DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2020 DK”

Danmarks Pelagiske Producentorganisation

DTU Aqua
Section for Monitoring and Data Hirtshals

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20-08-2020

Vessel: F/V Ceton S205

Cruise dates (planned): 29/6 – 10/7 2020

Cruise name: IESSNS 2020 DK

Participants

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

Kai Wieland (Cruise leader),
Per Christensen,
Søren Eskildsen

Fishing vessel Ceton S205 (Gifico Aps):

Jacob Claeson (Skipper)
and 5 crew members

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 then the depth range of the mackerel south of 60°N is larger extending 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 in order to investigate whether the applied methods in the IESSNS would also work for the North Sea. Based on the positive results from 2018 and 2019 the survey was conducted again in 2020 using the new fishing vessel F/V Ceton. The methods were the same as in the previous years except for but with a slightly changed layout of the sampling locations based on a request from the IESSNS coordinator.

Itinerary (local time)

29/6	10:30	Arrival of scientific team and loading of equipment in Skagen, Departure postponed due to administrative issues
1/7	12:45	Departure from Skagen
	15:30	Start of the survey sampling
9/7	22:00	Survey sampling completed (station 35)
10/7		Arrival Hirtshals, Unloading of equipment and samples

Achievements

Seven transects between about 59°45' N and 54°45' N were covered in the Skagerrak and the northwestern North Sea (Fig. 1) with the following activities conducted:

- 35 CTD profiles with Sea-Bird SeacatPlus (down 210 m or to about 5 m above bottom, prior to each fishing operation)
- 35 valid hauls with a Multipelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 7 m^2 Thyborøn type 15 doors.

One station was cancelled to catch up some time after the delayed departure, and station 12 was moved towards east because outstanding permission for UK waters at that time.

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 300 m with a difference between SB and BB of 5 - 10 m in general. Average depth of the SB and BB doors ranged from 4 - 16 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 4.0 to 5.3 kn, 24 to 39 m and 115 to 140 m between the stations (Fig. 2) and amounted to 4.8 kn, 31 m and 127 m on average for all stations. The low SOG recorded at a few stations was due to strong head currents.

Bottom depth and distance of footrope to bottom were between 59 and 530 m and between 31 and 496 m during nominal tow duration. However, during setting the trawl the footrope shortly touched 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 65 to 75 m. Towed distance was received from the fishing plotter based on the continuously recorded GPS positions during the tow and ranged between 3.7 and 4.9 km per banana tow. These values were used to compute swept area converting total catch (kg) to densities (kg/km^2) per tow for mackerel and herring.

Catches and species distribution

Mackerel was caught on all stations with total catch weights between 9 and 3484 kg per tow (Fig. 3). Highest catches were recorded in the northeastern part of the survey area whereas catches were small in English and Scottish coastal waters. The total catch of mackerel amounted to 14.2 tons and average mackerel density was 1318 kg/km^2 which is about 29 % higher than in 2019.

Herring was mainly restricted to the northern part of the survey area with a maximum catch of 5.0 tons (Fig. 4). The total catch of herring amounted to 16.6 tons and average density was 1499 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 sprat were occasionally recorded whereas the occurrence of 0-group haddock and whiting was observed more frequently, in particular in the western part of the survey area (Fig. 5).

Mackerel mean weight, length and age distribution

Mackerel length was between 19 and 43 cm. Single fish weight was recorded for one specimen per cm group ≤ 25 cm and two individuals per cm group > 25 cm on each station. This yielded in a total number of observations for 889 individuals (Fig. 6). The exponent of the length-weight relationship was 2.83, which is slightly lower than the values from the previous years (2018: 2.88, 2019: 2.94) indicating that mackerel condition has decreased a bit.

Mean individual weight by station was highest in the western and northwestern part of the survey area whereas the lowest values were found in the eastern part of the survey area and in particular in the Skagerrak (Fig. 7).

The mackerel heads of each individual for which single fish length and weight was recorded were frozen on board for later otolith extraction in the lab. Ages 1 to 16 were identified in the single fish data of which fish older than 9 years were pooled into a plus-group (Fig. 8). The length and age composition for the survey indicate a execptional high amount of small (≤ 25 cm, age 1) individuals this year whereas the abundance of mackerel older than age 2 was similar to the previous two years (Fig. 9).

Temperature conditions

Sea surface temperature ranged from 10.9 to 17.7 °C with the highest vales in the eastern part of the survey area. A pronounced thermocline in the upper 20 to 35 m was found for most of the stations (Fig. 10). Only in the western part of the survey area, i.e. off the Scottish and English coast, such strong stratification was missing. Below the thermocline, i.e. at depths > 40 m, temperature was between 7.1 and 9.0 °C.

Acknowledgements

Many thanks to skipper Jacob Claeson and his competent crew for the 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 and during the survey.

