DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2021 DK”

Danmarks Pelagiske Producentorganisation

DTU Aqua
Section for Monitoring and Data Hirtshals

Kai Wieland

03-08-2021

Vessel: F/V Ceton S205

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

Cruise name: IESSNS 2021 DK

Participants

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

Kai Wieland (Cruise leader),
Per Christensen,
Brian Thomsen

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, 2019 and 2020, the survey was conducted again in 2021 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)

30/6 15:00 Loading of equipment in Hirtshals,
16:00 Departure from Hirtshals
19:00 Start of the survey sampling (station 1)

9/7 11:00 Survey sampling completed (station 39)
10/7 00:05 Arrival Hirtshals,
00:15 Unloading of equipment and samples in Hirtshals
00:45 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:

- 39 CTD profiles with Sea-Bird SeacatPlus (down 210 m or to about 5 m above bottom, prior to each fishing operation),
- 39 valid hauls with a Multipelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 8 m^2 Thyborøn type 15 doors.

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 300 and 350 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 - 12 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 4.3 to 5.3 kn, 22 to 36 m and 125 to 153 m between the stations (Fig. 2) and amounted to 4.8 kn, 27 m and 140 m on average for all stations. The low SOG recorded at a few stations was due to strong head currents. There were some minor deviations from the survey manual (Wire length: 350; 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.

Bottom depth and distance of footrope to bottom were between 59 and 519 m and between 35 and 483 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 81 m. Towed distance was received from the fishing plotter based on the continuously recorded GPS positions during the tow and ranged between 4.1 and 5.0 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 2 and 7521 kg per tow (Fig. 3). Highest catches were recorded in the northern part of the survey area whereas catches were relatively small in Scottish and English waters close to the coast and at the southwestern edge of the survey area . Mackerel catch exceeded 1 ton at 9 stations (Fig. 3). The total catch of mackerel amounted to 31.8 tons and average mackerel density was 2429 kg/km^2, which is considerably higher than in the previous years (Fig. 4).

Herring was mainly restricted to the northern part of the survey area with a maximum catch of 4.8 tons (Fig. 5). The total catch of herring amounted to 10.0 tons and average density was 800 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 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.

Mackerel mean weight, length and age distribution

Mackerel length was between 18 and 45 cm. Single fish weight was recorded for one specimen per cm group ≤ 28 cm and two individuals per cm group > 28 cm on each station. This yielded in a total number of observations for 845 individuals (Fig. 6). The exponent of the length-weight relationship was 2.90, which is slightly lower than the values from the previous years (2018: 2.88, 2019: 2.94, 2020: 2.83) indicating that mackerel condition has increased a bit.

Mean individual weight by station ranged from 102 to 403 g and was highest in the western and northwestern part of the survey area (Fig. 7). The lowest values were found in the eastern part of the survey area, but also in the southwest close to the English coast and in particular in the Skagerrak where the catch was dominated by small (< 25 cm) individuals.

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 15 were identified in the single fish data of which fish at age 8 and older were pooled into a plus-group (Fig. 8). The length and age composition for the survey indicate an exceptional high amount of small (≤ 26 cm, age 1) individuals this year but the abundance of older mackerel, in particular age 2, was considerably higher than in the previous three years too (Fig. 9).

Temperature conditions

Despite correct handling at sea, several profiles were truncated due technical failure of the CTD. This was first recognized after the survey when the data were download from the memory of the CTD. The reason for the failure is yet not clear but a thorough check and testing prior to the next survey is required.

Sea surface temperature ranged from 12 to 15 °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. 10). 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 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 the survey.

