DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2022 DK”

Gifico Pelagic | Fiskeri AB Ginneton

Danmarks Pelagiske Producentorganisation

DTU Aqua
Section for Monitoring and Data Hirtshals

Kai Wieland

26-07-2022

Vessel: F/V Ceton S205

Cruise dates (planned): 10 days in the period 28/6 – 11/7 2022

Participants

Scientific team (DTU Aqua, Section for Monitoring and Data, Hirtshals):

Kai Wieland (Cruise leader),
Per Christensen,
Kasper Schaltz

Fishing vessel Ceton S205 (Gifico Aps):

Johannes Claeson (Skipper) and crew

Objectives

The main objective of the IESSNS (International Ecosystem Summer Survey in the Nordic Seas) is to estimate mackerel abundance per age class, but also CTD and plankton samples are being collected. The survey is carried out during July and a special designed gear, the Multipelt 832 pelagic trawl with Dynema warps, is used to catch the mackerel. The trawl fishery takes place at a combination of fixed and non-fixed stations located along transects, and fishing depth is form surface to about 30 – 35 m depth.
Even though the importance of the IESSNS survey for the mackerel assessment has recently increased, one criticism of the survey that has been raised several times is that the survey does not cover the southern edge distribution. Only samples taken north of 60° N are included in the index, thus the entire North Sea, Waters around the British Isles and the Bay of Biscay are not sampled. There are two reasons for that. First, the survey is designed and performed by Norway, Iceland, Faeroes and Greenland with focus on their waters. Secondly, there is concern to what extend the survey design are applicable in more shallow areas like the North Sea. The reason for this concern is the absence of a thermocline in the southern and shallower waters, which is dividing the water column into a warmer upper layer and a colder deeper layer. The presence of a thermocline in the northern waters (at around 30 m depth) is believed to limit the habitat of the mackerel, as the fish are unlikely to cross the thermocline and dive into the cold deeper waters. If such a thermocline is not present the depth range of the mackerel south of 60°N may extend beyond the layer fished by the trawl
Despite the concern about the applicability of the survey design south of 60°N, there appears to be a potential in expanding the survey as this might improve the index, especially for the younger year classes which are expected to be located more southerly than older and larger individuals.

With this background, Denmark joined the IESSNS in 2018 using a commercial vessel to investigate whether the applied methods in the IESSNS would also work for the North Sea. Based on the positive results from 2018, 2019, 2020 and 2021, the survey was conducted again in 2022 using the new fishing vessel F/V Ceton. The methods were the same as in the previous years except for a slightly changed layout of the sampling locations.

Itinerary (local time)

3/7 06:00 Loading of scientific equipment in Hirtshals,
06:30 Departure from Hirtshals
09:45 Exchange fishing equipment in Skagen
18:15 Departure from Skagen
20:30 Start of the survey sampling (at station 1)

11/7 12:30 Survey sampling finished (at station 37)
12/7 02:45 Arrival Hirtshals,
03:00 Unloading of equipment and samples in Hirtshals
03:30 Storage of equipment and samples at DTU Aqua Hirtshals completed

Achievements

Eight transects between about 59°30' N and 54°00' N were covered in the Skagerrak and the northwestern North Sea (Fig. 1) with the following activities conducted:

- 34 CTD profiles with Sea-Bird SeacatPlus (down to 200 m or to about 5 m above bottom, prior to each fishing operation),
- 34 valid hauls with a Multipelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 7 m^2 Thyborøn type 15 doors.

4 of the planned stations (stations 2, 5, 31 and 38) had to be cancelled because the financial equivalent to the available research quota did only allow for an 8.7-day instead of the intended 10-day survey period.

Results

Sampling and gear performance

The survey was conducted with the new F/V Ceton (69.90 m length, 14 m width, max. draught 7.5 m) in 24 h operation covering almost equally all times of the day (Fig. 2). Tow duration measured from the time at which vessel speed and trawl geometry was stable until hauling back the warp was 30 min in all cases. So-called banana tows were conducted in which heading was constantly changed with a turn radius of 5 to 10° and a curvature between 80 and 120° in total. On average, warp length during towing was between 290 and 305 m with a difference between SB and BB of 5 - 10 m in general. Average depth of the SB and BB doors ranged from 6 - 15 m.

Position, course, speed and trawl geometry (from Marport sensors) were protocolled every 5 minutes. Towing speed over ground (SOG), vertical net opening and door spread ranged from 4.5 to 5.6 kn, 25 to 35 m and 126 to 137 m between the stations (Fig. 2) and amounted to 4.8 kn, 27 m and 140 m on average for all stations. There were some deviations from the survey manual (Wire length: 350 m; vertical net opening: 30 – 35 m; door spread: 120 m), and the attachment of the trawl to the doors should be checked in the beginning of the next year survey. The wider door spread, however, is accounted for through standardization of the catches by swept area and thus the focus was on achieving correct vertical opening and speed over ground as close as possible.

Bottom depth and distance of footrope to bottom were between 56 and 532 m and between 27 and 503 m during nominal tow duration. However, during setting the trawl, the footrope shortly came close to the bottom at the shallowest stations.

Horizontal trawl opening (Wingspread) calculated according to the equation from the IESSNS manual for an average towing speed of 5 kn based on flume tank simulations, i.e.

$$WS = 0.3959 * \text{Door spread} + 20.094,$$

ranged from 70 to 74 m. Towed distance was received from the fishing plotter based on the continuously recorded GPS positions during the tow and ranged between 4.3 and 5.1 km per banana tow. These values were used to compute swept area converting total catch (kg) to densities (kg/km^2) 19.3per tow for mackerel and herring.

Catches and species distribution

Mackerel was caught on all stations except for two stations off the Scottish coast. Most catches were below 500 kg and eight catches exceeded 1000 kg with the highest catch of 2.9 tons per tow (Fig. 3). Catches were relatively small in Scottish and English waters close to the coast and at the southwestern edge of the survey area. Mackerel catch of more 1 ton were wider distributed than in previous years occurring at 9 stations (Fig. 3). The total catch of mackerel amounted to 19.3 tons and average mackerel density was 1689 kg/km^2, which is considerably lower than in the previous year but higher than in 2020 and 2019 (Fig. 4).

Herring was mainly restricted to the north-western and eastern part of the survey area and scattered distributed the with maximum catches of 8.3 and 10.3 tons at two stations that were covered in the middle of the night (Fig. 5). The total catch of herring amounted to 20.7 tons and average density was 1970 kg/km^2.