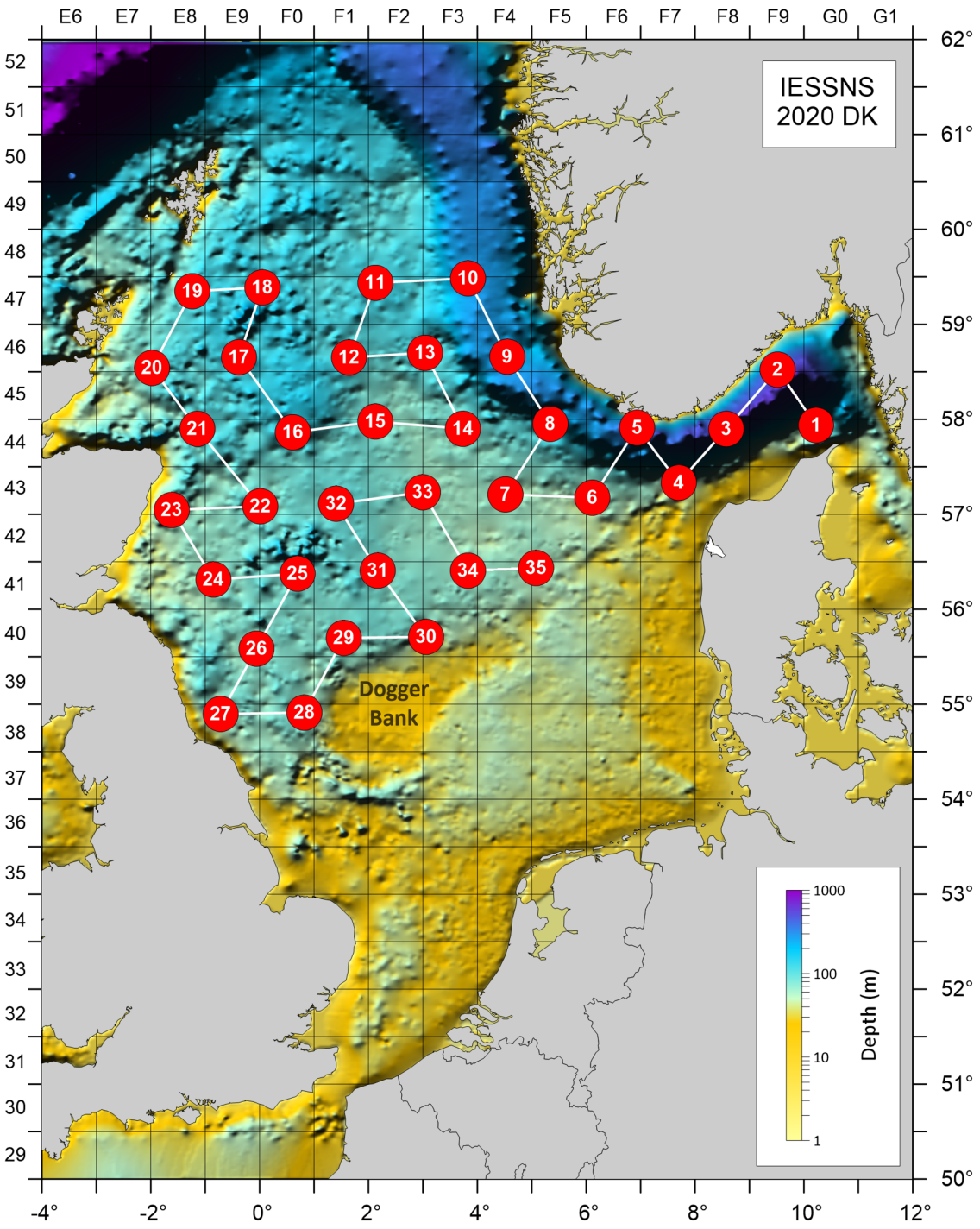

Fig. 1: Survey map with sampling locations.

