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FRV *Scotia*

Cruise 0921S

Cruise Report

7th July – 26th July 2021

Ports

Departure: Aberdeen, 7th July

Half-landing: 14th July (reduced due to Covid-19 restrictions)

Arrival and unloading: Aberdeen, 25th July, unloading 26th July

Personnel

S O'Connell (SIC)

H Holah (co-SIC)

M Rennie

R Kynoch

L Clayton (SIT)

C Pert

C Altass

D Copland (First half)

Estimated days by project: 20 days – RV2109 (20664)

Sampling Gear

Midwater trawls PT160 x 3

BT237 x 1

SIMRAD FS70 net sonde x 2

RBR concerto CTD, salinity bottles surface and at depth

Scanmar trawl eye

Anchorlab BlackBox and Archipelago EM Observe v4 REM systems

SMARTFISH CatchSnap QR tagged photography boards (A4-A2)

Objectives

- To conduct an acoustic survey to estimate the abundance and distribution of herring in the north western North Sea and north of Scotland between 58°30' -62°N, and from the shelf edge to 2°E, excluding Faroese waters.
- To obtain biological samples by directed trawling with pelagic nets to confirm echosounder trace identification.

- To obtain samples of herring and sprat for biological analysis, including age, length, weight, sex and maturity throughout the survey area.
- Collect samples and data for stock identity determination of herring. Otoliths will be collected for morphometric stock ID analysis. For herring caught west of 4°W a maximum of 100 fish per haul will have tissue samples collected. For herring caught east of the 4°W herring tissue samples will be taken, 30 individuals per haul. These samples will be analysed for stock identification in both areas.
- To obtain physical oceanography and hydrographic data for comparison to the horizontal and vertical distribution of herring and sprat.
- Collect herring samples (from five hauls). Fish will be measured and lengths recorded, then frozen and returned to the lab where they will be measured again to ascertain any effect of freezing on the length of the fish
- Photographs of individuals will be taken from a range of species along with weight and length data recorded in the image as part of the SMART FISH H2020 project.
- Undertake training (with two staff members on the survey) as part of participation in the Co-SIC program, this will help to inform the roll out of the pilot scheme to the wider MSS survey program.

Narrative

After a delay to our scheduled departure, due to mechanical difficulties with the gamma frame, Scotia departed Aberdeen at 20:00 on 6th July 2021 and made passage directly to the first transect line to begin acoustic sampling. The first transect began at 07:00 on the 8th of July. At 12:00 (crew change) we performed a shakedown tow to give both crew shifts a dry run of deploying our nets.

As we made our way north we encountered increasingly high densities of herring East of Orkney with densities peaking around the 1°W mark see (Figure 1).

We sailed into Breiwick, Shetland on the afternoon of the 13th July and setup our acoustic calibration kit prior to deploying the anchor. We then went through our acoustic calibration procedure, completing the calibration of all four frequencies by midday the following day. Scotia then sailed into Lerwick harbor for water and a crew change. We departed approximately 19:00 that evening and began the next transect immediately west of Lerwick.

On the 16th a crew member sustained an injury during fishing operations. Later on the 18th this required the ship to be brought to Lerwick to offload the injured crew member as a precautionary. We returned to surveying at 03:00 on the 19th. At this time we experienced some poorer weather conditions which required the drop keel to be lowered to 3m to prevent and reduce the effects of cavitation at the transducer faces.

Surveying west of Shetland, it was clear there were much fewer herring marks when compared to the eastern side. This contrast has become typical over the years, however it seemed

pronounced this year compared to others. There was only a couple of transects where we saw any quantity of herring worthy of note west of Shetland.

We fished two good bottom marks on the two most northern transects in strata 1 (Figure 7) unfortunately as we towed back over where the marks were the shoals had moved and we had two unsuccessful tows.