Several other species were caught (Tab. 1) and it appears remarkable that classical demersal species such as grey gurnard, lumpfish and spurdog occurred in the surface layer catches even at deep stations and this was observed both during night and day. High catches of 0-group sandeel and the occurrence of 0-group haddock and whiting was observed mainly in the western and southern part of the survey area. In addition, 7.5 kg of 0-group fish (3 – 8 cm in length, presumably sprat or sardine, stations 18 and 25) were not identified to species level at sea, and a sample was taken for later morphological and genetic analysis in the laboratory.

Mackerel mean weight, length, and age distribution

Mackerel length was between 17 and 44 cm. Single fish weight was recorded for one specimen per cm group < 25 cm, two individuals between 25 and 30 cm and three individuals per cm group > 30 cm on each station as far as present. This yielded in a total number of observations of 802 individuals for a length-weight relationship (Fig. 6). The exponent of the length-weight relationship was 2.76, which is slightly lower than the values from the previous years (2018: 2.88, 2019: 2.94, 2020: 2.83, 2021: 2.90) indicating a somewhat poorer average condition of the larger / older mackerel this year.

Mean individual weight by station ranged from 127 to 407 g and was highest in the western and northwestern part of the survey area (Fig. 7). The lowest values were found in the eastern and southern part of the survey area.

The heads of each individual mackerel for which single fish length and weight was recorded were frozen on board for later otolith extraction in the lab. Ages 1* to 14 were identified in the single fish data of which fish at age 8 and older were pooled into a plus-group (Fig. 8). For 11 fish out of 35 individuals caught in the size range between 18 and 20 cm a first winter ring was not detectable. It appears, however, unlikely that these fish originated from the 2022 spawning, and they were thus combined with the 1-group.

No clear pattern is visible in the mackerel distribution by age group (ages 1*, 2, 3 and 4+; Fig. 9). However, the presence of small individuals (age 1) and the absence of large individuals (age 3 and age 4+ explains the differences in the distribution of mackerel mean weight (Fig. 7).

Overall, the length and age composition for the survey indicate a considerably lower amount of small (<28 cm, age 1) individuals this year whereas the abundance of older mackerel, notably age 2, was about the same than in the previous year (Fig. 10).

Temperature conditions

Sea surface temperature ranged from 12 to 18 °C with the highest vales in the eastern part of the survey area. A pronounced thermocline in the upper 20 m was found for most of the stations (Fig. 11). Only in the northwestern part of the survey area, i.e., off the Scottish coast, such strong stratification was missing. Below the thermocline, i.e., at depths > 40 m, temperature was between 7 and 8 °C.

Acknowledgements

Many thanks to skipper Johannes Claeson and his competent crew for the good atmosphere and very successful cooperation onboard. Further thanks to Claus Sparrevohn, 'Danmarks Pelagiske Producent Organisation' (DPPO), for organizational issues and logistics prior to the survey.

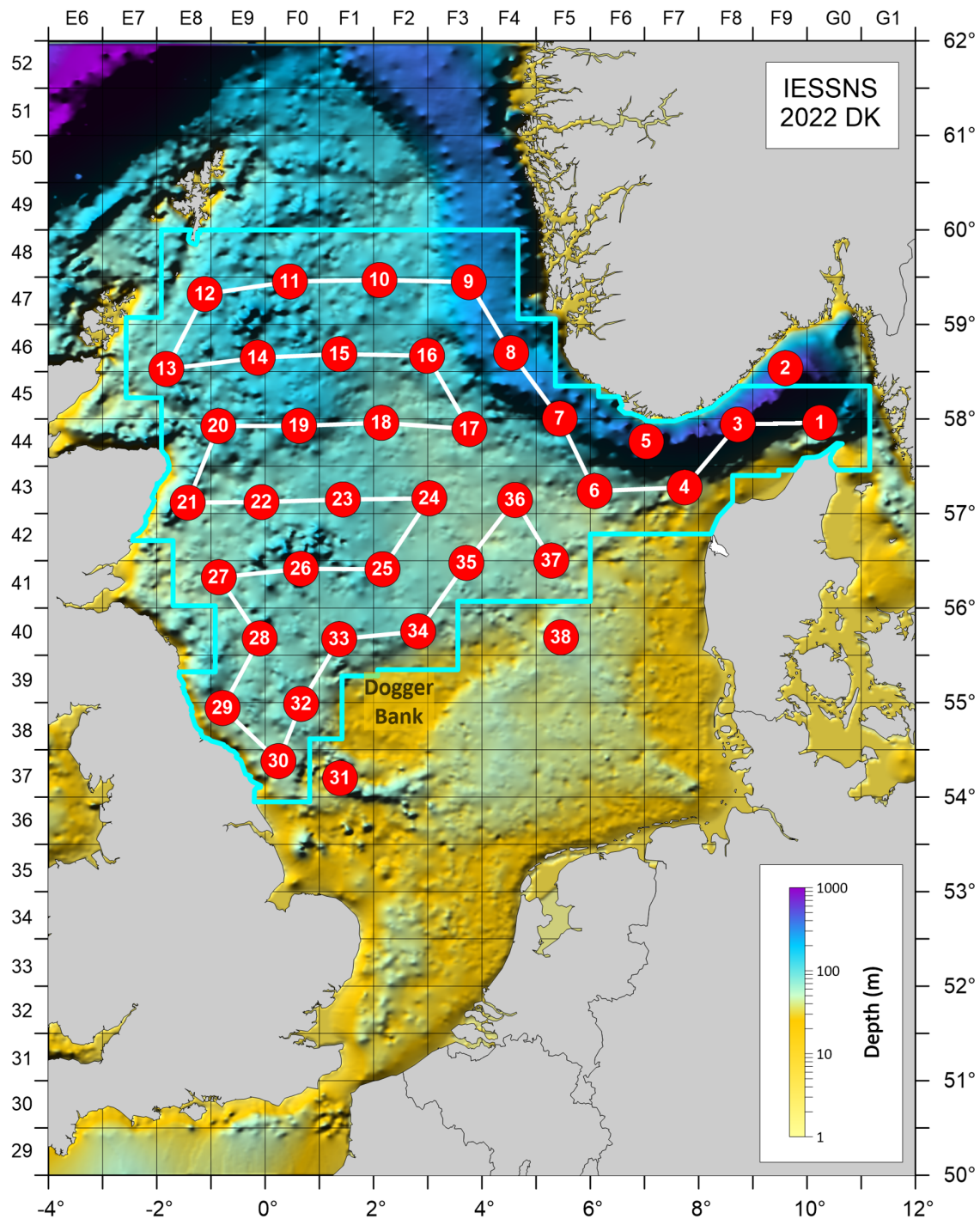

Fig. 1: Survey map with sampling locations and updated stratum limits for future surveys (core area: 279280 km^2).