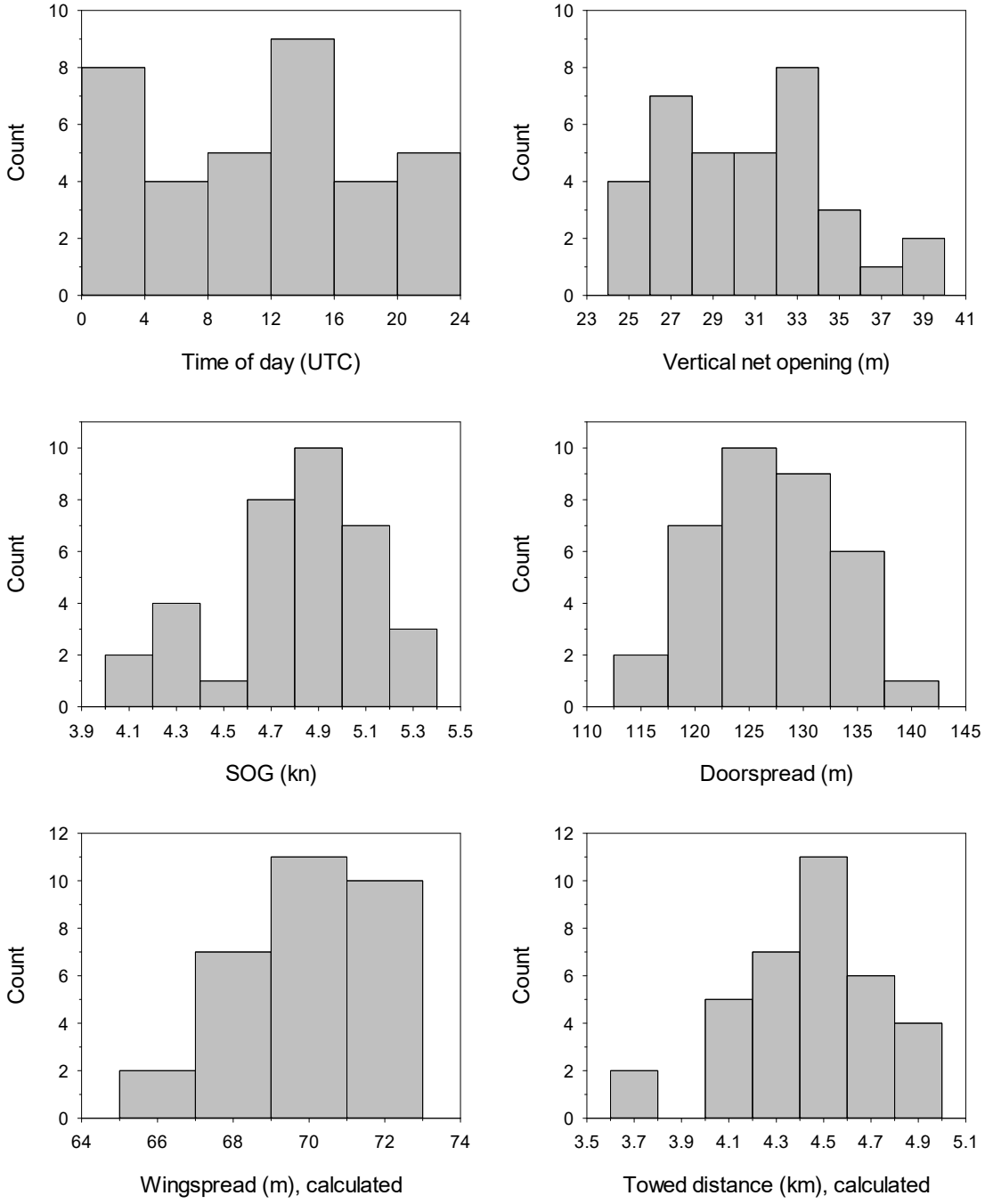

Fig 2: Times of day fished, vessel and gear performance (mean values by station).

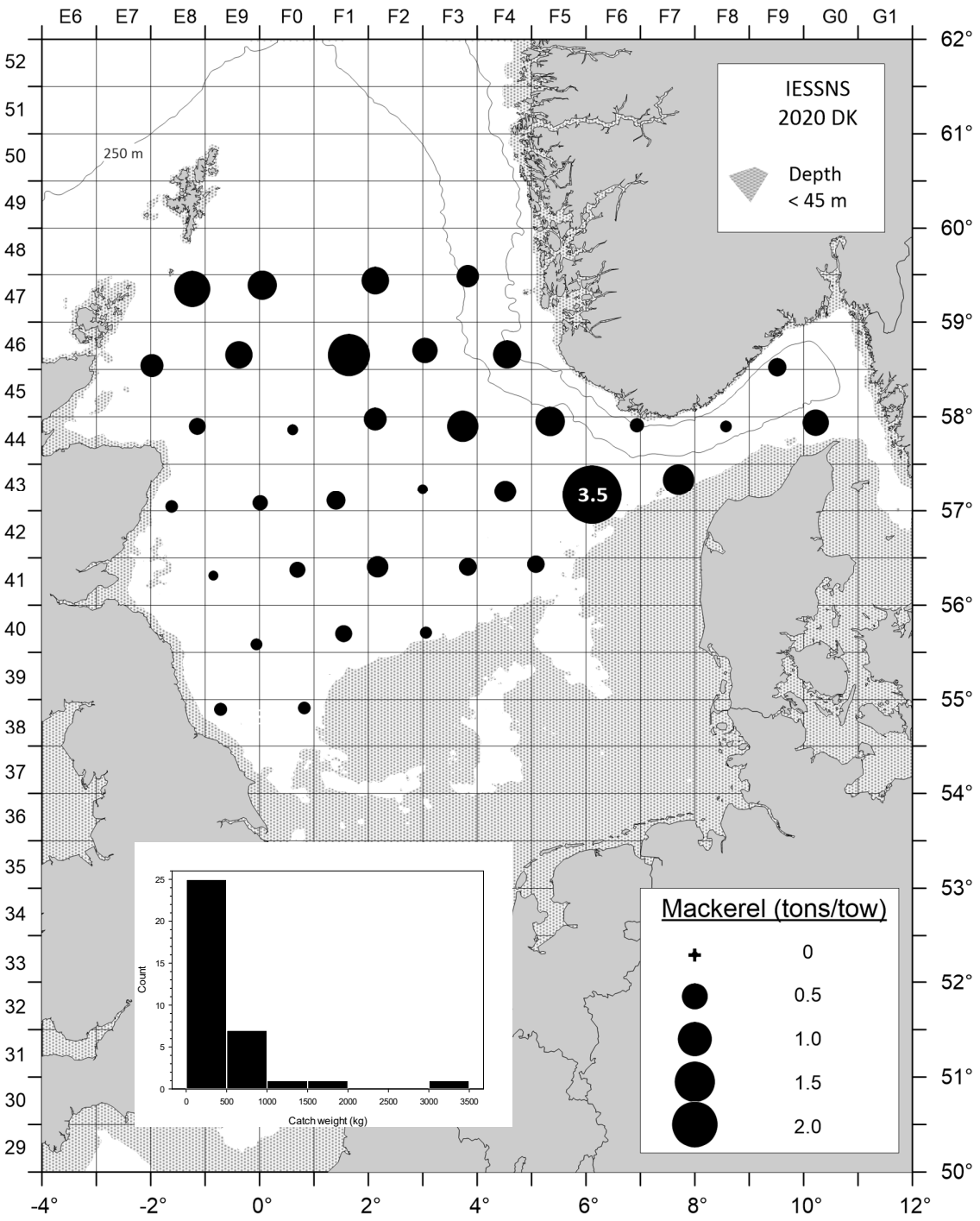

Fig. 3: Distribution of mackerel catches.

