DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2019 DK”

Danmarks Pelagiske Producentorganisation

DTU Aqua
Section for Monitoring, Data and Teknik
Hirtshals

Kai Wieland

18-08-2019

Vessel: F/V Ceton S205 Cruise dates (planned): 2/7 – 12/7 2019

Cruise number: 12/2019 Cruise name: IESSNS 2019 DK

Port of departure:	Skagen	**Date:**	02 July
Port of return:	Hirtshals	**Date:**	12 July
Other ports:	Hanstholm	**Date and justification:**	3 July Collection of spare parts

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, 2/7-3/7)
Alexander Fhåge (Skipper, 3/7-12/7),
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 the survey was conducted again in 2019 using the same vessel and methods but with a slightly changed layout of the sampling locations based on a request from the IESSNS coordinator.

Itinerary (local time)

1/7-2019 12:30 Arrival of scientific team and loading of equipment in Skagen, Departure postponed due to technical reasons
2/7-2019 12:45 Departure from Skagen
14:00 Test of trawl and adjustments of rigging (2 trials, finished 16:30)
17:00 Start of the survey sampling, interrupted (after station 3)

3/7-2018 09:00 Arrival Hanstholm
13:45 Departure Hanstholm
19:15 Survey sampling resumed (station 4)

12/7-2018 03:30 Survey sampling completed (station 38)
16:00 Arrival Hirtshals, Unloading of equipment and samples (until 16:15)

Achievements

Eight transects between about 59°42' N and 54°30' N were covered in the Skagerrak and the north-western North Sea (Fig. 1) with the following activities conducted:

- 38 CTD profiles with Sea-Bird SeacatPlus (down 200 m or to about 5 m above bottom, prior to each fishing operation)
- 38 valid hauls with a Multipelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 7 m^2 Thyborøn type 15 doors
- Length of between-station cruise track: 1870 nmi.

Results

Sampling and gear performance

The survey was conducted with F/V Ceton (62.60 m length, 1337 GT) 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. Weather conditions did not permit conducting a banana tow at stations 16 and 17 where and S-shape towing paths was used instead. On average, warp length during towing was 310 m with a difference between SB and BB of 10 m in general. Average depth of the SB and BB doors ranged from 4 - 28 m.

Since no continuous digital recording system has been available (except for the Simrad ES 80 echo sounder, 38 khz), 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 4.1 to 5.5 kn, 25 to 41 m and 114 to 128 m between the stations (Fig. 2) and amounted to 4.8 kn, 32 m and 119 m on average for all stations. The low SOG recorded at 2 stations was due to strong head currents (≈ 0.6 to 0.8 kn).

Bottom depth and distance of footrope to bottom were between 55 and 533 m and between 24 and 505 m during nominal tow duration. However, during setting the trawl the footrope had touched the bottom at the shallowest stations with bottom depths of about 50 m (station 20 and 38).

Horizontal trawl opening (Wing spread) 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 62 to 70 m, and towed distance calculated from towing speed and duration was between 3.7 and 5.1 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 and the highest catch amounting 1.6 tons was recorded 20 nm off Hanstholm (Fig. 3), and average mackerel density was 1009 kg/km^2.

Herring was restricted to the northern part of the survey area with a maximum catch of 3.8 tons (Fig. 4) and an average density of 825 kg/km^2.

Several other species were caught (Tab. 1) and it appears remarkable that classical demersal species such as grey gurnard and lumpfish 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 (stations 21 and 26, respectively) whereas the occurrence of 0-group, in particular whiting but also haddock, was observed more frequently.

Mackerel mean weight, length and age distribution

Mackerel length was between 20 and 43 cm (Tab. 1). Single fish weight was recorded for one specimen per cm group and station, which yielded in total data for 591 individuals (Fig. 5). Mean individual weight by station was highest in the western and northwestern part of the survey area whereas the lowest values were found close to Doggerbank and in the southwestern Skagerrak (Fig. 6).

289 mackerel stomachs (1 fish per cm from every second station) and 600 mackerel heads (1 fish per cm from each station) for later otolith extraction in the lab were collected and frozen on board.

Ages 1 to 12 were identified in the single fish data of which fish older than 8 years were pooled into a plus-group (Fig. 7). The length and age composition for the survey indicate a relative low amount of small (< 25 cm) individuals this year whereas the abundance of older mackerel was higher than in 2018 (Fig. 8).