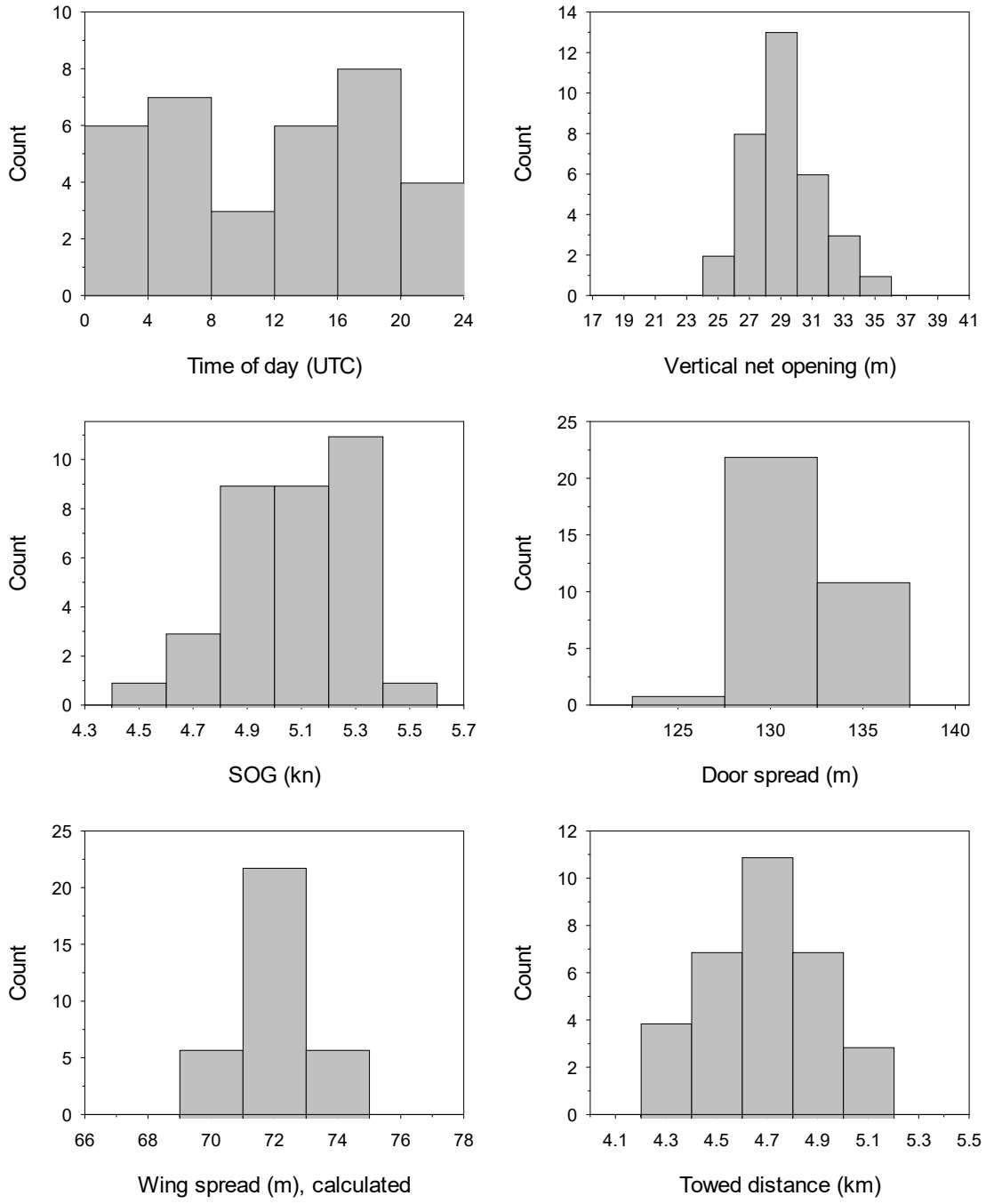

Fig 2: Times of day fished, vessel and gear performance (mean values by station).

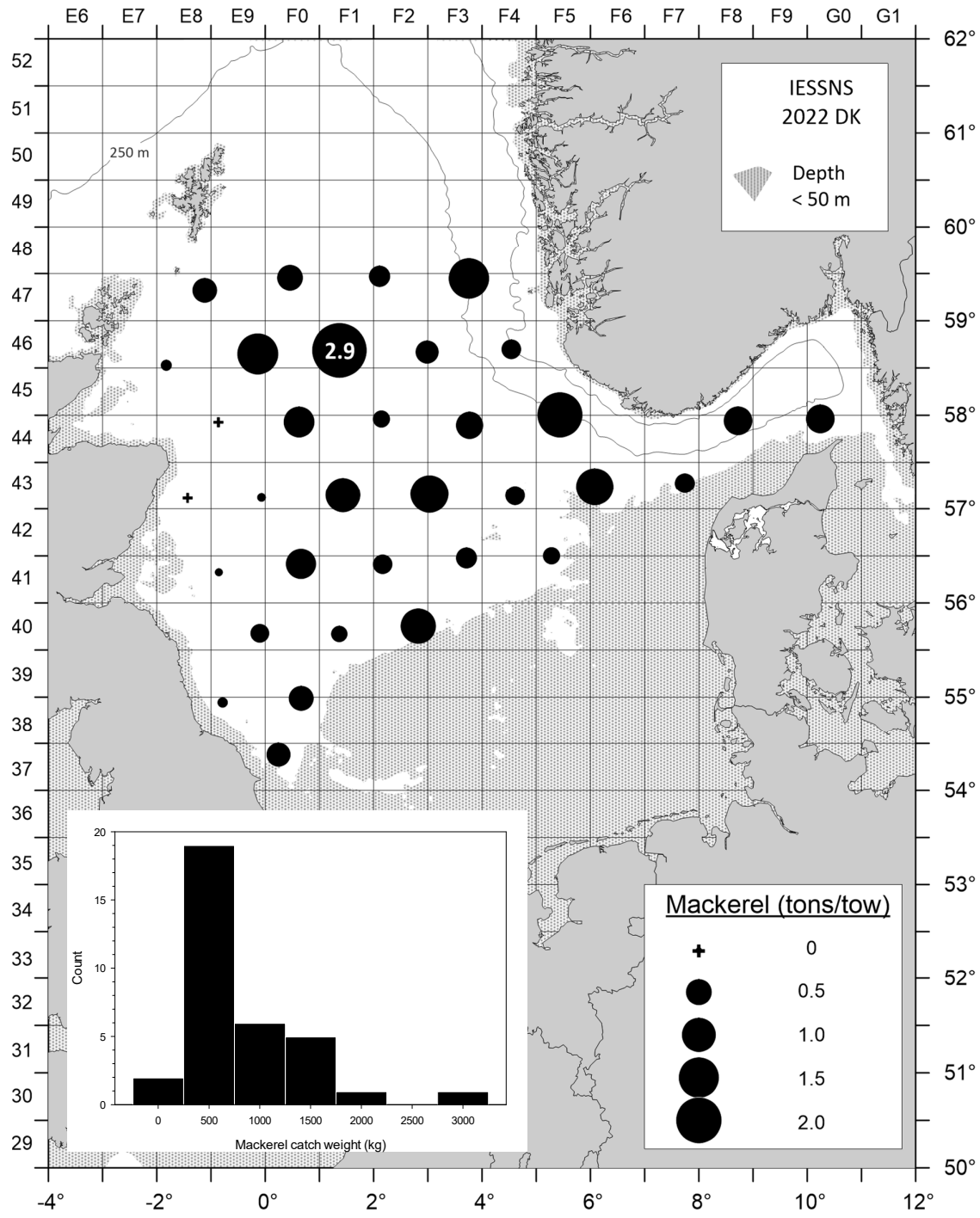

Fig. 3: Distribution of mackerel catches.

