

North Sea Herring and Pelagic Ecosystem Survey (HERAS) report for RV "TRIDENS", 28 June – 22 July 2021

Bram Couperus

CVO report: 21.026 (internal report)

Commissioned by:

CVO

PO Box 68

1970 AB, IJmuiden

Attn Sieto Verver

This research is carried out by Wageningen Marine Research and requested and funded by the Dutch Ministry of Agriculture, Nature and Food Quality under the statutory research tasks for fisheries.

Project number:

4311211060

BAS code:

WOT-05-001-003

Publication date:

25th of July 2022

Stichting Wageningen Research
Centre for Fisheries Research (CVO)
P.O. Box 68
1970 AB IJmuiden
Phone. +31 (0)317-487418

Visitor address:
Haringkade 1
1976 CP IJmuiden

This research is conducted as part of the statutory task programme "fisheries research" and subsidised by the Dutch Ministry of Agriculture, Nature and Food Quality.

© 2020 CVO

De Stichting Wageningen Research-
Centre for Fisheries Research is
registered in the Chamber of commerce
in Gelderland nr. 09098104,
VAT nr. NL 8089.32.184.B01

This report was prepared at the request of the client above and
is his property. All rights reserved. No part of this report may
appear and/or published, photocopied or otherwise used
without the written consent of the client.

CVO rapport ENG V11

Table of Contents

Table of Contents.....	3
1 Introduction.....	4
1.1 Survey purpose.....	4
1.2 Survey design.....	5
2 Survey report 2021.....	5
2.1 Scientific staff.....	5
2.2 Narrative.....	5
2.3 Transect coverage.....	6
2.4 Acoustic calibrations.....	6
2.5 Acoustic data collection.....	6
2.6 Biological data collection.....	6
2.7 Hydrographical data.....	7
3 Results.....	7
3.1 Trawl data results.....	7
3.2 Acoustic data results.....	7
4 Quality assurance.....	12
4.1 On board procedures.....	12
4.1.1 Acoustic calibration.....	12
4.1.2 Maturity staging.....	12
4.2 Age readings.....	12
4.3 Data quality assurance.....	12
4.4 CVO quality assurance.....	12
References.....	13
Justification.....	14

1 Introduction

The Dutch institute Wageningen Marine Research (WMR) has participated in the international North Sea acoustic survey for herring (HERAS) since 1991. The other participating countries in this survey are Scotland, Norway, Germany, Denmark and Ireland. The survey is part of the EU data collection framework (DCF) and is coordinated by the ICES Working Group for International Pelagic Surveys (WGIPS).

The Dutch survey was carried out during two periods of two weeks from 28th June to 8th July and from 12th to 12th July 2021, covering the survey strata in an area east of Great Britain from latitude 53°00' to 58°30' North and from longitude 2°30' West (off the Scottish/English coast) to 2°00' East. Tridens covered stratum 101, 81 and part of 91 in 2019 (Figure 1).