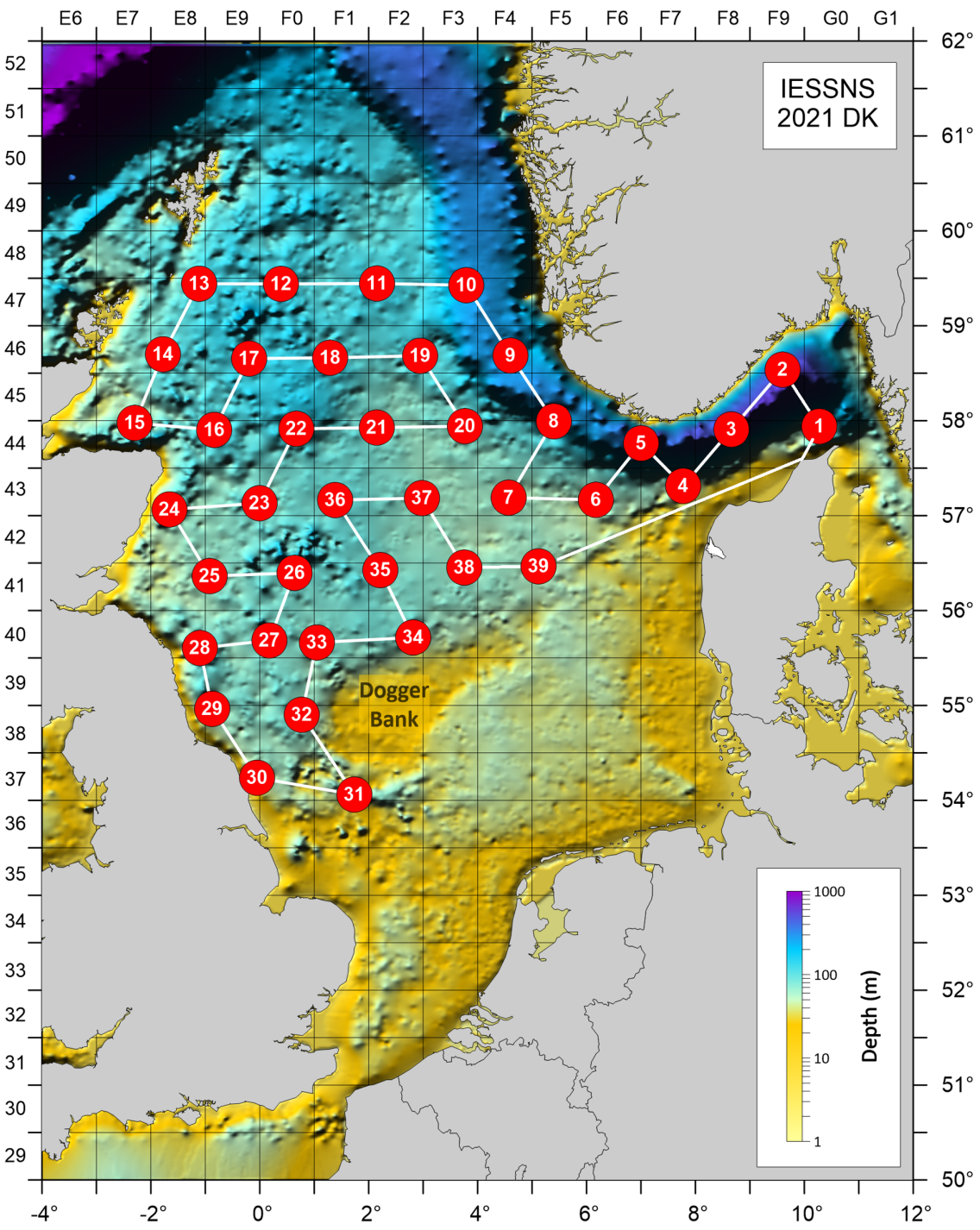

Fig. 1: Survey map with sampling locations.

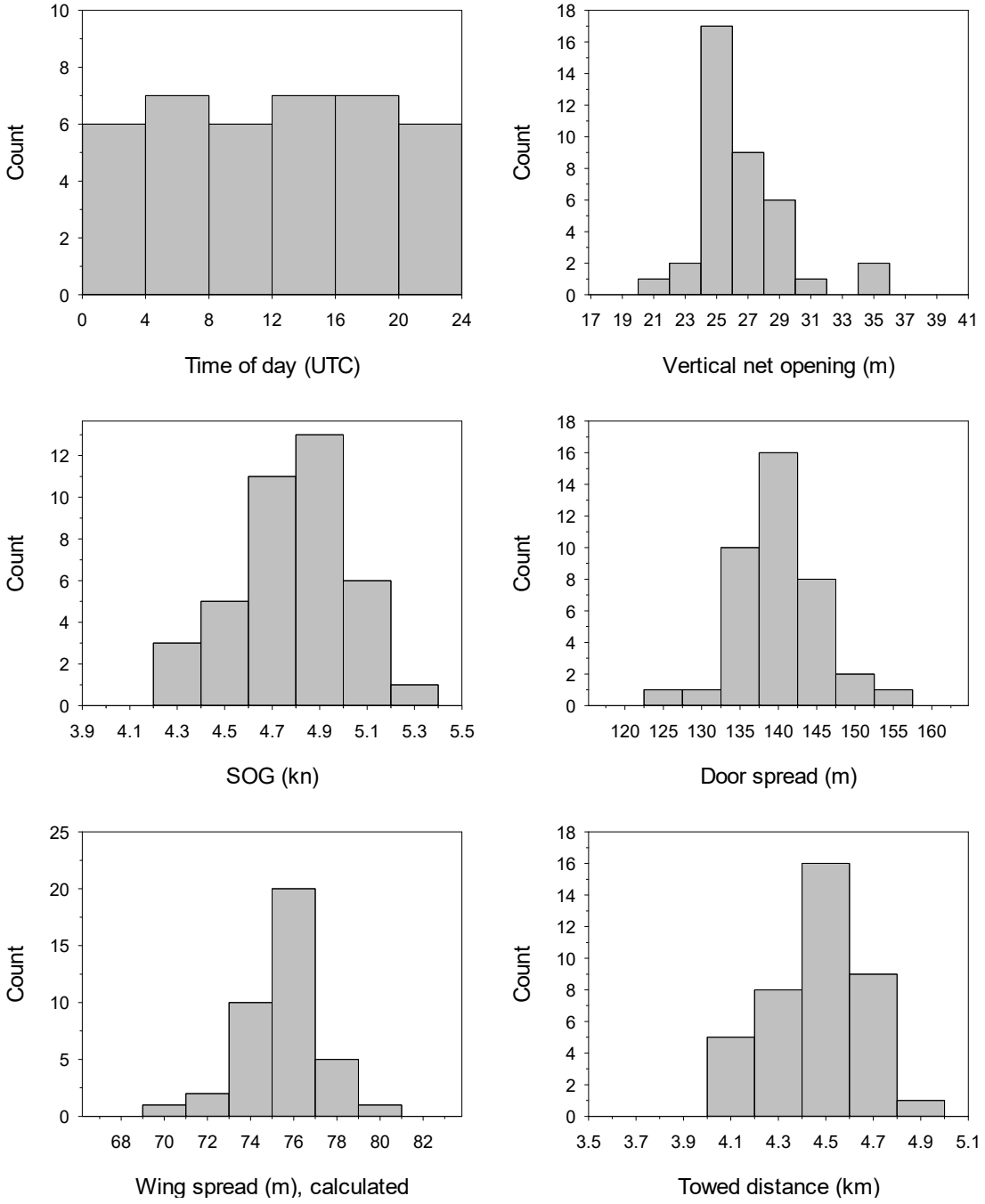

Fig 2: Times of day fished, vessel and gear performance (mean values by station).