Temperature conditions

Surface temperature ranged from about 6.9 to 15.5 °C. A pronounced thermocline in the upper 20 to 35 m was found for most of the stations (Fig. 9). Only in the western part of the survey area, i.e. off the Scottish and English coast, such stratification was missing (stations 11, 19, 20 and 27).

Acknowledgements

Many thanks to Skippers Jacob Claeson and Alexander Fhåge, and the 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.

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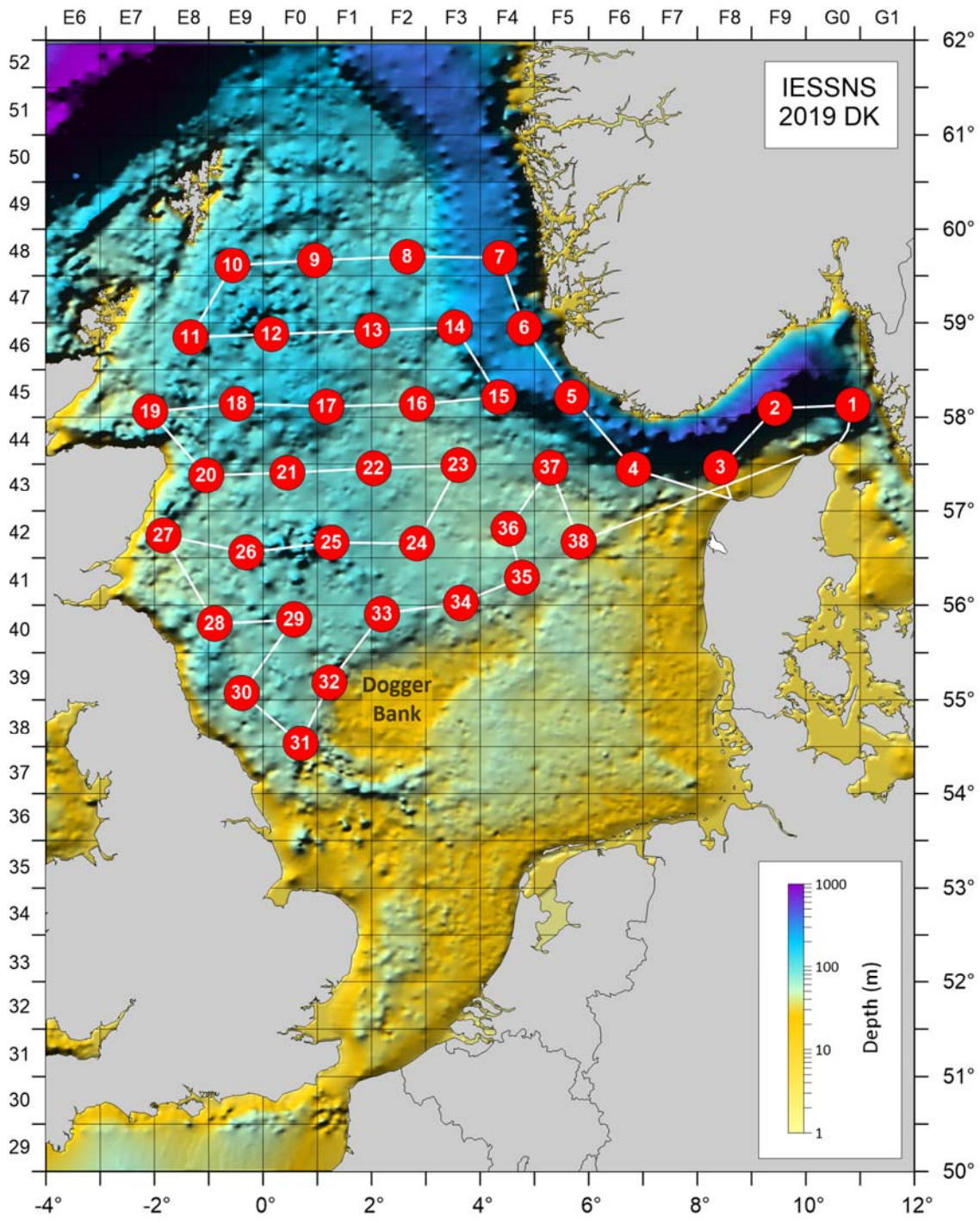

Fig. 1: Survey map with sampling locations and cruise track.