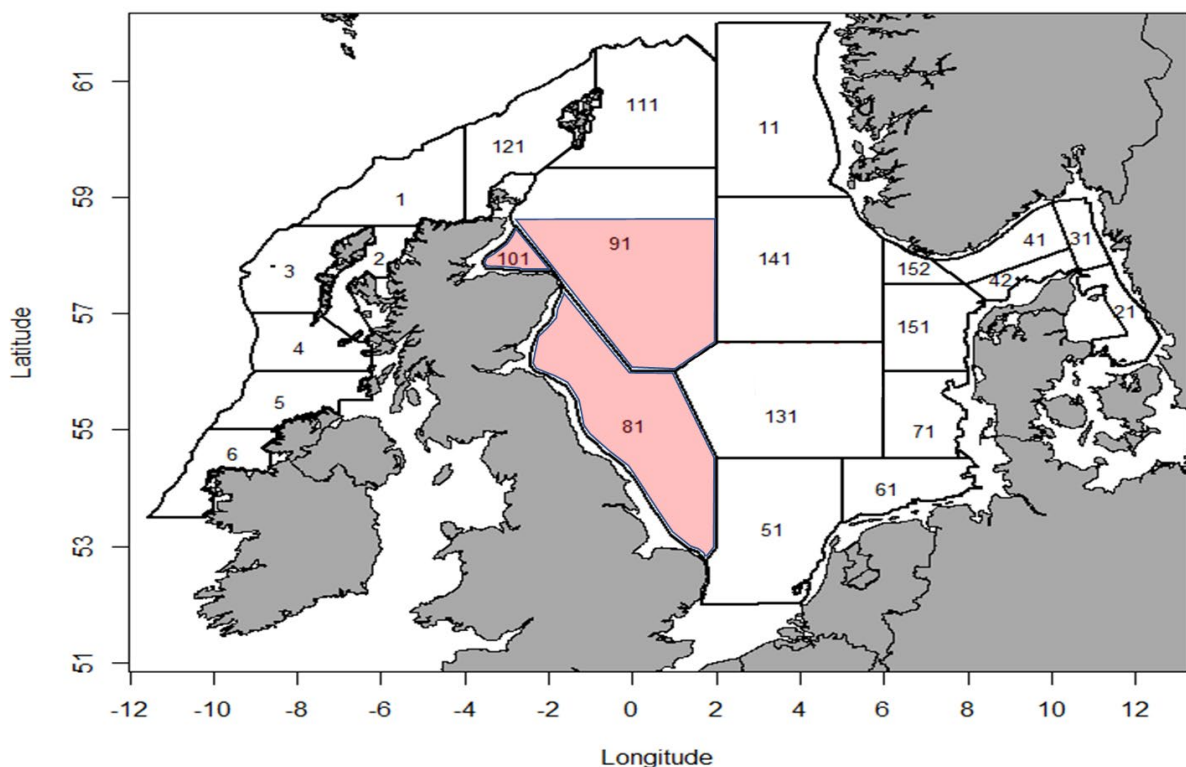


Figure 1. International HERAS survey strata with area (strata 81, part of 91 and 101) covered by RV Tridens during the July 2021 North Sea herring acoustic survey.

1.1 Survey purpose

The aim of this survey is to provide an abundance estimate of the whole North Sea herring population. This estimate is used as a tuning index by the ICES Herring Assessment Working Group (HAWG) in its assessment of the population size. In this report the results for the 2020 survey in the central North Sea as carried out by the Dutch research vessel Tridens are presented. The area covered is therefore limited to the biological strata covered by Tridens. As a consequence, the presented size and composition of the herring and sprat stock is independent from the remainder of the North Sea.

For the estimation of the total North Sea stocks, the acoustic and biological data of all participating countries will be uploaded to the ICES acoustic database and used by WGIPS to carry out an integrated analysis using the software StoX.

1.2 Survey design

Since 2016, a stratified transect design with random start is applied. Parallel transects along latitudinal lines are used with spacings set at 15 and 35 nmi in the respective strata, based on the observed abundance and variance in the survey over the last 10 years. The aim of the current survey design is to choose transect spacing to maintain or improve the precision of the survey. Acoustic data from transects running north-south ("intertransects") are excluded from the dataset to avoid sampling autocorrelation, according to standard practice. Inshore extension was maintained at the 20m contour for shallow waters regions of the Baltic and southern North Sea, and the 30m contour for all other areas where applicable. The 200m contour marks the lower depth limit of the international survey at the shelf edge and in the northern boundary.

The change in 2016 was initiated by an ICES workshop (WKEVAL, see ICES 2015a) where several geographical areas were identified that required standardization amongst participating survey nations. With the move away from rectangle based estimation, a new set of survey strata has been established at WGIPS 2016 maintaining the historical geographical coverage for the HERAS survey area. These strata were applied in the herring acoustic survey in 2016 onwards.