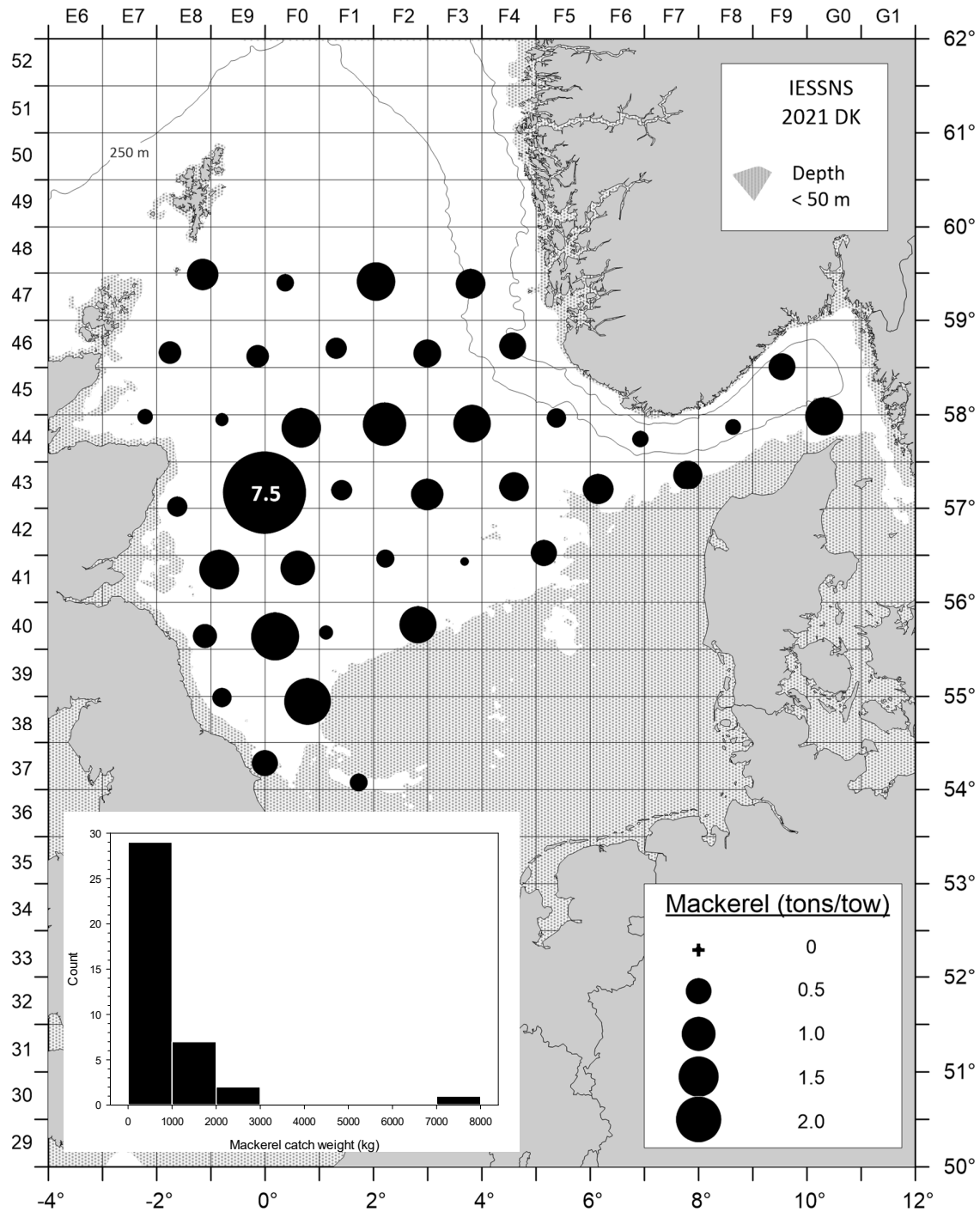

Fig. 3: Distribution of mackerel catches.

