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# Cruise Report
# FRV Solea cruise 754
# 01.10. - 19.10.2018

# Hydroacoustic survey for the assessment of small pelagics in the Baltic Sea (GERAS/BIAS)

Cruise Leader: Dr. Matthias Schaber (TI-SF)

## 1. Summary

The cruise was part of an international hydroacoustic survey providing information on stock parameters of small pelagics in the Baltic Sea, coordinated by the ICES Working Group of International Pelagic Surveys (WGIPS) and the ICES Baltic International Fish Survey Working Group (WGBIFS). Further WGBIFS contributors to the Baltic survey are national fisheries research institutes of Sweden, Poland, Finland, Latvia, Estonia and Lithuania. FRV Solea participated for the 31st time. The survey area covered the western Baltic Sea including Kattegat, Belt Sea, Sound and Arkona Sea (ICES Subdivisions (SD) 21, 22, 23 and 24). Altogether, 1211 nmi (plus 107 nmi night and daytime transects for comparison) of hydroacoustic transects were covered. The survey effort was comparable to previous years.

In the majority of sampled rectangles, mean NASC values per nautical mile were distinctly higher than the values measured in 2017, and in SD 22 and SD 21 (in 2 and 3 cases, respectively) higher than the long-time mean values. Despite this increase from 2017, the majority of rectangles sampled in 2018 still showed mean NASC values below the long time mean. While NASC values measured were higher in ICES Subdivisions 21, 22 and 23, levels in SD 24 were in all but two rectangles distinctly lower than the already low NASC values measured in the previous year. In SD 23, unusually low NASC values were measured again (albeit higher than in the previous year), indicating absence of the dense aggregations of herring usually observed in that area at this time of the year. On a repetition of the transect in SD 23 during daytime for comparison, NASC values measured were higher than those recorded during nighttime, indicating undetected presence of clupeids in the area during the previous nighttime sampling.

For species allocation and identification, altogether 62 fishery hauls were conducted (incl. comparison hauls). Vertical hydrography profiles were measured on 106 stations.

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## 2. Cruise objectives and Survey design

The survey has the main objective to annually assess the clupeoid resources of herring and sprat in the Baltic Sea in autumn. The reported acoustic survey is conducted every year to supply the ICES Herring Assessment Working Group for the Area South of 62°N (HAWG) and Baltic Fisheries Assessment Working Group (WGBFAS) with an index value for the stock size of herring and sprat in the Western Baltic area (Kattegat/Subdivisions 21 and Subdivisions 22, 23 and 24).

The following objectives were planned for SB754:

- Hydroacoustic measurements for the assessment of small pelagics in the Kattegat and western Baltic Sea including Belt Sea, Sound and Arkona Sea (ICES Subdivisions 21, 22, 23 and 24)
- (Pelagic) trawling according to hydroacoustic registrations
- Hydrographic measurements on hydroacoustic transects and after each fishery haul
- Identification and recording of species- and length-composition of trawl catches
- Collection of biological samples of herring, sprat and additionally European anchovy and cod for further analyses

ICES statistical rectangles were used as strata for all Subdivisions (ICES, 2014). The area was limited by the 10 m depth line. The survey area in the Western Baltic Sea is characterized by a number of islands and sounds. Consequently, parallel transects would lead to an unsuitable coverage of the survey area. Therefore a zig-zag track was adopted to cover all depth strata regularly and sufficiently. Overall regular cruise track length was 1211 nmi (2016: 1167 nmi) covering a survey area of 12 400 $nmi^2$ (Figure 1).

## 3. 2. Cruise narrative and preliminary results

### 3.1 Cruise narrative

The 754$^{th}$ cruise of FRV Solea represents the 31$^{st}$ subsequent GERAS survey. Embarkation of scientific crew as well as equipment of FRV Solea with all hydroacoustic equipment and biological sampling gear took place on the morning of October 1st in Kiel harbor. On the same afternoon, Solea left port for the calibration of scientific echosounders. The calibration site off Strande that had been chosen for calibration in the previous year was again approached based on the prevailing weather conditions that were considered acceptable (4-5 Bft, westerly winds). After calibration the vessel returned to Kiel harbor in the late evening to allow switching of survey operations to night time. Leaving of port and start of survey was scheduled for October 2$^{nd}$ in the afternoon. The hydroacoustic survey operations commenced October 2nd at 06:00 PM in SD 22 in Kiel Bight.

Generally, survey operations were conducted during nighttime to account for the more pelagic distribution of clupeids during that time. Adverse weather conditions at the beginning of the survey required to start survey operations in the westerly survey area of the comparatively sheltered western Baltic SD 22. In the first night of survey operations, weather conditions deteriorated (10 Bft westerly winds) but allowed continuation of the survey in the narrow Belt Sea. After finishing SD 22, survey operations commenced in SD 24 and SD 23 which both were covered as planned due to favorable weather conditions, as was SD 21 afterwards. Regular survey operations were accomplished on October 16$^{th}$. After a switch of survey operations back to daytime, a comparative sampling (hydroacoustics and fishery) of SD 23 (Sound) was conducted to validate weak registrations recorded during the regular, initial passage. The scientific program was finished on October 18$^{th}$, 04:45 PM. The ship arrived at Marienehe port on October 19$^{th}$, 07:00 AM.

Altogether, the following survey schedule was accomplished:

| | |
|---|---|
| Belt Sea (SD 22) | 02. - 06.10. |
| Arkona Sea (SD 24) | 07. - 11.10. |
| Sound (SD 23) | 12.10. |
| Kattegat (SD 21) | 13. - 16.10. |
| Sound (day) (SD 23) | 18.10. |

| | |
|---|---|
| Total survey time | 15 nights (+ 1 day comparison in SD 23) |
| Fishery hauls | 62 (58 valid, 2 invalid, 3 daytime comparison) |
| CTD-casts | 106 |
| Hydroacoustic transects | 1211 nmi (+ 107 nmi transects for comparison) |

### 3.2 Hydroacoustics

#### 3.2.1 Calibration

All transducers (38, 70, 120 and 200 kHz) were calibrated prior to the beginning of the survey in acceptable weather conditions from an anchored vessel in Strande Bay/Kiel Bight (54°25.35 N, 10°12.29 E). Overall calibration results were considered good based on calculated RMS values. Resulting transducer parameters were applied for consecutive data-collection and post-processing of hydroacoustic survey data.

#### 3.2.2 Echo recording

All acoustic investigations were performed during night time to account for the more pelagic distribution of clupeids during that time. Hydroacoustic data were recorded with a Simrad EK80 scientific echosounder with hull-mounted 38, 70, 120 and 200 kHz transducers at a standard ship speed of 10 kn. Post-processing and analysis were conducted with Echoview 9 software (Echoview Software Pty Ltd, 2018). Mean volume back scattering values ($S_v$) were integrated over 1 nmi intervals from 10 m below the surface to ca. 0.5 m over the seafloor. Interferences from surface turbulence, bottom structures and scattering layers were removed from the echogram. The transducer settings applied were in accordance with the specifications provided in ICES (2015, 2017).

Figure 2 depicts the spatial distribution of mean NASC values (5 nmi intervals) measured on the hydroacoustic transects covered in 2018. The majority of these NASC measurements can be allocated to clupeids. In many rectangles surveyed, mean NASC values were significantly higher than those recorded in 2017, in some rectangles also above the long-time survey average. However, despite this increase from the previous year, mean NASC per rectangle was in the majority of rectangles still well below the long-term average. On ICES subdivision scale, mean NASC values were higher than in the previous year in subdivisions 21, 22 and 23, but significantly lower in SD 24.

In SD 21, overall NASC values measured were distinctly higher than those measured in the previous year. Only in one rectangle (42G1), mean NASC per 1 nmi EDSU was lower. SD 21 had the largest fraction of rectangles with NASC values exceeding not only the 2017 measurements (in 6 out of 7 rectangles) but also the long-term survey mean (in 3 out of 7 rectangles). Aggregations were mostly patchy along the cruisetrack, with the exception of the northern part of the Kattegat area surveyed, where increased NASC levels were measured more continuously.