Due to the cumulative time lost prior to and during the cruise it was necessary to considerably reduce the number of CTDs we were able to complete, only successfully completing 23 deployments out of a planned 50. The end of cruise calibration was not performed in order to complete the survey on schedule

On the 25th of July we arrived in Aberdeen at approximately 15:00. The gear was unloaded the next morning including the four hydrographic moorings. Most gear was returned to the Marine Laboratory while the net and associated rigging was delivered to the Altens store yard.

The Covid-19 measures adopted by the ship worked well and were adhered to by all staff on board.

Results

Scotia completed all planned survey tracks and acoustic data was collected from 2184 nmi of transects in total with a completed survey track (not counting passage at start and end of trip or half landing) was approximately 2400 nmi.

The distribution of herring observed on this survey was largely in agreement with the patterns seen historically on this survey. This year the large aggregations seen NE of Shetland were much reduced in comparison to last year, likely due to our late departure as the fish may have progressed in their southern migration. In line with this, we saw greater abundance of herring East of Fair Isle than last year, again suggesting a greater southerly progression of herring compared to last year. West of Scotland herring were again scarce; we saw less this year than last. We saw a large isolated concentration of herring West of Shetland closer to the shelf edge although further south along last year's corresponding transect.

Fishing took place on an opportunistic basis with the aim of verifying species and size composition of echotraces encountered. A total of 32 hauls were successfully completed (Figure 2) on the survey throughout the water column as shallow as ~15m and as deep as ~200m, this was 10 less hauls than last year. The PT160 midwater trawl was used for the majority of fishing operations. Hauls carried out with the PT160 were monitored using the Simrad FS70 scanning netsonde connected with the steel wire armored cable. Headline depth was recorded with the EK60 RAW data and visualized in real time on the EK60 echogram. Most hauls in the west were completed using the BT237 to sample acoustic marks close to the sea bed without the risk of damaging our pelagic gear.

A load shackle with remote readout was used to weigh catches from the PT160.

The multipurpose doors that are used to quickly change between pelagic and ground gears were again used on this survey. The deck crew with our gear technician and fishing master developed a method of changing the doors which will reduce the time taken by 15 minutes. These doors provided greater stability and lift to the pelagic net than doors previously used, allowing it to be fished in a stable and reliable manner as shallow as 17m depth however the

fewer midwater and near surface marks seen on this year's survey meant we did not need to fish at these depths.

Herring catches were secured in most areas where significant herring schools were observed (Figure 2,3 and Table 1). Twenty four of the 32 trawls performed contained herring (Figure 4) (over 30 herring is considered the minimum requirement for a sample in the coordinated survey) (Table 1). In area 6a (West of 4° W), only a few herring schools were encountered. Two relatively large schools were encountered, however when we attempted fish on these marks, by the time we had turned around and had shot the net the marks had disappeared.

A total of 6242 herring were sampled to obtain length frequency data and 1974 of these fish were further sampled for biological parameters such as weight, age, sex, maturity. From the length frequency distributions in (Figure 5) we can see that the mode increases as we make our way North through strata 91 and 111 (Figure 7). You can see from Figure 6 that the proportion of middle aged fish as seen in this survey has declined over the last three years.

Additionally tissue samples were taken from 128 fish from 4 hauls as part of an ongoing collaborative genetics study with the Marine Institute (Ireland), Scottish Pelagic Fishermen's Association (SPFA), University College Dublin, Killybegs Fishermen's Organization, Wageningen Institute, Pelagic Fishermen's Association, Pelagic AC to further our understanding of herring stock structure to the west of the UK and Ireland.

Genetic samples were also taken from herring in hauls containing more than thirty fish East of the 4 degree line. Each haul had a maximum of 30 samples taken. A total of 22 vertical hydro dips were carried out over the survey area (Figure 3). Data collection parameters were conductivity, temperature, and oxygen. Water samples were collected at the surface for all dips for calibration of salinities.

The vessel thermosalinograph (TSG) was run continuously to obtain sea surface temperature and salinity throughout the survey area. These readings are recorded on our haul sheets for each fishing attempt.