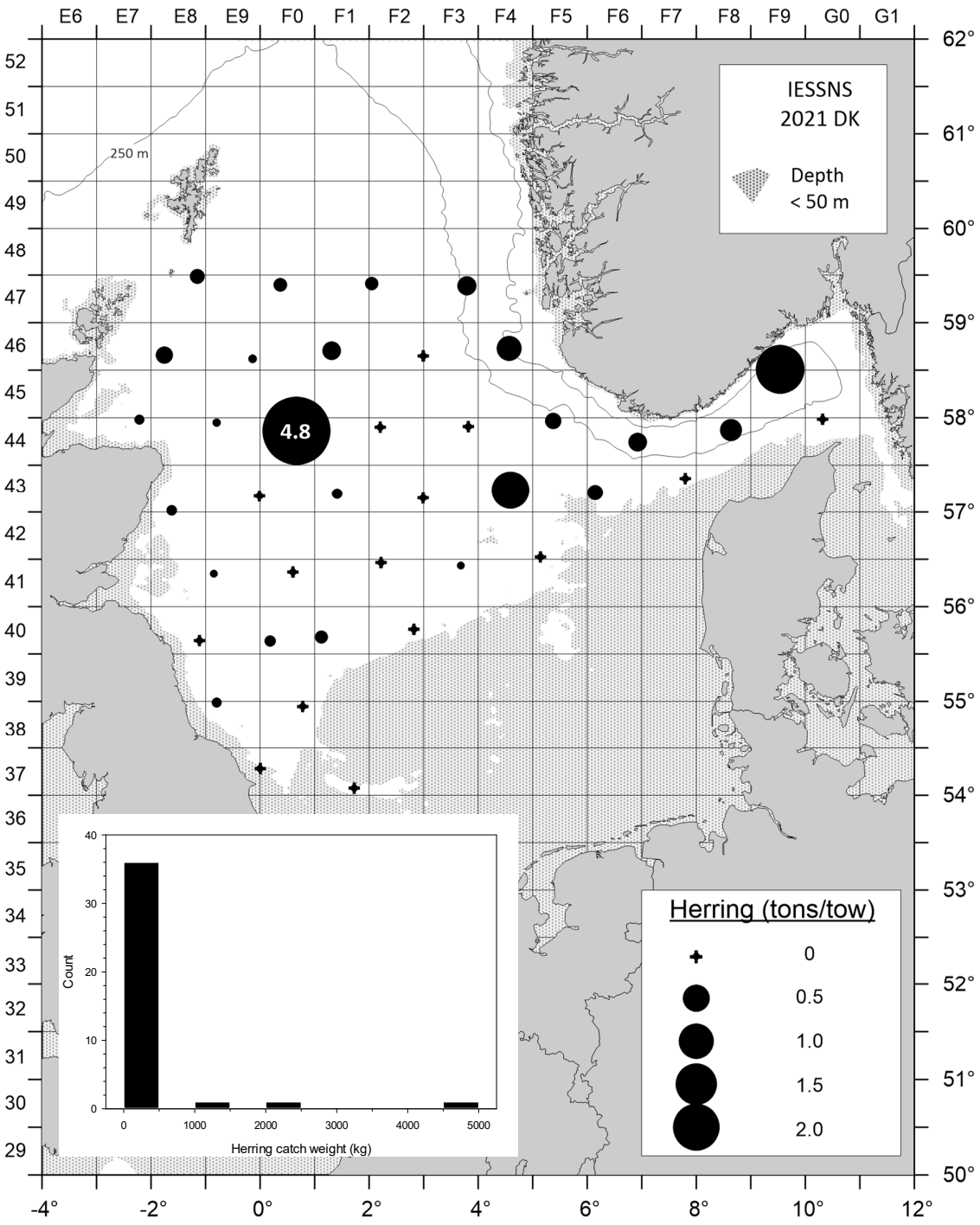

Fig. 4: Distribution of herring catches.

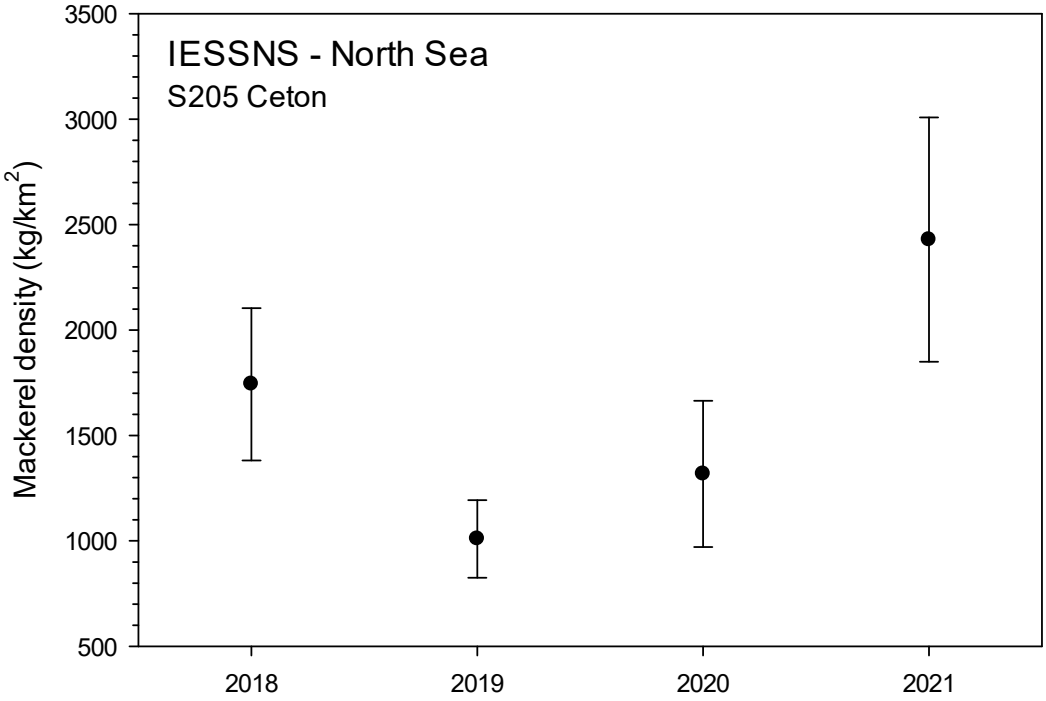

Fig. 5: Mackerel density (mean and standard error) in 2018 - 2021.