2 Survey report 2021

2.1 Scientific staff

Table 1. Scientific staff on board *Tridens* during the North Sea herring acoustic survey 2021

Name	Organisation	Role	Wk 26	Wk 27	Wk 28	Wk 29
			1 st half		2 nd half	
Bram Couperus	WMR	Acoustics (CL)	X		X	
Beanne Snaar	WMR	Acoustics	X		X	
Dirk Burggraaf	WMR	Technician/Acoustics	X		X	
André Dijkman	WMR	Fish Lab	X			
Hendrik Westerink	WMR	Fish Lab	X			X

2.2 Narrative

Table 2. Departure – and arrival dates and time (UTC) in ports

Departure	Date	Time (UTC)	Arrival	Date	Time (UTC)
Scheveningen	28-06-2021	10:00	Scheveningen	08-07-2021	21:30
Scheveningen	12-07-2021	10:00	Scheveningen	22-07-2021	8:00

During the survey a blog is kept which contains all activities: <http://herringsurvey.blogspot.com/>

2.3 Transect coverage

The total transect length surveyed was 1690 nmi (nautical miles), 4150 nmi has been covered including steaming and transitioning between the transects (Figure 2).

2.4 Acoustic calibrations

The usual calibration at the beginning of the survey at Scapa Flow (or another more sheltered location in Northern Scotland) was skipped this time. The calibration results at the end of the previous acoustic survey (IBWSS; (Couperus 2021) in April 2021) were very good. The calibration results at the end of the previous acoustic survey (IBWSS; (Couperus 2021) in April 2021) were very good. The transducer gains were the same as during HERAS 2020. This indicates that the echosounders can be relied upon for the present survey.

2.5 Acoustic data collection

A Simrad EK80 echosounder operating at 18, 38, 70, 120, 200 and 333 kHz was used for acoustic data collection. Transducers were mounted close together on the vessels drop-keel which protruded 3.23 m below the vessel given a total transducer depth of around 7 m below the water surface. Acoustic raw data were logged and post-processed using LSSS software. The EK80 received position data and vessel speed from the ship's GPS. A ping rate of 0.6 seconds was used. The data were logged in 1 nautical mile intervals. A typical vessel speed of 10 knots was used on one engine, to avoid interference with the acoustic data collection. Acoustic density values (Nautical Area Scattering Coefficient's: NASC's) by log interval were assigned to the categories "herring", "sprat", "Norway pout", "bottom fish", "sandeel", "mackerel", "haddock", "whiting" and "krill" based on school characteristics and trawl catch composition. All echoes were recorded with a threshold of -82dB up to a depth of 250 meters below the transducer.

2.6 Biological data collection

Fishing

The acoustic recordings were verified by fishing with a 2000 mesh pelagic trawl with a 20 mm mesh lining in the cod-end. Fishing was carried out to identify species-composition of major recordings observed on the echo sounder and to obtain biological samples of herring and sprat. In general, after it was decided to make a tow with a pelagic trawl, the vessel turned and fished back on its track line.

