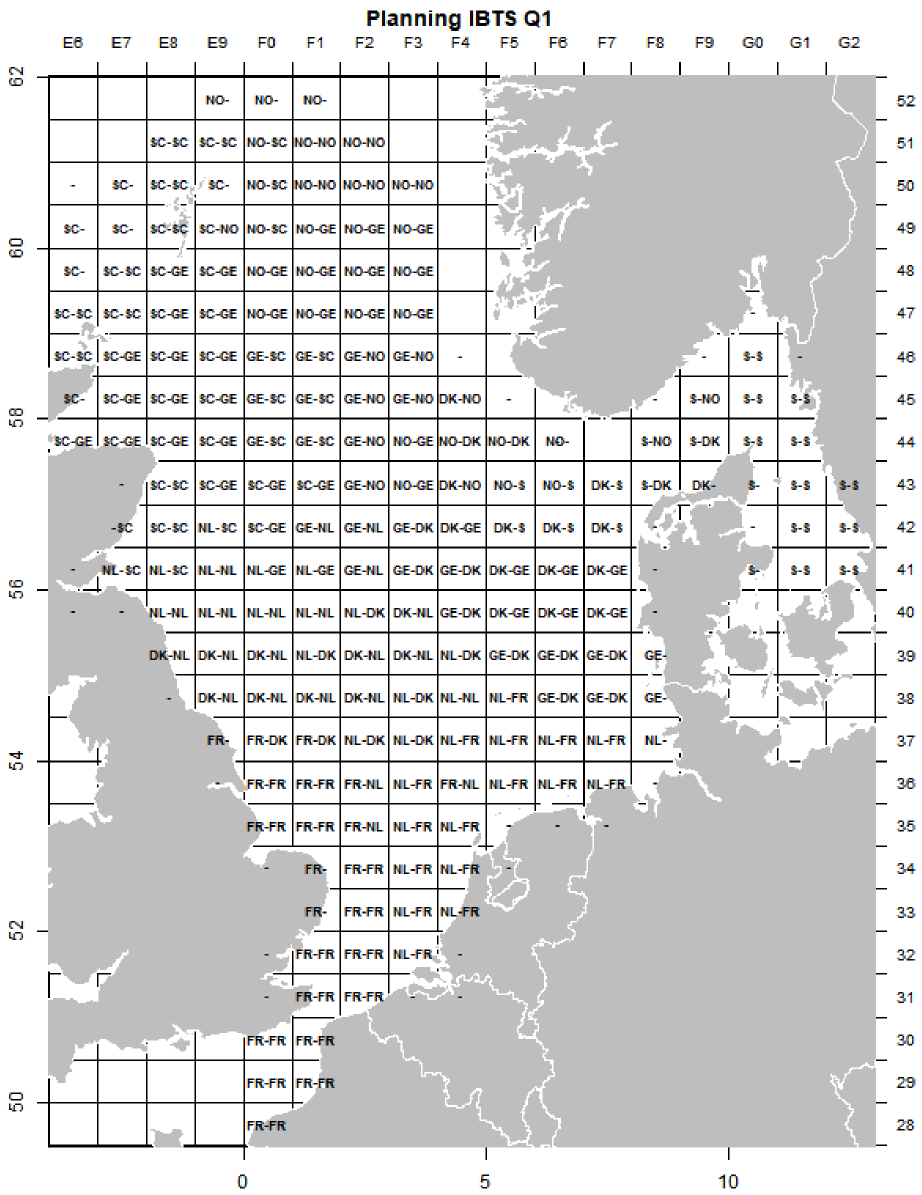

Figure 2.1. Allocation map for Q1 2024.

2.3 Summary report of the North Sea Q3 IBTS

(Coordinator: Kai Wieland)

2.3.1 General overview

The North Sea IBTS Q3 survey aims to collect data on the distribution, relative abundance and biological information on a range of fish species in ICES Division 3.a and Subarea 4. The Grand Ouverture Verticale (GOV) bottom trawl with standard groundgear A for normal bottom conditions, or groundgear B for rough ground (Scotland in Division 4.a only) is used during daytime. Age and biological data were collected for individual fish for the standard species (herring, sprat, cod, haddock, whiting, saithe, Norway pout, mackerel and plaice) and for a number of additional species (see Annex 4). A CTD was deployed at most trawl stations to collect temperature and salinity profiles.

Six nations participated in the quarter 3 survey in 2022. The overall survey period extended from 21 July to 12 September. In this period, 349 valid GOV hauls were conducted. All Rectangles allocated to the survey area were covered by at least one GOV haul. The total number of tows was still among the highest in the past five years. Average tow duration decreased slightly compared to the most recent years (Figure 2.2). A detailed report for the survey in 3Q 2022 is provided in Annex 4.

Figure 2.2. Mean tow duration and total number of valid tows in the 3rd quarter NS-IBTS (1991-1997: standard tow duration of 30 min adopted by all countries first in 1998; 2009: no participation of Norway, 2015-2016: 50 % of the tows in Subarea 4 planned as 15 min tows).

2.3.2 Highlights and issues

- Due to technical issues for three countries, five Rectangles did not achieve full coverage with two hauls as planned. Other Rectangles with only one haul were Rectangles that are largely covered by land or other obstructions made it impossible to find tracks which are fishable with the GOV.
- 40 tows (11.4 %) reported as valid to DATRAS were shorter than 25 minutes. Except for five of these tows, which were shorter than 15 min, limited space due to safety distance rules from an increasing number of obstructions (e.g. cables and pipelines) and rough bottom conditions on alternative tracks were the main reasons for this.
- Mass occurrence of bryozoans (*Electra* cf. *pilosa*) was observed again in the south-eastern part of the area during the combined Danish survey with RV "Dana" which resulted in five tows shorter than 15 min (Figure 2.3); England made similar observations in this area on its survey. The effect on fish abundance and size composition is not known and whether these tows (Table 2.1) are representative or should be excluded from any index calculation requires a detailed analysis.

- Compared to the other countries, Sweden and in particular Norway reported relative low values for vertical net opening below the lower theoretical limits. Considering the differences between countries and changes over time, it appears advisable that a vessel/country effect is included in modelling abundance indices for pelagic species, such as mackerel.
- It appears that occurrence of southern species such as anchovy, sardine and striped red mullet continued to increase in the southern North Sea. However, a quantitative analysis on this, and on the potential impact of continuing increasing bottom temperatures is required.

Table 2.1. Rectangles and tows which are potentially non-representative sampled during the NS-IBTS in 3Q 2022 due to mass occurrence (≥ 150 kg / tow) bryozoans (DEN: tows were aborted when door spread continuously decreased for about 1 to 2 minutes, based on previous years' experience to avoid trawl damages; catch refers to the portion of bryozoans found in the cod-end, i.e. without the portion clogging the wings).

Country	Rectangle	Station	Haul number (as in DATRAS)	Duration (min)	Catch of bryozoans (kg)	Note
DEN	35F3	104	33	10.1	509.5	
DEN	33F3	129	41	12.9	515.9	
DEN	33F3	131	-	2.5	150.0	Invalid (Catch not worked up in detail)
ENG	34F3	5	9	30.0	1634.0	

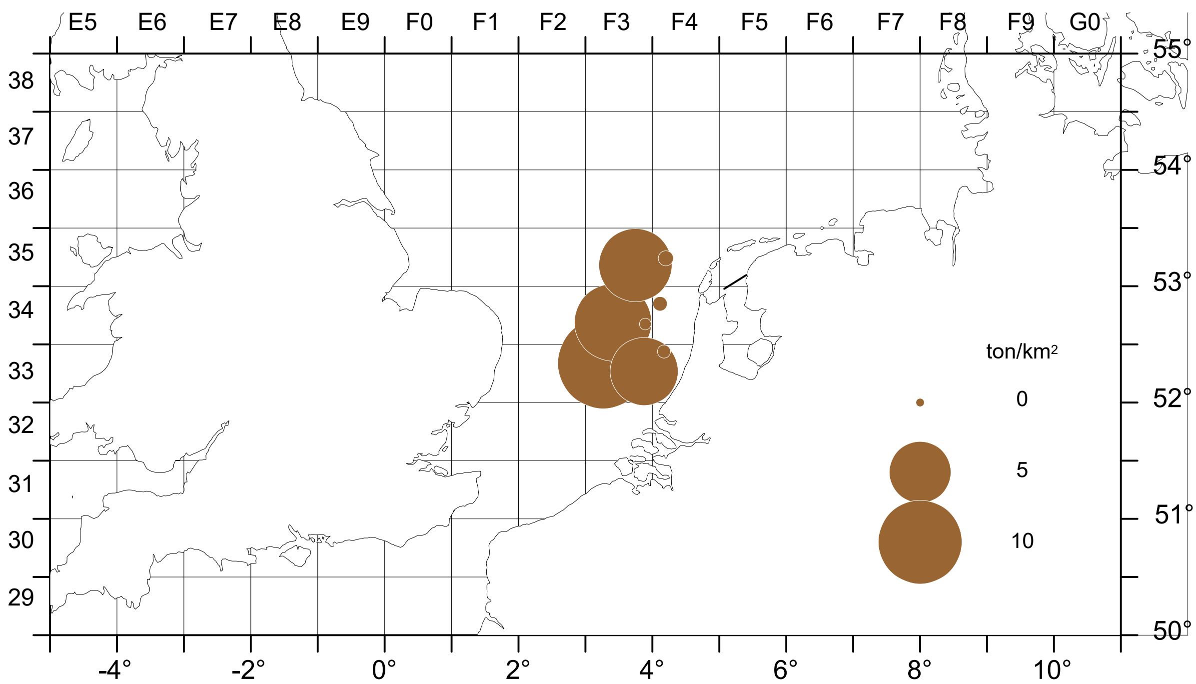

Figure 2.3. Area a mass occurrence of bryozoans as observed during the 3Q North Sea IBTS 2022 by Denmark and England.

2.3.3 Planning and coordination

All regularly contributing countries intend to participate in the 3Q 2023 North Sea IBTS survey program. Below is a table showing the expected program dates for each country for this year.

Denmark	Dana	17 August to 4 September
England	Cefas Endeavour	5 August to 3 September
Germany	Walther Herwig III	18 July to 3 August
Norway	Kristine Bonnevie	21 July to 12 August
Scotland	Scotia	7 August to 28 August
Sweden	Svea	20 August to 1 September

The actual Rectangle allocation to the countries is show in Figure 2.4. Country specific maps (and allocation to Rectangle base files) as well as information on additional sampling requests will be distributed to the participants in the international survey program by the coordinator at latest in early June.

Deadlines for data submission to DATRAS are set to 10 October 2023 for gadoids (including age data) and 1 March 2024 for the remaining species (final complete submission).

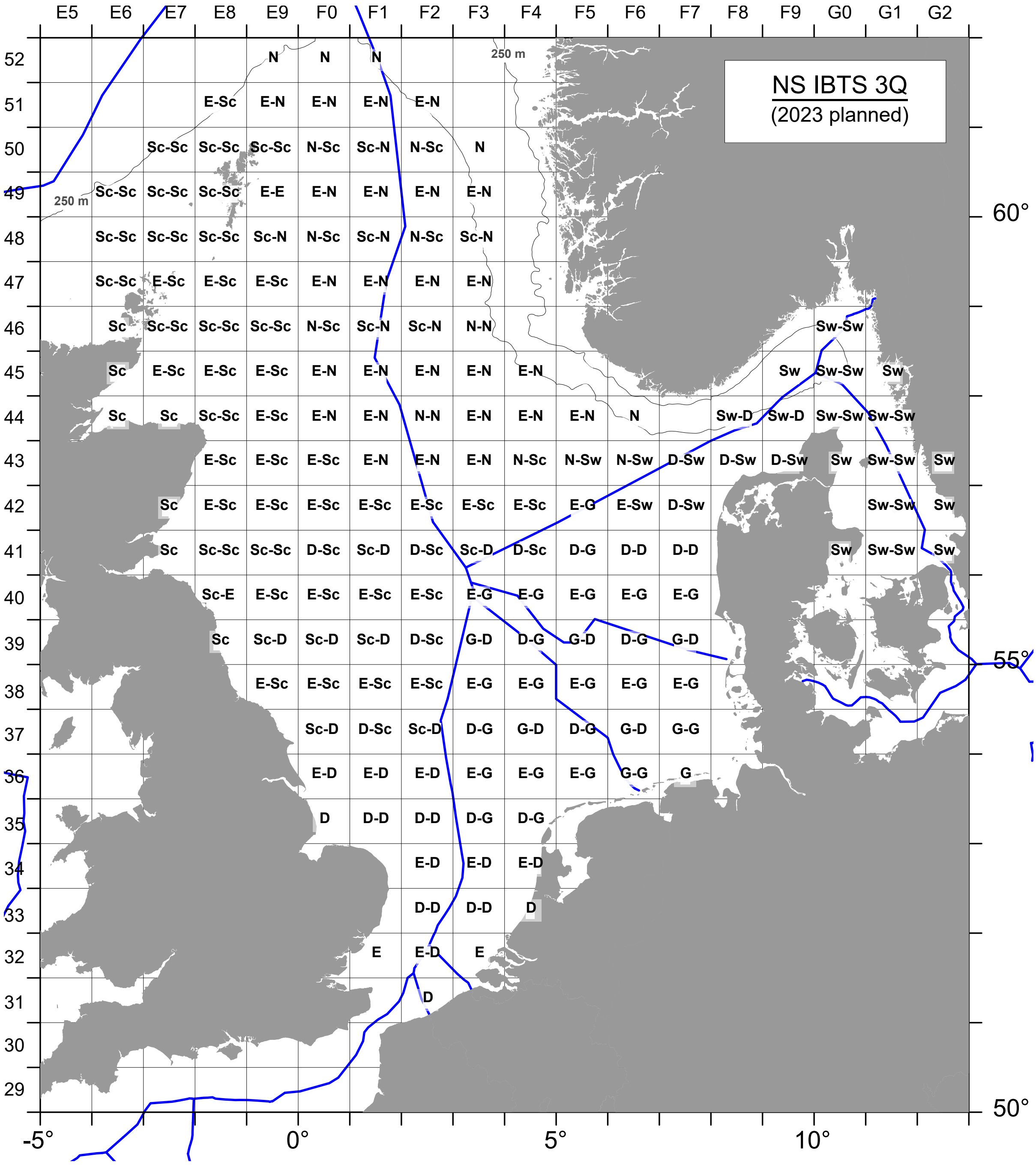

Figure 2.4. Rectangle allocation by country for the North Sea IBTS in 3Q 2023 (D: Denmark, E: England, G: Germany, N: Norway, Sc: Scotland, Sw: Sweden; EEZ limits indicated by blue lines).

2.4 Summary report of the North-eastern Atlantic IBTS

(Coordinator: Finlay Burns)

2.4.1 General overview

In 2022, seven vessels from six nations undertook 13 surveys along the North-eastern Atlantic (NEA) IBTS area. A total of 987 valid hauls, out of the 1104 planned hauls, were accomplished over 346 survey days distributed across all quarters of 2022 (see Annex 6).

With the exception of the SCOWCGFS-Q1, which was cancelled due to serious vessel breakdown issues, all of the other surveys were undertaken successfully, and the majority being mostly completed without significant issue. Covid restrictions were lifted on most vessels during 2022, however its impact was still felt onboard with outbreaks of the virus resulting in a loss of several days on two of the surveys operating during the 4th quarter. This issue was further compounded by extremely poor weather experienced in the Celtic Sea and Biscay areas during November, and which also resulted in the loss of several days across several of surveys out at that time. Despite this, the overall impact on the NEA survey schedule can overall be described as slight, with completed valid stations still almost 90% and, crucially, with no significant spatial gaps in coverage other than that left by the cancelled Q1 Scottish Survey.

With the loss of the Scottish survey, only two surveys (Northern Ireland and Ireland) were undertaken during Q1 in February and March, with the Irish anglerfish survey once again extending into April. Scotland and Spain were active during Q3, with a slightly delayed Rockall survey taking place alongside the Porcupine Bank, and Northern Spanish Coast shelf surveys, with Portugal, France, Northern Ireland, Ireland, Scotland and Spain all active during Q4.

Survey programme highlights as well as the realized and provisional survey dates for 2023 are provided below, with a more comprehensive account of survey activities and the individual survey reports given in Annex 6.

2.4.2 Highlights and issues

- A welcome return for the Spanish Gulf of Cádiz surveys (SP-CGFS-Q1/Q4) in 2022 after both surveys were cancelled in 2021. From Q4 2022 onwards both surveys have and will change vessel with the "Vizconde de Eza" replacing the "Miguel Oliver" as the designated vessel assigned to these surveys. Spain plan to undertake some comparative analyses of the catch data during 2023 in order to assess and report any potential changes in catchability resulting from the change in vessel. A similar issue was reported for the Spanish North Coast survey in 2021, and it is hoped that something similar could be presented in time for the IBTSWG meeting in 2024.

- The Portuguese survey experienced several stoppages due to a combination of extreme weather with around three days lost but also a vessel breakdown event that resulted in the "Mario Ruivo" being out of action for a week. Consequently, only 67% of the planned stations were completed and three strata remained unsampled. In addition, most of the completed hauls collected limited or no gear parameter readings. This raises concerns regarding the ability to validate gear performance. IPMA has agreed to present the results of intersessional investigations in order to address this issue as well as any ongoing developments regarding the creation of the new survey indices at the IBTSWG in 2024.

- France encountered significant disruption during the EVHOE survey in 2022. Nine survey days were lost as a result of Covid-related issues combined with very bad weather that culminated in the loss of the Northern Celtic Sea stations. The overall impact was that 20% of the planned trawl stations remained unsampled, with the majority of these located in the Northern Celtic Sea area. This has an impact on the survey indices for cod and haddock within the Celtic Sea region although overlap with the Irish groundfish survey within the affected area ensured that, from an assessment perspective, that the overall impact felt within this region should be minimal.

- From 2024 Northern Ireland plans to reduce the remaining ~ 20 trawl stations still fished for 1 h (3 nm) in Q1 down to 20 min (1 nm). This would standardise the distance and duration and bring these stations into alignment with the other Q1 trawl stations as well as those sampled during the Q4 survey. The decision had been taken initially in 2016 by IBTSWG to reduce all stations to 20 minute (1 nm), however AFBI decided to keep a subset of stations at 1 hour (3nm) for a further few years to test for further analyses. The preliminary comparative abundance plots from 2016 were presented again to IBTSWG and at first glance there appears to be little or no impact in the number of species encountered, however IBTSWG encouraged AFBI to engage/inform with relevant end-users ahead of the implementation of this change.

- COVID restrictions continued to be in place during the IE-IAMS-Q1/Q2 during 2022. Consequently, the operational working window was again reduced from 24 to 12 h. From 2023 onwards the plan is for these restrictions to be lifted and for 24-hour trawling to resume from 2023.

- The Irish IAMS survey in Q1 experienced loss of several days due to poor weather, however the subsequent impact on number of completed trawl stations was minimal. In order to mitigate the impact on spatial survey coverage it was decided to take pragmatic approach to haul duration. The cut-off for a valid 30 min in IBTS is >15 min and at the Marine Institute we endeavour to stay on the precautionary side of that at 20 min. A similar approach was taken during the IAMS survey, which utilizes a nominal 60 min tow duration, and so this translated to 40 min, taking into account deeper water and ostensibly lower catch rates.

  During the 2022 survey, the trawl sensors were monitored closely during the tow and where reasonable catches were evident, then the tow duration was reduced somewhat to afford the possibility of an extra haul or two over a 24 h period. This is done periodically where acoustics suggest significant fish in the area anyway, and far more than required may be caught. Likewise, work done by IBTS in 2016/2017 (ICES. 2016; ICES. 2017) comparing 30 vs 15 min tow durations suggested little glaring evidence for a significant negative impact on gadoid catch rates at least. Some questions around species diversity may remain, but the priority objective for IBTS surveys currently is the timely, annual monitoring of recruitment and abundance of commercially exploited fish stocks. To that end, combined with a recent trend towards spatio-temporal models for producing indices, the 2022 IAMS survey ensured reasonable spatial coverage by a 10–30% reduction in haul duration on leg 3 where acoustics suggested sample sizes would remain at a 'reasonable level'.

- The French Channel Groundfish Survey (FR-CGFS) did not receive permissions to survey within the UK 6 nm limit in 2022, where previously this had been permitted. This impacted five stations that are important for juvenile fish and so there is likely to be an impact on the survey generated abundance indices. WGNSSK have been informed and the implications will be discussed at the upcoming assessment working group meeting. Data from the Western part of the Channel (FR-WCGFS) has been now created in DATRAS. The complete series (2018-2023) will be available before the end of the year, and it is hoped that preliminary data will be presented at the 2024 meeting of IBTSWG.

- SCOROC survey in 2022-Q3 unsurprisingly posted the highest ever CPUE abundance estimate for 1-year old haddock on Rockall Bank since the start of the new survey series back in 2011. This of course is on the back of last year's record high estimate (also since 2011) of 0-group haddock within Division 6.b.

2.4.3 Planning and Coordination

The expected dates for the NEA IBTS surveys taking place in 2023 are shown in Table 2.2.

Table 2.2. Provisional/realised dates for 2023 NEA surveys and any planned intercalibration.

Survey	Code	Starting	Ending	Expected hauls	Planned Inter-cal.
UK-Scotland West (spring)	UK-SCOWCGFS-Q1	14/02/2023	07/03/2023	62	-
UK-Scotland Rockall	UK-SCOROC-Q3	01/09/2023	14/09/2023	40	-
UK-Scotland West (aut.)	UK-SCOWCGFS-Q4	11/11/2023	04/12/2023	60	-
UK-North Ireland (spring)	UK-NIGFS-Q1	27/02/2023	23/03/2023	60	-
UK-North Ireland (aut.)	UK-NIGFS-Q4	03/10/2023	21/10/2023	60	-
Ireland - Anglerfish Survey 7bcjk	IE-IAMS-Q1	11/02/2023	07/03/2023	70	-
Ireland - Anglerfish Survey 6a	IE-IAMS-Q2	14/04/2023	23/04/2023	45	-
Ireland - Groundfish Survey	IE-IGFS-Q4	31/10/2023	16/12/2023	170	-
France - EVHOE	FR-EVHOE-Q4	21/10/2023	04/12/2023	155	-
France - Eastern Channel	FR-CGFS-Q4	16/09/2023	16/10/2023	122	-
Spain - Porcupine	SP-PORC-Q3	08/09/2023	14/10/2023	80	-
Spain - North Coast	SP-NSGFS-Q4	20/09/2023	24/10/2023	116	-
Spain - Gulf of Cádiz (spring)	SP-GCGFS-Q1	01/03/2023	17/03/2023	45	-
Spain - Gulf of Cádiz (aut.)	SP-GCGFS-Q4	29/10/2023	11/11/2023	45	-
Portugal (aut.)	PT-PGFS-Q4	03/10/2023	02/11/2023	96	-

2.5 References

ICES. 2016. First Interim Report of the International Bottom Trawl Survey Working Group (IBTSWG), 4-8 April 2016, Sète, France. ICES CM 2016/SSGIEOM:24. 292 pp.

ICES. 2017. Interim Report of the International Bottom Trawl Survey Working Group. IBTSWG Report 2017 27-31 March 2017. ICES CM 2017/SSGIEOM:01. 337 pp.://doi.org/10.17895/ices.pub.8707

3 DATRAS and related topics on data quality

3.1 Introduction

This section of the report provides information on updates to DATRAS and any issues relating to data quality. This report section addresses ToR (b).

3.2 Recent updates to DATRAS

The ICES DATRAS team presented the developments in the system, and topics discussed by the Working Group on DATRAS governance (WGDG). Among the implemented tasks during the previous year, the DATRAS team presented the implementation of the new field in HH Survey-IndexArea. This field allows submitters to include this information directly on submission. The field value is defined by the ad hoc vocab CodeType for the different areas existing for each survey. In this regard, the DATRAS team asked for feedback on how to better proceed to merge two Code Types existing for the same survey DYFS, one for English otoliths and another one for the rest.

Other implemented tasks presented include a new survey FR-WCGFS available in DATRAS, the publication of the DATRAS data schematic and the service-based submission, a machine to machine system already in place with Wageningen Marine Research (Netherlands) that allows bulk (re)submissions in an automated way.

The DATRAS team also requested feedback from IBTSWG on two ongoing processes: the review of the SpecVal descriptions, and the review of the suggestion from WGDG on data products naming and description, to be displayed in the download page. This last task aims to improve the understanding for the general user of the different data products. Also, the group was asked to reflect on a proposal from WGDG to align the CPUE product for beam trawl surveys and surveys under IBTSWG and WGBIFS.

The team also presented the DATRAS data comparison tool for exchange data, which is crucial for ensuring the accuracy and usefulness of the data. This process involves analysing two sets of data versions and identifying any differences between them. The comparison may involve analysing values and contextual information associated with the data to determine if there are any changes that could affect the accuracy or usefulness of the data/data products. When working with datasets such as HH, HL, and CA, it is essential to perform a thorough comparison of data versions. This comparison can help determine how to reconcile any differences between the data versions and ensure that the most accurate and up-to-date information is being used. By comparing multiple versions (5 version maximum), Working Groups can also see a comprehensive report of differences that can help highlight changes affecting field values and provide a clear view of each change, and can also use the report to determine if any updates or changes need to be made to the data before analysis.

Subscription of related stocks notification will be very useful for stock coordinators which they are responsible for, DATRAS Data comparison tool development is in the developing and testing phase and the target date to launch the final version at the end of 2023, there will be required a tester group from the WG members who can guide and give feedback to the DATRAS team for further improvements.

3.3 Catch weight issues in DATRAS

During the 2022 Working Group, evidence was presented that there were systematic errors in the catch weights data reported by most countries to DATRAS before 2004 in the North Sea (CatCatchWgt field in the HL records; *cf.* IBTSWG 2022, Annex 8).

Following up on this issue, NS-IBTS DATRAS data provided by Norway were, prior to the working group, systematically compared to the original Norwegian data hosted at the IMR. Beyond the expected issues before 2004, systematic errors, most of which are imputable to wrong aggregation levels, were also uncovered (details are given in the Working Document in Annex 7) and presented to the group.

These wrong aggregations may lead to an overestimation of catch weights by a factor of up to three, for those species sampled for biology (with sex and maturity information). Similar errors were furthermore identified for elasmobranch data provided by Scotland since 2013. Discussions with assessment working groups, during the dedicated session, revealed that, despite lacking documentation, the issue was known and that it was unlikely to have affected stock assessments.

It was moreover pointed out that these errors may have found their origin in ambiguous specifications of the DATRAS fields, that are also documented in Annex 7.

Given the public accessibility to the data, and the subsequent high risk of inappropriate use, IBTSWG decided to convene an intersessional group to:

1. **Provide adequate warnings to users either downloading the data through the data portal or using the official icesDatras R package.**
2. **Clarify the DATRAS specifications.**
3. **Propose methods and procedures to correct systematic errors (both before and after 2004) in catch weights in the DATRAS database. Draft recommendations.**

3.4 Updates to developments on the MSS/OSPAR Groundfish Survey Monitoring and Assessment Data Products

A presentation outlining updates to the MSS/OSPAR "Groundfish Survey Monitoring and Assessment Data Products" was presented by Dr Ruth Kelly and Dr Caroline Mc Keon. This was then discussed by IBTSWG, in relation to ToRs b and e, and the decision was taken to continue these developments intersessionally.

The overall aim of this being 'to provide a standardised, reproducible dataset of species abundance and density (per km^2) across DATRAS surveys at a haul level, which is accessible to those less familiar with technical survey terminology. This data product will build on the extensive work conducted during the development of the MSS/OSPAR data product in 2017, and since then by members of the IBTSWG and others.

The presentation outlined the developments to the data product conducted at AFBI since the ICES WKSAE workshop in 2021 (ICES, 2021a). The data product was originally developed by Moriarty and colleagues (Moriarty et al, 2017; Moriarty et al., 2019), with the aim of providing a standardised dataset of groundfish surveys which was quality controlled in a standardised documented manner and suitable for use for OSPAR assessments and Marine Strategy Framework Directive (MSFD) indicators.

This data product is made up of two core components referred to as 'Sampling Information' and 'Biological Information'. The former contains quality-controlled information relating to the hauls in DATRAS (e.g., depth, location, duration and gear parameters), based on the HH data provided in the ‘exchange file’ format on DATRAS (https://datras.ices.dk). This code for this product was adapted and rerun as part of WKSAE in 2021 (ICES, 2021a). For time periods or surveys which are not covered by the DATRAS Flexfile product, the WKSAE updated version of the ‘sampling information’ product was used by ICES WKABSENS 2021 (ICES, 2021b), to produce abundance estimates of sensitive species for biodiversity assessments in response to an OSPAR request to ICES in 2021 (see ICES, 2021c and links therein).

The presentation and discussion at the 2023 IBTSWG meeting, therefore, focused mainly on the second part of the data product, namely ‘Biological Information’. This part of the data product is based mainly on the HL part of the DATRAS data and contains standardised estimates of species abundance and density per length category within each survey. The scripts to produce this second dataset have been adapted and recently been rerun with data up to the 2021 data year. Some re-scripting was conducted to run the scripts due to small changes in DATRAS coding since 2017 (e.g., ship names), and to make the scripts more user-friendly. The surveys included in these reruns are listed in Table 3.1 and the distribution of hauls illustrated in Figure 3.1.

There were three main alterations from the process described by Moriarty et al. (2017);

1. Specific data points which appeared erroneous in the quality control process were not double checked with data submitters, and only scripted quality control procedures were applied, as per Moriarty et al. It is hoped that manual data checking of errors in the datasets has improved since the introduction of data errors and warnings in the DATRAS upload system;

2. The k-nearest neighbour (kNN) method of assigning species names to species which were recorded at genus or family level on survey was not applied (i.e., species-level identities were not inferred where they had not been recorded on survey). There are both pros and cons to this method and it could be applied if required.

3. The inclusion of data was not restricted to the ‘standardised survey area’ included in the original MSS/OSPAR product. The criterion for inclusion of hauls in this ‘standardised survey area’ was based on the frequency of sampling of Rectangles within the timespan of the dataset, and is designed to avoid issues with artificially increasing species diversity with increasing survey area. Again, there are both pros and cons to this method and it could be applied in future.

Discussion of the presentation at the meeting focused on the further developments to the data product which could be conducted intersessionally and/or at the next IBTSWG.

The Working Group agreed that the data product would be a useful addition to the suite of data products currently provided by DATRAS, and that they would be interested in progressing the work towards an annually updated data product.

This process would require input from other working groups, including WGBEAM, and the ICES Data Centre, and potentially other end-users, such as OSPAR. This product should be compatible with ICES TAF and hosted on github if it is to be integrated into the ICES data hosting framework.

A subgroup of IBTSWG volunteered to continue this work, with a focus on scripting, data hosting options, and decisions regarding kNN methods and survey areas for inclusion intersessionally.

Table 3.1. List of the surveys and time-periods covered by Kelly and McKeon when re-running the MSS/OSPAR Groundfish Survey Monitoring and Assessment Data Products.

Survey	Start year	End year	Missing years	Added national data used
BTS	1993	2021	Y	N
BTS-VIII	2011	2021	N	N
EVHOE	1998	2021	Y	N
FR-CGFS	1988	2021	N	N
IE-IGFS	2003	2021	N	N
NIGFS	1993	2021	N	Y
NS-IBTS	1986	2021	N	Y
ROCKALL	1999	2009	Y	N
SCOROC	2011	2020	N	N
SCOWCGFS	2011	2021	N	N
SWC-IBTS	1996	2010	N	N

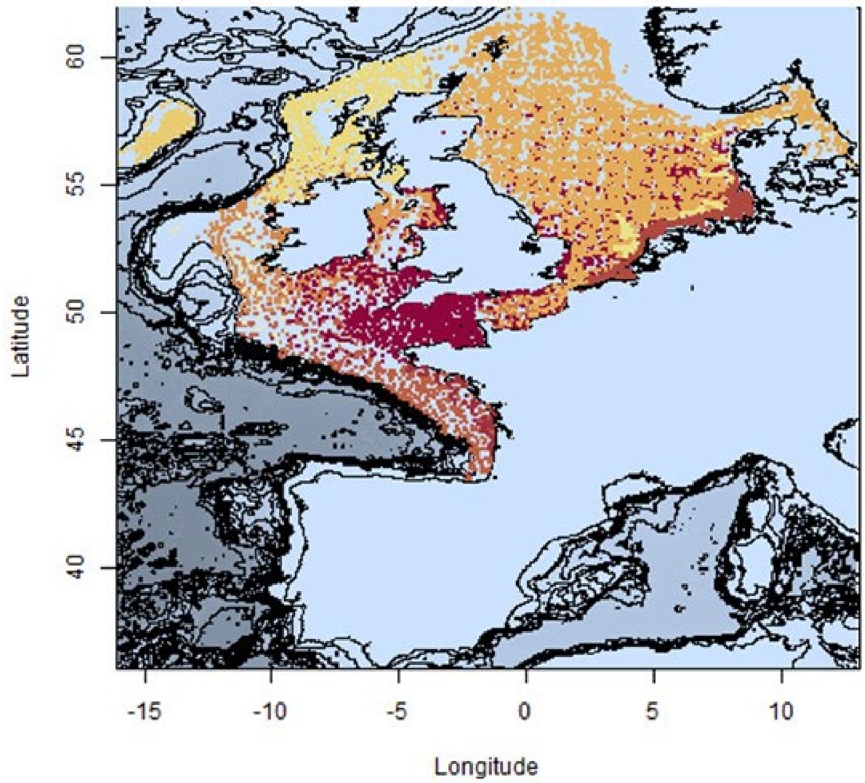

Figure 3.1. Spatial distribution of trawl locations used in the current MSS/OSPAR Groundfish Survey Monitoring and Assessment Data Products, and associated bathymetry.

3.5 Shiny Apps

A presentation was given to IBTSWG from Martin Pastoors and Einar Hjorleifsson, who have been developing a ShinyApp to provide summaries of DATRAS data, including distributional information. The ICES Data Centre had started developing a ShinyApp, although this was still to progress.

There should be further consideration of how ShinyApps could best be used to showcase DATRAS data, though this would preferably involve a range of Expert Groups and other relevant stakeholders.

An Intersessional Sub-group of IBTSWG will further investigate the ShinyApp.

3.6 Oceanographic data

Whilst nations participating in IBTSWG-coordinated surveys collect some oceanographic data and samples (salinity bottles), these data are generally processed by other sections of the laboratories, typically the oceanographic section. Given that representatives of these sections were not present at the meeting, it was not possible for IBTSWG to propose a deadline for data submission.

It was agreed that relevant IBTSWG members should liaise with their respective oceanographic sections in order to identify an appropriate deadline for submitting oceanographic data, and once such information is collated, then a deadline could be suggested.

3.7 Species identification

3.7.1 Identification of *Lophius* spp.

A Working Document on the Identification of *Lophius* spp. by Hans Gerritsen and David Stokes (MI, Ireland) was presented to IBTSWG, and this is included below.

Two species of anglerfish are caught regularly on IBTS surveys: white-bellied anglerfish (*Lophius piscatorius*) and black-bellied anglerfish (*Lophius budegassa*). *L piscatorius* is widely distributed in the NE Atlantic, North Sea and northern Skagerrak; *L budegassa* is not very commonly caught in the North Sea area but is widely distributed in the NE Atlantic.

On Irish surveys, the species were traditionally distinguished by the pigmentation of the peritoneum: *L. budegassa* specimens generally have dark pigmentation which can be seen through the gill opening or by cutting open the body cavity. The UNESCO guide "Fishes of the North-eastern Atlantic and the Mediterranean" states that a distinguishing feature is the count of dorsal fin rays: with 9 or 10 fin rays for *L. budegassa* and 11 or 12 for *L. piscatorius*. On a practical note: the easiest way to count the dorsal fin rays is to remove the skin first (Figure 3.2).

During IGFS and IAMS surveys, 393 small *Lophius* individuals were identified using the pigmentation of the peritoneum and also keyed out using the fin ray counts. Table 3.2 shows the frequency distribution of fin ray counts. Counts outside the expected range of 9-12 occasionally occurred. All fish with counts of 10 or less were identified as *L. budegassa*.

The results indicate that if pigmentation is present, the fish nearly always keys out as *L. budegassa*. However, in small fish the pigmentation is not always developed and more than half of the fish <20 cm total length that did not have any pigmentation were keyed out as *L. budegassa* (Table 3.3) even though the absence of pigmentation suggested they were *L piscatorius*. This indicates that, in small fish, the absence of pigmentation cannot be used to identify the species. For fish of 20 cm and over this did not appear to be a problem.

In conclusion, anglerfish (*Lophius* spp.) under 20 cm total length should be identified using fin ray counts, as absence of pigmentation cannot be used to identify the species.

Recent genetics work (Aguirre-Sarabia et al., 2021) indicates that hybrids between *L piscatorius – budegassa* are reasonably common. Currently, there is no agreed method to identify hybrids without genetic analysis.

Figure 3.2. Skinned anterior part of a small L. budegassa individual showing the dorsal fins.

Table 3.2. Frequency distribution of fin ray counts. *L. budegassa* is expected to have 9 or 10 fin rays but fish with 6 and 7 were also encountered; these were also assigned to L. budegassa. *L piscatorius* is expected to have 11 or 12 fin rays but a small number of fish had more than that.

Fin ray count	Frequency	Species
6	1	L bud?
7	8	L bud?
8	43	L bud?
9	221	L bud
10	69	L bud
11	30	L pis
12	17	L pis
14	3	L pis?

Table 3.3. Small *Lophius* were identified using the pigmentation of the peritoneum as well as fin ray counts. The bracketed numbers indicate incorrect identification based on pigmentation. When pigmentation was present, nearly all fish had fin ray counts consistent with *L. budegassa* (black-bellied angler). However, many individuals without pigment also had fin ray counts that identified them as *L. budegassa*, indicating that the absence of pigmentation cannot be used to identify small individuals of this species.

	No pigmentation		Pigmentation	
Fish length	*L. pis*	*L. bud*	*L. pis*	*L. bud*
5				1
6		[1]		
7		[1]		
8		[3]		6
9	1	[4]		3

10	1	[1]		11
11		[13]		22
12	8	[17]	[1]	31
13	2	[3]	[1]	16
14	8	[4]		22
15	5	[4]		22
16	5	[5]	[1]	28
17	6	[2]	[1]	28
18	3	[1]		33
19	5	[1]		33
20	2			21
21				5
24				1
Total	46	[60]	[4]	283

3.8 References

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4 Gear-related topics and the new survey trawl

4.1 Introduction

There have been longer-term discussions regarding trawl design for many of the surveys undertaken under the auspices of IBTSWG. For example, in the early 2000s, the Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas (SGSTG; ICES, 2003, 2004) and the subsequent Study Group on Survey Trawl Standardisation (SGSTS; ICES, 2005, 2006, 2007, 2008, 2009) highlighted the need for a survey trawl that was more robust than the GOV trawl as used in the North Sea.

Whilst initial work on this topic focused on the North-eastern Atlantic surveys, the NS-IBTS has subsequently seen a need to extend survey coverage to the north-western parts of the Subarea 4, in areas where the standard GOV is prone to damage, and there is increased interest in sampling other coarse ground areas which may be important habitats for some target species. Furthermore, many participants in the NS-IBTS are finding it increasingly difficult to source spare materials for the GOV trawl, necessitating some nations to change netting materials etc.

IBTSWG has recognised the need to introduce a more robust trawl for survey work, and this led to two recent ICES workshops, namely the Workshop on Impacts of planned changes in the North Sea IBTS (WKNSIMP; ICES, 2019) and the Workshop on the Further Development of the New IBTS Gear (WKFDNG; ICES, 2022).

IBTSWG made progress in agreeing many elements of the new survey trawl during the 2022 meeting, with additional intersessional work and meetings undertaken in the subsequent months, primarily in terms of refining the plans and accounting for some of the features that had been developed by the Marine Institute and experts for the trawl they had been developing.

4.2 Most recent iteration of proposed gear design

Since the last IBTSWG (2022) a number of virtual meetings were held to refine the new trawl specification (see Figure **4.1** to Figure **4.6** for the most current gear plans, noting that minor modifications may be made for the final plans), mostly focusing on the trawl net plan and in co-operation with net makers two nets were built to the plan and first trials were undertaken in late 2021 and early 2022 by Ireland and Scotland (see below) as well as England (CEFAS).

During the 2023 meeting of IBTSWG first trial data were presented and further discussions were held on strengthening, such as guard meshes and tearing strips. It was suggested the current design given in Figure **4.1** should be considered the maximum required to construct a robust trawl. However, it was acknowledged for some users that it would be more cost effective to incorporate the level of strengthening deemed necessary for their local operational and seabed conditions. The group considered that the exclusion of 3 to 6 meshes deep of double twine inserted at the positions indicated in Figure **4.1** would not compromise the trawls selectivity or catchability.

To monitor netting panel shrinkage, it was recommended that mesh size measurement should be made using the Omega gauge during the trawl testing phase (2023–2024). This will ensure the netting is not suffering significant dimensional change, such as shrinkage, which is common in braided twines used in demersal trawls due to sand ingress into the twine braid.

During the meeting twine runnage was discussed and it was felt the mid-compact twines selected offered sufficient strength to allow thinner twines to be used. However, it was agreed the current twine runnage given in Figure **4.1** is too fixed and requires some flexibility to enable a broader range of different twines to be used. This is critical to prevent historical drift from the current specification, as has occurred with the current GOV trawl design. Further discussions defining a runnage range for each twine will be further investigated during 2023.

The group agreed the flotation package (150 x 200 cm) is potentially more buoyant than required to obtain the optimum headline height and could, in high tidal areas, compromise groundgear catchability. The intention is to trial reduced floatation and adjustment of headline chain extension length over the next year to assess the configuration to maintain the required headline height.

It should be noted the trawl door, backstrop extension and wire pennants shown in Figure **4.6** are specific to the UK Scotland survey vessel MV "Scotia" and may/will differ for each survey vessel.

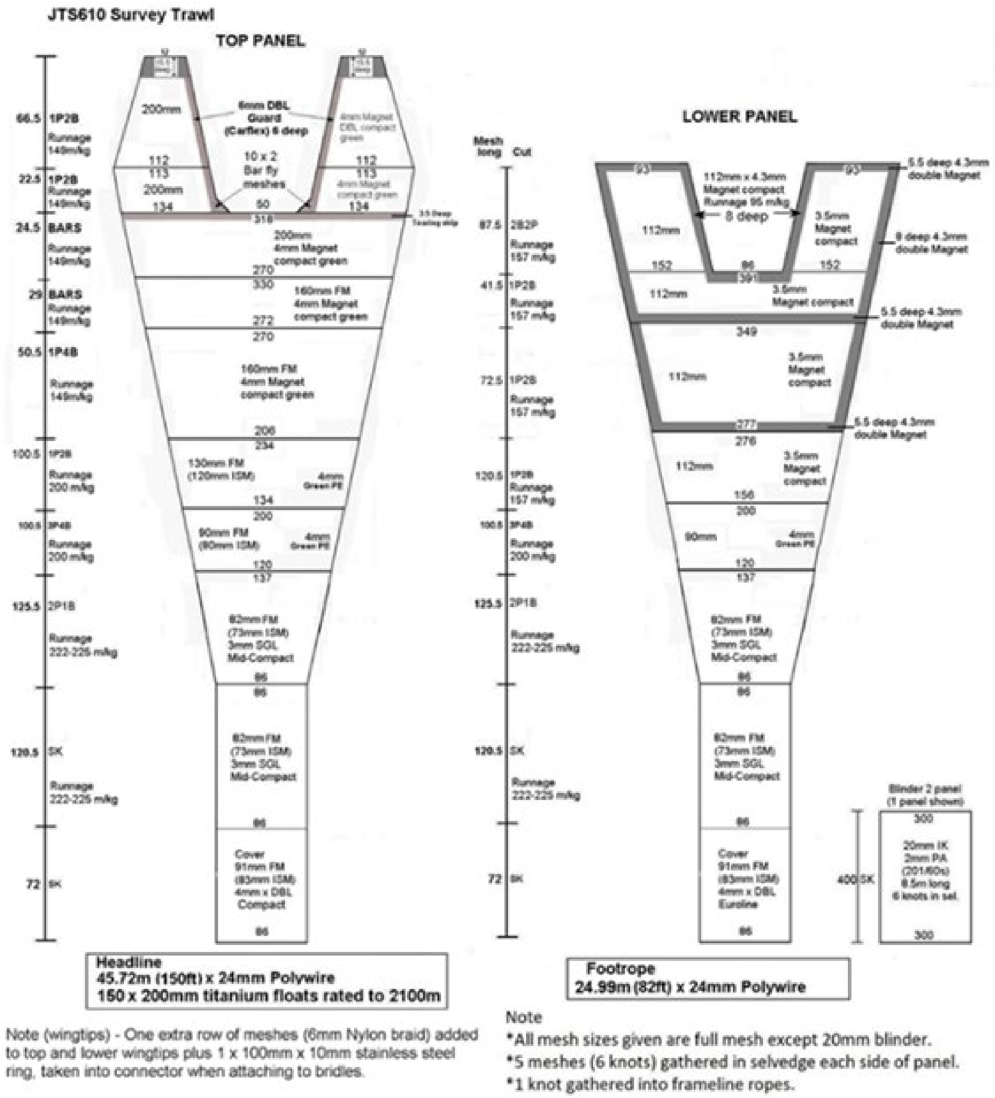


Figure 4.1. Net plan for the proposed survey trawl

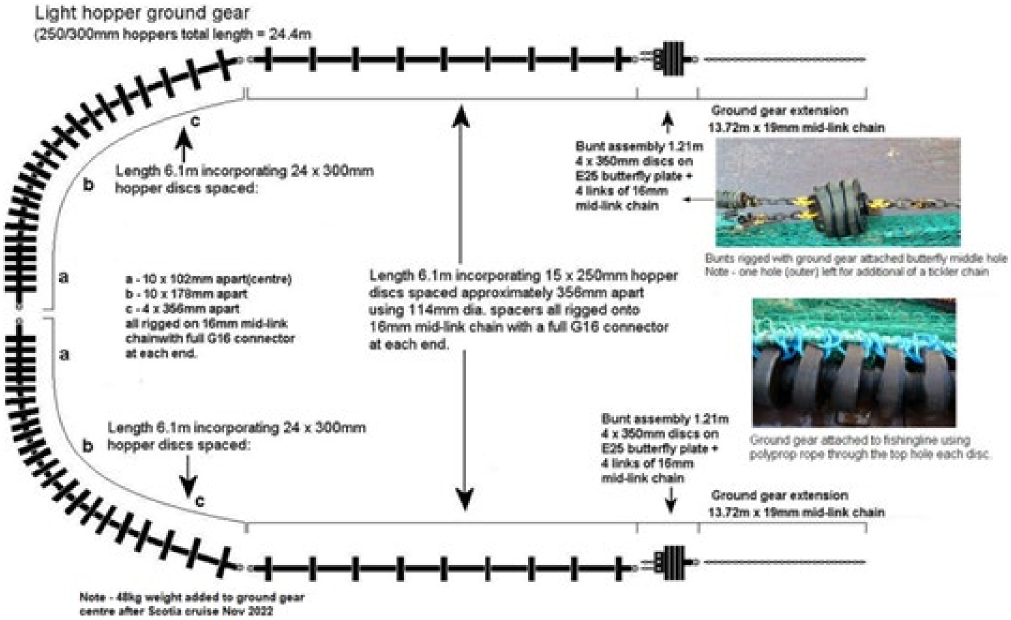


Figure 4.2. Light rockhopper groundgear specification for the proposed trawl.

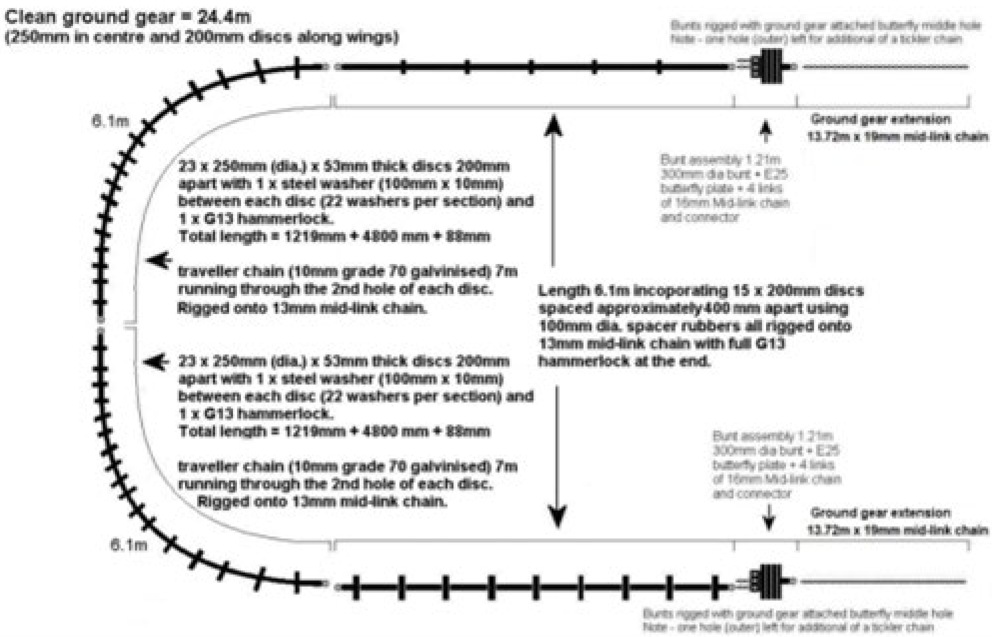


Figure 4.3. Clean groundgear specification for the proposed trawl.

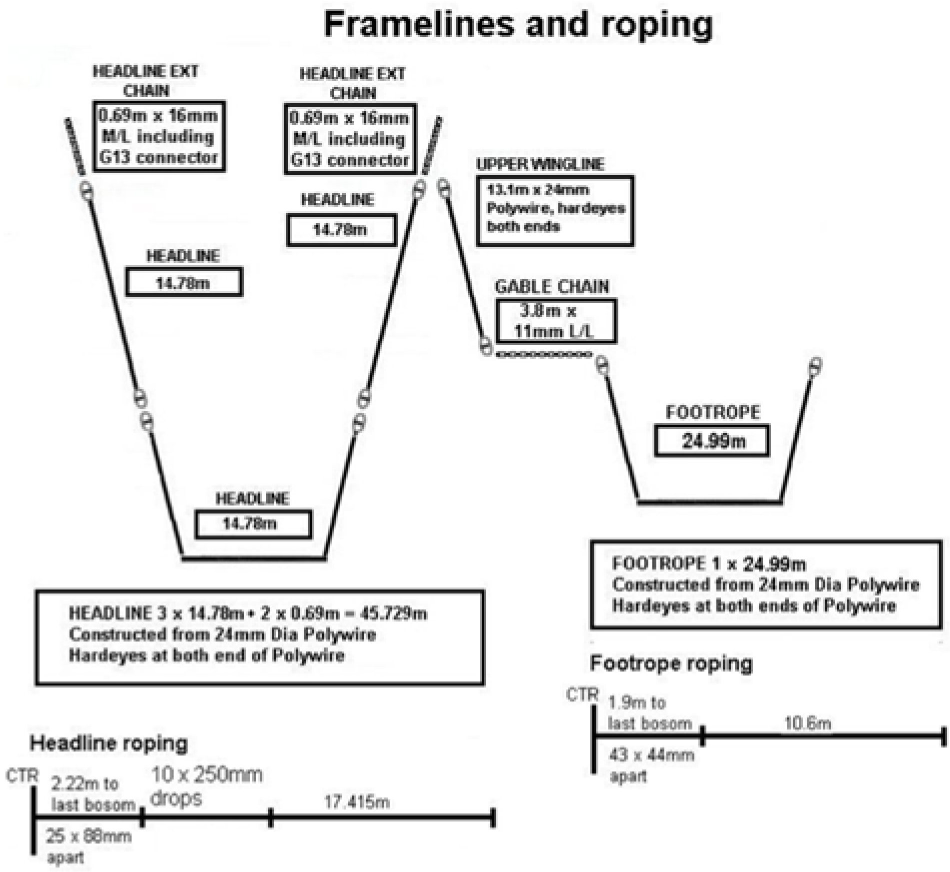


Figure 4.4. Framelines, headline and footrope roping for the proposed trawl.

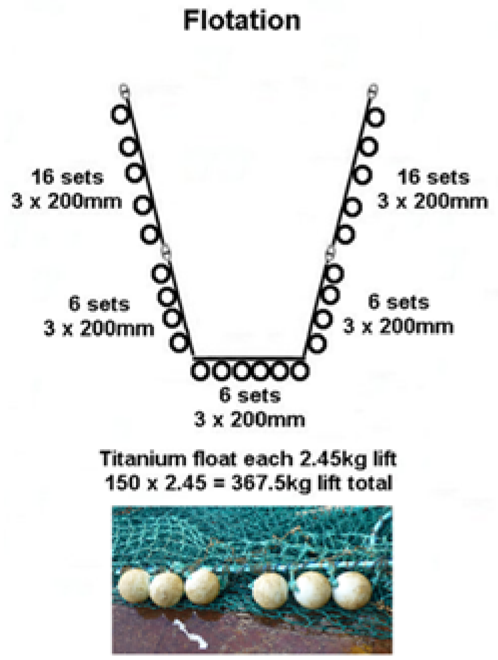


Figure 4.5. Current floatation specification, including positioning around the headline, for the proposed trawl.

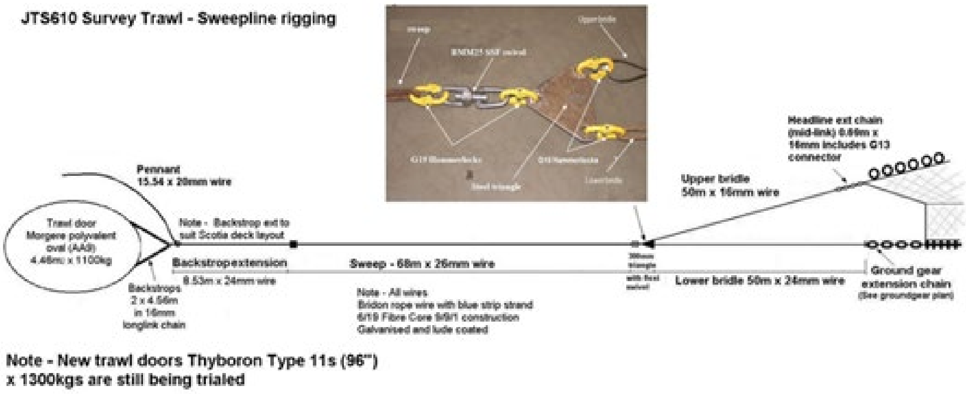


Figure 4.6. Wire rig specification for the proposed trawl.

4.3 Recent sea-going trials

4.3.1 Ireland

At the 2022 annual meeting, IBTS agreed to progress development of a new Survey Trawl (TOR C) by further modifying the existing Jackson Trawl BT237 being trialled by Marine Science Scotland (MSS). The Marine Institute (MI) undertook to build a 'clean groundgear' version while Marine Scotland Science (MSS) would progress the heavier 'light hopper gear' configuration. The Working Document (see Annex 7) presented highlighted key points and initial comments in relation to construction, operation and potential improvements needing consideration going forward.

Only one evening to set up and one day fishing was allocated for testing by the MI to ensure the trawl had some reasonable default settings across a range of depths before being loaned to the North Sea participants for proper sea trials. Therefore, the focus at the 2023 IBTS meeting was on the physical characteristics of the trawl geometry rather than meaningful interpretation of very limited catch data. Nevertheless, initial observations suggested quite similar catch levels to the GOV from operations in the area over the adjoining survey days. Predictably enough the exceptions were megrim and hake which are likely related to the smaller meshes in the wings and higher headline hight respectively. To reiterate though, the data are anecdotal, but does not seem to initially suggest the improved catchability we saw with the MI001 prototype.

Overall thoughts on the geometry were good with a stable sweep angle across depths of 18-19 degrees and a stable, if significantly higher, headline.

Materials during the build, even just post covid, were reasonable available with rubber disks for groundgear and some magnet twine proving more difficult. The main difficulty for the build at the MI was access to technical details for this design which resulted in quite delayed progress as design options waited for confirmation by the commercial manufacturer Jackson Trawl. Pragmatically, some options had to be implemented to meet agreed deadlines so these still need to be consolidated between the trawl built at MI and the two built by Jackson Trawl in-house. A lot of the technical detail has been worked through by now and noted, so a lot of the hard work has been done.

While evaluation by the North Sea surveys progresses, a few specifics were highlighted for particular attention as part of that process.

1. More ballast for groundgear in water deeper than our trials is likely to be required and should be evaluated during North Sea Trials.
2. Warp depth ratios are likely to differ somewhat between vessel/door/warp combinations and should be investigated as a first step during trials (see Annex 7).
3. Constant joining rows are much simpler and could easily be implemented in this design for more robust and fool-proof mending over time. A simple fine tuning could help simplify construction considerably without changing the overall design or efficiency to any great extent. Feedback from crew in terms of mending would be very useful.
4. Construction of top and bottom panels around the bosom section is very close to length for length. Given the much smaller meshes in the lower section and its increased likelihood of shrinking therefore, it will be important to monitor the relative lengths in these sections to ensure tension remains in the top panels to ensure stable catchability.
5. The trawl plan does not provide any information on joins and again this will only lead to deviation, so details supplied with the trawl need expanding.

4.3.2 UK Scotland

4.3.2.1 Gear development trials (Oct-Nov) 2022

A development cruise with the new survey gear was undertaken by Marine Scotland Science from 25 October to 3 November. The main aims of the cruise were to build on data collected during 2021 cruise in assessing and fine tuning the fishing performance of the Thyboron Type 11 trawl doors (4.85 m^2; 1300 kg).

A total of 57 gear geometry (engineering performance) hauls (blocks) were completed during the cruise. Each haul was between 15–20 min duration and provided around 60 data points. The parameters measured (every haul) were speed over the ground, headline height, trawl sounder (bottom) contact, wingend and door spread. Door tilt sensors measured roll and pitch angles for both trawl doors and a self-recording angle sensor, attached to ground gear centre, recorded touch down/lift off and bottom contact during each haul. Other parameters such as warp deployed, water depth and tide/wind conditions were recorded manually from the vessels bridge systems.

A limited number of deployments were made with self-recording TV systems, but visibility was poor, and no useful observations were made.

A number of different trawl door rigging configurations were made during the cruise including:

- Door heel angle - moving towing chain to lower attachment point and reducing upper backstrop length by 100 mm (1 link of 16 mm long-link chain).
- Increasing bottom contact by adding 48 kg additional weight around ground gear centre.
- Effect on net opening by reducing flotation from 156 to 150 floats and shortening the headline extension chain length by 146 mm (2 links x 16 mm mid-link shorter).
- Warp-to-depth ratios and its effect on maintaining correct trawl geometry in deeper water depths.

<u>Door heel angle</u> – With the towing chain attachment point set to the upper position the doors heeled significantly inward (+25 degrees) but once re-rigged to the lower position this reduced to ~11 degrees. It was noted this was around the recommend angle of 10–14 degrees inward heel. However, it was found while towing into higher swells at towing speeds >3.8 kts the trawl tended to lift off. To further improve door stability the upper backstrop chain was shortened by 1 link (100 mm). Further development will be required to ensure correct operation of the doors with the new survey trawl. For the 2023 Marine Scotland comparative fishing trials the intention is to use the Morgere polyvalent doors used with the Scottish GOV trawl.

Ground gear contact – During the 2021 cruise it was noted from the bottom contact sensor data the ground gear was possibly too light and for the 2022 cruise 48 kg of ballast chain was added around the centre of the groundgear. Overall, it was found the additional weight improved ground gear stability with a slight reduction in wingend spread noted, suggesting groundgear drag had increased. For the final configuration the chain will be replaced by the equivalent weight of steel discs.

Net opening – During the 2021 cruise flotation was reduced from 156 to 136 (200 mm) floats with headline height reduced by 1.5 m. For the 2022 cruise the decision was taken to reduce overall floatation by six floats to 150, removing three floats per side from wing headline sections. From subsequent headline height and trawl eye sensor data there were suggestions of a slight reduction in headline height. To further reduce net opening and increase ground gear contact the headline extension chains were shortened by 146 mm or 2 x chain links. There appeared to be no difference in headline height, but data obtained from the bottom contact sensor suggested improved ground contact. At IBTSWG, the group agreed to further investigate flotation with a view to obtaining the ideal headline height range of 5.5–6.0m

Warp-depth ratios – During previous trials with the new survey trawl the warp-depth ratio was maintained at 3:1. It was suggested the Thyboron Type 11 doors were able to operate at reduced ratios. The following ratios were trials during the 2022 cruise; 3:1, 2.9:1, 2.8:1 and 2.7:1. Overall it was found the doors tended to lose stability and lifted off with ratios/towing speeds of 2.8:1/>3.8kts and 2.7:1/>3.5kts respectively.

A Further 12-day development cruise is planned by Marine Scotland on FRV Scotia during October-November 2023.

4.3.2.2 Gear comparison trials during NSIBTS (Jan-Feb) 2023

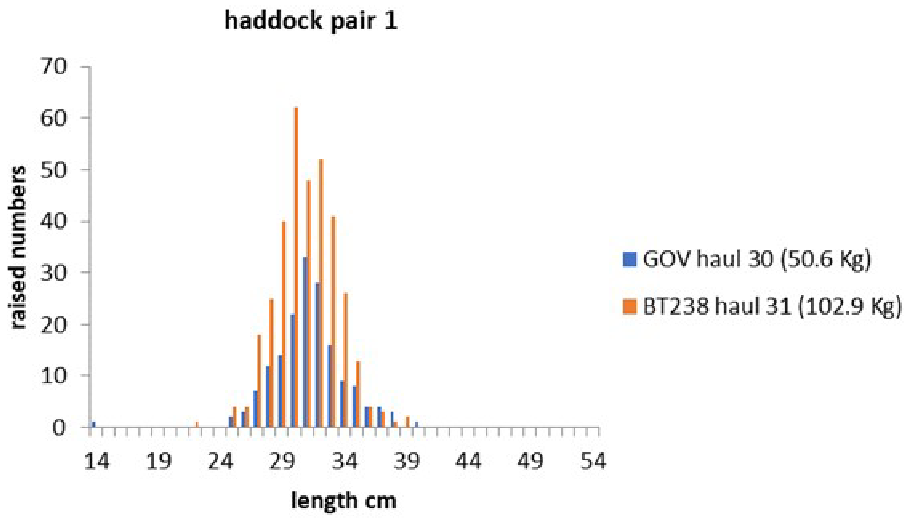
Two sets of paired valid hauls for comparison between the GOV (groundgear B) and the new survey net BT238 (light hopper groundgear) were completed during cruise 0223S (SCO IBTS NS Q1). Pair 1 (haul nos. 30/31 and pair 2 (haul nos. 59/60) were undertaken along parallel tracks as close as possible to each other without going over exactly the same section of seabed and with as short a time (~1 hour) between the two as practical. Trawl duration was the same for each pair; net geometry and other parameters showed similar mean values (Table 4.1) with the exception of headline height which stands out as significantly higher in the case of BT238 (a feature noted elsewhere in this report).

Table 4.1. Gear parameters of paired hauls with the GOV (with groundgear B) and the proposed survey trawl.

haul	trawl	depth m	headline m	wings m	doors m	speed kts	dist. km	catch wt. kg
30	**GOV-B**	**133**	4.8	20.0	82.7	3.8	2.45	242.6
31	**BT238**	**141**	5.5	21.6	78.6	3.7	2.26	274.8
59	**GOV-B**	**151**	4.5	21.5	90.3	3.7	3.32	360.8
60	**BT238**	**152**	6.1	21.5	82.5	3.7	3.45	384.0

Four demersal species were selected for comparison: haddock, whiting, Norway pout and long-rough dab. noting that catches of small pelagic fish in these hauls were negligible. Given the limited data, and undetermined environmental variation likely to be present as well as the slightly differing trawl tracks, the numbers are not further adjusted for swept area. The raw plots, however, do allow preliminary, visual comparisons of the overall range and length-frequency profiles (Figure 4.7 to Figure 4.10).

Some preliminary observations, in advance of more extensive comparative data, are that while some variance in overall catch weights between the gears was observed for these four species, the overall length range and length-frequency distributions are seen to be broadly comparable. There was no indication of any components of the length range missing between gears. Year class peaks in the length frequency, where clearly present (e.g., haddock pair 2, Norway pout pair 1) were captured appropriately in both cases. Preliminary data for long-rough dab suggests the BT238 demonstrates far better ground contact during both paired hauls than the GOV (with groundgear B).



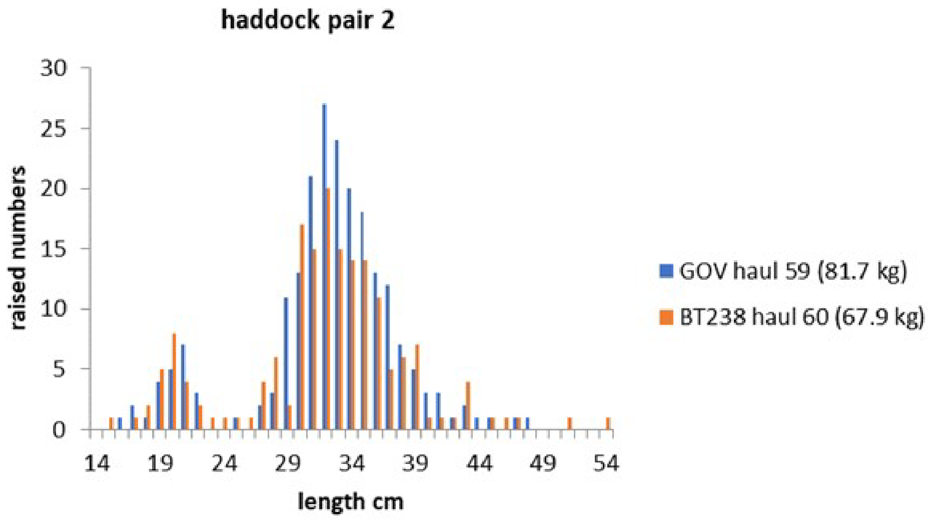


Figure 4.7. Paired haul comparisons (raised numbers at length) for GOV-B / BT238 for haddock in paired haul 1 (top) and paired hail 2 (bottom). Total weights caught by each gear are shown in the legend.

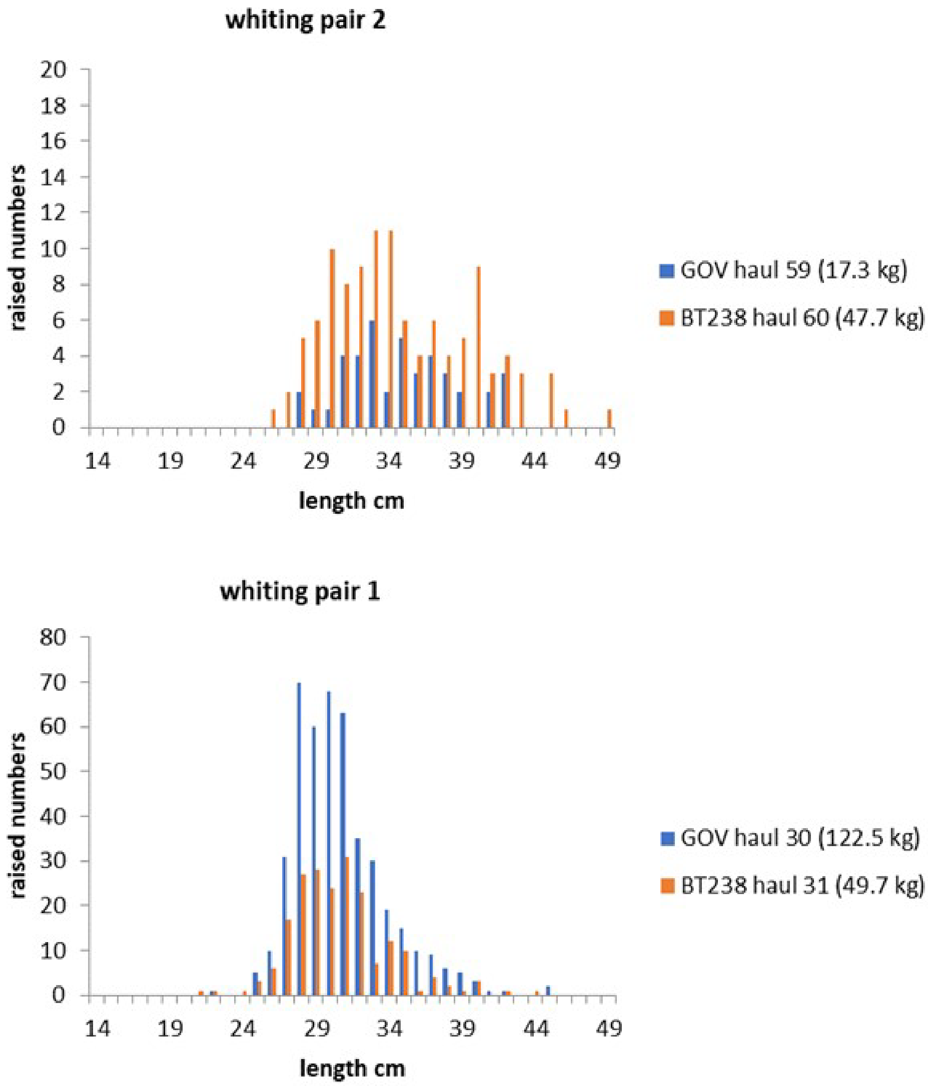


Figure 4.8. Paired haul comparisons (raised numbers at length) for GOV-B / BT238 for whiting in paired haul 1 (top) and paired hail 2 (bottom). Total weights caught by each gear are shown in the legend.