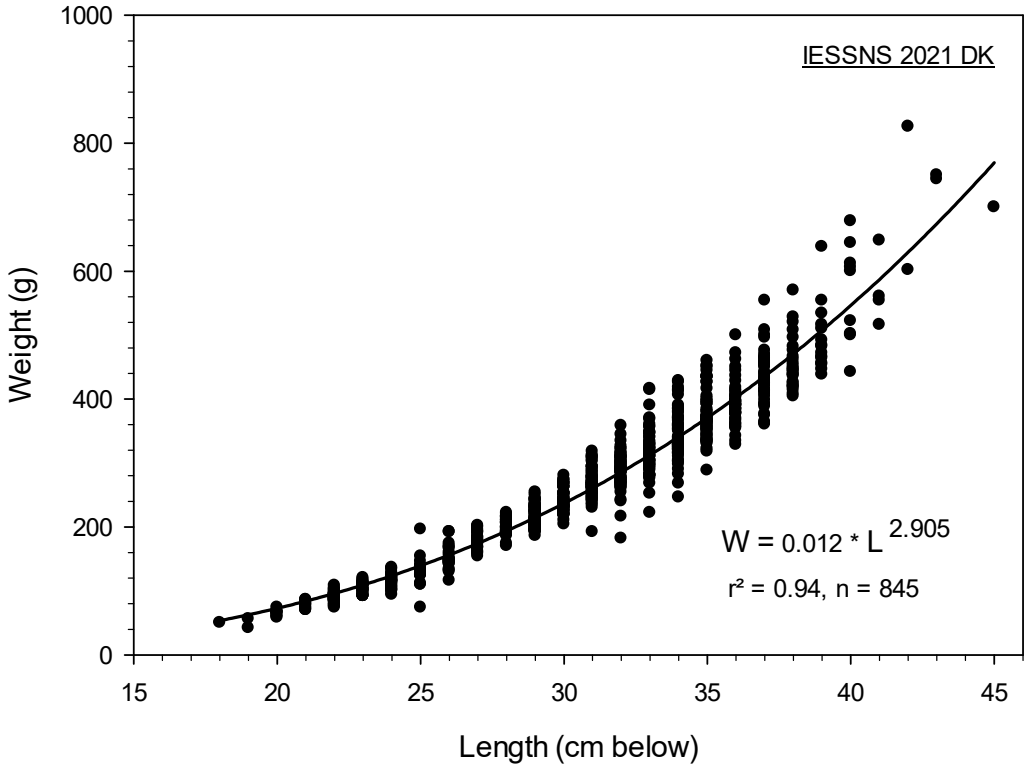

Fig. 6: Length-weight relationship for mackerel.