In SD 22, mean NASC values recorded were also higher than the previous year in 6 out of 11 rectangles surveyed (similar values recorded in 2 out of 11 rectangles). In some rectangles, the increase in NASC measured was almost tenfold, but originated from only short transect sections in the area that usually is characterized by very low NASC levels. In comparison to the long-term survey mean, all but 2 rectangles in SD 22 showed decreased NASC values. No clear aggregation or area of increased NASC measurements was evident.

As in the previous year, the large aggregations of big herring that usually can be observed in SD 23 in the Sound were not present in autumn 2018. Although NASC values were distinctly higher than the levels measured in 2017, they still were well below the long-term survey mean. A replicate measurement of parts of the transect in SD 23 during night time and a full daytime replicate a few days later corroborated these findings, although daytime measurements showed somewhat increased NASC values in the area (Figure 3).

In SD 24, mean NASC values were significantly lower than the values measured in 2017 in 6 out of 9 rectangles surveyed. The only exception -with a fourfold increase from the previous year- was rectangle 37G2 (west of Fischland-Darß-Zingst Peninsula), an area with usually very low NASC measurements. As in the years before, higher aggregations were detected north-east and east of Rügen Island, but also –to a lesser degree- in the central and northern parts of the Arkona Basin.

### 3.3 Biological sampling (Tomas Gröhsler, TI-OF)

Fishery hauls according to ICES Subdivision (Figure 1):

| SD | Hauls (n) |
|---|---|
| 21 | 15 (incl. 1 invalid haul) |
| 22 | 18 |
| 23 | 8 (incl. 3 daytime hauls) |
| 24 | 21 (incl. 1 invalid haul) |

Altogether, 1 623 individual herring, 917 sprat, 295 European anchovies and 166 sardines were frozen for further investigations (e.g. determining sex, maturity, age). Results of catch compositions by Subdivision are presented in Tables 2-4. Altogether, 41 different species were recorded. Herring were caught in 58, sprat in 56 hauls (of 58 day- and nighttime hauls). SD 23, which is typically characterized by the highest mean catch rates per station (kg 0.5 $h^{-1}$), showed the lowest values ever recorded (during nighttime hauls). In contrast to 2017, when sardines (*Sardina pilchardus*) only appeared in catches from SD 21, this species in 2018 was also caught in SD 22 and SD 23. As in previous years, anchovy (*Engraulis encrasicolus*) were present in the whole survey area, albeit in a higher frequency of occurrence compared to 2017 (7 of 57 hauls in 2017; 26 of 58 day- and nighttime hauls in 2018).

Altogether, the following fish species were sampled and processed:

| Species | Length measurements (n) | Prevalence (n of hauls) |
|---|---|---|
| *Aphia minuta* | 761 | 37 |
| *Belone belone* | 22 | 13 |
| *Clupea harengus* | 12 915 | 58 |
| *Ctenolabrus rupestris* | 49 | 8 |
| *Cyclopterus lumpus* | 8 | 5 |
| *Engraulis encrasicolus* | 523 | 26 |
| *Eutrigla gurnardus* | 14 | 7 |
| *Gadus morhua* | 248 | 24 |
| *Gasterosteus aculeatus* | 1 214 | 39 |
| *Gobius niger* | 14 | 7 |
| *Limanda limanda* | 222 | 19 |
| *Merlangius merlangus* | 887 | 44 |
| *Merluccius merluccius* | 12 | 3 |
| *Mullus surmuletus* | 3 | 3 |
| *Neogobius melanostomus* | 8 | 3 |
| *Platichthys flesus* | 51 | 13 |

| Species | Length measurements (n) | Prevalence (n of hauls) |
|---|---|---|
| *Pleuronectes platessa* | 28 | 10 |
| *Pomatoschistus minutus* | 208 | 32 |
| *Sardina pilchardus* | 245 | 17 |
| *Scomber scombrus* | 195 | 16 |
| *Sprattus sprattus* | 10 515 | 56 |
| *Trachinus draco* | 177 | 17 |
| *Trachurus trachurus* | 617 | 46 |
| *Trisopterus esmarkii* | 30 | 4 |
| Others | 183 | - |

Figures 4 and 5 show relative length-frequency distributions of herring and sprat in ICES subdivisions 21, 22, 23 and 24 for the years 2017 and 2018. Compared to results from the previous survey in 2017, the following conclusions for **herring** can be drawn (Figure 4):

- Catches in SD 21 showed a multimodal distribution with modes at 11.75 cm, 15.25-15.75 cm and 21.2.5-21.75 cm. This is in contrast to 2017, when a bimodal distribution showed modes at 14.75 and 17.75 cm,
- The catches in SD 22 were dominated by the incoming year class (ca. ≤15 cm) with a mode at 13.25 cm. This is in contrast to a multimodal distribution with two modes at 11.25 cm and 15.26 cm and one mode of 18.75 cm in 2017.
- As in the two years before, larger herring (>20 cm) were more or less absent from night time catches conducted in SD 23. The catches in 2018 as in 2017 were dominated by the contribution of the incoming year class (ca. ≤15 cm), showing a mode at 13.25 cm in 2017 and at 12.25 in 2018 cm.
- In SD 24, the herring length-frequency distribution was characterized by a similar contribution of the incoming year class (ca. ≤15 cm) and older herring (>15 cm) in both years. However, the bimodal distribution in 2018 showed a higher contribution of younger herring (ca. ≤15 cm) (≤15 cm: mode 2017/11.75 cm and mode 2018/13.75 cm; >15 cm: mode 2017/18.25 cm and mode 2018/17.75 cm).

Relative length-frequency distributions of **sprat** in the years 2017 and 2018 (Figure 5) can be characterized as follows:

- In SD 21 catches of the incoming year class (ca. ≤10 cm) were virtually absent in both years. The catches were dominated by the contribution of larger sprat.
- In SDs 22 and 24, the sprat length-frequency distribution was characterized by a similar contribution of the incoming year class (ca. ≤10 cm) and older sprat in both years. However, the bimodal distribution in 2018 showed slightly more of the incoming year class (<10 cm), at the same time less of older sprat.
- In SD 23, the catches were dominated by the incoming year class (ca. ≤10 cm) in 2018, whereas the catches in 2017 showed a bimodal distribution with equivalent contributions of the incoming year class (ca. ≤10 cm) and older sprat.
- Altogether, the present contribution of the incoming year class (ca. ≤10 cm) seemed to be rather low.

### 3.4 Hydrography

Vertical profiles of temperature and salinity were measured with a SeaBird SBE CTD-probe on a station grid covering the whole survey area. Hydrography measurements were either conducted directly after a trawl haul or, in case of no fishing activity, in regular intervals along the cruise track. Altogether, 106 CTD casts were conducted during this survey.

Surface temperatures ranged from ca. 14°C in the Kiel Bight (SD 22) and ca. 13 °C in the Kattegat area to (SD 21) around 10-11°C in the northern Arkona Basin (SD 24)(Figure 6). Bottom temperatures were similar in most parts of Subdivisions 21, 22 and 23, but due to strong thermohaline layering in most parts of the Arkona Basin and the area of the Bornholm Basin covered were significantly different in SD 24. While bottom temperatures in the central Arkona Sea exceeded surface temperatures (maximum temperatures around 13 °C), bottom temperatures in the Bornholm Basin area were comparatively low at around 8 °C.

As usual due to the hydrographic nature of the western Baltic Sea, surface salinities showed a large gradient (from ca. 7.5 PSU in the eastern Arkona Sea to > 25 PSU in the Kattegat). Compared to the previous year, surface salinity in the western parts of the survey area (SD 22) was comparatively high at levels of ca. 20 PSU. Salinity near the seafloor ranged from 8 PSU in the Arkona Sea to ca. 34 PSU in the Kattegat. Especially in the Sound (SD 23), a very strong stratification with steep salinity gradients was observed.