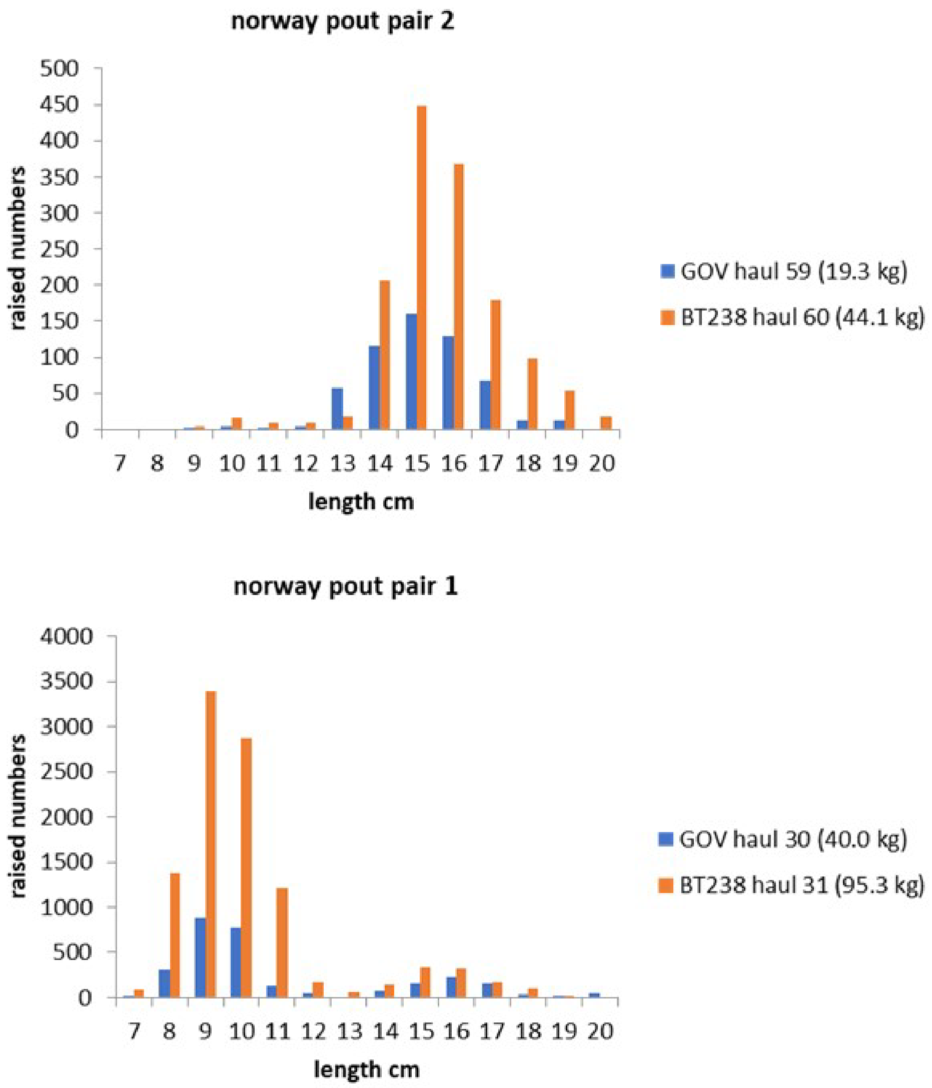


Figure 4.9. Paired haul comparisons (raised numbers at length) for GOV-B / BT238 for Norway pout in paired haul 1 (top) and paired hail 2 (bottom). Total weights caught by each gear are shown in the legend.

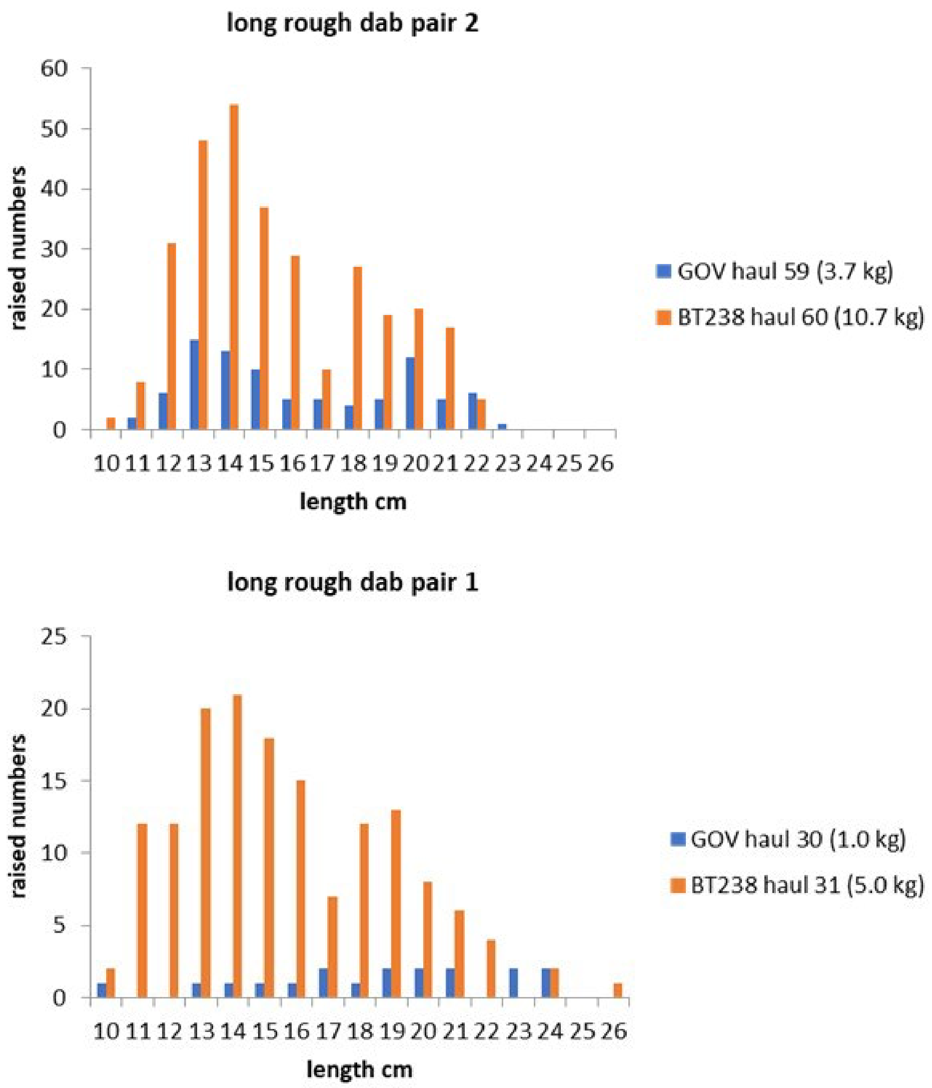


Figure 4.10. Paired haul comparisons (raised numbers at length) for GOV-B / BT238 for long-rough dab in paired haul 1 (top) and paired hail 2 (bottom). Total weights caught by each gear are shown in the legend.

4.3.3 UK England

Cefas undertook a trawl survey to the southwest of the UK in Q1 2023. During this survey the proposed survey trawl with the light hopper rig was trialled. Overall, 30 valid tows were undertaken, with these spanning a depth range of approximately 40–130 m.

From a practical viewpoint, there was no issue getting the gear on the net drum. The otter doors used were the AA9 doors, as used on RV "Endeavour" for the Q3 North Sea survey, and the same backstrops and pennant wires were also used. A few minor adjustments were introduced, including adding chain to the fishing line to add weight and improve ground contact. Strong tides in the Bristol Channel areas meant that the connectors had to be swapped to barrel swivels. The speed over ground used was 3.4–3.7 kts, averaging 3.45 kts.

Preliminary observations on net geometry (Figure 4.11) indicated that the door spread ranged from approximately 50 m (at 40 m depth) to 70–80 m at depths of 100–130 m. The headline height ranged from about 5.5–7 m, with the higher observed headline heights in shallower water (ca. 40

m depth) and headline heights of 5.5–6.5 m in the main surveys area (at depths of 60–130 m). No data were available for the wing spread. The door spread was slightly higher than the GOV, given the longer sweeps. The headline height was quite high and the speed over the ground was reduced in areas of faster tides in order to ensure effective ground contact. Given the headline height is higher than the GOV, there could be consideration of reducing flotation slightly.

Preliminary data on the length frequency of selected species are shown for various gadoids (Figure 4.12), small pelagic fish (Figure 4.13), flatfish (Figure 4.14), elasmobranchs (Figure 4.15) and selected other fish species (Figure 4.16). These are summary data of the overall length composition observed using data aggregated across all hauls and are shown for illustrative purposes only. It is hoped that further trials will be undertaken, and more detailed analyses will be undertaken when more data are available.

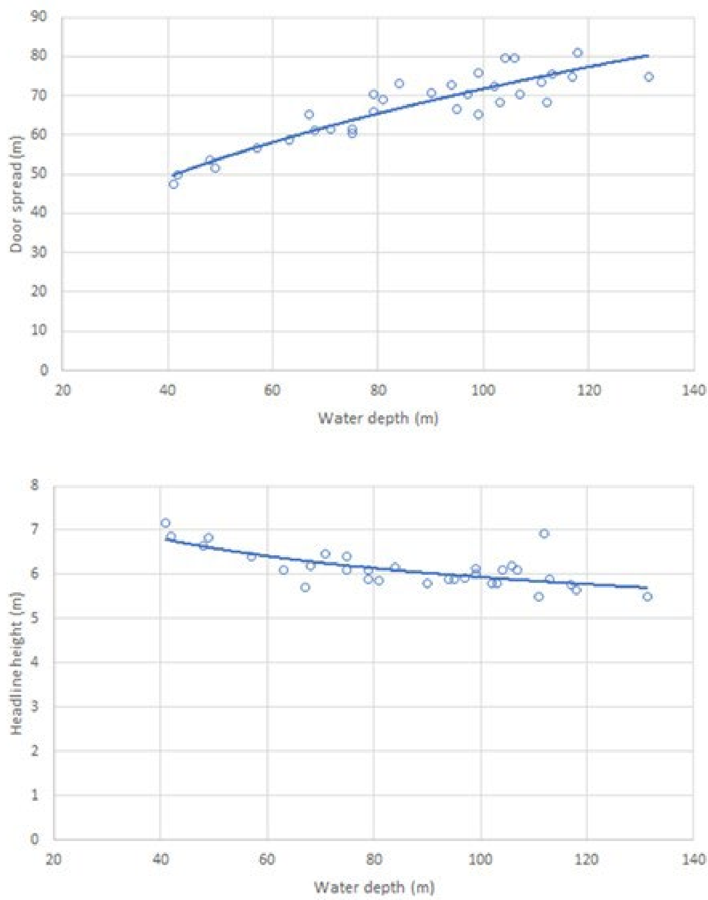


Figure 4.11. Door spread (top) and headline height (bottom) of the proposed new survey trawl as observed in preliminary studies undertaken to the southwest of the British Isles. No comparable data for wing spread were available.

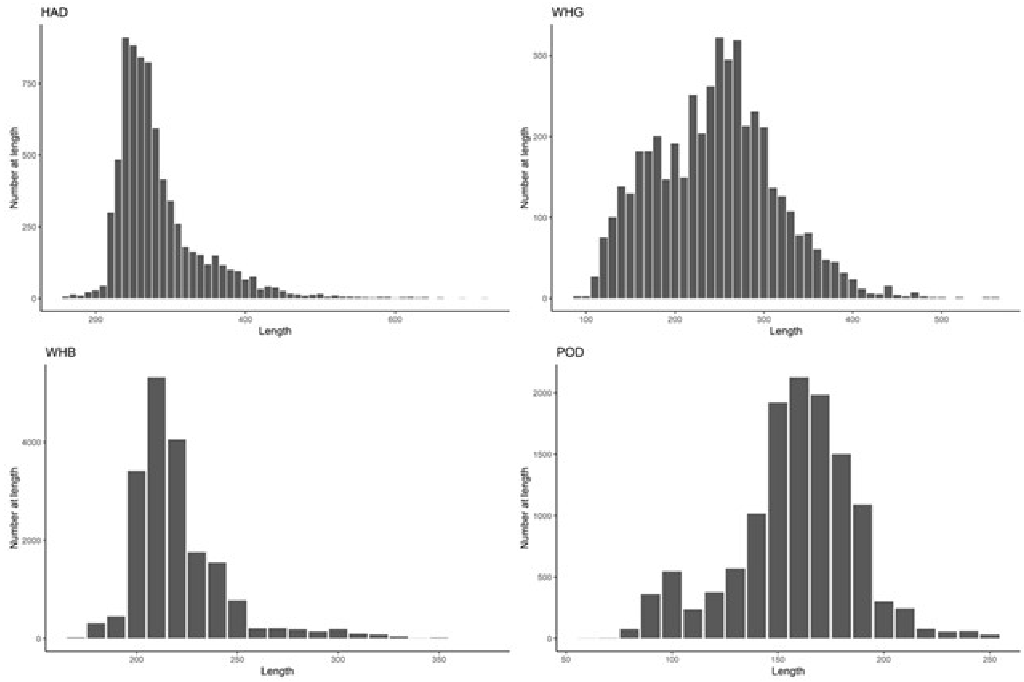


Figure 4.12. Aggregated length-frequency data for the more abundant gadoid species (HAD = haddock; WHG = whiting; WHB = blue whiting; POD = poor cod) observed in preliminary studies undertaken to the southwest of the British Isles.

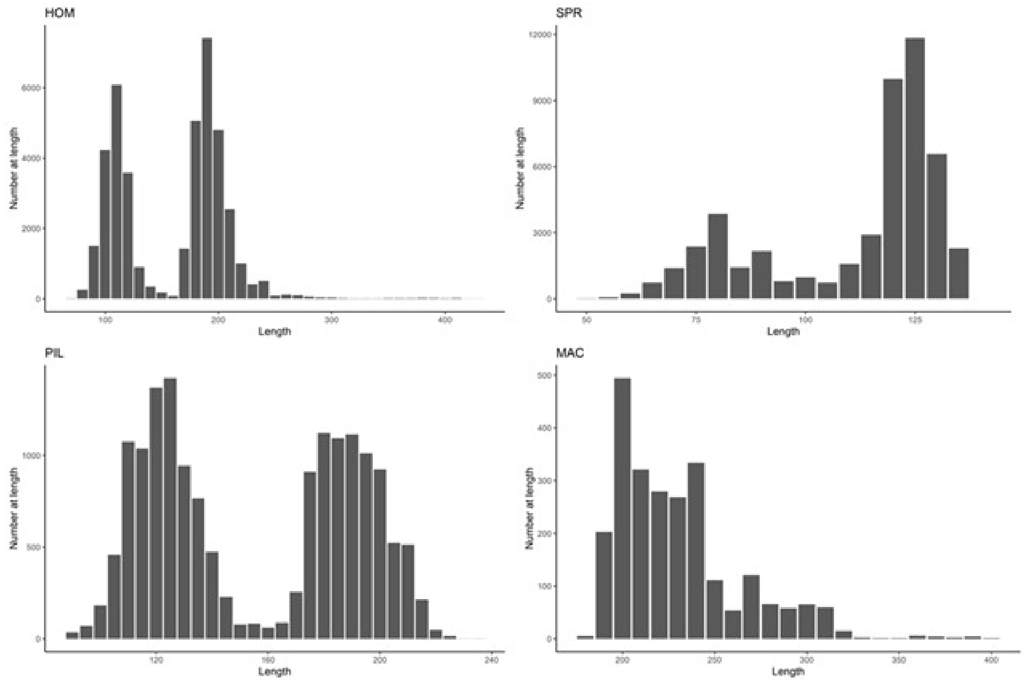


Figure 4.13. Aggregated length-frequency data for the more abundant small pelagic species (HOM = horse mackerel; SPR = sprat; PIL = pilchard; MAC = mackerel) observed in preliminary studies undertaken to the southwest of the British Isles

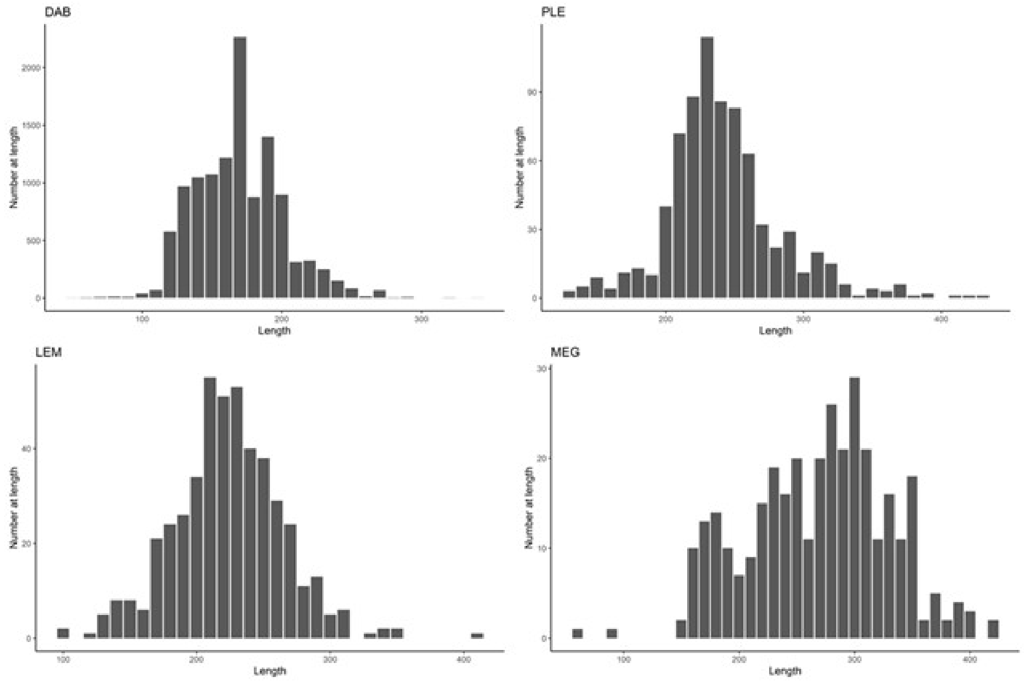


Figure 4.14. Aggregated length-frequency data for the more abundant flatfish species (DAB = dab; PLE = plaice; LEM = lemon sole; MEG = megrim) observed in preliminary studies undertaken to the southwest of the British Isles.

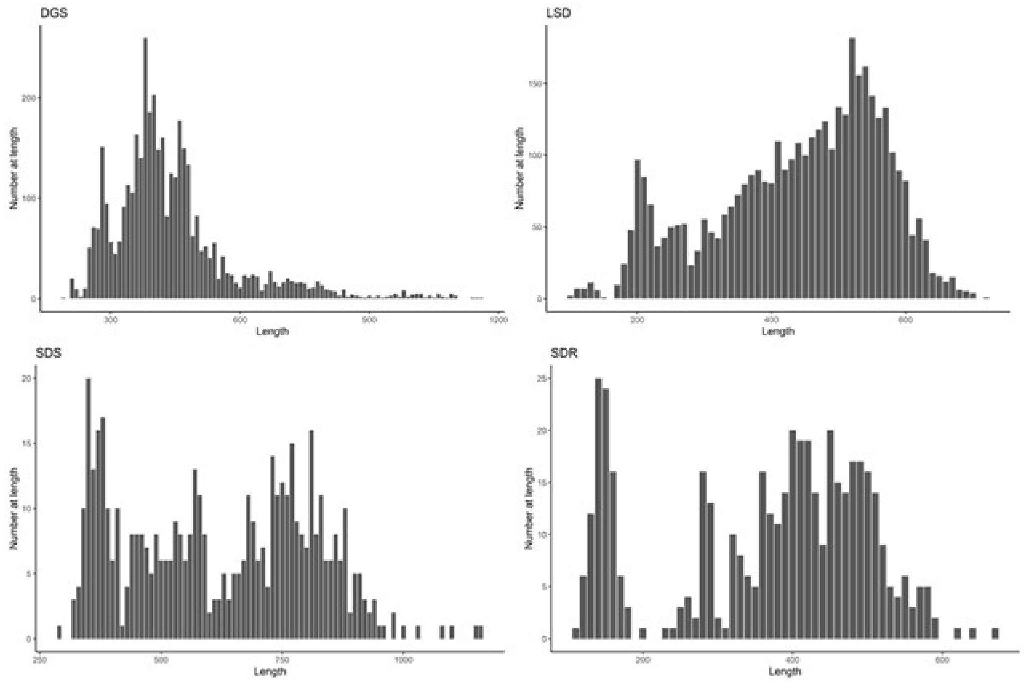


Figure 4.15. Aggregated length-frequency data for the more abundant elasmobranch species (DGS = spurdog; LSD = lesser-spotted dogfish; SDS = starry smooth-hound; SDR = spotted ray) observed in preliminary studies undertaken to the southwest of the British Isles.

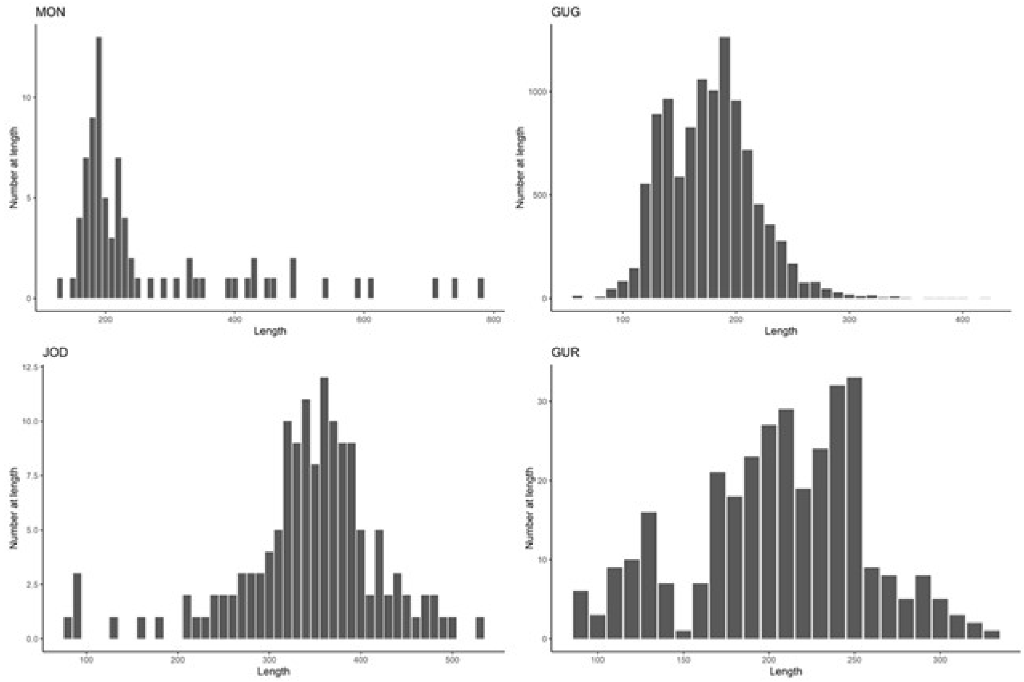


Figure 4.16. Aggregated length-frequency data for selected fish species (MON = anglerfish; GUG = grey gurnard; JOD = John dory; GUR = red gurnard) observed in preliminary studies undertaken to the southwest of the British Isles.

4.4 Future considerations for refining the gear design

Several aspects of the gear design were discussed during the 2023 meeting, as detailed below.

Flotation: IBTSWG noted that studies to date had shown the headline height to be higher than observed for the GOV at comparable depths. Given the experiences of recent work, there may be opportunities to reduce the current flotation (as shown in Figure **4.5**) slightly. There may also be consideration of increasing the weight of the groundgear (e.g., using steel washers).

Tension (e.g., for the headline): There was some discussion on the degree of tension to be used when rigging the trawl. The degree of tension when rigging trawls does appear to show at least in part some regional preference. However, the degree of tension that may be applied in a net store or quayside may be different to that can be applied at sea. Further information on the appropriate degree of tension should be developed.

Rigging of lower bridles for the clean groundgear: There was some concern over whether the clean groundgear needed to have as robust a rigging as the light rockhopper rig, in terms of the lower bridle diameter and the extension chain (see Figure **4.6**). In contrast, it was also highlighted that those vessels operating over different ground types may have efficiency savings in having the same rigging (thus reducing the likelihood of incorrect rigging, fewer rigging components being needed, and ease of swapping between trawls). Further discussions on this are required, including any considerations from upcoming trials.

Tearing strips / twines: There was discussion regarding the tearing strips and how these may impact on repairs for when experienced net menders may not be available. Further information on this was provided above (see Section 4.2). Similarly, with some reported difficulties in obtaining supplies of some twine types, a degree of acceptable tolerance for some twines may need to be developed.

Trawl doors: There was further discussion on trawl doors, and once again it was agreed that vessels should continue with their current doors. In those cases where an institute needs to replace doors, or vessel, then there could be due consideration of the type of trawl door to be used. The key focus going forward needs to be on standardizing, as much as possible, catchability across the IBTS surveys providing combined indices at least. In that respect sweep angle and ground contact are probably the simplest targets to aim for. If a particular vessel needs a greater scope ratio or a door adjustment to achieve that target geometry the fish probably won't care, but what happens from doors back to the centre of the footrope is what underpins survey data.

4.5 Other practical considerations

From a practical viewpoint, the following considerations were also highlighted:

Gear manual: There needs to be an appropriately detailed plan and maintenance manual to provide the most up-to-date information and specifications for joins and rigging etc.

Shallow water: Some surveys need to undertake survey hauls in relatively shallow water (the shallowest hauls are usually ca. 18-20 m deep), and so there is a need to also trial the gear in such depths to inform on net geometry and optimal warp:depth ratio.

Sourcing of materials: There were indications that the supplies of some netting materials were problematic at the moment. There may need to be a degree of flexibility in, for example, some of the twine sizes for certain sections.

4.6 Expected gear geometry

Whilst work is still ongoing regarding the optimal warp:depth ratio, other elements of the net geometry indicated that the proposed trawl should be able to give a headline height of 5.5–6.0 m and a door spread of ca. 75 m (70–80 m). The optimal sweep angles were considered to be 13–13.5 degrees.

4.7 Next steps

Given the encouraging results to date, IBTSWG considered that work on the proposed trawl should continue.

IBTSWG also stressed that a survey trawl is not simply a trawl to catch fish, rather it should be viewed as an important piece of scientific sampling equipment, thus requiring appropriate trialling and documentation.

The following topics were all considered to be highly relevant and studies on these are strongly encouraged.

- Updates of the trawl dynamics using the Dynamit software. It is hoped that as the trawl design becomes refined, that work using the Dynamit software can provide important information on the optimal net geometry.
- A scale mode of the proposed trawl could usefully be constructed, maintained, and made available for flume tank trials to provide important corroborating data on gear performance and net geometry.
- The IBTSWG was informed that IFREMER are planning some sea trials (in September 2023) to trial the trawl, including the monitoring of tension and water flow. IBTSWG welcomed this initiative.

- IBTSWG recognised the need for further trials, thus providing data for different vessels, ground types, water depths etc., and to enable the scientists and crews of those vessels to provide feedback (e.g., in relation to deployment and retrieval of the net, net geometry, minor modifications that could be considered, feedback on repairing the net).
- IBTSWG encouraged those nations conducting gear trials to offer places to appropriate staff from other institutes in order to share best practise and facilitate knowledge exchange.

IBTSWG also agreed to convene an intersessional meeting of IBTSWG (in September/October 2023) to examine current results and to initiate discussions with data users (including with experts on survey design and analysis) on appropriate and practical approaches to introducing the new trawl into the survey (see also ICES, 2019, 2022).

4.8 Variability of Net Geometry in Relation to Warp Length to Depth Ratio

A study was conducted in 2015 for the IBTSWG investigating the conformity of the recommended IBTS gear geometry limits within the North Sea IBTS. It revealed multiple tows during that survey year were out with vertical net opening and door spread boundaries and for some participants never maintaining recommended gear parameters. The Working Document (see Annex 7) built on the previous study, analysing data from the North Sea IBTS between from 2016 to 2023. Also considered were i) variations in the gear geometry across the sample depth range within and between participating nations to evaluate the standardisation of the data and ii) the variation in the warp length being deployed across the depth ranged sampled.

The study concluded there is considerable variation found in the net opening, door spread, and warp lengths deployed by some nations which participate in the North Sea IBTS. It also provided further evidence that some nations struggle to achieve the gear geometry limits recommended by IBTS. These results suggested there may be a lack of standardisation in the gear geometry and fishing methods employed within national North Sea surveys. The aim of this working document was to highlight the current issues faced and to open discussions on how this can be improved moving forward with the new survey gear currently being introduced.

4.9 References

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5 Survey design and data collection

5.1 Introduction

This section considers a range of topics related to the surveys, including any aspects relevant to survey design, any extra data collection conducted during the surveys, or analyses of data collected by IBTSWG-coordinated surveys.

5.2 Trawl times

5.2.1 North Sea surveys

Almost all countries have problems to maintain the standard tow duration of 30 min. Consequently, the average tow duration has declined continuously in recent years (see Section 2). Shorter tows of between 15 and 30 min are not uniformly distributed over the survey area and the reasons for the shorter tow durations may be due to a range of factors. In order to return to a more standardized conduction of the survey, IBTSWG may consider to:

• Revisit the material related to tow duration (comparison of 15 min and 30 min tow, results of zero-minute experimental tows, data on towing times outside the nominal tow duration) collected since 2015;

• Collect detailed information on a haul-by-haul basis for the reasons as to why tow durations were shorter than 30 min, such as:

- o Trawl track too short because of safety distance to cables, pipelines, offshore windfarms, other vessels etc.
- o Indication of unsuitable bottom conditions which could result in gear damage.
- o Strong signals on the echosounder for small pelagics or other fish (reducing over-sampling whilst ensuring representative sampling).
- o Minimising trawl duration in order to reduce the likelihood of excessive catches of elasmobranchs (or other species) based on previous years' experience.
- o Deteriorating weather conditions.
- o Concerns over changes in observed net parameters or catch weight, as indicated my marine electronics.

• Advise on whether a new standard tow duration shorter than 30 min, or a specified minimum towed distance, which can be achieved everywhere in the survey area under regular conditions.

5.2.2 Northern Irish Groundfish Survey

Historically the NI groundfish survey used survey transects of 3 nautical miles at 3 knots, i.e. approximately 1 hour tow duration.

After a comparison about species richness and the differences in indices in 2016 it was decided to reduce survey transects from 3 to 1 nautical mile. However, at that time AFBI decided to keep a number of stations (20 stations in Q1 from all strata) for the following few years to be able to do further analyses.

The same presentation from 2016 was presented to the IBTSWG again and it was decided that those analyses will be conducted in summer 2023. Following the successful outcome of this the tow durations for the NIGFS Q1 survey will be reduced to 1 nautical mile.

5.3 Stomach sampling

Pierre Cresson (IFREMER) provided an update on the collection of stomach sampling being overseen by the Intersessional subgroup (ISSG) for Stomach sampling, under the Regional Coordination Group for the North Atlantic, North Sea and Eastern Atlantic (RGC NaNSea).

The stomach sampling in 2022 focused on **whiting, megrim and anglerfish**, and relevant samples were collected by various participants in NS-IBTS-Q1 and NS-IBTS-Q3.

The provisional plan for 2023 was for **horse mackerel, plaice and skates and rays (including starry ray,** although the ISSG and RGC would be discussing options for modifying the sampling scheme). Various participating nations have tag and release programmes for skates and rays, which would impact on collection of stomach contents data. Further details of the sampling protocol were provided in ICES (2021) and RCG NA NS&EA RCG Baltic (2021).

IBTSWG was made aware that there was ongoing uncertainty as to the processing of the stomach samples that had already been collected. It was originally anticipated that certain institutes would process the samples, but more recently indicated that individual institutes would need to process the samples they collected. In relation to the latter, it was noted that not all nations would have the resource and/or appropriately trained staff to support the laboratory analyses, with some IBTS nations not eligible for EU funding. **Hence, clarification on the resource for processing and analysing stomach samples is still required.**

It was noted that freezer space in some institutes is limited, and samples collected from recent North Sea surveys have not been processed yet. Furthermore, in terms of the extra work for sea-going staff, and potential for 'disengagement', IBTSWG could not commit to coordinating further sample collection until resources for processing the stomachs were identified.

IBTSWG recommend that stomach sampling be suspended for the short term, at least until there is more information on resource available for processing the stomachs contents. If funding is not available in the short-term, then the Intersessional subgroup (ISSG) for Stomach sampling should provide an indication of how long the samples being held frozen are viable for.

Whilst it might be possible for some nations to process stomach samples at sea (depending on the skills and number of scientists onboard), this would likely necessitate other approaches to diet quantification (e.g., fullness/points or volumetric methods) rather than weight-based data. Whilst such data could be collected at sea, such data would not be fully compatible for the models requiring contemporary dietary data (e.g., the Stochastic Multi Species model (SMS) used by WGSAM), and so would be of a lower priority in terms of data needs. It would also potentially mean some prey items being identified to higher taxonomic levels (e.g., genus or family) for some prey groups.

For example, in terms of some of the Spanish trawl surveys, fish stomach contents are analysed with a volumetric method, which, although not as accurate as gravimetric methods, allows for more stomachs to be analysed. Diet data are useful to analyse consumer-resource interactions among organisms and therefore for studying the functioning of marine networks. These data are also useful for calculating the trophic level of species and performing predator-prey matrices that inform ecosystem models. Stomach contents are used in MSFD D4 assessments and can potentially help support EBM (e.g., stock assessment, GES of food webs).

5.4 Anchovy and temporal changes in southerly fish species

Denmark observed a substantial increase in catch rates of anchovy from 1.1 ind.h^{-1} in 1Q 2021 (mean bottom temperature 5.42°C) to 38.3 ind.h^{-1} in 1Q 2023 (mean bottom temperature 7.24°C) covering the same area in the North Sea. The increase of catch rates was less pronounced in the international data, but still considerable amounting 40.1 ind.h^{-1} in 1Q 2021 and 57.7 ind.h^{-1} in 1Q 2023 and this increase was seen almost in all parts of the surveyed area (Figure 5.1).

The recently observed levels of abundance were much higher than reported in the literature for earlier time periods (Heessen et al., 2015). Similar changes have been anecdotally reported for other southern species, such as sardine and striped red mullet which warrants further studies and IBTSWG agreed to initiate this work.

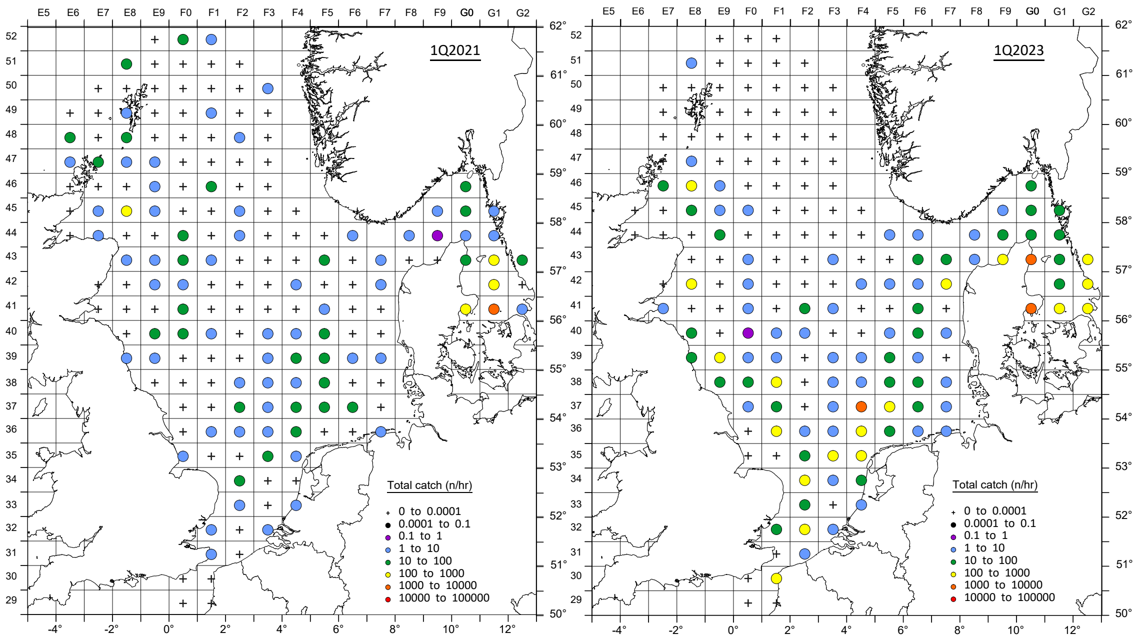

Figure 5.1. Distribution of anchovy in North Sea IBTS in 1Q 2021 and in 1Q 2023.

5.5 Fish parasites

There has been an increase in fish parasites in recent years, given that high parasite loads may impact on fish health and condition, and also in that the parasite fauna of fish can be used in the interpretation of stock units.

5.5.1 North Sea cod infestation with liver worms

Considering earlier findings for Baltic cod that infestation with liver worms had a negative effect on cod condition and may thus have contributed to the deterioration of the Central Baltic cod stock (Ryberg et al., 2021), IBTSWG agreed to conduct a pilot study for North Sea cod in 3Q 2021. Additional sampling was carried out in 1Q 2022 and in 1Q 2023 and all countries collected information on cod liver worms.

The same liver infestation category scale as used in the Baltic Sea study, and described by Ryberg et al. (2021), was used, as well as individual fish length, weight and, for some participants, liver weight as well (see Annex 4). The data from all participants in the NS-IBTS were sent to the survey coordinator for analysis prior to the IBTSWG 2023 meeting.

In total, 3 064 cod ≥25 cm length were examined from the three surveys, with liver weight recorded for 2 468 individuals. In addition, Denmark collected some liver samples for identification of the parasitic worms.

The spatial distribution of prevalence expressed as mean liver category (weighted by the number of observations) by Rectangle indicated that the infestation is widely distributed across the North Sea, with highest values in the northern and north-eastern part of the North Sea around the Orkney and Shetland islands (Figure 5.2). However, average infestation was low to moderate (categories 1 to 2).

Liver categories >1 occurred first at cod lengths larger than about 30 cm, and almost all cod >90 cm were infected. The parasite load had a significant effect on individual fish condition (Figure 5.3), Here, it appears that smaller fish had a higher infection density that larger individuals although the latter carried a higher amount of liver worms (Figure 5.4). However, simple box plots did not indicate a negative effect on condition at a population level (Figure 5.5).

However, future analyses should consider an effect of size implicitly together with a spatial segregation e.g., using the current borders for the presumed North Sea cod subpopulations (Northwestern, Viking 4.a, Skagerrak, and Southern).

Participants in the North Sea 3Q 2023 agreed to continue with data and sample collection, and a detailed analysis is planned thereafter.

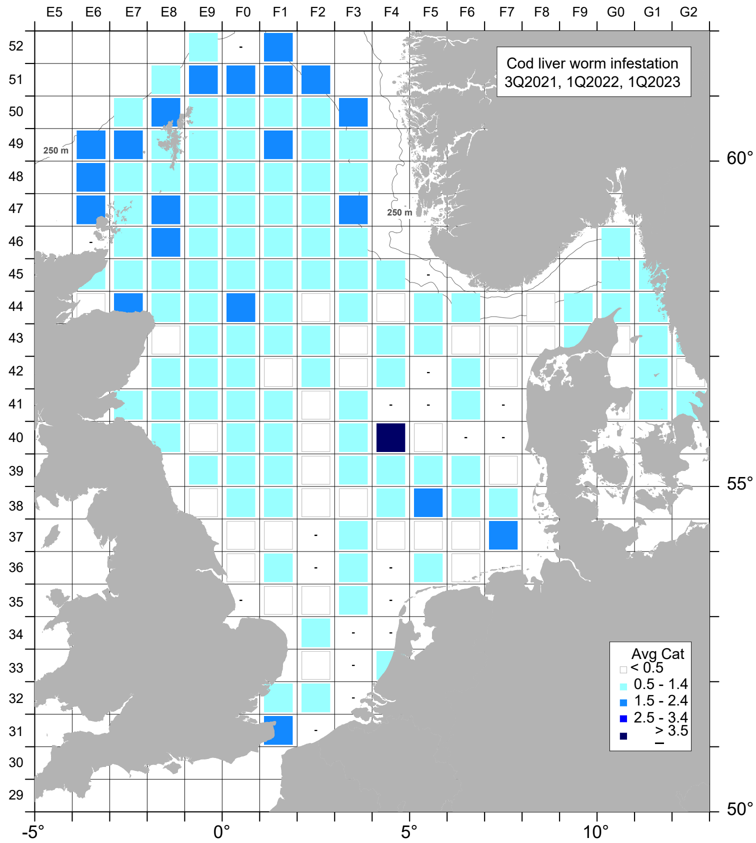

Figure 5.2. North Sea cod liver worms. Spatial distribution of cod liver worm prevalence (for cod ≥25 cm, -: no information or no cod ≥25 cm caught; Note: in 40F4 just one fish (in category 4)).

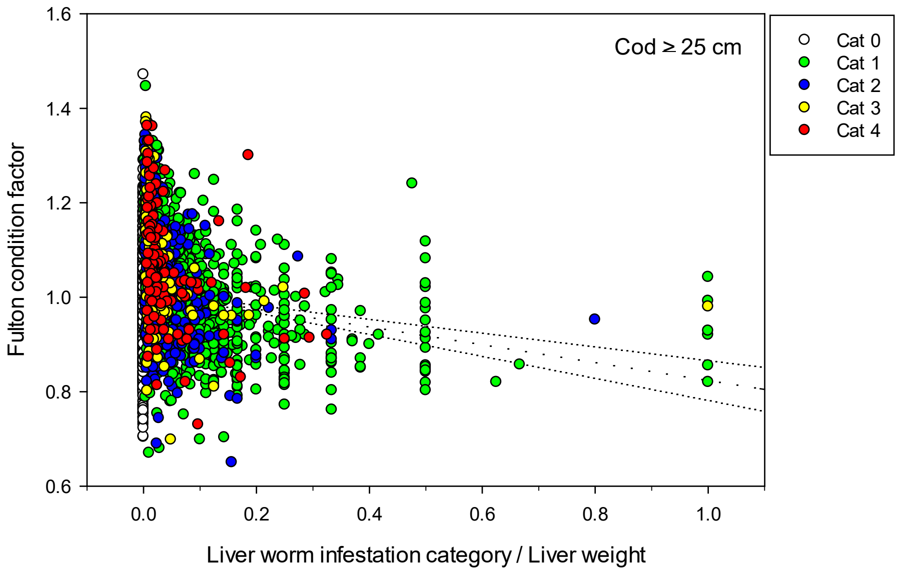

Figure 5.3. North Sea cod liver worms. Infection density effect on individual condition (Linear regression: r2 = 0.028, P < 0.001, slope significant).

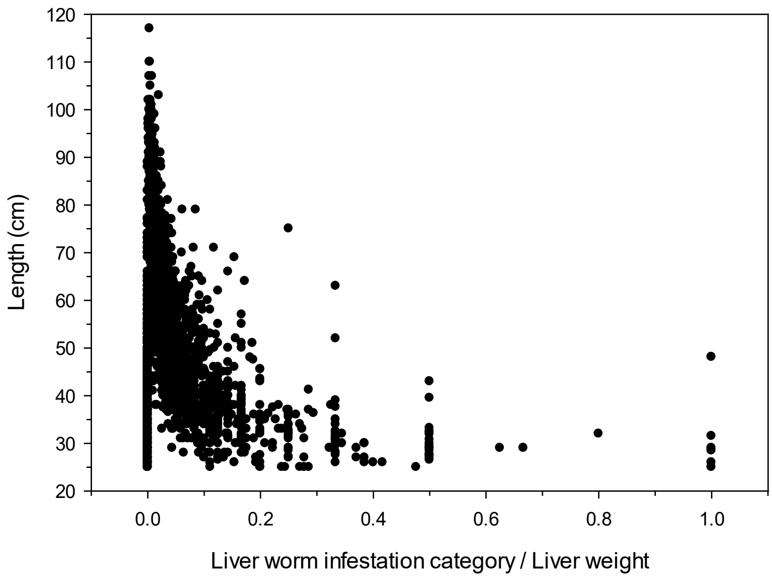

Figure 5.4. North Sea cod liver worms. Infection density in relation to length.

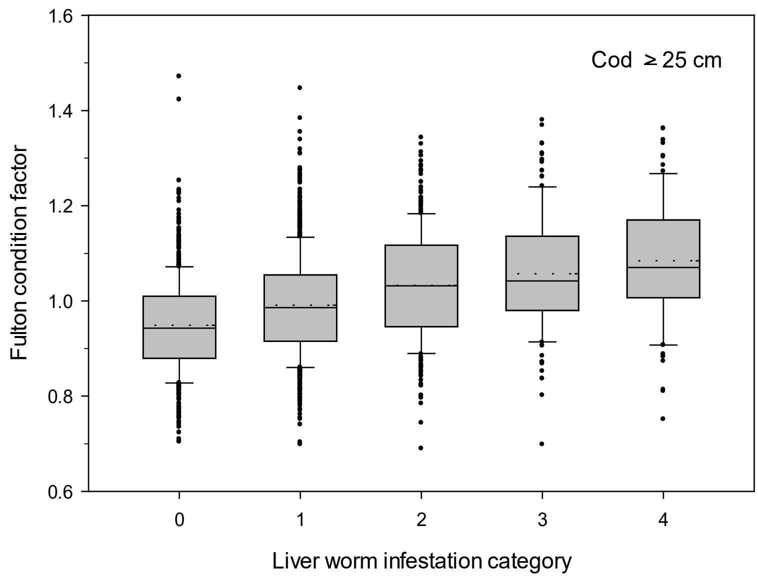

Figure 5.5. North Sea cod liver worms. Liver worm infestation category and average condition (all surveys pooled).

5.5.2 Haddock gill parasites

In the IBTSWG 2020 report (ICES, 2020) remarks were made on the poor condition observed in some of the haddock observed in the North Sea Q1 survey. Especially, the length range 35–40 cm in the area fished by Denmark and the Netherlands were considered in very poor conditions. These remarks resulted in a quick analysis of the Fulton's condition based on the information in the Datras CA-records of the 2020 survey showing a distinct spatial distribution in the condition factor. With the conditions in the northern area being better than in the south.

It was then proposed to collect additional data on length/weight (e.g., condition) and on a potential cause for the lower condition, being the gill parasite *Lernaeocera branchialis* which seemed associated with the fish being in poor condition. It was a simple research idea made up during the meeting without further evaluation or financial backing. This resulted in a simple guideline for collecting this additional data, and voluntary participation. As a result, data were collected slightly differently and not on all surveys consistently, or for all hauls where haddock was found. For some this additional sampling was difficult to implement in their regular sampling and registration scheme.

Despite that in 2021 four countries were able to provide additional data resulting in more than 12k haddock sampled individually and inspected for the presence of gill parasites. The continuation of the sampling in 2022 was hampered by the very bad weather conditions and mechanical issues. In the end it resulted in three countries sampling slightly more than 2 000 haddock. In the 2023 sampling was continued with six countries sampling more than 12 000 haddock (Table 5.1). In all the three years the spatial difference in condition is observed (Figure 5.6). At first glance a similar distribution in the occurrence of gill parasites is observed, but with a higher percentage of the caught haddock having gill parasites (Figure 5.7).

Despite the observed poor conditions in 2020, there have been very good year classes that survived to adult ages, which has resulted in a large increase in abundance of haddock since 2020. The presence of the gill parasite seems to have limited effect on the population size.

Table 5.1. Numbers of haddock examined for condition factor and presence of the gill parasite *Lernaeocera branchialis.*

Year	GFR	DEN	SCO	NL	NO	SWE	Total
2021	2525	407	74	3349	6390		12745
2022		187	301	1750			2238
2023	1009	794	1841	2478	5749	560	12431

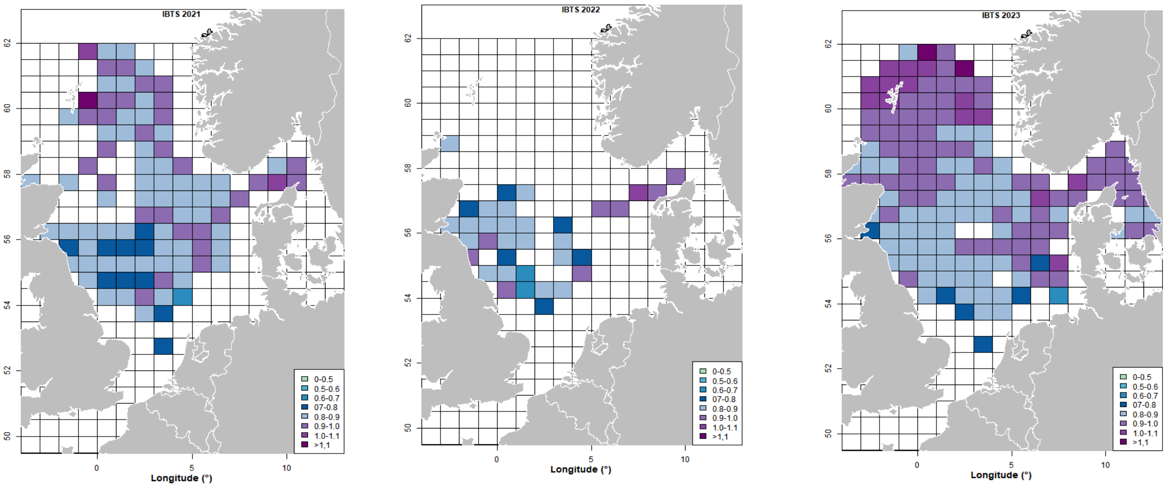

Figure 5.6. Fulton's k condition of all the haddock weighed and measured individually.

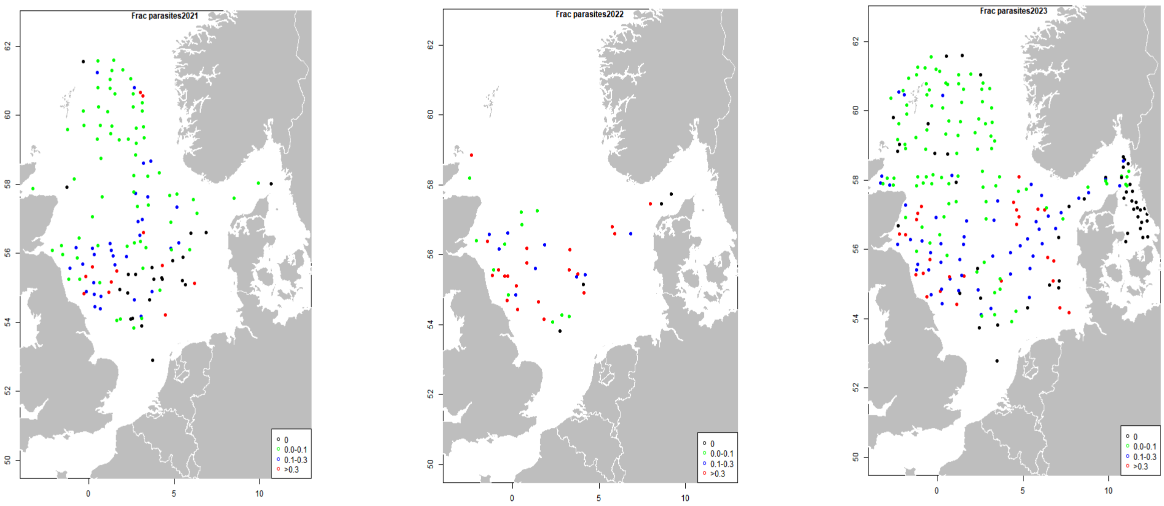

Figure 5.7. Percentage of haddock with gill parasites by haul.

5.5.3 Mackerel parasites

Lucilla Giulietti and Julia Storesund (IMR Bergen, Norway) provided an update on the sampling of mackerel parasites, which made use of samples collected during IBTSWG-coordinated surveys.

Kudoa thyrsites is a myxozoan parasite which causes soft flesh condition in Atlantic mackerel. Its prevalence in mackerel has increased in commercial landings in Norway in the last two-three years. *Ichthyophonus* spp. are cosmopolitan parasites causing proliferative, systemic disease in several commercially important species. A high prevalence of *Ichthyophonus* infections in Atlantic mackerel has been observed recently, however, mode of infection and how detrimental it is to host health is still unknown.

The aim of this ongoing study is to investigate the geographic distribution and epidemiology of *K. thyrsites* and *Ichthyophonus* spp. in the Northeast Atlantic Ocean and, in particular, to analyse small mackerel (first infected) from different geographic locations and the occurrence of *K. thyrsites* parasites in the benthic community (annelids).

Juvenile mackerel (individuals <300 g) were collected from different area in Northeast Atlantic Ocean (Figure 5.8) by nine participants of IBTSWG. Samples were frozen right after catch and supplied to IMR scientists for parasitological examination.

Further samples would be beneficial, including for areas where samples were not available from in the 2022 sample collection, such as the southern/central North Sea.

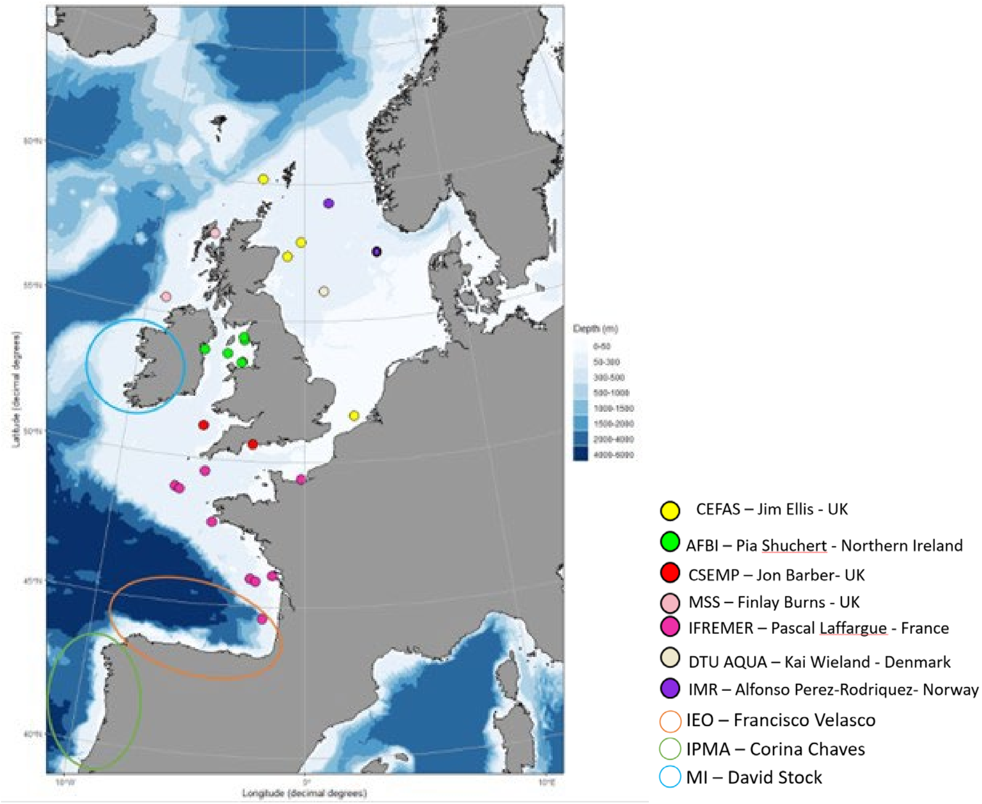

Figure 5.8. Map showing stations from which samples of juvenile mackerel were collected in 2022. Approx 25 specimens were collected from each station.

5.6 A pilot survey on the feasibility of establishing a sprat recruitment index based on larval sampling during Q3 IBTS surveys

Sprat is a short-lived species, and the sprat stock in the North Sea is dominated by young fish. Thus, the size of the stock is to a large degree driven by the recruiting year class, and catches are mainly composed of 1-year old fish (up to 80%).

Sprat is also an important forage fish and represents a major food source for many other fish species as well as sea birds and marine mammals. It is therefore a highly relevant species in multispecies and ecosystem approaches to fisheries management.

An analytical assessment for sprat was established some years ago, however the availability and quality of data for the assessment are relatively poor, and the assessment of and advice for the North Sea sprat stock needs to be improved. There is presently no information available on young-of-the-year (0-group) sprat for possible use in short-term forecasts, or for use in the stock assessment model. However, such information could potentially be very useful, particularly as sprat is a short-lived species that matures early.

The aim of the present study is, by conducting a series of pilot surveys, to evaluate the feasibility of establishing a sprat recruitment index based on larval sampling conducted during night-time on the Q3 IBTS surveys and to contribute generally to a better understanding of the biology, ecology, and distribution of the North Sea sprat stock. Thus, the basic idea is to follow similar procedures as the MIK herring larvae surveys during the Q1 IBTS. These surveys are targeting relatively large larvae (2 to 3 cm) and the abundance of these has shown to relate to later recruitment to the stock, thus providing a recruitment index for autumn spawning herring in the North Sea.

So far, a total of five pilot surveys have been conducted in July/August 2018, 2019, and 2020 and in August/September 2021 and 2022, targeting sprat larvae with a MIK net. The surveys were conducted by DTU Aqua, Denmark, in 2018 and 2019 in the framework of the project "BEBRIS - Maintaining a sustainable sprat fishery in the North Sea" and in 2020 and 2021 in the follow-up project "PELA – Pelagic species". Sampling was conducted during nighttime on the Q3 IBTS. Furthermore, the Thünen Institute of Sea Fisheries in Bremerhaven, Germany contributed to the sampling in 2020 and 2021.

During the first four years, it became clear that a number of prerequisites for establishing a recruitment index were fulfilled, including that sprat larvae are present in the survey area at the time of the survey and can be caught representatively, spawning activity of sprat is finished before the time of the survey and the MIK sampling can effectively be incorporated into the standard routines of the Q3 IBTS. However, catchability tests between daylight and nighttime have shown that sprat larvae are only caught representatively at night, which is limiting the available time for sampling to approximately 7-8 hours per night. Furthermore, while the main distribution area of sprat larvae seems to be covered by the Danish Q3 IBTS, a better spatial coverage would be desirable. Based on the promising preliminary results from these first four years, DTU Aqua decided to continue the pilot survey in 2022.

Table 5.2 provides an overview of the sampled stations in the first five years of pilot surveys. Overall, 71 and 66 valid standard hauls (plus several additional hauls for gear tests etc.) were conducted in 2018 and 2019, respectively. In 2020, a total of 128 hauls was conducted (68 by Denmark and 60 by Germany). In 2021, a total of 89 hauls was conducted on a joint Danish-German survey. In 2022, a total of 63 hauls was conducted by Denmark. Figure 5.9 shows the distribution of the MIK sampling stations during the 2022 Q3 IBTS. In addition, Marine Scotland Science also conducted MIK sampling during their Q3 IBTS in 2021 on 51 stations.

The gear in use during the pilot surveys is a MIK net with a ring of 2 m diameter and a mesh size of 1.6 mm. In addition, a small MIKeyM net (20 cm Ø, 500 µm mesh size) was attached to the MIK ring on the Danish surveys in 2018-2020 and 2022. This was done to test if there were still eggs and/or very small larvae in the area during the time of the Q3 IBTS surveys, which would indicate that the seasonal spawning activity has not finished yet. The gear was equipped with a depth sensor and was deployed in a double-oblique haul from the surface to 5 m above the seafloor (measured from the lower end of the MIK ring). Fishing speed was 3 knots through the water, and the wire was paid out at a speed of 25 meters per minute (= 0.4 m s^{-1}) and retrieved at 15 meters per minute (= 0.25 m s^{-1}). Both the MIK and the MIKeyM were equipped with flow meters to record the volume of filtered water.

With very few exceptions, clupeid larvae were found on all sampling stations in the five years investigated, and abundances were generally relatively high, with many stations yielding several hundred larvae. However, in all years the clupeid larvae not only contained sprat but also sardine larvae in high abundances. A similar, recurring pattern in the spatial distribution of sprat and sardine larvae could be observed in all five years, with sprat larvae mainly occurring in the northern part of the study area and sardine larvae most abundant in the south. This shows that careful identification procedures to species level are required. Catches of sprat larvae in 2022 were the lowest in the five years investigated so far. The MIKeyM samples did not suggest any catches of sprat eggs, indicating that sprat spawning activity had finished and larvae had hatched well before the time of the surveys.

The larvae had a broad size range from approx. 6 mm to juvenile fish of 4-5 cm with very similar size frequency distributions for both sprat and sardine. The majority of larvae were in the 12-20 mm size range.

Recruitment estimates from the stock assessment are available for the year-classes corresponding to the first four years of the pilot survey (2018-2021). The first 3 years indicated similar trends in larval abundance and recruitment, while the last year did not fit so well. However, the recruitment estimate for the last year (2021) is so far only based on age 1 sprat catches from the Q1 IBTS and is therefore still very preliminary. Besides, the catches of these age 1 sprat of the 2021 year-class may be underestimated due to the extremely bad weather conditions and other severe difficulties during the 2022 Q1 IBTS.

Thus, it still requires more reliable recruitment estimates, further analyses, and a longer time-series to make a final judgement as to whether the larval survey can provide an early recruitment index. Nevertheless, the first four years of pilot surveys illustrate that this kind of larval survey during nighttime of the Q3 IBTS has the potential to provide larval abundance estimates, and potentially a recruitment index, for North Sea sprat. However, additional surveys will be necessary to provide further yearly observations and more data for the modelling of recruitment patterns.

It is noteworthy that in addition to sprat and sardine, a number of larvae of other fish species were caught in the MIK. The more abundant species were mackerel, horse mackerel, sandeel, gurnards, lemon sole, scaldfish and other flatfishes, as well as several non-commercial species (e.g., gobies, crystal goby, rocklings, pipefish, dragonets, and greater weever). In addition, a limited number of larger gadoid larvae and/or pelagic juveniles were caught. With regards mackerel larvae, there was a tendency of higher catches in the northern part of the sampling area, whereas horse mackerel dominated in the southern part. In the 2022 survey, mackerel larvae were caught in the northeastern part of the survey area, whereas larger mackerel juveniles (approximately 4-6 cm) were caught in the northwestern area. It could be interesting to investigate further if these juveniles originate from mackerel spawning in the North Sea, or if they were drifted in from the Atlantic.

No dedicated funding is presently available to investigate these other species in detail. However, numbers of larvae of other species from the 2018 and 2019 surveys and partly from the 2020 survey were analyzed in the framework of student theses.

Based on the promising results from the first five years, DTU Aqua is planning to continue the pilot surveys in 2023. However, a better area coverage than obtainable by the Danish survey with RV Dana alone would be advisable, and other nations participating in the Q3 IBTS are encouraged to contribute to these pilot surveys.

Table 5.2. Overview of MIK sampling stations conducted during the Q3 IBTS. Data from 2021 from a joint Danish-German survey

Year	Denmark	Germany	Total
2018	71	-	71
2019	66	-	66
2020	68	60	128
2021	89		89
2022	63	-	63

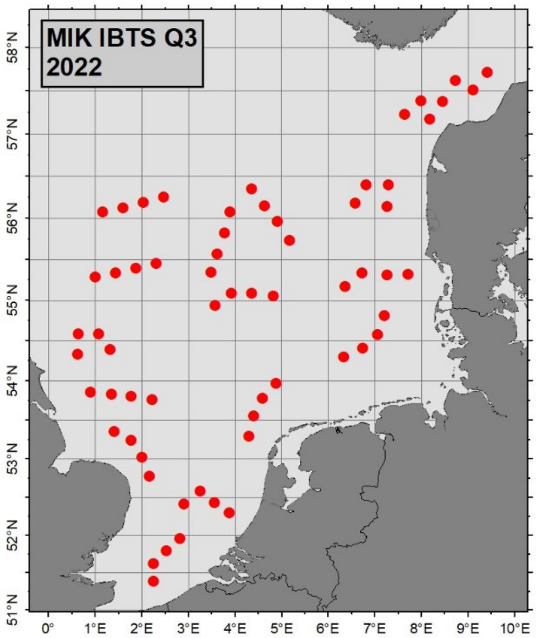

Figure 5.9. MIK sampling stations during the Q3 IBTS in 2022.

5.7 Fish tagging

Various institutes involved in IBTSWG-coordinated surveys use national trawl surveys as opportunistic platforms for conventional, mark-identifications tagging of selected fish species (See Annexes 4-6). To date, much of this work has focused on elasmobranchs, but with some tagging of other fish species (e.g., flatfish). Whilst opportunistic in nature, the data collected from such studies could, over the longer-term, help provide important information in relation to growth, longevity, movements, and stock identification. IBTSWG also recognised that there was increasing consideration of stock delineation in some recent benchmark assessments.

An improved synthesis of current tagging programmes is required and further discussions on this topic are required. Details for a proposed workshop on tagging were presented to the group.

5.8 Benthos

Observations of the benthic organisms caught in the survey trawls are carried out on numerous IBTS-coordinated surveys. These series of data are of interest because of their sampling with similar gear and the relatively wide geographical coverage.

The scientific interest is real and there are already many uses for such data: new or displaced species, modelling of ecological niches, distribution of faunal assemblages and communities, study of trophic networks, characterisation of ecological processes by functional approaches, development of indicators and particularly to estimate the impact of bottom trawling etc. (Figure 5.10).

They are already (potential) used within the ICES community by a significant number of groups (e.g., Benthos Ecology Working Group (BEWG), Working Group on Biodiversity Science (WGBIODIV) and Working Group on Ecosystem Effects of Fishing Activities (WGECO).

Currently, there are calls to share these data with the Working Group on Fisheries Benthic Impact and Trade-offs (WGFBIT; all epi-benthic species) and the Working Group on Vulnerable Marine Ecosystem (WGVME; specifically for seapens such as *Pennatula*).

These data, however, are not always available on DATRAS or described in a satisfactory manner. It would be interesting to summarize the observations made for all the IBTS surveys, including the temporal coverage and to propose an annual evaluation of the quality of these data (standard protocol, complete or partial observation, skills on board ....). The question of systematically loading these data, or subsets of these data (e.g., the more robust, quality-assured data), also requires future discussions.

The group's discussion shows an interest and often long-lasting observation on a good number of surveys. In addition to the immediate needs presented, certain phenomena such as the abundance of bryozoans in the North Sea could be monitored thanks to these data. Regarding VMEs, some species deserve to be added to the list of interest (e.g., *Virgularia sp.*). In general, a better exchange concerning the protocols or the identification guides would allow a better harmonization of these data and can be envisaged within the IBTS group.

In addition, the group discussions highlighted a number of problems concerning observation or the quality of the data collected. On some ships or some areas, the addition of benthos observation is not possible, in particular due to an insufficient number of possible staff or lack of suitably qualified staff. The on-board expertise for the identification of benthos is sometimes lacking and strong year-to-year variations can occur.

Recurring protocol issues can lead to lower quality data. This is particularly the case when it is not possible to control what is left on the deck of the contents of the trawl. It was also mentioned that the attachment of a certain number of organisms to the net can also lead to an underestimation of their quantity or a risk of finding these individuals at the next sampling station.

Among the follow-up to be given, the organization of a benthos session at the 2024 meeting of IBTSWG was proposed. This will include preparing a table summarizing the observations and their quality by survey. Regarding current benthic data demands, specific requests to the IBTS group will be directly made "intersessionally" to the whole group to find out what data are available and what are the possibilities for sharing within the framework of activities specific to the WGFBIT and WGVME groups.

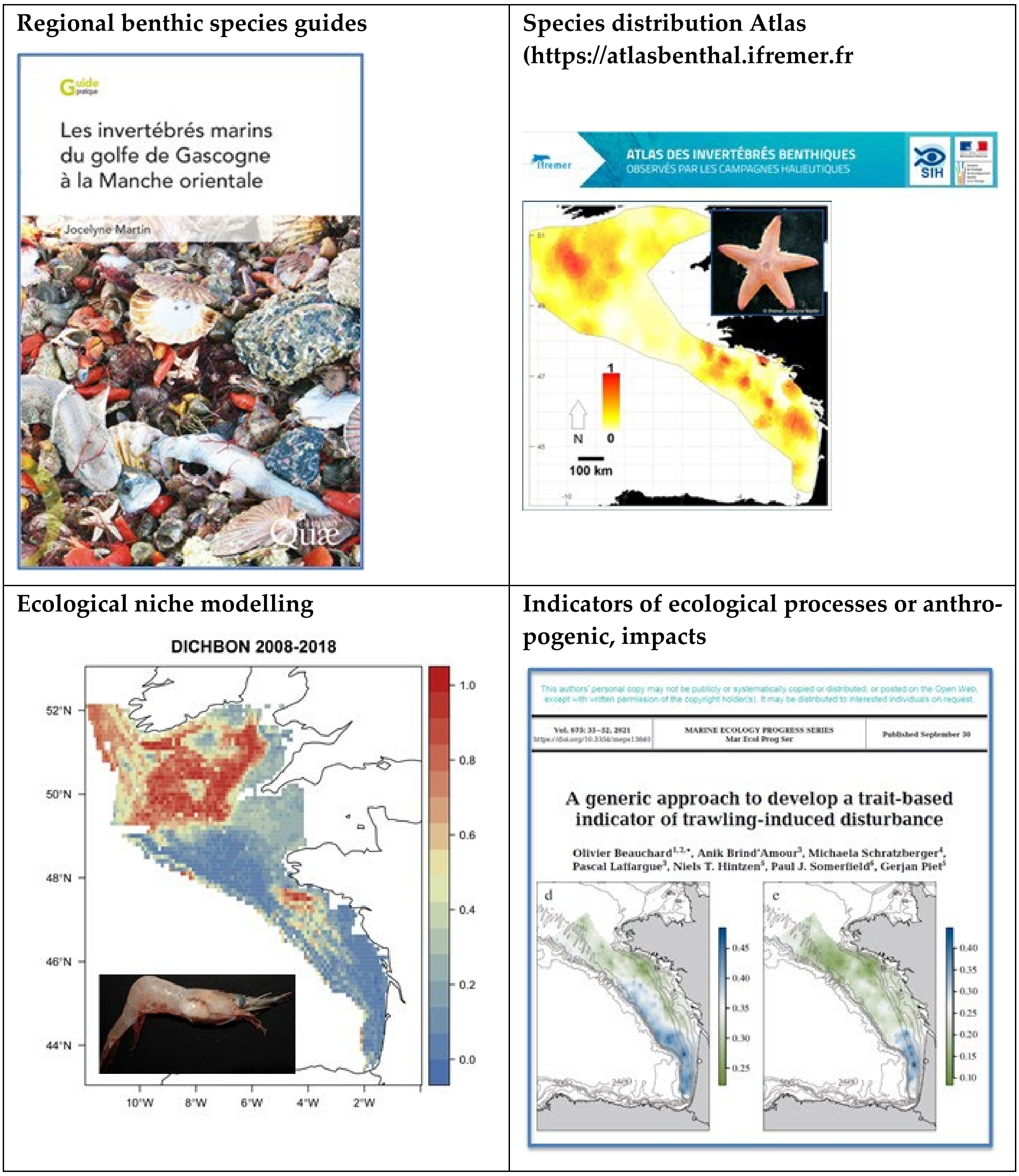

Figure 5.10. Examples of the types of scientific applications resulting from the collection of benthic data from IBTS surveys.