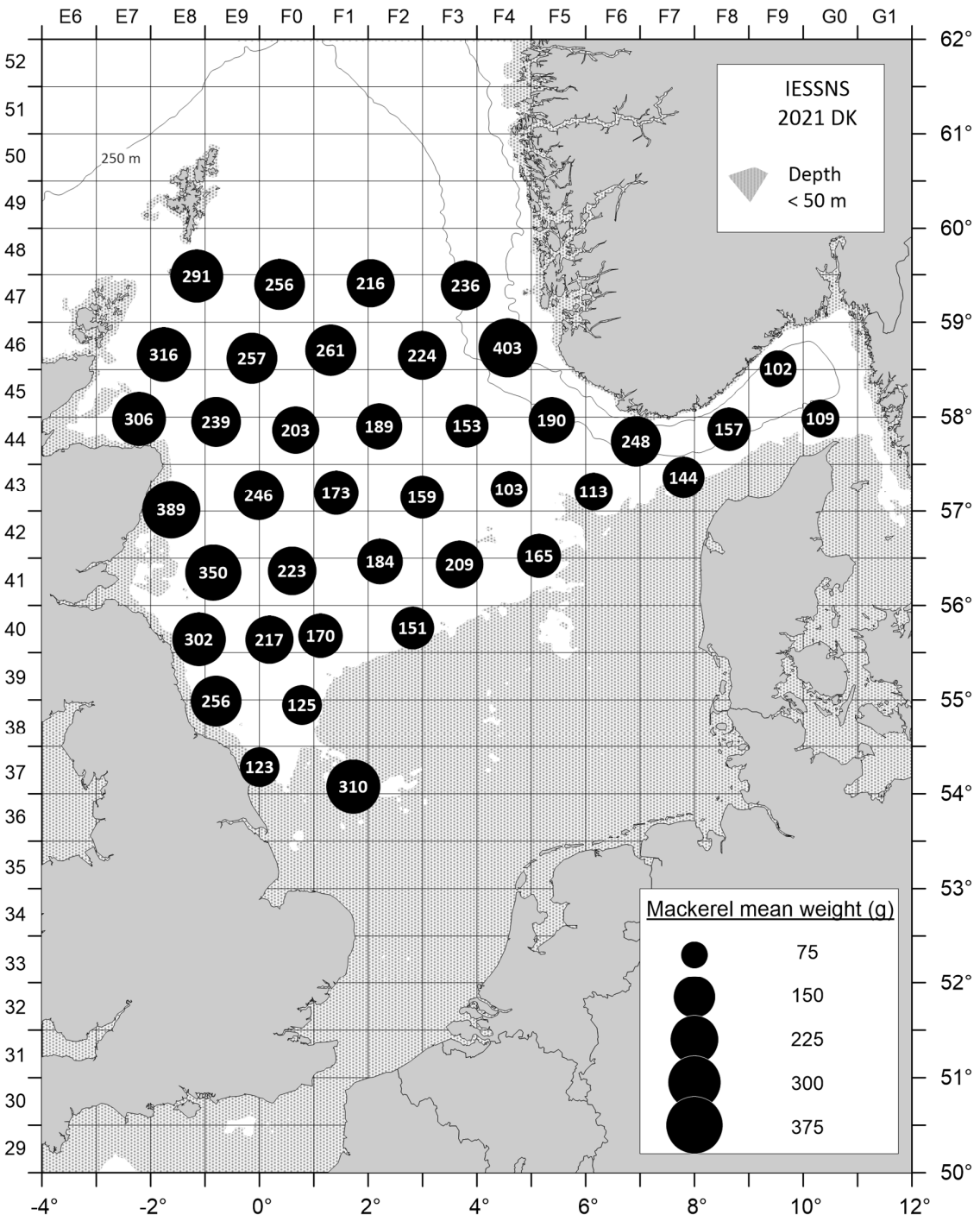

Fig. 7: Distribution of mean individual weight of mackerel.

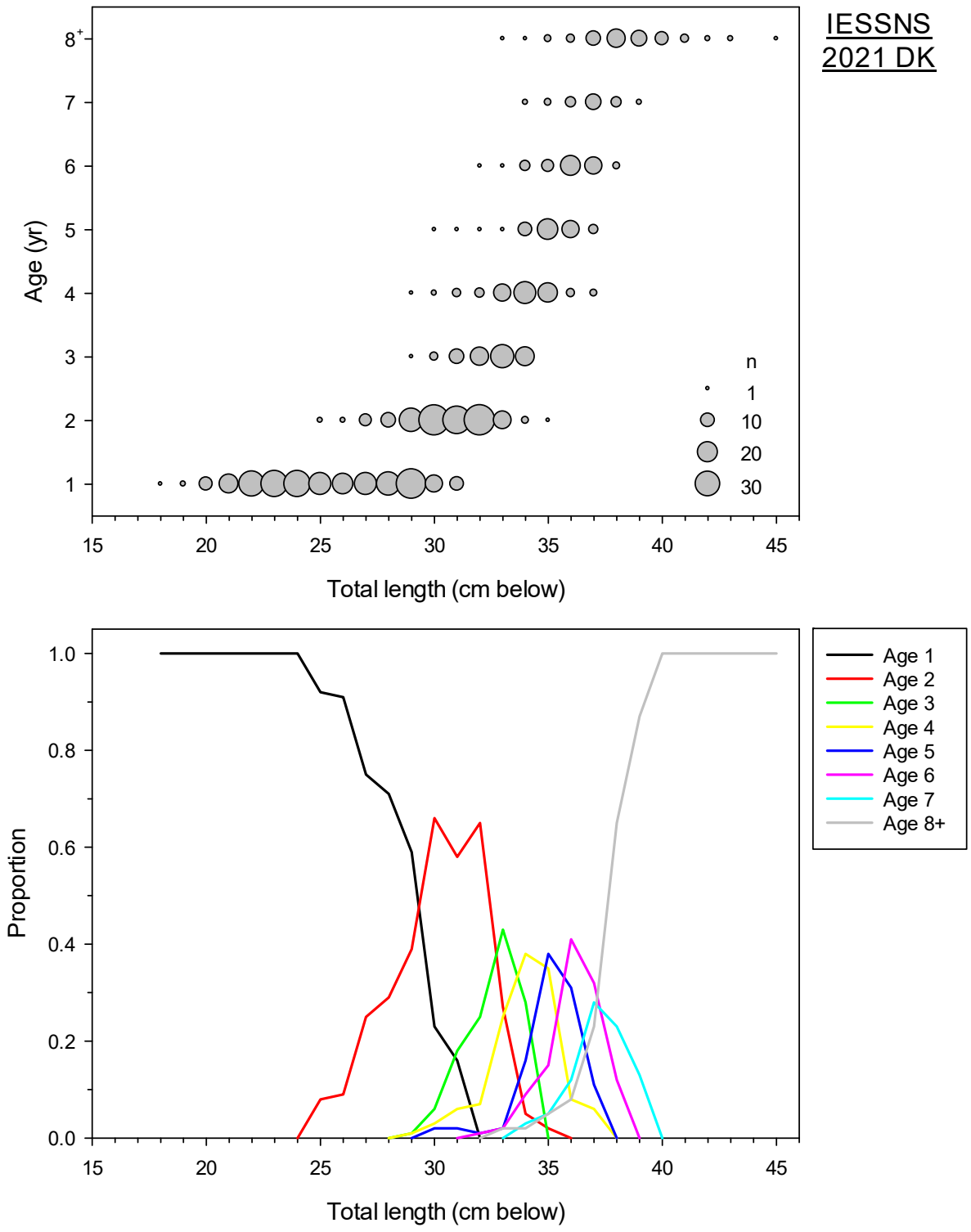

Fig. 8: Age-length key for mackerel (bubble size in upper panel refer to number of otoliths analyzed (n)).