We took samples as requested and detailed above in the survey objectives. These were placed in cold storage to be sampled at a later date

A total of 571 photos were taken covering 23 species as part of the SMARTFISH project. These images are used as training data sets for the development of fish identification algorithms by partners within the SMARTFISH project and also as training resources for seagoing staff within the MSS *Coastal and Offshore Fisheries Network*.

This was the first year that staff on the HERAS roster participated in the MSS Co-SIC program. Helen Holah acted as co-SIC shadowing the SIC predominantly for fishing activities undertaken in the bridge. This involved communicating with the crew regarding fishing operations and monitoring/recording fishing metrics. Lauren Clayton acted as SIT shadowing Helen Holah within the fish house with a particular focus on deciding the appropriate sampling strategy on a haul-by-haul basis and communicating this to the deck crew as well as problem solving with deckmaster/FSS data entry and data quality checking.

Submitted:
S. O'Connell 16th November 2021

Herring NASC 0921S

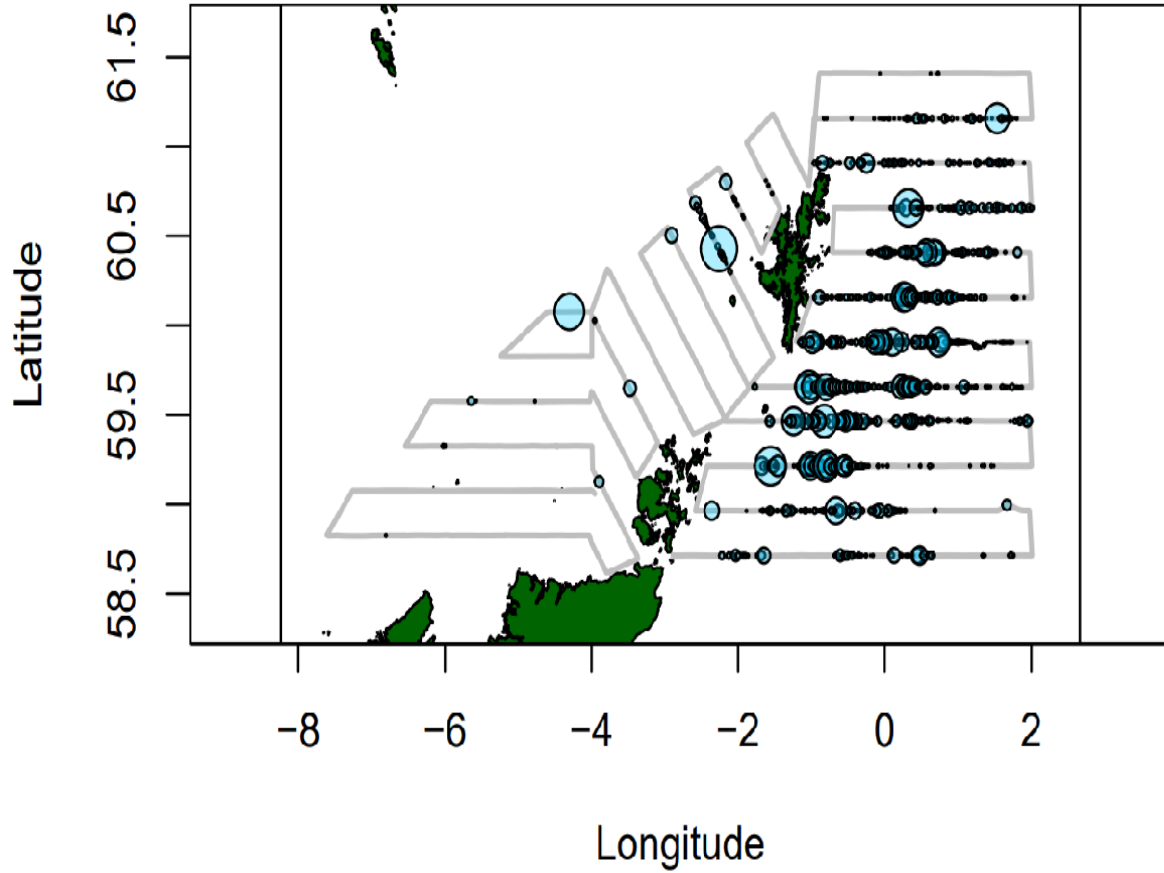


Figure 1. Cruise 0921S. Completed transects (grey lines) and distribution of herring (blue circles indicate position and size of aggregations). Survey begins at the North-East tip of mainland Scotland.

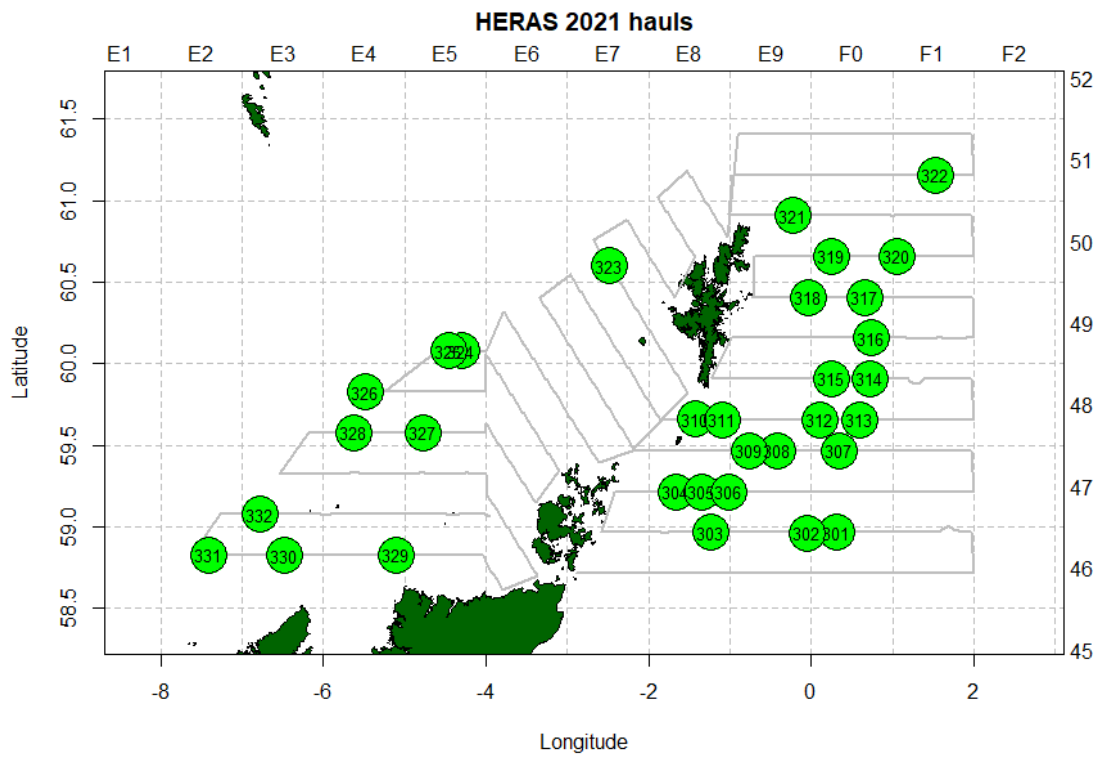


Figure 2. Cruise 0921S. Green circles represent haul positions and the numbers within are the associated haul number.