5.9 Recent analyses of cod

Work presented by Jonathan Ellis on the distribution of cod in the North-East Atlantic region using DATRAS data from IBTS surveys revealed a slight shift of cod in Division 6.a towards the north-eastern part of the Division over the recent past (five years), while densities and distributions in the Irish and Celtic Seas have been constant (Figure 5.11). Distribution shifts can be associated with declining abundances or shifts in migration, possibly related to environmental impacts. Looking into the centre of gravity distribution (Figure 5.12), there has been a north-easterly shift in the waters off north-western Scotland, a slight south-westerly shift in the Irish Sea, while no clear shifts were detected in the Celtic Sea. However, there was a lack of sea temperature in the available data, which might improve the analysis.

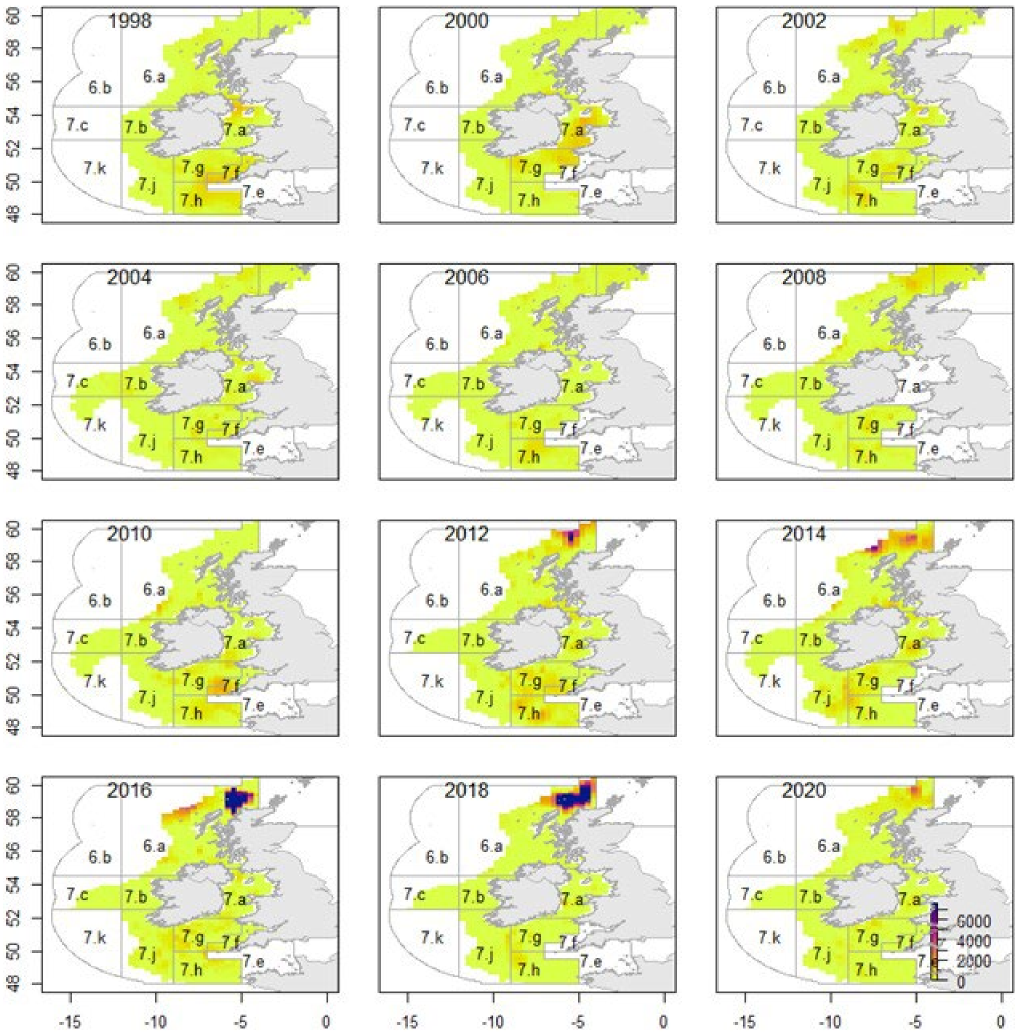

Figure 5.11. Maps showing the interpolated density (kg/nm2) in 3-year intervals from 1997–2021 in Quarter 4. The colour scale ranges from 0 kg/nm2 to over 5930 kg/nm2.

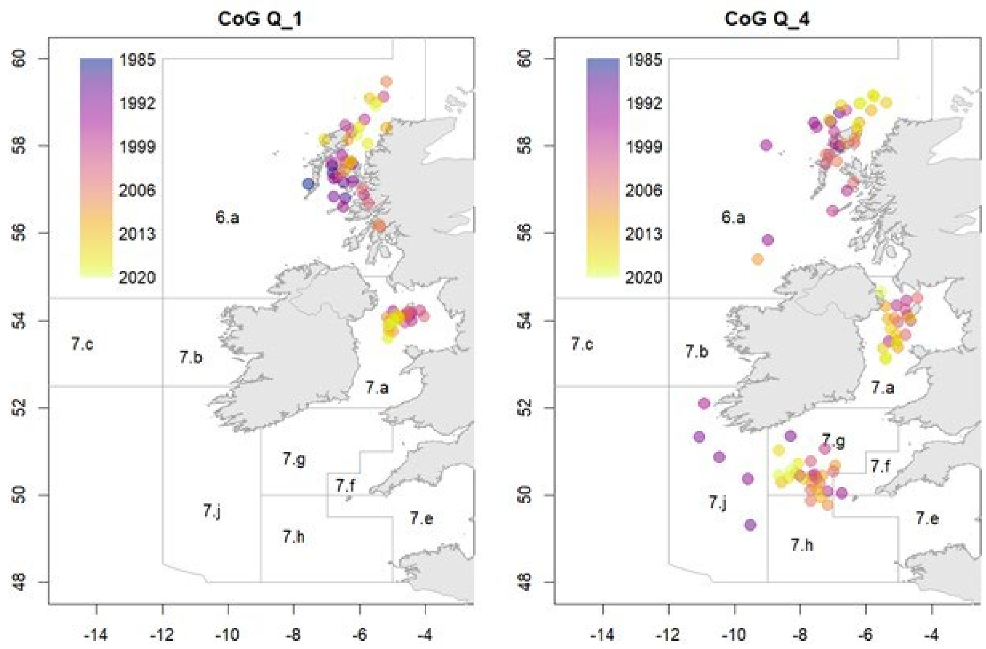

Figure 5.12. Centre of gravity of cod across years in Q1 (left) and Q4 (right).

5.10 Preliminary evaluation of the maximum fishing depth in NS-IBTS

The North Sea International Bottom Trawls Survey (NS-IBTS) has set a maximum fishing depth of 250 m for standard stations (ICES, 2020). However, concerns have been raised about the adequacy of this depth limit, and in the light of climate change, whether it will make it more difficult to monitor changes in the distribution of some target species.

To address this, data from the NS-IBTS were compared to data from the Norwegian bottom trawl survey for northern shrimp (NSS) in the Skagerrak and Norwegian deep (Søvik, 2020). The two surveys overlap in the 100–250 m depth stratum, covering the central parts of the Skagerrak and northeastern North Sea, but are spatially separated otherwise. The NSS cover the deeper parts of the Skagerrak and the Norwegian Deep, whereas the NS-IBTS extends to shallower waters towards the south and west (Figure 5.13, left panel).

In the exploratory analyses, we focused on depths below 100 m in the Skagerrak during the period from 2006 to 2020. NSS was filtered using the ICES statistical rectangles covered by the NS-IBTS, reducing the number of NSS hauls from 742 to 465. Sub-setting daytime hauls further reduced the dataset to 152 hauls. Hauls were assigned to three strata, 100–250 m, 250–350 m, and deeper than 350 m. The average number of available hauls in the different strata were 7.1, 2.6, and 1.9 hauls, respectively. During the same period, NS-IBTS Q1 made on average nine hauls per year in the 100–250 m depth stratum (Figure 5.13; right panel).

The NSS uses a different survey gear than the NS-IBST, a Campelen 1800 trawl with 14-inch rockhopper groundgear. The codend mesh size is 20 mm with a 10 mm inner lining. Strapping has been used since 2008 to maintain consistent gear geometry, with a targeted door spread of 48–52 m regardless of depth. Given a towing speed of 3 knots and a trawl duration of 30 minutes, the swept door area is approximately 0.14 km^2, which is notably smaller than a standard tow in NS-IBTS. For a comparison of haul information, see Table 5.3.

The average length distribution was estimated by pooling individuals from all hauls within a survey, stratum, and year and dividing by the number of hauls. These yearly estimates were used as input data for comparing length distributions between surveys using the R package fish-methods (Nelson, 2019). The average length distribution by survey and stratum over all years is presented in Figure 5.14.

The results show that NS-IBTS and NSS captured similar length distributions of cod in the Skag-errak (*mean lengths = 36.9 cm and 35.7 cm, respectively, DS = 0.096, p = 0.45*), but NS-IBTS caught on average almost seven times as many individuals per haul as the NSS (46.3 vs. 6.7, uncorrected for swept area). At depths below 250 m, the NSS caught on average 2.4 individuals per haul, representing 35% of the catch rate in 100–250 m depth stratum.

The length distributions of haddock were not significantly different between surveys (*mean lengths = 23.6 cm and 25.7 cm, respectively, DS = 0.117, p = 0.39),* although the NS-IBTS caught ap-proximately twice as many individuals per haul of smaller (<27 cm) haddock, whereas NSS caught relatively more of the larger (>27cm) haddock. The NSS also caught a fair quantity of haddock below the maximum fishing depth of NS-IBTS.

Whiting was caught mainly in the 100–250 m depth stratum. The length distribution between surveys were significantly different, with more smaller individuals in the NS-IBTS than in the NSS (*mean lengths = 22.6 cm and 26.3 cm, respectively, DS = 0.246, p = 0.03)*.

The catch per haul of saithe was low in both NS-IBTS and NSS (5.4 and 9.7 individuals per haul, respectively), but it was nevertheless evident that a significant part of the population occurred below the maximum fishing depth of the NS-IBTS. Interestingly, for saithe, NS-IBTS seemed to miss the smaller individuals, which NSS caught in the >350 m depth stratum. However, no sig-nificant differences in the length distributions was observed between the surveys (*mean lengths = 48.8 cm and 44.9 cm, for NS-IBTS and NSS respectively, DS = 0.125, p = 0.93)*.

The observation that the target species, cod, haddock, and especially saithe, are caught fre-quently below the current maximum fishing depth of the NS-IBTS merits further investigation. To begin with, a thorough comparison of NS-IBTS and NSS data should be carried out, including both the Skagerrak and the northeastern part of the North Sea. Inclusion of NSS night hauls would significantly extend the data available for analyses and should be evaluated. Analyses could also be carried out on the older part of the time series, although the seasonal overlap be-tween the surveys is not as close. Furthermore, the effect of any change in maximum fishing depth on survey indices would need to be assessed. It would also be valuable to collect overlap-ping data at depths below 250 m but, given the added cost and vessel time needed for additional hauls, this should await the results from the analyses and evaluations suggested above.

Table 5.3. Total number of hauls (N), and haul information by strata and survey used in the analyses, averaged over the period 2006 to 2020.

Survey	Depth stratum (m)	N	Mean depth (m)	Mean haul duration (min)	Mean door spread (m)	Mean dis-tance (nm)	Swept area (doors; km^2)	Mean headline height (m)
NS-IBTS	100–250	126	150.4	29.8	113.8	1.85	0.39	3.98
NSS	100–250	100	186.4	29.2	50.1	1.43	0.13	4.14
	250–350	31	285.2	29.9	50.6	1.47	0.14	4.10
	350–550	21	438.2	28.7	49.5	1.37	0.13	3.82

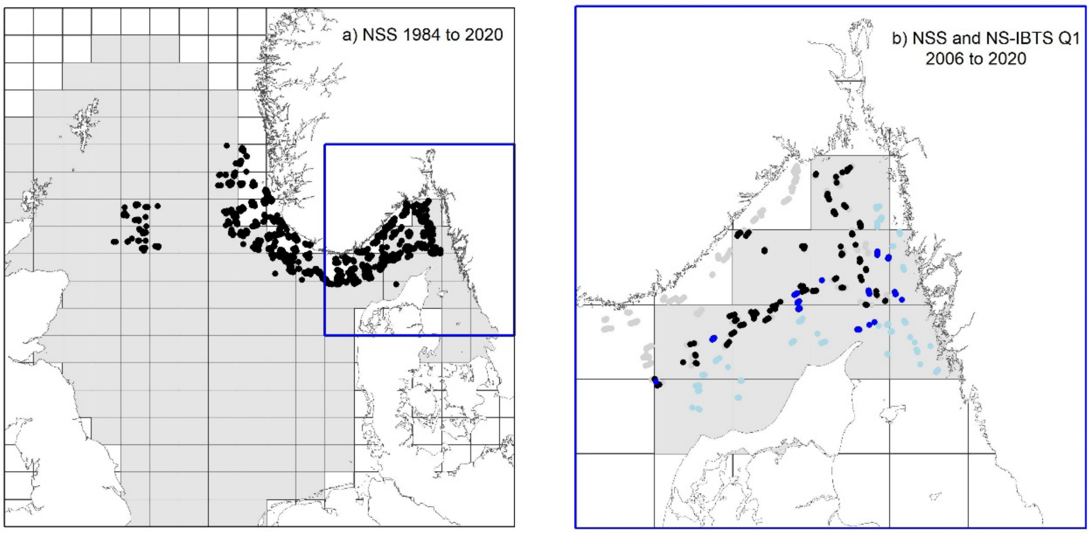

Figure 5.13: The distribution of survey data available for analysis in the Norwegian shrimp survey (points) from 1984 to 2020 and corresponding ICES Rectangles (shaded grey) sampled during the NS-IBTS (left). The corresponding data from the NSS and NS-IBTS Q1 Skagerrak data from 2006 to 2020 are shown (right), with black and dark blue points in the 100–250 m depth stratum.

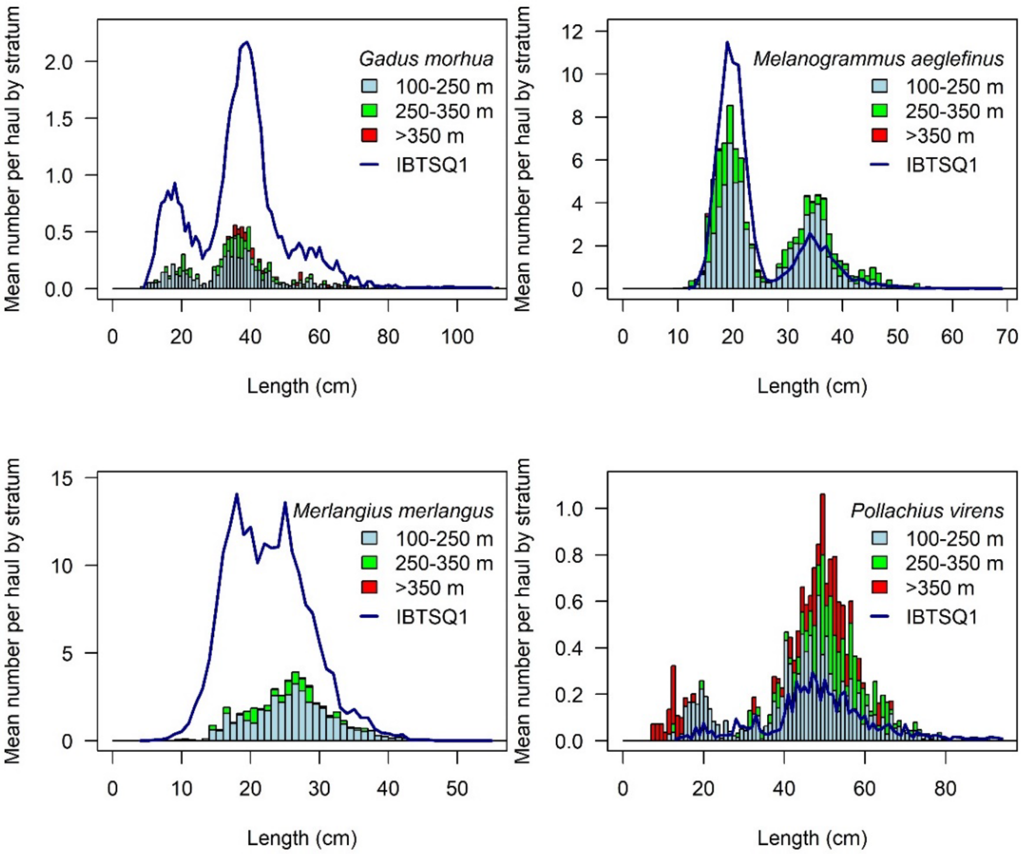

Figure 5.14: The average number at length of a) cod *Gadus morhua*, b) haddock *Melanogrammu aeglefinus*, c) whiting *Merlangius merlangus*, and d) saithe *Pollachius virens* in the 100–250 m depth stratum in the Skagerrak from 2006–2020. The solid line represents data from the NS-IBTS, while the blue bars represent data from the Norwegian shrimp survey

(NSS). Additionally, the stacked bars in green and red represent the mean numbers at length in the NSS for the 250–350 m and 350–550 m depth strata, respectively. Note that the means are uncorrected for swept area.

5.11 Fish welfare and sensitive fish species

IBTSWG discussed fish welfare and catches of sensitive species, summaries of which are below.

5.11.1 Fish welfare

Animal welfare refers to the mental feelings experienced by individual, live, sentient animals under direct human influence. It is impossible to determine if animals do experience feelings as understood by humans, and there are diverse opinions and beliefs on which animal taxa are sentient. Nevertheless, animal welfare is a growing concern for society and is addressed by various legal instruments. For example, the UK's Animal Welfare (Sentience) Act 2022 recently expanded recognition of sentience from just vertebrates to additionally encompass cephalopod molluscs and decapod crustaceans.

Within Europe, all vertebrates and cephalopods are included in Directive 2010/63/EU on the protection of animals used for scientific purposes. This Directive regulates the "*pain, suffering, distress and lasting harm*" experienced by finfish and cephalopods during scientific procedures (EU, 2010).

Trawl surveys are undertaken to understand the spatio-temporal dynamics of fish populations and support stock assessments and advice. These involve the catching, sorting and handling, sampling, tagging (in some instances), and return of live, moribund and dead animals to the sea. Trawl surveys can be considered to cause pain (via physical injuries, decompression), distress (via capture, air asphyxiation) and lasting harm (for physiologically and physically compromised animals released) to large numbers of animals. However, scientific trawl surveys are typically regarded to fall outside Directive 2010/63/EU; it is assumed that this Directive does not apply to normal fishing industry practices (which the IBTS reflect) nor in offshore waters. Nevertheless, those involved have a duty of care to minimize animal suffering by implementing humane practices and the principles of the '3Rs' (Replacement, Reduction and Refinement), while also ensuring that data collected are robust and informative for stock assessments and wider ecosystem studies.

As part of the trawl surveys, a number of measures are in place to improve animal welfare (e.g., the use of on-board tanks for some species; release of fit live fish; improved handling and sampling; humane treatment such as approved methods of euthanasia; and reduced haul duration when appropriate). Such measures address 'Reduction' and 'Refinement'.

Although such measures are implemented, IBTSWG considered that it would be useful to share and encourage good practice. To assess possibilities for further improvements, IBTSWG suggested the following:

- Participating institutes could usefully review and, if necessary, update their own practices for animal welfare on trawl surveys (e.g., handling and sampling protocols, ethical committee oversight) and have information ready for the 2024 IBTSWG meeting.
- Share and communicate the measures already being taken on-board, and other methodological and technical developments to reduce mortality and injury.
- Improve training/education for on-board (non-scientific) personnel.
- Consider trawl sensors (e.g., catch sensors) to monitor codend weight and inform on the potential for early hauling. This could decrease numbers of animals (Reduction) and the trauma experienced (Refinement), whilst ensuring the catch represents a valid scientific sample.

- For those species that are alive on-board, consider options for the collection of biological data (e.g., non-invasive techniques, sample sizes, focussed data collection on dead individuals).
- Evaluate other options to reduce impacts or implement new observation methods (e.g., trawling times, use of acoustics to detect/avoid large aggregations of pelagic fish) and future vessel design elements that may reduce trauma to trawl-caught animals.

IBTSWG also considered that it would be important to communicate effectively on the benefits of surveys (improved understanding of the state of fish stocks and wider ecosystem) and the mitigation measures to minimise "costs" to animal welfare.

Consequently, IBTSWG considered that further discussions on fish welfare should be conducted during the 2024 meeting.

5.11.2 Sensitive species

During discussions, the issue of sensitive species (i.e., specific taxa of conservation concern) was also raised. This ethical consideration relates to potential impacts on populations, rather than impacts on (the welfare of) individual animals. It could be suggested to reduce sampling effort or avoid areas with sensitive species (e.g., certain elasmobranchs), depending on the nature of the stocks (e.g., whether they are assessed, catch rates, survivability). However, it was noted that limiting the spatial distribution of survey effort may compromise data collection for stock assessments and wider biodiversity studies, including monitoring the recovery of some formerly depleted stocks.

5.12 References

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6 Joint session with assessment groups

6.1 Introduction

A new TOR was agreed for the reporting cycle to increase the communication between user groups and survey groups. Following the 2022 meeting of IBTSWG, either one of the Chairs gave presentations summarising the recent surveys to WGNSSK, WGCSE, WGBIE and WGEF.

6.2 Communications during 2022/2023

In 2023 another collaborative, open session was held between IBTSWG and chairs/members of various assessment groups, including members of the Working Group for the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), Working Group for the Celtic Seas Ecoregion (WGCSE), Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE), Working Group on Elasmobranch Fishes (WGEF) and Herring Assessment Working Group (HAWG). The discussions proved to be successful and an important part in taking science forward, improving indices and the assessments.

Continued communication with user groups will facilitate the better use and interpretation of survey data, a deeper understanding of the underlying survey used in the development of indices by the stock assessors, and to enhance scientific collaboration between the groups.

Updated presentations on the 2022/2023 surveys will be given at the assessment working group meetings by either of the Chairs.

6.3 Future communications

IBTSWG received positive feedback from the assessment Working Groups members, indicating the benefits of this improved communication. IBTSWG recognised the need for continued work with the assessment groups, including closer work relating to the new gear and how it may be introduced.

There would also be merit in IBTSWG having closer communication with the Working Group on Biological Parameters (WGBIOP).

IBTSWG also noted that there could be useful communication on the issues of sampling effort and distribution of survey stations and how this may be impacted by, for example, MPAs and OWFs. IBTSWG aim to invite members of relevant Expert Groups working on marine spatial planning etc. to a joint discussion during the 2024 meeting.

Noting the discussions on benthic invertebrates (see Section 5) and wider biodiversity, there would also be merits in having some joint discussions between IBTSWG with members from other relevant Expert Groups (e.g., BEWG, WGBIODIV and WGECO), including in relation to users of the MSS-OSPAR data product.

Annex 1: List of participants

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Other participants, including Chair-invited members			
David Warwick	SeaFish	United Kingdom	Survey trawl
Frankie Griffin	Chair-invited member	Ireland	Survey trawl
Jim Drewery	Marine Scotland	United Kingdom	Survey trawl
Didier Le Roy	IFREMER	France	Survey trawl
Annica de Groote	SLU Aqua	Sweden	
Pierre Cresson	IFREMER	France	Feeding ecologist
Cecilie Kvamme	IMR	Norway	HAWG
Ching Villanueva	IFREMER	France	WGBIE
Sophy McCully Phillips	CEFAS	United Kingdom	WGEF
Holger Haslob	Thünen-Institut für Seefischerei	Germany	WGNSSK
Richard Humphreys	Cefas	United Kingdom	Survey trawl
Lies Vansteenbrugge	ILVO	Belgium	WGNSSK
Tanja Miethe	Marine Scotland	United Kingdom	WGNSSK
Alessandro Orio	SLU Aqua	Sweden	WGNSSK
Alex Holdgate	CEFAS	United Kingdom	WGNSSK
Raphael Girardin	IFREMER	France	WGNSSK
Jonathan White	Marine Institute	Ireland	WGCSE
Alessandra Bielli	CEFAS	United Kingdom	
Lucilla Giulietti	IMR Bergen	Norway	Mackerel parasites
Julia Storesund	IMR Bergen	Norway	Mackerel parasites
Martin Pastoors	Independent consultant	Netherlands	Mapping DATRAS data
Einar Hjorleifsson		Iceland	Mapping DATRAS data
Henrik Mosegaard	DTU Aqua	Denmark	
Ingo Wilhelms	Thünen-Institut für Seefischerei	Germany	
Caroline McKeon	AFBINI	United Kingdom	
Jonathan Ellis	University if Aberdeen	United Kingdom	Use of survey data
Kim Ludwig	Thünen-Institut für Seefischerei	Germany	Data quality

Annex 2: Resolutions

2021/FT/EOSG01 The **International Bottom Trawl Survey Working Group (IBTSWG)**, chaired by Pia Schuchert*, Northern Ireland and Jim Ellis*, UK, will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2022	4–8 April	Lysekil, Sweden	Report by 20 May 2022 to EOSG	Outgoing: Ralf van Hal (Netherlands) and Pascal Laffargue (France). Incoming: Pia Schuchert, Northern Ireland and Jim Ellis, UK
Year 2023	27-31 March	Lysekil,Sweeden	Report by 30 April 2023 to EOSG	
Year 2024			Report by 20 May 2024 to EOSG	

ToR descriptors

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
a	Coordination and reporting of North Sea and North-eastern Atlantic bottom trawl surveys, including appropriate field sampling in accordance to the EU Data Collection Framework. Review and update (where necessary) IBTS survey manuals in order to achieve additional updates and improvements in survey design and standardization. (ACOM)	Intersessional planning of Q1, Q3 and Q4 surveys; communication of coordinators with cruise leaders; combining the results of individual nations into an overall survey summary. Intersessional activity, ongoing in order to improve survey and manuals quality.	3.1, 3.2	Recurrent annual update	1) Survey summary including collected data and description of alterations to the plan, to relevant assessment WGs and other EGs (WGCSE, WGNSSK, HAWG, WGBIE ,WGDEEP, WGWIDE, WGEEL, WGCEPH, WGEF, WGML) and SCICOM. 2) Indices for the relevant species to assessment WGs (see above) 3) Planning of the upcoming surveys for the survey coordinators and cruise leaders 4) Updated version of survey manual, whenever substantial changes are made.
b	Address DATRAS-related topics in cooperation with DGG: data quality checks and the progress in re-uploading	Issues with data handling, data requests or challenges with re-uploading of historical or corrected data to DATRAS have	2.1, 3.1	Multi-annual activity.	Prioritized list of issues and suggestion for solutions and for quality checking routines, as

	corrected datasets, quality checks of indices calculated, and prioritizing further developments in DATRAS. (ACOM)	been identified and solutions are being developed			well as definition of possible new DATRAS products, submitted to DATRAS group at ICES. Annual check of recent survey data.
c	Develop a new survey trawl gear package to replace the existing standard survey trawl GOV. (SCICOM)	The divergence in the GOV specification from the one given in the survey manual due to historical drift and technical creep has been acknowledged by the group (IBTSWG 2015). Furthermore, the deviation from the specification contained in the manual and between users has widened to the point where it will never be reversed. Therefore, the perefered option is to maintain the status quo of national GOV specifications and develop a new survey trawl package to replace the GOV. A number of IBTS members are due to replace vessels in the next few years and this provides an oppertunity to review time-series and undertake inter-calibration trials between the GOV and a new trawl. A further driver for a new gear has been highlighted by the Celtic Sea area where the necessity to optimize sampling opportunities are not been provided by the GOV. In parellel with trawl development the process of replacing the GOV will need to be defined with reference to continuing the assessments and existing time-series. (For this ToR, the IBTS WG seeks support from gear technology experts and welcomes their advice and input into the development of the new survey gear package)	3.1, 3.2	3 years	Final design(s); Full documentation of the gear, and how it should be rigged and operated at sea. Roadmap for implementing the gear in the ongoing survey. This will be developed at the WKFDN workshop as well as WKUSER 2 with support from WGISDAA and FTFB. There will also be linkages with the relevant assessment groups using IBTS data (WGNSSK, WGCSE, WGBIE, , WGWIDE, WGEF).
d	Evaluate the current survey design and explore modifications or alternative survey designs, identifying any potential benefits and drawbacks with respect to spatial distribution and frequency of sampling. Consider the effects of enforced changes in the distribution of survey stations (e.g. in relation to MPAs and offshore indutries). Explore potential additional data	The requirements for the surveys are continuously evolving. Additional information, like dietary data, are also required, while reductions in other parts being sampled might be possible and wished for in relation to ethical discussions. New techniques, like eDNA sampling, might be relevant to add to the surveys. Furthermore, the ecological footprint of the survey (fuel consumption,	3.2	1–3 years	Resources permitting, stomach sampling program to be included in the NS-survey and in draft for the other regions

	collection, e.g. stomach sampling and tagging (SCICOM) and engage with the Workshop on Pilot North Sea Fisheries Independent Regional Observation (WKPilot NS-FIRMOG).	bottom impact, impact in MPAs) is a topic having potential consequences for the current survey design.		
e	Making data from IBTS available to be used by different ICES end-users, such as assessment groups, OSPAR and others. Establish a communication with end user groups as to the needs of the users and the data available within DATRAS. Collate a user document that outlines the important caveats in the data with regards to non-target species (e.g. when a non-target species was first recorded as a species, the confidence in sampling). Establish a continued working relationship between user groups and survey group.	IBTS/DATRAS has got a wealth of data, which might be used in a number of applications. Originally set up to collect data on target species, data on other species and environmnental factors were often collected (sometimes sporadically), and the identification to species-level of some taxa has been dependent on the available time, the SIC at the time and the knowledge of the team. Using data without previous knowledge on all these factors could result in invalid assumptions. To get the most value out of the surveys, there needs to be a clear communication established with data users and the survey team. Often the current SIC or survey team does not even know how the data were collected historically. It is important to get a deeper understanding of the historic processes and how to progress into the future.	Multi-annual project	Establish closer coordination and communication channels with user groups and possible user groups: how do they use the data, how can we enhance the value of the data, what questions do arise? In which format should (historical) documentation be provided? Establish a guideline with user groups. What is actually being read, what is important. Create a more detailed chronology of historical and contemporary surveys, with this being a 'live document' (to be taken forward) about survey data capabilities and issues. Enable users to interact with the survey team to establish new possibilities, e.g. use the data for multi-species analysis, biodiversity questions. Also a personal link between users and survey people will enable the users to form specific requests or propose collaborative work.

Summary of the Work Plan

Year 1	DEVELOP A ROADMAP FOR THE IMPLEMENTATION OF THE NEW SURVEY GEAR (TOR C) ; DEVELOP A STOMACH SAMPLING PROGRAM FOR THE NS-IBTS AND DRAFTS FOR THE OTHER REGIONS (TOR D).
Year 2	Start the implementation of the roadmap for the new survey gear (ToR c); Depending on the outcomes of stomach sampling during the North Sea IBTS in year 1, and the resources available, refine and extend the stomach sampling programme as appropriate.
Year 3	Continue the roadmap of the new survey gear.
Recurrent annual activity	Updates for ToRs a, and b and initiate and updates for ToR e.

Supporting information

Priority	Essential. The general need for monitoring fish abundance using surveys is evident in relation to fish stock assessments, and it has increasing importance in relation to MSFD GES descriptors, including biodiversity, foodwebs, populations of commercially exploited fish species, sea floor integrity and marine litter.
Resource requirements	A 5-day IBTS meeting. Prepared documents from members following ToR Leaders identified above. 8-day Chair's time to edit. It is estimated that each ToR will require at least 8 hours of preparation.
Participants	The Group is normally attended by some 25–30 members and guests.
Secretariat facilities	SharePoint plus normal secretariat support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	ACOM. IBTS indices are used in the assessment of multiple stocks.
Linkages to other committees or groups	There are relations with other bottom-trawl surveys (WGBEAM, WGBIFS) that also use DATRAS as the international repository for its data (WGDG, DIG). There are also linkages with Assessment WGs using IBTS indices. Also relevant to the Working Group on Ecosystem Effects of Fishing Activities (WGECO) , the Working Group on Improving use of Survey Data for Assessment and Advice (WGISDAA), Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR), Working Group on Biodiversity Science (WGBIODIV) and the Workshop on Pilot North Sea Fisheries Independent Regional Observation (WKPilot NS-FIRMOG).
Linkages to other organizations	IOC, GOOS, OSPAR, Regional Coordination groups (DCF).

Annex 3: List of survey names and survey codes

Survey	Nation	ICES Divisions	Quarter	Survey Code
North Sea IBTS-Q1				
NS-IBTS-Q1	INT	3.a, 4.a–c, 7.d (in part)	1	G1022
North Sea IBTS-Q3				
NS-IBTS-Q3	INT	3.a, 4.a–c	3	G2829
North-eastern Atlantic surveys				
UK-SCOWCGFS-Q1	GB-SCT	6.a	1	G4748
UK-SCOWCGFS-Q4	GB-SCT	6.a, 7.b	4	G4815
UK-SCOROC-Q3	GB-SCT	6.b	3	G4436
UK-NIGFS-Q1	GB-NIR	7.a	1	G7144
UK-NIGFS-Q4	GB-NIR	7.a	4	G7655
IE-IGFS-Q4	IE	6.a, 7.b, 7.g–j	4	G7212
IE-IAMS-Q1-2	IE	6.a, 7.b–c, 7.j–k	1–2	G3098
FR-EVHOE-Q4	FR	7.e–j. 8.a–b,d–e	4	G9527
FR-CGFS-Q4	FR	7.d–e	4	G3425
SP-PORC-Q3	ES	7.b,c,k	3	G5768
SP-NSGFS-Q4	ES	8.c, 9.a (north)	4	G2784
SP-GCGFS-Q1	ES	9.a (south)	1	G7511
SP-GCGFS-Q4	ES	9.a (south)	4	G4309
PT-PGFS-Q4	PT	9.a	4	G8899

Annex 4: Report of North Sea IBTS-Q1

(Coordinator: Ralf van Hal)

A4.1 General overview

The North Sea IBTS Q1 survey aims to collect data on the distribution, relative abundance and biological information on a range of fish species in ICES Subarea 4 and Divisions 3.a and 7.d. During daytime, the GOV (Grand Ouverture Verticale) bottom trawl with standard groundgear A for normal bottom conditions, or groundgear B for rough ground (Scotland in Division 4.a only), was used to sample fish, with age data collected for the target species (cod, haddock, whiting, saithe, Norway pout, herring, mackerel, and sprat) and a number of additional species.

A CTD was deployed at most trawl stations to collect temperature and salinity profiles. Herring larvae were sampled with a MIK-net (Methot Isaac Kitt) during the night.

In 2023, there were seven participating vessels in the Q1 survey, namely “Dana” (26D4, Denmark), “GO Sars” (58G2, Norway), “Scotia” (748S, Scotland), “Thalassa” (35HT, France), “Walther Herwig III” (06NI, Germany), “Tridens II” (64T2, Netherlands) and “Svea” (77SE, Sweden). The survey covered the period 22 January to 27 February 2022 (Table A4.1).

A total of 325 GOV hauls (8 of which were invalid) (Table A4.2) were uploaded to DATRAS and 424 valid MIK hauls (Table A4.3) were deployed. Most rectangles were fished at least once this year, the majority is fished with two hauls as planned. The rectangles 46E6, 47E6, 48E6 and 49E6 were not covered at all. German had mechanical issue owing to which they had to halt their survey activities after 22 of their 67 hauls (see Figure A4.1), Norway took over some of these hauls, but it resulted in a part of the rectangles only being covered once.

Biological data (weight and/or gender and/or maturity and/or age material) are collected from a number of species (Table A4.4). Coordinated stomach collection occurred for cod, horse mackerel and a group of rarely caught species (Table A4.5) An impression of the catches is given in Figure A4.2, by presenting the total fish catch in kilograms. Gear geometry plots are given in Figures A4.3a-d (lines represent theoretical values for the GOV from flume tank experiments, ICES 2015).

Standard tow duration according to the IBTS Manual is 30 minutes, although shorter tow durations are allowed, i.e. haul early for safety reasons or in the case of very large catches. However, any tow under 15 minutes is considered invalid for the index calculation. Only one tow (France) was below 15 minutes (Figure A4.4). Furthermore, a certain number of tows had durations between 15 and 30 minutes. The reasoning for shortening various, and potentially results in some arbitrary decisions of the cruise leaders.

Scotland reported their data with datatype=P (Pseudocategory sampling). With re-uploads of older data the will change the datatype to P in historic years as well (see ICES, 2021).

Maturity data are uploaded in the A–E format by Denmark, France and the Netherlands, while being uploaded in the 61–66 format by the other countries.

A4.2 Issues and problems encountered

Various countries encountered some mechanical issues: Germany (steering wheel issues, broken winch), Dutch (broken winch, melted transformers of the stern thruster), Denmark (attachments of the washing machines broke causing loss of fresh water) and Scotland (limitations on engine power imposed towards end of survey). In case of Denmark and the Netherlands this caused some loss of fishing days, but in the end did not hamper the full program. In case of Germany, it caused the loss of many days and the full program could not be executed. In the case of Scotland they caused the loss of one trawl station.

Bryozoans have hampered fishing in last year Q1 and Q3. This year Q1 only the Netherlands had significant catches of bryozoans in two hauls above the Dutch islands. These did not hamper the sorting and processing of these catches.

A4.3 Additional activities

In addition to the GOV and MIK tows, all countries have collected additional data. All countries collected sea floor litter from the GOV tows and collected CTD (temperature and salinity) at all GOV stations when possible. A complete list of additional activities is given in Table A4.6.

A4.4 Preliminary results from GOV sampling

The preliminary indices for the recruits of seven commercial species based on the 2023 Q1 survey were not produced this year. Distribution maps of the 1-group of NS-IBTS target species with the limits of the species-specific stock assessment or index areas are given in Figures A4.5a-e.

A4.5 MIK net sampling

During the International Bottom Trawl Survey in the first quarter (Q1 IBTS), night-time catches are conducted with the MIK net, a fine meshed (1600 µm) 2-m midwater ring net (ICES 2017) providing abundance estimates for large herring larvae (0-ringers) of the autumn spawning stock components. In addition, the Q1 IBTS also provides the time series for the 1-ringer herring abundance index in the North Sea from GOV catches carried out during daytime.

The total abundance of 0-ringers in the survey area is used as a recruitment index for the stock. Since 2017, this 0-ringer index (also called MIK index) time series is calculated with a new algorithm, which excludes larvae of Downs origin more rigorously. This is done by excluding the smaller larvae – presumably of Downs origin – from the analyses in certain parts of the survey area. The index from the 2023 survey (corresponding to the 2022 year-class) is 90.8. This corresponds to an average index value, and is a bit below the long-term average of 100.7 (in the time-series since 1992).

The previous MIK-IBTS survey in 2022 had been faced with numerous challenges which resulted in poor sampling coverage (see previous HAWG report for details). The 2023 survey was again faced with several challenges, but fortunately considerably fewer than in 2022. Due to technical issues with the steering gear and the trawl winches on RV Walther Herwig III, Germany lost approximately 1.5 weeks of survey time. Scotland also had technical problems with the engine as well as a Covid-19 infection onboard of RV Scotia, resulting in a loss of approximately one 24 hour period of survey time. In addition, several participants had issues with severe weather conditions during parts of the survey period.

A total of 586 MIK hauls were conducted in 2023, which is 153 more than in 2022 but 97 less than in 2021. For the 2023 MIK 0-ringer index (corresponding to the 2022 year-class), all hauls north of 51° N were used, in total 569 hauls (for comparison: 2022 = 410 hauls and 2021 = 663 hauls).

A total of 716 MIK hauls were planned according to the 2023 NSIBTS Q1 program (the target is 4 hauls per ICES rectangle) and 586 were conducted, i.e. 82% of the planned MIK-stations were sampled in 2023. Thanks to coordination between participants during the survey, almost all ICES squares in the survey area were covered. Furthermore, the main distribution area of the herring larvae in the central and southern North Sea was well covered with at least 3 and mostly 4 MIK hauls per ICES square. Lower coverage with only 1 or 2 hauls per ICES square did mainly occur in the northern part of the survey area, which usually only yields relatively few herring larvae.

Overall, the coverage achieved during the 2023 MIK survey was good and can be regarded to provide a representative 0-ringer index.

Figure A4.6 shows the size distribution of MIK larvae in 2023. Herring larvae measured between 6 and 40 mm standard length (SL). Again, and as in most years, the smallest larvae <12 mm were numerous, with a peak at 10 mm. However, while these small larvae <12 mm often accounted for around 50 to 60% of the total number of larvae in other years, they only made up 33% of the total number of larvae in 2023. Instead, larvae in the size range between 13 and 17 mm were also numerous in the 2023 survey, with another peak at 15 mm. This interesting feature in the 2023 length distribution is similar to the length distribution in 2022, which also showed a peak at 15 mm. Larger larvae >18 mm SL were rarer, but their relative share was 20% and thus higher than in the two previous years 2022 and 2021, where the share of these larger larvae >18 mm was only 11 and 12%, respectively.

Figure A4.7 illustrates the spatial distribution of 0-ringers (>18 mm) in 2021, 2022 and 2023. As in previous years, the smallest larvae in 2023 were again chiefly caught in 7.d and in the Southern Bight. The 2023 distribution is partly similar to 2021, with higher abundances east of Scotland and along the UK coast. However, in the southeastern and eastern part of the North Sea, the potential nurseries, abundance of larger herring larvae in 2023 was lower than in the two previous years. An interesting feature of the 2023 spatial distribution are the few stations with very high abundances in the English Channel/Southern Bight area, which have a relatively strong impact on the index value.

As in previous years, sardine larvae were again found in the samples of the 2023 MIK survey. Most sardine larvae occurred in the southern and south-eastern North Sea as well as in the Skagerrak. However, in contrast to previous years, some sardine larvae were also found relatively far north and north-west.

A4.6 Staff exchange

No staff exchange occurred during the IBTS Q1 2023.

A4.7 References

Wieland, K., H.J. Olesen, E.M. Fenger Pedersen & J.E. Beyer (2011). Potential bias in estimates of abundance and distribution of North Sea cod (*Gadus morhua*) due to strong winds prevailing prior or during a survey. *Fisheries Research*, 110: 325–330.

Table A4.1. Overview of the surveys performed during the North Sea IBTS Q1 survey in 2022. In grey fishing activity, in purple no fishing due to storm, in red no fishing due to mechanical issues.

		January																					
country	Vessel	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Sweden	Svea (77SE)																3	4	3	2	4	2	4
France	Thalassa II (35HT)															2	3	3	2	3	3	3	2
Norway	GO Sars (58G2)																						
Germany	Walther Herwig III (06NI)																			4			
Scotland	Scotia III (748S)				active fishing									2	3	3	4	4	3	4	4	4	3
Denmark	Dana (26D4)				due to weather no activities												1	3	3	3	3	2	2
Netherlands	Tridens 2 (64T2)				mechanical/COVID issues										1	3	4	4					2

		February																												
country	Vessel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Sweden	Svea (77SE)	4	5	3	4	4	4	1																						
France	Thalassa II (35HT)	3	2		3	3	3	3	3	3	3	3	4	2																
Norway	GO Sars (58G2)				2	3	3	2				1	3	3	3		4		2	3		2	3	1		3	3	2		
Germany	Walther Herwig III (06NI)		2		4	3	4	4	1																					
Scotland	Scotia III (748S)	4	4		2	3	2	4	1																					
Denmark	Dana (26D4)	2	3	3	3			3	3	3	3	3	2																	
Netherlands	Tridens 2 (64T2)	4	4	3			4	4	2					3	1	4	4	1			3	4	3							

Table A4.2. Overview of the GOV stations fished in the North Sea IBTS Q1 survey in 2023.

ICES Divisions	Country	Gear	Tows planned	Valid	Invalid	% stations fished
3.a	SWE	GOV-A	40	41	1	103%
	DEN	GOV-A	2	2		100%
	NOR	GOV-A	3			0%
4.a-c	GFR	GOV-A	67	22		33%
	SWE	GOV-A	6	5		83%
	NO	GOV-A	41	42		102%
	FRA	GOV-A	44	43	2	98%
	DEN	GOV-A	42	42	1	100%
	NED	GOV-A	56	57	1	102%
	SCO	GOV-A	12	12		100%
	SCO	GOV-B	46	40	2	87%
7.d	FRA	GOV-A	10	10	1	100%
other	NO	GOV-A	1	1		100%

Table A4.3. Overview of the MIK stations fish in the North Sea IBTS Q1 survey in 2023.

ICES Divisions	Country	Gear	Tows planned	Valid	% stations fished
3.a	SWE	MIK	35	35	100%
	DEN	MIK	8	8	100%
4.a–c	GFR	MIK	134	80	60%
	SWE	MIK	12	9	75%
	NO	MIK	84	74	88%
	FRA	MIK	88	85	97%
	DEN	MIK	84	82	98%
	NED	MIK	112	120	107%
	SCO	MIK	116	78	67%
7.d	FRA	MIK	20	19	95%

Table A4.4. Overview of individual length, weight and/or maturity and/or age samples collected during the North Sea IBTS Q1 survey in 2023.

Species	DE	DK	FR	GB-SCT	NL	NO	SE	Total
Melanogrammus aeglefinus	324	750	211	1182	2921	1646	559	7593
Clupea harengus	215	822	405	375	533	660	1731	4741
Merlangius merlangus	271	731	1058	728	532	612	804	4736
Pleuronectes platessa	155	493	717	206	345	78	561	2555
Sprattus sprattus	85	307	413	105	328	2	807	2047
Gadus morhua	60	148	92	428	175	236	464	1603
Trisopterus esmarkii	92	115	22	353	65	281	208	1136
Scomber scombrus	27	72	0	90	56	121	81	447
Pollachius virens	4	33	0	40	1	159	36	273
Trachurus trachurus	0	15	0	93	22	35	47	212
Glyptocephalus cynoglossus	0	0	0	23	0	0	170	193
Mullus surmuletus	0	0	186	0	0	0	0	186
Merluccius merluccius	22	8	0	81	0	64	0	175
Scyliorhinus canicula	53	0	0	0	92	6	0	151
Micromesistius poutassou	14	0	0	0	0	123	0	137
Solea solea	0	0	119	1	0	0	14	134
Limanda limanda	0	115	0	1	0	0	0	116
Dicentrarchus labrax	0	0	100	0	0	0	0	100
Engraulis encrasicolus	16	58	0	0	0	10	0	84
Amblyraja radiata	3	0	0	5	1	63	4	76
Mustelus sp.	31	0	0	18	15	2	0	66
Raja montagui	0	0	0	45	11	0	0	56
Microstomus kitt	35	19	0	0	0	0	0	54
Lophius piscatorius	7	0	0	39	0	0	0	46
Squalus acanthias	4	0	0	34	5	2	0	45
Molva molva	0	5	0	19	1	15	4	44
Sardina pilchardus	35	0	0	0	0	1	0	36
Leucoraja naevus	7	0	0	23	3	3	0	36
Scophthalmus maximus	1	3	0	1	10	1	3	19
Scophthalmus rhombus	1	2	0	5	3	0	8	19
Raja clavata	1	0	0	0	10	0	1	12
Raja brachyura	0	0	0	9	3	0	0	12
Pollachius pollachius	0	4	0	0	0	4	4	12
Cancer pagurus	11	0	0	0	0	0	0	11

Species	DE	DK	FR	GB-SCT	NL	NO	SE	Total
Eutrigla gurnardus	10	0	0	0	0	0	0	10
Lithodes maja	0	0	0	0	0	8	0	8
Chelidonichthys lucerna	0	4	0	1	0	0	2	7
Dipturus batis	1	0	0	6	0	0	0	7
Dipturus intermedia	0	0	0	5	0	1	0	6
Lophius budegassa	0	0	0	4	0	0	0	4
Galeus melastomus	0	0	0	0	0	4	0	4
Hippoglossus hippoglossus	0	2	0	0	0	1	0	3
Brosme brosme	0	0	0	0	0	1	0	1

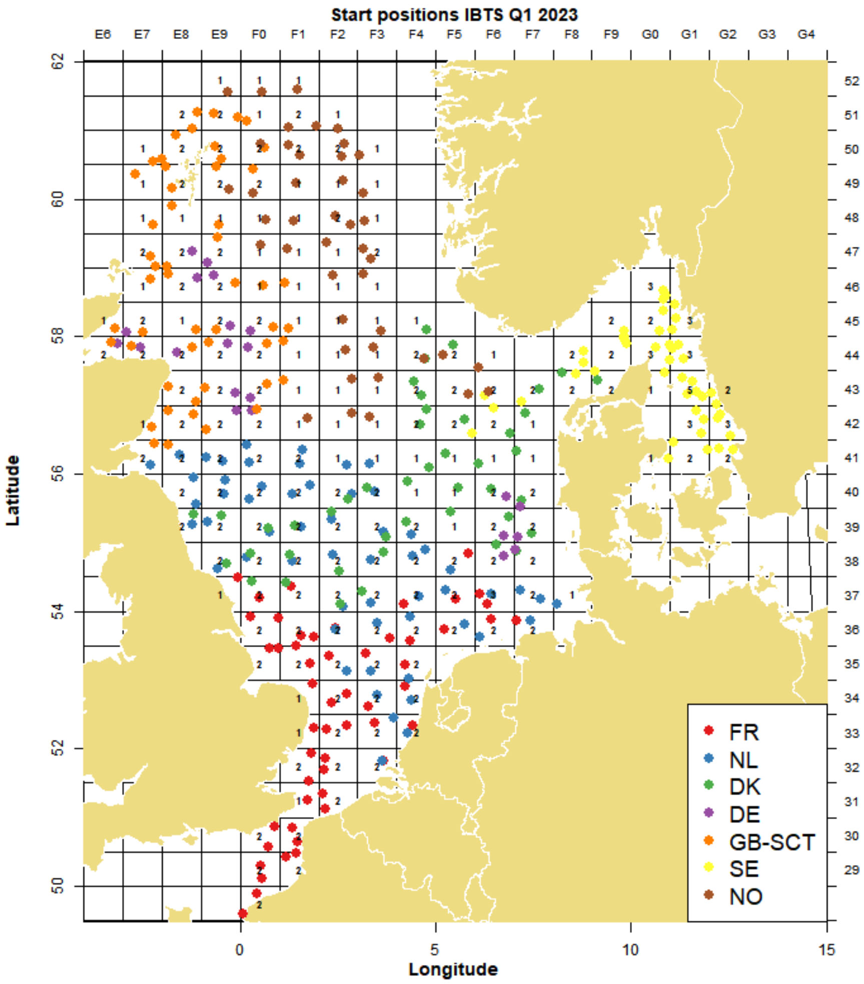
Table A4.5. Overview of stomach samples collected during the North Sea IBTS Q1 survey in 2023.

Species	DE	DK	FR	GB-SCT	NL	NO	SE
Merlangius merlangus					~300		
Trachurus trachurus		1	18	101	22		47
Gadus morhua	61	39	85	311	175		316
Molva molva		3		21	1		4
Scophthalmus maximus		1	3	1	10		3
Scophthalmus rhombus	1	1		4	3		8
Squalus acanthias	1				5		
Pollachius pollachius		4					4
Amblyraja radiata							4
Raja clavata							1
Hippoglossus hippoglossus		2					
Chelidonichthys lucerna		3	40	1			2

Table A4.6. Overview of additional activities in the North Sea IBTS Q1 survey in 2023

Activity	GFR	NOR	SCO	DEN	NED	SWE	FRA
CTD(temperature-salinity)	x	x	x	x	x	x	x
Seafloor litter	x	x	x	x	x	x	x
Water sampler (Nutrients)			x		x		x
Egg samples (Small fine-meshed ringnet; CUFES)	x	x	x	x	x		x
By-caught benthic animals		x			x		x
Fish/Benthic genetics		x			x	x	
Fish diet	x	x	x	x	x	x	x

Fish tagging				x		
Additional biological data on fish	x	x	x	x	x	
Observer for mammals and/or birds						x
Zoo and phytoplankton	x					x
Jellyfish	x	x				x
Hydrological transects						x



A4.1. Number of hauls per ICES rectangle with GOV during the North Sea IBTS Q1 2023 and the start positions of the trawls by country.

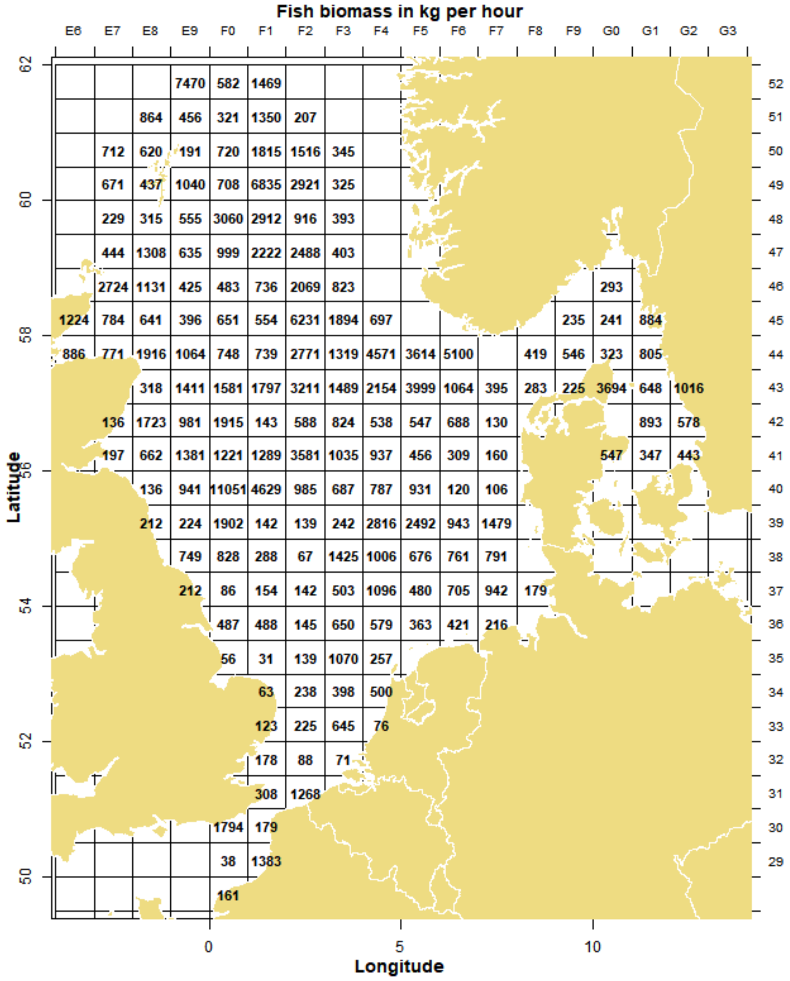


Figure A4.2. Distribution of fish biomass in IBTS hauls by rectangle in the North Sea, Q1 2023 (values standardized to kg per hour haul duration; mean per rectangle).

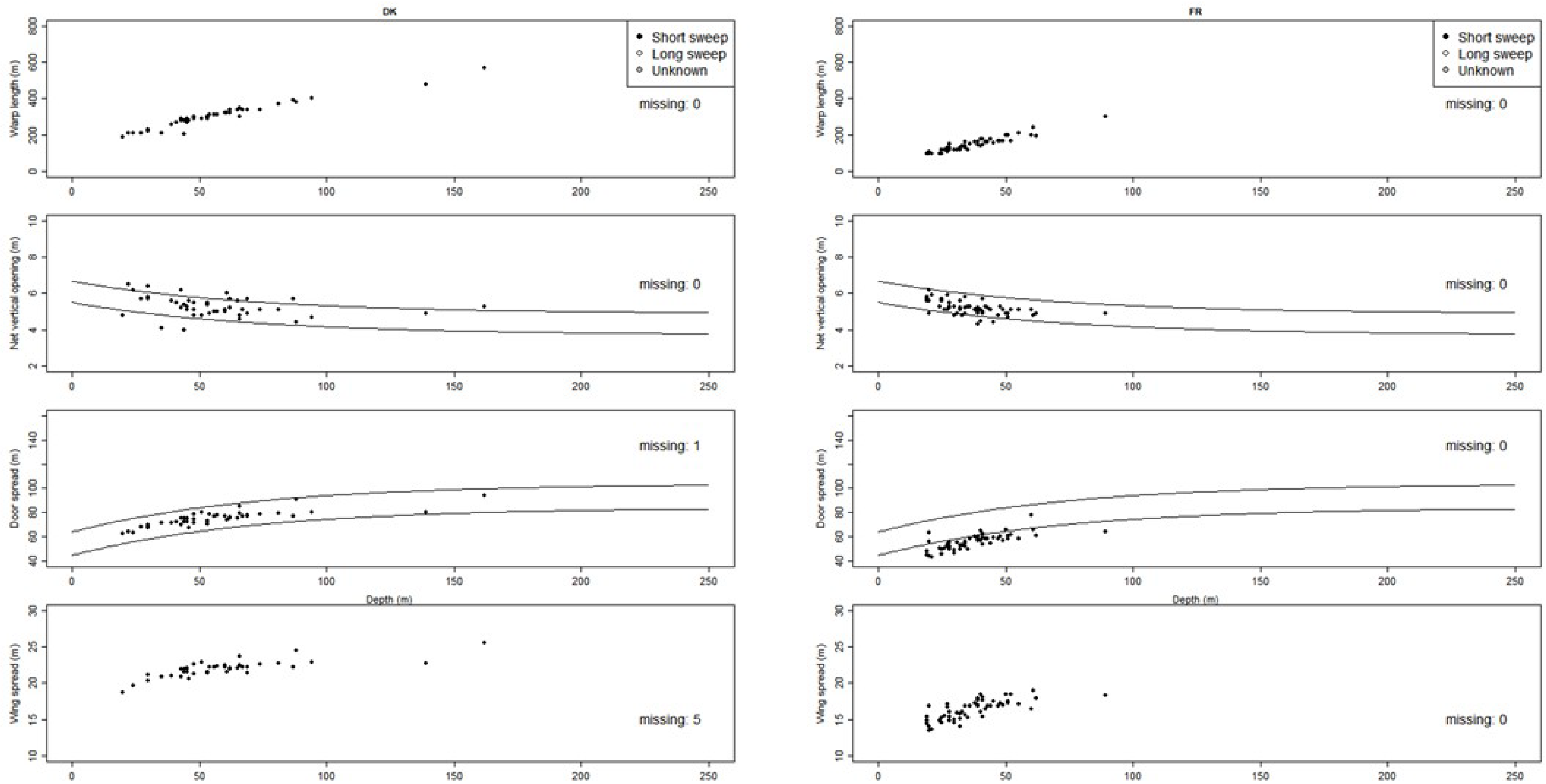


Figure A4.3a. Danish and French warp length and gear geometry

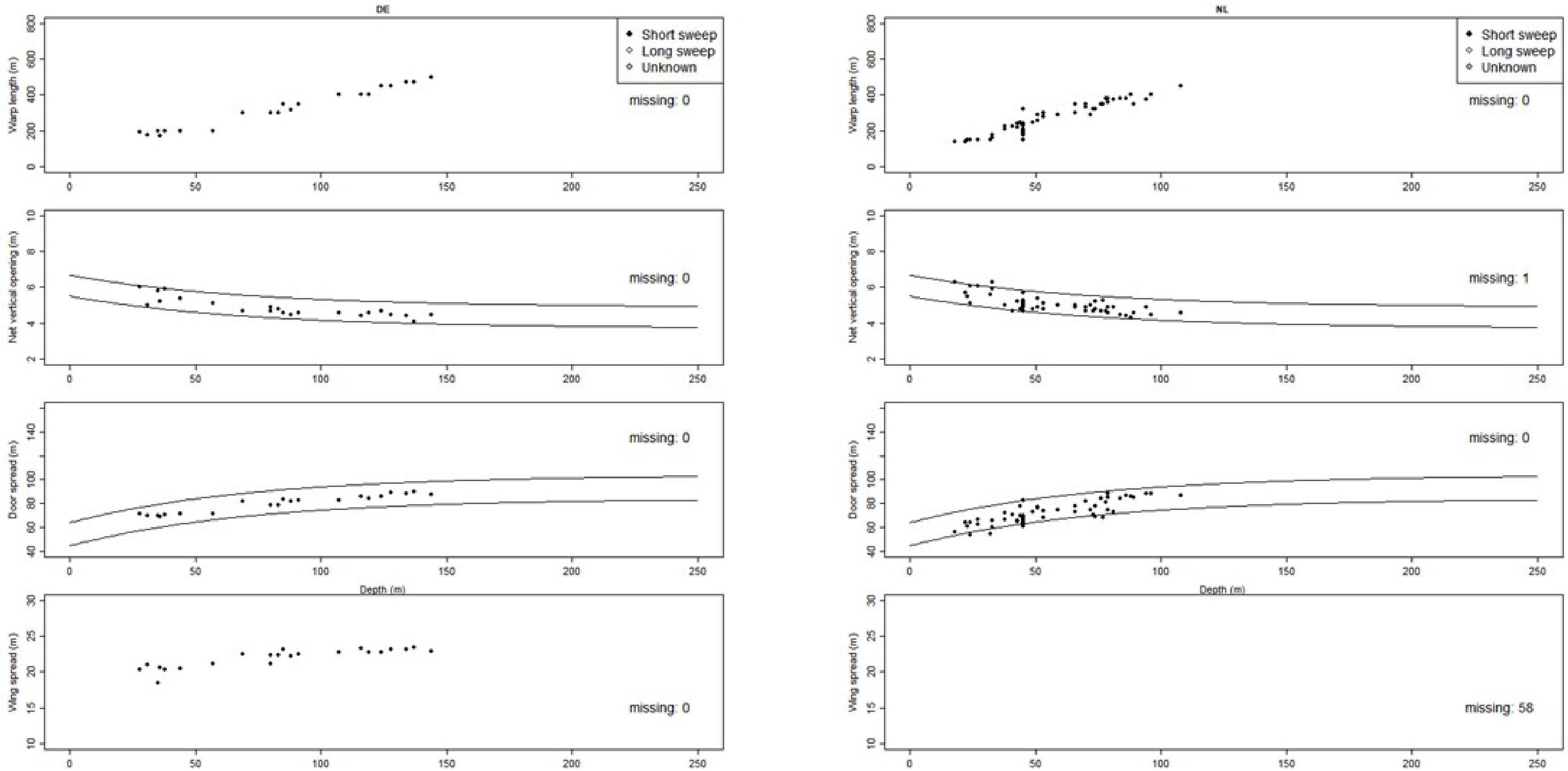


Figure A4.3b German and Dutch warp length and gear geometry.

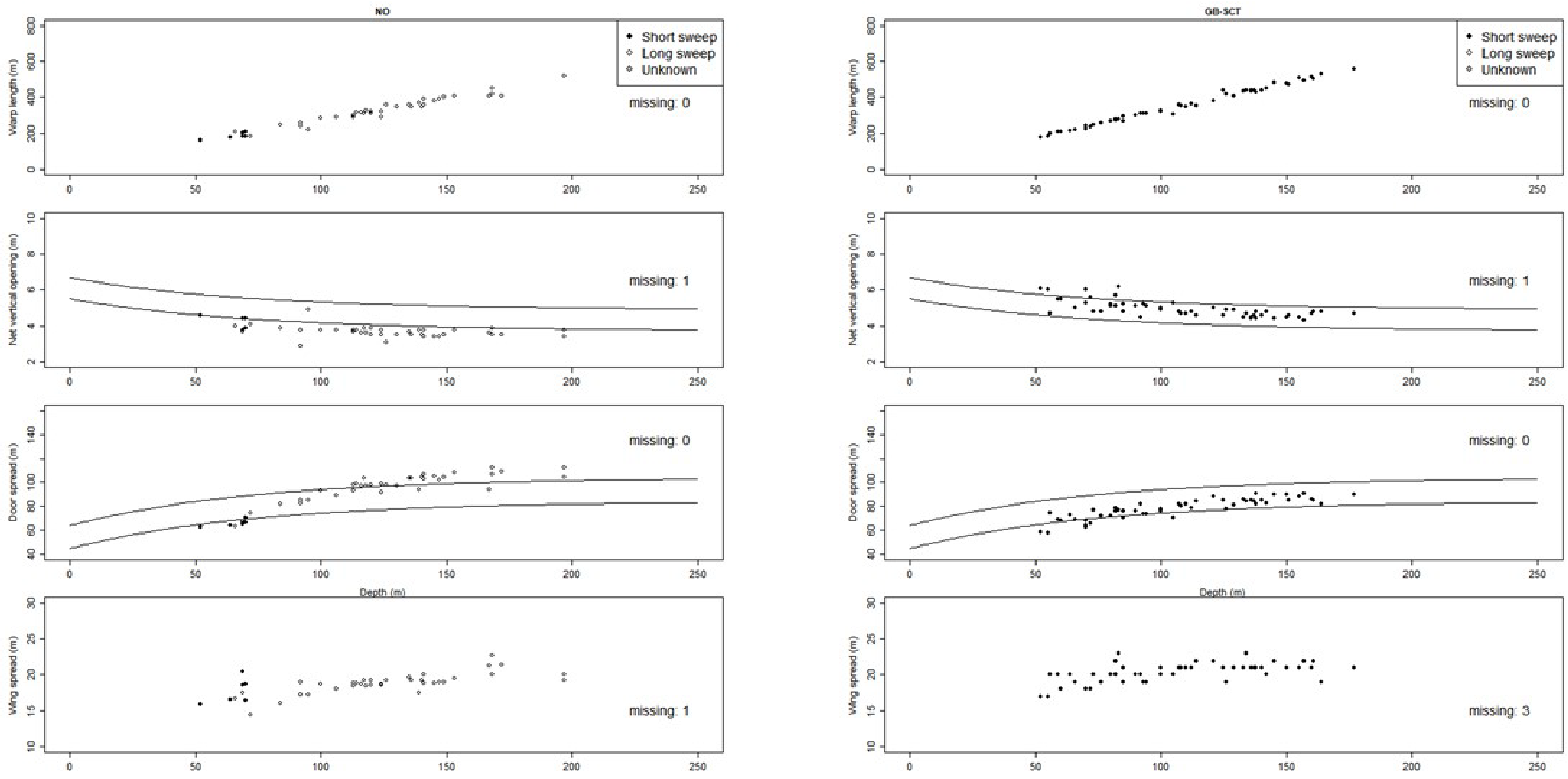


Figure A4.3c Norwegian and Scottish warp length and gear geometry.

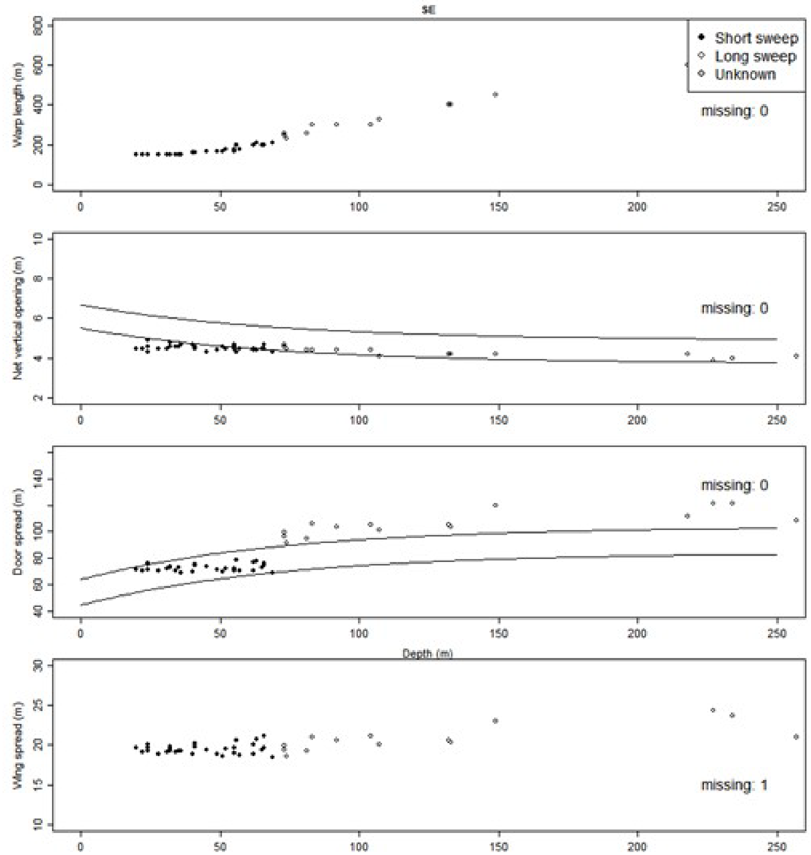


Figure A4.3d Swedish warp length and gear geometry, the deepest haul was done long sweeps but needs to be corrected in Datras.