Surface waters were well oxygenated throughout the survey area. Near the seafloor, local anoxic conditions were measured in the inner Mecklenburg Bight/Bay of Lübeck as well as in the southwestern part of the Little Belt (SD 22). Reduced oxygen levels were also measured in the deeper parts of the Bornholm Basin area covered.

## 4. Survey participants

| Name | Function | Institute |
|---|---|---|
| Dr. M. Schaber | Hydroacoustics, Cruise leader | TI-SF |
| B. Lüdke | Hydroacoustics, Hydrography | TI-SF |
| B. Stefanowitsch | Hydroacoustics, Fishery biology | TI-SF |
| M. Koth | Fishery biology | TI-OF |
| S.-E. Levinsky | Fishery biology | DTU Aqua (DK) |
| S. Winning | Fishery biology | TI-OF/TI-SF |

## 5. References

Echoview Software Pty Ltd (2018). Echoview software, version 9. Echoview Software Pty Ltd, Hobart, Australia.

ICES (2017). SISP Manual of International Baltic Acoustic Surveys (IBAS). Series of ICES Survey Protocols SISP 8 – IBAS. 47pp.

ICES (2015). Report of the Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT). ICES CM 2015 / SSGIEOM: 18

## 6. Acknowledgements

I hereby thank the crew of FRV “Solea” and Captain S. Meier as well as all participants for their outstanding cooperation and commitment that facilitated the successful accomplishment of this survey.

(Dr. M. Schaber, TI-SF / Scientist in charge)

## Figures

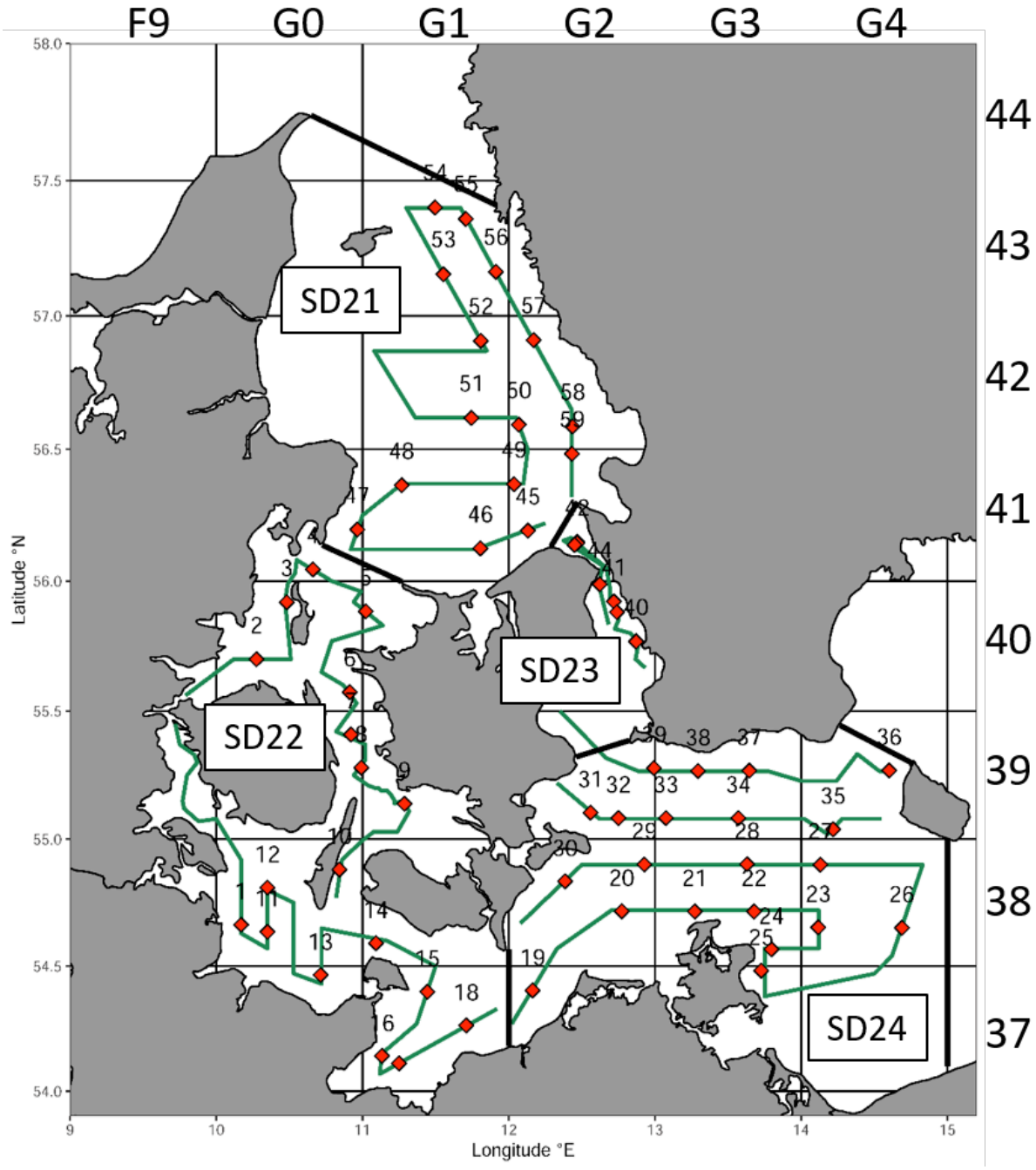


**Figure 1:** FRV "Solea" cruise 754/2018. Cruise track (dark green lines) and fishery hauls (red diamonds). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