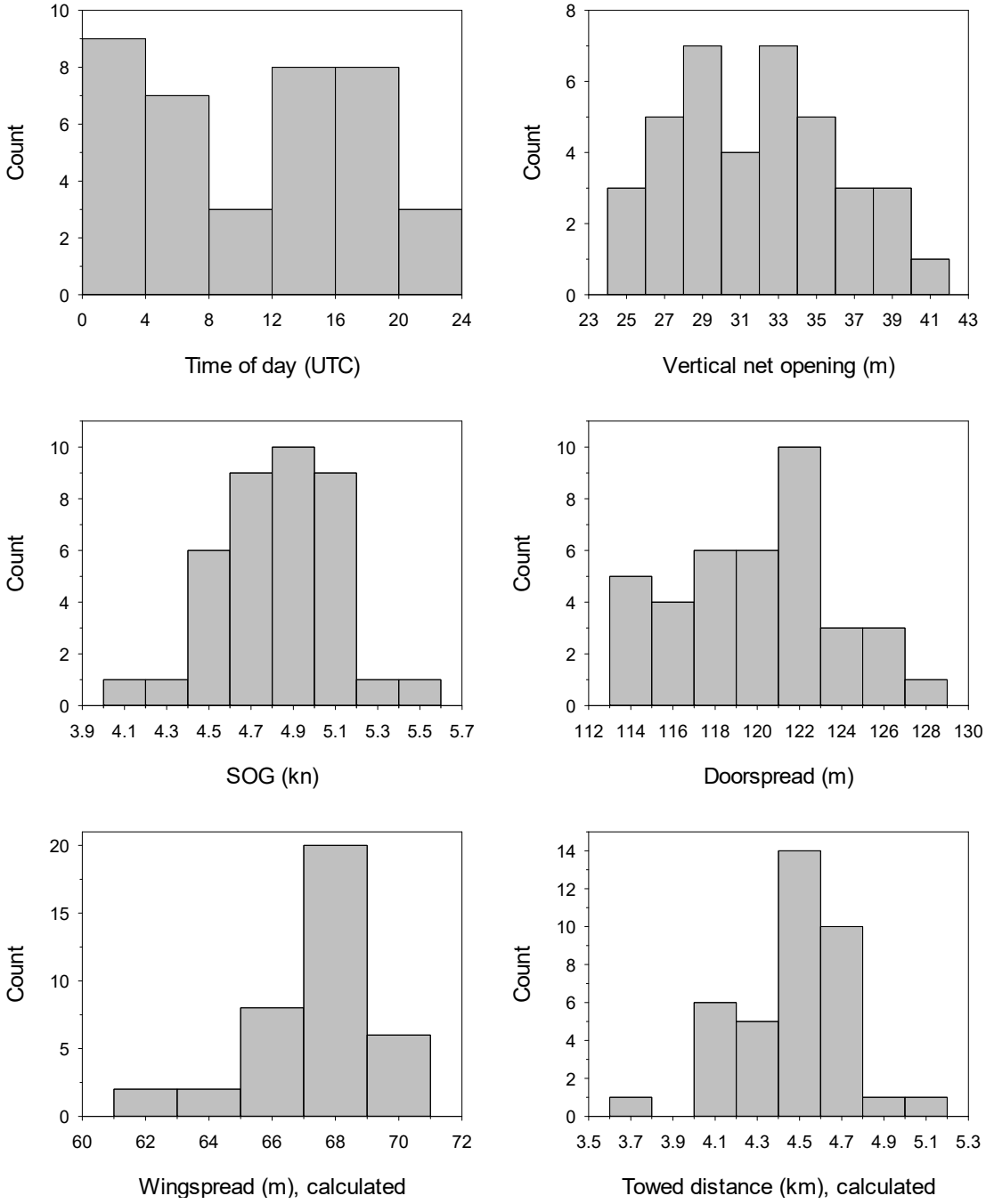

Fig 2: Times of day fished, vessel and gear performance (average values by station), IESSNS DK 2019.