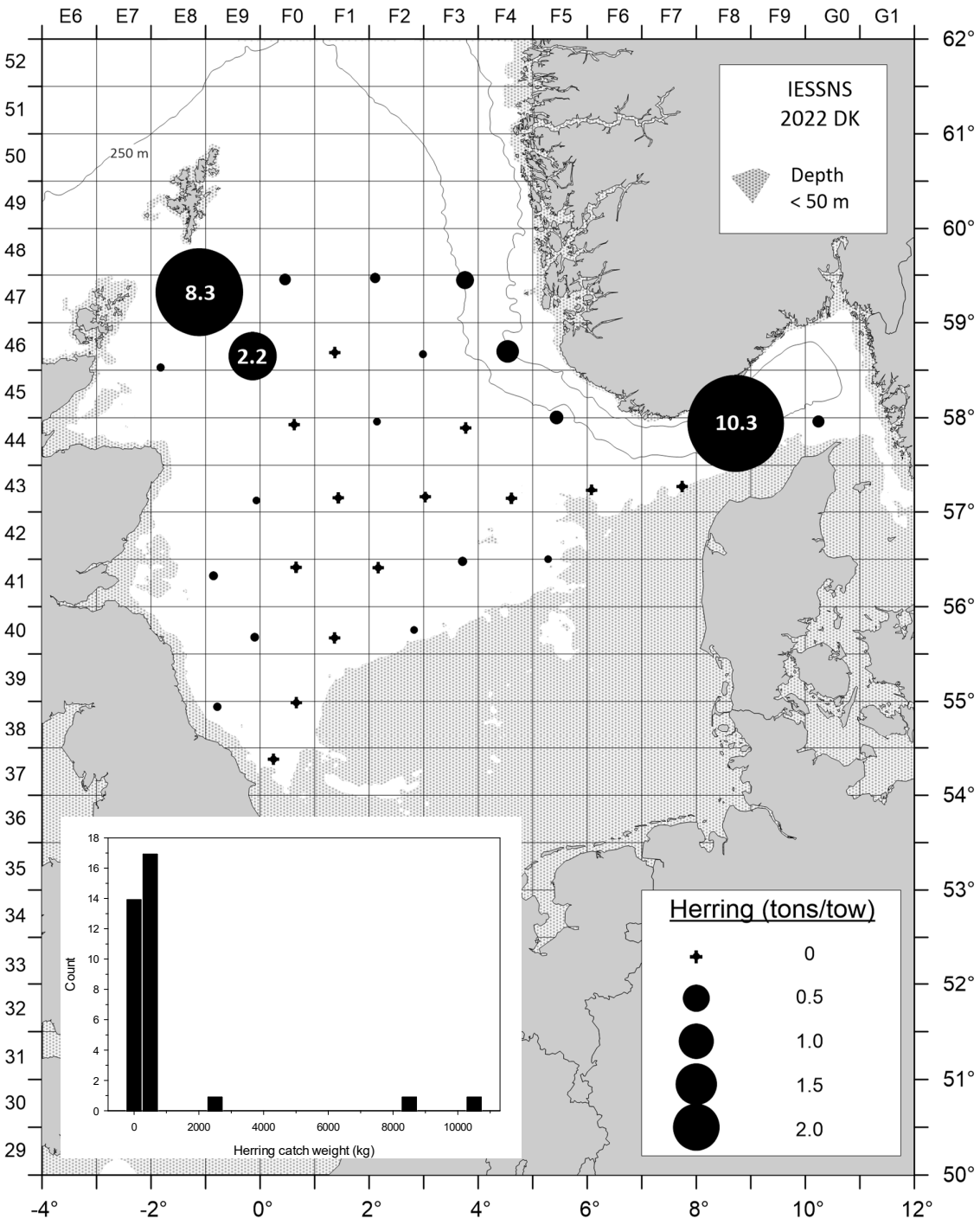

Fig. 4: Distribution of herring catches.

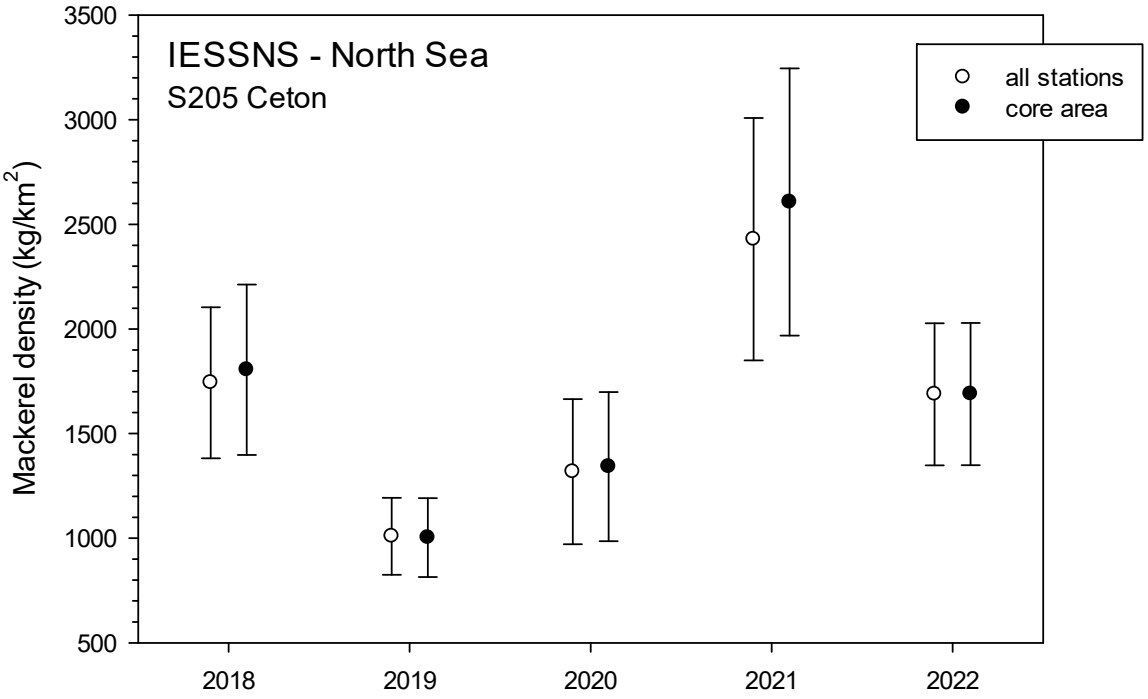

Fig. 5: Mackerel density (mean and standard error) in 2018 – 2022 (core area: stratum limits as shown in Fig. 1).