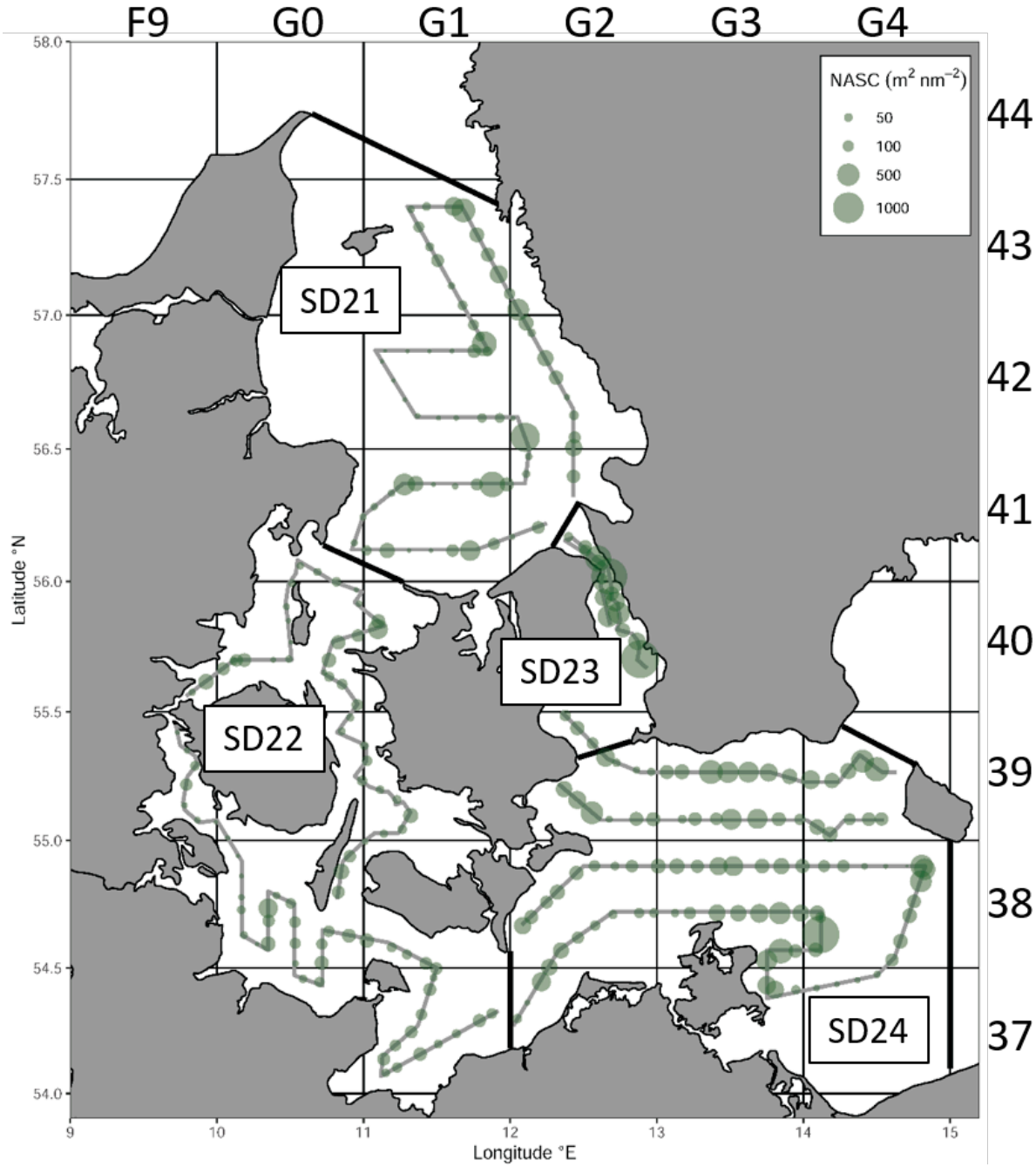


**Figure 2:** FRV "Solea" cruise 754/2018. Cruise track (thin grey lines) and mean NASC (5 nmi intervals, dots). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

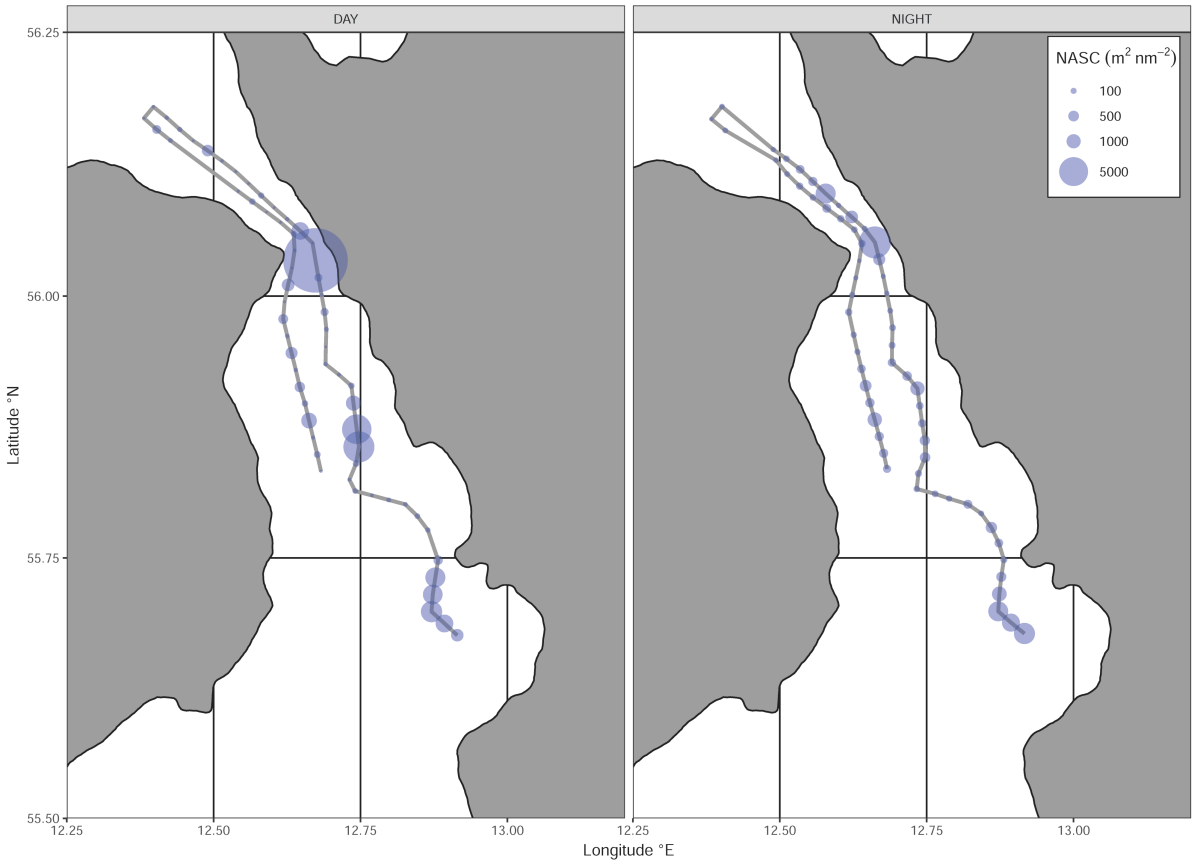


**Figure 3:** FRV "Solea" cruise 754/2018. Cruise track (thin grey lines) and mean NASC (5 nmi intervals, dots) measured during a daytime (left) and nighttime (right) comparison of clupeid distribution/abundance in the Sound (SD 23).

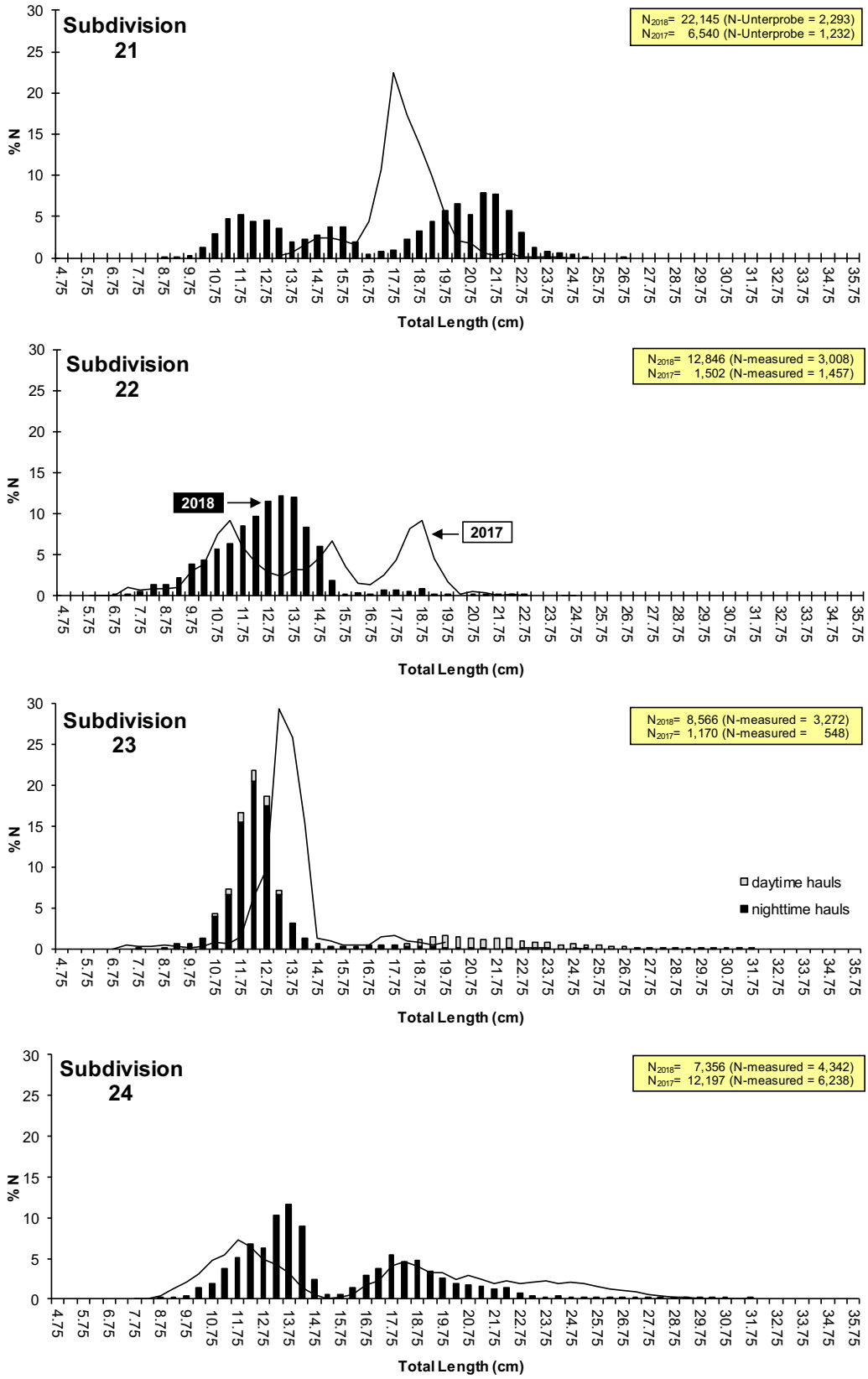


**Figure 4:** FRV "Solea" cruise 754/2018. Herring (*Clupea harengus*) length-frequency distribution (bars) compared to previous year (cruise 740/2017, lines). Daytime comparison hauls conducted in SD 23 are included.