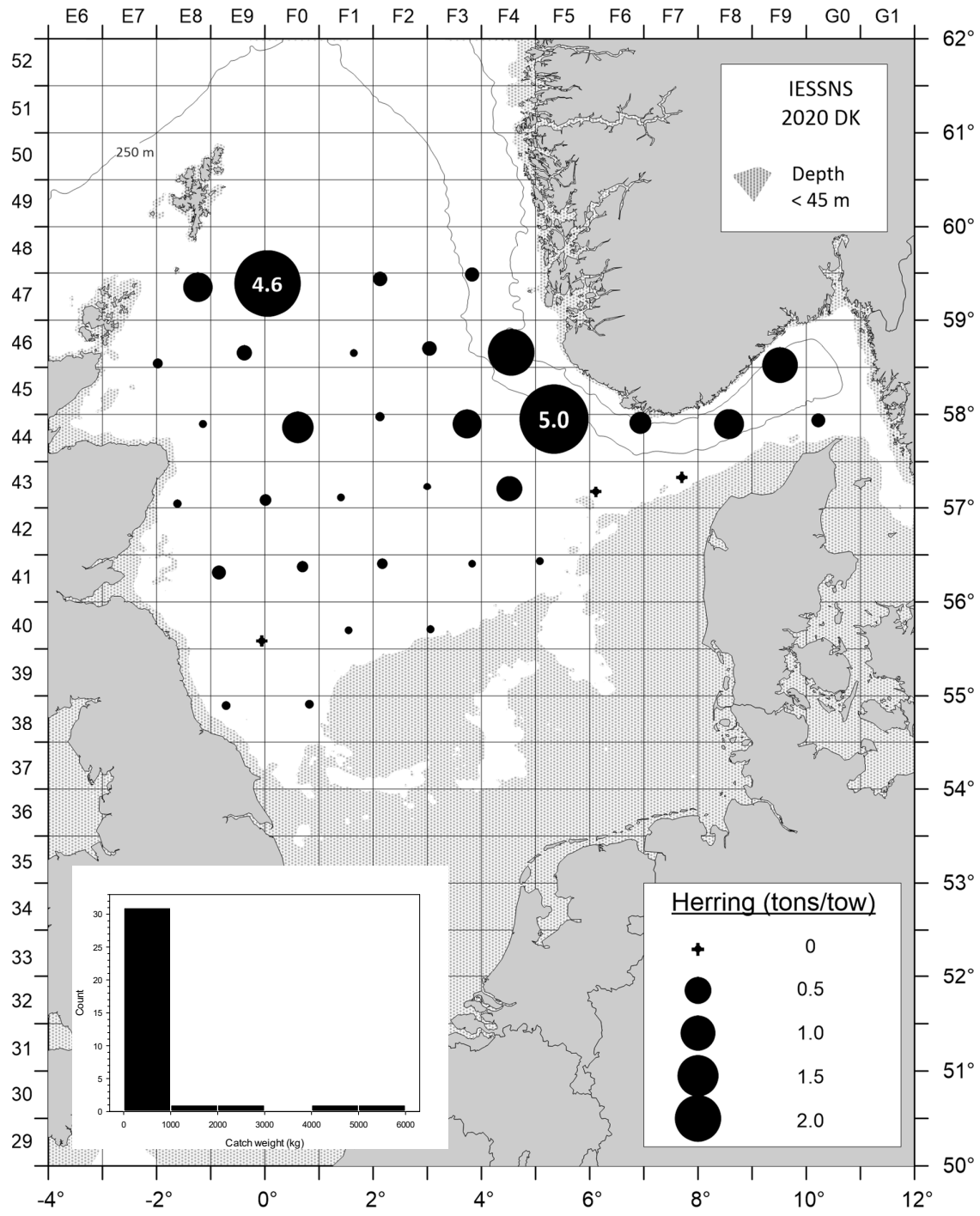

Fig. 4: Distribution of herring catches.