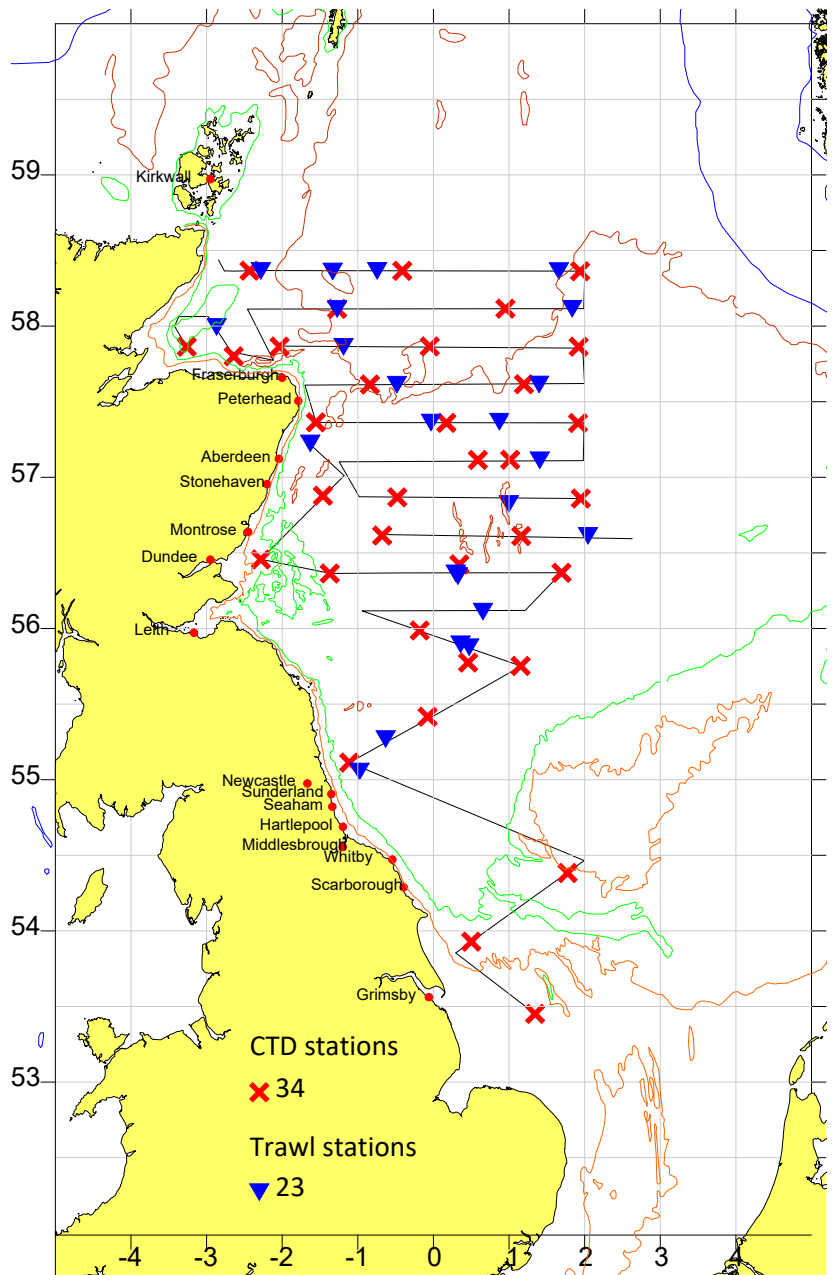


Figure 2. Trawl – and CTD stations during HERAS 2021.

During fishing the ME70 and SU90 sonars were used as a supplementary help to identify the real centre of the schools in comparison to the trackline. In most hauls, the footrope was very close to the bottom with vertical net opening varying from 20 to 30 m (specifications are listed in the survey manual: Damme *et al.*, 2021).

During the survey extensive use was made of the scientific omnidirectional sonar SU90 to facilitate capture of fish of the target schools identified on the echogram. With the new sonar it was possible to track the schools after the vessel turned to shoot the net, and therefore chances were higher to actually catch the desired school to collect a representative biological sample – and eventually increase survey accuracy.

Biological samples

The following sampling procedures applied:

- For all fish:
 - Total species weight of the catch
 - 150 to 250 specimens for individual length measurement, for herring and sprat 'to the 0.5 cm below', which means that fish between 20 and 20.5 cm is recorded as 20, and fish from 20.5 to 21.0 cm as 20.5. Other species are measured 'to the cm below'. Depending on the catch weight, subsampling is applied, based on weights.
- Stratified samples of five fish per length class were taken from the length measured herring and sprat. The following parameters are sampled from these fish:
 - Individual length 'to the mm below'
 - Individual weight
 - Gender
 - Maturity stage
- Age of herring and sprat, by means of otolith reading (otoliths collected on board, age reading is and onshore activity)

In total, 25 trawl hauls have been carried out (Figure 2). Sample ID's used in 2021: 2021.5400551 – 2021.5400575.