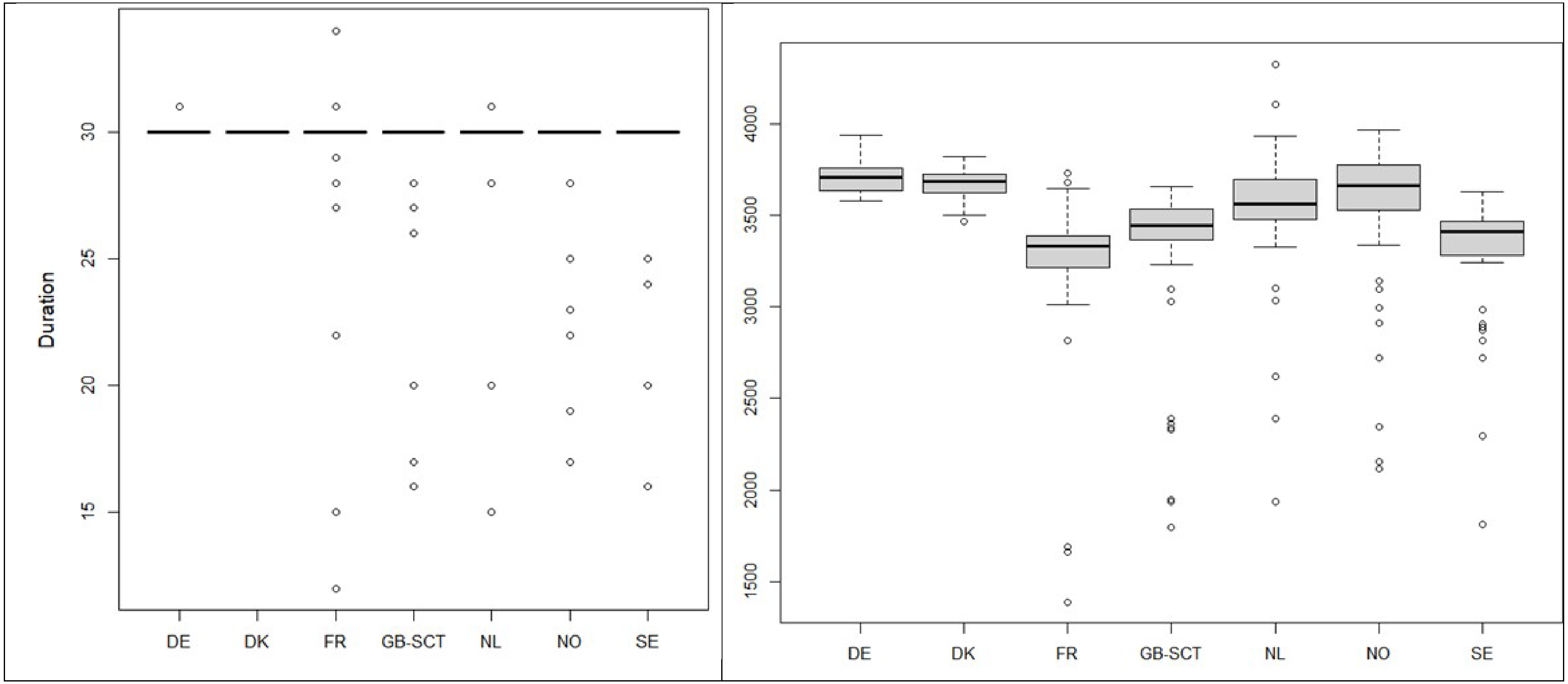


Figure A4.4. Duration and distance over ground by country for the North Sea IBTS Q1 2023.

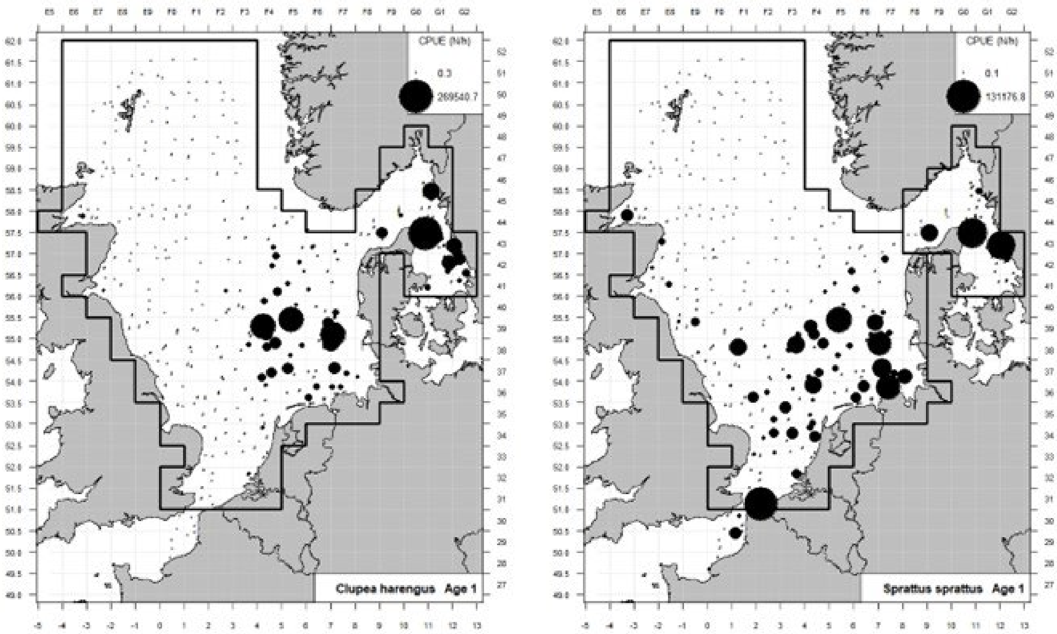


Figure A4.5a. Distribution of herring and sprat age 1 in the quarter 1 IBTS 2023 (thick lines: index areas for sprat in Q1 but for herring in Q3).

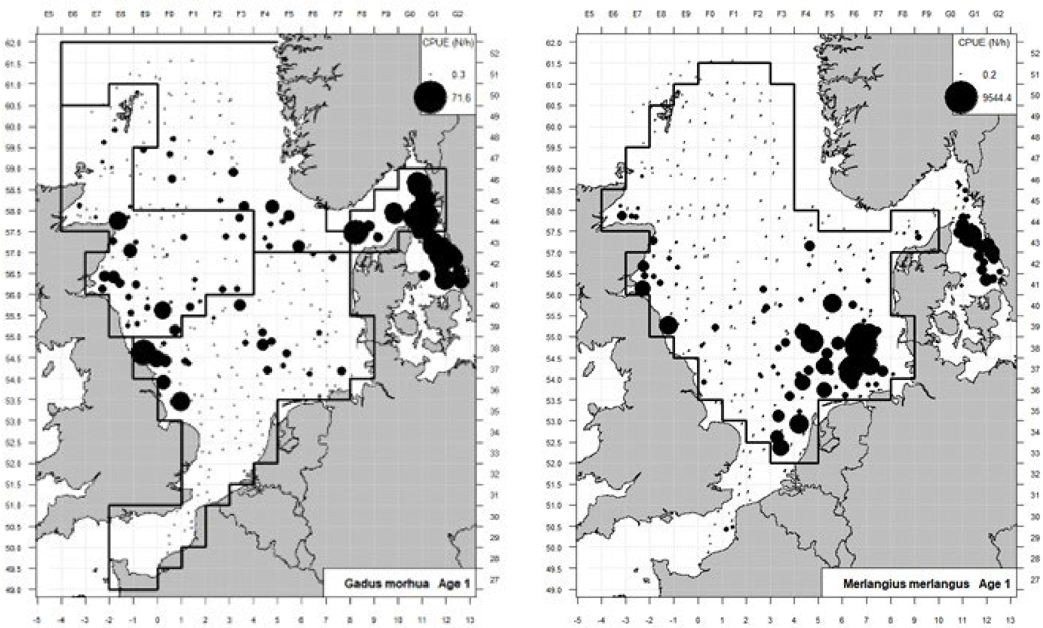


Figure A4.5b Distribution of cod and whiting age 1 in the quarter 1 IBTS 2023 (thick lines: Subpopulation separation for cod, index areas for whiting).

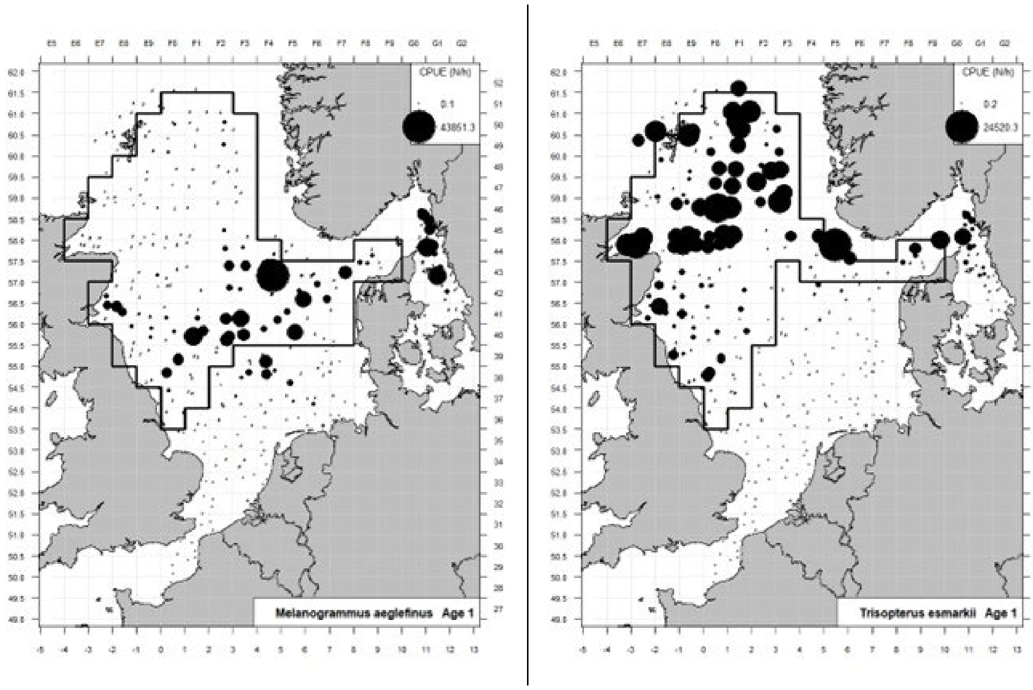


Figure A4.5c Distribution of haddock and Norway pout age 1 in the quarter 1 IBTS 2023 (thick lines: index areas).

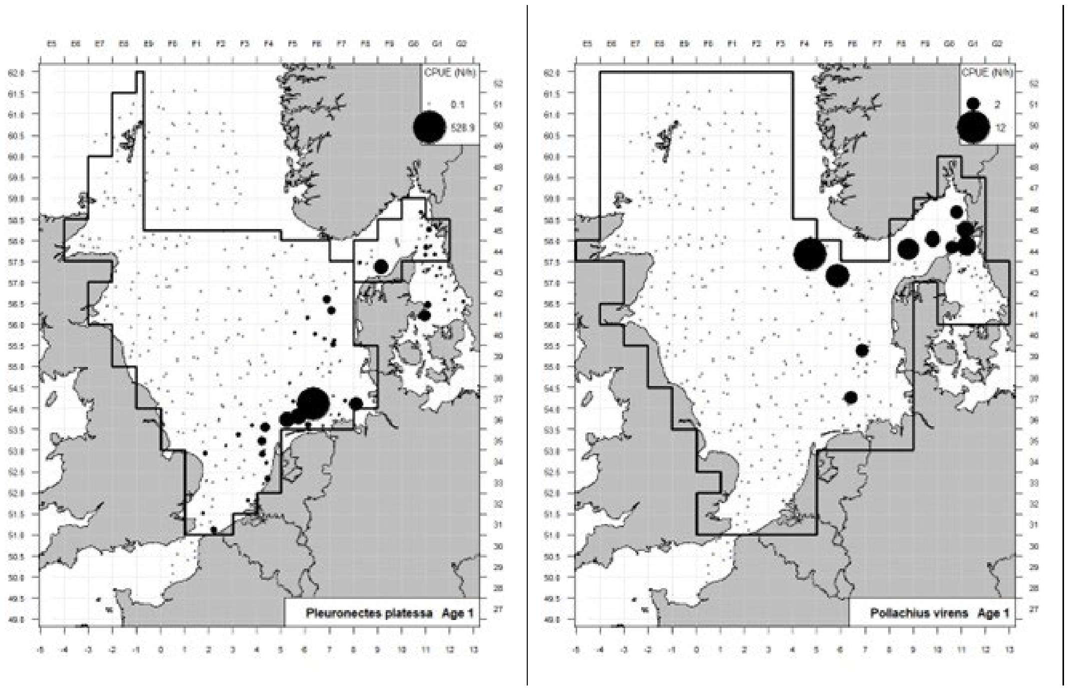


Figure A4.5d Distribution of plaice and saithe age 1 in the quarter 1 IBTS 2023 (thick line: old index areas).

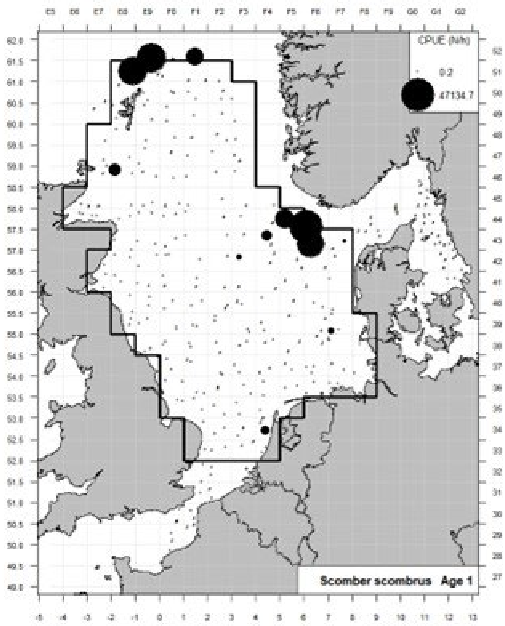


Figure A4.5e. Distribution of mackerel age 1 in the quarter 1 IBTS 2023 (thick line: index area).

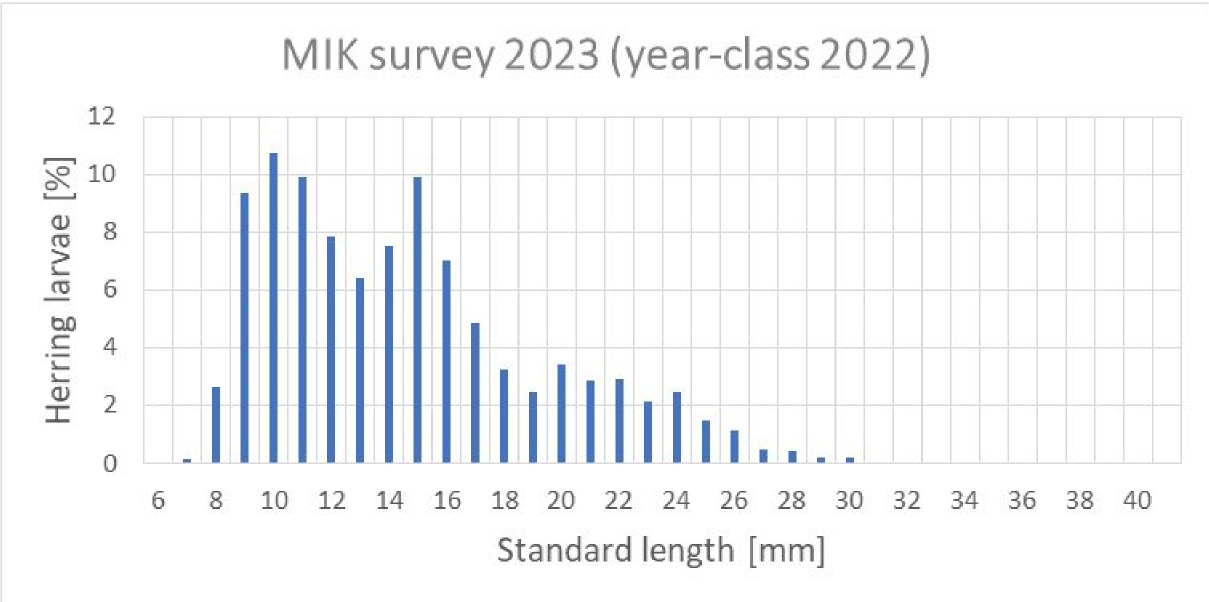


Figure A4.6. North Sea herring. Length distribution of all herring larvae caught in the MIK during the 2023 Q1 IBTS.

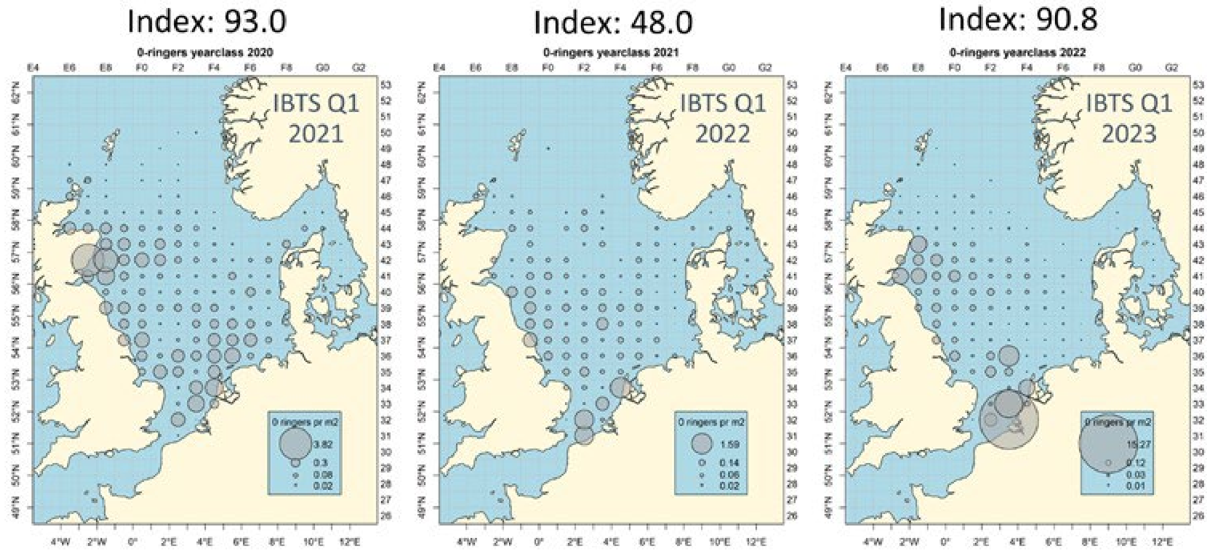


Figure A4.7. North Sea herring. Distribution of 0-ringer herring, year classes 2020–2022. Density estimates of 0-ringers (>18 mm) within each statistical rectangle are based on MIK catches during IBTS in January/February 2021–2023. Areas of filled circles illustrate densities in no m–2

Annex 5: Report of North Sea IBTS-Q3

(Coordinator: Kai Wieland)

A5.1. Participation

Six vessels participated in the quarter 3 survey in 2022: “Dana” (Denmark), “Cefas Endeavour” (England), “Walter Herwig III” (Germany), “Kristine Bonnevie” (Norway), “Scotia” (Scotland) and “Svea” (Sweden). Due to technical issues, the available survey periods were delayed for Scotland and shortened for England, respectively. Germany had to interrupt the survey due to Covid-19 issues. The overall sampling period extended from 21 July to 12 September (Table A5.1), and Scotland conducted the survey relatively late compared to the other countries and previous years.

In total, 349 valid standard GOV hauls were made in the planned rectangles (Table A5.2). As Scotland was expecting not to receive permission for Danish and Norwegian waters in time due to late submission of the applications, some revision of the rectangles allocation to the different countries was made prior to the survey. Due to the technical issues experienced by England and Scotland some further changes were adopted during the survey, e.g., in particular Norway but also Denmark and, to a minor extent, Sweden performed additional tows. Despite this additional effort, area coverage differed somewhat from previous years. However, all rectangles were covered with at least one haul (Figure A5.1) and the number of rectangles with only one haul in the core survey area was only slightly higher than in previous years. Other rectangles that did not achieve coverage of two hauls were rectangles, which are covered largely by land, have a small amount of area at depths < 250 m, which is the maximum survey depth limit, or in which only a few tracks are known that can be fished with the GOV at moderate risk for gear damages.

All standard hauls were planned to be of 30 min duration. However, 40 tows reported as valid to DATRAS were shorter than 25 minutes (Table A5.3) this may indicate that it is becoming increasingly difficult to find full 30 min tracks due to the increasing number of obstacles, such as wind farms, cables and pipelines, in the North Sea. In addition, rough bottom conditions in parts of the survey area make it difficult to find alternative tracks that are suitable for the GOV. Three of the short tows, classified as valid (no trawl damages), were even shorter than 15 min, and this was due to a mass occurrence of bryozoan in the south-eastern part of the area covered by the Danish survey (see Section 2.3).

Biological data (weight, sex, maturation stage, and age material) were collected for many species (Tables A5.4 and A5.5); maturation stage can be difficult to determine outside of the spawning period and was therefore not recorded as routinely as in quarter 1.

A5.2 Additional activities

All countries are required to collect sea floor litter from the GOV tows and CTD data (temperature and salinity, oxygen for some countries) at all GOV stations when possible. A list of other additional activities is given in Table A5.6.

A5.3 Gear geometry

The current manual (ICES 2020: SISP 10 Revision 11) does not specify a fixed warp length to depth ratio, as this may not be appropriate for each of the different vessels. It has, however, been emphasised that each country should carefully measure net geometry, i.e. door spread and headline height over bottom (vertical net opening) and wing spread and adhere to their “historical” standards for warp length-to-depth as far as possible. The number of missing observations of these parameters was quite low for each country (Table A5.7).

The applied warp length to depth ratio and the observed values for vertical net opening, door spread and, if available, wing spread, are show in Figures A5.2a-c by country and are compared across countries in Figure A5.3 Most observed values for door spread were close to the theoretical values. For wing spread, a few missing values and highly variable observations were common. Differences between the countries were most pronounced for vertical net opening for which the values for Sweden and in particular for Norway were much lower than those for the other countries. Door spread values for Norway were also relatively low.

All countries fished according to the manual with a speed over ground (SOG) between 3.5 and 4.5 knots. On average, SOG was about 4 knots for Denmark, England, Germany and for Norway and about 3.7 knots for Scotland and Sweden (Figure A5.4). Scotland and Sweden used lower SOG either for ensure that the same SOG can be applied irrespectively of e.g. weather conditions and tidal currents (Scotland) or for historical reasons (Sweden).

A5.4 Distribution of target species

Distribution maps (in number per km^2, swept area based on door spread) for the recruits of the NS-IBTS standard species for the 3Q 2022 survey are shown in Figures A5.5a-i.

A5.5 Staff exchange

No staff exchanges occurred during the 2022 Q3 surveys. However, IBTSWG continues to encourage staff exchange.

A5.5 Data exchange

During the cruises, information about successfully completed hauls are regularly exchanged between survey vessels. It has been agreed that preliminary indices based on length splitting for the standard species will no longer be exchanged during the Q3 survey, since the final data for the NS-IBTS main target species (if not all species), including age information, were usually submitted to DATRAS within 2 to 3 weeks after completion of the survey. This, however, has not been the case in the past three years and thus preliminary length-based indices might be produced shortly after the survey using HH and HL records provided by the participants. For this, the length-splits given in the manual needs to be checked for validity considering recent changes in the North Sea in recent years.

Table A5.1. Sampling periods in the North Sea IBTS Q3 survey in 2022.

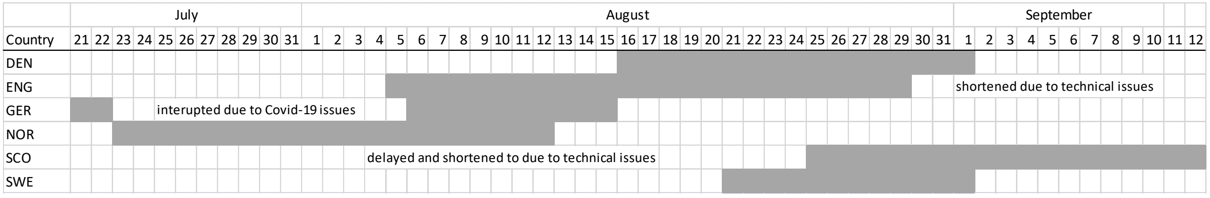


Table A5.2. Overview of valid GOV stations fished in the North Sea IBTS Q3 survey in 2022.

ICES Division	Country	Gear used	Number of standard tows planned (IBTSWG 2022)	Number of requested standard tows (as planned)	Proportion of requested standard tows fished (%)	Number of additional non-mandatory standard tows	Number of additional experimental tows
3.a	SWE	GOV-A	25	25	104	20	-
4.b			3	4		0	-
3.a	DEN	GOV-A	4	4	108	0	-
4.a-c			48	52		0	-
	ENG	GOV-A	78	71	91	0	-
	GER	GOV-A	33	32	97	0	-
4.a-b	NOR	GOV-A	48	58	121	0	-
4.a	SCO	GOV-B	50	48	92	0	-
4.b		GOV-A	40	35		0	-

Table A5.3. Achieved tow durations by country, valid tows NS-IBTS 3Q 2022.

Nominal tow duration (min)	DEN	ENG	GER	NOR	SCO	SWE	Total
9	0	0	0	0	0	0	0
10	2	0	0	0	0	0	2
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	1	0	0	0	0	0	1
14	0	0	0	0	0	0	0
15	2	3	1	2	6	0	14
16	0	0	0	3	1	0	4
17	0	2	0	2	1	0	5
18	1	0	0	1	2	0	4
19	0	0	0	2	0	0	2
20	1	1	0	3	0	4	9
21	0	1	0	3	0	1	5
22	2	1	0	2	1	1	7
23	0	1	0	3	3	1	8
24	0	0	1	2	0	0	3
25	1	0	0	0	1	4	6
26	0	0	0	1	2	2	5
27	1	0	0	0	1	0	2
28	0	0	0	0	1	1	2
29	0	0	0	2	0	0	2
30	44	56	30	26	64	35	255
31	1	6	0	6	0	0	13
32	0	0	0	0	0	0	0

Table A5.4. Number of age readings of NS-IBTS target species available in DATRAS (download 08/03/2023) from the survey in 2022 (-: species not caught, *: SWE area 4b only).

Species	DEN	ENG	GER	NOR	SCO	SWE	Total
Clupea harengus	435	1266	302	523	1024	1028	4578
Gadus morhua	192	371	4	278	534	464	1843
Melanogrammus aeglefinus	284	1635	73	942	1424	572	4930
Merlangius merlangus	567	1637	185	658	872	678	4597
Pleuronectes platessa	708	1458	135	68	325	433	3127
Pollachius virens	25	103	-	308	173	109	718
*Scomber scombrus**	281	405	159	266	521	35	1667
Sprattus sprattus	190	138	174	18	132	312	964
Trisopterus esmarki	18	390	-	370	335	164	1277

Table A5.5. Overview of additional individual biological data collected in addition to the regular measurements specified in the manual during the North Sea IBTS Q3 survey in 2022 ([1)]: individual weight, [2)]: individual weight and sex, [3)]: individual weight, sex and maturity, [4)]: individual weight, sex, maturity and age, [5)]: individual weight, sex and male maturity, [6)]: carapace length, sex and maturity (except GER), [7)]: individual weight, sex and age; *: genetic samples, **: stomach samples).

Species	DEN	ENG	GER	NOR	SCO	SWE
Amblyraja radiata	1 [1)*]	61 [3)]		28 [2)]	34 [5)]	
Anarhichas lupus		5 [3)]				
Chelidonichthys cuculus		7 [4)]				
Chelidonichthys lucerna		20 [4)]				
Chimaera monstrosa				20 [2)]		
Dipturus intermedius		3 [3)]			20 [5)]	
Dipturus batis (=D. flossada)					1 [5)]	
Engraulis encrasicolus	18 [1)*]		5 [3)]			
Etmopterus spinax		0 [3)]				
Eutrigla gurnardus		183 [4)]				
Galeorhinus galeus		0 [3)]	1 [2)]			
Galeus melastomus		2 [3)]		10 [2)]		
Glyptocephalus cynoglossus		26 [4)]			41 [7)]	62 [4)]
Gymnammodytes semisquamatus						
Helicolenus dactylopterus		23 [4)]		4 [2)] / 3 [1)]		
Hippoglossus hippoglossus					1 [2)]	
Hyperoplus lanceolatus			5 [1)]	1 [1)]		
Lepidorhombus wiffiagonis				2 [1)]	89 [2)**]	
Leucoraja fullonica					1 [5)]	
Leucoraja naevus		42 [3)]		2 [2)]	52 [5)]	
Limanda limanda		244 [4)]				
Lithodes maja				1 [2)]		
Lophius budegassa		6 [4)]			1 [2)**]	
Lophius piscatorius		55 [4)]	1 [3)**]	17 [1)]	86 [2)**]	
Merluccius merluccius	23 [3)*]	40 [4)]	1 [3)]	41 [1)] / 56 [2)]	82 [2)]	
Micromesistius poutassou				353 [1)]		
Microstomus kitt		195 [4)]	89 [3)]			
Molva molva		12 [4)]				
Mullus surmulletus		29 [4)]				
Mustelus asterias / M. mustelus		55 [3)]	10 [2)]		2 [5)]	
Nephrops norvegicus			39 [2), 6)]	20 [6)] / 3 [2)]		685 [6)]
Raja brachyura	7 [1)*]	1 [3)]			1 [5)]	
Raja clavata	10 [1)*]	9 [3)]	1 [2)]		6 [5)]	
Raja montagui	10 [1)*]	32 [3)]			68 [5)]	
Scopthalmus maximus		9 [4)]	3 [3)**]		1 [2)]	
Scopthalmus rhombus		5 [4)]	1 [2)]		1 [2)]	
Scyliorhinus canicula			15 [2)]	1 [1)]/ 9 [2)]/4 [3)]		
Squalus acanthias		116 [3)]		1 [2)]	278 [5)]	
Solea solea		58 [4)]				9 [4)]
Trachurus trachurus				366 [1)] / 1 [2)]		
Zeus faber		1 [3)]				

Table A5.6. Overview of additional activities in the North Sea IBTS Q3 survey in 2022 (Water samples for CTD calibration not explicitly listed, x: routinely (data submitted to ICES databases), (x): ad hoc studies (data available from the national representatives)).

Activity	DEN	ENG	GER	NOR	SCO	SWE
CTD	x	x	x	x	x	x
Seafloor Litter	x	x	x	x	x	x
Recording of GOV deployment and retrieval time		(x)				
Cod liver worm registration	(x)	(x)		(x)		(x)
Recording of cod liver weight		(x)		(x)		
Water sampler (Nutrients, eDNA)		(x)			(x)	
Jellyfish from GOV or MIK	(x)	(x)		(x)	(x)	
Benthos (from GOV)		(x)	(x)	(x)		
Ichthyo- and zooplankton (e.g. MIK for sprat larvae)	(x)					
Plankton biodiversity					(x)	
Sediment (Grab)						(x)
Acoustics (Ichthyofauna)		(x)		(x)		
Fish tagging (mark-ID tags)		(x)				
Fish and shellfish genetic samples, see Tab. A.4.1.5	(x)					(x)
Fish stomach samples (numbers for whiting, monkfish, megrim)	(209, 12, 0)	(0, 41, 0)	(170, 1, 0)	(51, 1, 16)	(491, 77, 72)	(275, 7, 0)

Table A5.7. Number of valid tows with missing gear parameters, NS-IBTS 3Q 2022.

Parameter	DEN	ENG	GER	NOR	SCO	SWE
Net opening	0	0	0	0	0	0
Door spread	0	0	0	0	0	0
Wing spread	4	4	6	1	0	0

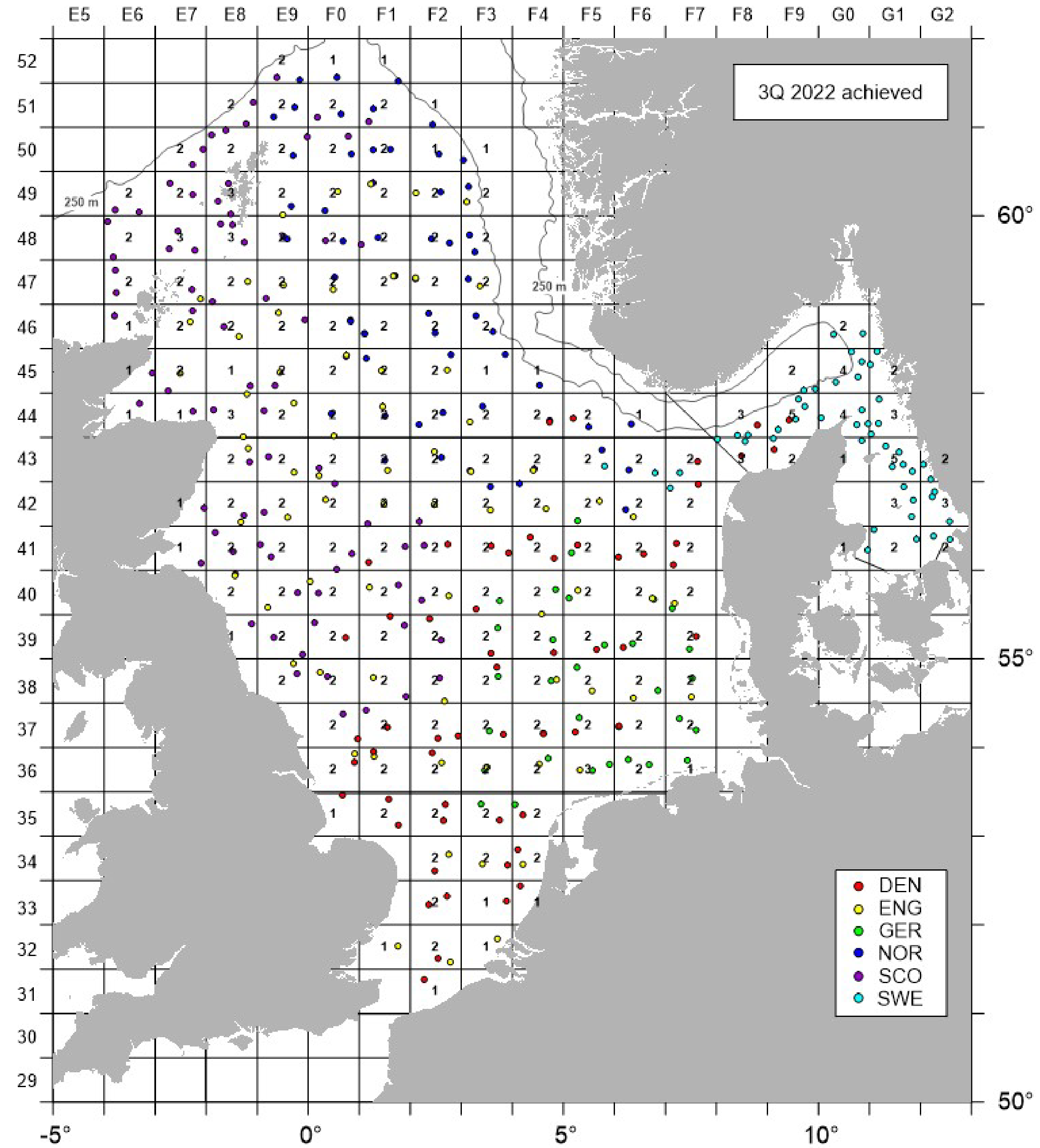


Figure A5.1. Number and start position of hauls per ICES statistical rectangle as taken with the GOV during the North Sea IBTS Q3 2022. Tows are separated into ICES Divisions in the North Sea (4.a, 4.b and 4.c), and Skagerrak/Kattegat (3.a).

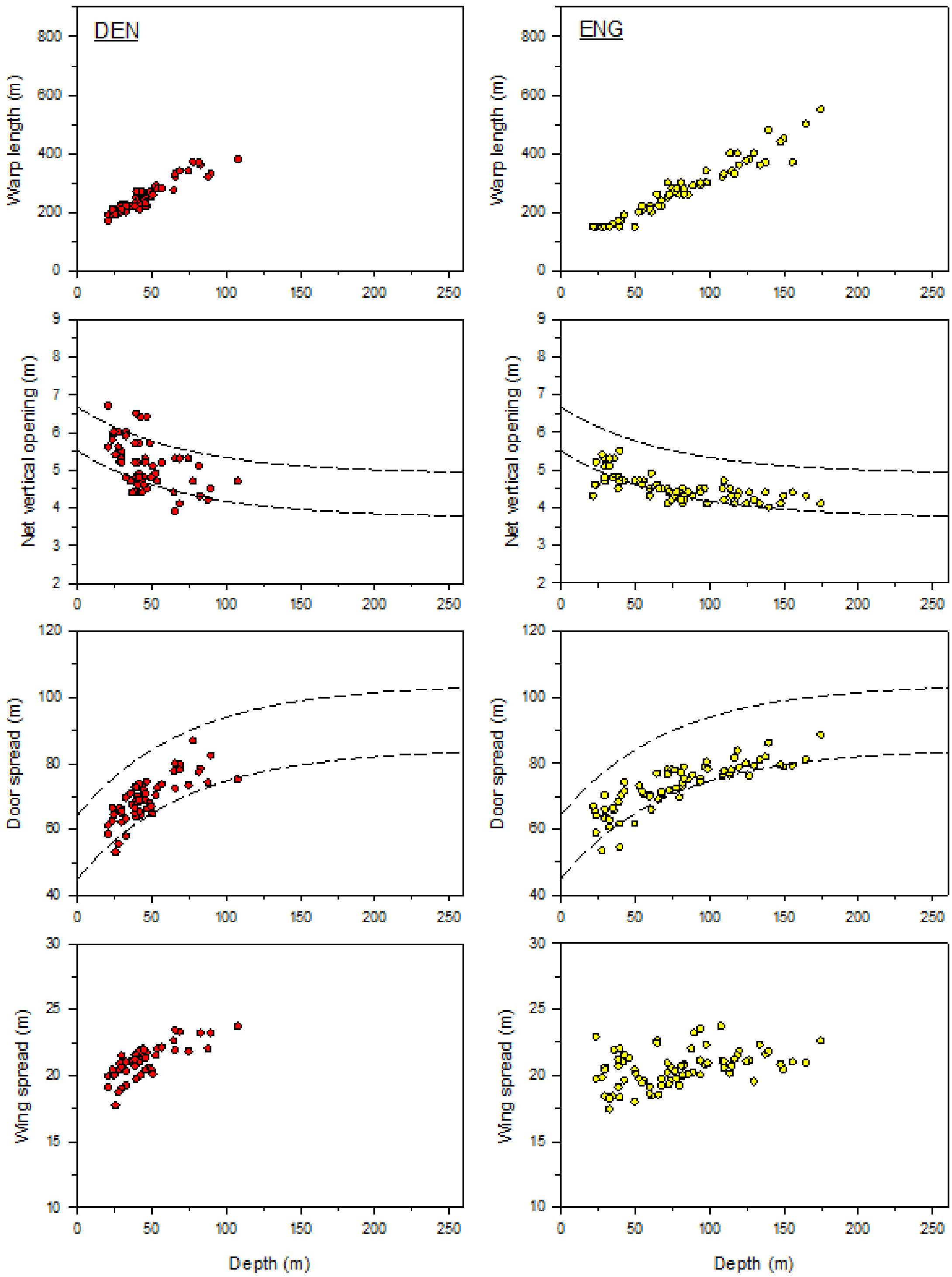


Figure A5.2a. Warp length and net geometry related to depth by country for the North Sea IBTS Q3 2022, Denmark (all tows with Vonin flyers instead of the standard Exocet kite) and England (Dashed lines: theoretical lower and upper limits for the standard GOV 36/47 based on flume tank experiments, see manual).

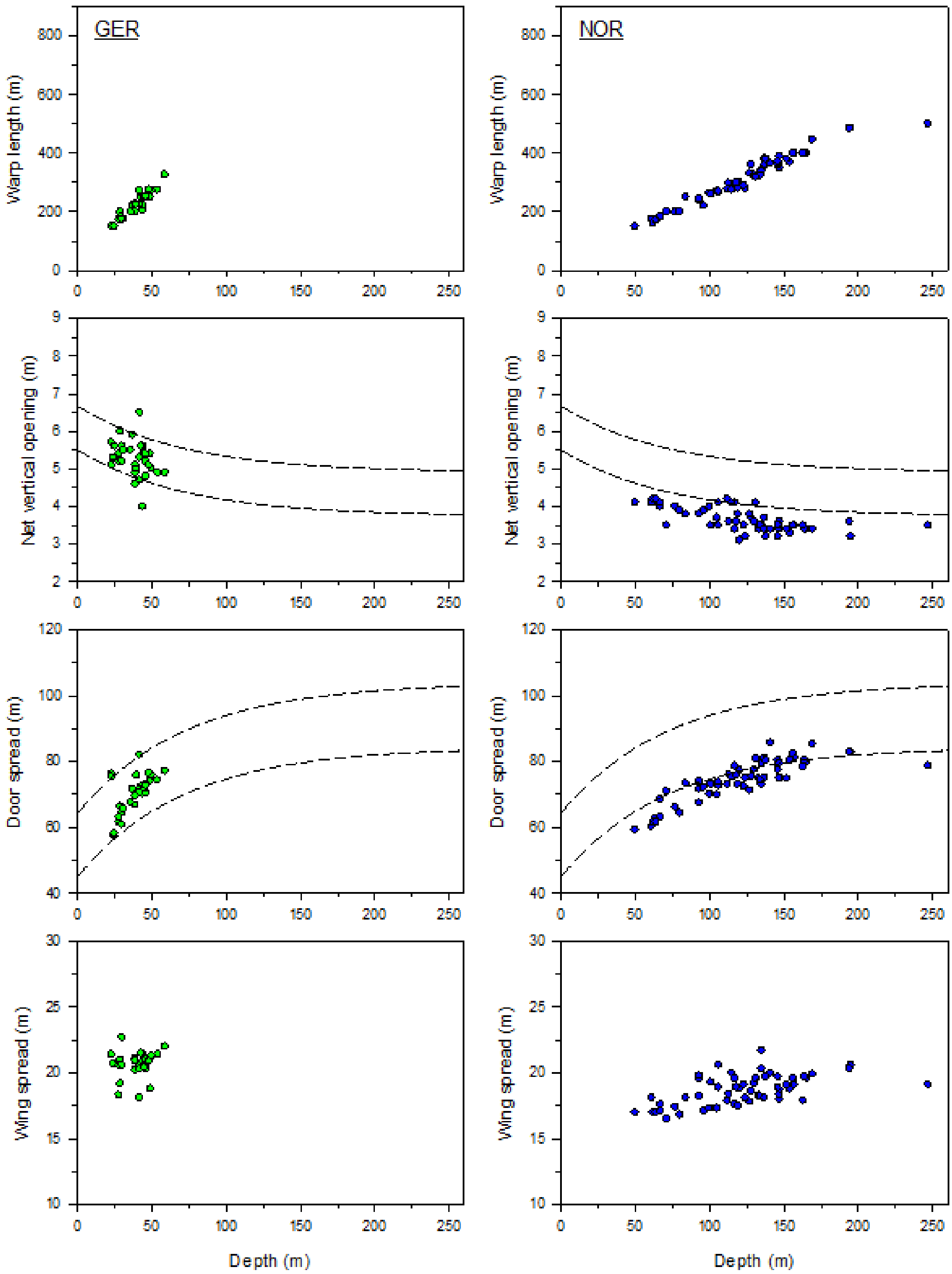


Figure A5.2b. Warp length and net geometry related to depth by country for the North Sea IBTS Q3 2022, Germany (all tows with Vonin flyers instead of the standard Exocet kite) and Norway (Dashed lines: theoretical lower and upper limits for the standard GOV 36/47 based on flume tank experiments, see manual).

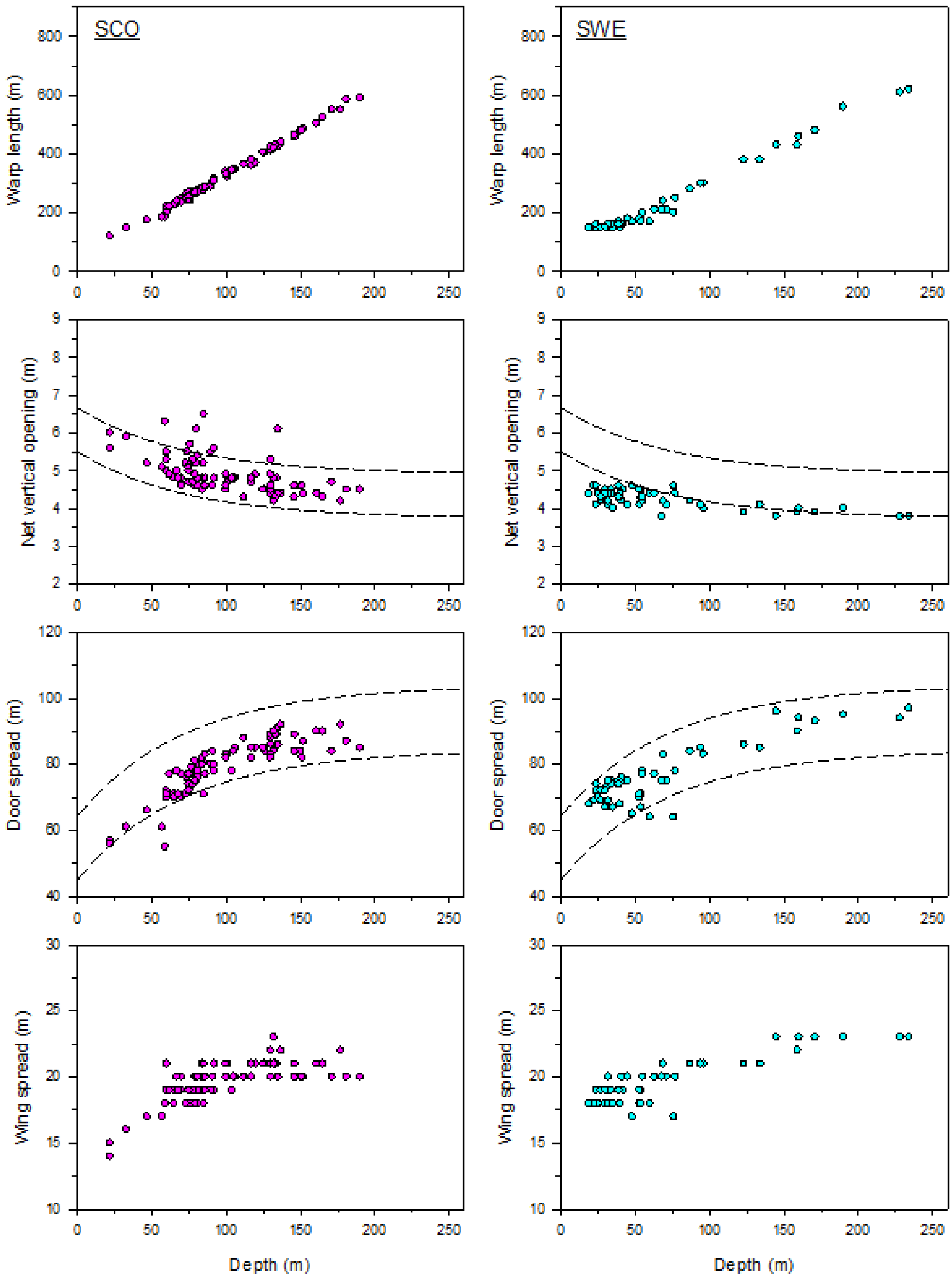


Figure A5.2c. Warp length and net geometry related to depth by country for the North Sea IBTS Q3 2022, Scotland and Sweden (Dashed lines: theoretical lower and upper limits for the standard GOV 36/47 based on flume tank experiments, see manual).

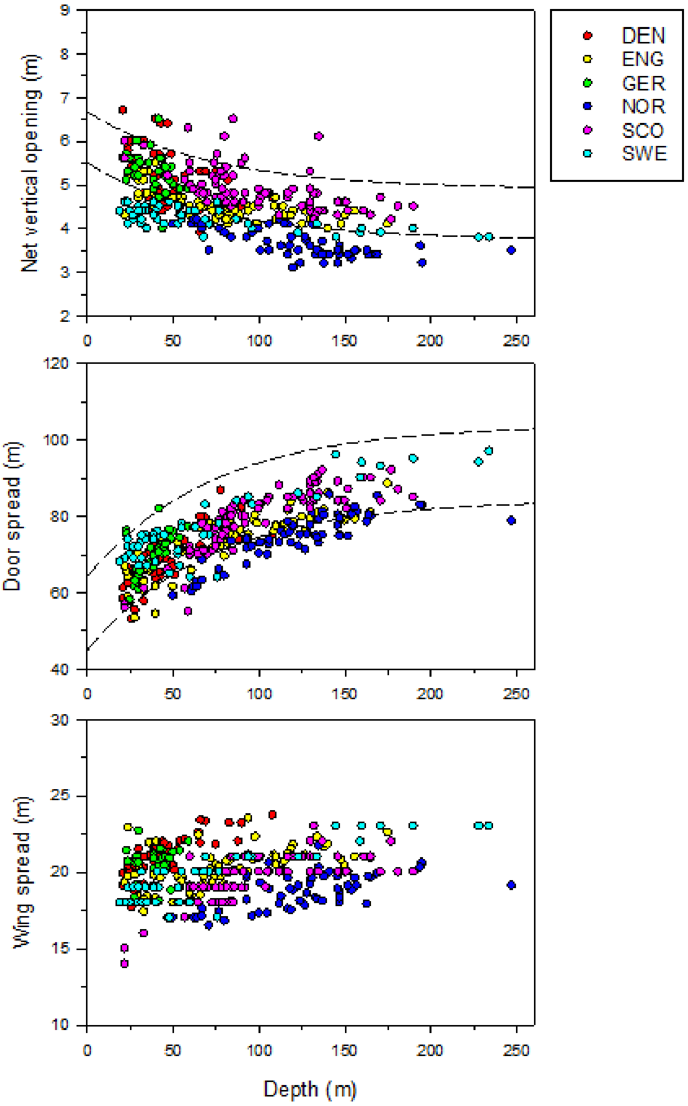


Figure A5.3. Comparison of trawl geometry related to depth between countries for the North Sea IBTS Q3 2022 (Dashed lines: theoretical lower and upper limits for the standard GOV 36/47 based on flume tank experiments, see manual).

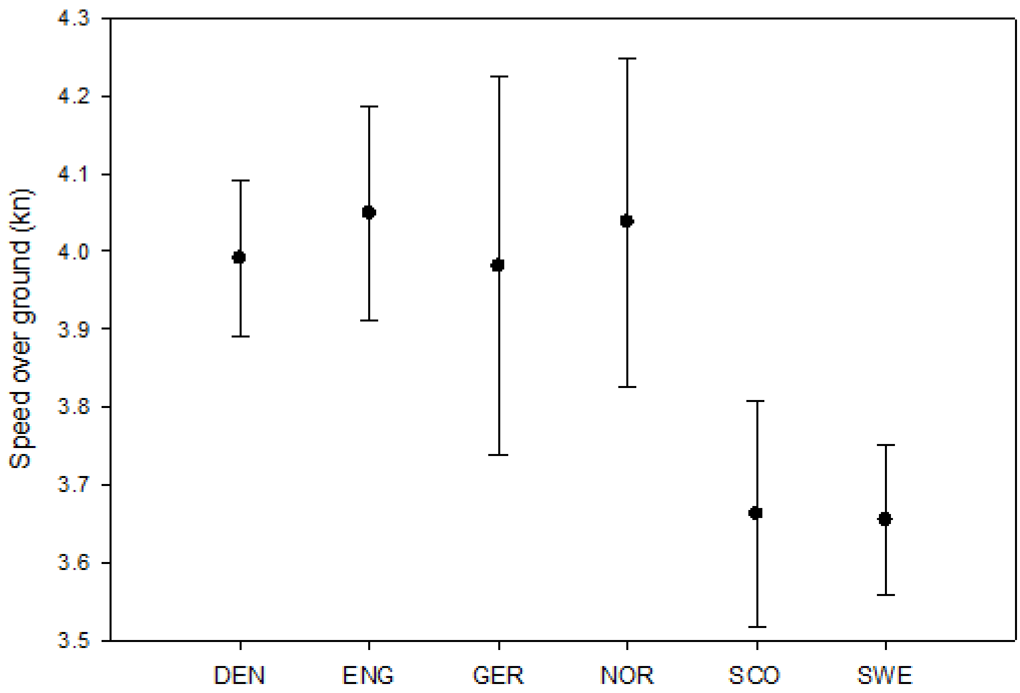


Figure A5.4. Average towing speed over ground by country for the North Sea IBTS Q3 2022 (mean ±; 1 standard deviation).

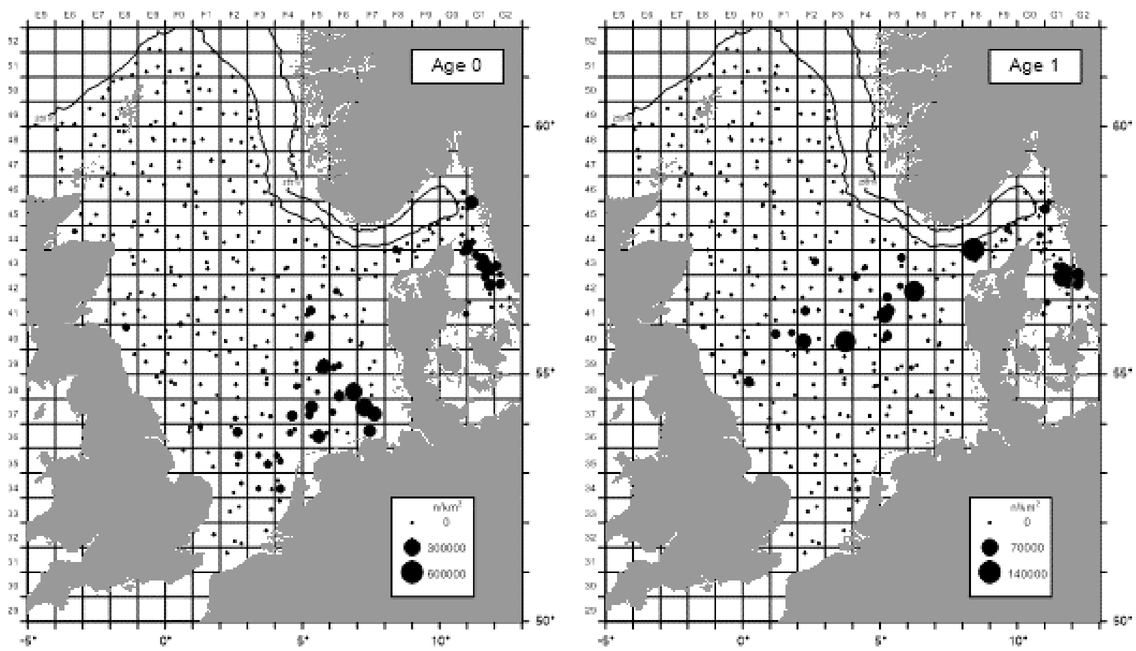


Figure A5.5a. Distribution of age 0 and age 1 herring in 3Q 2022.

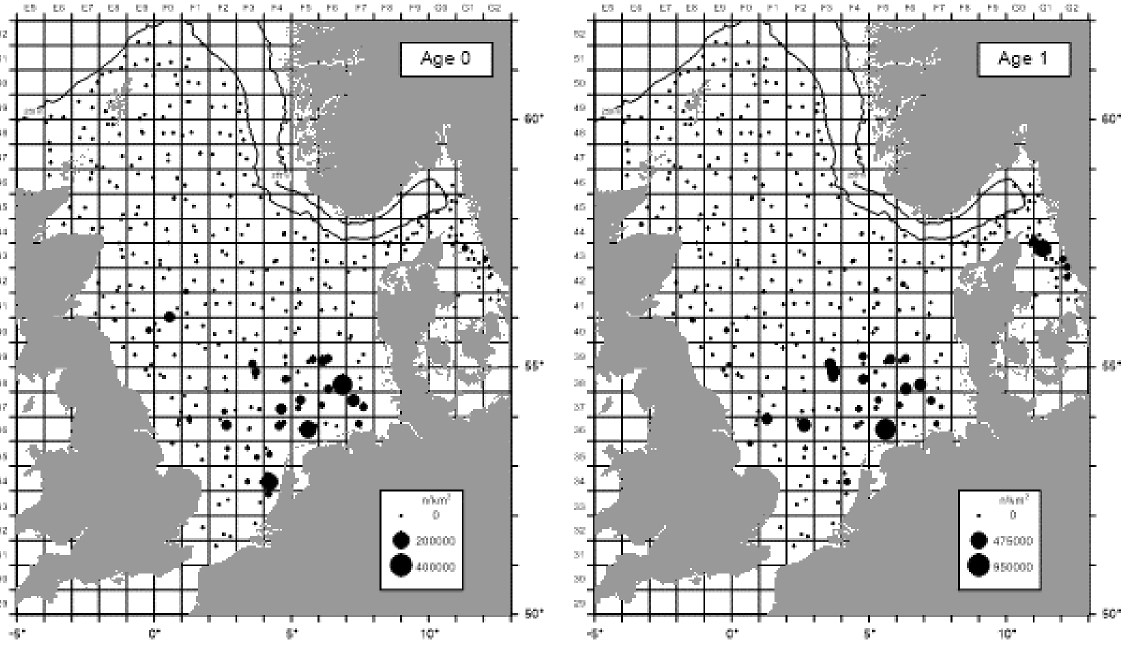


Figure A5.5b. Distribution of age 0 and age 1 sprat in 3Q 2022.

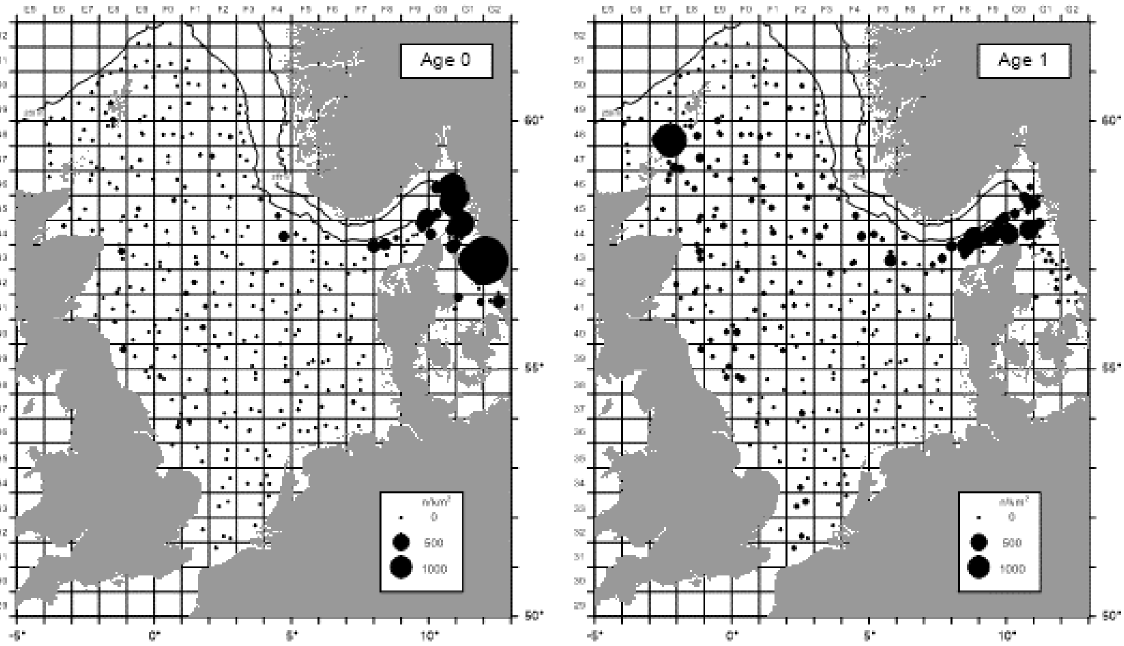


Figure A5.5c. Distribution of age 0 and age 1 cod in 3Q 2022.

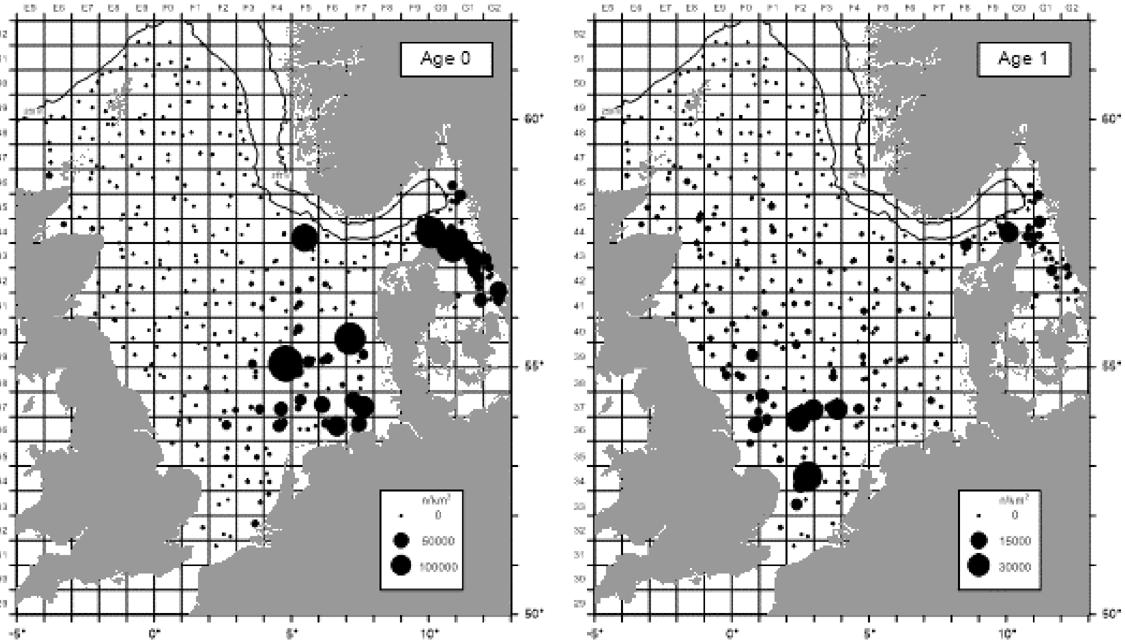


Figure A5.5d. Distribution of age 0 and age 1 whiting in 3Q 2022.

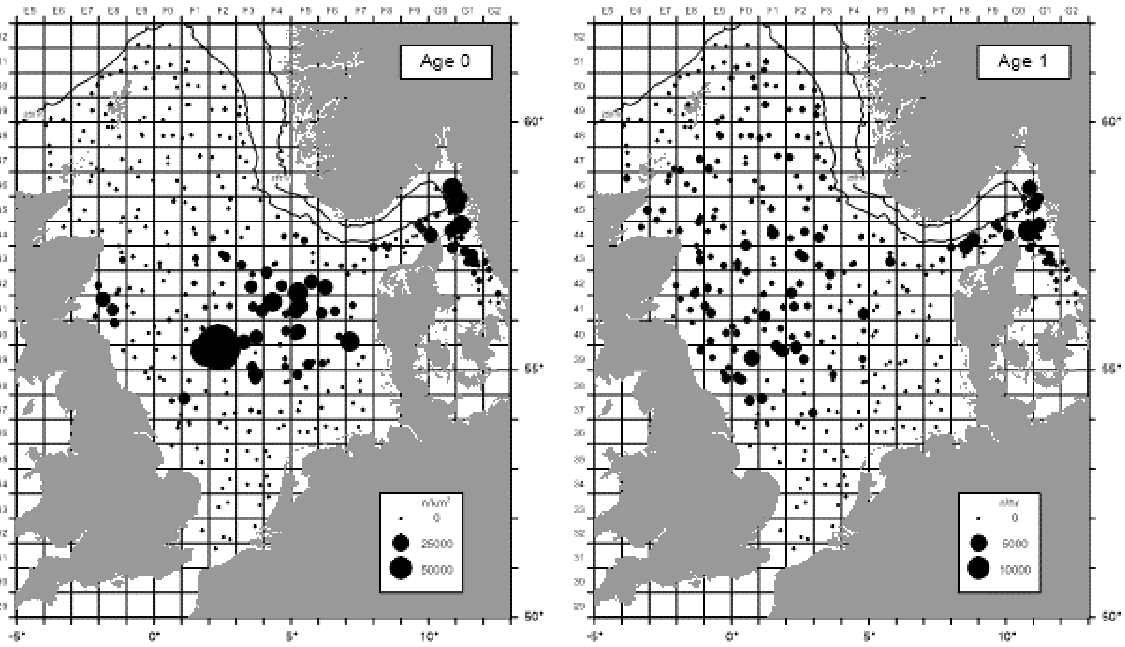


Figure A5.5e. Distribution of age 0 and age 1 haddock in 3Q 2022.

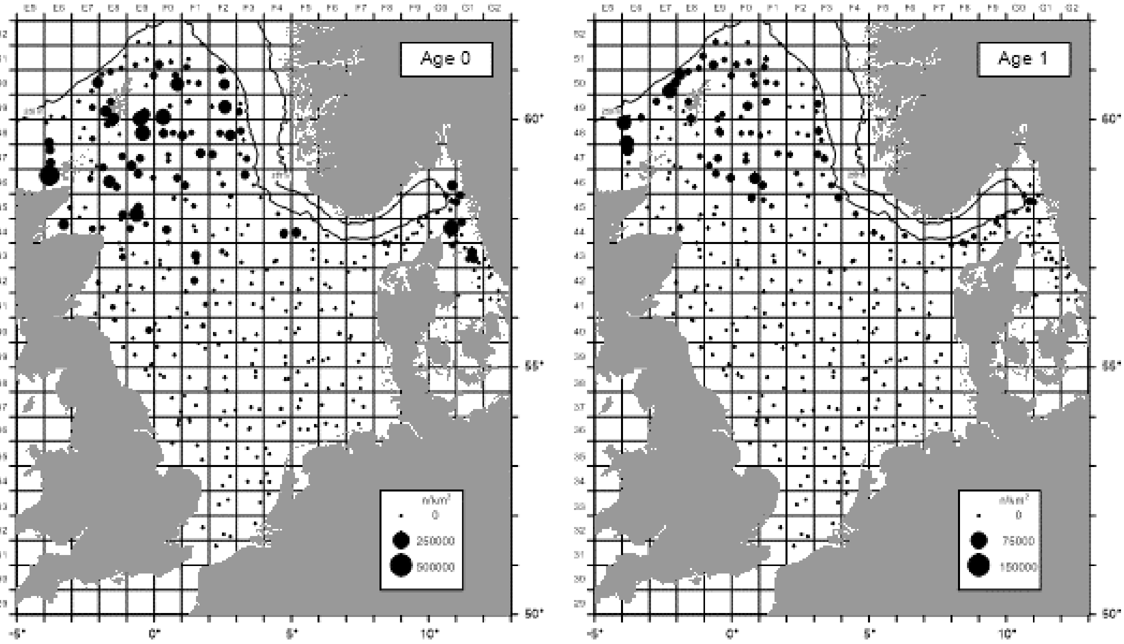


Figure A5.5f. Distribution of age 0 and age 1 Norway pout in 3Q 2022.