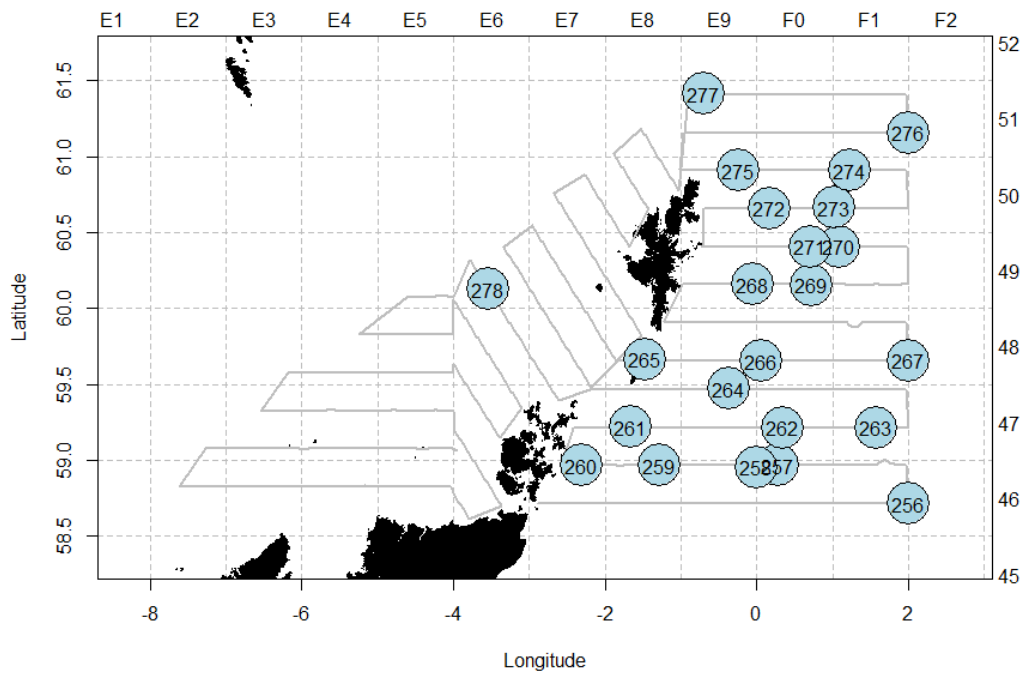


Figure 3. Cruise 0921S. Position of CTD stations. The blue circles represent the positions of CTDs and the numbers within are their associated station number.

Haul	Herring Catch Kg
303	28.9
327	7.2
328	12.1
330	1.39
332	1.74
302	158.7
312	158.546
313	1493.62
314	1520.89
315	407.26
316	1049.8
317	1360.34
304	1579.49
306	2960
307	597.9
308	2719
310	2.2
311	386.95
321	707.334
322	1291.336
318	230
319	1271
320	607.048
323	78.2
Total	18630.944

Table 1: Herring catch weights (Kg)