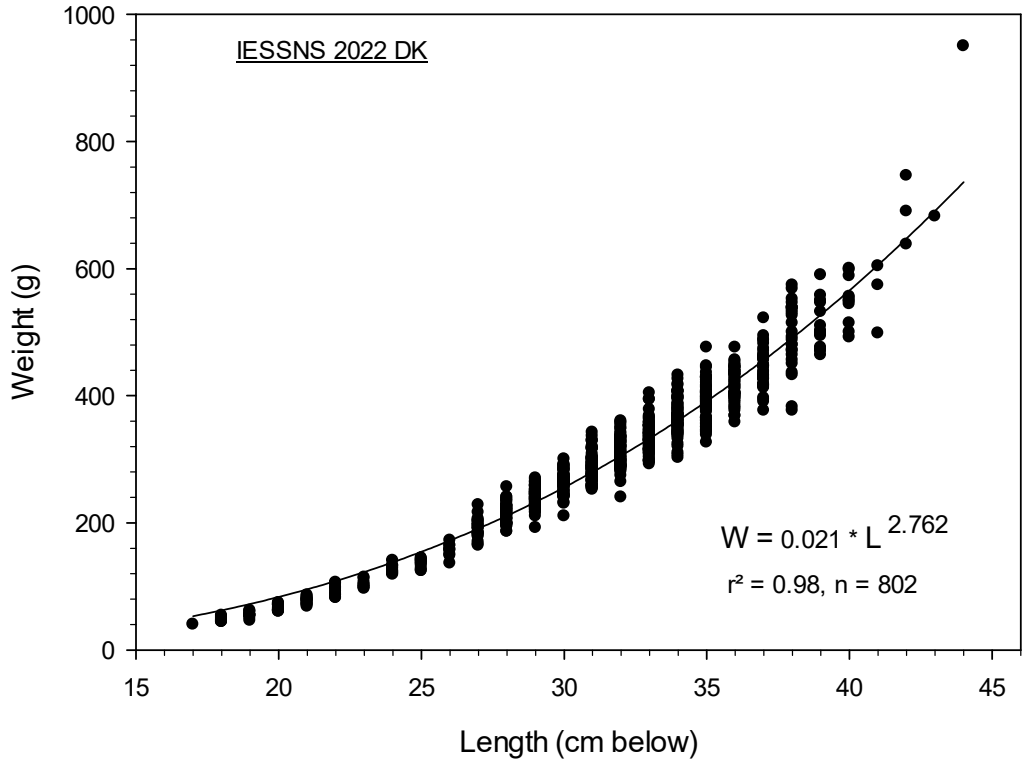

Fig. 6: Length-weight relationship for mackerel.

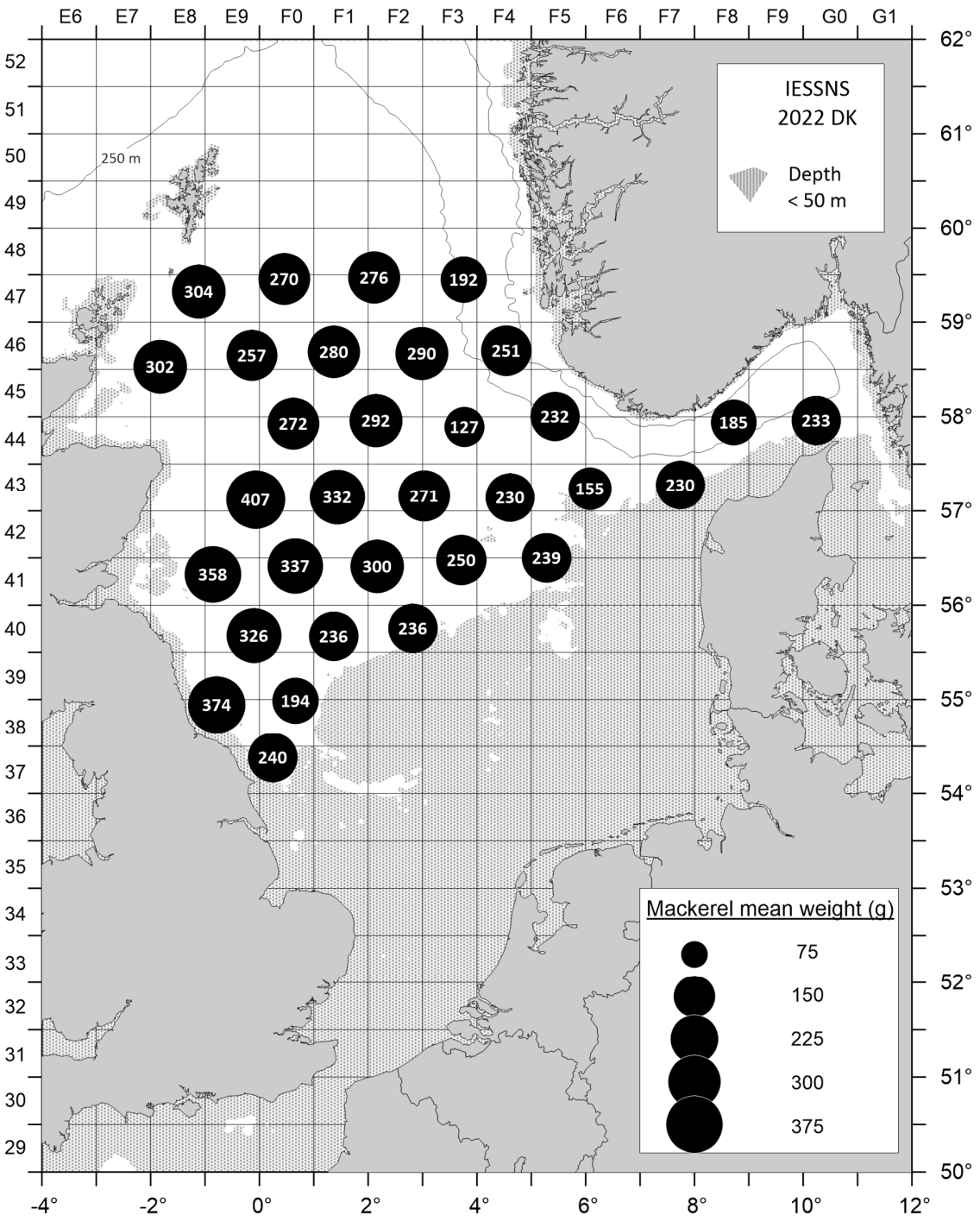

Fig. 7: Distribution of mean individual weight of mackerel.