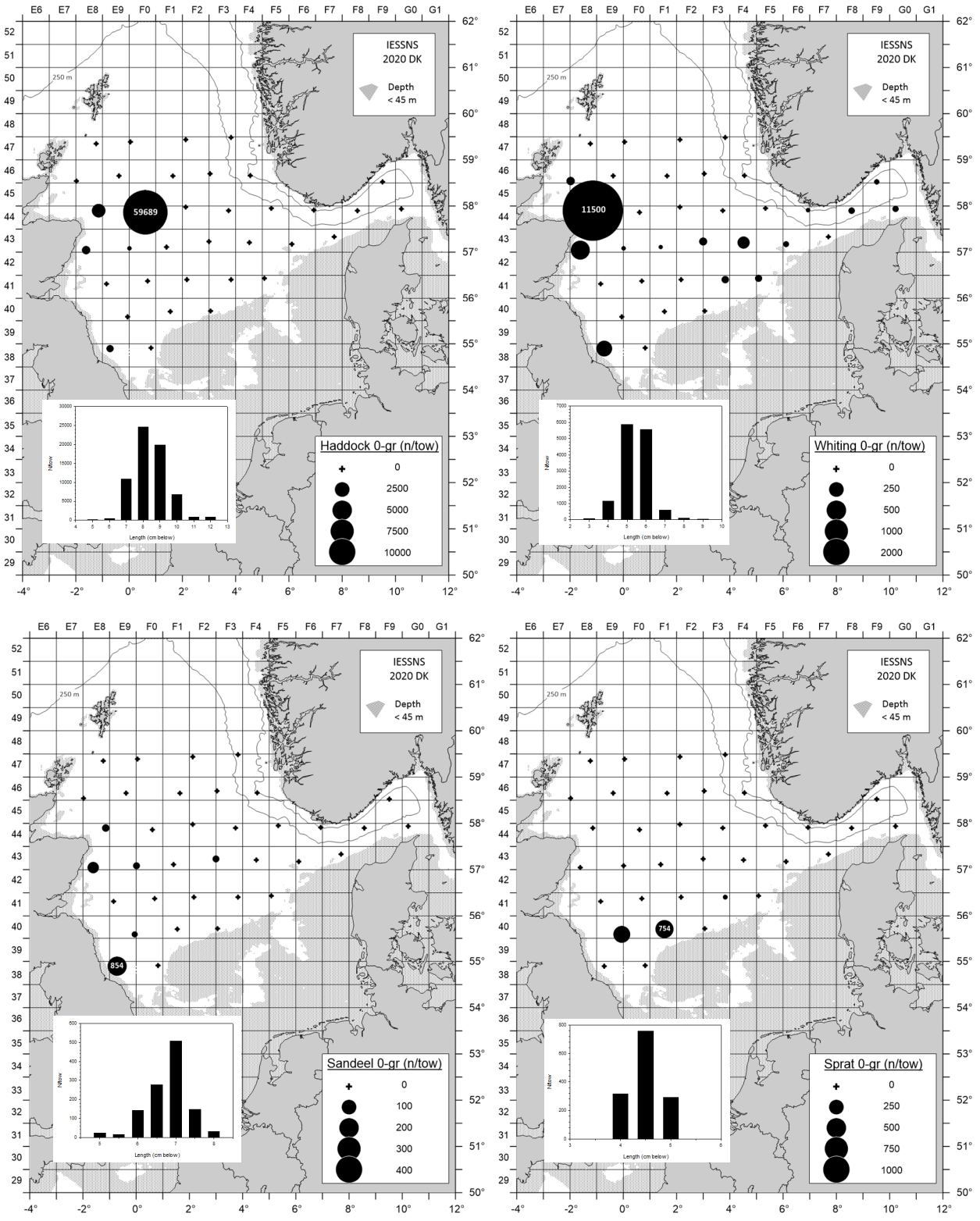

Fig. 5: Distribution and length frequencies of 0-group haddock, whiting, sandeel and sprat.

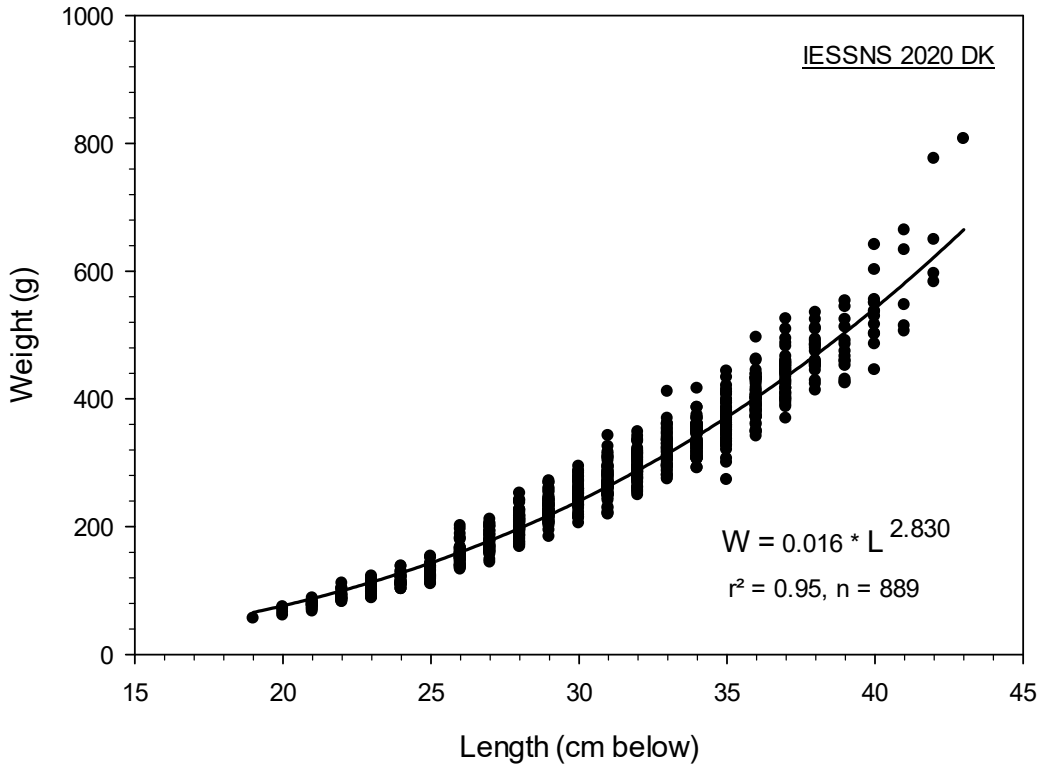

Fig. 6: Length-weight relationship for mackerel.