2.7 Hydrographical data

Hydrographical data (conductivity, temperature at different depths) were collected on pre-defined stations on the transects with approximately 30nmi interspacing, in total 34 (Figure 2). At each station a downcast was carried out with a Seabird CTD device, type SBE 9plus. It had been successfully calibrated in advance by the manufacturer.

3 Results

3.1 Trawl data results

In total 440 herring samples for biological sampling were taken in 8 hauls (2, 3, 4, 8, 12, 19, 21, 24); 93 sprat samples were taken in 3 hauls (1, 9 and 24). The trawl list, and the catch weights per haul and species are presented in Table 3.

3.2 Acoustic data results

Most herring (HER) was found in the northern part of the survey area (stratum 91) south of 59°00', down to and 57°30'N and east of the 1°W line (Figure 3a). The area in between was empty. The appearance of sprat (SPR) over the years has always been irregular in quantity and distribution, mostly

at the coast (Figure 3b). This year the species was found southwest of the Devil Holes, between 56°N and 57°N and – much less - in the north of 57°30', west of 1°W, extending into the Moray Firth (Figure 3a-b). It should be noted that by introducing zigzag transects in stratum 81, the coast is less well covered, making it more likely to miss incidental sprat concentrations.

Instead of herring, this year – similar to 2020 – most echoes were attributed to Norway pout (NOP, Figure 3c), whiting (WHG, Figure 3d), and haddock (HAD, Figure 3e). Norway pout was found mainly in the Moray Firth (juveniles), in the northwest of the area (east of 1°E, between 58° and 58°30'N) and in the area of the Devils Holes. Whiting and haddock were scattered over the area north of 55°30'N, mainly in the west. Below the line of 55°30'N, whiting was found evenly distributed in the south (west of the Doggerbank). No haddock was not found below 55°30'N (Figure 3c-d and 3e).

Schools of gadoids and sprat can easily be confused with herring schools. Distinguishing the species requires frequent fishing and requires experience in the scrutiny of acoustic data in the area. During this year's survey and the survey carried out in 2020, this appeared to be no problem. We are confident that we were able to assign the right species to the acoustic recordings.

Table 3. Details of the trawl hauls and catches in kg taken on RV Tridens during the North Sea herring acoustic survey 27 June – 22 July 2021