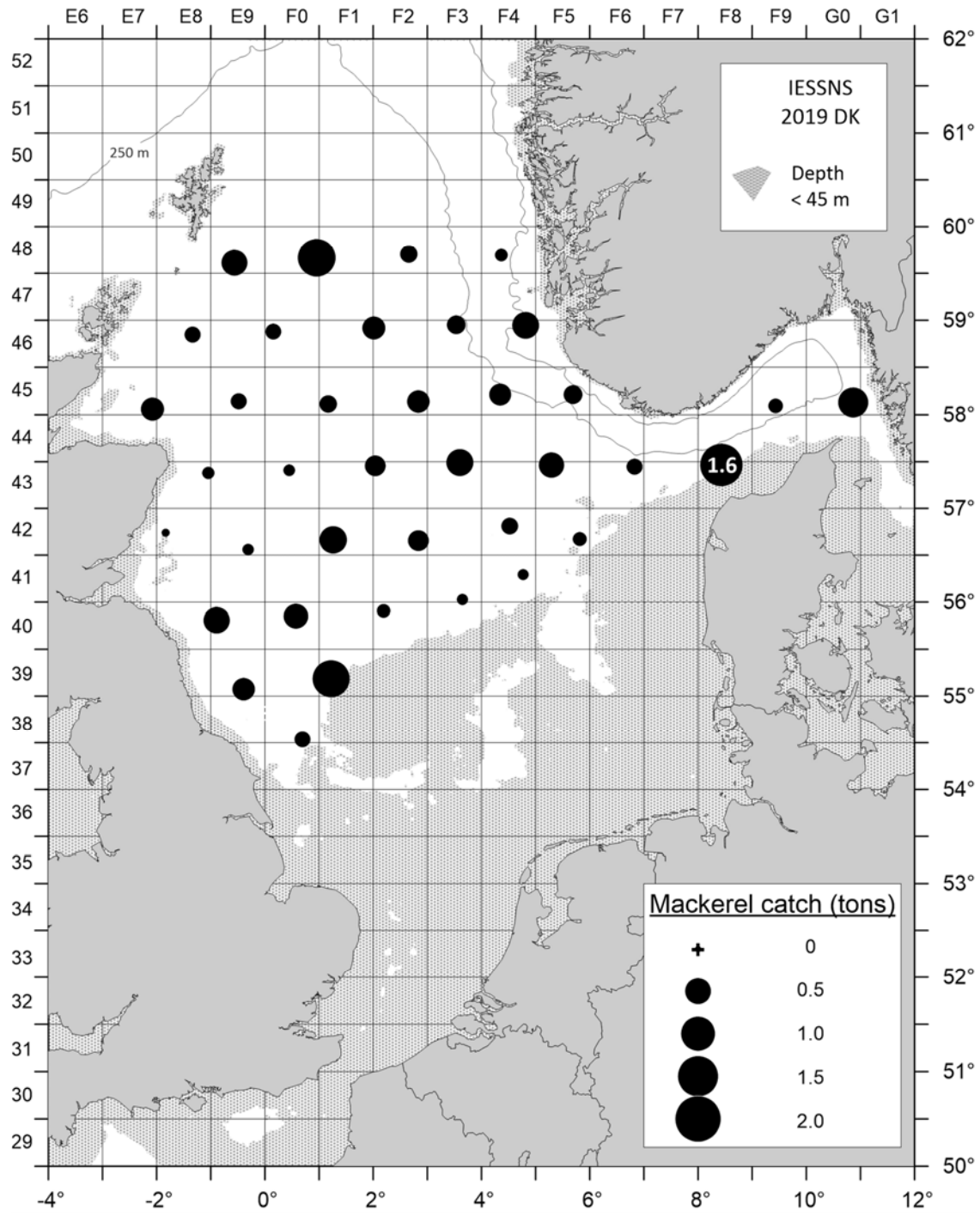

Fig. 3: Distribution of mackerel catches.