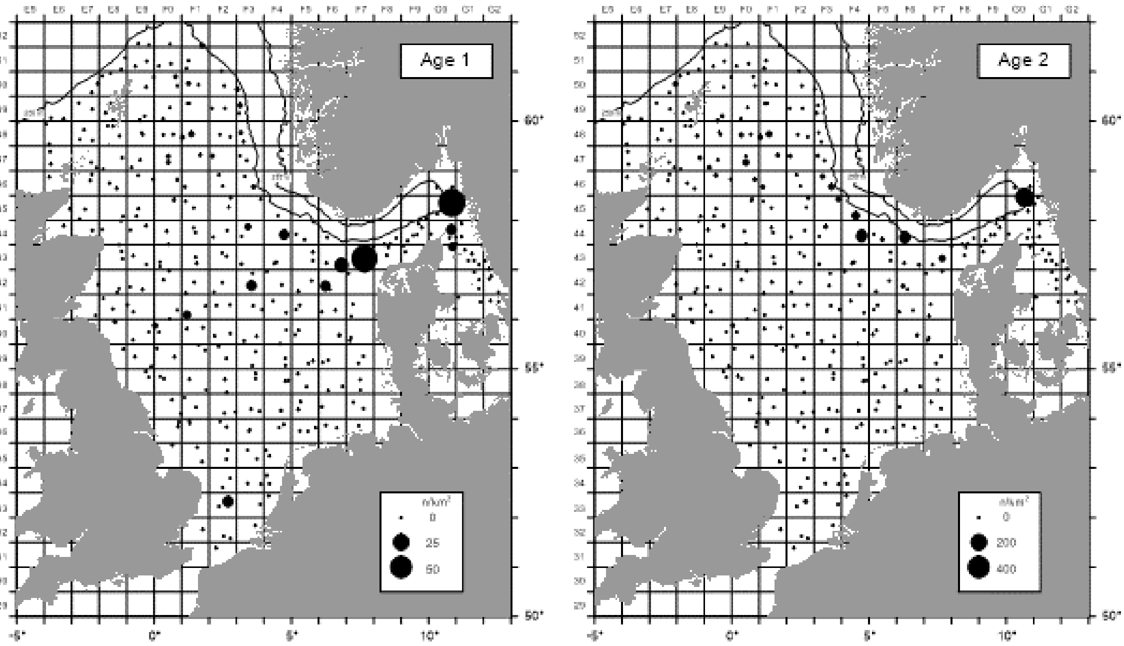


Figure A5.5g. Distribution of age 1 and age 2 saithe in 3Q 2022.

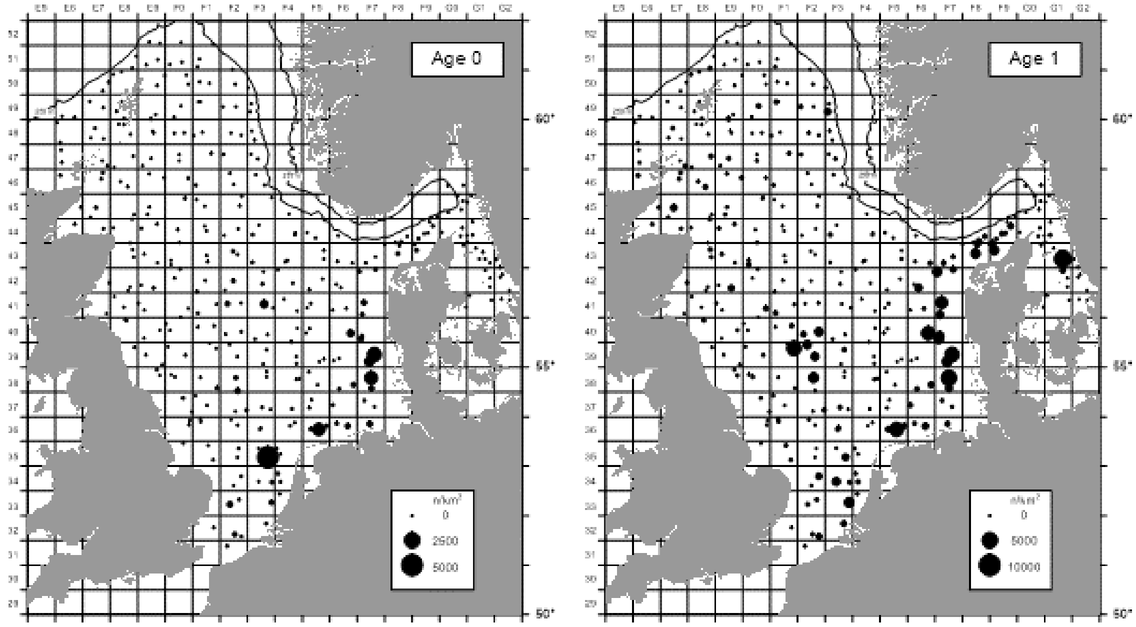


Figure A5.5h. Distribution of age 0 and age 1 mackerel in 3Q 2022.

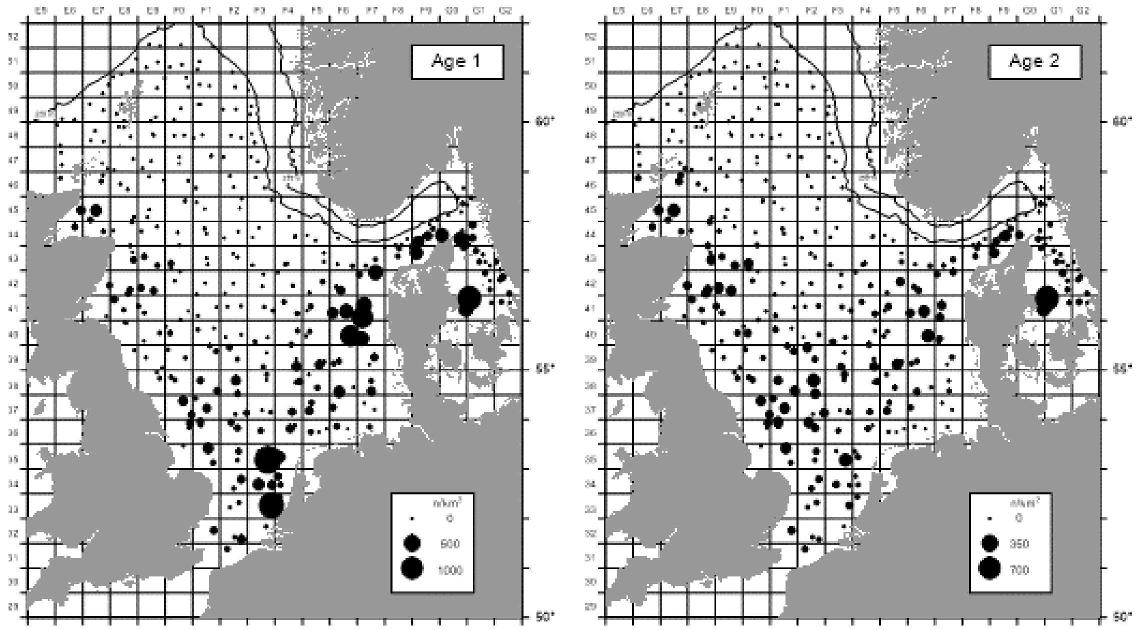


Figure A5.5i. Distribution of age 1 and age 2 plaice in 3Q 2022

Annex 6: North-eastern Atlantic surveys

(Coordinator: Finlay Burns)

A6.1 General overview

In 2022, seven vessels from six nations performed 13 surveys along the North-eastern Atlantic (NEA) IBTS area. A total of 987 valid hauls, out of the 1104 hauls planned, were accomplished over 346 days and distributed between all quarters of 2022 (Tables A6.1 and A6.2).

With the exception of the SCOWCGFS-Q1 that was cancelled due to serious vessel issues breakdown all of the other surveys were undertaken successfully, the majority being completed without significant issue.

Two surveys (Northern Ireland and Ireland) were undertaken during Q1 in February and March, with the Irish anglerfish survey once again extending into April. Scotland and Spain were active during Q3, with a slightly delayed Rockall survey taking place alongside the Porcupine Bank, and the Northern Spanish Coast shelf, with Portugal, France, Northern Ireland, Ireland, Scotland and Spain all active during Q4.

Data from all NEA surveys reported here during 2022 have been uploaded to DATRAS. Table A6.3 provides an overview of the numbers of fish for which individual biological data were collected per survey during the 2022 NEA IBTS survey schedule. Additional activities for all reported surveys are summarised in Table A6.4, with more detailed information for all reported surveys, including survey coverage plots and catch per unit effort (CPUE) estimates for target species, presented in the subsequent individual survey summary reports.

Gear parameter plots (warp out, door spread, wing spread, vertical opening) are also provided for each survey undertaken in the 2022 NEA IBTS (Figures A6.1a-l). Where different sweep configurations exist (long and short) within an individual survey, these are plotted separately within the same plot window.

Table A6.1. Summary of surveys, hauls and days at sea per country performed in the IBTS North-eastern Atlantic area in 2022.

Country	Survey	Hauls					Days
		Planned	Valid	Null	Additional	Total	
UK-Scot	UK-SCOROC-Q3	40	43	2	-	45	13
	UK-SCOWCGFS-Q4	60	60	4	-	64	21+2*
UK-NI	UK-NIGFS-Q1	61	59	-	-	59	16
	UK-NIGFS-Q4	62	45	3	-	48	16
Ireland	IE-IAMS-Q1/Q2	97**	91	-	3***	94	43
	IE-IGFS-Q4	171	152	4	-	156	44
France	FR-CGFS-Q4	74	68	-	-	68	16
	FR-EVHOE-Q4	158	124	1	3***	128	44
Spain	SP-PORC-Q3	80	80	3	11	94	37
	SP-NSGFS-Q4	115	115	1	15	131	35
	SP-GCGFS-Q1	45	44	1	-	45	13
	SP-GCGFS-Q4	45	45	1	-	46	14
Portugal	PT-PGFS-Q4	96	61	3	-	64	32
Total		1104	987	23	32	1042	346

* Additional days for COMPASS moorings

**Planned surveys reduced to 97 for 2022, due to Covid restrictions under Legs 1 and 2 only.

*** Additional planned trawls for deep-water monitoring.

Table A6.2. Overview of the North-eastern Atlantic IBTS surveys performed during 2022 (Q1–Q4).

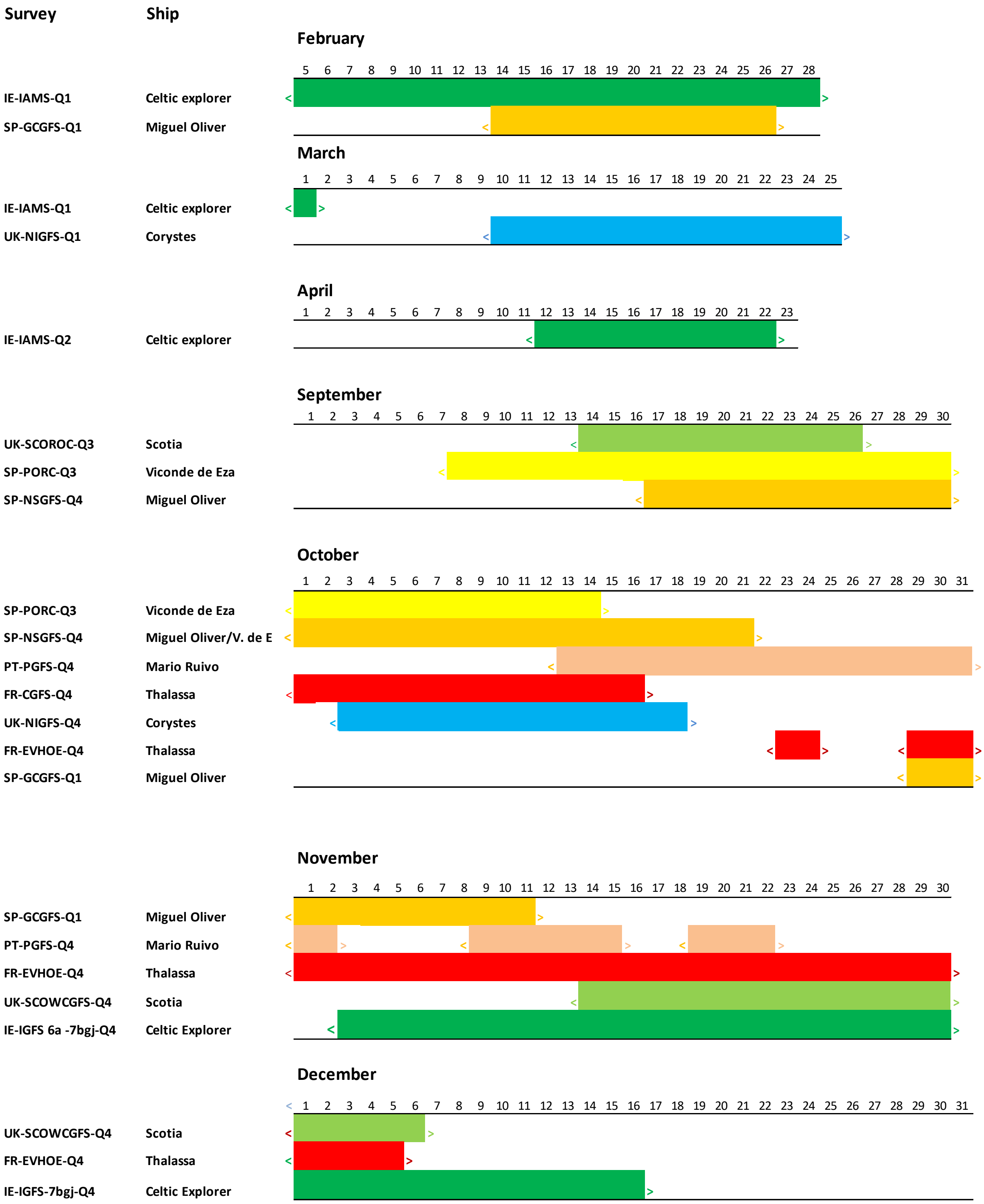


Table A6.3. Number of individuals sampled for maturity and/or age during the NEA IBTS in 2022.

Target species	UK-SCOROC-Q3	UK-SCOWCGFS-Q4	UK-NIGFS-Q1	UK-NIGFS-Q4	IE-IAMS-Q1/Q2	IE-IGFS-Q4	FR-CGFS-Q4	FR-EVHOE-Q4	SP-PORC-Q3	SP-NSGFS-Q4	SP-GCGFS-Q1	SP-GCGFS-Q4	PT-PGFS-Q4
Clupea harengus		256				174							
Gadus morhua	29**	86**	209	12	32	95	6	8					
Lepidorhombus boscii					209**			-	295	500			234/ 144[1]
Lepidorhombus whiffiagonis					1229	2425		380	564	541			14
Lophius budegassa					761	425		248	100[2]	61[2]			17[2]
Lophius piscatorius					615	514	1	132	203[2]	100[2]			
Melanogrammus aeglefinus	1725**	1512**	997	580	657	2138	58	304					
Merlangius merlangus	75**	1166**	1280	929	225	1417	157	89					
Merluccius merluccius	2***	234**	70*	9	9**	1009		751	410		1433/ 310[1]	1496/ 197[1]	1377/ 449[1]
Nephrops norvegicus									536*		61*	2906	188
Pollachius virens	1**	14**	6*		25	46		-					
Scomber scombrus	19	266				276	131	179		449			234/ 122[1]
Sprattus sprattus		199**											
Trachurus trachurus						1050				524			856/ 312[1]
Additional species													
Argyrosomus regius								3					
Aristeus antennatus													184†
Boops boops													257
Chelidonichthys cuculus							96	170					
Chelidonichthys lastoviza													7
Conger conger									45	58			
Trisopterus esmarki		425**											
Dicentrarchus labrax						7*	203	26					
Diplodus vulgaris													176
Dipturus batis cf. flossada	74†	12†			95*								
Dipturus intermedius		58†			114**								
Dipturus oxyrinchus	12†												
Engraulis encrasicolus								67		33			
Galeorhinus galeus		10†			5†								
Galeus atlanticus													89†
Galeus melastomus													38†
Glyptocephalus cynoglossus	105	58**			282**	402**		89					
Helicolenus dactylopterus									165	182			
Leucoraja fullonica	16†	3†											
Leucoraja naevus		44†			380								4
Loligo vulgaris												375	176
Loligo forbesi												55	
Micromesistius poutassou						793				355			584/ 198[1]
Microstomus kitt					198**	1144	7	124					
Molva dypterygia													
Molva molva	21***				80	43		4	9				
Mullus surmuletus							144	121					
Mustelus spp.		26†											
Octopus vulgaris											160*	135*	16

Target species	UK-SCOROC-Q3	UK-SCOWCGFS-Q4	UK-NIGFS-Q1	UK-NIGFS-Q4	IE-IAMS-Q1/Q2	IE-IGFS-Q4	FR-CGFS-Q4	FR-EVHOE-Q4	SP-PORC-Q3	SP-NSGFS-Q4	SP-GCGFS-Q1	SP-GCGFS-Q4	PT-PGFS-Q4
Pagellus acarne													210
Pagelus bogaraveo													17
Pagelus erythrinus													42
Parapenaeus longirostris											2599*	2120*	1399
Phycis blennoides								140	248	204			
Pleuronnectes platessa		165**	368	301		1217	233	4					
Trisopterus luscus							152	151					
Raja clavata													115†
Raja miraletus													19†
Raja montagui													20†
Raja oxyrinchus													13†
Sardina pilchardus								114					
Scyliorhinus canicula													204†
Sepia officinalis											55*	115*	1
Solea solea						334	152	84					
Scomber colias													318/ 167 (1)
Scophthalmus maximus		4***					10	4					
Scophthalmus rhombus		5***					3	-					
Spondyliosoma cantha-rus													140
Todaropsis eblanae													26*
Trachurus picturatus													856/ 312 (1)

† length, weight, sex and externally determined maturity only

* Samples collected for maturity only

** No maturity data collected

***length, weight and sex only

(1) Maturity / Otoliths

(2) Otoliths + Illicia

(3) Tagging

Table A6.4. Additional activities undertaken during the NEA IBTS in 2022.

	UK-SCOROC-Q3	UK-SCOWCGFS-Q4	UK-NIGFS-Q1	UK-NIGFS-Q4	IE-IAMS-Q1/Q2	IE-IGFS-Q4	FR-CGFS-Q4	FR-EVHOE-Q4	SP-PORC-Q3	SP-NSGFS-Q4	SP-GCGFS-Q1	SP-GCGFS -Q4	PT-PGFS-Q4
CTD (Temp+salinity)	1	1					1	1	1	1	1	1	1
Seafloor Litter	1	1	1	1	1	1	1	1	1	1	1	1	1
1Water sampler (Nutrients)								1					
Plankton sampling							1	1					
Benthos sampling						1	1	1	X	X	X	X	1
Observers: mammals, birds							1	1		*			
Additional biological data on fish	X	X			1	1	1	1	X	X	X	X	X
Fish stomach contents							X			1	1	1	X
Benthic samples (boxcore, video, dredge)	X							X	X	*	X		
Jellyfish	1	1	1	1	*	1	1	1					
Hydrological transect					*	*	1	1					
Acoustic for fish species							X	X					
Multibeam: seabed mapping							X	X					
Manta trawl; microplastics							1	1					
Acoustic mooring deployment	X	1					X						
Elasmobranch tagging			*	*	1	1	X						

1: Annually, X: Occasional

*: Not performed due to COVID-19 reduction in crew.

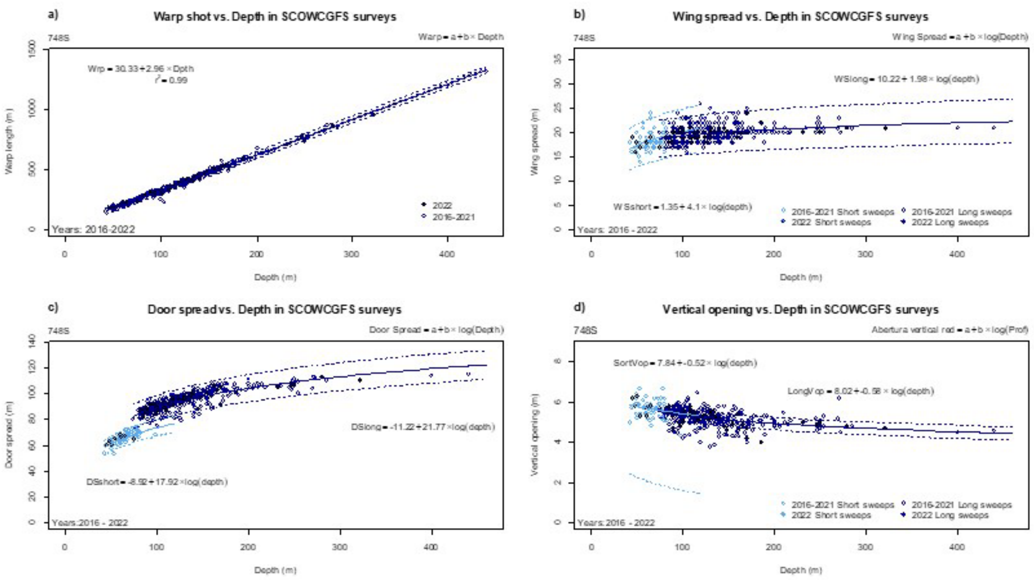


Figure A6.1a. Gear parameter plots forSCOWCGFS-Q4 ***(Q1 survey did not take place in 2022)*****.**

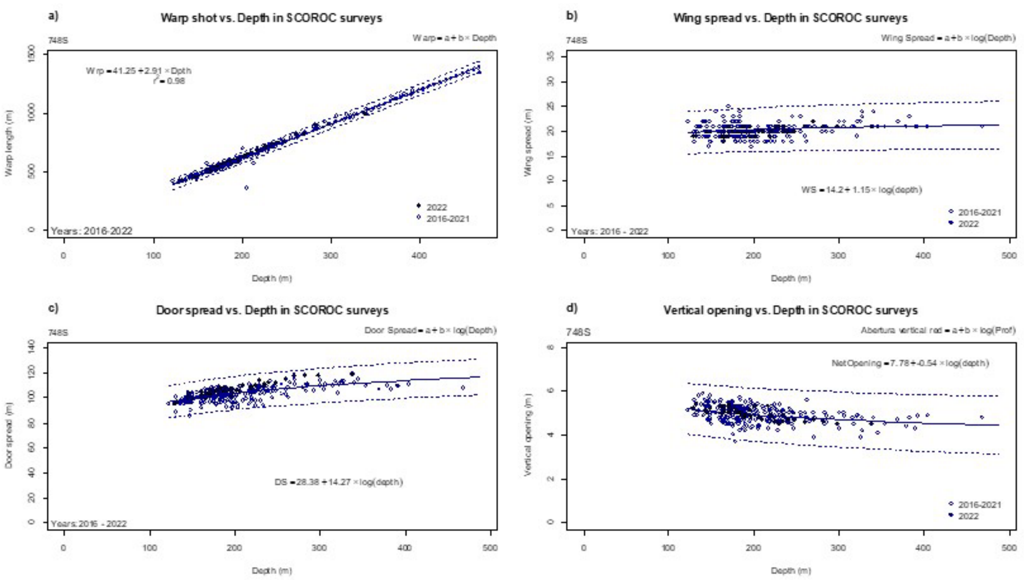
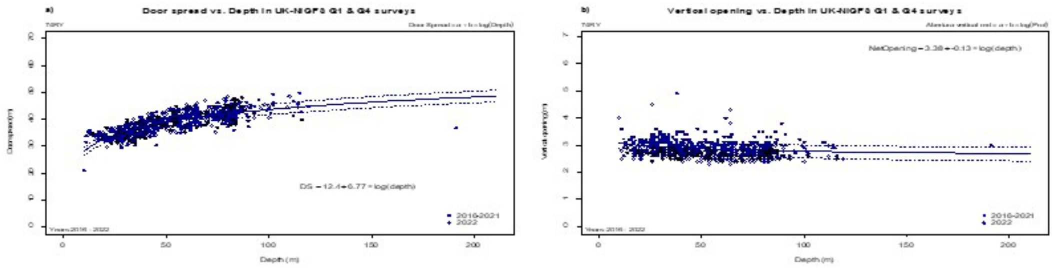


Figure A6.1b. Gear parameter plots for UK-SCOROC-Q3.



A6.1c. Gear parameter plots for UK-NIGFS-Q1. Notes: The reported depth (191 m) of one haul (2018, haul no. 37) was considered an input error and changed to 34 m (thus similar to the depth of hauls in the same area from other years). No wing parameter data from 2021 or 2022 surveys so plots have therefore been omitted.

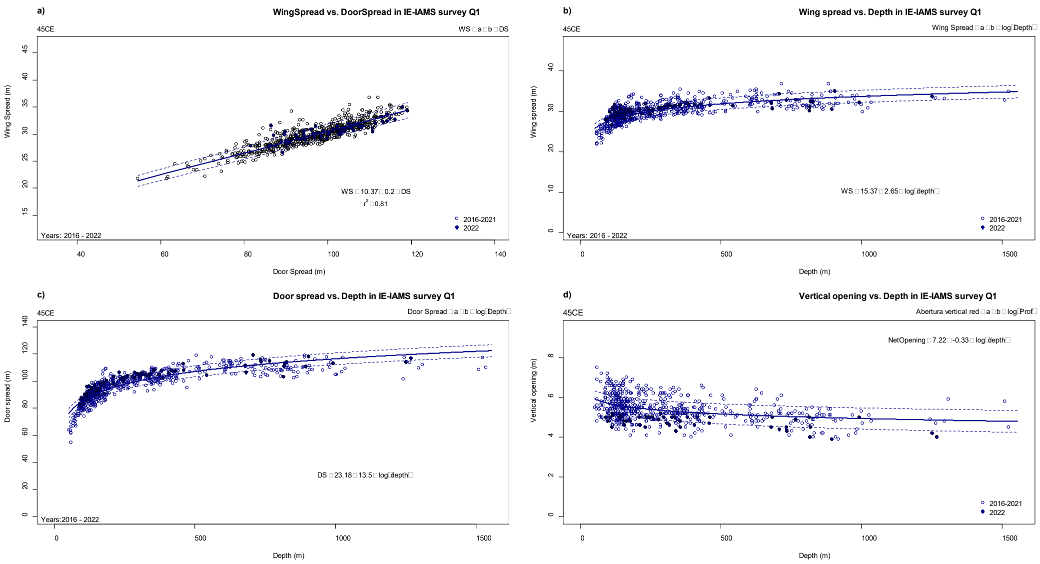


Figure A6.1d. Gear parameter plots for IE-IAMS-Q1.

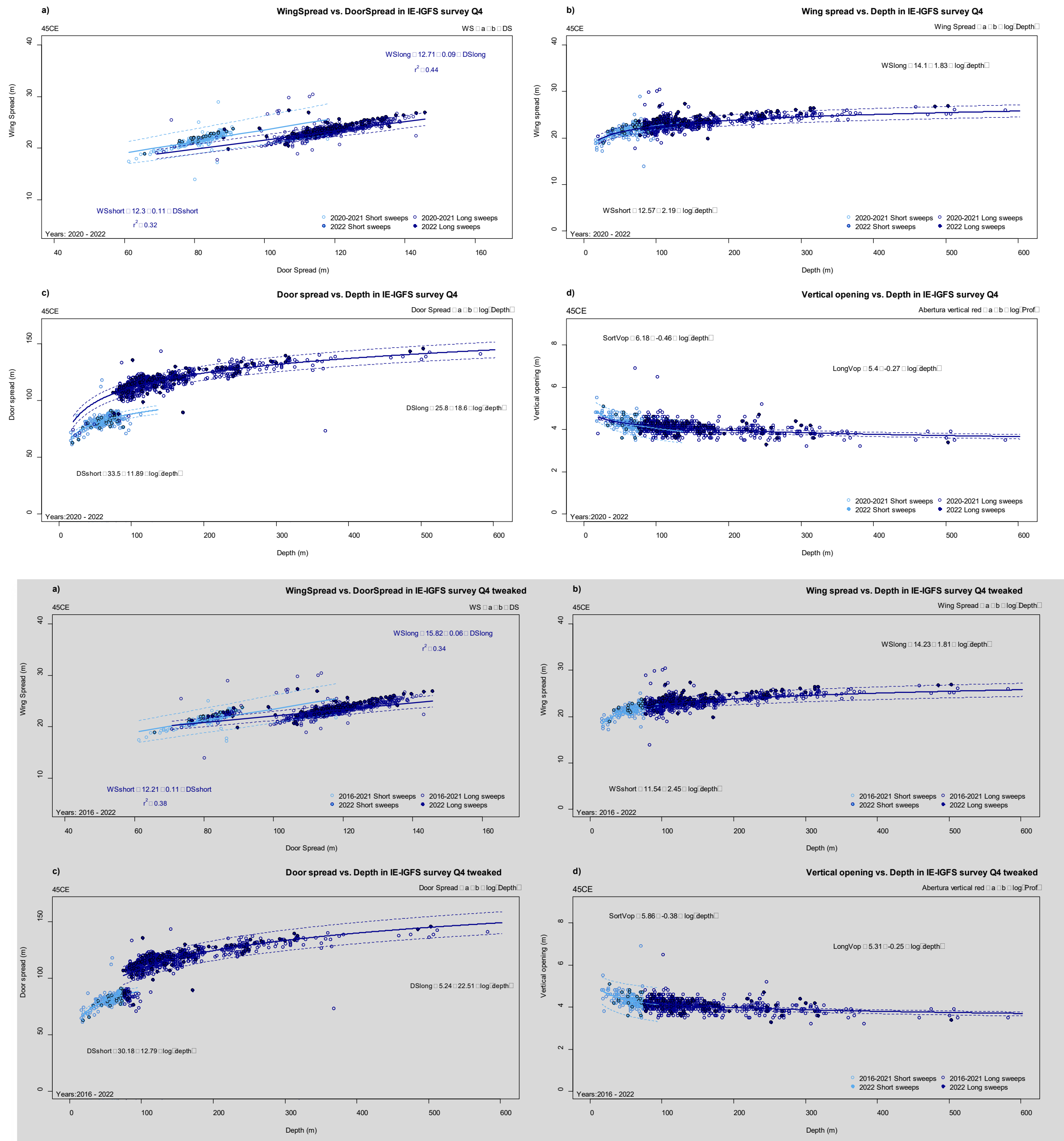


Figure A6.1e. Gear parameter plots for IE-IGFS-Q4. Notes: There is a potential issue with mis-assigned sweeps. The data in DATRAS (grey panel) were corrected/tweaked (bottom) by assigning 55 m / short sweeps to hauls shallower than 75 m, and 110 m sweeps to hauls deeper than 75 m, but there is still a degree of overlap between both sweeps ranges in panels b-d. MI to investigate and correct where necessary the affected records in DATRAS.

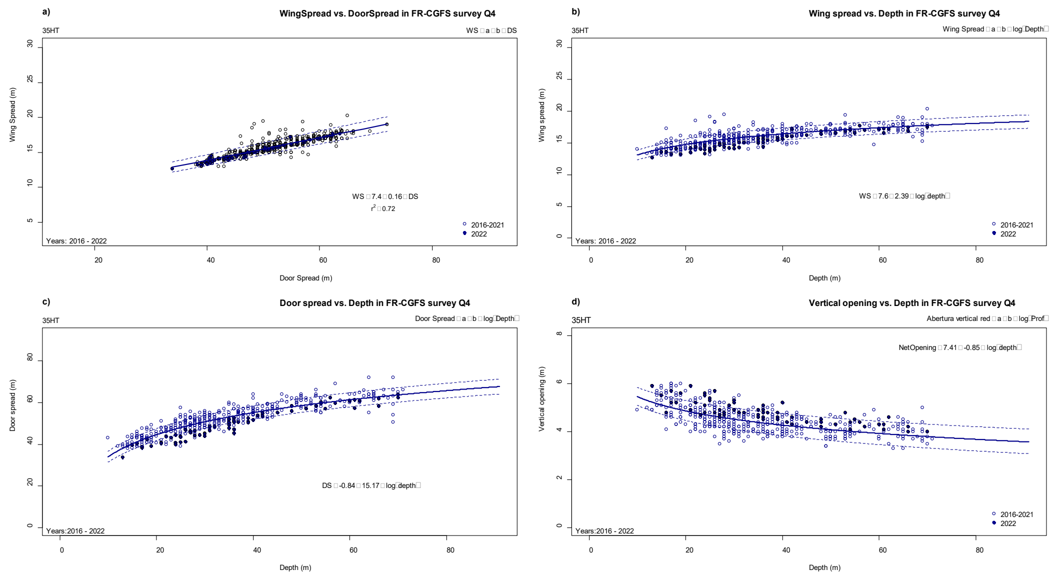


Figure A6.1f. Gear parameter plots for FR-CGFS-Q4.

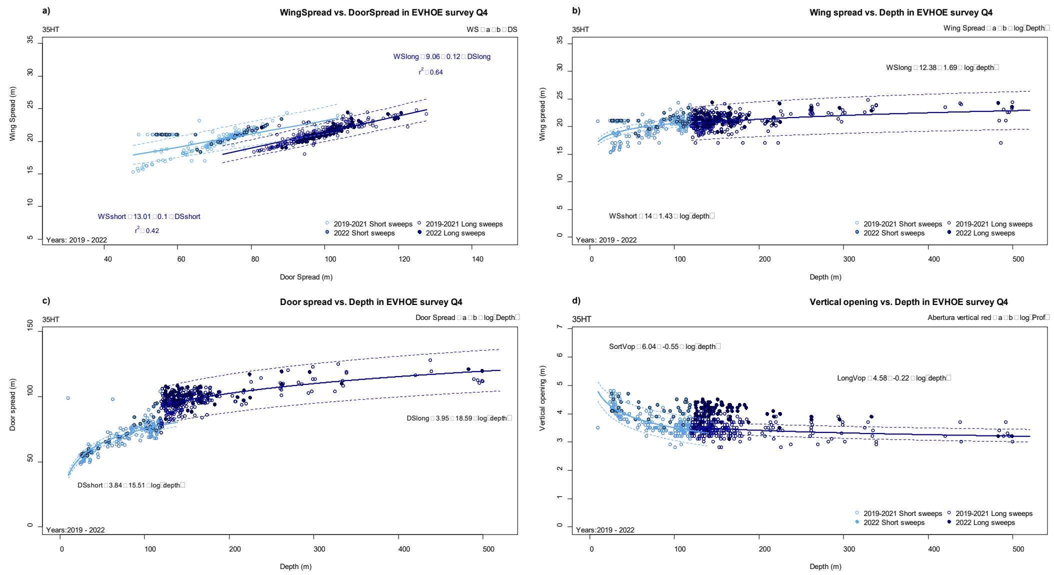


Figure A6.1g. Gear parameter plots for EVHOE-Q4. Seven HH records from 2018 with door spread = 0 were excluded from the plots but still exist on DATRAS and need to replaced with '-9'; potential problems with the assignment of long and short sweeps, or input errors. Data for 2019 indicates 50 m sweeps used at depths of 10–120 m and 100 m sweeps in depths >120 m, but earlier data are not consistent and several stations looks suspect as well as the sweep assignment. Two points from 2019 with depth = NA and sweeps = 50 also still on DATRAS.

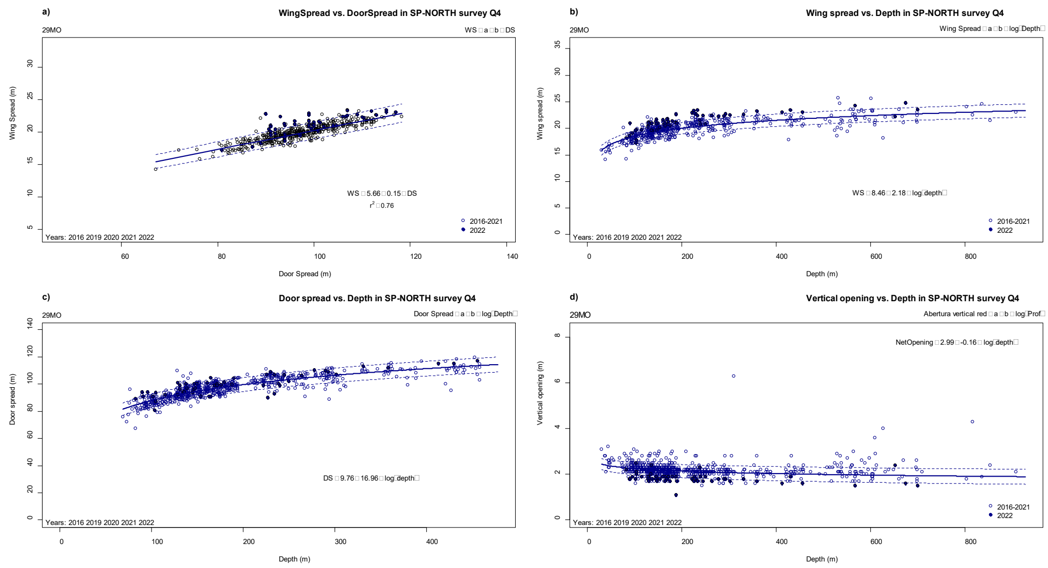


Figure A6.1h. Gear parameter plots for SP-NSGFS-Q4. Notes: Back to normal with entire survey undertaken on the one vessel (*R/V Miguel Oliver*)

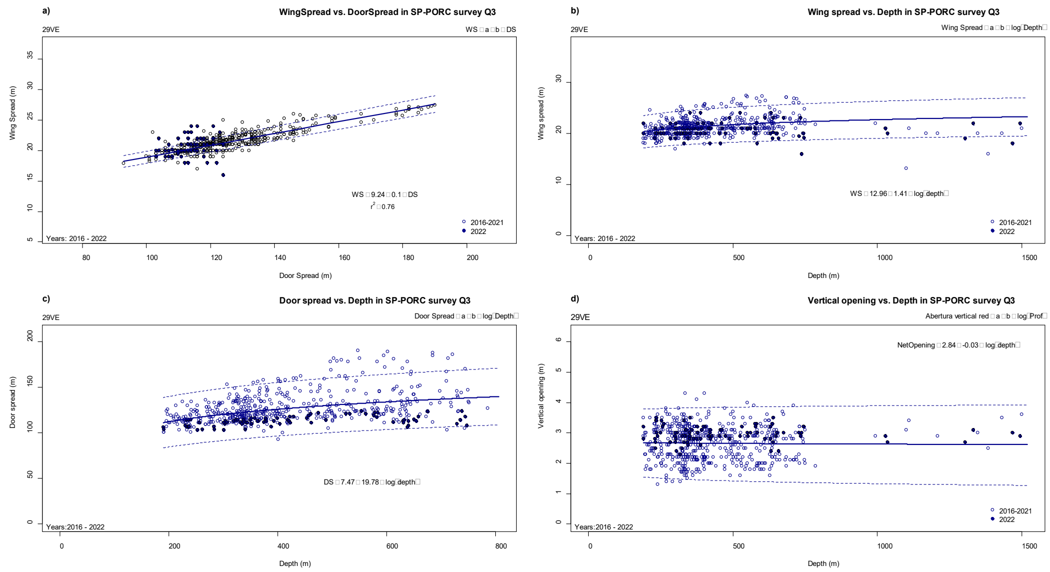


Figure A6.1i. Gear parameter plots for SP-PORC-Q3.

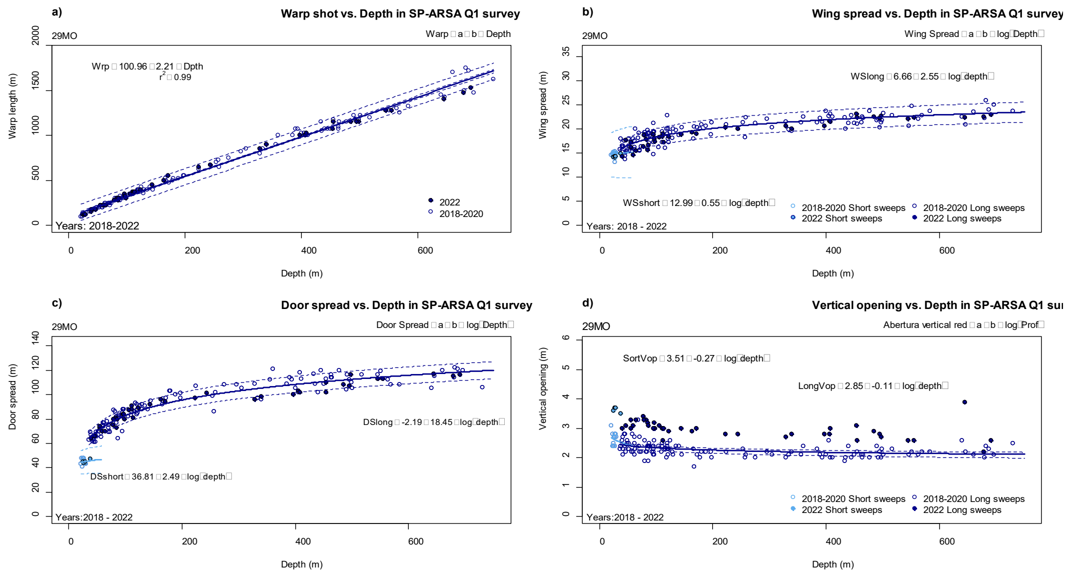


Figure A6.1j. Gear parameter plots for SP-ARSA-Q1. Survey returned after both Gulf of Cádiz surveys being cancelled in 2021. The vertical opening looks consistently high across high across the entire depth range and across both short and long sweeps and IBTSWG would urge IEO to further investigate the reasons behind this.

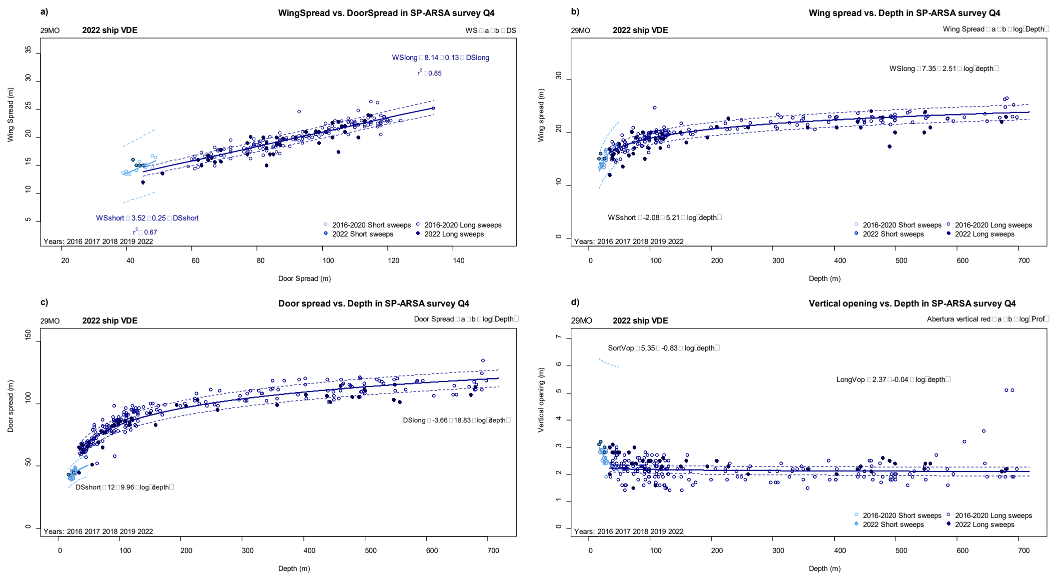


Figure A6.1k. Gear parameter plots for SP-ARSA-Q4. This survey was undertaken using the R/V Vizconde de Eza (*as opposed to the R/V Miguel Oliver*) and this will continue to be the situation going forward for both surveys (Q1 + Q4).

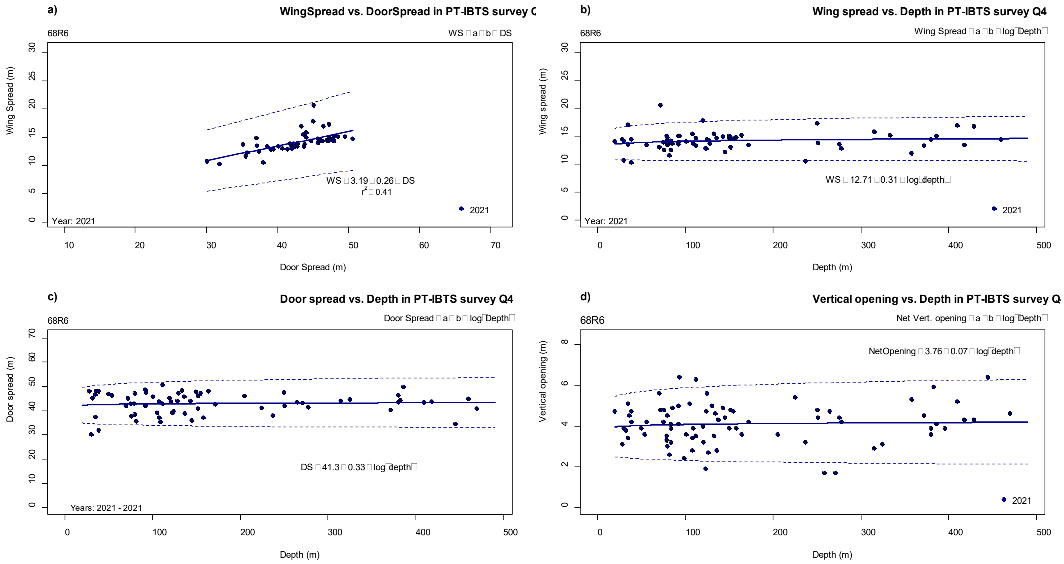


Figure A6.1l. Gear parameter plots for PT-PGFS-Q4. Notes: The new vessel used for the second time on this survey in 2022 however no scanmar data available and therefore only results provided from 2021 are shown above and without comparison.

A6.2 Northern Irish groundfish survey (Q1)

Nation:	**UK (Northern Ireland)**	**Vessel:**	Corystes
Survey:	Groundfish Survey CO1022	**Dates:**	March 10– March 25, 2022
Cruise	• To obtain information on spatial patterns of abundance of different size-and-age classes of demersal fish in the Irish Sea. • To obtain abundance indices of cod, whiting, haddock and herring for use at ICES Working Groups. • To quantify external parasite loads in whiting and cod by area. • To collect additional biological information on species as required under DCF. • To collect tissue samples for genetics studies on mature cod and hake. • To collect information on the extent of marine litter in the Irish Sea.		
Gear details:	A commercial rockhopper trawl fitted with a 20mm liner in the cod-end was towed over three nautical miles or one nautical mile in the Irish Sea and St George's Channel. Gear and towing procedures were those employed on all previous AFBI groundfish surveys.		
Notes from survey (e.g. problems, additional work etc.):	A stratified survey with fixed station positions was employed. The survey was divided into strata defined by length and substratum. The species composition of the catch at each station was determined, and length frequencies were recorded for each species. All cod, most hake and representative sub-samples of haddock and whiting were taken for recording length, weight, sex and maturity stages and for the removal of otoliths for ageing. The level of infestation of whiting and cod by external parasites was estimated from biological samples collected at each station. For all hauls fishing was carried out during daylight commencing each day at first light. 59 valid hauls were completed, 20 stations were towed for one hour and 38 stations were 20 min. tows. Stations 56 was towed for 1.75 nm and stations 81 and 75 were trawled for 2 nm. The width of seabed swept by the trawl doors increased from around 32 m in shallow water (30 m sounding) to around 48 m in deeper water (85 m sounding), with variations due to tidal flow. The average headline height was 2.4–2.9 m. Trawl parameters were consistent with previous surveys. Cod and whiting taken for biological analysis were screened for external parasites. Trawl data and length frequencies were archived using the newly developed groundfish survey database. Preliminary indices of abundance for 0-group and 1-group cod, whiting and haddock were obtained from the length distributions. More accurate indices will be available once the otoliths collected during the cruise have been aged. Additional Sampling: All litter picked up in the trawl was classified, quantified and recorded and uploaded to the national litter database from where it will eventually be uploaded to DATRAS. The litter was retained onboard for appropriate disposal ashore. Additional biological data and stomach samples were taken for food web analysis.		

Number of fish species recorded and notes on any rare species or unusual catches:	A total of 135 species were recorded during the survey of which 76 were measured for length frequencies. Biological data was recorded for a number of species in accordance with the requirements of the EU Data Regulations. A total of 3,196 biological samples were taken during the survey.

Table A6.5. Number of stations surveyed/gear.

ICES Division	Strata	Gear	Hauls Planned	Valid	Additional	Invalid	% Achieved	Comments
7.a	All	Rock-hopper	61	59	0	0	97	

Table A6.6. Numbers of biological observations per species collected during CO1022. These consist of length, weight, sex and age, unless specified (*a* = age data not collected length; *b* = weight, length and sex recorded).

Species		**No.**	**Species**		**No.**
Gadus morhua		209	*Scophthalmus maximus*	*b)*	0
Merlangius merlangus		1280	*Raja brachyura*	*b)*	16
Melanogrammus aeglefinus		997	*Raja clavata*	*b)*	156
Merluccius merluccius		70*	*Raja montagui*	*b)*	80
Pollachius pollachius	*a)*	6*	*Leucoraja naevus*	*b)*	14
Molva molva		0	*Squalus acanthias*	*b)*	0
Zeus faber		0			
Scophthalmus rhombus		0			
Pleuronectes platessa		368			
Microstomus kitt		0			
Lepidorhombus whiffiagonis		0			
Chelidonichthys cuculus		0			

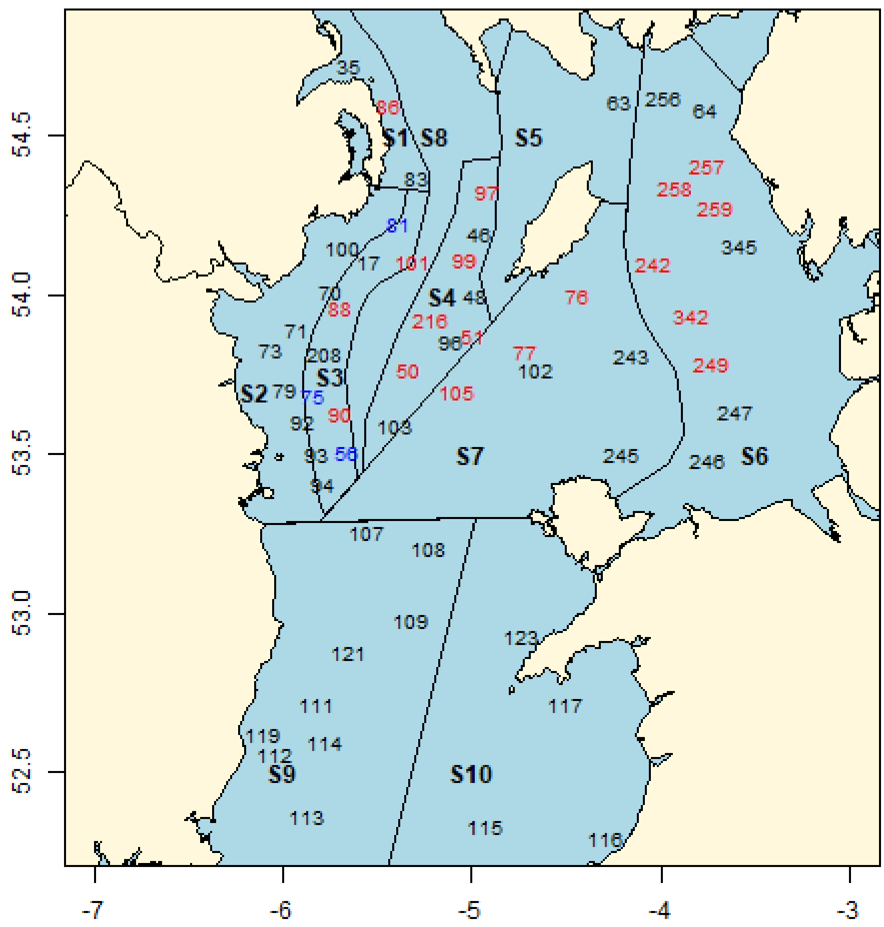


Figure A6.2. Map of the NI groundfish survey stations completed during CO1022. Stations sampled for either 60 min (3nm; red), 30 min (1.5 nm; blue) or 20 min (1nm; black).

A6.3 Irish Anglerfish and Megrim Survey (IAMS)

Nation:	Ireland	Vessel:	Celtic Explorer
Survey	IE-IAMS-Q1	Dates:	5 Feb – 1 Mar 2022 (7.b–c, j–k) 12 – 22 April 2022 (6.a)
Cruise	The main objective of the Q1 Irish Anglerfish and Megrim Survey is to obtain abundance and biomass indices for anglerfish (*Lophius piscatorius* and *L. budegassa*) and megrim (*Lepidorhombus whiffiagonis* and *L. boscii*) in Division 6.a (south of 58°N) and parts of Subarea 7 (west of 8°W). Secondary objectives are to collect data on the distribution and relative abundance of anglerfish, megrim and other commercially exploited species. The survey also collects maturity and other biological information for commercial fish species. The Irish Anglerfish and Megrim Survey (IE-IAMS-Q1) data are uploaded to DATRAS and is used as a tuning index for mon.27.78abd (WGBIE). Information on the IAMS-Q1 is also included as an annex of the Manual of the IBTS North Eastern Atlantic Surveys, SISP 15 (ICES, 2017).		
Gear details	The trawl is based on a standard commercial otter trawl used in the anglerfish fishery and is described in detail in Reid et al. (IJMS 2007, 64:8 p1503–1511).		
Notes	• Nine full days lost to bad weather in Feb; no weather downtime in April; 8 hours of technical downtime. • Additional deep water transects (500–1,500m) were added to survey protocols (3 additional days have been added to facilitate this work). This work is funded independently through EMFF.		
Number of fish species, unusual catches	In 2022, 81 species of teleost, 35 species of elasmobranch, 10 species of cephalopod and 20 other species/groups were recorded.		

Table A6.7. Stations fished (aim to complete 115 valid tows per year; including deep-water stations).

Divisions	Stratum	Stratum area (km²)	Valid tows	Swept area (km²)
6.a	VIa_Shelf_L	37,003	9	3.3
6.a	VIa_Shelf_M	4,746	4	1.6
6.a	VIa_Slope_H	3,114	5	2.1
6.a	VIa_Slope_M	3,044	7	3.4
7bcjk	VII_Porc_L	11,798	2	1.1
7.bcjk	VII_Shelf_H	50,764	13	6.5
7.bcjk	VII_Shelf_L	42,034	10	5.1
7.bcjk	VII_Shelf_M	14,621	8	4.0
7.bcjk	VII_Slope_H	35,768	22	12.0
7.bcjk	VII_Slope_L	7,914	1	0.6
7.bcjk	VII_Slope_M	29,406	7	4.2
6.a	DeepArea4	Additional sampling	(2)	
7.c	DeepArea5	Additional sampling	(1)	
	TOTAL	240,212	88(+3)	43.9

Table A6.8. Biological samples collected during IAMS2022. Sampling includes length, weight, sex, maturity and age material unless otherwise specified. Species denoted * sampled for length, weight, sex and maturity only; species denoted ** sampled for length and weight only.

Species	No.	Species	No.
Gadus morhua	41	*Deania calcea***	388
Lepidorhombus whiffiagonis	1462	*Dipturus intermedius***	326
Lophius budegassa	1101	*Etmopterus princeps***	27
Lophius piscatorius	1201	*Etmopterus spinax***	205
Melanogrammus aeglefinus	945	*Galeorhinus galeus***	10
Merlangius merlangus	378	*Galeus melastomus***	697
Molva molva	116	*Glyptocephalus cyno-glossus***	420
Pleuronectes platessa	370	*Hexanchus griseus***	21
Pollachius pollachius	11	*Lepidorhombus boscii***	310
Pollachius virens	62	*Leucoraja circularis***	31
Solea solea	24	*Magnisudis atlantica***	0
*Raja brachyura**	2	*Merluccius merluc-cius***	1232
*Raja clavata**	472	*Microstomus kitt***	433
*Raja montagui**	365	*Mustelus mustelus***	157
Dipturus batis (D. cf. *flossada)**	163	*Neoraja caerulea***	5
*Leucoraja naevus**	628	*Raja microocellata***	0
*Squalus acanthias**	649	*Rajella bigelowi***	0
*Apristurus aphyodes***	18	*Rajella fyllae***	35
*Apristurus laurussonii***	0	*Scophthalmus maxi-mus***	0
*Apristurus microps***	0	*Scophthalmus rhom-bus***	0
*Borostomias antarcticus***	0	*Zeus faber***	259
*Centrophorus squamosus***	141		
*Centroscyllium fabricii***	33		
*Centroscymnus coelolepis***	76		
*Centroscymnus crepidater***	18		
*Conger conger***	0		

Table A6.9. Summary statistics by stratum. Stratum area is given in Km², No. hauls is the is the number of valid hauls in each stratum and Swept-area is the total area swept between the doors in each stratum (in Km²), catch numbers are given for *L. piscatorius* (MON), *L. budegassa* (WAF), *L. whiffiagonis* (MEG) and *L. boscii* (LBI).

Stratum	Stratum area	No. hauls	Swept area	Catch number			
				MON	WAF	MEG	LBI
VIa_Shelf_L	37,003	9	3.3	60	4	26	0
VIa_Shelf_M	4,746	4	1.6	9	36	47	0
VIa_Slope_H	3,114	5	2.1	46	6	83	11
VIa_Slope_M	3,044	7	3.4	83	0	66	0
VII_Porc_L	11,798	2	1.1	17	0	16	261
VII_Shelf_H	50,764	13	6.5	62	310	283	35
VII_Shelf_L	42,034	10	5.1	76	104	63	0
VII_Shelf_M	14,621	8	4.0	62	170	76	10
VII_Slope_H	35,768	22	12.0	152	201	864	227
VII_Slope_L	7,914	1	0.6	0	5	2	2
VII_Slope_M	29,406	7	4.2	61	0	24	8
Total	240,212	88	43.9	628	836	1,550	554

Table A6.10. Estimated numbers (millions) and biomass (kT) in the survey area, with CV and confidence intervals (CI_{lo} and CI_{hi}). Only fish >500g live weight (approximately 32cm) were included in the estimate.

	VIa MON	VII MON	VIa WAF	VII WAF
NumMln	1.881	9.339	1.140	27.069
NumCV	42.403	15.404	25.292	18.016
$NumCI_{lo}$	0.318	6.520	0.575	17.511
$NumCI_{hi}$	3.443	12.159	1.704	36.628
BiomkT	3.162	15.951	0.504	16.213
BiomCV	44.231	9.994	30.227	15.803
$BiomCI_{lo}$	0.421	12.827	0.205	11.191
$BiomCI_{hi}$	5.903	19.076	0.803	21.235

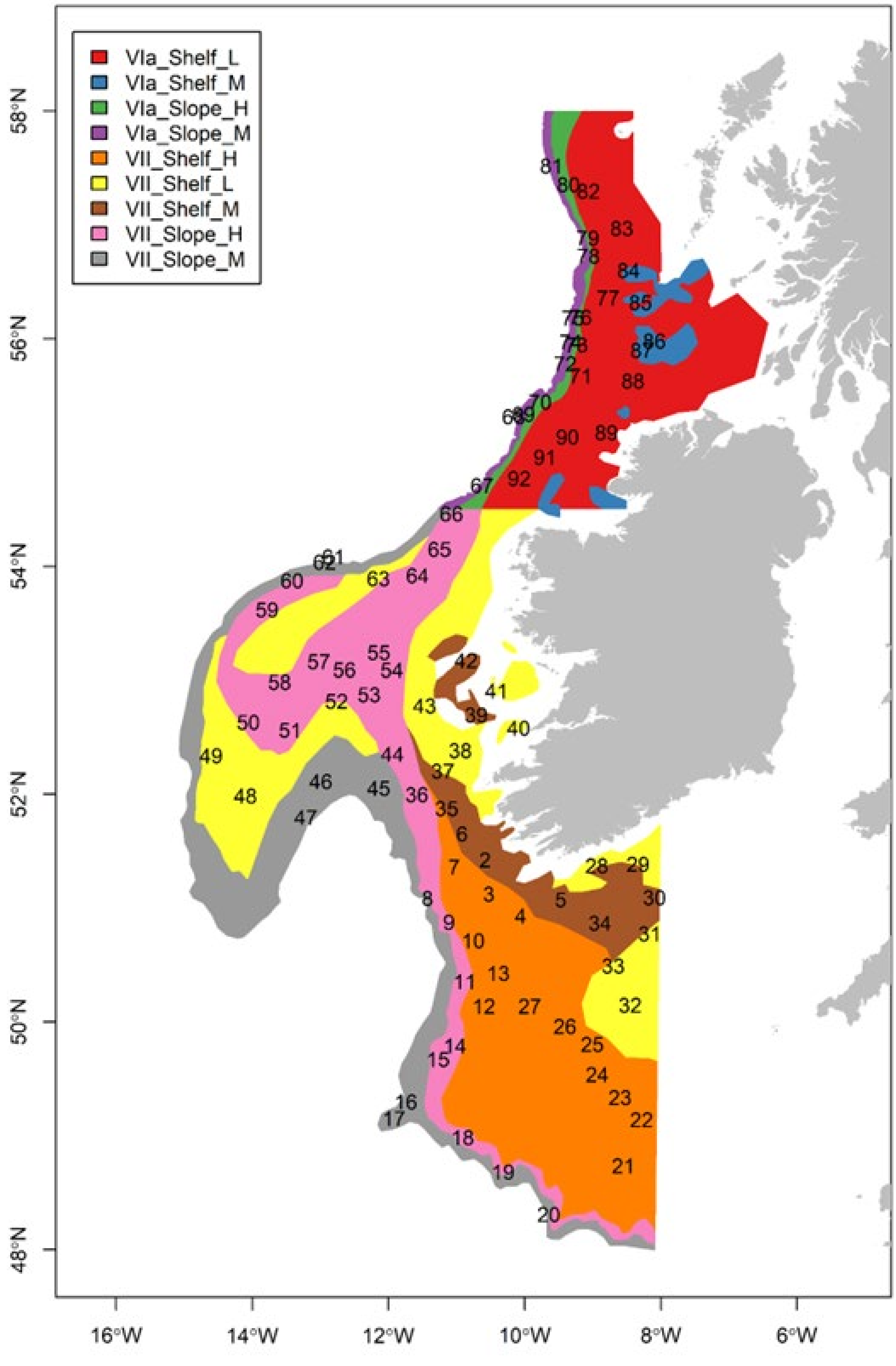


Figure A6.3.Map of valid survey stations completed by the Irish Anglerfish and Megrim Survey in 2021. The numbers refer to the haul number.

A6.4 Spanish Gulf of Cádiz groundfish survey (SP-GCGFS-Q1)

Nation:	**SP (Spain)**	**Vessel:**	**Miguel Oliver**
Survey:	SP-GCGFS-Q1 (ARSA 0322)	**Dates:**	14 – 26 February 2022
Cruise:	Spanish Gulf of Cádiz bottom trawl survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Gulf of Cádiz area (Division 9.a). The primary species are hake, horse mackerel, wedge sole, sea breams, mackerel and Spanish mackerel. Data and abundance indices are also collected and estimated for other demersal fish species and invertebrates as rose and red shrimps, *Nephrops* and cephalopod molluscs.		
Survey Design:	The survey is random stratified with 5 depth strata (15–30 m, 31–100 m, 101–200 m, 201–500 m, 501–800 m). Stations are allocated at random according to the strata surface.		
Gear details:	Baca 44/60 with Thyborøn doors (350 kg).		
Notes from survey (e.g. problems, additional work etc.):	Hydrographic data at each trawl station was collected using a net-mounted CTD. Additionally, 10 trawls with beam trawl and 28 dredges were carried out with a box-corer. Analyses of stomach contents of main demersal species was performed in all hauls during the survey.		
Number of fish species recorded and notes on any rare species or unusual catches:	Overall a total of 153 fish, 52 crustacean, 52 molluscs and 19 echinoderm species were recorded.		

Table A6.11. Numbers of stations fished (aim: to complete 45 valid tows per year).

ICES Division	Strata	Gear	Stations					
			Planned	Valid	Additional	Invalid	% Fished	Comments
9.a	All	Baca 44/60	45	44	-	1	98%	
	TOTAL		45	44	-	1	98%	

Table A6.12. Numbers of individuals biologically sampled (length, weight, sex, maturity, age) by species. Species noted * recorded for maturity only.

Species	No.	Species	No.
Merluccius merluccius	310	*Nephrops norvegicus**	61
*Merluccius merluccius**	1433	*Sepia officinalis**	55
*Parapenaeus longirostris**	2599	*Octopus vulgaris**	160

Table A6.13. Biomass estimates for the main species in the Q1 Gulf of Cadiz bottom trawl survey.

Biomass and number estimates								
			Biomass index			Number index		
Species	Strata	Valid tows	y_i kg/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change	y_i n/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change
Merluccius merluccius	All	44	2.19	-24.8	6.8	138.3	289.4	56.8
Micromesistius poutassou	All	44	3.13	1322.7	-68.8	70.5	3098.0	-50.6
Nephrops norvegicus	All	44	0.05	-96.0	181.7	1.7	-97.4	385.7
Parapenaeus longirostris	All	44	1.95	97.5	26.5	375.4	149.8	3.2
Octopus vulgaris	All	44	1.24	109.3	-20.2	1.9	111.5	-28.8
Loligo vulgaris	All	44	0.58	0.9	137.3	2.5	3.6	-11.0
Sepia officinalis	All	44	0.24	-64.4	-48.8	0.5	-72.7	-52.6

$\mathbf{y_i}$, year estimate (2022); $\mathbf{y_{i-1}}$, previous year estimate (2020); $\mathbf{y_{(i,i-1)}}$, Average of last two year estimates (2022 and 2020); $\mathbf{y_{(i-2,i-3,i-4)}}$, Average of the previous three year estimates (2019, 2018 and 2017).

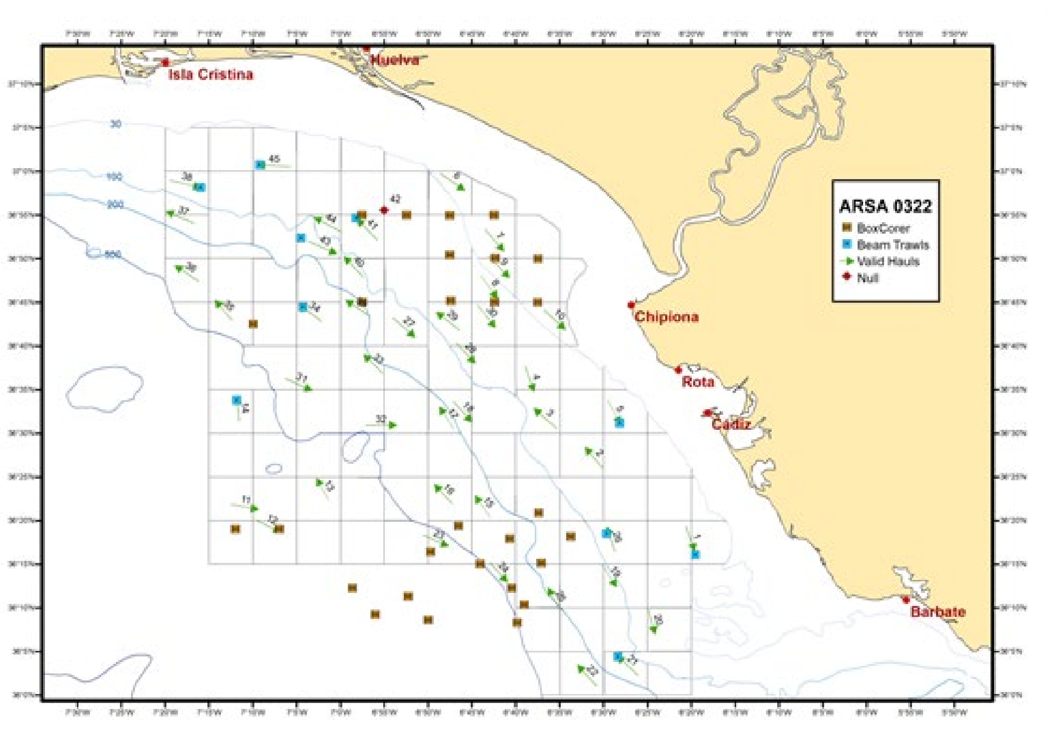


Figure A6.4. Trawl stations in Q1 Gulf of Cádiz 2022 survey.

A6.5 Scottish Rockall Survey (SCOROC-Q3)

Nation:	Scotland	**Vessel:**	Scotia
Survey:	1122S (Rockall Haddock)	**Dates:**	14 – 26 September 2022
Cruise:	Q3 Rockall 2021 survey aims to: • Undertake the bottom trawl survey of haddock (*Melanogrammus aeglefinus*) and other species on the upper Rockall Bank within the 350 m isobaths. • Undertake vertical CTD deployments at selected trawl stations for collection of environmental data covering the overall survey area. • Undertake comparative habitat mapping over selected areas within and without the Rockall Haddock Box (RHB) and to map the habitat in data-poor sectors in other protected areas. • Collect additional biological data in line with the UK Work Plan, the EU Multi Annual Plan as appropriate and by request. • Record marine litter at each trawl station in line with UK Marine Strategy. • Recover an acoustic monitoring mooring deployed in 2021 at a depth of 298 m at position 56° 35.97N, 14° 18.00W if conditions and logistics permit.		
Gear details:	Strengthened GOV incorporating ground-gear D and 97 m sweeps was used at all stations. The following parameters were recorded during each tow using Scanmar hardware and vessel's own navigation system: headline height, wing spread, door spread, speed over the ground and distance covered. A bottom contact sensor was attached to the ground-gear and downloaded each tow to monitor contact with the seabed. VMUX towed video chariot with HD camera system and integrated CTD with Ranger 2 USBL positioning system		
Notes from survey (e.g. problems, additional work etc.):	The survey design since 2011 has been random-stratified with primary trawl locations randomly distributed within four sampling strata defined by depth contour: 0-150 m, 150–200 m, 200–250 m, 250–350 m. The survey area excludes three protected areas, the boundaries of which lie mainly or partly within the 350 m isobath: two Special Areas of Conservation at the northeast and northwest of the bank and a NEAFC closure to the southwest. Trawls were undertaken within a radius of 5 nm to the specified sampling position and as near to the actual point as was practicable. If for any reason the trawl could not be undertaken at the primary site then a replacement was taken from a list of secondary random positions. There were 43 valid and two invalid trawls completed (Table A6.14) within the survey area with all fishing taking place during daylight hours. Figure A6.5 displays sampling strata, trawl locations and haul numbers (200–244). Catches overall were large with a total of 44.049 t recorded for a combined trawl time of 18.70 hours. As part of efforts to maintain operations within manageable time limits as set out in the cruise programme, a significant amount (44%) of trawls were of duration reduced from the standard of 30 min. Nevertheless, catches averaged over 1 t (range 0.5–2.8 t). Overall, the survey went with few interruptions bar two foul hauls, neither of which incurred lengthy repairs, and a period of downtime on 18 Sep during the State Funeral for Her Majesty The Queen, arranged by agreement between vessel master and SIC allowing all who wished to attend the broadcast of the procession and service.		