haul-no	sample_id	Date	Time (UTC)	Lat_N	Lon	HER	SPR	NOP	HAD	WHG	MAC	Oth	Total	Bott-Depth	Wind-Dir
1	5400551	30-06-2021	7:48	57.93117	-2.993	0	0.7	35.7	8.2	0	0	0	44.6	82.7	NA
2	5400552	01-07-2021	6:28	58.46417	-0.97017	683.4	0	142.9	14.2	43.8	6.1	4.3	894.7	106	NA
3	5400553	01-07-2021	11:10	58.47017	-0.15283	392.1	0	1.1	0.4	4.8	0.8	0.4	399.6	119.8	NA
4	5400554	01-07-2021	12:47	58.46717	-0.08183	112	0	0	0	0	16	0	128	130.5	NA
6	5400556	02-07-2021	7:27	58.2185	1.89117	0	0	0.7	104	37.4	8.7	9.1	159.9	83.2	338
7	5400557	02-07-2021	10:08	58.21583	1.667	0.5	0	882.5	6.5	59.1	1	12.3	961.9	97.3	338
8	5400558	02-07-2021	19:51	58.2205	-0.81967	1219.5	0	0.3	1.4	2.1	2.6	0.1	1226	109	180
9	5400559	03-07-2021	13:32	57.94317	-1.14183	0	147.9	115.7	391.6	69.2	0	6.1	730.5	103.7	158
10	5400560	04-07-2021	6:53	57.989	1.47417	0.3	0	234	1.7	1.3	6.5	1.4	245.2	103.5	90
11	5400561	04-07-2021	10:01	57.96833	1.90717	0	0	0.3	36.1	33.9	113.3	7	190.6	83.2	90
12	5400562	04-07-2021	14:34	57.72067	1.76567	933.1	0	0	548.4	40	136.6	1	1659.1	88.2	90
13	5400563	05-07-2021	17:15	57.46867	-0.46817	0	0	3.7	203.5	16.3	5.5	2.3	231.3	95	90
14	5400564	06-07-2021	8:50	57.46567	1.84567	0	0	0	177.1	54.3	6.7	1.7	239.8	87.5	113
15	5400565	07-07-2021	12:19	56.934	-0.23917	0.1	0	0	553.1	151.9	8.7	5.9	719.7	73.8	113
16	5400566	13-07-2021	9:51	56.75267	1.14467	0.1	0	889.7	0.3	5.9	7.7	0.2	903.9	89.8	23
17	5400567	14-07-2021	6:56	56.46617	0.0945	0.4	0	0	127.7	72.9	7.5	0.3	208.8	79.7	315
18	5400568	14-07-2021	10:16	56.47233	0.55817	0.1	0	0.7	304.1	166.7	10	1.7	483.3	86.2	315
19	5400569	16-07-2021	15:34	56.46333	-0.99717	0.7	0	0	0	0.6	1.6	2	4.9	66	225
20	5400570	17-07-2021	9:59	55.94967	-2.16333	0	0	0	0	0	0.3	3.9	4.2	71.3	225
21	5400571	17-07-2021	11:13	55.93733	-2.21267	0.1	0	0	0.4	0	0.9	28.5	29.9	59.2	315
22	5400572	18-07-2021	12:58	55.985	0.2655	0	0	0.3	1247.5	101.2	0	0.2	1349.2	77.5	23
23	5400573	18-07-2021	16:45	55.99017	0.94533	0.1	0	0	808.1	170.4	0	1.5	980.1	70.2	NA
24	5400574	19-07-2021	14:18	55.45583	-1.1735	362.8	2519.8	0	0	0	15.4	24.6	2922.6	84.9	135
25	5400575	19-07-2021	19:38	54.9625	-1.00117	0.3	0.1	0	0	1001.1	3	0	1004.5	78.7	135

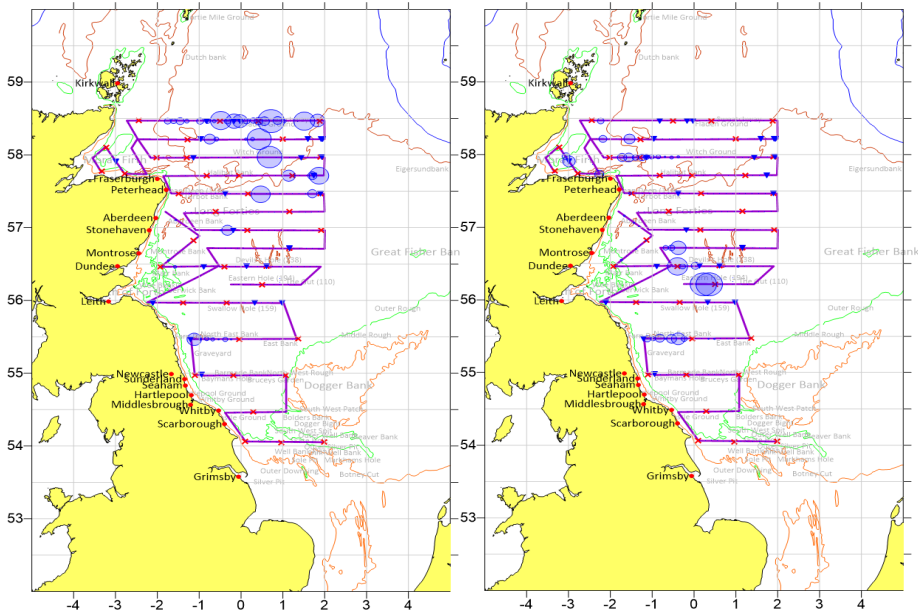


Figure 3a-b. Post plot showing the distribution as NASC of 5 nm intervals in 2021. Left: herring - bubbles scaled to maximum value of NASC=1027.8. Right: sprat - bubbles scaled to maximum value of NASC=495.8.