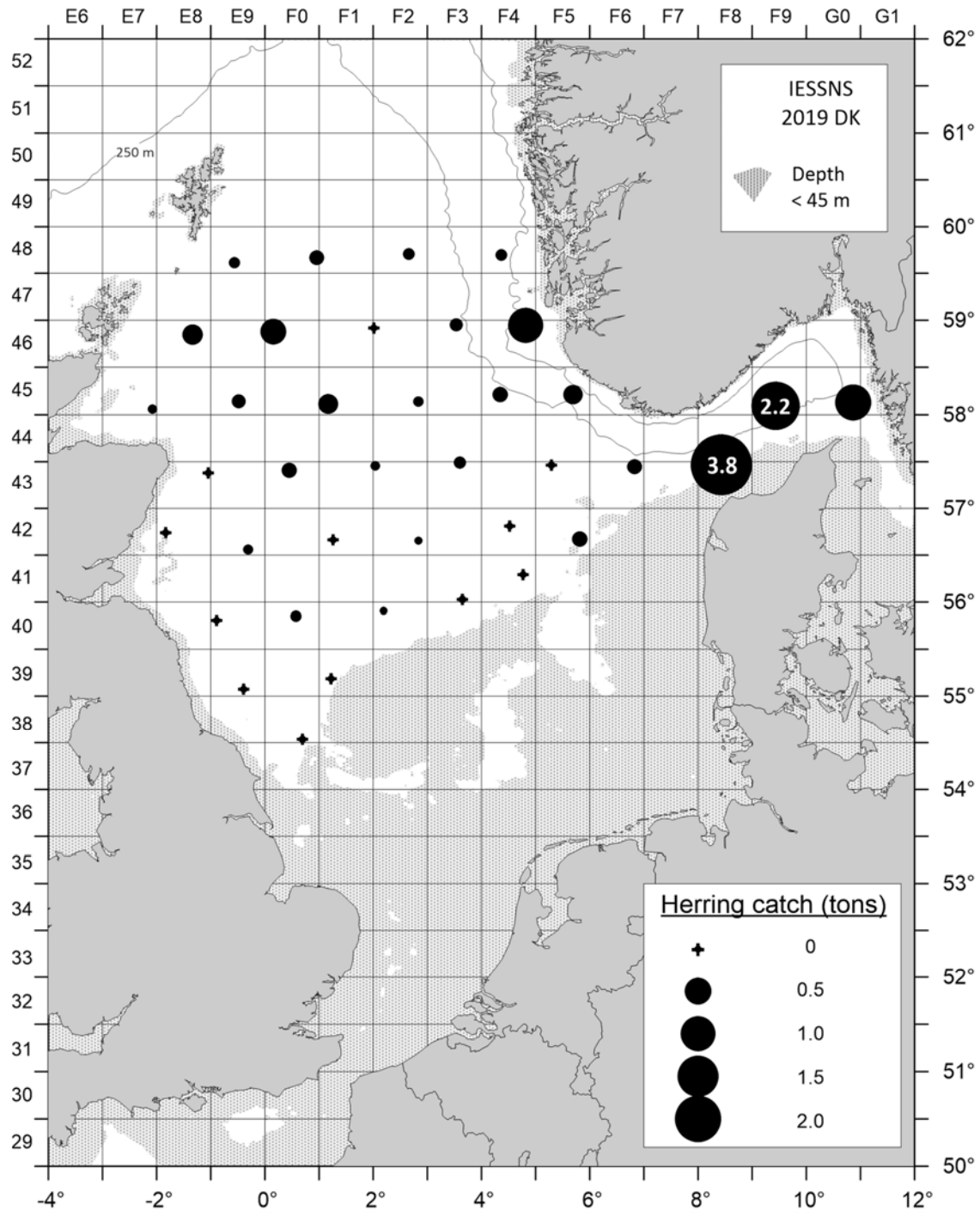

Fig. 4: Distribution of herring catches.