	Biological sampling: Ages were recorded for haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus*, cod *Gadus morhua* and mackerel *Scomber scombrus* along with sex, and weight data. All otoliths were aged post-cruise back at marine lab. Data on other species sampled for biological information are summarised in Table A6.17. **Hydrography:** While the intention was to collect hydrography data from a subset of trawl stations only the CTD unit itself proved troublesome with many failed casts. Only four CTD casts produced usable data and the use of the unit was discontinued after station 229. A CTD minilogger was attached to the headline and data was collected thereafter for all trawl stations 230–244. **Marine litter:** All litter picked up in the trawl was classified, quantified and recorded, then retained for appropriate disposal ashore. Litter data will be put on the MS database and subsequently uploaded to DATRAS. **Non-indigenous Invasive Species:** All catch, fish and benthos were screened as far as possible for the presence of non-indigenous species, though none were evident. **Habitat mapping** The VMUX (Chariot) system collects high-definition camera footage at a low towed speed while displaying accurate positioning along with real-time measurements of depth, temperature and salinity at the locality. Using this method, a total distance of ~286 km of seabed (over 100 hours of high-definition video footage) was visually surveyed during 1122S. Exceptionally for chariot work, no time was lost due to ether technical issues, maintenance requirements or sea conditions during this cruise. Footage was collected from the East Rockall Bank SAC (1 run, a distance of ~55 km), North West Rockall Bank SAC (2 runs, ~61 km in total), SW Rockall (Empress of Britain) NEAFC closed area (2 runs, ~26km in total). Sets of paired sites (one within and one without the boundaries of the RHB in locations considered similar in environment in terms of depth, sediment type etc.) were mapped for comparative purposes and 8 runs (4 pairs, ~120 km in total) were completed. An additional single chariot run of ~12 km was completed in the Geikie Slide and Hebridean Slope MPA on the return journey. All chariot runs in closures other than the RHB provided visual information in sections where that is currently lacking which, following analysis, will be used to update ICES/NAFO Working Group on Deep-water Ecology (WGDEC) with VME data. Studies of the RHB paired site footage will further efforts in understanding changes in benthic habitats when fishing pressure is removed from an area and as such will feed into Scottish MPA and HPMA projects. **Acoustic Mooring** Despite considerable effort in excellent conditions no contact with the mooring could be made and thus recovery procedures were not instigated. Logistics prevented any subsequent attempt at the same position. **Additional Samples and Miscellaneous Requests** • Whiting: An otolith plus tissue sample were collected from 71 whiting for a study on population genetics at the Agricultural Food and Bioscience Institute, Belfast. • Ling: An otolith plus length and weight data was collected / recorded from all ling (*Molva molva*) to fulfil a request from Cefas.

	• Deepwater squaliforms: A tissue section including muscle, skin and vertebrae were collected from 54 *Etmopterus spinax* and preserved in ethanol for a collaborative population genetics study (MS / Nord University, Bodø, Norway). • Porifera: Axinellida - tissue samples and reference specimens from ~35 specimens of mainly *Phakellia ventilabrum* were collected for phylogenetic study (Natural History Museum). • Holothuria: 5 sets of 8–10 *Parastichopus tremulus* were preserved in 4% formalin for collaborative studies on plastics in macrobenthos stomach contents MS / Dove Marine (Newcastle University). • All shelled molluscs were retained frozen for identification and studies on distribution by D. Mackay. • Other macrobenthos from trawls were identified as far as possible at sea and recorded to provide data that will feed into studies on the chariot footage. A subset of VME indicator species will be extracted for submission to ICES in advance of WGDEC 2023.
No. fish species recorded and notes on any rare species or unusual catches:	All 43 valid hauls contained haddock. Presence of 1-year old haddock stood out as very high (Figure A6.6). In fact, although direct comparison is difficult due to a change in survey design in 2011, this age class may be at the highest levels seen in the entire survey time series and reflects the very high recruitment observed in 2021. Age 1 haddock were observed to be uniformly spread out over upper Rockall bank as were the age 2 fish which were present at lower but still respectable levels. Haddock over the age classes 3–4 years were observed to be at broadly similar levels to those observed over the past seven years, while those of ages 5 and 6 while still low overall showed a slight increase. Levels of age 0 haddock this year were however the lowest since 2011 and concentrated to some extent in the northern end of the upper bank. A total of 55 species were recorded during the survey. Haddock itself stood out as being by far the major component at ~29.335 tonnes (an average of 0.682 tonnes per trawl) while Norway haddock (*Sebastes viviparous*, ~5.694 tonnes) and blue whiting (*Micromesistius poutassou*, ~3.635 tonnes) were also prominent. Though encountered in very low numbers overall, cod (*Gadus morhua*) appeared slightly more abundant than in former years with 29 being caught for a total weight of 120.6 kg. There was small but noticeable increase in amounts of whiting (*Merlangius merlangius*, 75 individuals, ~21.2k g), the majority of which were 1-year olds. Rounded CPUE indices/year class of main commercial species are shown in table A6.15, and that of the most abundant species overall in table A6.16. Of additional note was the capture of two large hake (*Merluccius merluccius*) totalling 19.6 kg one from each of stations 229 and 230 in the RHB. While historical landings data for hake attributed to the area does exist, this species has only rarely been encountered at Rockall during scientific surveys.

Table A6.14. Number of stations surveyed by gear.

			Hauls					
ICES Division	Strata	Gear	Planned	Valid	Additional	Invalid	% Achieved	Comments
6.b	All	GOV-D	40	43	0	2	112	

Table A6.15. Rounded CPUE data (all strata combined) for the most abundant species caught during 1122S. Note the cod indices omit one fish of 68cm that remains un-aged at the time of writing.

Age	Haddock No./10 hr	Whiting No./10 hr	Cod No./10 hr	Saithe No./10 hr
0	418	1.7	0	0
1	88403	23.1	0.7	0
2	5579	1.0	9.5	0.3
3	362	0	0	0
4	675	0	0.8	0
5	221	0	0	0
6	633	0	0.5	0
7	10.4	0	0	0
8	13.3	0	0	0
9	7.4	0	0	0
10	1.3	0	0	0
11	0.7	0	0	0
12	1.5	0	0	0

Table A6.16. Rounded CPUE indices (no. per 10 hrs fishing) of prominent species.

Species	Mean Kg/hr	Mean No./hr
Melanogrammus aeglefinus	1616	11297
Sebastes viviparus	314	5611
Micromesistius poutassou	200	2621
Helicolenus dactylopterus	92.7	1652
Argentina sphyraena	29.0	481
Dipturus batis (=D. cf. flossada)	26.9	4.1
Ammodytes marinus	23.5	1720
Lophius piscatorius	20.5	6.1
Lepidorhombus whiffiagonis	15.0	62.0
Gadiculus argenteus	10.4	711
Trisopterus minutus	9.9	114
Eutrigla gurnardus	9.1	37.2
Microstomus kitt	8.3	74.2
Dipturus oxyrinchus	8.2	0.7
Molva molva	7.2	1.2
Gadus morhua	6.7	1.6

Table A6.17. Numbers of biological observations per species collected during 1122S. Data recorded is individual length/whole weight/sex/eviscerated weight/age except * where eviscerated weight and age data were not collected and ** where otoliths will be aged at a later date.

Species	No.	Species	No.
Gadus morhua	29	*Dipturus batis (D. cf. flossada)**	74
Glyptocephalus cynoglossus	105	*Dipturus oxyrinchus**	12
Melanogrammus aeglefinus	1725	*Leucoraja circularis**	7
Merlangius merlangius	75	*Leucoraja fullonica**	16
*Merluccius merluccius***	2	*Raja clavata**	38
*Molva molva***	21	*Squalus acanthias**	9
Pollachius virens	1	Scomber scombrus	19

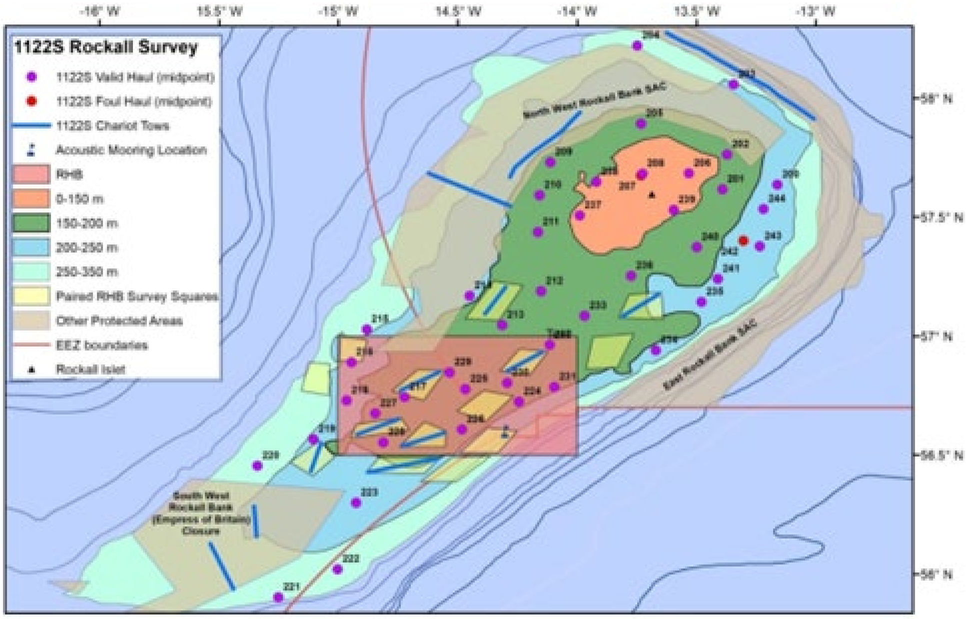


Figure A6.5. Survey strata, NEAFC closed areas and trawl positions along with haul numbers of stations completed at Rockall during 1122S.

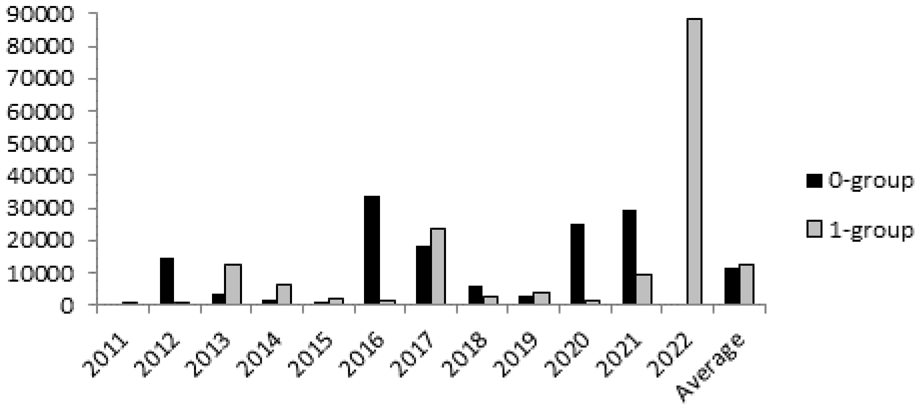


Figure A6.6. Indices of 0 and 1-group haddock at Rockall in 2022 shown relative to the previous years and the average since 2011 (beginning of new survey design).

A6.6 Spanish Porcupine bottom trawl survey (SP-PORC-Q3)

Nation:	**SP (Spain)**	**Vessel:**	**Vizconde de Eza**
Survey:	SP-PORC-Q3 (Porcupine 2022)	**Dates:**	8 September – 14 October 2022
Cruise:	Spanish Porcupine bottom trawl survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Porcupine Bank area (ICES Division 7.b,k). The primary target species are hake, monkfish, white anglerfish and megrim, which abundance indices are estimated by age, with abundance indices also estimated for *Nephrops*, four-spot megrim and blue whiting. Data collection is also carried out for several other demersal fish species and invertebrates.		
Survey Design:	The survey is random stratified with two geographical strata (northern and southern) and three depth strata (170–300 m, 301–450 m, 451–800 m). Stations are allocated at random according to the strata surface.		
Gear details:	Porcupine Baca 39/52 with Polyvalent doors.		
Notes from survey (e.g. problems, additional work etc.):	Weather conditions were poor on the second leg of the survey. This year the reduction in tow duration implemented in 2016 to 20 minutes from 30 minutes after ground contact has been maintained. Additional work undertaken included six additional deep tows (> 800 m) on the east margin of the study area and 100 CTD casts, at most trawl stations, four within the non-trawlable area, and five in radials perpendicular to the bank limits.		
Number of fish species recorded and notes on any rare species or unusual catches:	Overall a total of 139 fish species, 44 crustacean taxa including 38 species, 41 mollusc taxa including 34 species, 44 echinoderm taxa including 39 species and 43 taxa of other invertebrates including 34 species were identified.		

Table A6.18. Numbers of stations fished (aim: to complete 80 valid tows per year).

ICES Divisions	Strata	Gear	Stations					
			Planned	Valid	Addi-tional	Invalid	% Fished	Comments
7.b,c,k	All	Porcupine Baca	80	80	11	3	114%	
	TOTAL		80	80	11	3	114%	

Table A6.19. Numbers of individuals biologically sampled (length, weight, sex, maturity, age) by species. Species de-noted * recorded for maturity only.

Species	No.	Species	No.
Merluccius merluccius	410	*Molva molva*	9
Lepidorhombus whiffiagonis	564	*Conger conger*	45

Lepidorhombus boscii	295	*Helicolenus dactylopterus*	165
Lophius budegassa	100	*Phycis blennoides*	248
Lophius piscatorius	203	*Nephrops norvegicus**	536

Table A6.20. Biomass estimates for the main species in the Porcupine bottom trawl survey.

Biomass and number estimates								
			Biomass index			Number index		
Species	Strata	Valid tows	y_i kg/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change	y_i n/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change
Merluccius merluccius	All	80	19.74	-30.6	-17.6	16.8	-37.9	-49.8
Lepidorhombus whiffiagonis	All	80	13.5	-25.7	26.3	173.8	-25.7	3.2
Lepidorhombus boscii	All	80	12.00	-10.4	8.0	130.2	-2.5	6.4
Lophius budegassa	All	80	1.81	74.0	50.0	2.3	127.2	152.8
Lophius piscatorius	All	80	22.21	76.4	9.2	5.5	42.6	18.3
Micromesistius poutassou	All	80	941.76	29.2	37.8	13738.7	49.7	52.9
Nephrops norvegicus	All	80	1.80	83.7	-32.6	74.2	99.8	-20.0

$\mathbf{y_i}$, year estimate (2022); $\mathbf{y_{i-1}}$, previous year estimate (2021); $\mathbf{y_{(i,i-1)}}$, Average of last two year estimates (2022 and 2021); $\mathbf{y_{(i-2,i-3,i-4)}}$, Average of the previous three year estimates (2020, 2019 and 2018).

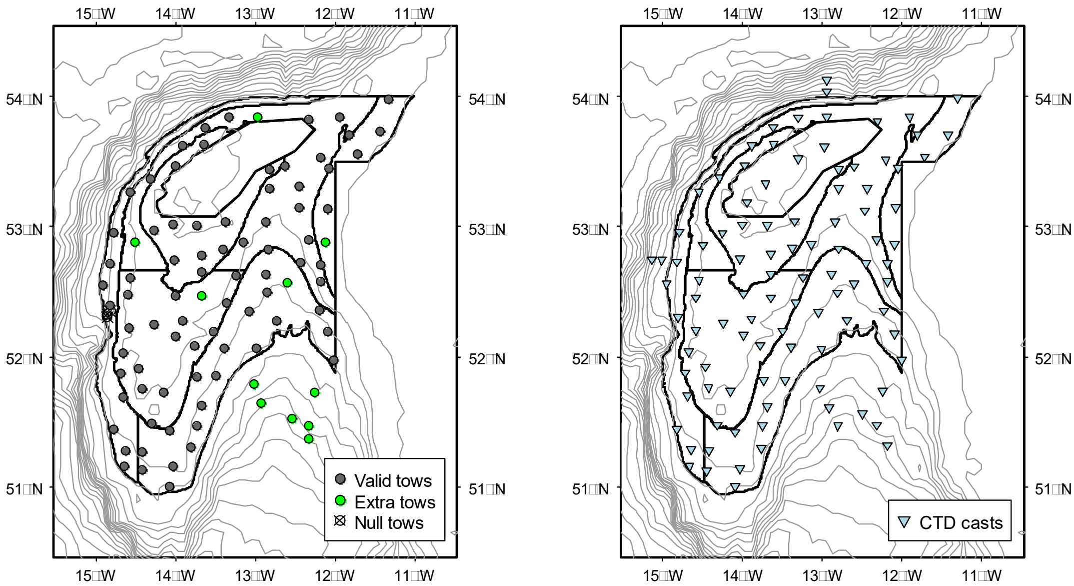


Figure A6.7. Spanish Porcupine Bank survey showing the distribution of trawl stations (left) and CTD stations (right) sampled during the 2022 survey.

A6.7 Scottish West Coast Groundfish Survey (SCOWCGFS-Q4)

Nation:	Scotland	Vessel:	Scotia
Survey:	1722S (SCOWCGFS-Q4)	Dates:	14 November – 6 December 2022
Cruise:	Objectives of SCOWCGFS – Q4: • Demersal trawling survey (SCOWCGFS-Q4) of the grounds off the north and west of Scotland and Ireland in ICES Divisions 6.a and 7.b. • To obtain temperature and salinity data from the surface and seabed at each trawling station. • Collect additional biological data in connection with the UK Workplan and EU Data Collection /EUMap regulation. • Retrieval and re-deployment of acoustic moorings located at discrete sites within the survey area as part of the INTERREG COMPASS project (2 additional days added to the survey).		
Gear details:	The SCOWCGFS - Q4 utilises a random-stratified survey design which randomly allocates 60 primary trawl locations distributed within 12 sampling strata (11 within ICES Division 6.a and one from Division 7.b). GOV incorporating groundgear D was used at all stations and was deployed on 64 occasions (Table A6.21). Sweeps were 97 m in all cases where the mean depth was >80m (n = 55), otherwise 47 m sweeps were used (n = 9). The following parameters were recorded during each haul using SCANMAR: headline height, wing spread, door spread and distance covered. A bottom contact sensor was attached to the groundgear and downloaded following each haul to aid validation of touchdown and lift-off times for trawl.		
Notes from survey (e.g. problems, additional work etc.):	Despite experiencing some periods of unfavourable weather during the survey, the GOV was deployed on 64 occasions during 1722S with short 47 m sweeps where the seabed depth was 80 m or less being deployed on nine occasions (eight valid and one invalid hauls), the long 97 m sweeps being utilised on the remaining 55 deeper hauls (52 valid standard hauls and three invalid hauls). Of the 60 valid hauls completed, 55 of these were completed during daylight hours. There were four foul/invalid hauls. Two trawl stations were invalidated due to strong tide that resulted in the trawl lifting off the seabed and also the presence of static gear directly ahead of the vessel (hauls 325 and 319 respectively). Two of the foul hauls were attributable to significant damage sustained to the gear whilst trawling (hauls 289 and 340). The locations used for the valid trawl positions during this survey were a combination of established MSS survey tows, commercial trawled areas and also completely new tows. On 15 occasions grounds were successfully utilised that previously had been unfished by MSS. See Figure A6.8 for a plot of all survey tows. Hauls were typically of 30 min duration, however various factors (soft mud/hard/rocky terrain resulting in trawl sticking, rapid changes in bottom depth observed during the trawl as well as close proximity to static gear) resulted in reduced durations being recorded on four valid hauls (nos. 295, 312, 317, 320). In keeping with the 2009 IBTSWG report, no hauls of less than 15 minutes were marked as valid. The CTD recorder (RBR Concerto[3]) was deployed at 58 out of the 60 valid trawling stations in order to obtain a temperature and salinity profile to within approximately 5 m of the seabed. Hauls 278 and 298 had no associated hydrography data in order to provide a time saving that would enable another daylight trawl to be completed during the very short daylight window that exists at this time of year.		

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INTERREG/Compass Acoustic Moorings Deployments/Retrieval

As part of the COMPASS marine mammal passive acoustic monitoring project, "Scotia" successfully retrieved five (out of a possible six) moorings from five different locations from within the Minches area. The five redeployed moorings at Tolsta, Shiants, and Hyskier (x3) were deployed back onto the same or similar locations to those retrieved. See Figure A6.8 for mooring locations.

Additional sampling undertaken during 1722S

- Bobtail squid identification. All bobtail squid (Sepiolida) caught were frozen for identification at *Naturalis Biodiversity Centre, Leiden*.
- Retention of *Craniella* sponges. Ongoing collaborative phylogenic study between MSS and the *Natural History Museum*.
- Mackerel retained for research project into myxozoan parasite prevalence. Tow samples of Juvenile 25 fish were collected for analysis from haul's 304 and 337 – *IMR, Bergen*
- Two sets of 50 whole individually bagged juvenile mackerel retained for investigations into variations in field metabolic rate (FMR) proxy using sagittal otoliths. Fish retained from haul's 286, 332 and 335 – *Southampton University*
- Whiting genetics samples retained for analysis as Part of an ongoing research project – 90 samples retained from haul's 290 and 301 - *AFBI, NI*
- 50 blue whiting measured, weighed and then frozen as part of an MSS Pelagic Co-Sampling Trial
- Retention of 7 kg each of mackerel and herring from the Minch area for environmental monitoring - *CRCE Scotland, Glasgow*

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<tr><td>No. fish species recorded and notes on any rare species or unusual catches:</td><td>

Catch Results*(2021 results presented in parentheses)*

A total of 102 (*89*) species were recorded for an overall catch weight of ~40.4 tonnes (*39.0*). Major species components in approximate tonnes included: haddock *Melanogrammus aeglefinus:* 11.05 (*15.15*), mackerel *Scomber scombrus:* 1.49 (*3.43*), cod *Gadus morhua:* 0.25 (*0.49*), Norway pout *Trisopterus esmarkii:* 1.96 (*1.66*), whiting *Merlangius merlangus:* 3.20 (*3.47*), herring *Clupea harengus:* 2.05 (*0.17*), and scad *Trachurus trachurus:* 4.56 (*4.74*).

Catches overall of target species during the 2022 survey were for the most part slightly down or on a par with those observed in 2021 and with a slight increase in overall bottom time (*28hrs, 2021 / 29hrs, 2022*). Catches of haddock were down by roughly 25% compared to catches reported in 2021 whilst catches of whiting were almost identical as was also the situation with Norway Pout. Cod effectively halved in weight from what was already a very low level with the total catchweight for cod now sitting at a mere 250 kg for the entire survey. Saithe once again was virtually absent during this survey, with only 14 fish being encountered during the survey and for a total catchweight of 20 kg.

Despite a doubling in overall catchweight for herring during 2021, the reported catchweight for this species was still extremely low when compared with results from previous surveys going back to 2011. It was interesting to note that over 80% of the entire herring catch (2.05 t) from this survey was caught at one station (haul 286) located just south of the windsock. Almost 90% of all the mackerel reported by weight for the entire survey (1.49 t) were derived from four hauls and at two locations, namely offshore from Northern Ireland Coast and the North Minch. The majority of these were juvenile individuals and, although no large aggregations of these were observed, significant

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	numbers were reported from these four stations (hauls 304, 305, 337 and 339) with haul 305 located 50 nm west of Torry Island providing the vast majority of the 0-group fish recorded on the survey. Table A6.22 provides overall catch rates per unit effort (CPUE) of the above species and several other major species. The CPUE index (numbers caught per hour fishing) for 1-group gadoids (cod, haddock, whiting, saithe and Norway Pout) weights the indices for each of the 11 relevant Division 6.a sampling strata by the surface area of said strata. These are then pooled to produce abundance indices for the survey. Results for all age classes of the major commercial gadoid species are shown in Table A6.23 while those of 1-groups only for period 2015–2022 are shown in Table A6.24 together with percentage change between indices estimates from previous year as well as 10-year average for reference. The outlook regarding the 1-group abundance estimates for target gadoid species are altogether fairly underwhelming with haddock in particular reporting a significant decrease of almost 50% in 1-group abundance that is also well below the 10-year average estimate. Numbers of 1-group cod were also down on last year albeit this was at an already low level and it should be noted that this has been the situation since the survey's inception in 2011 which is borne out with a 10-year average CPUE estimate of just 1.3. Whiting 1-group abundance increased by over 70% compared to 2021 although crucially this is still below the 10-year average, whereas Norway Pout fared much better with 160% + increase on 2021 estimates that is also significantly above the 10-year average. Saithe as per last year continue to be effectively absent for all cohorts. See Table A6.24 for 1-group CPUE indices of target species. The unusual and notable species of the survey was the discovery of a Warty Bobtail Squid *(Rossia palebrosa)* which was encountered during haul 296 on the shelf edge West of St Kilda and at a depth of 322 m. This is almost certainly a first for MSS and the specimen was frozen together with the other sepiolids to be verified by the Naturalis Biodiversity Centre in Leiden. Several small pods of white beaked dolphins *(Lagenorhynchus albirostris)* were spotted prior to deploying the trawl during haul 324 and south of the Stanton Banks. Around 20 animals in total. Several large pods of Common dolphin *(Delphinus delphis)* were also observed around several sights around the Minches during the survey whilst a pod of 10 Risso's dolphins *(Grampus griseus)* were also spotted in the Tolsta area of the North Minch and close to the location of the COMPASS mooring. **Biological Sampling** In total 6370 biological observations on selected species were collected in support of the UK Workplan and also the EU Data Collection Regulation. A summary of numbers collected for all sampled species is displayed in Table A6.25. All otoliths were aged back at the laboratory. **Marine litter** All litter picked up in the trawl was classified, quantified, recorded and retained for appropriate disposal ashore. The data are uploaded to the MSS database from where it will eventually be uploaded to DATRAS. **Monitoring of Non-Indigenous Invasive Species (NIS)** All catches were screened for the presence of selected NIS species with the results being reported back to the project coordinator at CEFAS.

Table A6.21. Number of stations surveyed/gear during survey 1722S.

ICES Division	Strata	Gear	Hauls Planned	Valid	Additional	Invalid	% Achieved	Comments
6.a	11	GOV-D	56	56	0	4	100	
7.b	1	GOV-D	4	4	0	0	100	

Table A6.22. Overall CPUE of major components of combined catch Q4 2022.

Scientific name	Common name	kg/hr	no/hr
Melanogrammus aeglefinus	Haddock	380	1275
Scomber scombrus	Mackerel	51.2	482.7
Gadus morhua	Cod	8.6	3
Trisopterus esmarkii	Norway pout	67.6	4519
Merlangius merlangus	Whiting	109.9	1042
Clupea harengus	Herring	70.6	558.9
Trachurus trachurus	Horse mackerel	156.9	710
Scyliorhinus canicula	Lesser-spotted dogfish	43.7	84.1
Pleuronectes platessa	Plaice	4.8	23.2
Eutrigla gurnardus	Grey gurnard	27.2	372.5
Capros aper	Boarfish	144.7	4368
Squalus acanthias	Spurdog	101.7	115
Pollachius virens	Saithe	0.7	0.5
Merluccius merluccius	Hake	9.1	108.3
Dipturus intermedius	Flapper Skate	16.6	2.1
Loligo sp.	Long-finned Squid	13.8	80.8
Raja montagui	Spotted ray	6.3	7.2
Lophius piscatorius	Anglerfish	4.6	2.6
Sprattus sprattus	Sprat	0.4	70
Raja clavata	Thornback ray	6.4	4.6
Chelidonichthys cuculus	Red gurnard	6	21.8
Micromesistius poutassou	Blue whiting	79.3	2.6
Limanda limanda	Common dab	2.5	70
Microstomus kitt	Lemon sole	2.3	4.6
Lepidorhombus whiffiagonis	Megrim	3.5	13.4

Table A6.23. CPUE indices (no/hr) by year class of major demersal species Q4 2022.

Age	Cod	Haddock	Whiting	Saithe	N. Pout
0	0.0863	66.6094	513.814	0.0219	3403.872
1	0.9348	314.6035	91.0573	0.0363	359.6715
2	8.912	991.7931	248.1718	0.1872	240.9483
3	1.4769	373.7324	75.4985	0.1241	16.485
4	0.0392	39.438	8.6442	0	0
5	0.1822	27.0997	4.1751	0	0
6	0.1158	7.1717	1.4287	0	0
7	0.0256	94.4865	0.0132	0	0
8	0	0.3263	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0

Table A6.24. CPUE indices (no/hr fishing) for 1-groups of the main demersal species in Q4 since 2015.

Species	2015	2016	2017	2018	2019	2020	2021	**2022**	% change from 2021	10 Yr Av.
Cod	2.8	0.6	1	0.5	1.8	1.6	0.9	**0.5**	-43.0267	1.3
Haddock	995.6	93.6	168.8	98.9	627.5	290.3	314.6	**163.2**	-48.1325	282.7
Whiting	279.4	241.5	294.3	50.25	195.5	239.2	91.1	**158**	73.40966	171.4
Saithe	0.5	0.06	0	0.04	0.08	0	0	**0.03**	NA	0.1
N. Pout	1481	1227	48.7	96.8	1797	296.9	359.7	**964.2**	168.0534	667.3

Table A6.25. Numbers of biological observations per species collected during 1722S. These consist of length, weight, sex, age (*+maturity for mackerel and herring*) unless specified otherwise (*a* = length, weight, sex, and otoliths retained (to be aged at a later date); *b* = length, weight and sex; *c* = length, weight and age; and *d* = length, weight, sex and externally determined maturity only).

Species		No.	Species		No.
Melanogrammus aeglefinus		1512	*Scophthalmus maximus*	b)	5
Merlangius merlangus		1166	*Dipturus batis* (=*D.* cf. *flossada*)	d)	12
Gadus morhua		86	*Dipturus intermedius*	d)	58
Pollachius virens		14	*Leucoraja naevus*	d)	44
Trisopterus esmarkii		425	*Mustelus asterias*	d)	26
Clupea harengus		256	*Raja brachyura*	d)	10
Sprattus sprattus	c)	199	*Raja clavata*	d)	125
Scomber scombrus		266	*Raja montagui*	d)	189
Merluccius merluccius	a)	234	*Squalus acanthias*	d)	770
Pleuronectes platessa		165	*Galeorhinus galeus*	d)	10
Scophthalmus rhombus	b)	3	*Galeus melastomus*	d)	53
Glyptocephalus cynoglossus		58	*Scyliorhinus canicula*	d)	53
Leucoraja fullonica	d)	3			

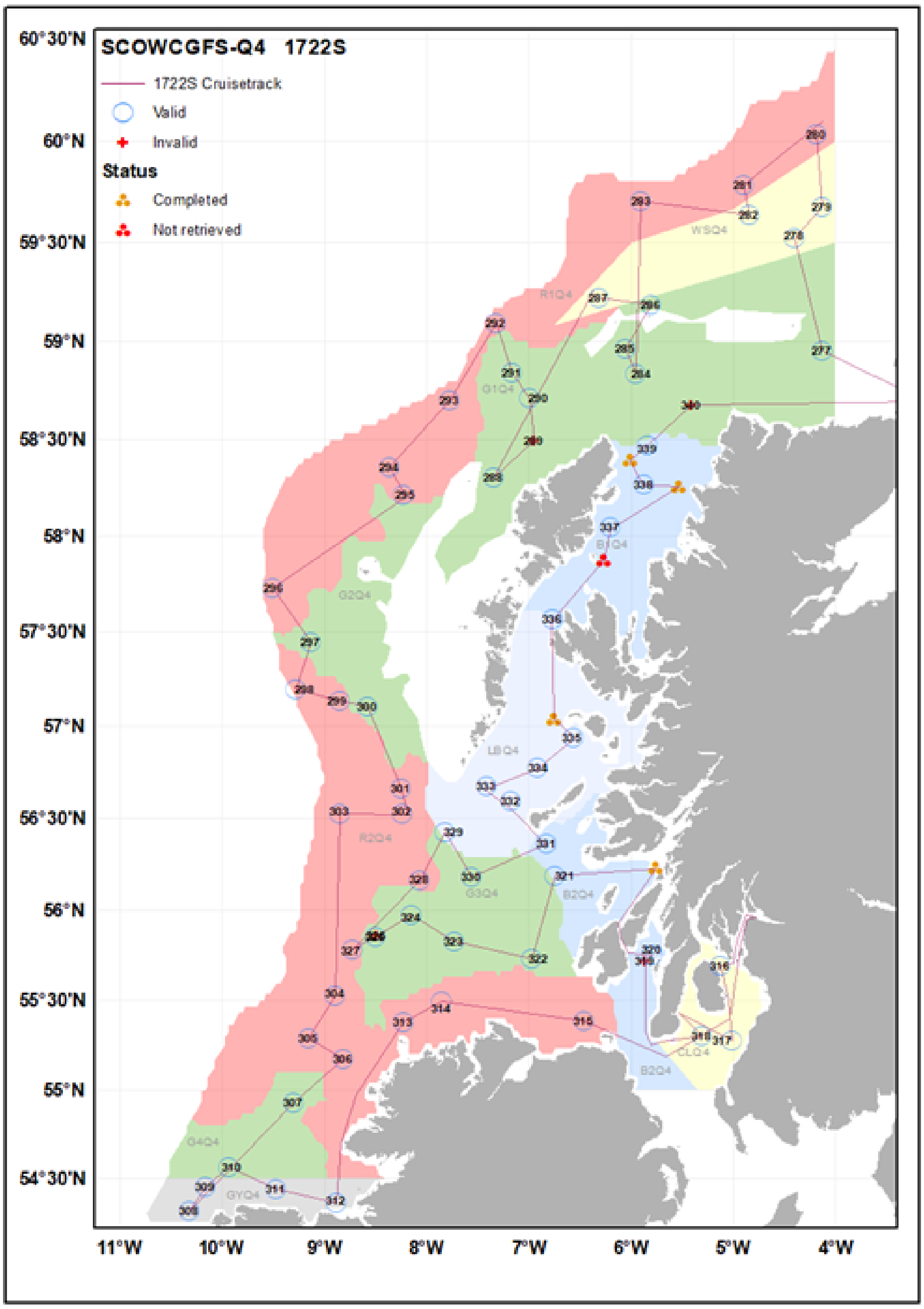

Figure A6.8: 1722S survey map showing survey strata (coloured polygons), trawl and COMPASS mooring deployments. Also shown is the survey track taken.

A6.8 Northern Irish groundfish survey (Q4)

<table>
<tr><td>Nation</td><td>UK (Northern Ireland)</td><td>Vessel:</td><td>Corystes</td></tr>
<tr><td>Survey:</td><td>Groundfish Survey CO-4122</td><td>Dates:</td><td>3rd – 18th October 2022</td></tr>
<tr><td>Cruise:</td><td colspan="3">• To obtain information on spatial patterns of abundance of different size-and-age classes of demersal fish in the Irish Sea.
• To obtain abundance indices of cod, whiting, haddock and herring for use at ICES Working Groups.
• To quantify external parasite loads in whiting and cod by area.
• To collect additional biological information on species as required under DCF.
• To collect tissue samples for genetics studies on mature cod and hake.
• To collect information on the extent of marine littering in the Irish Sea.
• Collect 15 fish samples for reverse ring test organized by Thomson Unicomarine Ld, recording species, length and station.
To collect stomachs and fish samples from target species list for analysis of food webs.</td></tr>
<tr><td>Gear details:</td><td colspan="3">A commercial Rockhopper trawl fitted with a 20 mm liner in the cod-end was towed over three nautical miles (or one nautical mile) in the Irish Sea and St George’s Channel. Gear and towing procedures were those employed on all previous AFBI groundfish surveys.</td></tr>
<tr><td>Notes from survey (e.g. problems, additional work etc.):</td><td colspan="3">A stratified survey with fixed station positions was employed. The survey was divided into strata defined by length and substratum.

The species composition of the catch at each station was determined, and length frequencies were recorded for each species. All cod, most hake and representative sub-samples of haddock and whiting were taken for recording length, weight, sex and maturity stages and for the removal of otoliths for ageing. The level of infestation of whiting and cod by external parasites was estimated from biological samples collected at each station.

For all hauls fishing was carried out during daylight commencing each day at first light. 48 valid hauls were completed, one haul was repeated. All tows were 20 min. duration. The width of seabed swept by the trawl doors increased from around 31 m in shallow water (30 m sounding) to around 48 m in deeper water (80 m sounding), with variations due to tidal flow. The average headline height was 2.5–3.1 m. Trawl parameters were consistent with previous surveys. Cod and whiting taken for biological analysis were screened for external parasites. Trawl data and length frequencies were archived using the newly developed groundfish survey database. Preliminary indices of abundance for 0-group and 1-group cod, whiting and haddock were obtained from the length distributions. More accurate indices will be available once the otoliths collected during the cruise have been aged.

Station 99 was trawled for five minutes due to a large aggregate of herring. 655 kg of herring and 61 8kg of elasmobranchs were caught at station 99. Station 216 was trawled for 10 minutes again due to a large aggregate of herring.

Station 92 was towed for 11 minutes due to static gear on tow line.</td></tr>
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	The survey was cut short due to an outbreak of COVID-19 on the vessel. Additional Sampling: All litter picked up in the trawl was classified, quantified and recorded and uploaded to the national litter database from where it will eventually be uploaded to DATRAS. The litter was retained onboard for appropriate disposal ashore.
Number of fish species recorded and notes on any rare species or unusual catches	A total of 116 species were recorded during the survey of which 65 were measured for length frequencies. Biological data were recorded for a number of species in accordance with the requirements of the EU Data Regulations. A total of 1,977 biological samples were taken during the survey.

Table A6.26. Number of stations fished.

ICES Division	Strata	Gear	Hauls					
			Planned	Valid	Additional	Invalid	% Achieved	Comments
7.a	All	Rock-hopper	62	45	0	3	73	

Table A6.27. Numbers of biological observations per species collected during CO4122. These consist of length, weight, sex and age, unless specified (*a* = age data not collected length; *b* = weight, length and sex recorded).

Species	No.	Species		No.
Gadus morhua	12	*Scophthalmus maximus*		0
Merlangius merlangus	929	*Raja brachyura*	b)	1
Melanogrammus aeglefinus	580	*Raja clavata*	b)	96
Merluccius merluccius	9	*Raja montagui*	b)	39
Pollachius pollachius	0	*Leucoraja naevus*	b)	10
Molva molva	0	*Squalus acanthias*	b)	0
Zeus faber	0			
Scophthalmus rhombus	0			
Pleuronectes platessa	301			

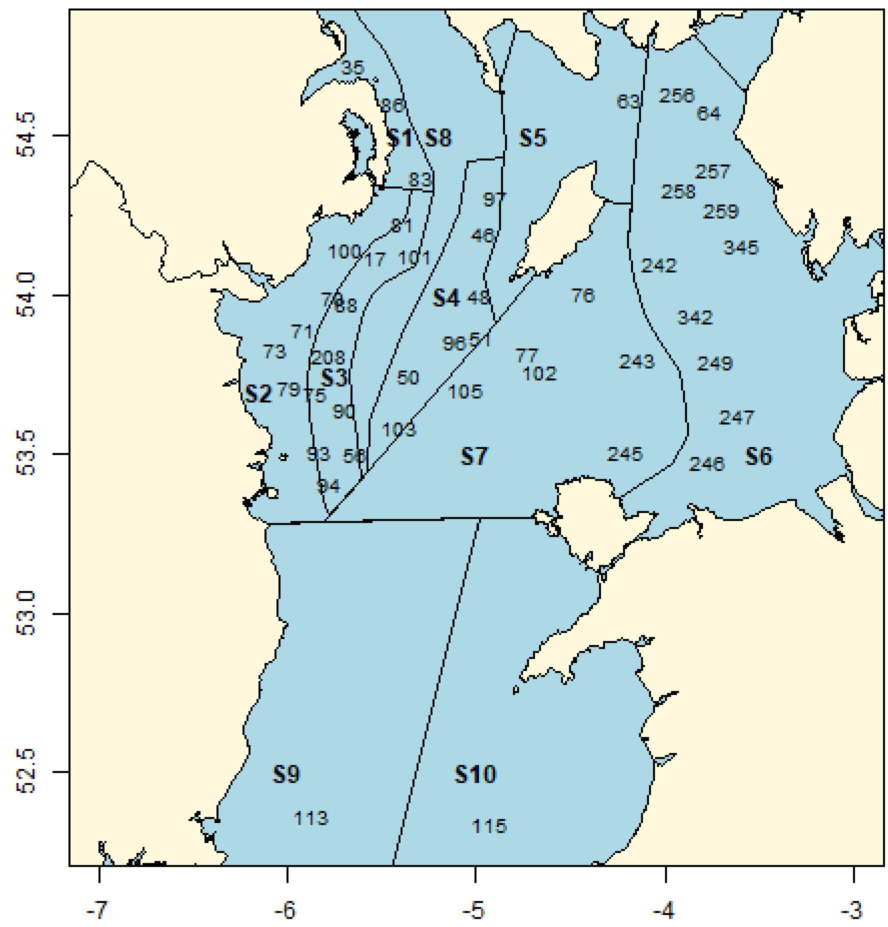

Figure A6.9. Map of the NI groundfish survey stations completed during CO4122.

A6.9 Irish Groundfish Survey (IGFS)

Nation:	Ireland	**Vessel:**	Celtic Explorer
Survey:	IE-IGFS	Dates:	03 Nov –16 Dec 2022
Cruise	The Q4 Irish Groundfish Survey (IGFS) collects data on the distribution, relative abundance and biological parameters of commercially exploited demersal species in Divisions 6.a (south), 7.b and 7.g,j (north). The indicess currently utilised by assessment WG's are for haddock, whiting, plaice, cod, hake and sole. Survey data are also provided for white and black anglerfish, megrim, pollack, ling, blue whiting and a number of elasmobranchs as well as several pelagic species (herring, horse mackerel and mackerel).		
Gear details:	Two gear survey since 2004, using GOV ground gear "A" for 7.b, 7.g and 7.j, and a 16" hopper gear (ground gear "D") for 6.a.		
Notes from survey (e.g. problems, additional work etc.):	Three days lost to bad weather during 2022, and a further delay of one day at the beginning due to issues in pre-survey dry dock. No other mechanical or technical problems.		
Number of fish species recorded and notes on any rare species or unusual catches:	In 2022, 87 species of fish, 18 elasmobranchs, 10 cephalopods, 62 crabs and shrimp (Malacostraca) and 108 other species/taxa were caught. Between 2021 and 2022 only herring seem to show a significant improvement in biomass (875.6%) and only for the northwest area (Division 6.a). Over the 5-year period, while some catches such as young whiting appeared to be up at times during the survey, the data confirms very little increase in virtually all target species if not a slight decrease in some. The only notable exception was blue whiting which tends to be sporadic anyway. Even increases of 40–80% are well within the variability of survey catch rates over that time frame so not as positive as the figure might initially suggest.		

Table A6.28. Stations fished (aim to complete 171 valid tows per year).

ICES Divisions	Strata	Gear	Tows planned	Valid	Additional	Invalid	% stations fished	comments
6.a	All	D	45	32	0	3	77	
7.b–c	All	A	38	37	0	0	97	
7.g	All	A	48	39	0	1	83	
7.j	All	A	40	44	0	0	110	
TOTAL			171	152	0	4	95	

Table A6.29. Biological samples (length, weight, sex, maturity and age material); maturity* (lengh, weight, sex and maturity); length weight only (length and weight).**

Species	No.	Species	No.
Clupea harengus	174	*Micromesistius poutassou*	793
Dicentrarchus labrax	7	*Microstomus kitt*	1144
Gadus morhua	95	*Molva molva*	43
*Glyptocephalus cynoglossus***	402	*Pleuronectes platessa*	1217
Lepidorhombus whiffiagonis	2425	*Pollachius pollachius***	9
Lophius budegassa	425	*Pollachius virens*	46
Lophius piscatorius	514	*Scomber scombrus*	276
Melanogrammus aeglefinus	2138	*Solea solea*	334
Merlangius merlangus	1417	*Trachurus trachurus*	1050
Merluccius merluccius	1009		

Table A6.30. Abundance (numbers) and biomass of the main species sampled during 2022 IGFS compared with previous years. Year estimate 2022 (y_i); previous year estimate 2021 (y_{i-1}); average of last two years estimate ($y_{(i,i-1)}$); average of the previous three-year estimates 2018–20 ($y_{(i-2,i-3,i-4)}$). As results for survey trends are ratios, they are quite sensitive to stocks with high variance, therefore comparing the 2 yr vs. 5 yr trend is advisable.

Biomass and number estimates								
			Biomass index			Number index		
Species	Strata	Valid tows	y_i kg/Hr	y_i/y_{i-1} %	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ %	y_i No/Hr	y_i/y_{i-1} %	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ %
Gadus morhua	6.a	32	1.5	70.9	-41.5	1.4	126.2	-45.3
Melanogrammus aeglefinus	6.a	32	515.4	13.8	84.4	1808.4	-3.3	78.6
Clupea harengus	6.a	32	28.8	875.6	-17.4	266.5	113.9	-63.1
Merluccius merluccius	6.a	32	10.1	-23.6	37.0	20.0	-42.9	-35.4
Trachurus trachurus	6.a	32	269.1	-17.3	-17.4	1324.8	-34.2	-34.1
Scomber scombrus	6.a	32	99.5	-18.7	15.1	1947.8	24.9	0.3
Lepidorhombus whiffiagonis	6.a	32	1.7	0.6	7.8	9.7	-17.5	-2.9
Lophius piscatorius	6.a	32	2.1	-32.2	28.7	1.4	-49.6	11.1
Pleuronectes platessa	6.a	32	8.2	11.8	-5.1	46.9	8.5	-8.0
Solea solea	6.a	32	0.5	38.5	6.6	2.9	98.2	21.0
Micromesistius poutassou	6.a	32	250.8	8.2	317.4	3870.4	-60.1	317.9
Merlangius merlangus	6.a	32	150.5	8.9	-22.2	872.7	-14.6	-37.5
Gadus morhua	7.bgj	120	1.7	-61.7	29.9	1.2	7.3	-21.4
Melanogrammus aeglefinus	7.bgj	120	105.4	-33.4	-27.9	384.9	-61.3	-53.7
Clupea harengus	7.bgj	120	1.9	-46.0	-85.7	84.1	43.7	-86.6
Merluccius merluccius	7.bgj	120	13.5	-5.7	-40.1	97.0	85.2	-32.5
Trachurus trachurus	7.bgj	120	178.2	54.7	-1.8	2575.7	-17.2	24.4
Scomber scombrus	7.bgj	120	7.3	-58.1	-84.9	125.4	-53.2	-87.7
Lepidorhombus whiffiagonis	7.bgj	120	5.6	15.4	14.3	51.8	13.5	8.1
Lophius piscatorius	7.bgj	120	11.9	41.6	39.3	8.7	-9.7	-5.2
Pleuronectes platessa	7.bgj	120	5.6	-34.1	8.2	31.1	-37.1	7.7
Solea solea	7.bgj	120	1.0	50.4	13.1	4.3	63.9	-9.2
Micromesistius poutassou	7.bgj	120	41.0	-72.6	116.4	582.3	-88.8	197.7
Merlangius merlangus	7.bgj	120	40.4	-33.5	11.9	322.9	-42.8	-25.2

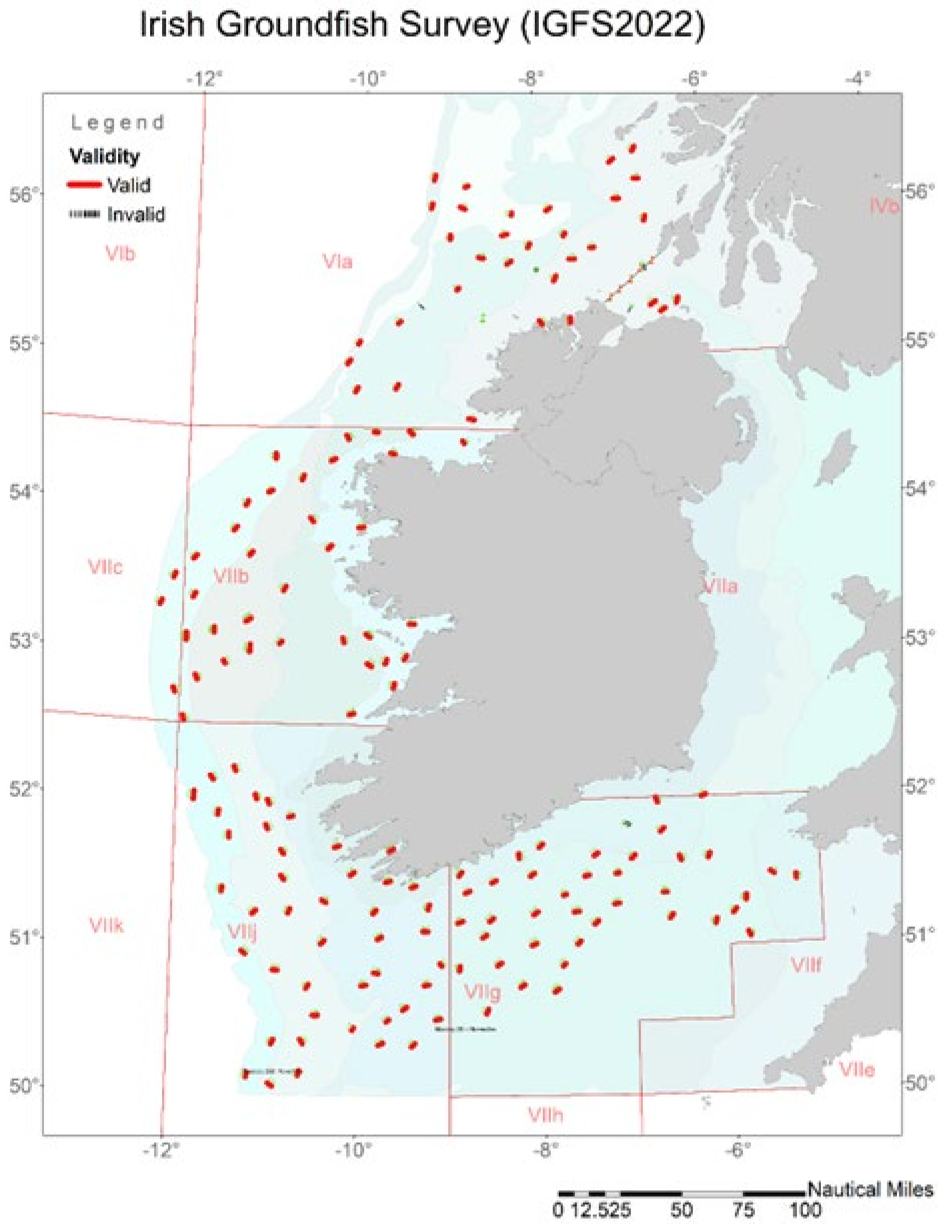

Figure A6.10. Map of survey Stations completed during the Irish Groundfish Survey in 2022 (Red lines = valid hauls; crosses = invalid hauls).

A6.10 French Channel Groundfish Survey Q4 (FR-CGFS)

Nation:	France	**Vessel:**	Thalassa II
Survey:	CGFS2022 (Eastern Channel)	**Dates:**	16 September – 16 October 2022
Cruise	As from 2018 France sampled both the Eastern (7.d) and Western (7.e) English Channel. Currently, only data from the Eastern French English Channel Q4 survey is submitted to DATRAS but starting 2023 data from the Western Channel will be also available (Datras code **FR-WCGFS**). Trawling was carried out during the day. CTD was deployed at each trawl station to collect temperature and salinity profiles. Age data were collected for 20 species.		
Gear details:	The gear used for the Eastern English Channel is the standard GOV 36/47 with ground gear modified for CGFS (bobbins Ø 250 mm) and a GOV 36/49 adapted to the Western Channel with a 400 mm diameter washer with Marport sensors to record door spread, wing spread and vertical opening.		
Notes from survey (e.g. problems, additional work etc.):	The 2022 CGFS survey proceeded under almost normal conditions as we received the necessary authorizations to work in English waters at the beginning of the survey, with the exception of five stations located in the 6 nm of UK inshore waters in the eastern channel. The ban on trawling in the 6 nm inshore of the UK, where smaller size classes were previously collected, could impact the abundances and/or biomasses of certain species of interest as these are nursery areas. However, we were still able to cover most of the Channel and carried out all the planned work for the CGFS campaign. The "Thalassa" left Brest on September 16th, and the Western Channel was covered with 52 GOV36/49 trawl stations until September 29th. The Eastern Channel was covered from Cherbourg from October 1st to 16th, during which 68 valid GOV36/47 trawl stations were completed. In addition to the five stations on the English coast, we had to cancel one station on the Fécamp wind farm site as we were denied access. Additional work undertaken: • The CUFES device (Continuous Underwater Fish Egg Sampler) was used during all the survey (day and night) and samples were scanned on board. • Plankton samples were collected for analysis on the planktonic foodweb structure (27 stations with a plankton net (20µm), WP2 and Fluoroprobe) • Microplastics were collected with a Manta net • Observers for mammals and birds information was collected throughout out the survey.		
Number of fish species recorded and notes on any rare species or unusual catches:	60 different fish species were recorded (sharks and rays included). Cephalopods and shellfish were also measured, and benthic fauna identified for each haul.		

Table A6.31. Stations fished.

ICES Divisions	Strata	Gear	Tows planned	Valid	Invalid	% stations fished	comments
7.d	**ICES rectangles**	**GOV**	**74**	**68**	**0**	**92%**	

Table A6.32. Number of biological samples (weight, maturity and age material (otoliths) collected by Division.

Species	Samples			Species	Samples		
	7.d	7.e	Total		7.d	7.e	Total
Merlangius merlangus	157	309	466	*Gadus morhua*	6	3	9
Mullus surmuletus	144	15	148	*Dicentrarchus labrax*	203	98	188
Pleuronectes platessa	233	4	237	*Chelidonichthys cuculus*	96	113	301
Trisopterus luscus	69	83	152	*Solea solea*	152	1	153
Melanogrammus aeglefinus	-	58	58	*Scophthalmus maximus*	10	0	10
Pollachius pollachius	-	14	14	*Scophthalmus rhombus*	3	0	3
Lophius piscatorius	1	14	15	*Lophius budegassa*	0	2	2
Lepidorhombus whiffiagonis	0	7	7	*Microstomus kitt*	7	67	74
Scomber scombrus	131	119	250	*Molva molva*	0	0	0
Phycis blennoides	0	0	0	*Glytocephalus cynoglossus*	0	0	0

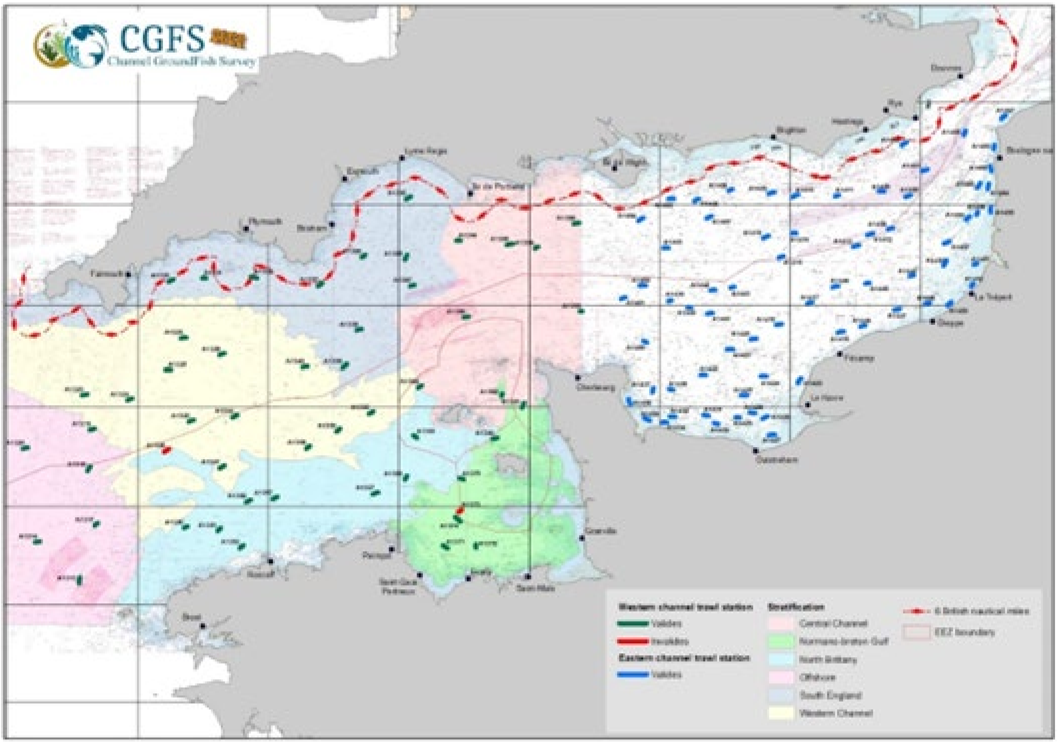

Figure A6.11. French CGFS survey grid (2022) showing the GOV sampling sites in the eastern and western Channel.

A6.11 French EVHOE-Q4survey

Nation:	France	**Vessel:**	Thalassa 2
Survey:	EVHOE 2022	**Dates:**	23 October – 5 December 2022
Cruise	Realized on the RV Thalassa each autumn, the EVHOE groundfish survey aims to collect data on the distribution, relative abundance and biological parameters of all fish and selected commercial invertebrates in Divisions 7.f–j and 8.a–b,d. The primary species are hake, anglerfishes, megrim, cod, haddock and whiting. Data are also collected for all other demersal, pelagic fish and cephalopods as well as for the whole invertebrate megafauna. Since 2016, the sampling design has been fixed stations, based on a previously randomly selected set of points based on bathymetric and sedimentary strata.		
Gear details:	A GOV (36/47) with standard Ground gear (A) is used, with the kite replaced by six extra floats. The boards have been replaced by new equivalent ones and the ground gear attachment has been adjusted to be more in line with the original plan of the trawl and to limit the risk of damage. Marport sensors have been utilized to record door spread, wingspread and vertical net opening.		
Notes from survey (e.g. problems, additional work etc.):	In 2022 the survey was carried out in two legs of about three weeks and the sampling plan was equivalent to the previous year. Unfortunately, we were not able to sample the northern Celtic Sea due to a COVID-related delay at the beginning of the cruise and a few days lost due to poor weather. All these difficulties led to a total loss of about nine days. Around 80% of the initial program have been realized and validated (124 valid hauls of 158 initially planned, see Table A6.33 and Figure A6.12). As in the previous year we continued the strategy based on live acoustics in order to detect strong aggregations of pelagic fish and avoid the risk of damage and sorting difficulties. During EVHOE 2022, 21 hauls were shorter than the normal 30 min (from 20–29 min, distribution of trawling duration in Figure A6.15). When strong acoustic detections have been observed we reduced the length of the tow trying to keep the time accepted as valid (≥20 minutes) or sometimes by stopping the trawling in progress. We kept this year the additional observation of small pelagics as a complement to the pelagic which takes place in spring (PELGAS survey). This resulted in an increase in the acoustic monitoring with the multibeam echosounder and additional measurements and biological samples, in particular on anchovy and pilchards. These additional operations did not affect the normal course of the EVHOE survey. During the survey following additional data collection have been performed : • A total number of 3193 biological samples (otoliths, scales and/or illicia) were collected for 23 fish species (table A6.34). • Trawl geometry data (Marport sensors) have been collected during all the hauls. • 125 CTD temperature and salinity profile • Continuous records with multibeam echosounder to collect data for pelagic ecosystem during transects and trawling hauls • Litter were counted and weighted at each trawl station.		

	• Invertebrates ("benthos", 246 taxa) were sorted, identified counted and weighted at the lowest taxonomic level (mostly species) for each trawled station. • Marine mammal and seabird observations during legs 1 and 2. Additional works, partly for MSFD, were realized at night mostly in the evening or early morning: • 25 Manta net hauls for collecting surface microplastics • 20 samples with WP2 net for zoo and phytoplankton • transects with CUFES device (Continuous Underwater Fish Egg Sampler) • 22 vertical profiles with "SBE 19 Bathysonde" to collect temperature, phytoplankton, particle densities ... • 33 Photo/Video transects with PAGURE sledge • 15 “profiles boxes” with multibeam echosounder to collect bathymetry and reflectivity data • 14 profile with seawater pump to collect eDNA samples • 138 acoustic transects (ME70 echosounder) for water column • Three deep-water pelagic trawl stations to sample meso-pelagic communities • Additional samples and observations have been collected on a set of selected species: muscle, stomach contents, fish morphometry
Number of fish species recorded and notes on any rare species or unusual catches:	About 127 fish and 23 cephalopods taxa were recorded. Only 11 fishes or cephalopods species represented 88% of the total biomass caught (Figure A6.13). Among fish species, as in previous years, small demersal-pelagic species (*Capros aper*, and to a lesser extent *Micromesistius poutassou*, *Trachurus trachurus*, *Engraulis encrasicolus*) strongly dominated the biomass of fish species We can note a large dominance in abundance and biomass of *Capros aper* abundance with high abundance similarly to the four previous years. The biomass of demersal fish was dominated by six species: hake (*Merluccius merluccius*), haddock (*Melanogrammus aeglefinus*) especially in the Celtic Sea (Figure A.5.12.3 and A.5.12.4), small-spotted catshark (*Scyliorhinus canicula*) and poor cod *Trisopterus minutus*, bib *Trisopterus luscus* and cuckoo ray *Leucoraja naevus*. As in previous years, stronger catches of certain rays must also be reported such as *Raja clavata* and *R. undulata* (both with a significantly higher occurrence also), *Leucoraja fullonica* specifically in 2022, and *L. naevus*. As compared to previous years, the abundance of *Lophius budegassa* is still strong. We can note a lowering dynamic for the megrim *Lepidorhombus spp*. as compared to the four previous years. For hake, catches remained relatively stable in occurrence but continued a decline observed in the previous four years with a level of abundance in 2022 among the lowest in the recent time series. Poor catches of northern distributed species (e.g. *Melanogrammus aeglefinus, Merlangius merlangius*) are due to the absence of stations especially in the northern Celtic strata (**Cn**). Concerning the cephalopods, it should be mentioned that *Alloteuthis* and small *Loligo vulgaris* were aggregated under the family Loliginidae. The small individuals of these two species have often been subject to errors of identification

	on board and a procedure of control and correction of historical data should be considered.

Table A6.33 Trawl stations planned and completed during the EVHOE 2022 survey.

Strata	ICES Divi-sions	Gear (sweep length)	Tows				% Stations sampled (valid)	Comments
			Planned	Realised	Valid	Additional		
Cc	**7.g,h,j**	**GOV (m)**	**32**	**19**	**18**	**0**	**56**	
Cc3	7.g,h,j	GOV (100m)	8	3	3	0	38	
Cc4	7.g,h,j	GOV (100m)	17	12	11	0	65	
Cc5	7.g,h,j	GOV (100m)	4	2	2	0	50	
Cc6	7.g,h,j	GOV (100m)	3	2	2	0	67	
Cc7	7.g,h,j	GOV (100m)	0	0	0	0	-	
Cn	**7.g,h,j**	**GOV (m)**	**16**	**0**	**0**	**0**	**0**	
Cn2	7.g,h,j	GOV (50m)	7	0	0	0	0	
Cn3	7.g,h,j	GOV (50m)	9	0	0	0	0	
Cs	**7.g,h,j**	**GOV (m)**	**36**	**37**	**37**	**1**	**103**	
Cs4	7.g,h,j	GOV (100m)	24	26	26	2	108	
Cs5	7.g,h,j	GOV (100m)	8	7	7	0	88	
Cs6	7.g,h,j	GOV (100m)	4	4	4	0	100	
Gn	**8.a,b**	**GOV (m)**	**51**	**48**	**48**	**0**	**94**	
Gn1	8.a,b	GOV (50m)	5	3	3	0	60	
Gn2	8.a,b	GOV (50m)	5	5	5	0	100	
Gn3	8.a,b	GOV (50m)	14	13	13	0	93	
Gn4	8.a,b	GOV (100m)	20	21	21	1	105	
Gn5	8.a,b	GOV (100m)	3	3	3	0	100	
Gn6	8.a,b	GOV (100m)	2	2	2	0	100	
Gn7	8.a,b	GOV (100m)	2	1	1	0	50	
Gs	**8.a,b**	**GOV (m)**	**23**	**21**	**21**	**0**	**91**	
Gs1	8.a,b	GOV (50m)	3	3	3	0	100	
Gs2	8.a,b	GOV (50m)	6	6	6	0	100	
Gs3	8.a,b	GOV (50m)	4	4	4	0	100	
Gs4	8.a,b	GOV (100m)	4	4	4	0	100	
Gs5	8.a,b	GOV (100m)	2	2	2	0	100	
Gs6	8.a,b	GOV (100m)	2	1	1	0	50	
Gs7	8.a,b	GOV (100m)	2	1	1	0	50	
All		**GOV**	**158**	**125**	**124**	**3**	**78.5**	

Table A6.34. Biological observations (sex, maturity and collected material for aging) for species sampled during EVHOE 2022 in ICES Divisions 8.a–b and 7.f–j.

Species	Female (%)	Male (%)	Not sexed (%)	Undetermined (%)	Total number of samples	Type of material
Argyrosomus regius	0	100	0	0	3	Otolith
Chelidonichthys cuculus	64.1	25.9	0	10	170	Otolith
Dicentrarchus labrax	42.3	57.7	0	0	26	Scales
Engraulis encrasicolus	61.2	37.3	0	1.5	67	Otolith
Gadus morhua	50	50	0	0	8	Otolith
Glyptocephalus cynoglossus	51.7	41.6	0	6.7	89	Otolith
Lepidorhombus whiffiagonis	52.6	44.7	0	2.6	380	Otolith
Lophius budegassa	44.9	41.3	0	13.8	248	Illicia
Lophius piscatorius	37.4	45	0.8	16.8	132	Illicia
Melanogrammus aeglefinus	59.4	40.3	0	0.3	304	Otolith
Merlangius merlangus	43.2	56.8	0	0	89	Otolith
Merluccius merluccius	44.3	40.5	0.1	15.1	751	Otolith
Microstomus kitt	57.7	41.5	0	0.8	124	Otolith
Molva molva	100	0	0	0	4	Otolith
Mullus surmuletus	57.9	27.3	0	14.9	121	Otolith
Phycis blennoides	74.6	21.7	0	3.6	140	Otolith
Pleuronectes platessa	75	25	0	0	4	Otolith
Pollachius pollachius	0	100	0	0	1	Otolith
Sardina pilchardus	58	40.2	0	1.8	114	Otolith
Scomber scombrus	39.5	41.8	0	18.6	179	Otolith
Scophthalmus maximus	25	75	0	0	4	Otolith
Solea solea	71.4	28.6	0	0	84	Otolith
Trisopterus luscus	58.9	36.4	0	4.6	151	Otolith

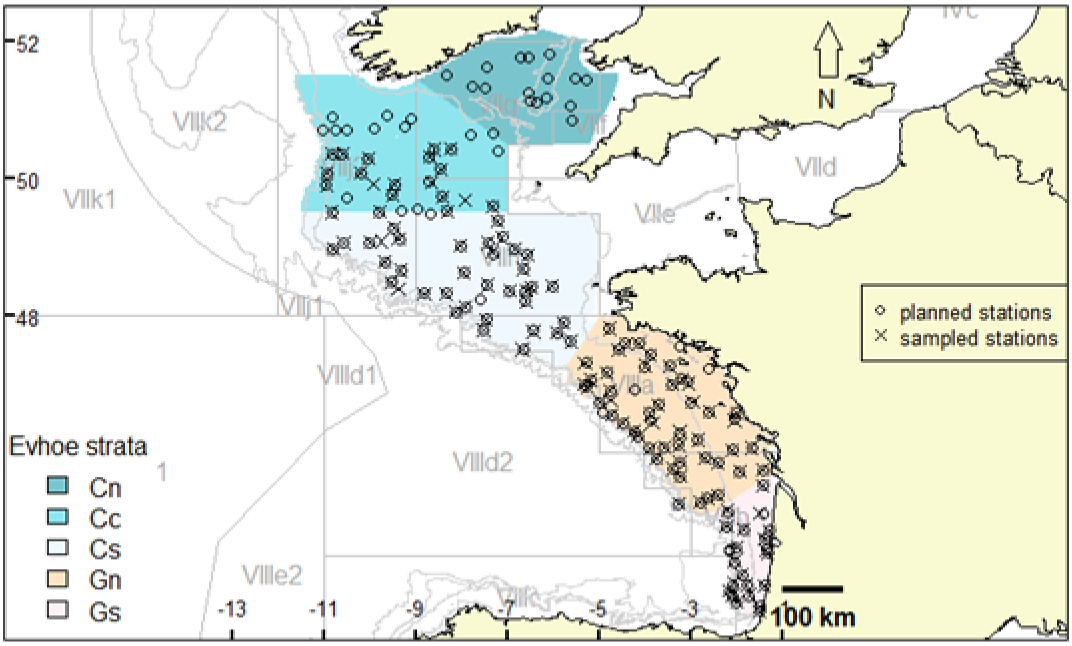

Figure A6.12. Planned stations in the fixed sampling plan (o) and validated tows (x) for EVHOE 2022. ICES areas as well as EVHOE strata (Gs, Gn, Cs, Cc, Cn) are indicated.