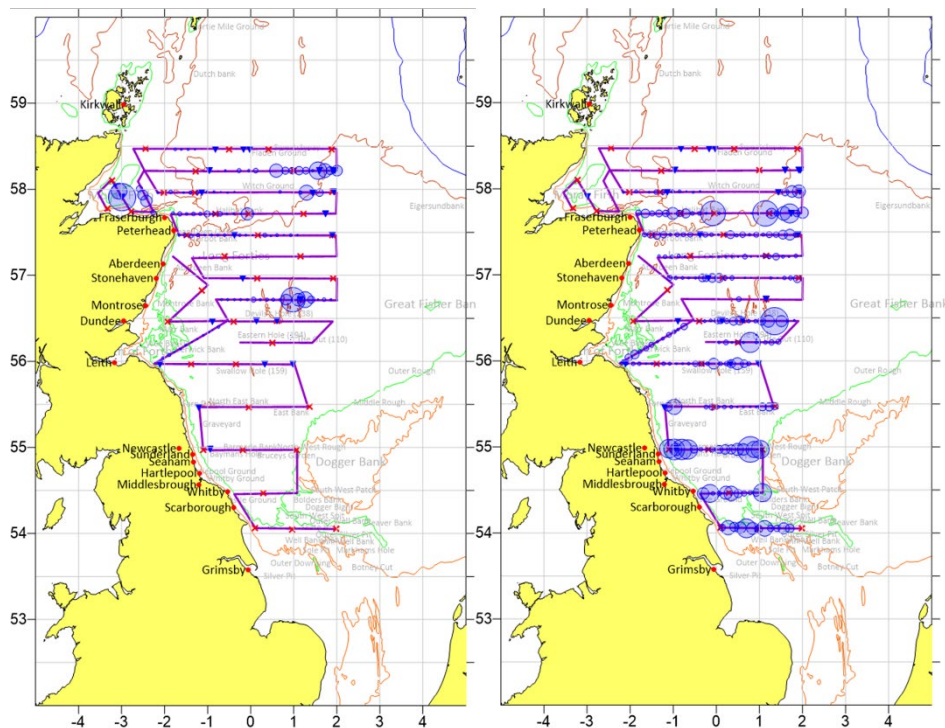


Figure 3c-d. Post plot showing the distribution as NASC of 5 nm intervals in 2021. Left: Norway pout - bubbles scaled to maximum value of NASC=2159.8. Right: whiting - bubbles scaled to maximum value of NASC=857.

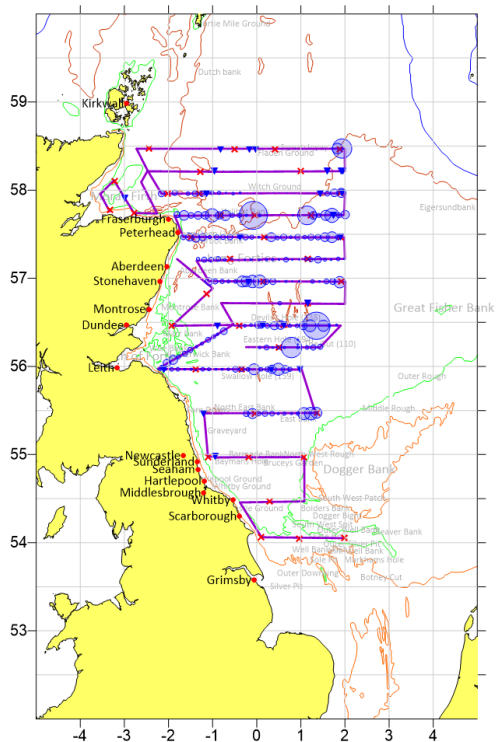


Figure 3e. Post plot showing the distribution as NASC of 5 nm intervals in 2021. Haddock - bubbles scaled to maximum value of NASC=1670.2.