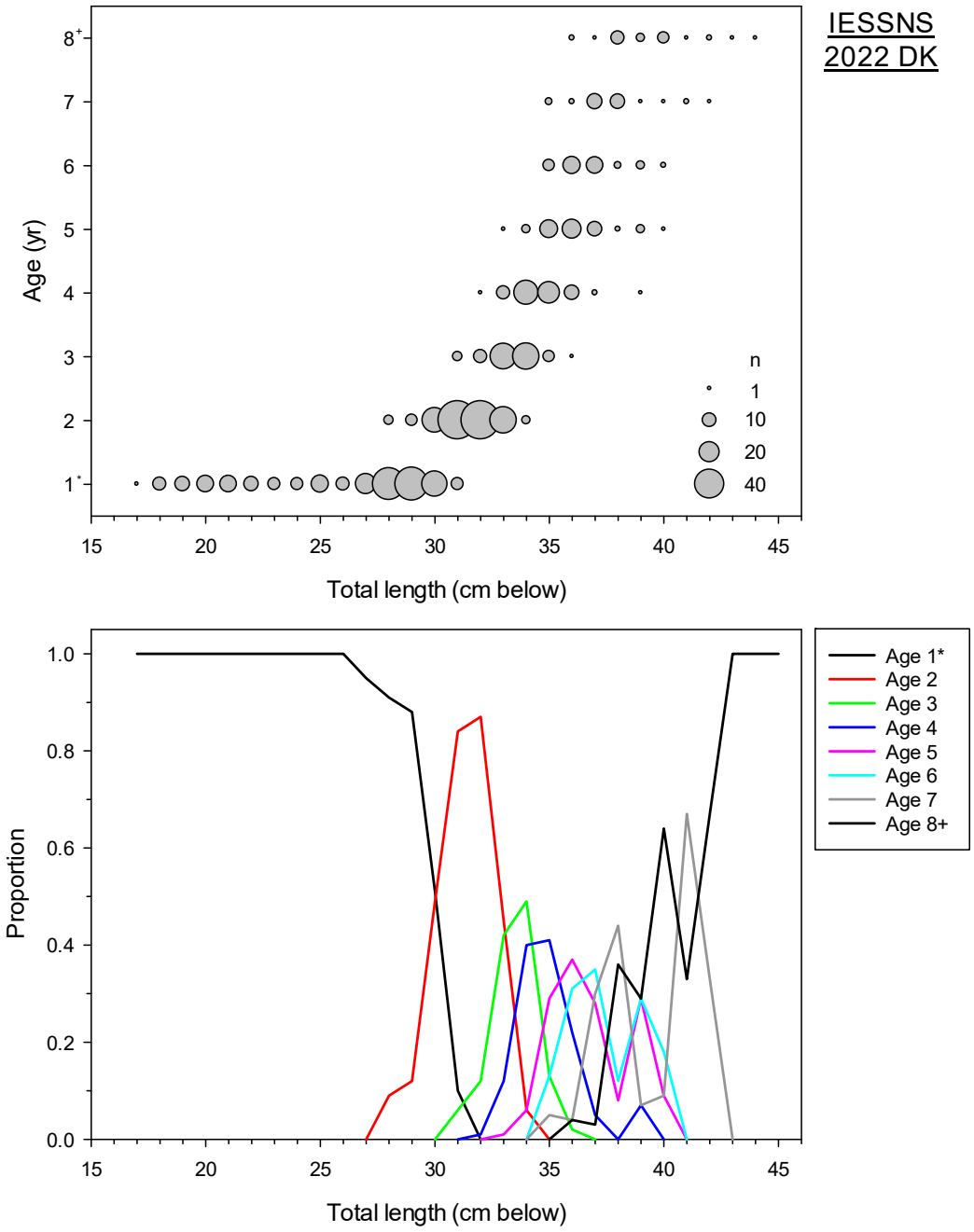

Fig. 8: Age-length key for mackerel (bubble size in upper panel refer to number of otoliths analyzed (n)).