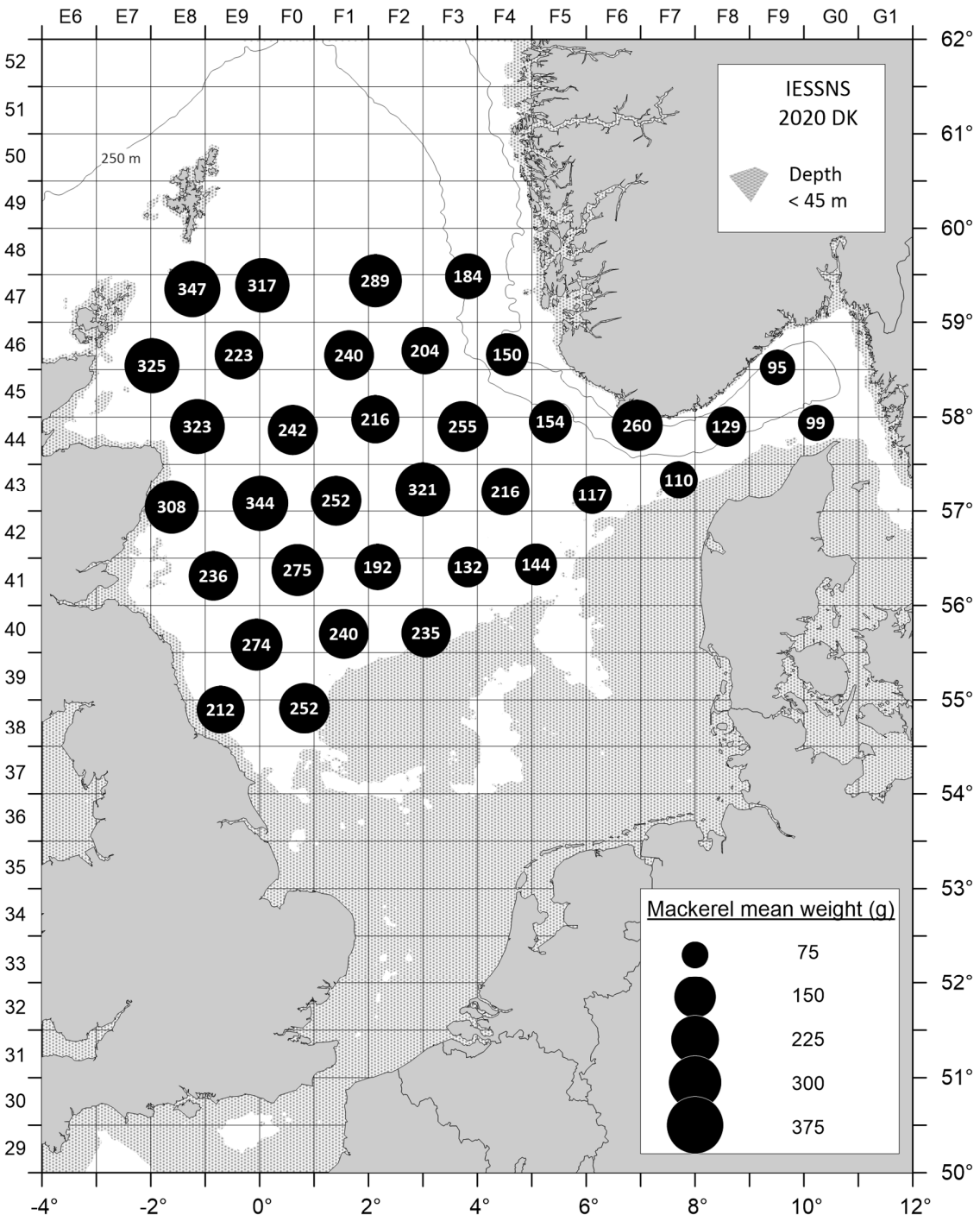

Fig. 7: Distribution of mean individual weight of mackerel.

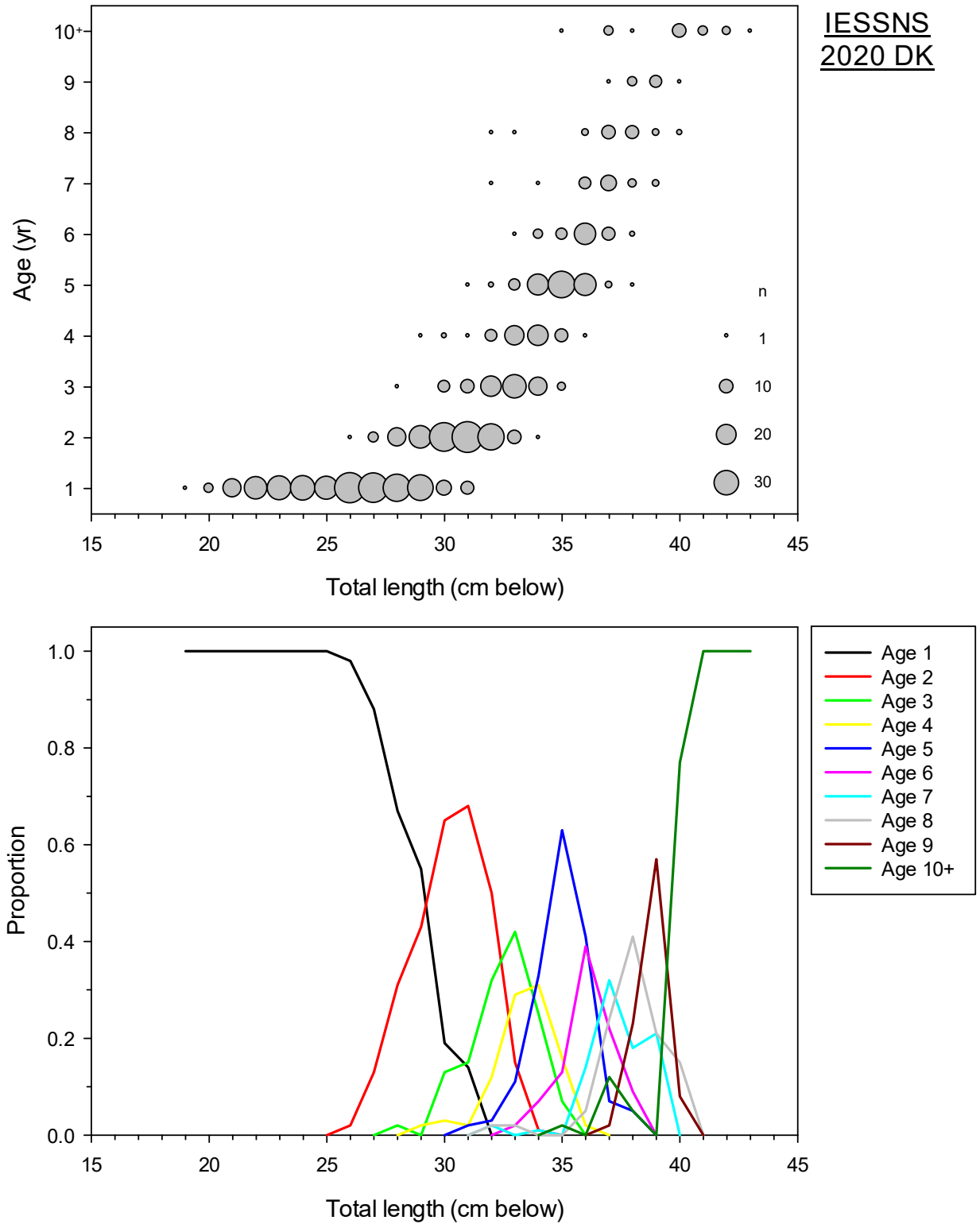

Fig. 8: Age-length key for mackerel (bubble size in upper panel refer to number of otoliths (n)).