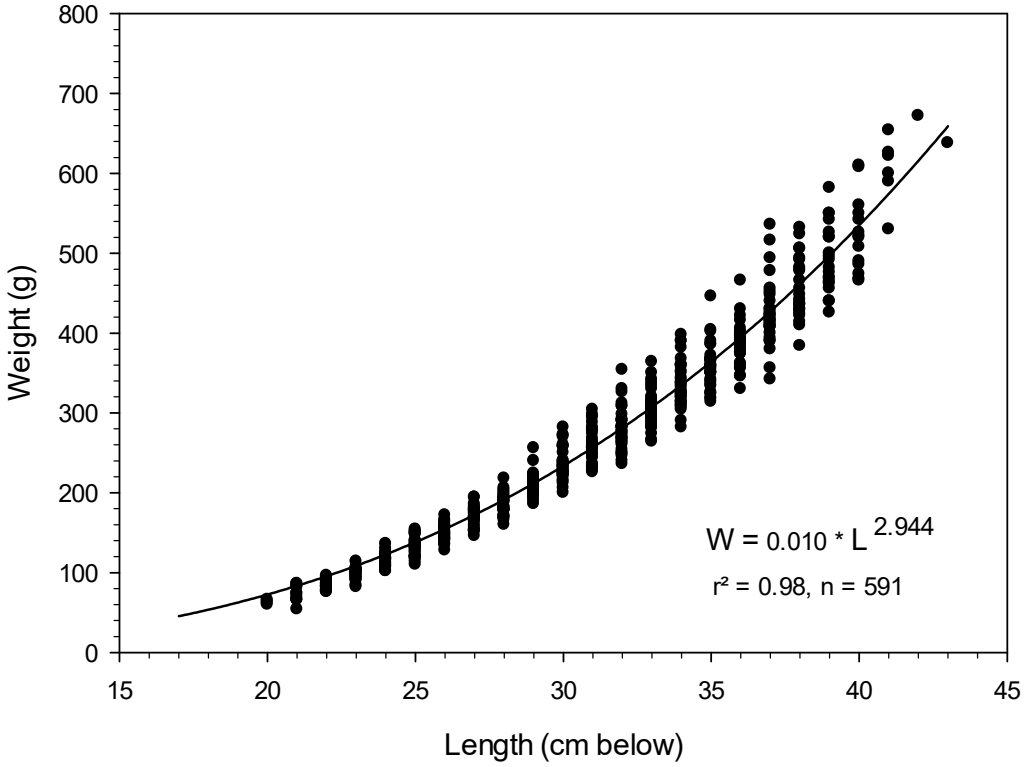

Fig. 5: Length-weight relationship for mackerel, IESSNS DK 2019.