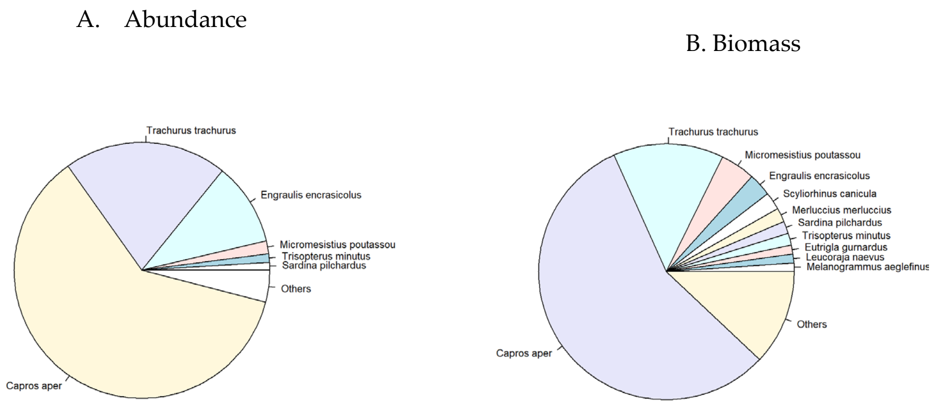

Figure A6.13. Fish and cephalopods species dominance over the entire "EVHOE" sampling area in term of A) abundance and B) biomass.

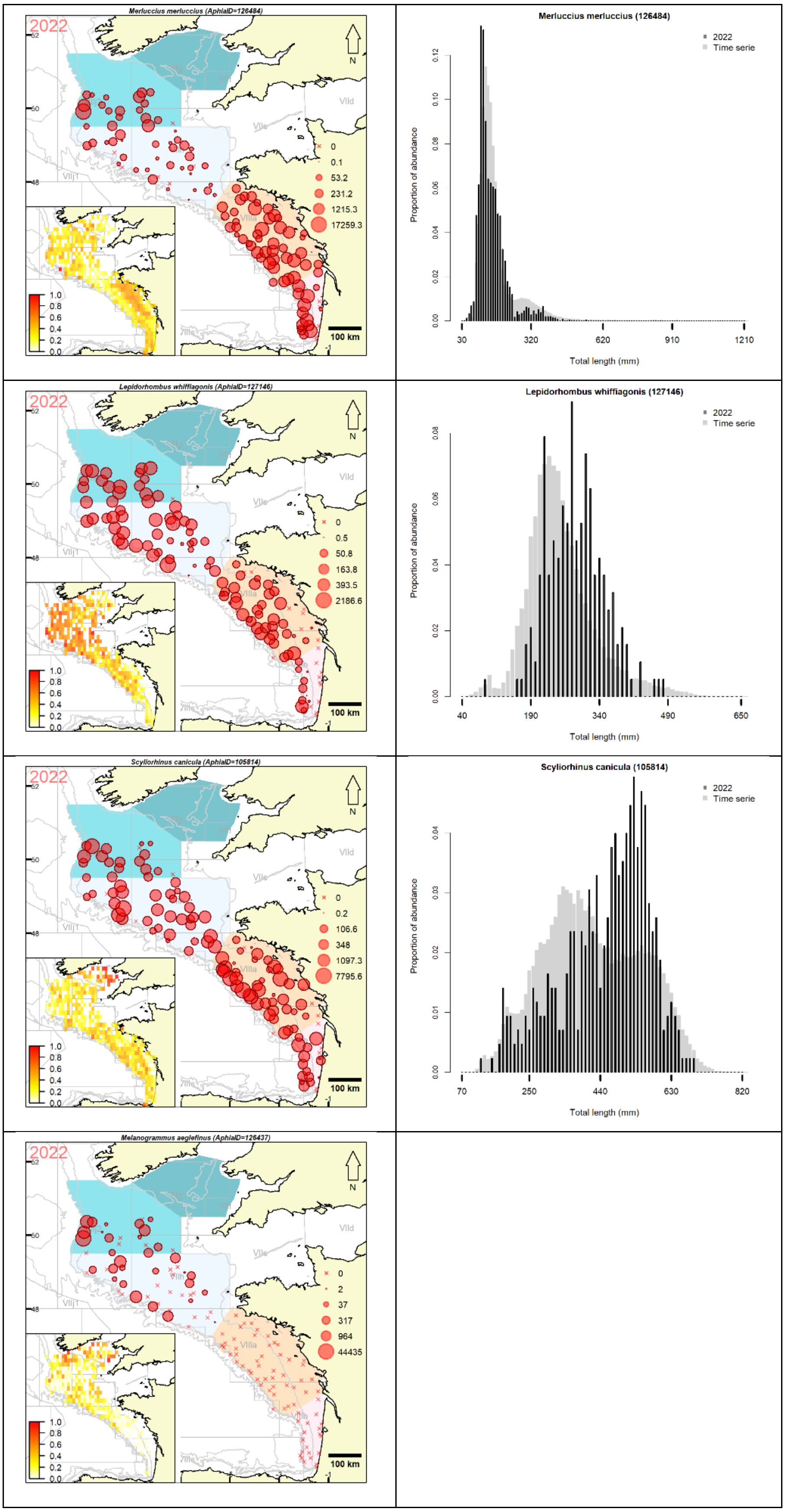

Figure A6.14. Spatial distribution of biomass and barplot of length distribution (logarithm of abundance by size class) for (top to bottom) hake, megrim, lesser-spotted dogfish and haddock caught during IBTS Q4 (EVHOE) survey in 2021 as compared to the whole time series (1997–2020).

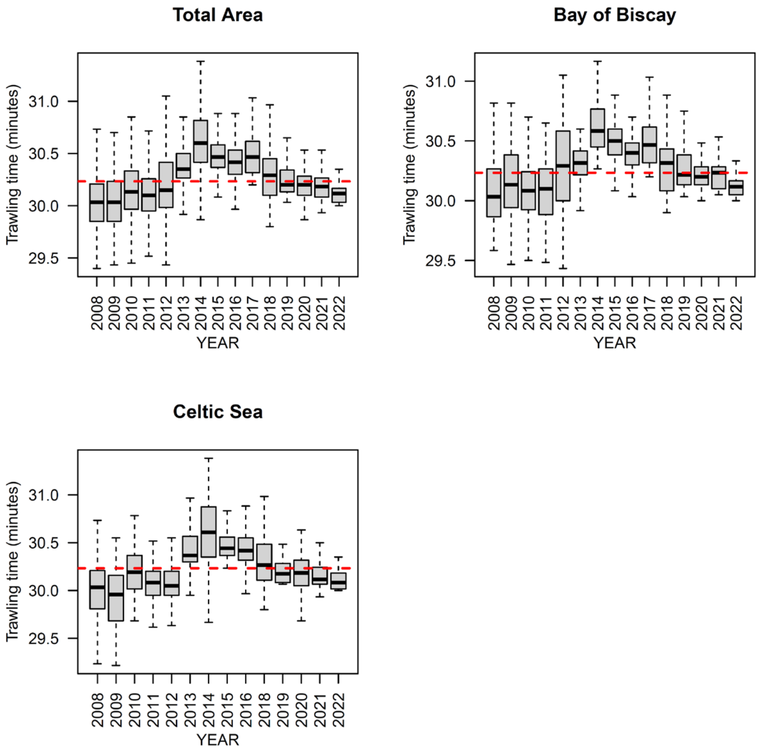

Figure A6.15. Distribution of the trawling duration (mins) at sampling stations by year during EVHOE IBTS Q4 surveys.

A6.12 Portuguese Autumn Groundfish Survey

NATION:	PT (PORTUGAL)	VESSEL:	MÁRIO RUIVO
Survey:	PT-GFS- Q4 (Autumn2022)	Dates:	13th October – 02nd November 2022 09th November – 15th November 2022 19th November – 22nd November 2022
Cruise	The Portuguese Autumn Groundfish Survey (PT-GFS) is undertaken every year since 1979 (except 1984, 2012, 2019, 2020). Main objectives are: • To estimate indices of abundance and biomass and distribution of hake and horse mackerel recruits; • Provide indices of abundance and biomass of the most important commercial species; • Collect biological parameters, e.g. maturity, ages, sex-ratio, weight, food habits; • Collect data to support biodiversity indicators; • Collect supporting data for MSFD purposes (litter, stomachs) The primary species are hake, horse mackerel, blue whiting, mackerel and Spanish mackerel. Data are also collected for several demersal fish species and invertebrates, focusing in providing the necessary information for stock assessment of commercial species. This survey supports other projects and collaborates with international institutes thru collection of data.		
Area	Portuguese continental waters (Div. 9.a), from 20–500 m depth.		
Survey Design	This survey is a mixed fixed and random stratified with twelve geographical strata along the coast and three depth strata (20–100 m, 101–200 m, 201–500 m). 96 fishing stations are allocated, 66 at fixed (grid) positions and 30 at random. Tow duration is 30 min, with a trawl speed of 3.5 knots, during day light. Temperature is recorded with a CTD (Conductivity, Temperature, Depth) equipment at the end of each haul or during haul with a portable CTD. Scanmar is used to monitor gear parameters.		
Gear details:	NCT (Norwegian Campbell Trawl) gear with rubber rockhopper and Thyborøn doors. The mean horizontal opening between the wings is 14.2 m , between doors is 42.1 m and the mean vertical opening is 4.5 m. Codend mesh size is 20 mm.		
Notes from survey (e.g. problems, additional work etc.):	The 2022 survey started two weeks later than expected due to vessel agenda. A set of sequential bad weather events, plus a breakdown in the vessel, caused three interruptions each ranging from 3–8 days which delayed the arrival time to a date that the vessel would not be available and a major bad weather event reduced the available days allocated to survey. Scanmar was planned to be used for the whole survey, but unexpected battery depletion and the loss at sea of the trawl-eye battery, did not allow for a set of reliable data for gear parameters. There was a 500 kg catch of the algae *Rugulopteryx okamurae* in the South region (haul #8).		

Number of fish species recorded and notes on any rare species or unusual catches:	Overall, 154 species of fish, 18 of cephalopods and 47 of crustaceans were recorded during the survey. 80 species of other groups were recorded, e.g., Echinodermata, Cnidaria, Bivalvia, Gastropoda, Polychaeta, Ascidiacea and Nudibranchia.

Table A6.35. Stations fished (aim: to complete 1 valid tows per strata)

ICES Division	Strata	Gear	Hauls					
			Planned	Valid	Additional	Invalid	% Achieved	Comments
9.a	All	NCT	96	61	0	3	67%	3 strata not covered

Table A6.36. Biological samples (length, weight, sex, maturity and age material)

SPECIES	SAMPLES*	MATURITY	OTOLITHS	SPECIES*	SAMPLES*	MATURITY	OTOLITHS
Boops boops	*19*	*257*	*265*	*Micromesistius poutassou*	*12*	*584*	*198*
Chelidonichthys lastoviza	*2*	*7*	*7*	*Nephrops norvegicus*	*5*	*188*	
Diplodu vulgaris	*9*	*176*	*176*	*Pagellus acarne*	*17*	*210*	*197*
Illex coindetii	*29*	*292*		*Parapenaeus longirostris*	*13*	*1399*	
Lepidorhombus boscii	*18*	*234*	*144*	*Scomber colias*	*9*	*318*	*198*
Loligo vulgaris	*21*	*176*		*Scomber scombrus*	*6*	*234*	*122*
Lophius budegassa	*11*	*17*	*17*	*Spondyliosoma cantharus*	*13*	*140*	*137*
Merluccius merluccius	*56*	*1377*	*449*	*Trachurus trachurus*	*22*	*856*	*312*

Table A6.37. Biomass and abundance index for the PT-PGFSQ4-2022 survey

BIOMASS AND NUMBER ESTIMATES								
			Biomass index			Number index		
Species	Strata	Valid tows	y_i kg/h	y_i/y_{i-1} %	$y_{(i,i-1)}/y_{(i-3,i-4,i-5)}$ %	y_i n/h	y_i/y_{i-1} %	$y_{(i,i-1)}/y_{(i-3,i-4,i-5)}$ %
Merluccius merluccius	9.a	61	20.2	-5.2	11.6	253.8	-6.9	15.5
Trachurus trachurus	9.a	61	37.1	-34.8	-27.7	548.5	-45.7	-19.0
Trachurus picturatus	9.a	61	4.6	2.8	30.8	58.8	30.6	29.4
Micromesistius poutassou	9.a	61	53.1	-68.4	29.6	773.6	-84.3	65.2
Scomber colias	9.a	61	6.7	250.6	-83.3	100.8	462.0	-86.8
Scomber scombrus	9.a	61	2.3	-83.8	-58.8	12.0	-86.7	-79.4
Lepidorhombus boscii	9.a	61	0.5	-52.0	159.7	6.2	-56.6	113.5
Lepidorhombus whiffiagonis	9.a	61	0.1	-40.8	181.6	0.4	103.8	58.9
Lophius budegassa	9.a	61	0.2	-50.9	124.0	0.3	-47.1	263.9
Lophius piscatorius	9.a	61	-	-	-	-	-	-
Capros aper	9.a	61	9.4	-52.8	20.4	263.9	-63.3	29.9
Phycis blennoides	9.a	61	0.2	-22.2	67.0	1.9	-43.1	193.0
Raja clavata	9.a	61	0.4	-92.8	-20.8	0.6	-88.5	-37.8
Scyliorhinus canicula	9.a	61	2.3	-44.9	-9.9	7.4	-48.4	14.7
Nephrops norvegicus	9.a	61	0.1	61.7	-43.0	2.9	96.2	-16.6

y_i, year estimate (2022); y_{i-1}, previous year estimate (2021); $y_{(i,i-1)}$, Average of last two year estimates (2022 and 2021); $y_{(i-3,i-4,i-5)}$, Average of the last three year estimates (2018, 2017 and 2016).

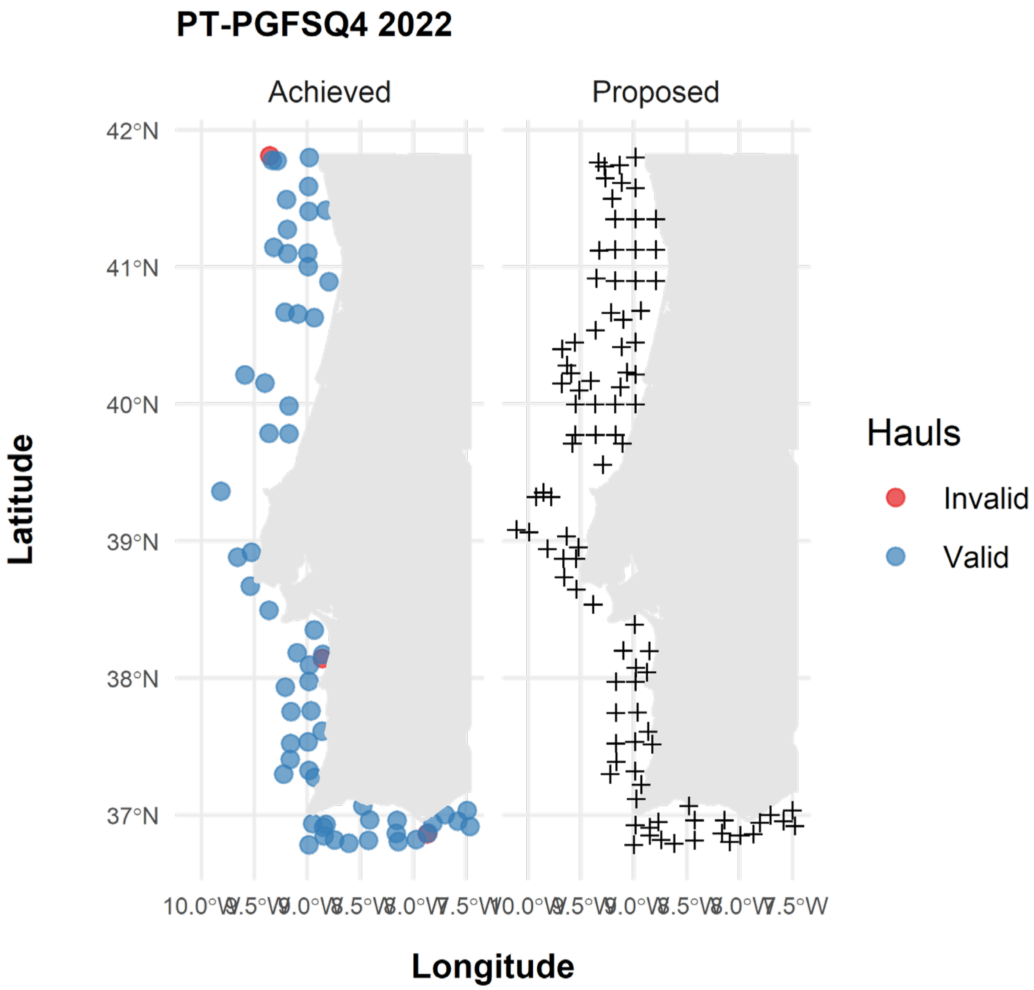

Figure A6.16. Location of hauls for PT-PGFS-Q4 survey

A6.13 Spanish Gulf of Cádiz groundfish survey (SP-GCGFS-Q4)

Nation:	**SP (Spain)**	**Vessel:**	**Vizconde de Eza**
Survey:	SP-GCGFS-Q4 (ARSA 1122)	**Dates:**	29 October – 11 November 2022
Cruise:	Spanish Gulf of Cádiz bottom trawl survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Gulf of Cádiz area (ICES Division 9.a). The primary species are hake, horse mackerel, wedge sole, sea breams, mackerel and Spanish mackerel. Data and abundance indices are also collected and estimated for other demersal fish species and invertebrates as rose and red shrimps, *Nephrops* and cephalopod molluscs.		
Survey Design:	The survey is random stratified with five depth strata (15–30 m, 31–100 m, 101–200 m, 201–500 m, 501–800 m). Stations are allocated at random according to the strata surface.		
Gear details:	Baca 44/60 with Thyborøn doors (350 Kg).		
Notes from survey (e.g. problems, additional work etc.):	The survey is carried out on board the R/V “Vizconde de Eza” from 2022 onwards. Hydrographic data at each trawl station was collected using a net-mounted CTD. Analyses of stomach contents of main demersal species was performed in all hauls during the survey.		
Number of fish species recorded and notes on any rare species or unusual catches:	Overall a total of 154 fish, 43 crustacean, 61 mollusc and 21 echinoderm species were recorded.		

Table A6.38. Numbers of stations fished (aim: to complete 45 valid tows per year).

ICES Divisions	Strata	Gear	Stations					
			Planned	Valid	Additional	Invalid	% Fished	Comments
9a	All	Baca 44/60	45	45	-	1	100%	
	TOTAL		45	45	-	1	100%	

Table A6.39. Biomass estimates for the main species in the Q4 Gulf of Cadiz bottom trawl survey.

Biomass and number estimates								
			Biomass index			Number index		
Species	Strata	Valid tows	y_i kg/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change	y_i n/0.5h	y_i/y_{i-1} % change	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$ % change
Merluccius merluccius	All	45	2.72	19.8	-28.3	33.7	27.1	-71.4
Micromesistius poutassou	All	45	2.34	265.6	-73.3	18.8	326.1	-89.0
Nephrops norvegicus	All	45	0.52	45.1	8.8	12.3	20.4	-30.5
Parapenaeus longirostris	All	45	1.42	31.6	19.7	244.0	11.4	5.0
Octopus vulgaris	All	45	1.27	80.1	40.1	2.4	110.8	1.7
Loligo vulgaris	All	45	0.70	-25.9	-32.9	4.0	-45.2	-58.6
Sepia officinalis	All	45	0.48	-34.5	-43.5	1.2	-39.4	-48.7

y_i, year estimate (2022); **y_{i-1}**, previous year estimate (2020); **$y_{(i,i-1)}$**, Average of last two year estimates (2022 and 2020); **$y_{(i-2,i-3,i-4)}$**, Average of the previous three year estimates (2019, 2018 and 2017).

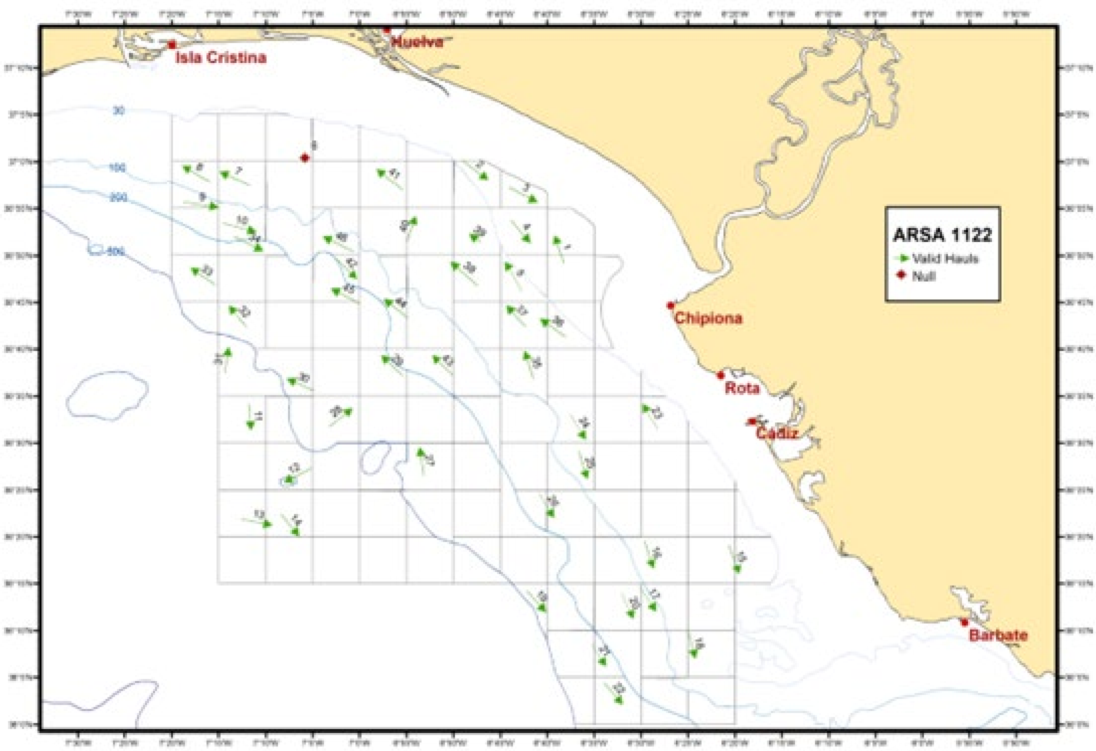

Figure A6.17. Trawl stations in Q4 Gulf of Cádiz 2022 survey.

A6.14 Spanish North Coast bottom trawl survey (SP-NSGFS-Q4)

Nation:	**SP (Spain)**	**Vessel:**	**Miguel Oliver**
Survey:	SP-NSGFS-Q4 (N22)	**Dates:**	17 September – 21 October 2022
Cruise:	Spanish North Coast bottom trawl survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in ICES Division 8.c and the northern part of 9.a. The primary species are hake, monkfish and white anglerfish, megrim, four-spot megrim, blue whiting and horse mackerel abundance indices are estimated by age, with abundance indices also estimated for *Nephrops*, and data collection for other demersal fish and invertebrates.		
Survey Design:	This survey is random stratified with five geographical strata along the coast and 3 depth strata (70–120 m, 121–200 m, 201–500 m). Stations are allocated at random within the trawlable stations available according to the strata surface.		
Gear details:	Standard baca 36/40 with Thyborøn doors.		
Notes from survey (e.g. problems, additional work etc.):	After last year breakdown of the “Miguel Oliver”, the 2022 survey was carried out on board the “Miguel Oliver”. The gear was the standard gear and results are in line with those from the time series, showing the usual proportion of bentho-demersal species as megrims, skates, catfish… As in previous years, three additional hauls were undertaken to cover shallow stations between 30 and 70 m, and 11 deeper stations at depths of 500–700 m. Additional work undertaken included CTD casts at all trawl stations. and dredges carried out with a box-corer 16 and a meso-box-corer 52 to create a grid of sediments and in some areas infauna samples. Seabird census, dredges and sediment samplings were not carried out because of the crew limitations due to COVID-19 restrictions. Analyses of stomach contents of main demersal species was performed in all hauls during the survey.		
Number of fish species recorded and notes on any rare species or unusual catches:	A total of 242 species were captured,105 fish taxa with 101 species, 58 crustaceans taxa with 52 species , 42 mollusc taxa with 37 species, 36 echinoderm taxa with 34 species, and 33 other invertebrates taxa with 18 species.		

Table A6.40. Numbers of stations fished (aim: to complete 116 valid tows per year).

ICES Divisions	Strata	Gear	Stations					
			Planned	Valid	Addi-tional	Invalid	% Fished	Comments
8.c	All	Standard baca	96	94	13	0	98%	
9.a North	All	Standard baca	20	21	1	1	105%	
8.b	All	Standard baca	0	0	1	0	Na	
	TOTAL		116	115	15	1	114%	

Table A6.41. Numbers of individuals biologically sampled (length, weight, sex, maturity, age) by species.

Species	No.	Species	No.
Merluccius merluccius	666	*Mullus surmuletus*	99
Lepidorhombus whiffiagonis	541	*Scomber colias*	165
Lepidorhombus boscii	500	*Zeus faber*	73
Lophius budegassa	61	*Trisopterus luscus*	170
Lophius piscatorius	100	*Helicolenus dactylopterus*	182
Trachurus trachurus	534	*Phycis blennoides*	204
Micromesistius poutassou	355	*Conger conger*	58
Engraulis encrasicolus	178	*Sardina pilchardus*	332
Scomber scombrus	434		

Table A6.42. Biomass estimates for the main species in the Spanish North Coast bottom trawl survey.

Biomass and number estimates									
			Biomass index			Number index			
Species	Strata	Valid tows	y_i	y_i/y_{i-1}	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$	y_i	y_i/y_{i-1}	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$
			kg/0.5h	% change	% change	n/0.5h	% change	% change
Merluccius merluccius	9aN	21	7.42	29.5	38.2	167.4	-11.4	-9.5
Lepidorhombus boscii	9aN	21	5.29	7.3	17.7	71.6	-7.7	5.1
Lepidorhombus whiffiagonis	9aN	21	0.13	-58.1	24.5	0.6	-68.8	-41.1
Lophius budegassa	9aN	21	0.01	-92.3	-63.8	0.1	140.0	-5.6
Lophius piscatorius	9aN	21	0.01	NA	-93.8	0.1	NA	87.5
Micromesistius poutassou	9aN	21	301.31	38.8	62.8	6413.4	-21.7	85.1
Trachurus trachurus	9aN	21	0.75	-56.4	-85.1	25.8	100.3	-73.1
Scomber scombrus	9aN	21	1.41	-51.0	-84.2	5.7	-66.3	-93.2
Nephrops norvegicus	9aN	21	0.00	NA	-100.0	0.0	-100.0	-81.3
Merluccius merluccius	8c	94	10.05	95.9	23.7	260.2	95.2	-1.7
Lepidorhombus boscii	8c	94	6.67	12.1	8.4	101.9	3.2	-1.0
Lepidorhombus whiffiagonis	8c	94	6.96	74.4	22.8	101.7	94.8	39.1
Lophius budegassa	8c	94	0.55	1.9	-2.7	0.8	45.6	150.0
Lophius piscatorius	8c	94	1.91	73.6	100.7	1.1	13.8	210.8
Micromesistius poutassou	8c	94	174.57	40.2	30.3	3236.2	-34.9	29.0
Trachurus trachurus	8c	94	21.88	376.7	-43.6	1623.3	2300.3	73.3
Scomber scombrus	8c	94	3.14	630.2	-1.4	85.2	5034.3	88.6
Nephrops norvegicus	8c	94	0.11	450.0	62.5	3.2	503.8	159.0
Merluccius merluccius	Total	115	9.59	83.4	25.6	244.3	70.9	-3.0
Lepidorhombus boscii	Total	115	6.43	11.4	9.6	96.7	1.7	-0.2
Lepidorhombus whiffiagonis	Total	115	5.78	72.5	22.6	84.3	93.5	38.4
Lophius budegassa	Total	115	0.46	-2.1	-6.4	0.7	47.9	144.5
Lophius piscatorius	Total	115	1.58	73.6	96.6	0.9	14.1	205.5
Micromesistius poutassou	Total	115	196.36	39.8	37.6	3782.4	-31.6	40.5
Trachurus trachurus	Total	115	18.24	344.9	-46.5	1348.7	2216.9	69.0
Scomber scombrus	Total	115	2.85	235.3	-51.8	71.6	1564.4	-20.9
Nephrops norvegicus	Total	115	0.09	350.0	83.3	2.7	488.9	152.7

$\mathbf{y_i}$, year estimate (2022); $\mathbf{y_{i-1}}$, previous year estimate (2021); $\mathbf{y_{(i,i-1)}}$, Average of last two year estimates (2022 and 2021); $\mathbf{y_{(i-2,i-3,i-4)}}$, Average of the previous three year estimates (2020, 2019 and 2018).

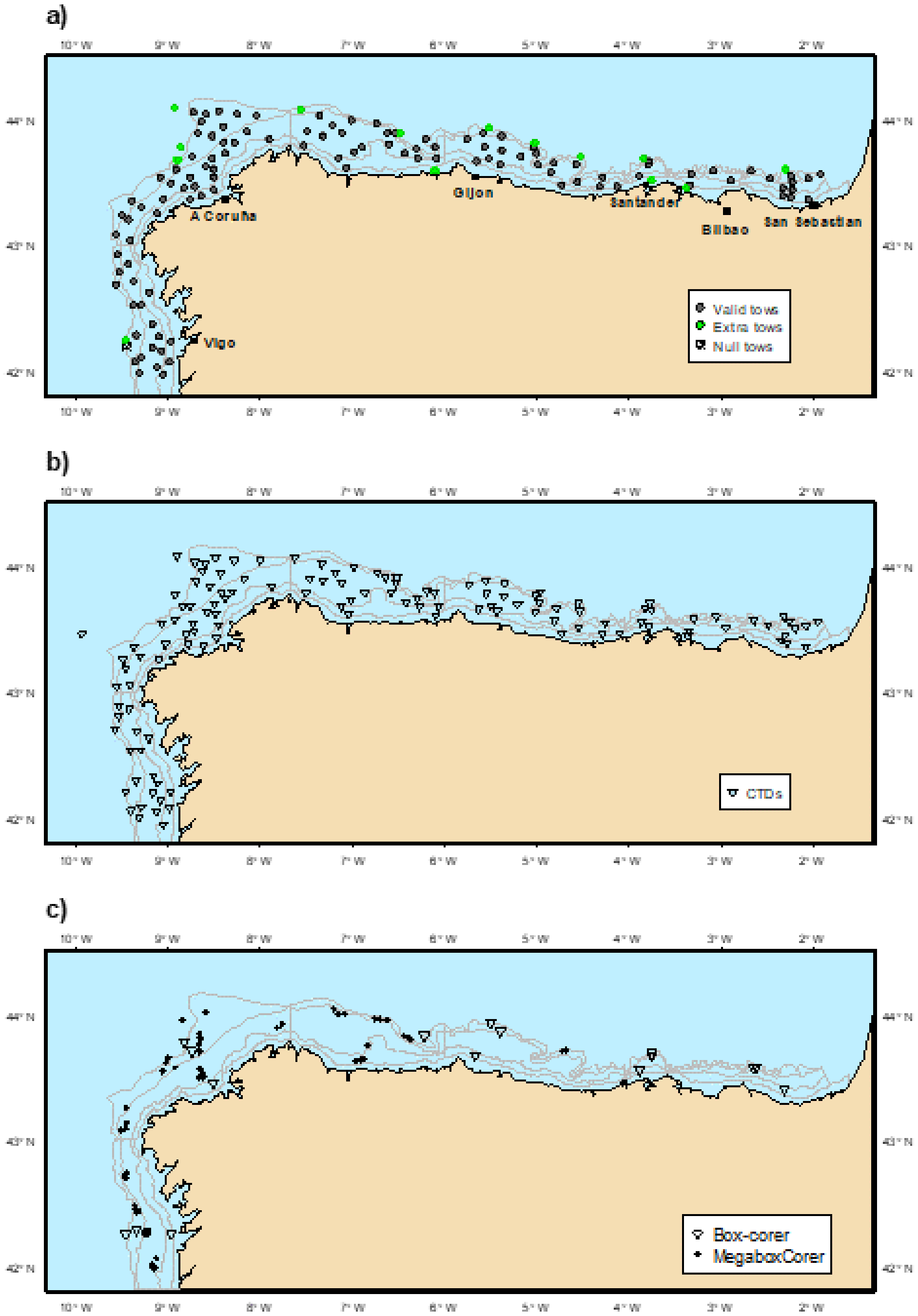

Figure A6.18. Spanish North Coast survey showing the distribution of a) trawl stations, b) CTD stations and c) dredges sampled during the 2022 survey.

Annex 7: Working Documents

In addition to a range of presentations, the following Working Documents were presented to the 2023 meeting of IBTSWG.

Gerritsen, H. and Stokes, D. (2023). Identification of *Lophius* spp.

The findings from this WD are included in Section 3.

Reecht, Y., Denechaud, C., Eidset, E., Eriksson Bjånes, C. and Fuglebakk, E. (2023). Catch weight errors in Norwegian DATRAS data.

This WD is included below, and summary information provided in Section 3.

Sinclair, L. and Kynoch, R. (2023). Variability in Net Opening, Door Spread and Warp Length.

This WD is included below, and summary information provided in Section 4.

Stokes, D. and Griffin, F. (2023). Prototype New IBTS Survey Trawl – build and initial setup. Summary Report to IBTS

This WD is included below, and summary information provided in Section 4.

A7.1 Catch weight errors in Norwegian DATRAS data

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Institute of Marine Research, Bergen, Norway

Created 23. Mar. 2023 (last modified 26/07/2023)

Background

After evidence was given during IBTSWG 2022 that there were widespread errors in catch weights reported by a number of countries before 2004 (see Annex 8 of the 2022 report), we intended to track those errors and reveal patterns in data provided by Norway (scaling factor per year, or survey) that could be used for the correction of data by the data centre, while avoiding resubmission.

Investigation of catch weight discrepancies

Methods

A first attempt consisted in checking consistency of mean individual weight (catch weight / catch number) versus mean individual size, per station and species within DATRAS data, and try to identify scaling factors per year or survey. Inconsistencies among years and surveys, together with the difficulty of using such an approach to precisely track down the origin of inconsistencies (wrong numbers or wrong catch weights?) led to adopting a more direct approach.

Catch numbers and weights were calculated per species and trawl haul (aggregated over sexes and catch categories – such as sampling of different cohorts), for both the delivered data originating from DATRAS, and the raw data hosted at the IMR, and then matched at the species and haul level. In case no mistake was done, parity (give or take rounding errors) should be found among catch numbers and weights from the two origins.

As IMR data are stored in internal databases as absolute catch, DATRAS data submitted as CPUEs (DataType "C") were transformed back to absolute catch using the value reported in the field HaulDur. All data were aggregated at the species and trawl haul level, to avoid possible matching issues due to change in catch category coding (this being arbitrary, therefore subject to recoding between the two databases).

Results

With the exception of a few outliers, and some spreading at very small abundances – which can be interpreted as due to the rounding error while transforming back from CPUEs – the catch numbers were found to be overall very consistent between DATRAS and data hosted at IMR (Figure 1). The only notable inconsistencies are some missing records in DATRAS, especially over the last few years. Those concern mostly invertebrates and a few fish species, likely filtered out before submission, or later corrections of species identification in the IMR database.

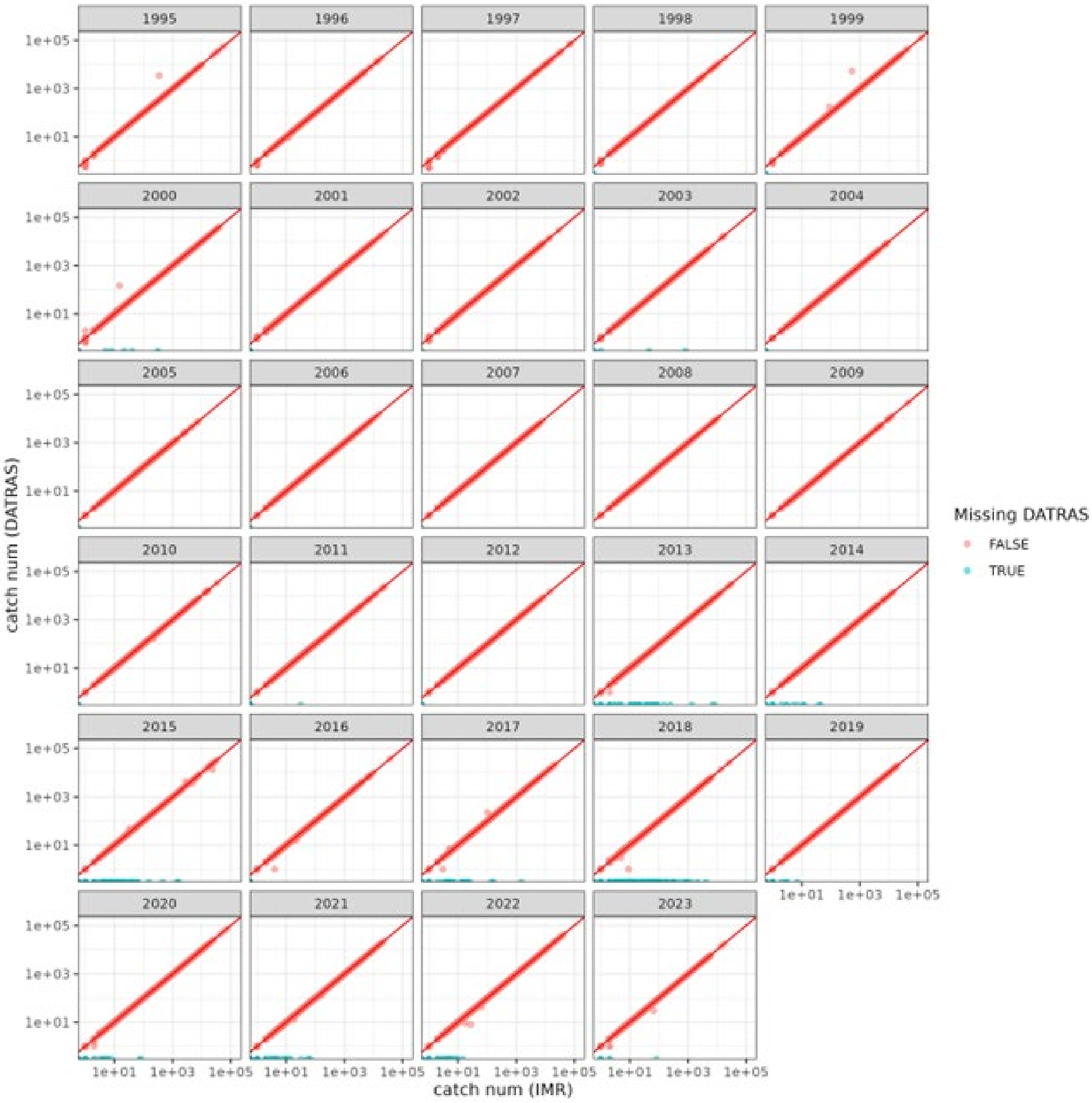


Figure 15. Comparison of matched abundances from data hosted at IMR and in DATRAS, split by year. Catch numbers aggregated at the species and trawl haul level.

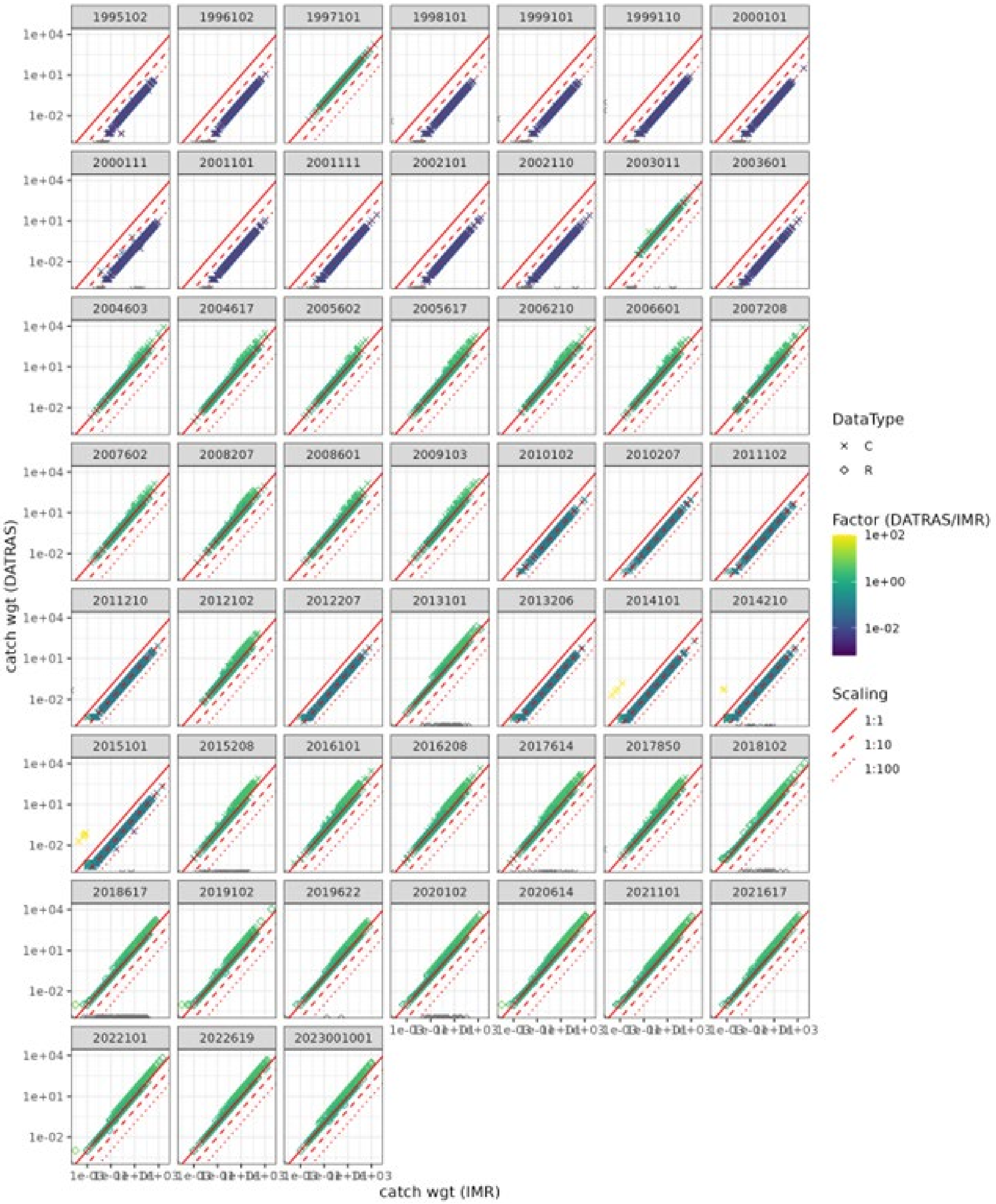


Figure 16. Comparison of matched catch weights from data hosted at IMR and in DATRAS, split by survey. Catch weights in kg, aggregated at the species and trawl haul level. The red lines are guides to identify scaling by orders of magnitude (1:1 indicates parity).

As initially suspected, the comparison of catch weights revealed inconsistencies (Figure 2). It shows that before 2004, catch weights were reported at one hundredth of their actual value (data hosted at IMR are assumed correct), with the exception of two surveys (one in 1997, and the other in 2003) were no inconsistency was found. Inconsistencies of seemingly different natures were furthermore found for **all** surveys from 2004 onwards:

(1) For nine surveys, the CPUEs were consistently reported to DATRAS at a tenth of their actual value. Among those, a few records had weights 100 times larger in DATRAS, and probably correspond to records in the wrong unit at the time of submission, later corrected in the IMR database (grams would have been recorded as kg; concerned invertebrates only).

(2) For all the other surveys, a substantial proportion of the catch weights (regardless of whether they were reported as CPUEs or absolute values) stand over the parity line, meaning they were over-reported to DATRAS.

For the latter issue, a closer look at the comparison between the latest submitted data (also considered in order to make sure the issue did not originated in subsequent data wrangling) shows that some catch weights are multiplied by two or three in the uploaded data (Figure 3).

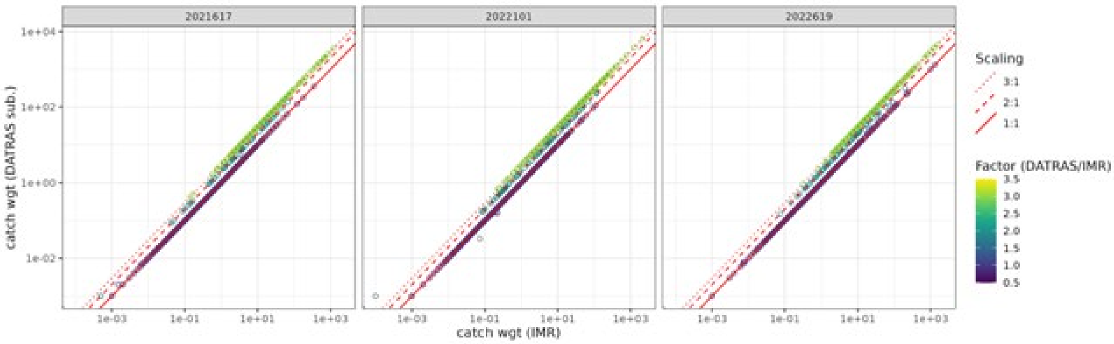


Figure 17. Comparison of matched catch weights hosted at IMR and submitted to DATRAS for three of the last surveys. Catch weights in kg, aggregated at the species and trawl haul level.

The origin was tracked down to HL records reported for catch categories by sex (M, F, U/NA), while the catch weight reported in the field CatCatchWgt was aggregated over the different sexes, leading to duplication of the catch weight by two or three times (depending on whether all measured individuals had been segregated by sex or not – then presenting a third NA category; or alternatively a third "U"-ndefined category when all segregated), for all those species where biology sampling was performed.

This is in contradiction with the definition given for **CatCatchWgt**: "Catch weight in grams per category (**for the unique combination of cruise haul, species, sex, and category identifier**), or total species weight per haul per hour for CPUE data type (see HH record for details)".

Comparison with data submitted by other countries

Because of some uncertainties arising about the interpretation of DATRAS specification (see Section 4), but also to evaluate the possible scale of consequences, we looked up similar records (HL, split by sex) within data submitted by other countries for 2022.

By contrast, it seems that Norway has misinterpreted the **possibility** of having different catch category by sex, when all individuals in the measured sample are segregated by sex (M/F/U; what all other countries did in 2022), to a **necessity** of submitting HL records disaggregated by sex information (or the absence thereof) whenever possible (Table 1). This could have had little or no consequences if the catch weights had been disaggregated accordingly.

When other countries had disaggregated HL record by sex, the catch weight was as a rule also disaggregated (Table 2 and 3), with the exception of Scottish data, where the same mistake as in Norwegian data was observed (Table 4). For all countries, including Norway, and regardless of the DataType (*e.g.* Table 2 and 3), TotalNo was disaggregated when HL records were disaggregated by sex.

Other years were not explored, but this suggest at least duplicated catch weights from both Norway and Scotland, with more systematic duplication (all species with biological samples) for the former. Scotland has moreover confirmed that catch weights had been consistently mis-reported for elasmobranchs since 2013.

Table 10. Sample of HL records from Norway (Q3 2022), from a same species, haul, and catch category combination, split by sex. Note the identical **CatCatchWgt** values (aggregated over sexes).

	Quarter	Country	Ship	StNo	HaulNo	**Sex**	**TotalNo**	CatIdentifier	NoMeas	SubFactor	**CatCatchWgt**	LngtClass	HLNoAtLngt	AphiaID	scientificname	DataType
1	3	NO	58UO	60256	60256	**F**	**17.20**	1	3	5.7336	**254820**	395	1	127023	Scomber scombrus	R
2	3	NO	58UO	60256	60256	**F**	**17.20**	1	3	5.7336	**254820**	335	1	127023	Scomber scombrus	R
3	3	NO	58UO	60256	60256	**M**	**28.67**	1	5	5.7336	**254820**	350	1	127023	Scomber scombrus	R
4	3	NO	58UO	60256	60256	**M**	**28.67**	1	5	5.7336	**254820**	370	1	127023	Scomber scombrus	R
5	3	NO	58UO	60256	60256	**<NA>**	**527.49**	1	92	5.7336	**254820**	350	3	127023	Scomber scombrus	R
6	3	NO	58UO	60256	60256	**<NA>**	**527.49**	1	92	5.7336	**254820**	370	12	127023	Scomber scombrus	R

Table 11. Sample of HL records from Germany (Q1 2022), from a same species, haul, and catch category combination, split by sex. Note that all measured individuals were segregated by sex (no NA category).

	Quarter	Country	Ship	StNo	HaulNo	**Sex**	**TotalNo**	CatIdentifier	NoMeas	SubFactor	**CatCatchWgt**	LngtClass	HLNoAtLngt	AphiaID	scientificname	**DataType**
1	1	DE	06NI	86	4	**F**	**56**	1	28	1	**3990**	15	2	127139	Limanda limanda	**C**
2	1	DE	06NI	86	4	**F**	**56**	1	28	1	**3990**	21	10	127139	Limanda limanda	**C**
3	1	DE	06NI	86	4	**M**	**46**	1	23	1	**2320**	19	2	127139	Limanda limanda	**C**
4	1	DE	06NI	86	4	**M**	**46**	1	23	1	**2320**	18	6	127139	Limanda limanda	**C**

Table 12. Sample of HL records from Dennmark (Q3 2022), from a same species, haul, and sex combination. Note the use of different catch category identifiers for males and females.

	Quarter	Country	Ship	StNo	HaulNo	**Sex**	**TotalNo**	**CatIdentifier**	NoMeas	SubFactor	**CatCatchWgt**	LngtClass	HLNoAtLngt	AphiaID	scientificname	**DataType**
1	3	DK	26D4	122	40	**F**	**15**	**2**	15	1	**6390**	530	1	105814	Scyliorhinus canicula	**R**
2	3	DK	26D4	122	40	**F**	**15**	**2**	15	1	**6390**	560	1	105814	Scyliorhinus canicula	**R**
3	3	DK	26D4	122	40	**M**	**4**	**1**	4	1	**1352**	480	1	105814	Scyliorhinus canicula	**R**
4	3	DK	26D4	122	40	**M**	**4**	**1**	4	1	**1352**	510	1	105814	Scyliorhinus canicula	**R**

Table 13. Sample of HL records from Scotland (Q3 2022), from a same species, haul, and sex combination. Note the identical **CatCatchWgt** values (aggregated over sexes).

	Quarter	Country	Ship	StNo	HaulNo	**Sex**	**TotalNo**	CatIdentifier	NoMeas	SubFactor
1	3	GB-SCT	748S	190	190	**F**	**10**	11	10	1
2	3	GB-SCT	748S	190	190	**F**	**10**	11	10	1
3	3	GB-SCT	748S	190	190	**M**	**233**	11	233	1
4	3	GB-SCT	748S	190	190	**M**	**233**	11	233	1

	CatCatchWgt	LngtClass	HLNoAtLngt	AphiaID	scientificname	DataType
1	**447259**	660	1	105923	Squalus acanthias	P
2	**447259**	680	2	105923	Squalus acanthias	P
3	**447259**	840	4	105923	Squalus acanthias	P
4	**447259**	830	5	105923	Squalus acanthias	P

Possible impacts on assessments

Most category 1 & 2 assessments in the North Sea, relying essentially on indices in numbers at age, and weight at age from a different source (ECA), should not be affected, as a rule of thumb. The absence of use of any weight-based tuning series should however be checked on a per case basis.

Possible influence on the growing number of category ≥3 assessments needs to be evaluated, as they are more likely to use indices based on catch weights. The alternation of Norwegian surveys with under- and over-reporting might furthermore generate spurious contrast in the time-series.

It was brought to our attention that some of the WGNSSK category ≥3 assessment actually use weight-based indices calculated from abundance and length-weight relationships, and would therefore not be affected by the issue.

Reflection on possible ways to fix misreported catch weights

Ways and deadlines to fix the data will need to be discussed with the group and with the ICES data centre. Following are some thoughts about possible ways to tackle the issues (not exhaustive):

- Data from surveys with a fixed scaling error should be easily fixed by the ICES data centre (as suggested in IBTSWG 2022).
- For the other surveys, resubmission from scratch would require 1) fixing the used framework (anticipated to be easy enough), and 2) work back all incriminated surveys, which represent a huge amount of (un-budgeted) work. It does not emerge as a short-term solution for surveys older than 2021, for which history of decisions regarding validity of trawls, exclusion of data, etc. has been lost due to staff turnover.
- The likely fastest way to fix improperly aggregated data, could be resubmission of patched data:
    1. download existing data from DATRAS
    2. patch data by properly:
        1. aggregating HL when not all measured individuals have been segregated by sex (sum for TotalNo, unique value for CatCatchWgt)

2. split CatCatchWgt when all measured individuals have been segregated by sex (possibly recalculate/rescale based on the sum of individual weights, or raised weights based on individual weights and size distribution by sex).
3. Check consistency using the framework above.
4. Strip down fields generated by the DATRAS upload tools (*e.g.* DateOfCalculation) and re-submit.

- Alternatively, the same procedure could be carried out directly by the ICES data centre.

Concomitant issues with DATRAS specifications

While investigating the issues above, one noticeable obstacle was the lack of unambiguous definitions of the fields in the DATRAS database. This played both while setting up aggregation rules to compare with data hosted at the institute, and while trying to later figure out correct interpretations. In no particular order, one can mention:

- if there is no rationale to aggregate catch weights differently for CPUEs, the specifications seem to suggest so by explicitly specifying "*[…] or total species weight per haul per hour for CPUE data type (see HH reocrd for details)*" in specifications for CatCatchWgt. It however seems that the implicit understanding is to aggregate DataTypes C and R or S in the exact same way (*cf.* examples in Table 2 and 3 above).
- along the same line, the headline of TotalNo specifications gives no mention of disaggregation by catch category and sex ("*Total number of fish in the given haul and species.*"), while the shared understanding appears to be that it must be disaggregated.
- in that latter case, the user has to refer to the latter definition based on NoMeas (and seek its definition: "*Number of measured fish in the given haul **or subsample, species, and sex.***") – TotalNo=NoMeas*SubFactor – to elucidate the matter.
- The DATRAS FAQ (https://www.ices.dk/data/Documents/DATRAS/DATRAS_FAQs.pdf) clarify some of these uncertainties, but also seem to enact the lack of consistency between aggregation levels in catch numbers and weights among DataTypes. For instance:
    - type R should have similar aggregation levels for TotalNo and CatCatchWgt:
      "*TotalNo – report the total number of fish of one **species, sex, and category** in the given haul;*"
      "*CatCatchWgt – report catch weight of fish per **species, sex, and category** in the given haul (**as in TotalNo**).*"
    - while type C should, according to this source, have different aggregation levels in both fields:
      "*TotalNo – report the total number of fish of one **species and sex** in the given haul, raised to 1 hour hauling;*"
      "*CatCatchWgt – report the total catch weight **per species** per haul, raised to one hour of hauling.*"
      ...hence having a completely different nature depending on dataType! This is not

actually implemented in recent years (see for instance data from Germany, Table 2), and might, on the other hand, be the origin of aggregation over sex categories of weight data – reported as CPUEs until 2017 (Figure 2) – for Norway.

Conclusion

Given that DATRAS has public access, and data can end-up being used in operational and/or published work out of the circle of ICES experts, we strongly advocate that (1) errors in DATRAS should be documented and obvious warnings given to potential users, (2) steps should be taken to fix errors in catch weights, and (3) the DATRAS specifications should be made unambiguous to prevent wrong handling.

A7.2 Variability in Net Opening, Door Spread and Warp Length

Louisa Sinclair & Rob Kynoch

Marine Scotland Science

Introduction

The North Sea International Bottom Trawl Survey provides data to the International Council for the Exploration of the Sea (ICES) to assist stock assessments on commercial fish species, in addition to examining changes in the relative abundance and distribution of fish in the North Sea (IBTS 2020). An important aspect of the International Bottom Trawl Survey (IBTS) is the consistency and standardisation of the data to allow for spatial and temporal changes in fish assemblages to be assessed (IBTS 2020). An aspect essential for data collection is maintaining a standardised survey trawl package which is then rigged and operated using fixed survey protocols every survey (IBTS 2020). In 1992, a standard gear known as the Chalut à Grande Ouverture Verticale (GOV) was adopted by all nations participating in the bottom trawl survey (IBTS 1992, 2020). Subsequent to the introduction of the GOV a detailed manual was compiled, detailing the construction, rigging and operation of the gear which is still found relatively unchanged in the current manual (IBTS 2020) However, it has been well documented that over time, the survey gear used by each nation has drifted from this original GOV plan (IBTS report 2015). This is thought to be due in part to the complexity of the original GOV construction which drove nations to alter it to suit their needs (IBTS 2020). In addition, the discontinuation of netting materials/components, introduction of new survey vessels and changes to trawling deployment methods may all have contributed to this drift (IBTS 2020). A study conducted in 2015 revealed that none of the survey gears used by the nations involved in the survey conformed to the original GOV specification detailed in the manual and all differ from each other (IBTS 2015). The study noted the survey gears used varied in many aspects including netting materials, groundgear construction, otterboard design, and flotation (IBTS 2015).

In an effort to ensure consistency, the manual also details operational protocols covering trawl speed over the ground, tow duration (30 minutes) and net geometry limits (IBTS 2020). Gear stability is imperative to ensure the validity of a tow and for most nations has been monitored using acoustic sensors measuring vertical opening, trawl door spread, and trawl wing spread (IBTS 2020). The warp length to depth ratio (WD) can be adjusted to alter the net geometry and therefore an initial standard WD ratio was recommended for the GOV from 1992 (Figure 1).

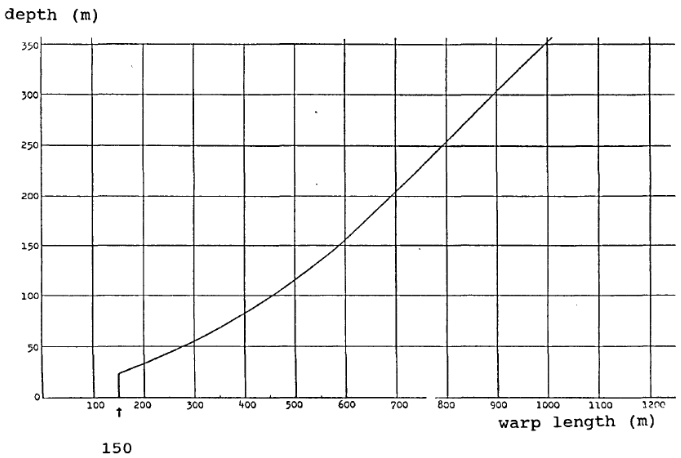


Figure 1 – Recommended warp length to depth ratio for the GOV in 1992 IBTS Survey Manual.

In the early two-thousands, several nations that participate in the IBTS found the historical gear parameters defined were difficult to achieve when trawling (IBTS 2020). As a result, analysis was conducted to determine new, more achievable gear parameters which were published in the 2012 survey manual and have remained the same since (Figure 2).

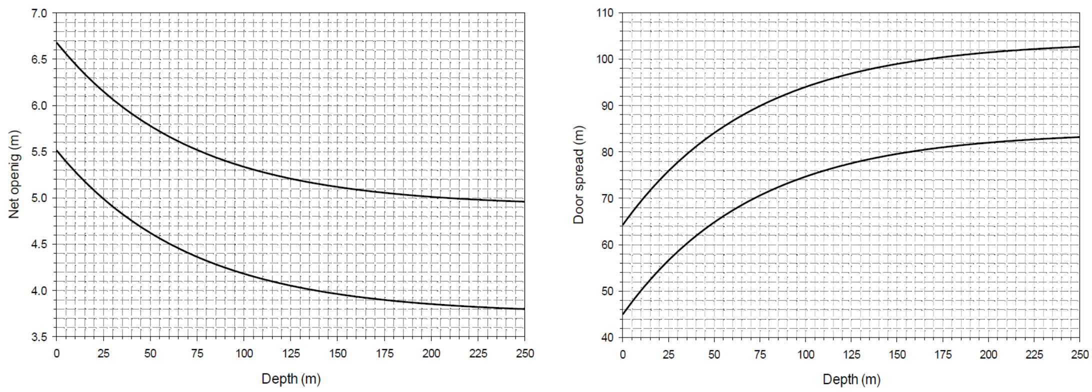


Figure 2 – Recommended vertical net opening and door spread in relation to the depth in the 2020 IBTS Survey Manual.

The warp length and net geometry related to the depth were analysed from the 2015 North Sea IBTS data to investigate the suitability of the recommended vertical net opening and door spread (IBTS report 2015). This analysis revealed that in general most nations remained within the recommended limits (IBTS report 2015). However, there were multiple tows out with these limits and a few nations were rarely able to achieve these limits (IBTS report 2015). However, these tows have been accepted by the IBTS Working Group (IBTSWG) as the gear geometry is classified as normal for these nations. The current IBTS advice is that nations continue with their standardised gear and fishing methods to maintain the consistency over the time series. It was noted that the differences in the survey gear used by each nation are the main cause for the differences in net geometry between nations (IBTS 2019). Therefore, IBTSWG have concluded to ensure standardisation there is a need to develop a new trawl survey gear to be used by all nations currently participating in the North Sea IBTS. This is with the aim to improve the standardisation between the nations. Over a number of years IBTSWG have been developing a new survey trawl package and established a workshop during 2021 to finalise and agreed the final design. Moving forward the group are now in a trialling/testing phase with the new gear and this is due to run until 2024 with another workshop planned during 2023.

This working document aims to investigate variation in the vertical net opening and door spread, while also determining if nations were able to remain within the current recommended limits for IBTS data between 2016 and 2023. In addition, this document will also examine the warp length to depth (WD) ratio deployed at similar depths. A particular emphasis will be on the variation in the gear geometry and WD ratio selection by nations at similar depths to investigate the consistency. The purpose of this document is to show general trends in the data rather that to single out individual nations. This is with the aim to aid future guidance on integrating the new survey gear currently being developed for the North Sea surveys and rebuilding and improving standardisation.

Material and Methods

Data Sources

All the International Bottom Trawl Survey data is archived and available from the International Council for the Exploration of the Sea (ICES) DATRAS database. The warp length to depth ratio and net geometry in relation to depth was investigated and discussed in 2015 (ICES report 2015). Therefore, this working document analysed data from 2016 to 2023 to further the understanding of these values. Eight nations take part in the North Sea International Bottom Trawl Survey and have been randomly named countries 1-8. Nations which conducted their trawl surveys in two different vessels over the time series of this study have been separated into A and B. This is due to the fact that the vessel used may change the net geometry and the warp length selected. From the North Sea IBTS dataset, the first quarter of the year (Q1) represents the longest time series for the IBTS, in addition is also the quarter where most nations participate. As a result, this working document analysed Q1 IBTS data for countries 1-7. Country 8 is the only nation not to participate in the Q1 IBTS. However, to include them in this study we analysed data from the third quarter (Q3).

Data Analysis

All data analysis was carried out in RStudio 1.2.5042. For the purpose of this study only valid tows with valid door spread and net opening values were analysed. The number of tows per year per country which were analysed are summarised in Table 1. The vertical net opening and door spread in relation to the depth were plotted to visualise the variability of the net geometry across the depth range and to determine if they are within the recommended ICES limits. The warp length was plotted against depth to visualise the range of warp lengths selected by countries in the NS IBTS. There are very few tows which occur within the same depth. Therefore, to allow for the variation in warp length to be properly investigated with large enough samples sizes, depth was grouped into 10-meter ranges. Generally, the warp length used is selected based on a ratio to the depth. For example, Scotland generally used 3 times the depth plus 30 to calculate the warp length. Therefore, if considering warp length across a 10-meter range there will be a variation just due to the increase in depth. However, the warp length to depth ratio should remain more similar within the 10 meters as thus this the WD ratio will be used as the main method to investigate the variation in warp length used. Although we will consider the variation between nations for all the above, we will focus on the variation within a nation. This is since the gear differs between nations and the IBTS emphasises that the consistency of the gear parameters within a nation should remain consistent over time (IBTS 2020). However, in order to determine if the variation within a country is greater than would be expected it will be compared to those with low variability. Even though different countries deal with different weather and tidal conditions, and ground type, it was determined to be those with low variation provide the best baseline to compare against, albeit with caution. It is important to note that Country 6 and Country 7 use two different sweep lengths (60m and 110m), based off the recommendation by IBTS is longer sweeps deployed in depths greater than 70 meters.

Table 1 – Number of valid tows conducted between 2016-2023 for each country. The total number of tows for these years is in bold.

	Country										
	1A	**1B**	**2**	**3**	**4**	**5A**	**5B**	**6**	**7A**	**7B**	**8**
2016	48		41	62	57	0	50	53	46		74
2017	68		41	61	58	2			47		75
2018	44		49	54	56	50		51	46		76
2019		41	47	51	56	61		44	45		72
2020		65	34	58	55	47		40		38	77
2021	61		43	52	55	53		45		50	80
2022	8		25	50	14	40		47		36	71
2023	22		43	53	51	56				46	
Total	**251**	**106**	**323**	**441**	**402**	**309**	**50**	**280**	**184**	**170**	**525**

Results

The net opening, door spread and warp length across the depth range of 10-257 meters was investigated using a total of 3041 North Sea IBTS tows between 2016 and 2023. The number of tows conducted by each country ranged from 50 to 525 across this given time period. All tows were conducted during the first quarter of the year except those by Country 8 which were conducted in the third quarter of the year.

Net Opening

The net opening ranged from 2.2 to 9.5 meters across all countries (Figure 3). The percentage of tows within a country which achieved the recommended net opening limits ranged from 10-88% (Figure 3). For a full summary of the percentage of tows with gear geometries within the recommended ICES limits refer to Appendix 1. There is clear variability in the net opening across the depth ranges for each country. When comparing the net opening between countries there appears to some clear differences. For example, the mean net opening between 51 and 100 meters was 3.8 meters for Country 6 (N = 65) and 5.6 meters for Country 1A (N = 120). However, as aforementioned, the variability within a country is more important to maintain consistency across a time series. Country 1A net openings from 51-100m ranges from 4.2 to 8.0 meters (N =

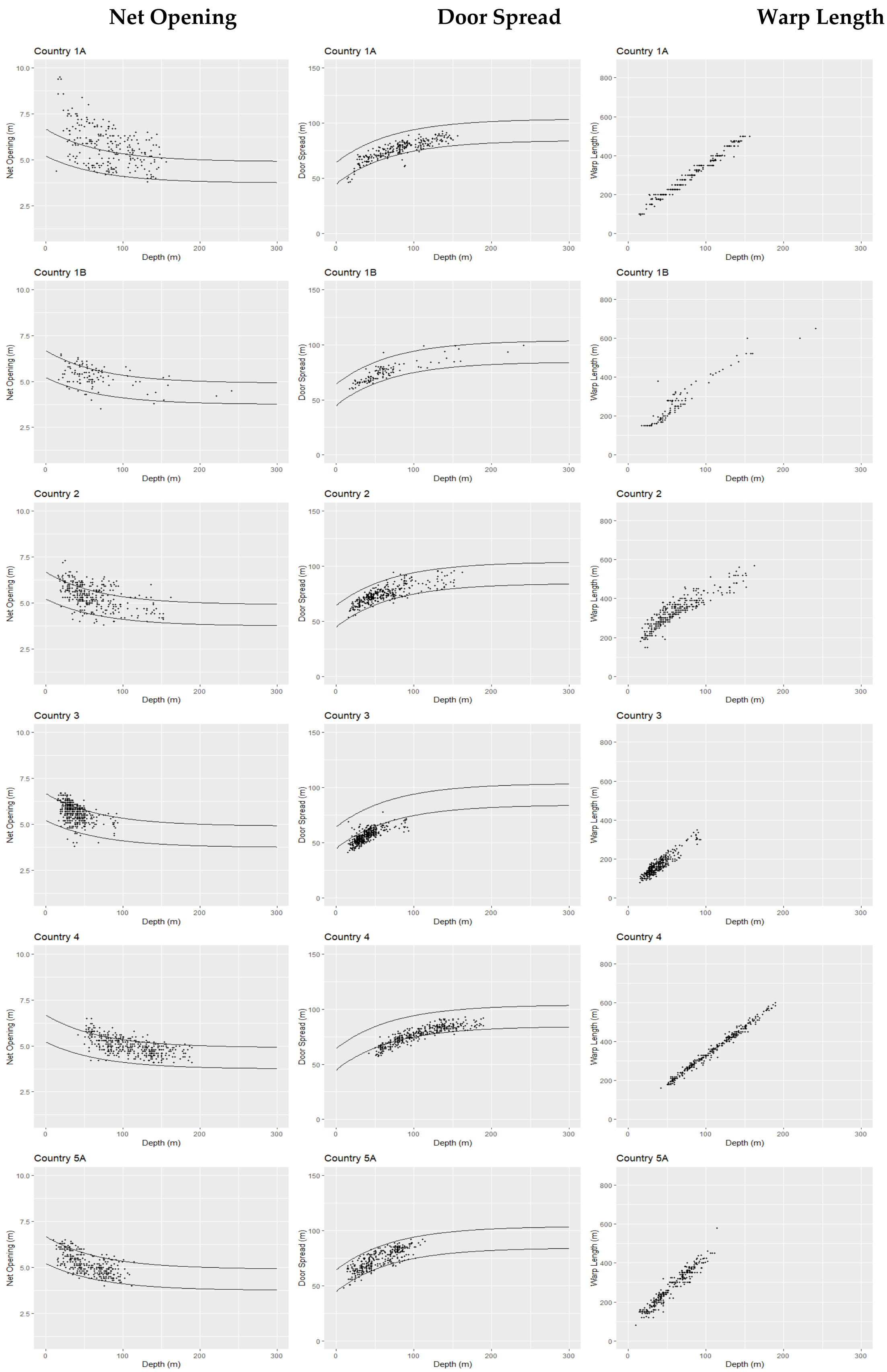
65). To compare to a country that has lower variability, Country 5A only has a net opening ranging from 4.0 to 5.7 meters within the same depth range (N = 146).