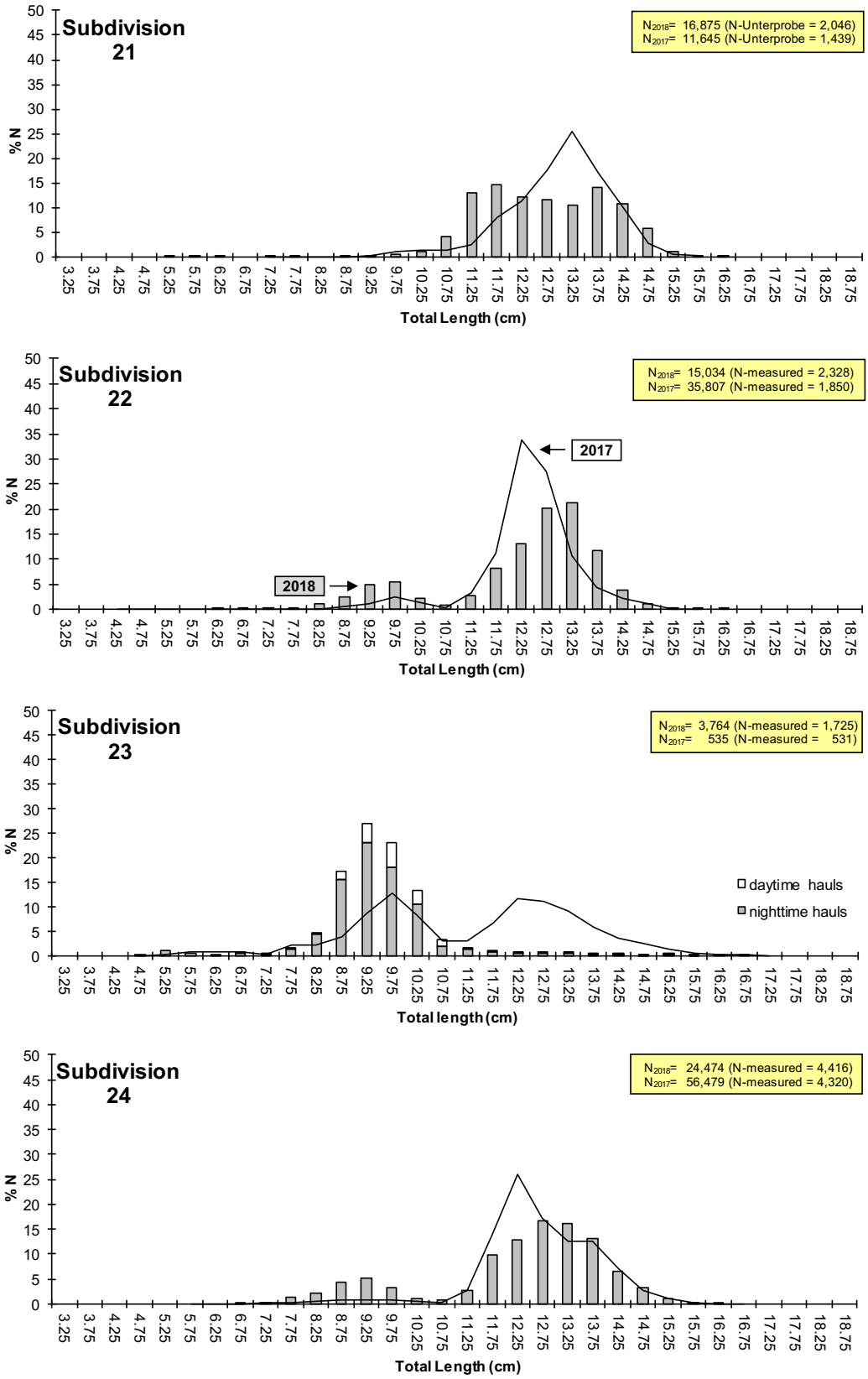


**Figure 5:** FRV "Solea" cruise 754/2018. Sprat (*Sprattus sprattus*) length-frequency distribution (bars) compared to previous year (cruise 740/2017, lines). Daytime comparison hauls conducted in SD 23 are included.