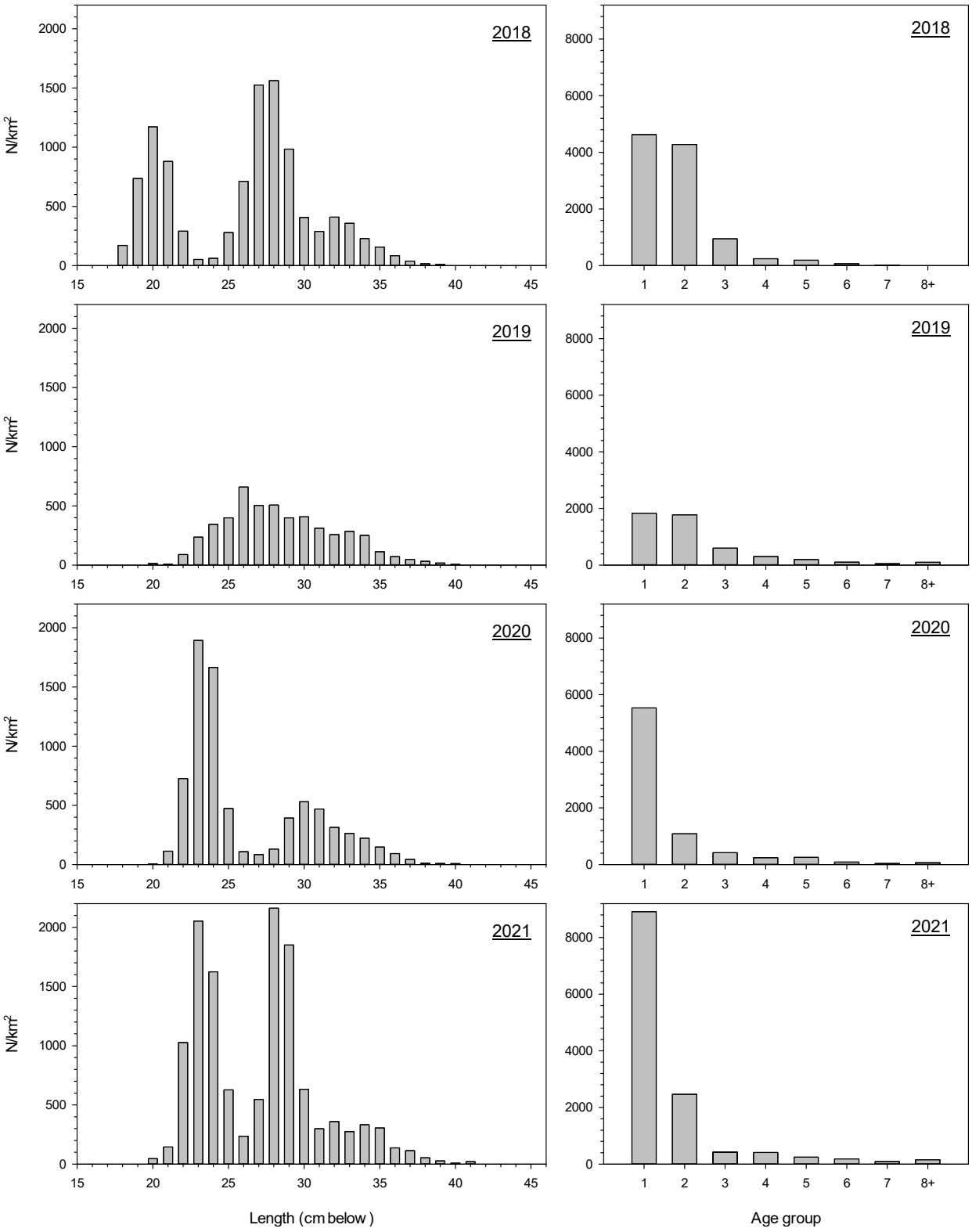

Fig. 9: Length and age composition of mackerel.