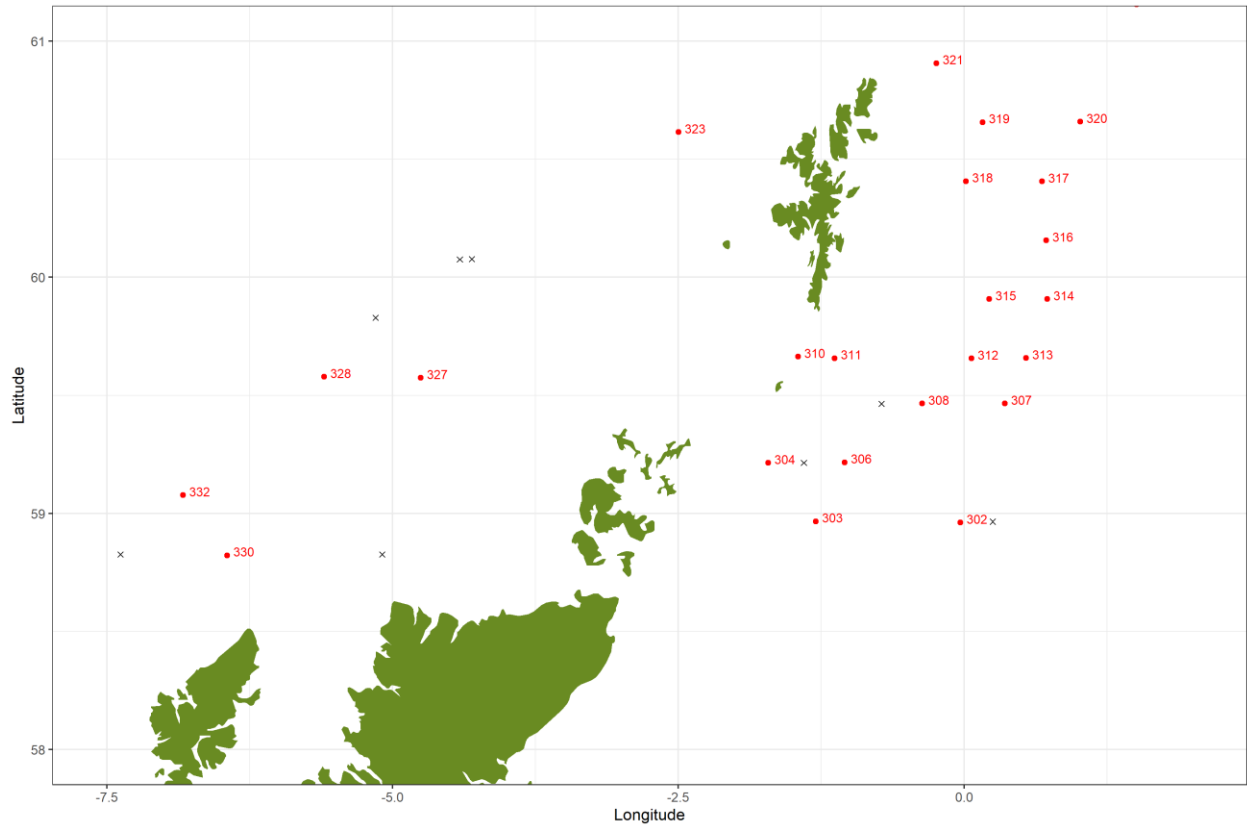


Figure 4: Location of hauls containing herring indicated by red dot and haul number. X indicates hauls with no herring.