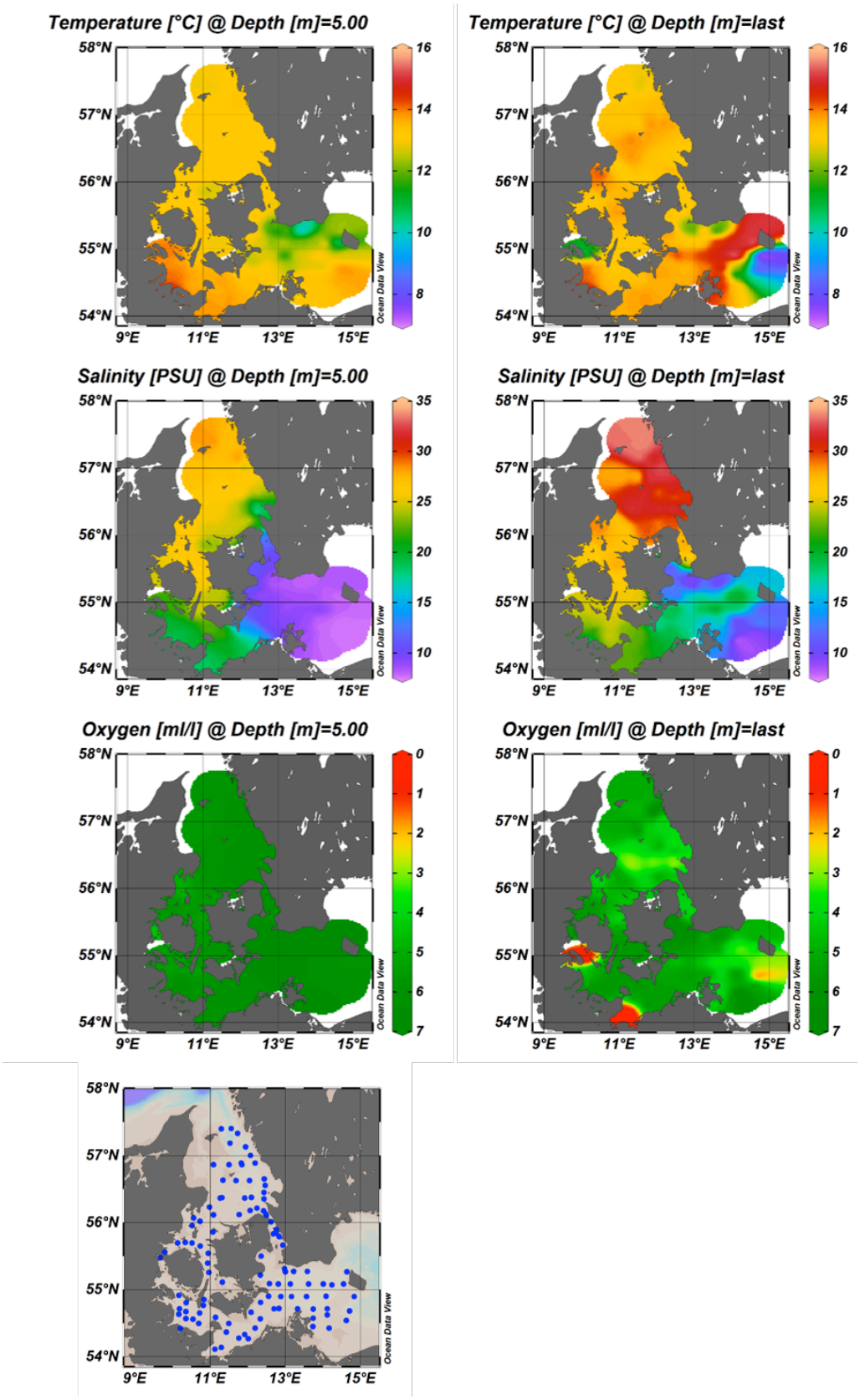


**Figure 6:** FRV "Solea" cruise 754/2018: Hydrography. CTD stations are depicted as blue dots in the area map (lower panel). Temperature (°C, top panels), salinity (PSU, middle panels and oxygen concentration (ml/l, lower panels) near the surface (left) and near the seafloor (right).

# Tables

**Table 1:** FRV "Solea" cruise 754/2018: Catch composition (kg 0.5 $h^{-1}$) by haul in SD 21.

| Haul No. | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 53 | 54 | 55 | 56 | 57 | 58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 41G2 | 41G1 | 41G0 | 41G1 | 41G2 | 42G2 | 42G1 | 43G1 | 43G1 | 43G1 | 43G1 | 42G2 | 42G2 |
| APHIA MINUTA | | | 0.02 | | 0.01 | | + | + | + | 0.01 | 0.01 | + | 0.01 |
| BELONE BELONE | | | | | | 0.09 | 0.04 | | 0.09 | 0.04 | | | |
| CARCINUS | | | | | | | | | 0.01 | + | | + | |
| CLUPEA HARENGUS | 0.86 | 773.09 | 0.10 | 40.81 | 0.51 | 12.76 | 1.48 | 0.54 | 30.40 | 9.53 | 31.81 | 0.62 | 5.32 |
| ENGRAULIS ENCRASICOLUS | | | | 0.14 | 0.54 | 0.02 | 2.08 | 0.02 | 0.77 | 1.38 | | 0.04 | 0.01 |
| EUTRIGLA GURNARDUS | | | | 0.12 | | | + | | | + | | | |
| GASTEROSTEUS ACULEATUS | | 0.01 | | | + | + | + | | 0.01 | | | | |
| LIMANDA LIMANDA | | | | 0.24 | | | | | | | | | |
| LOLIGO | 0.03 | | | 0.01 | 0.04 | 0.01 | | | | 0.02 | | 0.03 | 0.02 |
| LOLIGO FORBESI | | | | 0.01 | | + | 0.05 | 0.01 | + | 0.22 | 0.01 | 0.01 | |
| MERLANGIUS MERLANGUS | | 0.15 | | 0.15 | | 0.12 | 0.30 | | 0.18 | 0.46 | | 0.01 | 0.52 |
| MERLUCCIUS MERLUCCIUS | | | | | | | | 0.01 | | 0.01 | | | |
| MULLUS SURMULETUS | | | | | | | | | | 0.01 | | | |
| POLLACHIUS VIRENS | | | | 1.04 | | | | | | | | | |
| POMATOSCHISTUS MINUTUS | | | + | | | | | + | + | + | | + | + |
| SARDINA PILCHARDUS | | 0.07 | | 0.07 | | 0.02 | | | 0.03 | 1.26 | 0.20 | | 0.30 |
| SCOMBER SCOMBRUS | | 3.51 | 0.23 | 1.18 | 0.59 | | 1.98 | 11.99 | 0.28 | 0.22 | 0.17 | 3.19 | 2.83 |
| SEPIOLA | | | | | | | | + | | 0.05 | 0.01 | + | |
| SPRATTUS SPRATTUS | | 114.26 | 0.05 | 92.57 | 0.08 | 0.10 | 2.32 | 0.01 | 0.21 | 4.33 | 14.41 | 0.56 | 32.28 |
| SQUALUS ACANTHIAS | | | | | | | | | | 12.28 | 1.70 | | |
| TRACHINUS DRACO | 0.03 | 1.52 | | 4.82 | | 0.39 | 2.53 | 0.11 | 0.18 | 0.08 | 0.04 | 0.28 | 0.37 |
| TRACHURUS TRACHURUS | | 0.02 | + | 0.10 | 0.39 | + | + | 0.03 | 0.04 | 0.28 | 0.08 | 0.12 | 0.06 |
| TRISOPTERUS ESMARKI | | | | | | | | | 0.01 | 0.10 | | | |
| TRISOPTERUS MINUTUS | | | | | | | | | | 0.08 | | | |
| **Total** | **0.92** | **892.63** | **0.40** | **141.26** | **2.16** | **13.51** | **10.78** | **12.72** | **32.21** | **30.36** | **48.44** | **4.86** | **41.72** |
| **Medusae** | 0.47 | 0.00 | 7.07 | 1.06 | 0.31 | 0.41 | 0.23 | 0.15 | 3.28 | 1.05 | 1.33 | 0.18 | 2.27 |

Haul 52 not valid

| Haul No. | 59 | Total |
|---|---|---|
| Species/ICES Rectangle | 41G2 | |
| APHIA MINUTA | 0.01 | **0.07** |
| BELONE BELONE | | **0.26** |
| CARCINUS | | **0.01** |
| CLUPEA HARENGUS | 6.59 | **914.42** |
| ENGRAULIS ENCRASICOLUS | | **5.00** |
| EUTRIGLA GURNARDUS | | **0.12** |
| GASTEROSTEUS ACULEATUS | + | **0.02** |
| LIMANDA LIMANDA | 0.05 | **0.29** |
| LOLIGO | + | **0.16** |
| LOLIGO FORBESI | | **0.31** |
| MERLANGIUS MERLANGUS | 0.12 | **2.01** |
| MERLUCCIUS MERLUCCIUS | 0.00 | **0.02** |
| MULLUS SURMULETUS | | **0.01** |
| POLLACHIUS VIRENS | | **1.04** |
| POMATOSCHISTUS MINUTUS | | **+** |
| SARDINA PILCHARDUS | 0.02 | **1.97** |
| SCOMBER SCOMBRUS | | **26.17** |
| SEPIOLA | | **0.06** |
| SPRATTUS SPRATTUS | 4.13 | **265.31** |
| SQUALUS ACANTHIAS | | **13.98** |
| TRACHINUS DRACO | 0.29 | **10.64** |
| TRACHURUS TRACHURUS | 0.44 | **1.56** |
| TRISOPTERUS ESMARKI | | **0.11** |
| TRISOPTERUS MINUTUS | | **0.08** |
| **Total** | **11.65** | **1243.62** |
| **Medusae** | 3.81 | 21.61 |