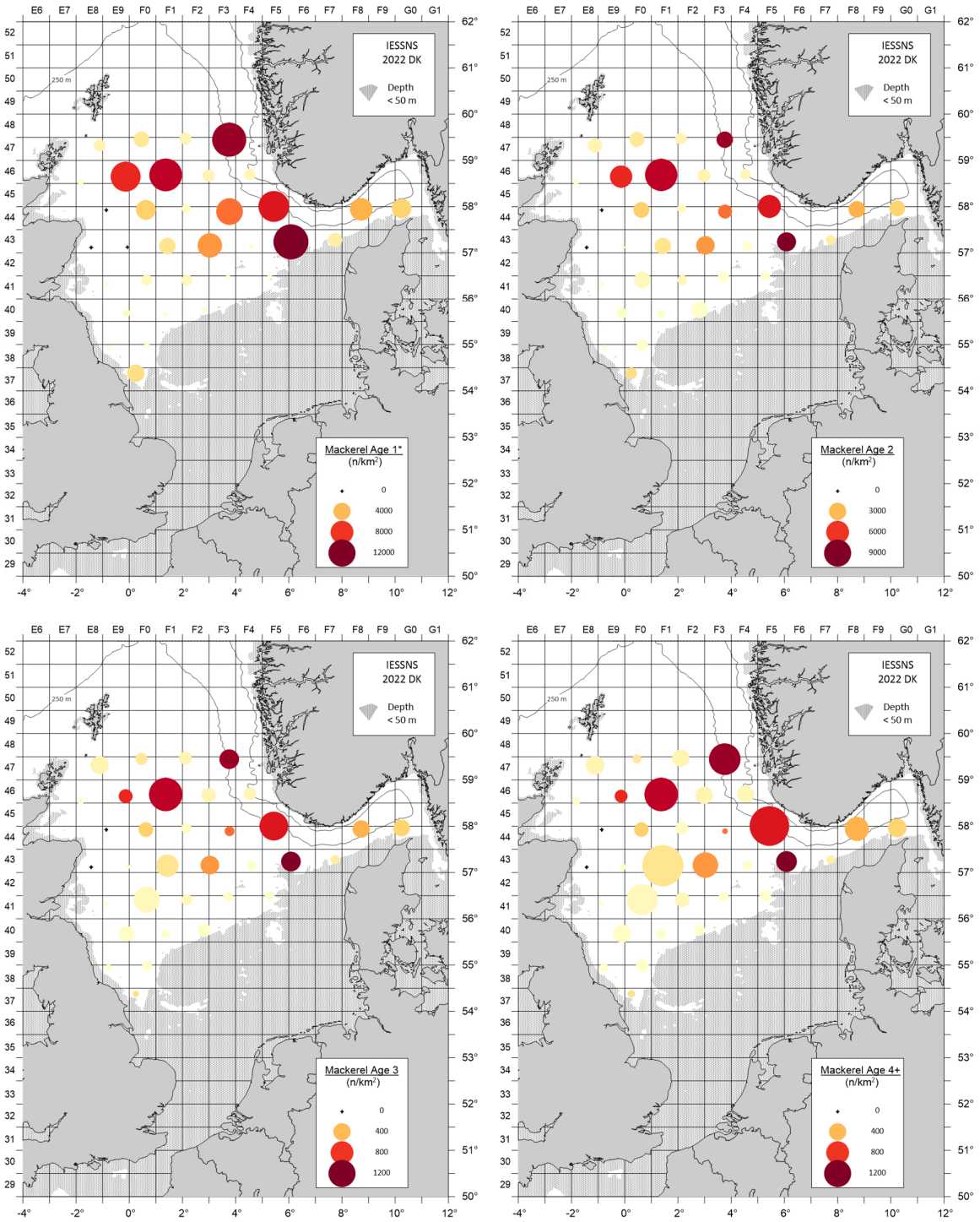

Fig. 9: Mackerel distribution by age.

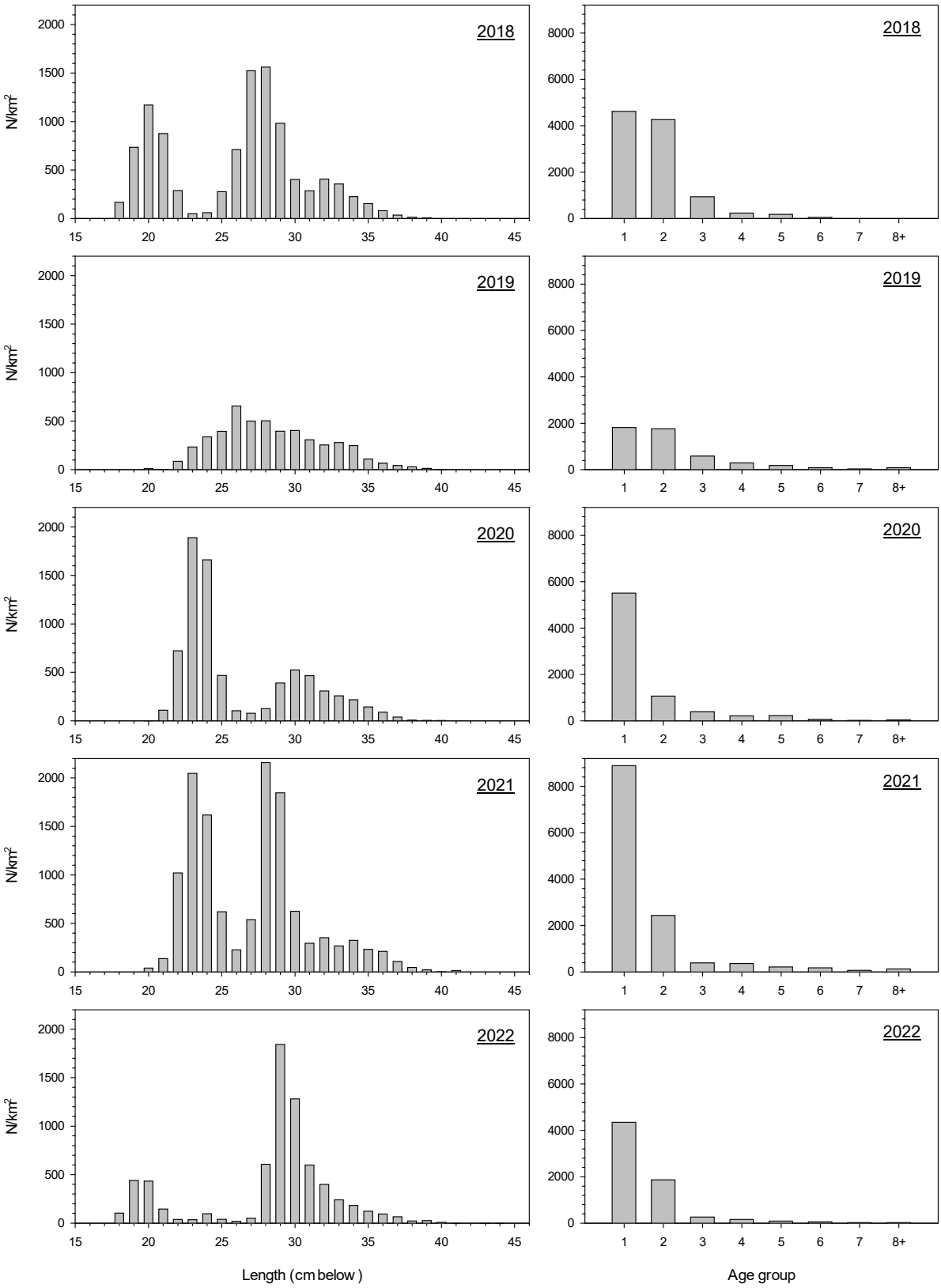

Fig. 10: Length and age composition of mackerel (based on all stations covered in the respective annual survey).