Door Spread

The door spread ranged from 26 to 138 meters across all countries (Figure 3). The percentage of tows which was able to achieve the recommended ICES door spreads was between 7-98% within a country (Figure 3, Appendix 1). There appears to be an effect of the sweep length on the ability to remain within the recommended ICES door spread limits for countries 7A and 7B. None of tows conducted by 7A using the long sweeps (110m) were within the limits, however, 88% of tows using the short sweeps (60m) were within the limits. For Country 7B, only 6% of tows using the long sweeps were within the limits while 93% using the short sweeps were. For Country 6, there is a less obvious difference between the percentage of tows within the recommended limits using the long and short sweeps at 42% and 71% respectively. The mean door spread varies between countries from 63.6 meters for Country 3 (N = 54) to 90.1 meters for Country 7A (N = 70) from 51-100 meters. There appears to be some countries which have a higher variation in the door spread than others at similar depths. For example, between 51- and 100-meters depth, the door spread for Country 6 varied by 43 meters (N = 65) and Country 7A door spread varies by 44 meters (N = 70). In comparison, the door spread for Country 3 varied by only 23 meters (N = 54) for the same depth range.

Warp Length and Warp Length to Depth Ratio

The warp length used ranges from 80 to 830 meters across all countries and all depths (Figure 3). There appears to be variability in the warp length used by some countries. Particularly, countries 6 and 8 appear to have a wider range of warp lengths used at similar depths in comparison to other countries such as 4 and 7A. To investigate the variation in warp length used further, warp length to depth (WD) ratio will be mainly considered. The WD ratio ranges from 1.9-13.9 across the whole depth range (Figure 4). It is important to note that the sample size for WD ratios used with in a 10m depth range is small in some cases, particularly for countries with a small number of tows over the whole range. For example, Country 5B only has 50 tows and therefore when split into 10-meter depth ranges the samples sizes are small (1-16 tows). For a full breakdown of the number of tows per country for each depth range refer to Appendix 3. There appears to be a general trend that the WD ratio selected by countries decreases with depth in shallower water, particularly under 100 meters (Figure 4). This is to be expected as more warp is required in shallower waters to ensure that the trawl doors maintain seabed contact. It is expected that the WD ratio selected may vary slightly due to external factors such as tide, weather conditions or swell. However, there appears to be a large difference between the variation in WD ratios selected by countries. Country 4 appears to have very low variation in the WD ratio with the most variation seen between 70-79 meters by only 1 (Median = 3.4, IQR = 3.3-3.5, min = 2.9, max = 3.9, N = 34). In comparison, for the same depth range, Country 8 WD varies by 1.8 (Median = 4.0, IQR = 3.5-4.2, min = 2.8, max = 4.6, N = 57). The largest variation in WD ratio within a 10-meter depth group was between 20-29 meters for Country 2, where the WD ratio varied by 6.3 (Median = 9.2, IQR = 8.0-9.7, min = 6.0, max = 12.3, N = 30). To put this into perspective using the most conservative option, if this was in 20 meters depth, the warp length would vary from 120 meters to 246. For Country 2, the average variation in the WD ratio in a 10-meter depth range is 2. In comparison, Country 4 has an average variation in the WD ratio was 0.5. It is also important to consider the outliers seen in Figure 4. The odd outlier could be explained by incorrectly entered data. However, multiple outliers indicate the frequent use of WD ratios out with the norm. The distance of the outlier from the median and the IQR must also be considered. For example, Country 4 has multiple outliers which lie close to the IQR which suggests these are not too far from the norm and may not cause too much effect on the gear. These may have been due to differing external factors such as tide or ground type. In comparison, Country 6 also has outliers, some of which lie further from the median and the IQR. This may suggest that they are deploying warp lengths out with the norm, which may affect on the gear geometry. Although further examples could be provided, the important result is that some countries have a large variation in the WD ratio selected in comparison to others.


Net Opening
Door Spread
Warp Length
Country 1A
Country 1B
Country 2
Country 3
Country 4
Country 5A
Net Opening (m)
Door Spread (m)
Warp Length (m)
Depth (m)

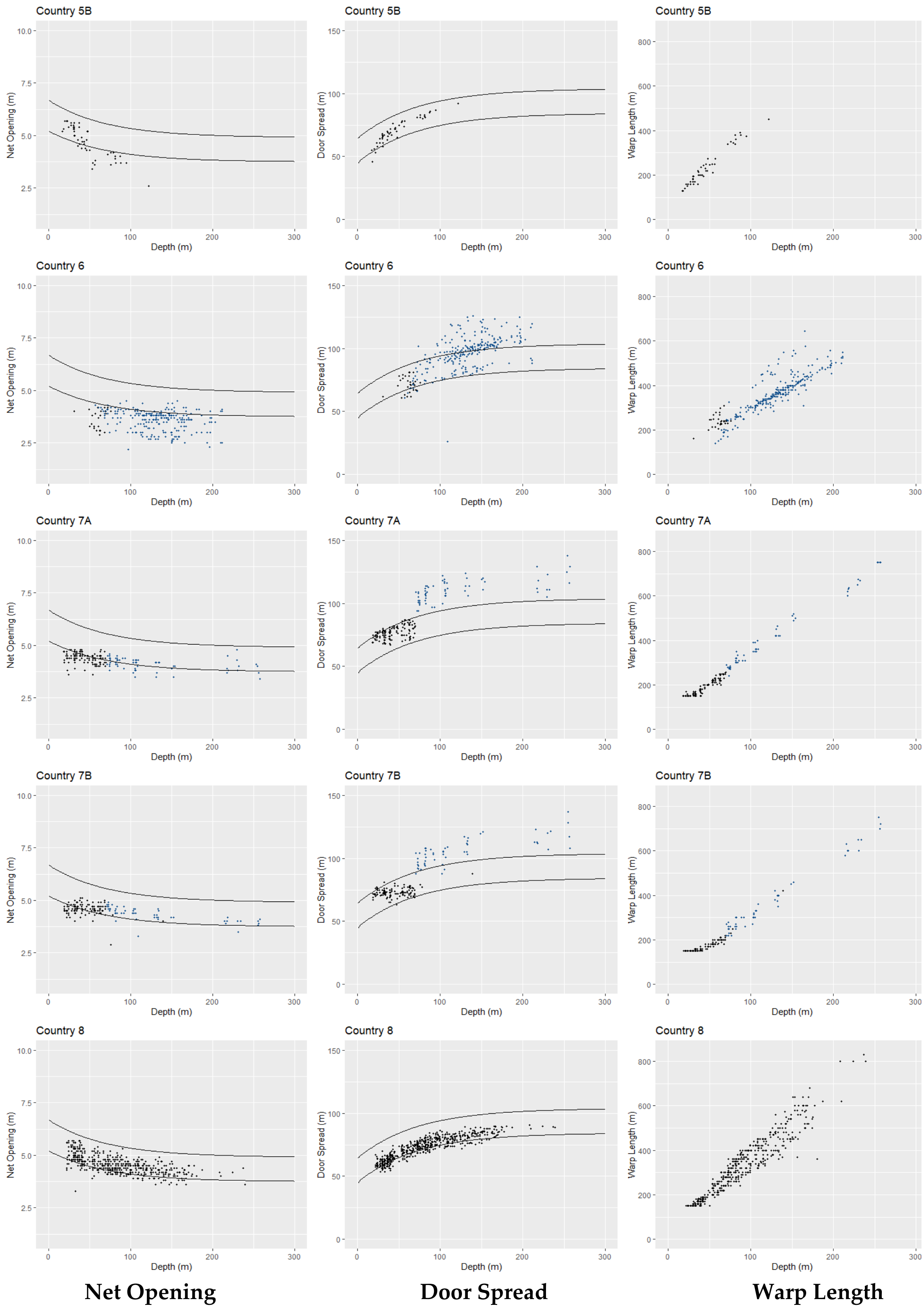


Figure 3 - Net opening, door spread, and warp length related to depth for the North Sea IBTS from quarter 1 for countries 1-7 and quarter 3 for county 8. The blue points for countries 6 and 7 represent the long 110m sweeps, while the black show the short 60m sweeps. The curve lines represent the recommended net opening and door spread limits in their respective figures. Countries which used 2 vessels within the time period 2016-2023, are represented by A and B.

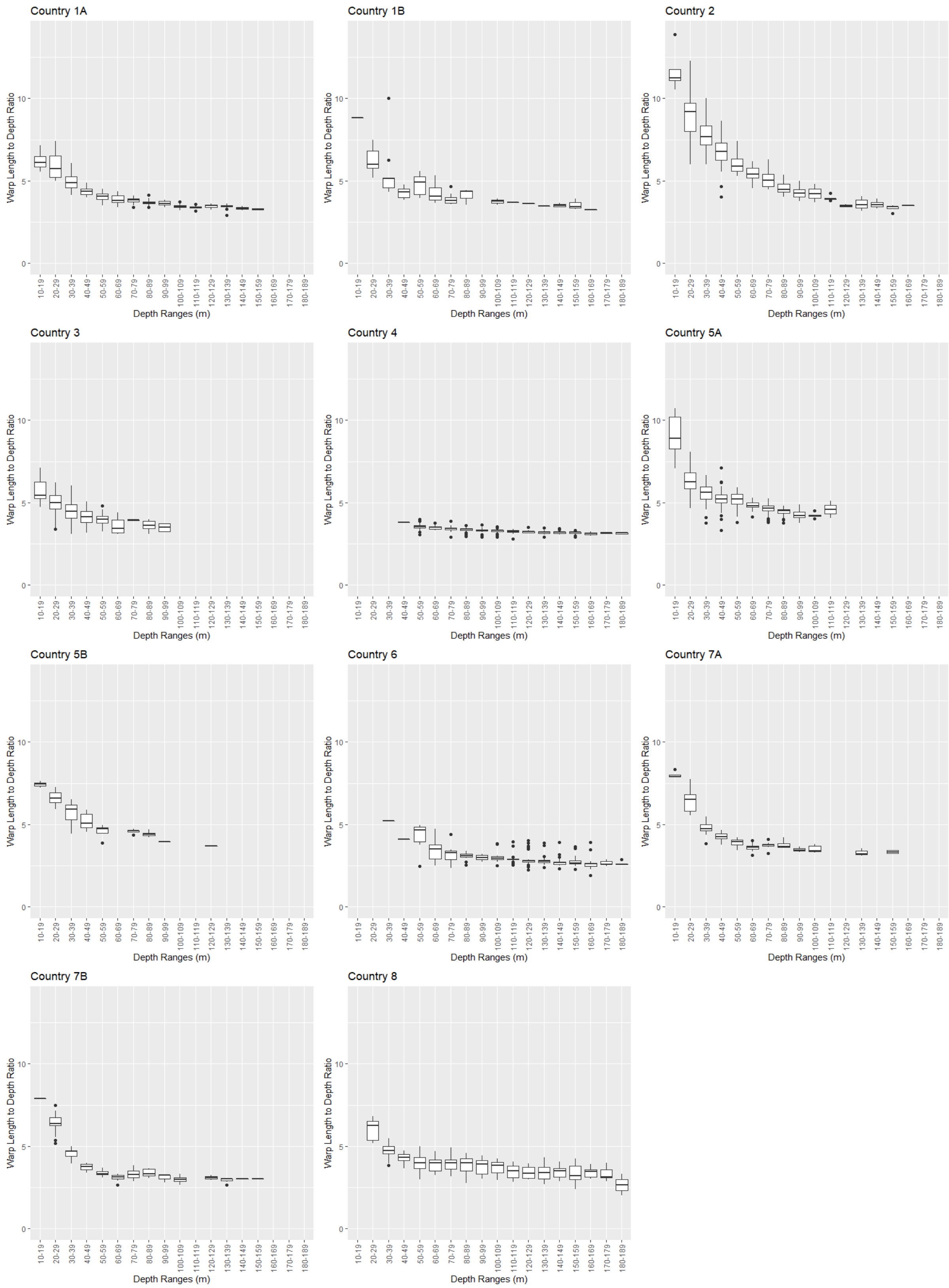


Figure 4 – The warp length to depth ratio (WD) selected split into 10-meter depth ranges for up to 189m for every country. Within the boxplot, the median value is represented by the solid line, the IQR is represented by the box (50% of the values), the whiskers show the maximum and

minimum values excluding the outliers and the dots represent outliers. Countries which used 2 vessels within the time period 2016-2023, are represented by A and B.

Discussion

This working document revelated that there is considerable variation found in the net opening, door spread and warp lengths by some nations which participate in the North Sea IBTS. Even though these issues were touched on in the 2015 IBTSWG report, this provides further evidence that some countries may lack standardisation in their gear geometry and fishing methods. Countries vary in their ability to achieve the reccomended IBTS net opening and door spread limits. Some have been able to achive these limits the majority of the time while others are rarely able to stay within these limits. Sweep legth had a clear effect on the ability of countries 7A and 7B to achieve these limits suggest a similar trent in Country 6. However, the new gear package does not have two different sweep lengths and therefore this will no longer be considered here. There are differences between the mean net opening and door spread limits between countries at similar depths. This reveals that despite there being reccomeded gear geometry limits to aid with standardisation between countries this is not being achived and there are clear differences. The study investigating the differences between the gear used by each nation found that all the gear used by each nation differs (IBTS 2015). This is likely to explain the differences in the gear geometry found between countries. However, the IBTS working group have agreed on a new standard gear package that is expected to be implemeted by every nation, with the aim to improve standardisation between countries. This change will bring more focus on the standardiation between countries and improving the similarity of the gear geometry.

When investigating the gear geometry within a country over the study period, some countries had high variability in the net opening and door spread at similar depths when comparing to those with low variability for the same depth. Although survey areas do overlap, none of the countries work the same areas for the whole survey. Therefore, they may experience different ground type, tidal conditions and often weather conditions. These factors can affect the gear geometry and could explain why some countries experience more variation than other. However, it is not expected that this would be substantial enough to cause the large difference in the varation seen by some. The high variation found suggests that some countries struggle to maintain gear standardisation. However, there is currently no advice on how variable the net opening and door spread can be while still being considered standardised.

This study revealed that the warp length to depth (WD) ratio selected varied substantially within a 10-meter depth range in some countries. The North Sea IBTS manual outlines most of the suvey design including the towing speed, tow duration, gear parameters, and quality control. The survey manual reccomends that the WD ratio should be altered to try to achieve the required gear geometry. As a result, you would expect the WD ratio to change depending on gear geometry and conditions. It is important to note that although the variation in the WD ratio is important, high variation in deep waters should be paid particularly attention to as this caused a greater difference in the warp length. There are many reasons that may cause a variation in the WD ratio used, all of which are based on human decisions. These may include, selecting the WD ratio due to weather conditions, trying to fit within the gear geometry limits, and bottom ground type. However, another way which may potentially introduce large variation is through the decisions of different staff members. For example, various fishing masters may use different WD ratios at the same depth and in similar conditions. This may be within a trip or between years depending on how staff changes work within a country. A large variation in the WD ratio effect on how the gear performs and this may cause issues with trying to maintain standard gear geometry. This is of particular concern the variation is due to human decision rather than external factors.

Ultimately, this study revealed how the IBTS participants differ in the amount of variation in gear geometry and WD ratio selection which may indicacte that some lack of standardisation in the North Sea IBTS data. Further studies should be conducted to investigate the relationship between the varaiton in WD ratio and the gear geometry to determine if this may causing some of the larger varation seen. In addition, determining the influence of external factors such as weather and tidal conditions on these varations. The impact of external factors should also be studies to determine the extent which this influences the variation in gear geometry and if this influences the human decision on the WD ratio selected. That being said, the main purpose of this working document was to highlight these variations and to initiate discussions on how standardisation can be improved going forward. The new gear designed is expected to be more stable than most of the current gear used in the North Sea IBTS and is planning to be implimented by all of the participants. This provides a unique opportunity for the current guidance to be reevaluated with the new gear to improve standardisation between and within countries. It will be important to begin discussions on how to reduce the variability in the gear geometry and WD ratio going forward.

Suggestions of points we believe should be discussed are:

- How should the advice on warp length be given with the near gear?
- Should a standard warp length to depth ratio be advised to reduce the influence of human decision?
- Should more guidance be given on how much variability is allowed in gear geometry while still being considered standardised rather than being based on individual countries opinions?

References

ICES (1992) *Manual for the International Bottom Trawl Surveys - Revision IV*

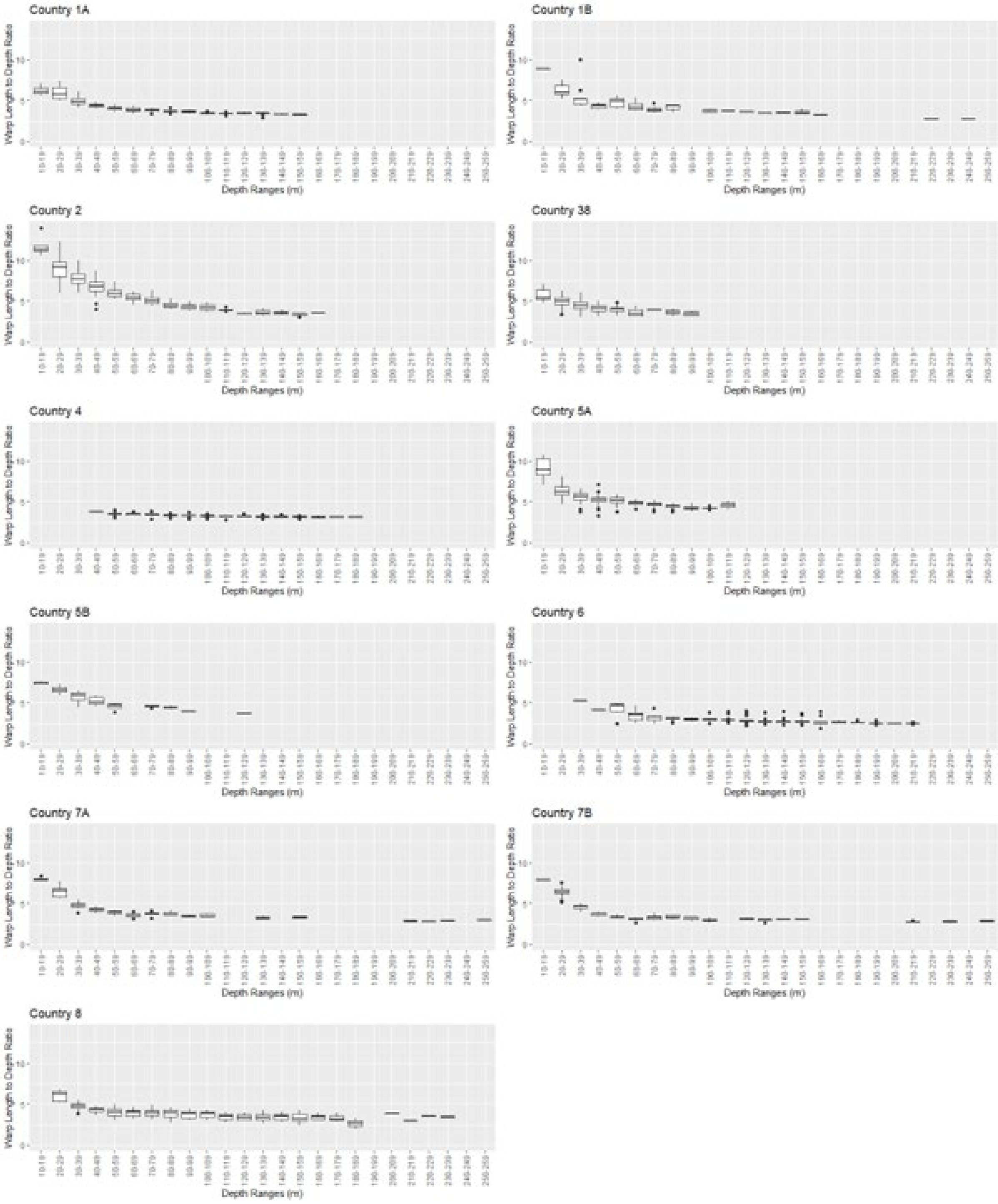
ICES (2015) *Report of the International Bottom Trawl Survey Working Group (IBTSWG)*

ICES (2020) *Manual for the North Sea International Bottom Trawl Surveys - Revision 11*

Appendix 1 – The number and percentage of North Sea IBTS tows conducted between 2016 and 2023 that fall within the recommended net opening and door spread limits. Data from all countries apart from Country 8 come from the first quarter of the year. Country 8 data is from the third quarter of the year.

	Country										
	1A	**1B**	**2**	**3**	**4**	**5A**	**5B**	**6**	**7A**	**7B**	**8**
Tows within net opening limits	105	76	210	328	315	271	29	29	70	120	433
Percentage within net opening limits	**41.83**	**71.70**	**65.02**	**74.38**	**78.36**	**87.70**	**58.00**	**10.36**	**38.04**	**70.59**	**82.48**
Tows within door spread limits	238	104	312	33	308	293	47	126	106	111	427
Percentage within door spreads limits	**94.82**	**98.11**	**96.59**	**7.48**	**76.62**	**94.82**	**94.00**	**45.00**	**57.61**	**65.29**	**81.33**

Appendix 2 – The warp length to depth ratio (WD) selected at 10-meter depth ranges for every country. Within the boxplot the median value is represented by the solid line, the IQR is represented by the box (50% of the values), the whiskers show the maximum and minimum values excluding the outliers and the dots represent outliers.



Appendix 3 – Number of tows conducted by each country within each 10-meter depth range for the North Sea IBTS between 2016 and 2023. Data from Countries 1-7 was from Q1 and the data from Country 8 is from Q3.

	Country										
Depth Ranges (m)	**1A**	**1B**	**2**	**3**	**4**	**5A**	**5B**	**6**	**7A**	**7B**	**8**
10-19	4	1	5	12		12	2		4	3	
20-29	10	11	30	105		33	6		18	18	32
30-39	20	11	40	135		46	16	1	38	32	75
40-49	18	19	68	130	1	62	10	1	19	18	44
50-59	20	18	39	28	32	24	5	8	17	17	30
60-69	25	20	38	14	25	22		23	23	25	35
70-79	15	8	30	3	34	51	4	13	14	12	49
80-89	43	3	24	10	48	37	5	13	13	10	57
90-99	18		15	4	38	15	1	7	3	3	37
100-109	18	3	3		33	5		16	13	10	28
110-119	20	2	5		24	2		31			33
120-129	11	1	3		27		1	29		2	18
130-139	18	1	13		53			34	6	7	22
140-149	9	2	5		31			27		1	21
150-159	2	3	4		27			29	4	1	15
160-169		1	1		14			19			15
170-179					6			7			7
180-189					9			5			2
190-199								11			
200-209								1			1
210-219								5	4	4	1
220-229		1							2		1
230-239									2	3	2
240-249		1									
250-259									4	4	

A7.3 Prototype New IBTS Survey Trawl – build and initial setup. Summary Report to IBTS

D. Stokes and F. Griffin

Introduction

At the April 2022 yearly meeting, IBTS agreed to progress development of a new Survey Trawl (TOR C) by further modifying the existing Jackson Trawl BT237 being trialled by Marine Science Scotland (MSS). While reviewing outputs from WKFDNG[1] for the two trawl designs being evaluated under this TOR it was noted that there were statistically significant improvements in bulk catch and length frequencies with the alternate MI001 design being trialled. It was likely these were explained by smaller mesh in specific areas, smaller groundgear and possibly a simpler design to some extent. Some of these aspects were therefore recommended for further revision to the BT237 and it was this modified version that IBTS2022 agreed to build and trial initially for the 2023 survey season (Appendix 1).

The core technical group identified by, and reporting back to, IBTS was Rob Kynoch (MSS), Francis Griffin (MI) and David Warwick (SEAFISH) with support from Louisa Sinclair (MSS) and Dave Stokes (MI). Having already designed and built the BT237 for an earlier project for MSS, Mark Buchann of Jackson Trawls was key to project as details beyond a general trawl plan would be needed during construction. Other commercial time commitments prevented him joining the group directly or regularly so it was agreed communications would broadly come through MSS.

The Marine Institute (MI) undertook to build a 'clean groundgear' version while Marine Scotland Science (MSS) would progress the heavier 'light hopper gear' configuration. The discussion document below highlights key points and initial comments in relation to construction, operation and potential improvements needing consideration.

Build

Construction time: Having amalgamated the various design concepts demonstrated under TOR C into a single trawl design at the 2022 IBTS meeting in March, sourcing materials could begin. Significant time was taken securing the revised technical drawings for the trawl and further clarifications as various sections were worked on. This time is obviously excluded from the work schedule below which gives the recorded man days for construction only (Table 2.1.1). For comparison, the average times to construct a standard GOV as well as the MI001 trawl are also provided.

Certain aspects of the new design, such as the panels in particular, are more complicated than the GOV or MI001 and will always take more time to construct. However, construction of any

[1] http://doi.org/10.17895/ices.pub.10094

new design will always speed up after the first build or two as notes are added and experience gained.

Table 2.1.1 Approximate man days for construction only with GOV and MI001 for comparison. Both new trawls would be quicker during subsequent builds.

	BT237	GOV (A)	MI001
Panels	23	17	15
Bag (70mm IM) & Liner	4	5	4
Roping/Framing	4	3	3.5
Bridles	1	1	1
Groundgear (build & attach)	2	3	2.5
Floatation	1	1	1
Total	35	30	27

Materials: Timing obviously was just post covid lockdowns so sourcing materials within a narrowing window was always likely to have challenges. However, most materials were available through routine national network of suppliers used by the MI. As is routinely the case with other MI trawls, the most problematic netting to source was the Magnet guard mesh (112mm, 4.3mm double in grey). It was agreed by the group to switch to green 4mm Magnet double 4mm which still had a lead time of 8 weeks from Lithuania through Swan Net Gundry (Fig 2.2.1). This mesh turned out to be quite stiff and hard to handle, but at the time even samples of the 4.3mm grey were not available from Jackson Trawl so options were limited.

Fig 2.2.1. Green vs grey Magnet netting.

In addition, disks for the groundgear were very difficult to source so a complete clean groundgear was specified and purchased from Jackson Trawl by the MI, once the trawl was virtually complete and exact final measurements known. This clean groundgear was designed to be similar to that used on MI001 but shorter to suit this particular trawl. Jackson trawl added ballast washers to the weight the groundgear as appropriate to their experience with this design. Once complete the final groundgear assembly could fit and be delivered on a single standard euro pallet (Fig 2.2.3).

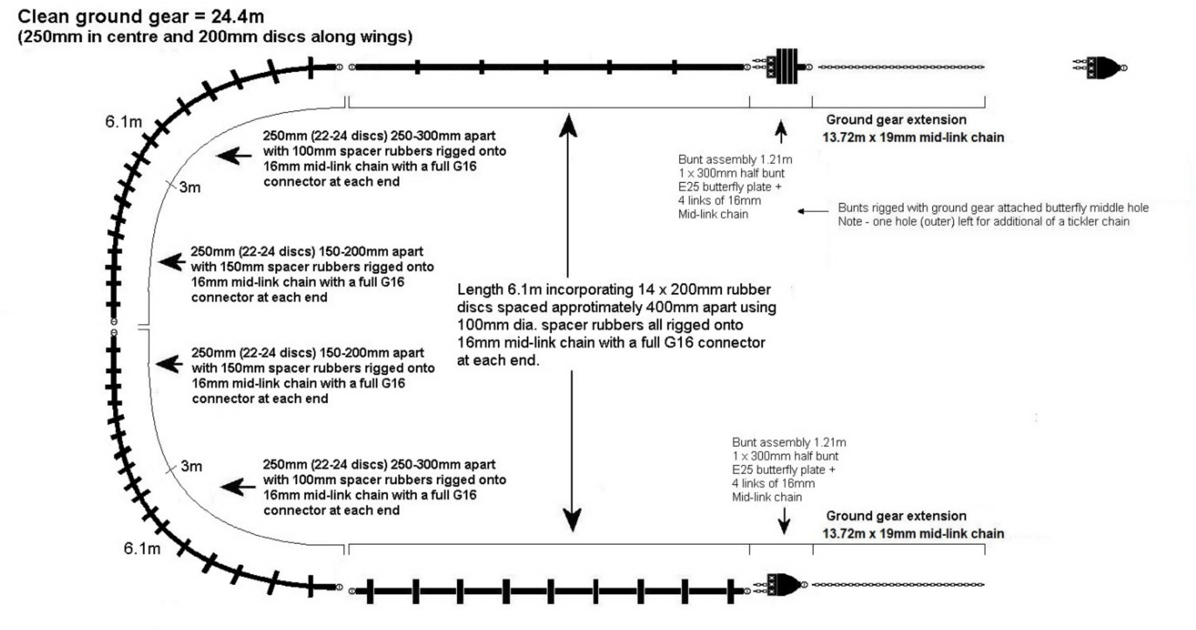


Fig 2.2.2 **Groundgear layout for the revised survey trawl.**

Fig 2.2.3 Groundgear on a standard euro 1sqm pallet. Final weight of groundgear 427.5 Kg, bunt assembly and chain legs 300Kg.

Design

The roadmap for this IBTS survey trawl development TOR derived from the SGSTS Study Group who took the standard parsimonious approach to problem solving. In other words, solutions to a problem should be as simple as possible and only incorporate complexity when and where necessary. Where we have moved away from the simplest possible join (mesh for mesh 1:1) we need to agree between various options for joining panels of differing mesh sizes. Ideally the next best scenario is a joining ratio that is constant across the join. Where larger meshes are joined to smaller meshes at a 4:5 or 7:9 ratios consistently across the join for example.

Joins: In the top panel of the current trawl for instance, the 269 x 200mm joins 330 x 160mm mesh (Fig 2.3.1), the join in the MI configuration uses 15 single meshes either side, followed by a 4:5 join across. This complicates a repair if there is damage in that selvedge area in particular where singles mix with 4:5 joins. The join suggested by CADTrawl was different so independent makers will diverge and needs addressing. At sea, survey crews will require clear detailed plans to be available for reference on deck.

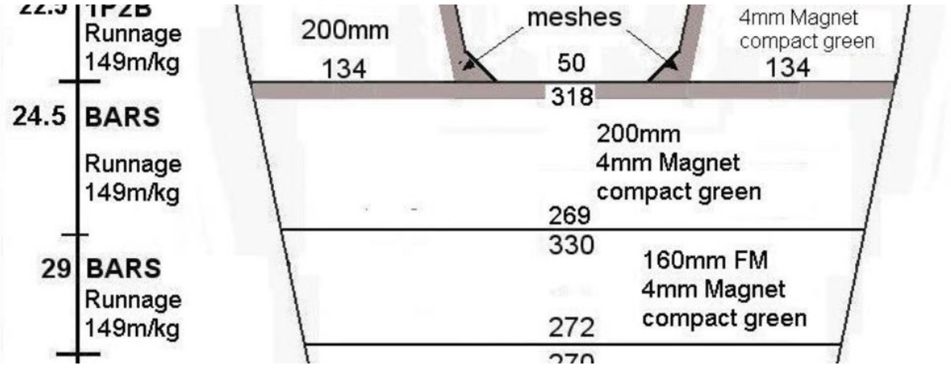


Fig 2.3.1 Top bosom section of the revised BT237.

Selvedges: Use of a heavy tearing strip back along the selvedge was hotly debated by the other gear techs and crew onboard the Explorer. It was felt to be routine enough in heavy commercial rock hopper fishing, but unnecessary in a survey trawl. The Bosun suggesting it will be difficult for many crew to mend correctly and certainly lead to mistakes being made. A tearing strip in this location is useful for protection, hopefully averting the need to open and close the selevge. That level of damage is generally not common in survey trawls and requires a far more complicated mend as you can not cut into the tearing strip as in normal mending. Consequently, you have to replicate the inverse cut of the tearing strip in the repair netting before you start. You then double back with the twine while mending onto the bar. Useful for rock hopper commercial fishing obviously, but a more advanced level of design and repair for survey vessel crews compared to broadly free flowing mending for survey trawls.

Fig 2.3.2 Heavy double twine guard mesh running along the selvedge.

Roping: Another area requiring clarification was the roping plan which wasn't clear from the plan. For example, the headrope clearly showed the Breast (Bosum) and Fly meshes sections, but was vague after that. When the remaining upper wing netting pulled as tight as possible by hand along the headline it remained 0.74m short (Fig 2.3.3).

Fig 2.3.3 Mounting upper wing along the headline leading to a 0.74m difference. Note small electric winch on the floor to the right required subsequently to mount the upper wing tips.

An electric winch was required to get the stainless ring at the upper wing tip to meet the shackle at the end of the headline (Fig 2.3.4). The netting had to be pulled out by about 6% causing some distortion in the meshes of the wings, inversely the GOV wing would be about 2% longer than the headline. This is reportedly a developing trend with some newer trawls, but survey crews may not be familiar and it needs to be well documented in the notes for the deck. You will not re-mount a new wing section to the headline without mechanical pulling at the wing tip. It is similar, but in the fishing line but not as extreme in the fishing line.

Fig 2.3.4 Steel ring of mounted upper wing tip alongside the eye of the headline after mechanical pulling of the wing (left panel). Some initial distortion in the wing meshes that should equalize after some use.

Overall tension: In terms of build, an overriding concern is the very limited difference in stretched length between the first two belly sections (top and bottom). Unlike the GOV, the mesh sizes top and bottom are not the same so the smaller meshes (112mm) in the lower section in this trawl will shrink more than the larger meshes above (160mm). Once constructed the 1st two sections below measured 12.87m vs 12.67m above (20cm or 1.5% difference). This area will need to be monitored closely during trials to ensure tension remains in the upper part of the trawl in order to maintain its shape.

Assembly

Joining ratios were not included in the net plan, but time at the assembly stage could not accommodate further delays for clarification so pragmatic choices were implemented here. This was unfortunate due to the fact that a constant ratio didn't appear likely for many, if any, of the joins and hence single/stroller meshes would need to be added between panels which could be done in various ways. Naturally this introduces complexity and potential error over time when coordinating multiple labs and survey vessels crews. While complex joins can be routine in commercial trawls it necessitates higher skill levels among the crew for maintenance as well as for ongoing standardization across research vessels. Importantly therefore it will require well documented agreements of the final preferred options going forward.

Blue marker twine added in top 160mm sheet to indicate change in cut from which is difficult to identify visually on the deck when doing a repair.

Setup

As part of discussions at IBTS 2022, the MI undertook to build a clean gear version of the trawl by Q4 that year. This should ensure at least a base configuration could be checked at sea and the trawl transported to the North Sea for more extensive and co-ordinated trials in that area which were agreed to initiate in Q1 2023. As budget and time were limited the trawl was tested over a single full day and a range of depths during the routine Irish Groundfish Survey 2022.

Sea trial

The work was carried out in December off the west coast of Ireland (Fig 3.1.1). Four stations were selected ranging in depth from 136m down to 208m. The same four stations were repeated over the following 48hrs as part of the routine IBTS survey using the clean gear (A rig) GOV.

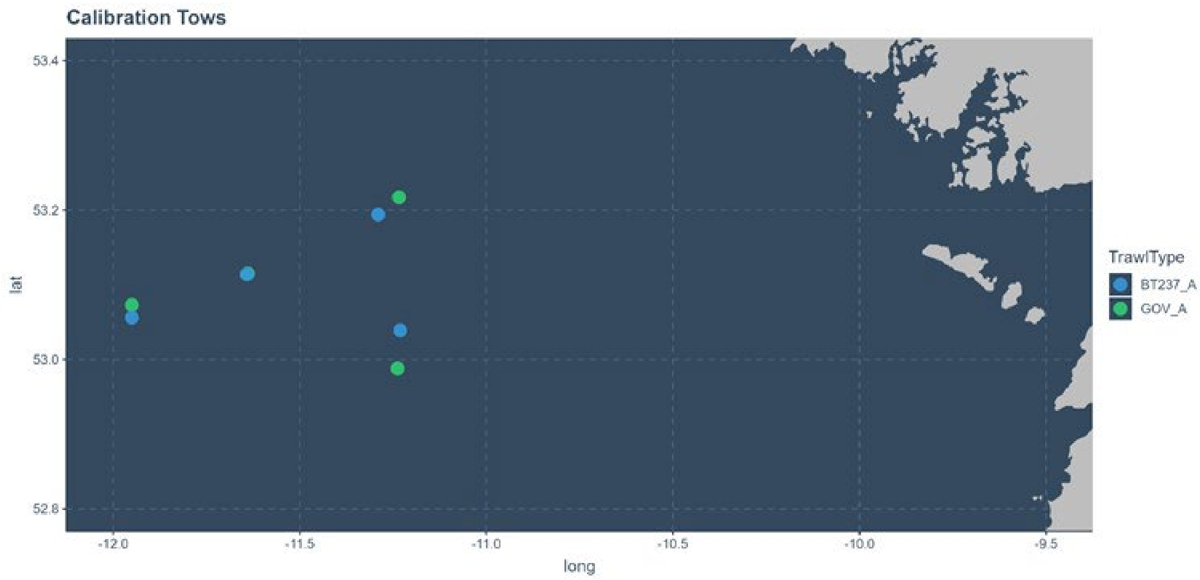


Fig 3.1.1 Map of station locations for sea trial in December 2022. The test net being the revised BT237 with 'clean groundgear (BT237_A) and the compared trawl being the routine GOV with clean 'A' type groundgear.

Scope ratio

On the previous evening to the trial, the first operational item checked was scope ratio. Towing at a fixed speed of 3.4 Kts a warp ratio of 3.3:1 (3 x depth + 30m = 295m) was shot and the gear allowed to settle. Warp was then repeatedly hauled in by 30-40m and the gear allowed to settle again. This was repeated until such point that the trawl became unstable and a balance point reached just before 'lift off'. For this tow the tipping point came at 182m which suggests a warp:depth ratio greater than 2.05:1 is required even in ideal conditions. The same process was repeated at a number of depths during the trial to ensure stable geometry was achievable with a fixed scope ratio across a range of depths. It was concluded that 3:1 + 30m, which was being used with the BT237 during trials on Scotia, was fine at these depths with the heavy Thyboron Type 10 doors on the Celtic Explorer also (Fig 3.1.2).

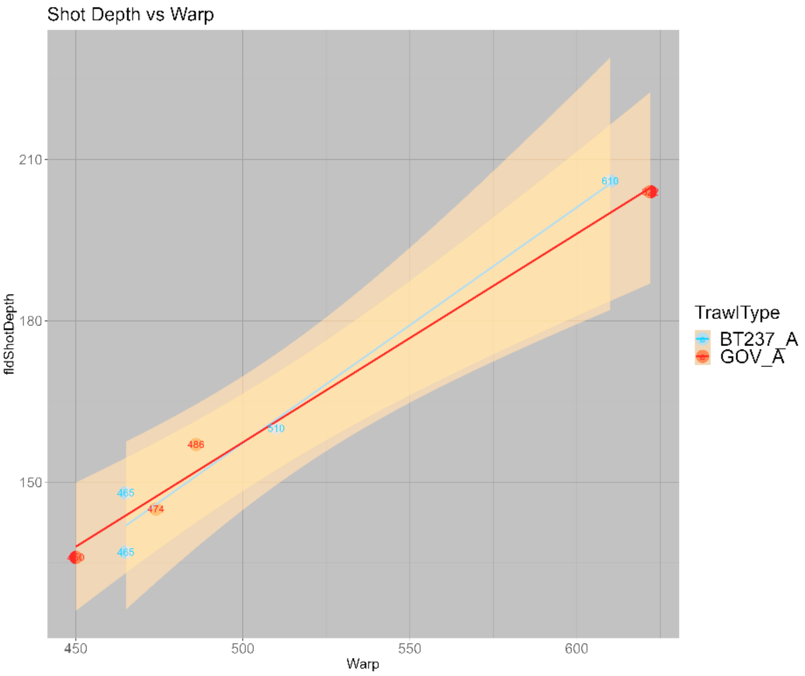


Fig 3.1.2 Warp to depth ratio (scope) of the test trawl BT237_A and standard GOV_A (with separate modelled scope ratio) used during the trial.

Towing speed

With a working scope ratio, the next aspect checked was trawl stability with increasing speed. After the trawl became stable at an initial speed of 3 Kts the speed was increased every 10 min by 0.5 Kts and trawl geometry noted. Between 3 Kts and 4 Kts we saw a 13% increase in door spread and 17% reduction in headline height (Table 3.1.1). A speed of 3.5 Kts was used then for the trials then taking place the following day and monitored with various MARPRT and SCANMAR trawl sensors (Fig 3.1.3).

Table 3.1.1 Trawl geometry values for incrementing towing speed from 3.0 to 4.0 Kts. Sensors used were a MARPORT Trawl Explorer (TE) on the headline; SCANMAR Trawleye (TEY) on the cover directly above the footrope; MARPORT distance sensors od doors and wings with pitch and roll in the door sensors.

Time	Kts	TE	TEY	Wing	Door
17:20	3.0	6.8	6.4	23.5	75.9
17:27	3.0	6.5	6.4	23.8	75.6
17:35	3.5	6.1	5.9	24.6	78.1
17:40	3.5	6.2	6.2	24.1	79.7

17:45	4.0	5.8	5.8	25.0	85.0

As deeper water is always likely to be the greatest test of configuration this initial set up was first evaluated at the deepest station available in the area at 208m. For the comparative test hauls the trawl geometry was as always monitored and showed the expected reduction in door spread compared to the GOV as well as reduced headline height.

Fig 3.1.3 Aft bench on Celtic Explorer where scientists monitor survey and trawl parameters on a Scanmar bridge unit (top left monitor), MARPORT unit (top middle monitor) and location in proximity to historic commercial and survey data on a Sodena Chart Plotter (top right monitor). A custom application in R to plot and log median values in real-time for the local database thus DATRAS, is running on the laptop.

Door spread was predictably smaller in the BT237_A than the GOV_A, as well as being somewhat more consistent (Fig 3.1.4).

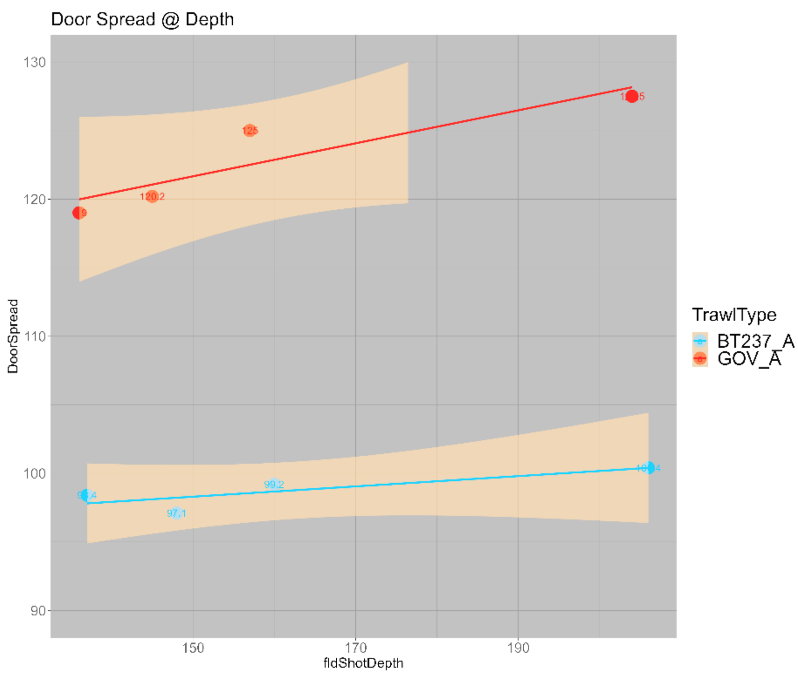


Fig 3.1.4 Door spreads for both trawls at the same paired stations using the same trawl doors, but different scope ratios.

Likewise, headline height was higher in the BT237_A and again showed less of a change in slope with depth than the GOV. The BT237_237 is of course a ballooned trawl so we would expect a net of these dimensions to have a comparatively high headline (Fig 3.1.5). The apparent relative stability of measurements over a range of depths is initially encouraging however.

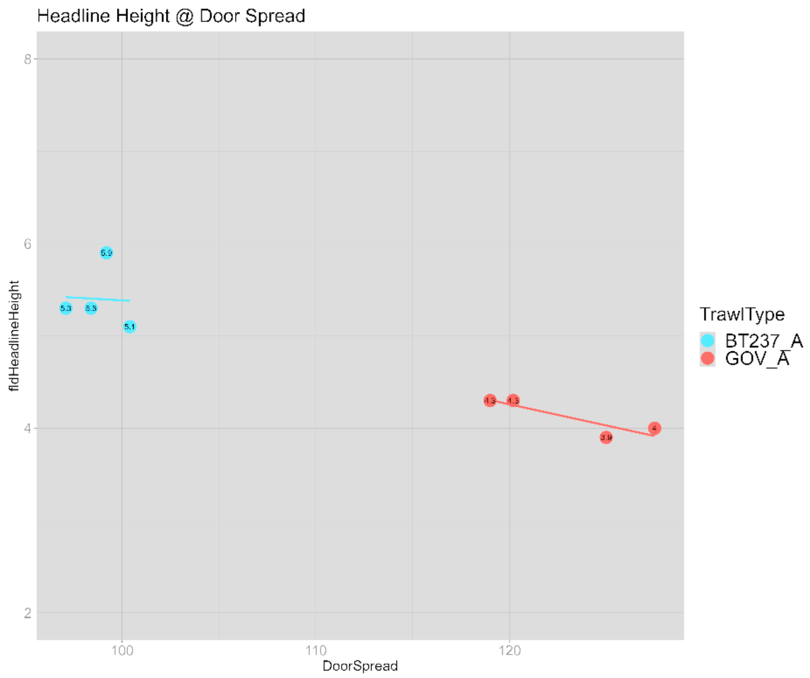


Fig 3.1.5 Headline height for various depths for both the BT237_A and GOV_A trawls.

Another noticeable difference was a lower and more consistent sweep angle with the revised BT237_A trawl (Fig3.1.6). This has relevance back to initial discussions around survey trawl development at both historic study groups – SGSTG and SGSTS. While herding greatly increases the effective sampling area for many species it relies heavily on interactions with the environment, fish behaviour and stability in the trawl geometry itself. It is highly variable therefore as we know so these study groups from the outset recommended minimising herding as far as possible. Where herding is difficult to eliminate, as in a demersal trawl, it should be as consistent with depth as possible to ensure catchability throughout the survey domain is reasonably constant should stocks be encountered in different areas over time.

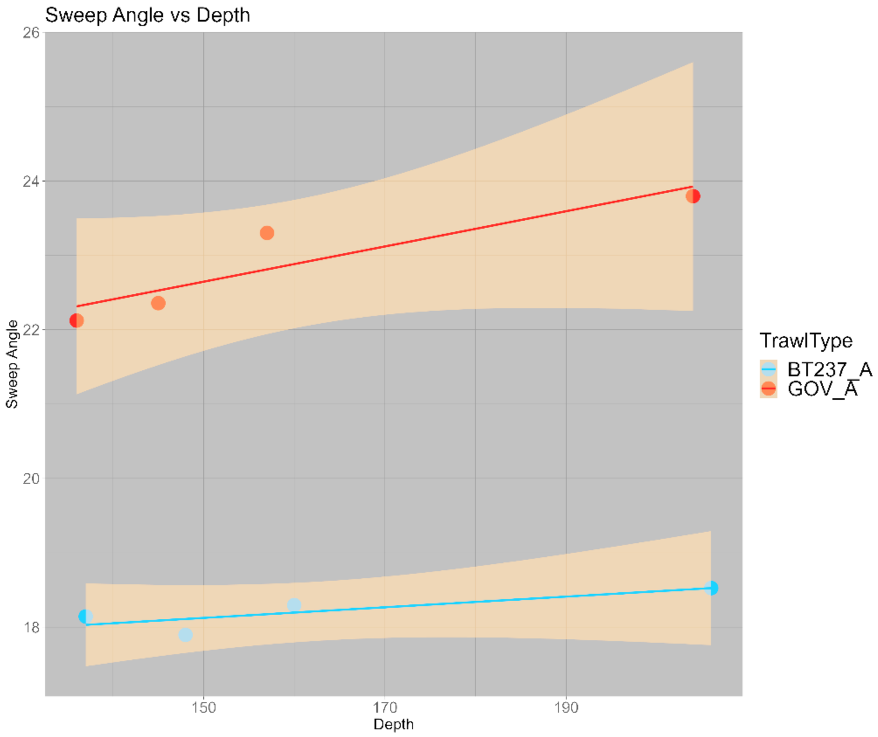


Fig 3.1.6 Sweep angles at various depths between the two trawls. The BT237_A had a mean sweep angle of 18.2 deg (±3.5%) while the GOV_A averaged 22.9 deg (±1.5%) over the same stations.

Catches

While obviously a couple of days testing exercise at sea will provide a useful "sanity check" on default settings for a new trawl, it will fall short of conclusive data in terms of catch rates. That said, data collection is very costly and therefore valuable so it would be remiss not present even initial values here.

At a summary level the total weight of all species components was similar between gears across the four paired hauls. In other words, the range of big and small catch components was broadly similar between trawls across all hauls (Fig 3.2.1). Despite fishing taking place on consecutive days there was good consistency between the two gears in terms of the pattern of big, small and average catch components regardless of species.

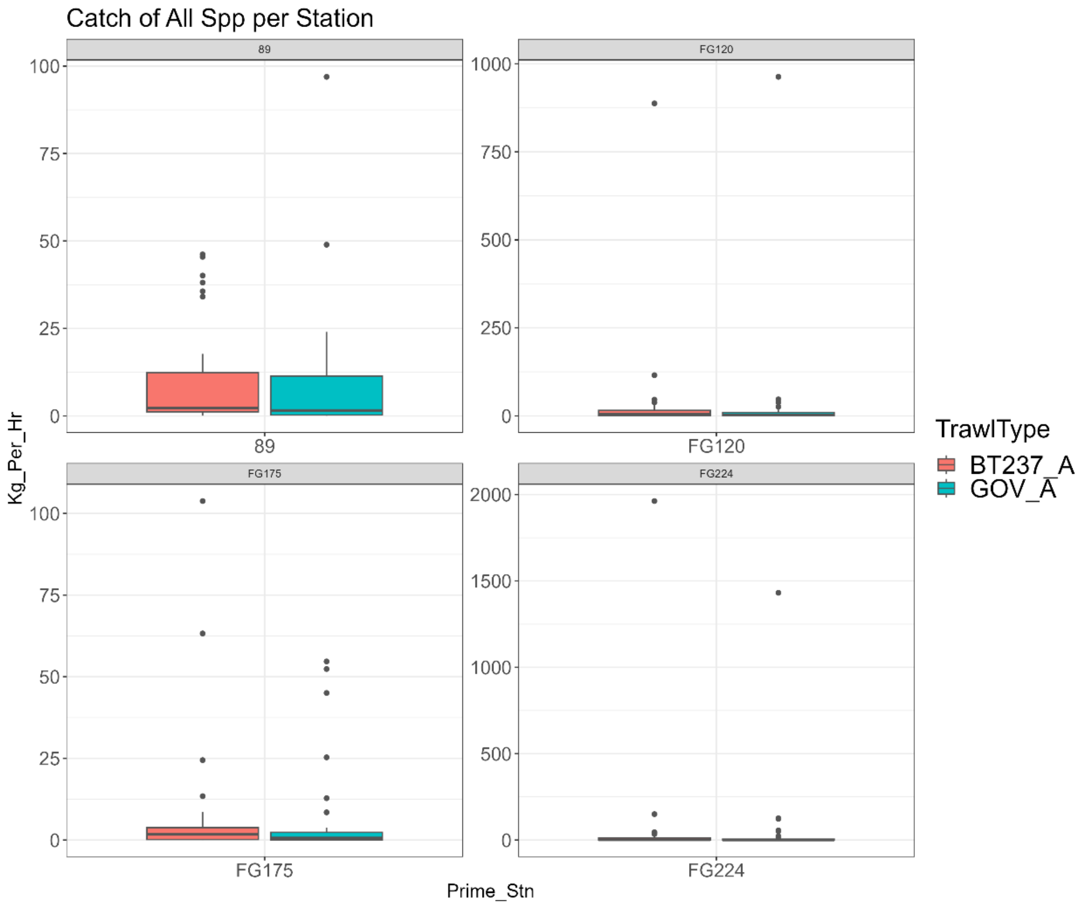


Fig 3.2.1 Box plots of catches between the two gears for each of the four paired hauls. The coloured box shows the main range of catch weights in Kg/Hr of the various species. The dots show catches beyond the inter-quertile range.

When subset down to key abundant species we see slightly greater catches for the new trawl for gadoids whiting (*Merlangius merlangus*), hake (*Merluccius merluccius*) and megrim (*Lepidorhombus whiffiagonis*). There was one higher catch for monkfish (*Lophius piscatorius*) and blue whiting (*Micromesistius potassou*) while overall bulk was lower (Fig 3.2.2). Catches were similar between trawls for haddock (*Melanogrammus aeglefinus*), argentines (*Argentina sphyraena*), grey gurnard (*Eutrigla gurnardus*) and plaice (*Pleuronectes platessa*). The GOV saw higher preliminary catches for cod (*Gadus morhua*) and poor cod (*Trisopterus minutus*).

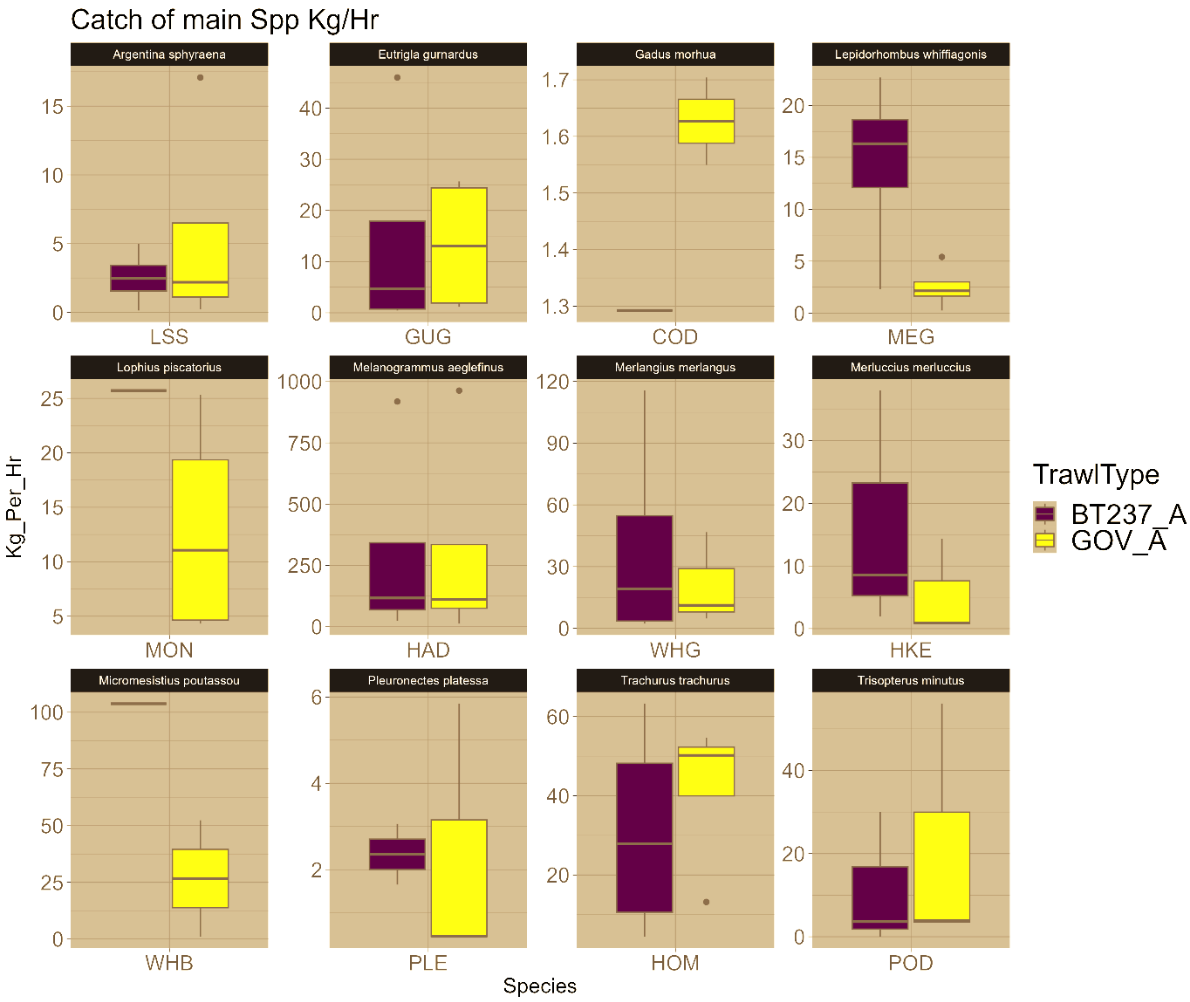
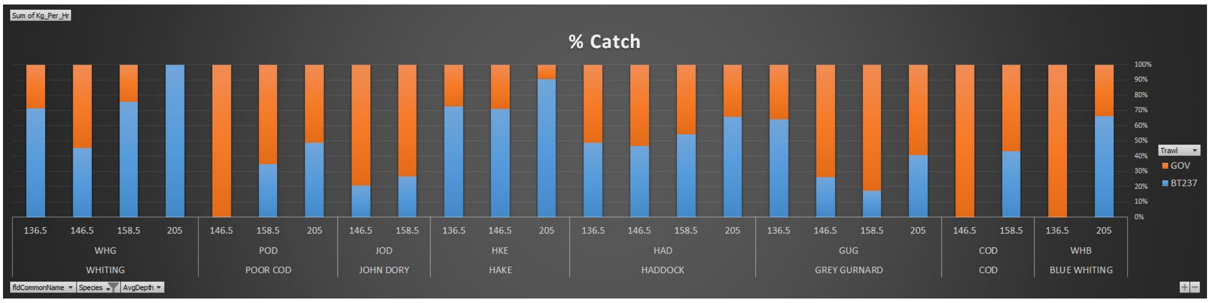


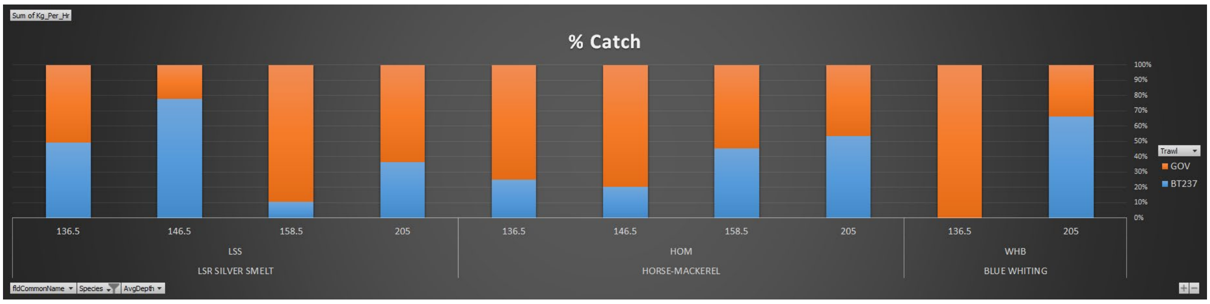
Fig 3.2.2 Box plots of catch rates for the four hauls combined for a range of dominant key species in the catches. Where the median horizontal line within one box falls above or below the top or bottom of the neighbouring box for that species, this indicates the catches of this species were significantly different between the two trawl. Results need to be treated with caution of course given the size of the data set.

Looking at the proportion of the total catch caught by each gear for related groups by haul we can see the data is quite noisy. We have ordered the paired haul data here by depth for comparative purposes while still cautioning against drawing any conclusions at this stage (Fig 3.2.3).

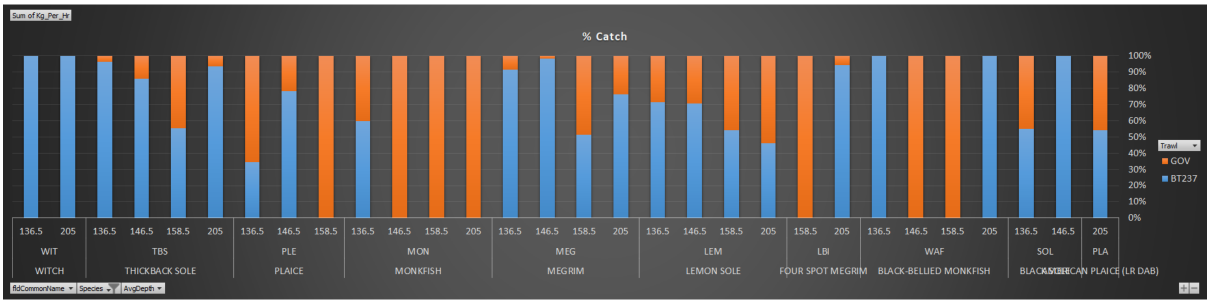
Gadoids



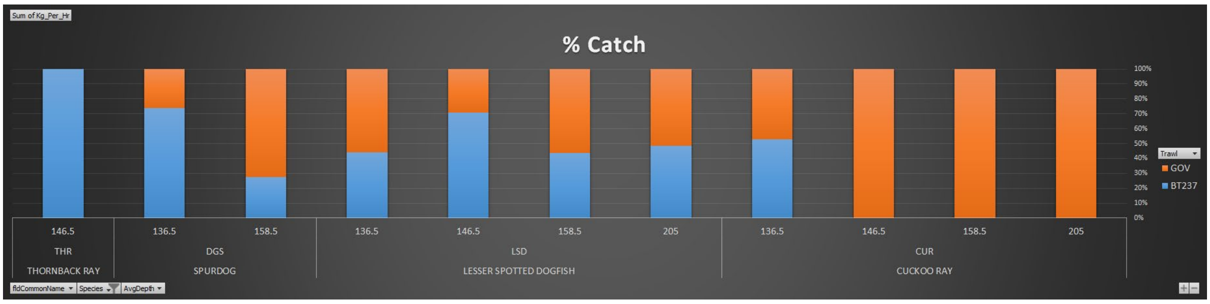
Pelagics



Flats



Elasmobranchs



Summary observations

The BT237 trawl has its roots in commercial rockhopper fishing so incorporates many positive design developments from there. It is robust with a good headline height and stable geometry, but relatively large and heavy as a consequence (Fig 4.1).

Fig 4.1 Showing the lower chain legs and floatation of the BT237_A being hauled onto the upper net drum on the Celtic Explorer (left panel). Fully stowed away the volume of net (excluding net drum core) was 7.25 m^3 and c.1,713Kg.

Tension on the winches while towing the BT237_A at the fixed speed of 3.5Kts Kts varied between 3.8-4.8 tons across the 4 hauls (Fig 4.2).

Fig 4.2 Screen for the RappHydema autotrawl system showing tension on the winches of 4.2 tons during one of the comparative hauls.

Even with good commitment from all sides, having an external partner with the mainstay of expertise for the BT237 resulted in quite broken and delayed communications through 2022. Thus highlighting a difficulty in this TOR of relying on project partners not directly within the normal ICES communications and peer review process of the group. Notwithstanding that, the clean groundgear version has now been built, provisionally trialled by December 2022 and delivered to the North Sea partners for more extensive evaluation.

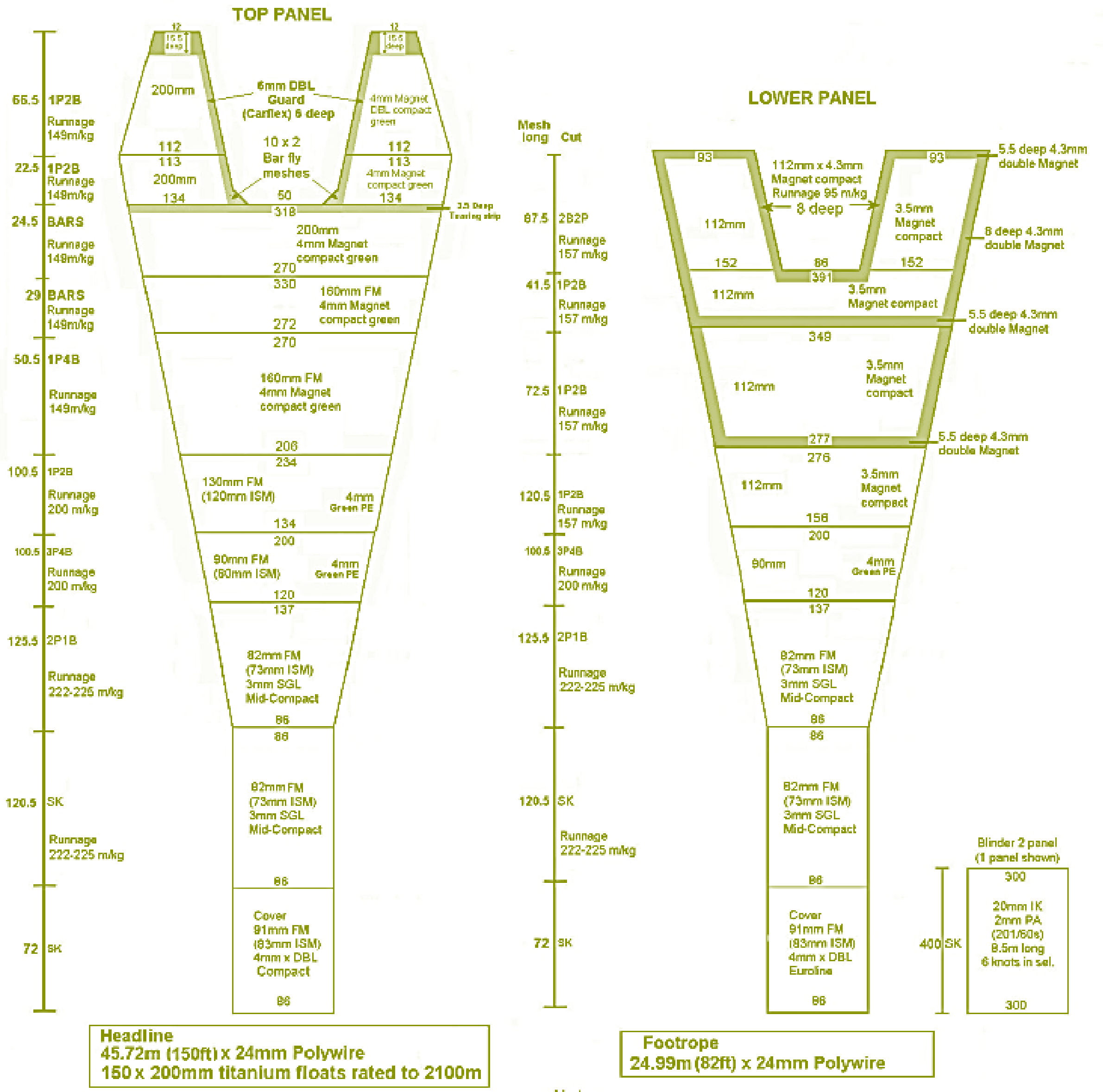
While evaluation by the North Sea surveys progresses a few specifics are highlighted below for consideration as part of that process.

1. More ballast for groundgear in water deeper than our trials is likely to be required
2. Ideally constant joining rows are much simpler and this could easily be implemented in this design for more robust and fool-proof mending over time. A simple fine tuning could help simplify construction considerably without changing the overall design or efficiency to any great extent.
3. The trawl plan does not provide any information on joins and again this will only lead to deviation so details supplied with the trawl need expanding.

To conclude positively, the trawl seemed to perform well overall. It will need a lot more testing of course before clear conclusions can be drawn on its suitability across all areas, species and vessels. Some participants have expressed valid concerns regarding its size and weight, but it should be reiterated that any trawl, including this one, can be scaled up or down in size. It can also be constructed in lighter twines and ropes, forgoing some robustness, but maintaining its original selectivity characteristics.

A lot of time, effort and expense has been given under this IBTS TOR to get to this proof of concept design. We would propose it is now time to try it on, see how it fits and come back with the alterations needed before the wedding day, this engagement can't go on! Once we know how it fits everyone we can make the final alterations to ensure that ALL users are comfortable with the final cost and fit before walking down the aisle!

Appendix 1: Net plan following revisions to BT237 incorporating smaller meshes and simpler lower panels in particular.



Note (wingtips) - One extra row of meshes (6mm Nylon braid) added to top and lower wingtips plus 1 x 100mm x 10mm stainless steel ring, taken into connector when attaching to bridles.

Note
*All mesh sizes given are full mesh except 20mm blinder.
*5 meshes (6 knots) gathered in selvedge each side of panel.
*1 knot gathered into frameline ropes.