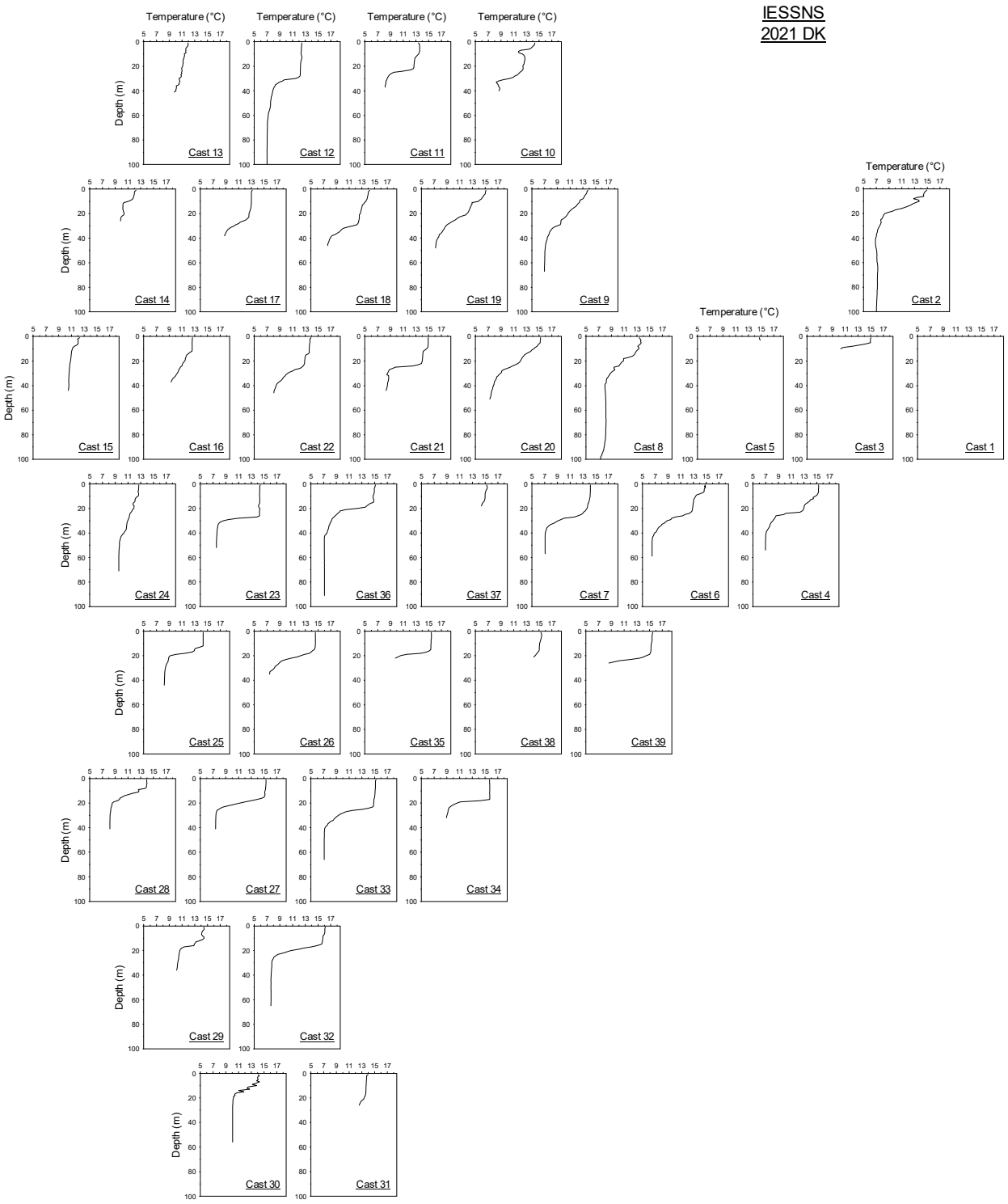

Fig. 10: Temperature conditions in the surface layer.

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
Scomber scombrus	Makrel	Mackerel	31757.275	168852	18	45	
Clupea harengus	Sild	Herring	9973.633	115735	14	31	
Merlangius merlangus	Hvilling	Whiting	662.587	18699	3	40	mainly 0-group
Melanogrammus aeglefinus	Kuller	Haddock	91.402	1334	4	36	mainly 0-group
Sprattus sprattus	Brisling	Sprat	85.459	8109	6.5	13.5	
Eutrigla gurnardus	Grå knurhane	Grey gurnard	58.811	430	16	34	
Cyclopterus lumpus	Stenbider	Lumpfish	49.276	57	5	34	
Squalus acanthias	Pighaj	Spurdog	37.636	24	41	97	
Belone belone	Hornfisk	Garfish	18.506	55	53	76	
Pollachius virens	Sej	Saithe	11.730	2	80	86	
Echiichthys vipera	Fjæsing lille	Lesser weever	7.173	319	8	16	
Illex coindetii	Rød blæksprutte	Southern shortfin squid	6.124	42	5	22	ML
Ammodytes marinus	Havtobis	Lesser sandeel	1.913	1228	6.5	10.5	0-group
Salmo trutta	Ørred	Sea trout	1.610	1	56	56	
Trachurus trachurus	Hestemakrel	Horse mackerel	1.548	4	24	44	
Hippoglossoides platessoides	Håising	American plaice	1.162	18	16	25	
Todarodes sagittatus	Flyveblæksprutte	European flying squid	1.154	10	10	17	ML
Loligo sp		Loligo sp	0.723	160	3	5	ML
Loligo forbesii		Northern squid	0.494	1	25	25	ML
Eledone cirrhosa	Eledone Blæksprutte	Horned octopus	0.422	1	11	11	ML
Scyphozoa	*Storgopler	Scyphozoans	0.390	0	0	0	
Sardina pilchardus	Sardin	Pilchard	0.382	3	24	24	
Todaropsis eblanae		Lesser flying squid	0.314	4	8	15	ML
Chelidonichthys lucerna	Rød knurhane	Tub gurnard	0.138	1	24	24	
Hyperoplus lanceolatus	Plettet tobiskonge	Greater sandeel	0.088	2	16	31	
Lampetra fluviatilis	Flodlampret	River lamprey	0.064	1	31	31	
Engraulis encrasicolus	Ansjos	Anchovy	0.032	1	16	16	
Micromesistius poutassou	Blåhvilling	Blue whiting	0.023	1	16	16	
Trisopterus esmarkii	Sperling	Norway pout	0.012	1	12	12	
Rossia macrosoma	Ross's blæksprutte	Stout bobtail squid	0.008	2	1	2	ML
Syngnathidae	*Tangnåle	Pipefishes and seahorses	0.002	1	18	18	

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