4 Quality assurance

4.1 On board procedures

The international working procedures are defined in ICES (2015b). Specific WMR working protocols are described in Van Damme *et al.* (2021).

4.1.1 Acoustic calibration

Calibration of the acoustic instruments is crucial for the interpretation of the acoustic profiles. See paragraph 1.4 for calibration details.

4.1.2 Maturity staging

International quality assurance and coordination for maturity staging takes place via workshops and/or ring tests. The last standardisation is defined in 2012 (ICES, 2014).

4.2 Age readings

Age readings for herring and sprat are carried out at return on the institute, from pictures using the software SmartDots. Procedures and age reading quality management are described in Bolle *et al.* (2020).

4.3 Data quality assurance

Biological survey data is checked on outliers using a standardised script checking a set of relevant parameters before upload to the WMR database friske.

4.4 CVO quality assurance

CVO is certified to ISO 9001:2015 since 2001. The certification is issued by DNV. The latest audit was conducted in November 2021.

References

- Bolle Loes J. , Ruben Hoek, Ineke Pennock, Ulrika Beier, André Dijkman, Betty van Os, Beanne Snaar, Marcel de Vries, Thomas Pasterkamp, Erika Koelemij, Jan Beintema, Arnold Bakker, Tim Huijer, Andrea Sneekes, Norie van der Meeren, Hanz Wiegerinck. 2020. Handboek leeftijdsbepalingen. (versie 3.0). CVO report 20.012.
- Couperus, A. S. 2021. Cruise report hydroacoustic survey for blue whiting (*Micromesistius poutassou*) with F.R.V. Tridens (IBWSS) 15 March - 8 April 2021. CVO report; No. 21.019
- Damme Cindy van, Ulrika Beier, Loes Bolle, Ingeborg de Boois, Dirk Burggraaf, Bram Couperus, Ralf van Hal & Thomas Pasterkamp. 2021. CVO Handboek en protocollen voor bestandsopnamen en routinematige bemonsteringen op zee en in estuaria. Versie 15, maart 2021. CVO report 21.008
- ICES, 2014. Report of the Workshop for maturity staging chairs (WKMATCH), 11–15 June 2012, Split, Croatia. ICES CM 2012/ACOM:58. 57 pp.
- ICES. 2015a. Report of the Workshop on evaluating current national acoustic abundance estimation methods for HERAS surveys (WKEVAL). ICES CM 2015/SSGIEOM:16
- ICES. 2015b. Manual for International Pelagic Surveys (IPS). Series of ICES Survey Protocols SISP 9 – IPS. 92 pp. <http://doi.org/10.17895/ices.pub/7582>

Justification

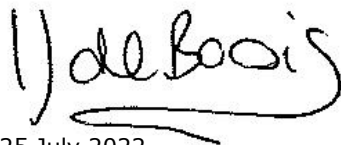
CVO Report: 21.026

Project number: 4311211060

The quality of this report has been peer reviewed by a colleague scientist and the head of CVO.

Approved by: Ing. I.J. de Boois
project lead fish surveys at sea

Signature:



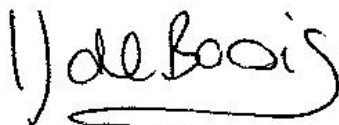
Date:

25 July 2022

Approved by: Ing. S.W. Verver
Head Centre for Fisheries Research

In absence: Ing. I.J. de Boois
Dept. head Centre for Fisheries Research

Signature:



Date:

25 July 2022