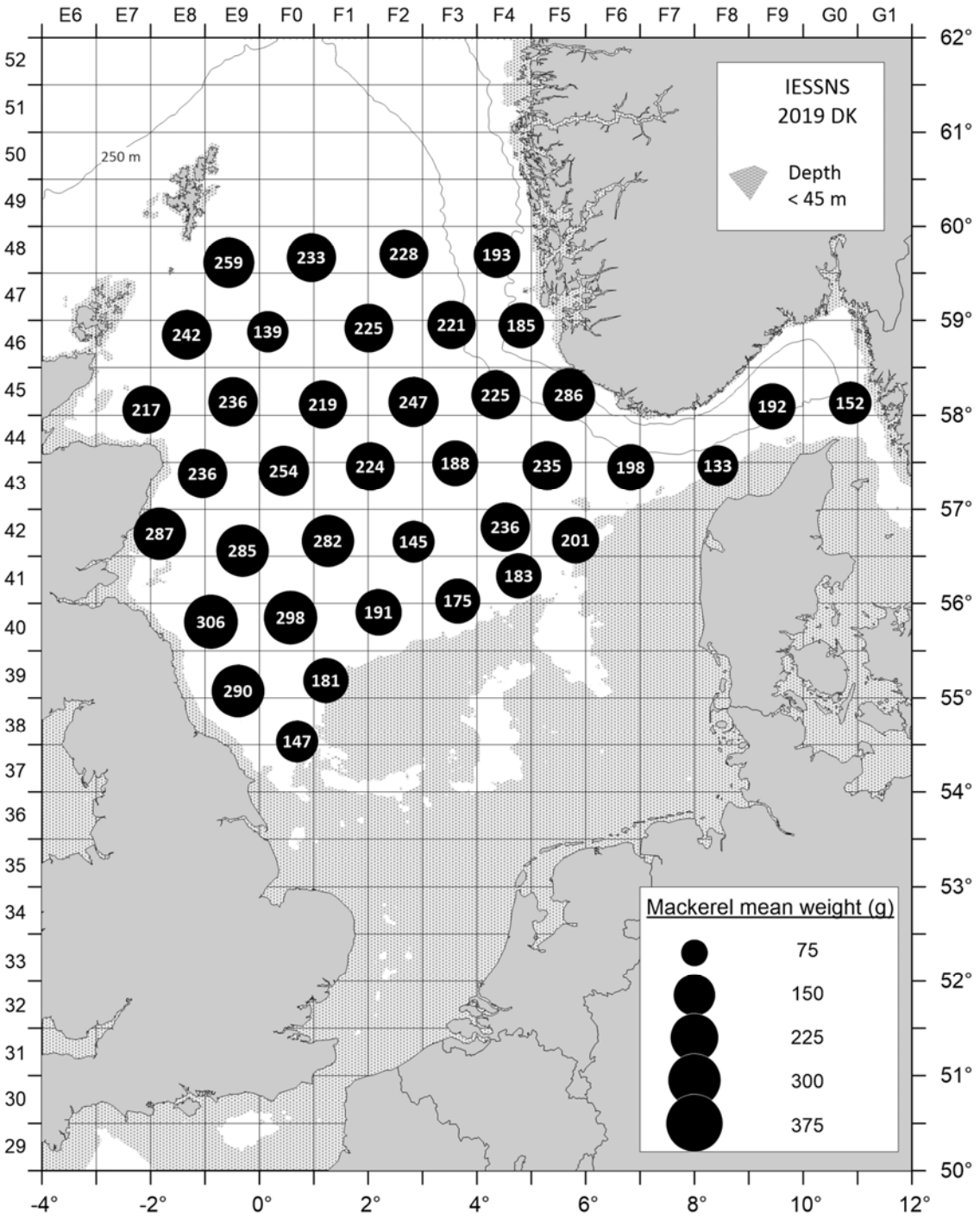

Fig. 6: Distribution of mean individual weight of mackerel.

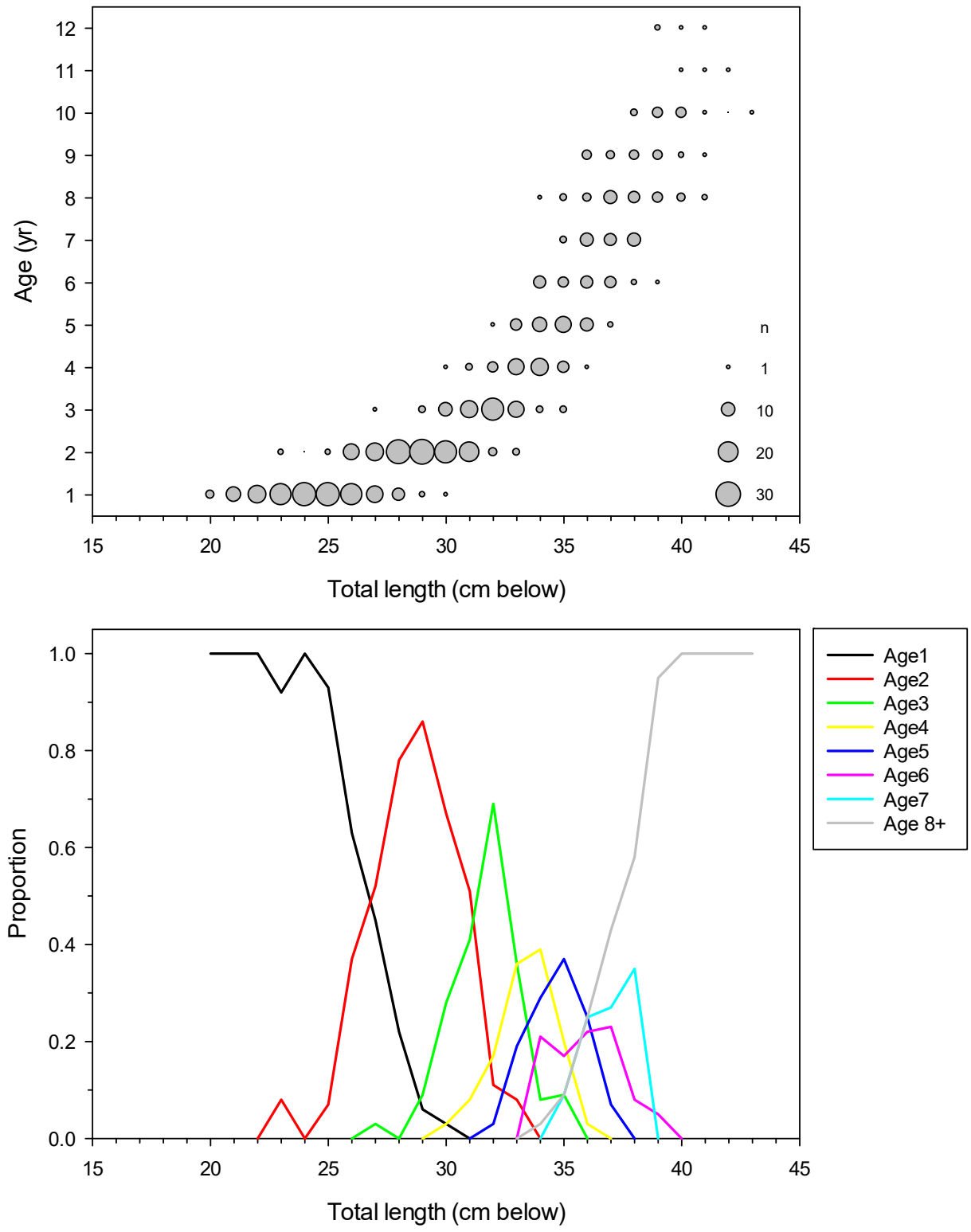

Fig. 7: Age-length key for mackerel (bubble size in upper panel refer to number of otoliths (n)), IESSNS DK 2019.