+ = < 0.01 kg

**Table 2:** FRV "Solea" cruise 754/2018: Catch composition (kg 0.5 $h^{-1}$) by haul in SD 22.

| Haul No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 38G0 | 40G0 | 40G0 | 41G0 | 40G1 | 40G0 | 39G0 | 39G0 | 39G1 | 38G0 | 38G0 | 38G0 | 37G0 |
| APHIA MINUTA | | + | + | 0.01 | + | 0.01 | 0.04 | | 0.01 | + | | + | + |
| BELONE BELONE | 0.03 | | | | 0.05 | 0.09 | 0.05 | 0.13 | 0.05 | 0.18 | | | |
| CLUPEA HARENGUS | 0.86 | 0.44 | 0.79 | 0.91 | 0.81 | | 2.08 | 103.78 | | 6.58 | 4.62 | 0.42 | 10.25 |
| CRANGON CRANGON | | | + | | | | + | | 0.01 | + | | | |
| CTENOLABRUS RUPESTRIS | | | 0.02 | | 0.01 | | 0.05 | | 0.23 | | | | 0.02 |
| CYCLOPTERUS LUMPUS | 0.07 | | | | | | | | | 0.71 | | | |
| ENGRAULIS ENCRASICOLUS | + | | 0.15 | 0.60 | 0.12 | | 0.06 | 0.19 | 0.02 | | | | 0.03 |
| EUTRIGLA GURNARDUS | | | | | | | | 0.03 | | | | | |
| GADUS MORHUA | | | | | | | | | 0.04 | 0.30 | | | |
| GASTEROSTEUS ACULEATUS | 0.15 | 0.08 | | + | | | + | | 5.50 | 0.01 | 1.00 | 0.17 | + |
| GOBIUS NIGER | | | 0.01 | + | + | | + | | 0.02 | | | | |
| LIMANDA LIMANDA | | | 0.37 | 0.01 | 0.01 | | 0.02 | 0.13 | 0.03 | 0.22 | | | 0.13 |
| LOLIGO | | | | | | | + | | | | | | |
| LOLIGO FORBESI | + | | + | 0.01 | | | + | | | | | | |
| MERLANGIUS MERLANGUS | 0.02 | | 0.01 | 0.12 | 0.08 | | 0.02 | 0.36 | | 0.02 | | 0.02 | 0.01 |
| MULLUS SURMULETUS | | | 0.01 | 0.01 | | | | | | | | | |
| NEOGOBIUS MELANOSTOMUS | | | | | 0.01 | | | | 0.01 | | | | |
| PLATICHTHYS FLESUS | | | | | | | | | | | | | |
| PLEURONECTES PLATESSA | | | | | | | | 0.44 | | | | | |
| POLLACHIUS VIRENS | | | | | | | | | | 3.94 | | | |
| POMATOSCHISTUS MINUTUS | | | + | | 0.01 | | + | | 0.01 | | | + | |
| PUNGITIUS PUNGITIUS | | | | | | | | | + | | | | |
| SARDINA PILCHARDUS | | | | | | | | 0.16 | | | | | 0.01 |
| SCOMBER SCOMBRUS | | | | | | | | 1.90 | | | | | 0.04 |
| SOLEA VULGARIS | | | | | | | | | | 0.71 | 0.26 | | |
| SPRATTUS SPRATTUS | 0.29 | 0.75 | 0.06 | 0.03 | 0.04 | | 0.25 | 134.79 | | 8.30 | 13.81 | | 22.97 |
| SYMPHODUS MELOPS | | | | | | | | 0.01 | | | | | |
| SYNGNATHUS TYPHLE | | | | | | | | | + | | | | |
| TRACHINUS DRACO | | | | 0.12 | 0.19 | | | | | | | | |
| TRACHURUS TRACHURUS | | 0.01 | 0.01 | 0.08 | 0.02 | 0.01 | 0.06 | 0.28 | 0.06 | 0.01 | + | | 0.09 |
| TRISOPTERUS ESMARKI | + | | | | | | | | | | | | |
| TRISOPTERUS MINUTUS | | | | | | | | | | + | | | |
| **Total** | **1.42** | **1.28** | **1.43** | **1.90** | **1.35** | **0.11** | **2.63** | **242.20** | **5.99** | **20.98** | **19.69** | **0.61** | **33.55** |
| **Medusae** | 14.44 | 43.12 | 4.86 | 3.67 | 1.93 | 2.81 | 2.31 | 3.01 | 2.62 | 3.20 | 7.63 | 12.26 | 16.77 |

| Haul No. | 14 | 15 | 16 | 17 | 18 | Total |
|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 38G1 | 37G1 | 37G1 | 37G1 | 37G1 | |
| APHIA MINUTA | + | | + | | + | **0.07** |
| BELONE BELONE | | | 0.09 | | | **0.67** |
| CLUPEA HARENGUS | 14.03 | 4.25 | 2.39 | 8.23 | 7.04 | **167.48** |
| CRANGON CRANGON | | + | | | | **0.01** |
| CTENOLABRUS RUPESTRIS | + | | | | 0.01 | **0.34** |
| CYCLOPTERUS LUMPUS | | | | | | **0.78** |
| ENGRAULIS ENCRASICOLUS | | | | | 0.03 | **1.20** |
| EUTRIGLA GURNARDUS | | | | 0.01 | | **0.04** |
| GADUS MORHUA | | 0.38 | 2.13 | | | **2.85** |
| GASTEROSTEUS ACULEATUS | 0.05 | | 0.04 | 0.58 | 0.17 | **7.75** |
| GOBIUS NIGER | | | | | | **0.03** |
| LIMANDA LIMANDA | 0.67 | 19.80 | | 0.08 | 0.92 | **22.39** |
| LOLIGO | | | | | | **+** |
| LOLIGO FORBESI | | | | | | **0.01** |
| MERLANGIUS MERLANGUS | 0.04 | 2.54 | | 0.08 | 0.40 | **3.72** |
| MULLUS SURMULETUS | | | | | | **0.02** |
| NEOGOBIUS MELANOSTOMUS | | | | | | **0.02** |
| PLATICHTHYS FLESUS | | 0.48 | 0.47 | | 0.33 | **1.28** |
| PLEURONECTES PLATESSA | 0.45 | 1.15 | | 0.18 | | **2.22** |
| POLLACHIUS VIRENS | | | | | | **3.94** |
| POMATOSCHISTUS MINUTUS | + | | | + | | **0.02** |
| PUNGITIUS PUNGITIUS | | | | | | **+** |
| SARDINA PILCHARDUS | | 0.02 | | | | **0.19** |
| SCOMBER SCOMBRUS | 0.04 | 0.10 | | | | **2.08** |
| SOLEA VULGARIS | | | | | | **0.97** |
| SPRATTUS SPRATTUS | 4.41 | 13.03 | 0.34 | 0.10 | 2.58 | **201.75** |
| SYMPHODUS MELOPS | | | | | | **0.01** |
| SYNGNATHUS TYPHLE | | | | | | **+** |
| TRACHINUS DRACO | | | | | | **0.31** |
| TRACHURUS TRACHURUS | 0.01 | | 0.02 | 0.06 | 1.36 | **2.08** |
| TRISOPTERUS ESMARKI | | | | | | **+** |
| TRISOPTERUS MINUTUS | | | | | | **+** |
| **Total** | **19.70** | **41.75** | **5.48** | **9.32** | **12.84** | **422.23** |
| **Medusae** | 7.02 | 5.09 | 2.80 | 8.85 | 10.89 | 153.29 |