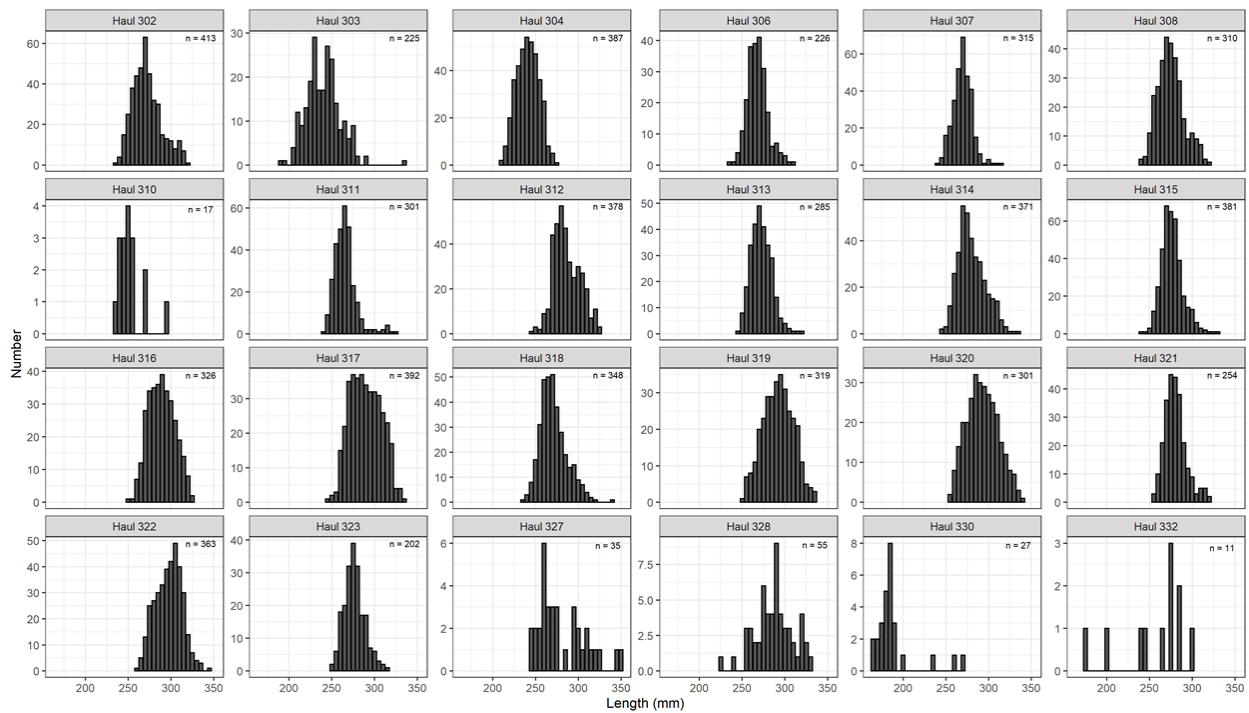


Figure 5: Length distribution of herring measured in each haul for HERAS 0921S

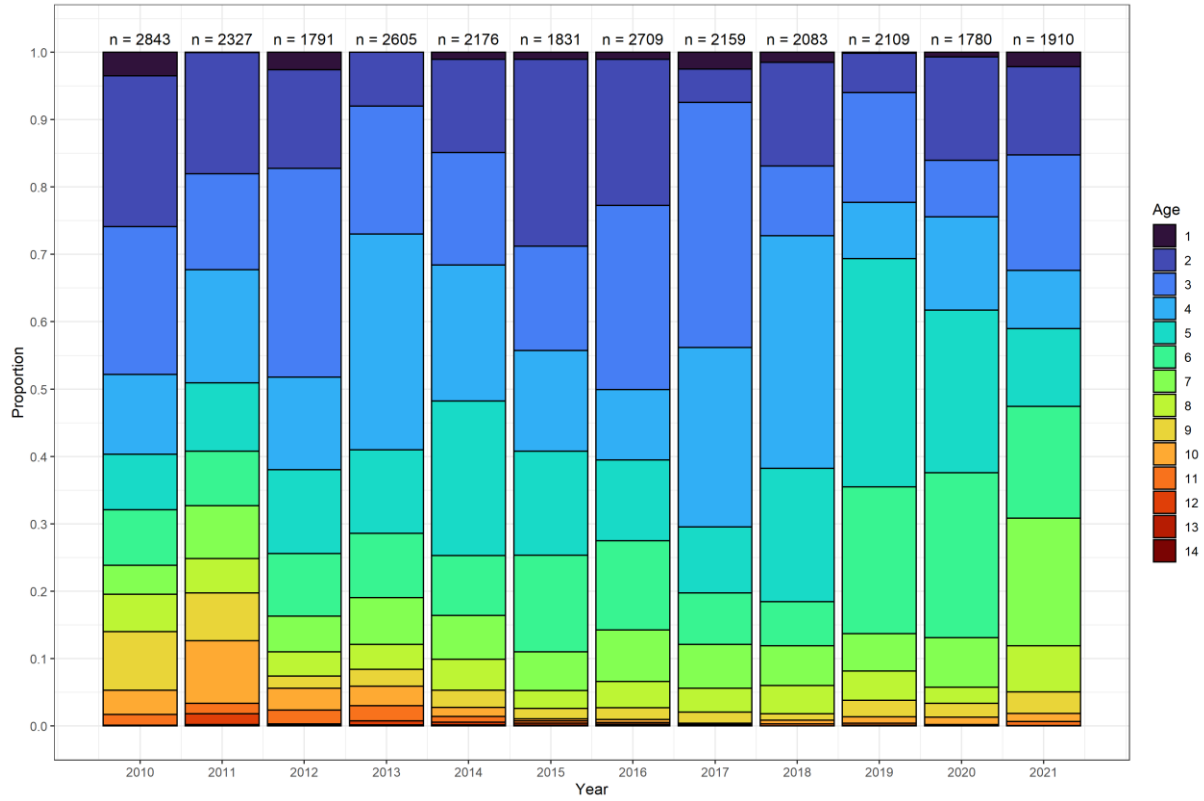