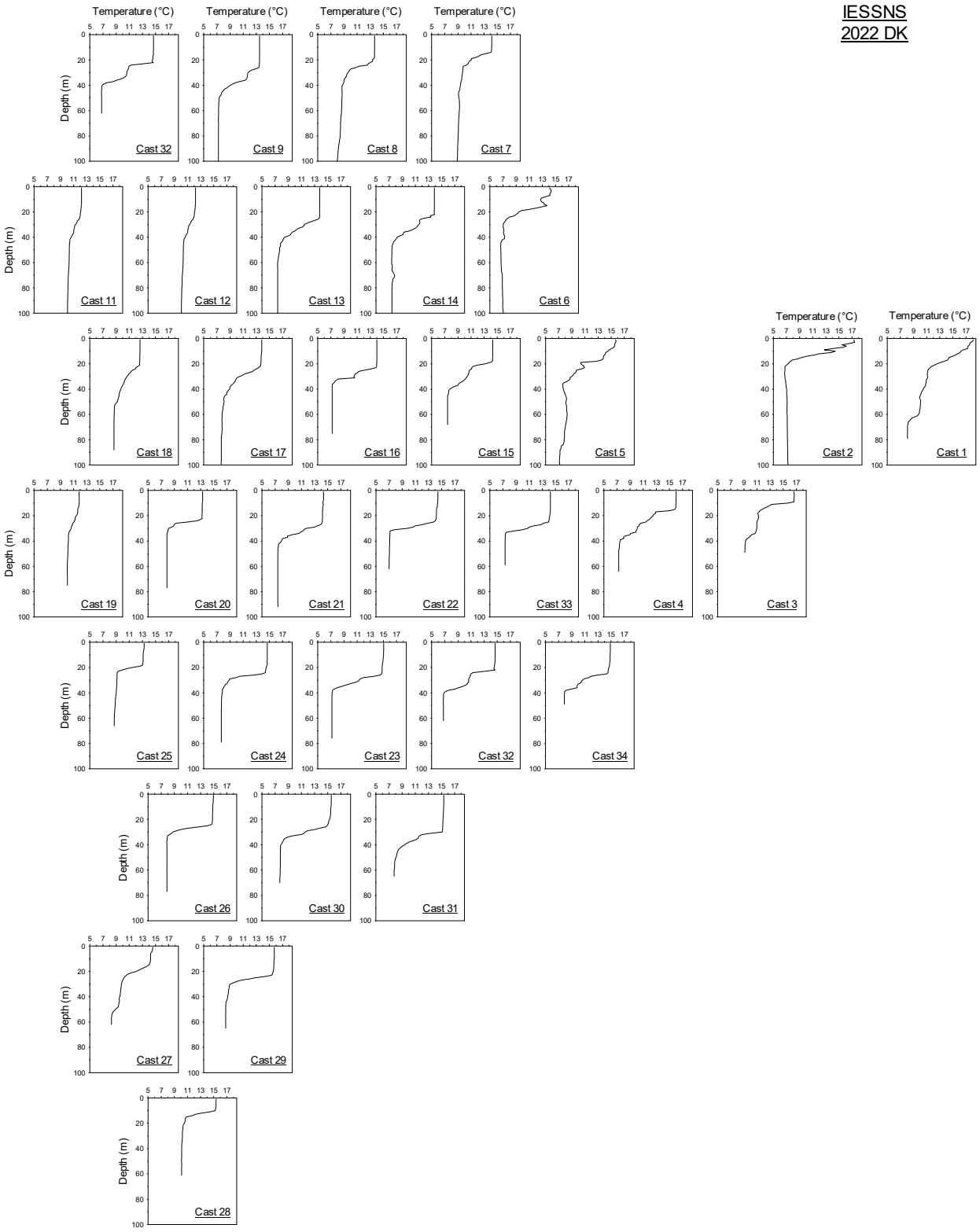

Fig. 11: Temperature conditions in the surface layer.

Tab. 1: Species list (L: total length in cm below (fish); ML: mantle length (cephalopods); St.: station number as in Fig. 1).

Latin name	Danish name	English name	Weight (kg)	Number	L_{min} (cm)	L_{max} (cm)	Remark
Clupea harengus	Sild	Herring	20739.627	159736	14	35	
Scomber scombrus	Makrel	Mackerel	19329.767	82075	17	44	
Sprattus sprattus	Brisling	Sprat	140.391	7905	10	14	mainly from one haul (St. 26, 130 kg)
Melanogrammus aeglefinus	Kuller	Haddock	80.581	425	5	37	0-group (six hauls) and adults (one haul)
Squalus acanthias	Pighaj	Spurdog	49.724	34	28	93	
Micromesistius poutassou	Blåhvilling	Blue whiting	41.867	752	17	24	from one haul at night (St. 8)
Eutrigla gurnardus	Grå knurhane	Grey gurnard	31.898	247	17	34	
Cyclopterus lumpus	Stenbider	Lumpfish	28.706	24	20	42	
Ammodytes marinus	Havtobis	Lesser sandeel	20.809	10601	5	10	0-group , from three hauls (St. 21, 22 and 27)
Belone belone	Hornfisk	Garfish	12.030	47	50	71	
Pollachius virens	Sej	Saithe	8.800	1	97	97	
Trachurus trachurus	Hestemakrel	Horse mackerel	7.621	21	30	36	
Merlangius merlangus	Hvilling	Whiting	3.711	1103	3	33	mainly 0-group, from six hauls
Sardina pilchardus	Sardin	Pilchard	3.564	29	20	26	
Trisopterus esmarkii	Sperling	Norway pout	1.828	1476	4	6	
Echiichthys vipera	Fjæsing lille	Lesser weever	1.800	76	10	15	
Illex coindetii		Southern shortfin squid	1.670	21	10	18	ML
Todaropsis eblanae		Lesser flying squid	0.784	4	12	19	ML
Trachinus draco	Fjæsing	Greater weever fish	0.570	3	23	34	
Gadus morhua	Torsk	Cod	0.064	27	4	7	0-group, from one haul (St. 1)

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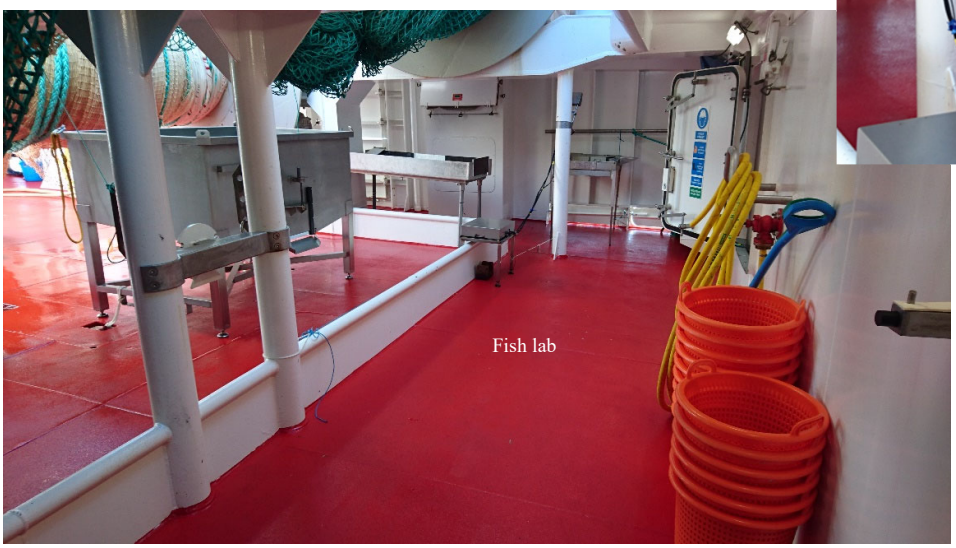
CTD deck


Fish lab

Bridge controls