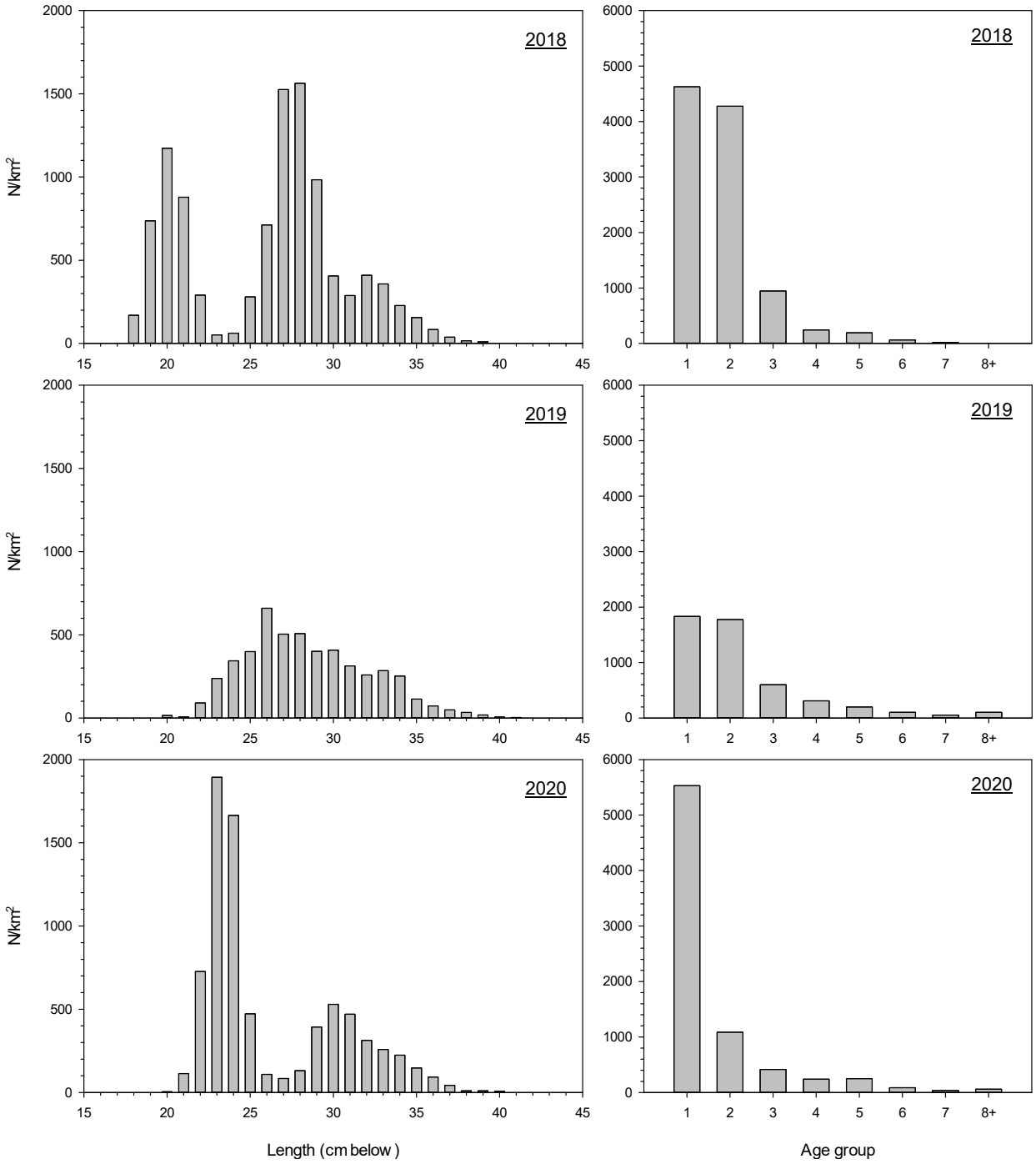

Fig. 9: Length and age composition of mackerel.