Figure 6: Proportion of fish ages present in each years survey from 2010-2021.

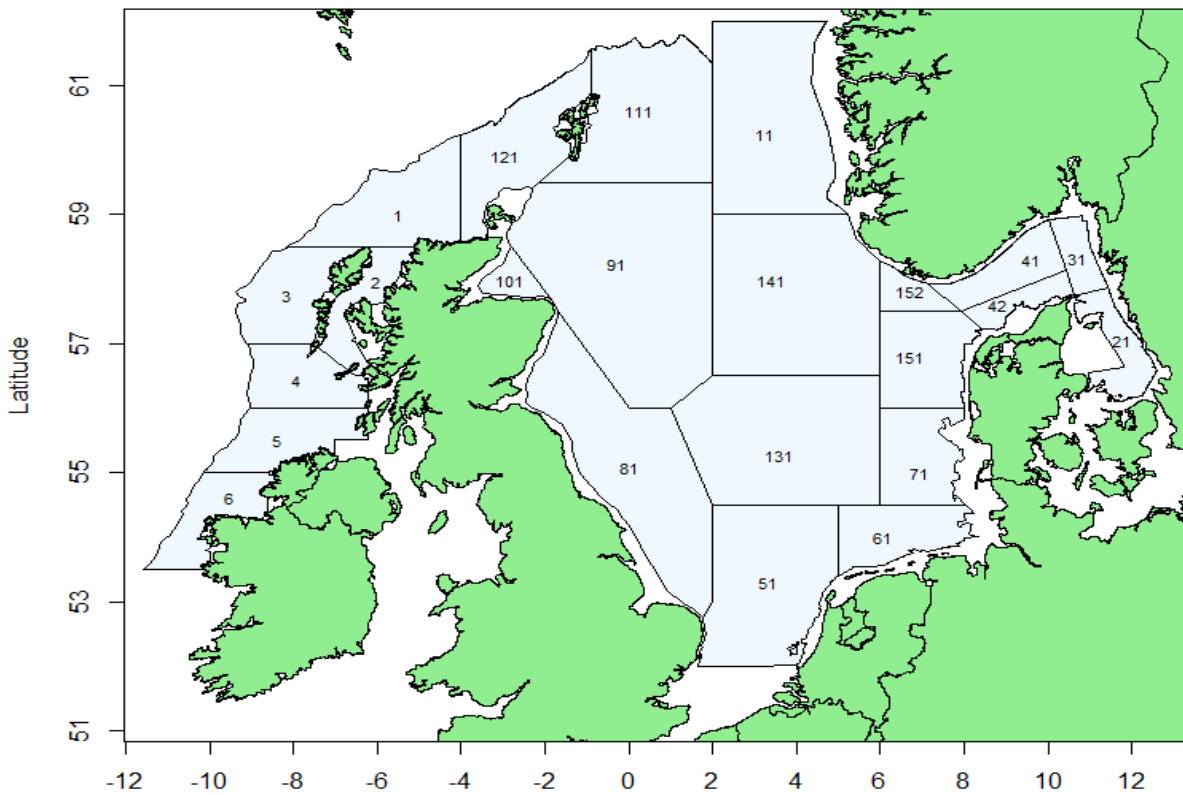


Figure 7: HERAS strata covering Malin Shelf, North sea, Skaggerak and Kattegat seas.