+ = < 0.01 kg

**Table 3:** FRV "Solea" cruise 754/2018: Catch composition (kg 0.5 $h^{-1}$) by haul in SD 23.

| Haul No. | 40 | 41 | 42 | 43 | 44 | *60 | *61 | *62 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 40G2 | 40G2 | 41G2 | 41G2 | 40G2 | 40G2 | 40G2 | 41G2 | |
| APHIA MINUTA | 0.14 | 0.08 | 0.03 | 0.03 | 0.01 | + | | + | **0.29** |
| CLUPEA HARENGUS | 4.31 | 9.52 | 14.98 | 38.02 | 12.60 | 0.51 | 95.03 | 2.48 | **177.45** |
| CRANGON CRANGON | + | | + | | | | | | **+** |
| CTENOLABRUS RUPESTRIS | | + | | | | | | | **+** |
| ENGRAULIS ENCRASICOLUS | 0.01 | | 0.01 | | | + | 0.03 | | **0.05** |
| EUTRIGLA GURNARDUS | | | + | 0.24 | | | | | **0.24** |
| GADUS MORHUA | 4.77 | 29.29 | | | 9.29 | | 3.70 | | **47.05** |
| GASTEROSTEUS ACULEATUS | + | 0.06 | 0.03 | + | 0.01 | | 0.02 | | **0.12** |
| LEANDER | + | | + | | | | | | **+** |
| LIMANDA LIMANDA | | | 0.72 | 1.77 | | | | | **2.49** |
| LOLIGO | | | + | | | | + | 0.38 | **0.38** |
| MERLANGIUS MERLANGUS | 0.11 | 0.04 | 0.09 | 1.31 | 11.57 | 0.06 | | | **13.18** |
| PLATICHTHYS FLESUS | 0.43 | | | | | | | | **0.43** |
| PLEURONECTES PLATESSA | | | | | 0.40 | | | | **0.40** |
| POMATOSCHISTUS MINUTUS | + | + | | + | + | | | | **+** |
| PSETTA MAXIMA | | | | 0.54 | | | | | **0.54** |
| SARDINA PILCHARDUS | 0.01 | 0.01 | | | 0.14 | + | 0.03 | + | **0.19** |
| SEPIOLA | | | | 0.02 | | | | | **0.02** |
| SPRATTUS SPRATTUS | 9.82 | 0.32 | 1.62 | 3.08 | 3.93 | 2.26 | 1.60 | 0.35 | **22.98** |
| TRACHINUS DRACO | | | 0.05 | 0.37 | 0.07 | | | | **0.49** |
| TRACHURUS TRACHURUS | + | 0.03 | 0.02 | 0.64 | 0.02 | | 0.23 | 0.01 | **0.95** |
| TRISOPTERUS ESMARKI | | + | | | | | | | **+** |
| **Total** | **19.60** | **39.35** | **17.55** | **46.02** | **38.04** | **2.83** | **100.64** | **3.22** | **267.25** |
| **Medusae** | 0.23 | 0.83 | 0.75 | 0.13 | 0.51 | 4.31 | 0.15 | 0.58 | **7.49** |

+ = < 0.01 kg

**Table 4:** FRV "Solea" cruise 754/2018: Catch composition (kg 0.5 $h^{-1}$) by haul in SD 24.

| Haul No. | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 37G2 | 38G2 | 38G3 | 38G3 | 38G4 | 38G3 | 37G3 | 38G4 | 38G4 | 38G3 | 38G2 | 38G2 | 39G2 |
| APHIA MINUTA | + | | | | | + | | | | | | + | + |
| BELONE BELONE | | | | | 0.19 | | | | | | | | |
| CLUPEA HARENGUS | 2.51 | 0.80 | 1.45 | 1.07 | 1.33 | 4.78 | 8.12 | 33.12 | 4.51 | 8.95 | 0.95 | 1.24 | 2.02 |
| CRANGON CRANGON | | + | + | + | | | | + | | + | | | + |
| CYCLOPTERUS LUMPUS | | | | | | | | | | | 0.13 | 0.47 | |
| ENGRAULIS ENCRASICOLUS | | | + | | | | | | | | | | 0.03 |
| GADUS MORHUA | 0.20 | 0.11 | 2.02 | 1.91 | 5.43 | 28.19 | 8.98 | 7.20 | 0.42 | 0.74 | | | 0.01 |
| GASTEROSTEUS ACULEATUS | | 0.47 | 0.19 | 0.02 | | | | + | 0.12 | 0.03 | 2.22 | 1.13 | 1.00 |
| GOBIUS NIGER | | | | | | | | | | | + | | + |
| LIMANDA LIMANDA | 1.42 | 0.08 | | 0.31 | | | | | | | | | |
| MERLANGIUS MERLANGUS | 0.09 | 1.11 | 0.70 | 10.44 | | 110.99 | 15.61 | | 0.46 | 3.46 | | 0.02 | + |
| MYOXOCEPHALUS SCORPIUS | | | | | | | | | | + | | | |
| NEOGOBIUS MELANOSTOMUS | | | | | | | | | | | | | + |
| PLATICHTHYS FLESUS | | 0.16 | 0.64 | 1.27 | | 4.45 | 2.34 | 0.21 | | 0.46 | | | |
| PLEURONECTES PLATESSA | | 1.61 | 1.25 | | | 0.28 | | 0.22 | | 0.55 | | | |
| POMATOSCHISTUS MINUTUS | | + | 0.02 | + | | + | 0.01 | + | | 0.01 | + | + | 0.02 |
| PUNGITIUS PUNGITIUS | | | + | | | | | | | | | | |
| SCOMBER SCOMBRUS | | | | | | 0.55 | | | | | | | |
| SCOPHTHALMUS RHOMBUS | 0.55 | | | | | | | | | | | | |
| SPRATTUS SPRATTUS | 5.57 | 0.39 | 11.78 | 77.20 | 56.20 | 4.62 | 4.37 | 13.78 | 4.53 | 20.99 | 0.01 | 0.71 | 0.16 |
| STIZOSTEDION LUCIOPERCA | | | | | | 0.71 | 1.27 | | | | | | |
| TRACHURUS TRACHURUS | 0.09 | 0.21 | 0.11 | 0.11 | | 0.15 | 0.02 | 0.04 | | 0.01 | | | + |
| **Total** | **10.43** | **4.94** | **18.16** | **92.33** | **63.15** | **154.72** | **40.72** | **54.57** | **10.04** | **35.20** | **3.31** | **3.57** | **3.24** |
| **Medusae** | 1.64 | 16.14 | 4.95 | 1.97 | 64.22 | 2.13 | 2.18 | 2.64 | 18.35 | 4.51 | 10.93 | 16.19 | 3.62 |

Haul 31 not valid

| Haul No. | 33 | 34 | 35 | 36 | 37 | 38 | 39 | Total |
|---|---|---|---|---|---|---|---|---|
| Species/ICES Rectangle | 39G3 | 39G3 | 39G4 | 39G4 | 39G3 | 39G3 | 39G2 | |
| APHIA MINUTA | + | + | | | | | + | **+** |
| BELONE BELONE | | | | | | | | **0.19** |
| CLUPEA HARENGUS | 5.27 | 13.03 | 7.49 | 17.44 | 15.63 | 12.40 | 50.41 | **192.52** |
| CRANGON CRANGON | + | | + | | | | | **+** |
| CYCLOPTERUS LUMPUS | | 0.79 | | | | | | **1.39** |
| ENGRAULIS ENCRASICOLUS | 0.04 | | | | 0.02 | | | **0.09** |
| GADUS MORHUA | 3.81 | 1.36 | 1.00 | | 10.07 | 5.30 | | **76.75** |
| GASTEROSTEUS ACULEATUS | 0.13 | 0.12 | 0.02 | 0.09 | | 0.01 | | **5.55** |
| GOBIUS NIGER | | | | | | | | **+** |
| LIMANDA LIMANDA | | | | | | | | **1.81** |
| MERLANGIUS MERLANGUS | 0.01 | 1.66 | 1.08 | 0.24 | 0.12 | 0.29 | | **146.28** |
| MYOXOCEPHALUS SCORPIUS | | | | | | | | **+** |
| NEOGOBIUS MELANOSTOMUS | | | | | | | | **+** |
| PLATICHTHYS FLESUS | | 0.26 | | | | | + | **9.79** |
| PLEURONECTES PLATESSA | | | | | | | | **3.91** |
| POMATOSCHISTUS MINUTUS | 0.01 | | + | | + | + | 0.01 | **0.08** |
| PUNGITIUS PUNGITIUS | | | | | | | | **+** |
| SCOMBER SCOMBRUS | | | | | | | | **0.55** |
| SCOPHTHALMUS RHOMBUS | | | | | | | | **0.55** |
| SPRATTUS SPRATTUS | 0.32 | 25.63 | 2.47 | 21.42 | 3.41 | 11.66 | 28.12 | **293.34** |
| STIZOSTEDION LUCIOPERCA | | | | | | | | **1.98** |
| TRACHURUS TRACHURUS | 0.01 | + | | | | | | **0.75** |
| **Total** | **9.60** | **42.85** | **12.06** | **39.19** | **29.25** | **29.66** | **78.54** | **735.53** |
| **Medusae** | 1.30 | 0.54 | 2.79 | 0.63 | 4.55 | 3.94 | 1.60 | **164.80** |

+ = < 0.01 kg