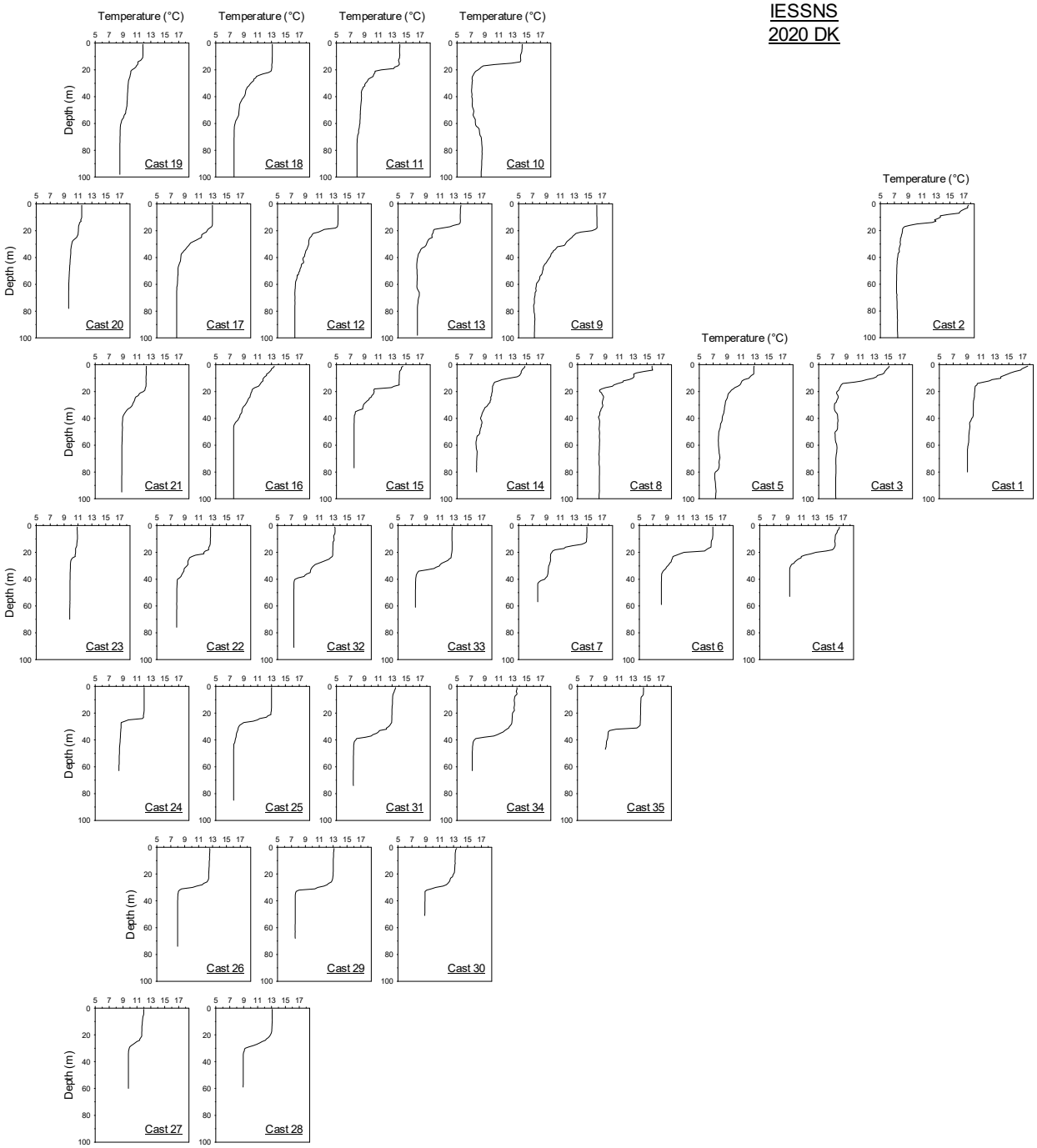

Fig. 10: Temperature conditions in the surface layer.

Tab. 1: Species list (L: total length in cm below (fish); ML: mantle length (cephalopods).

Latin name	Danish name	English name	Weight (kg)	Number	L_{min} (cm)	L_{max} (cm)	Remark
Clupea harengus	Sild	Herring	16639.21	139404	14.5	31	
Scomber scombrus	Makrel	Mackerel	14220.12	83964	19	43	
Melanogrammus aeglefinus	Kuller	Haddock	476.70	64435	5	32	mainly 0-group
Micromesistius poutassou	Blåhvilling	Blue whiting	152.12	1318	22	30	all from one tow (station 3)
Cyclopterus lumpus	Stenbider	Lumpfish	55.34	54	3	40	
Merlangius merlangus	Hvilling	Whiting	34.56	13659	3	32	mainly 0-group
Eutrigla gurnardus	Grå knurhane	Grey gurnard	27.21	235	16	37	
Squalus acanthias	Pighaj	Spurdog	26.68	72	24	78	
Sprattus sprattus	Brisling	Sprat	24.08	3650	2	13	mainly 0-group
Belone belone	Hornfisk	Garfish	19.76	58	47	77	
Pollachius virens	Sej	Saithe	4.75	1	80	80	
Illex coindetii		Southern shortfin squid	2.84	21	7	23	ML
Loligo forbesii		Northern squid	1.65	15	3	17	ML
Todaropsis eblanae		Lesser flying squid	1.56	21	6	16	ML
Ammodytes marinus	Tobis-hav	Lesser sandeel	1.44	1160	5	21	mainly 0-group
Dicentrarchus labrax	Havbars	European seabass	1.40	1	53	53	
Trachurus trachurus	Hestemakrel	Horse mackerel	1.19	3	33	38	
Sardina pilchardus	Sardin	Pilchard	1.13	10	20	25	
Hippoglossoides platessoides	Håising	Long-rough dab	0.63	12	16	21	
Lophius piscatorius	Havtaske	Anglerfish	0.39	1	25	25	
Chelidonichthys lucerna	Rød knurhane	Tub gurnard	0.26	1	31	31	
Loligo forbesi/vulgaris			0.16	21	3	5	ML, juveniles
Trachinus draco	Fjæsing	Greater weever fish	0.14	1	27	27	
Limanda limanda	Ising	Dab	0.12	2	18	19	
Todarodes sagittatus	Flyveblæksprutte	Flyveblæksprutte	0.05	3	5	10	ML
Echiichthys vipera	Fjæsing lille	Lesser weever	0.03	1	13	13	
Rossia macrosoma	Ross's blæksprutte	Stout bobtail squid	0.02	5	3	3	ML

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