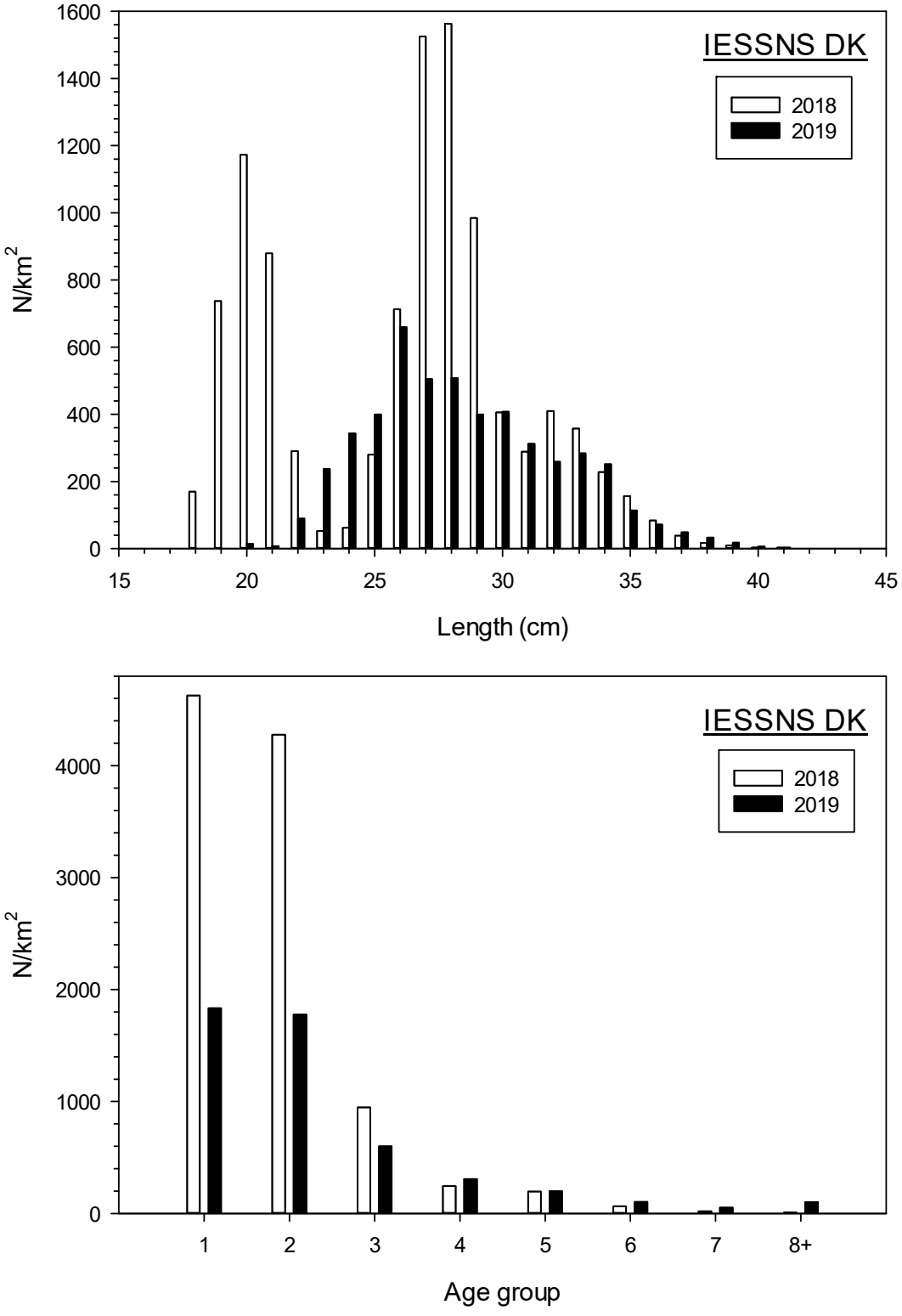

Fig. 8: Length and age composition of mackerel.

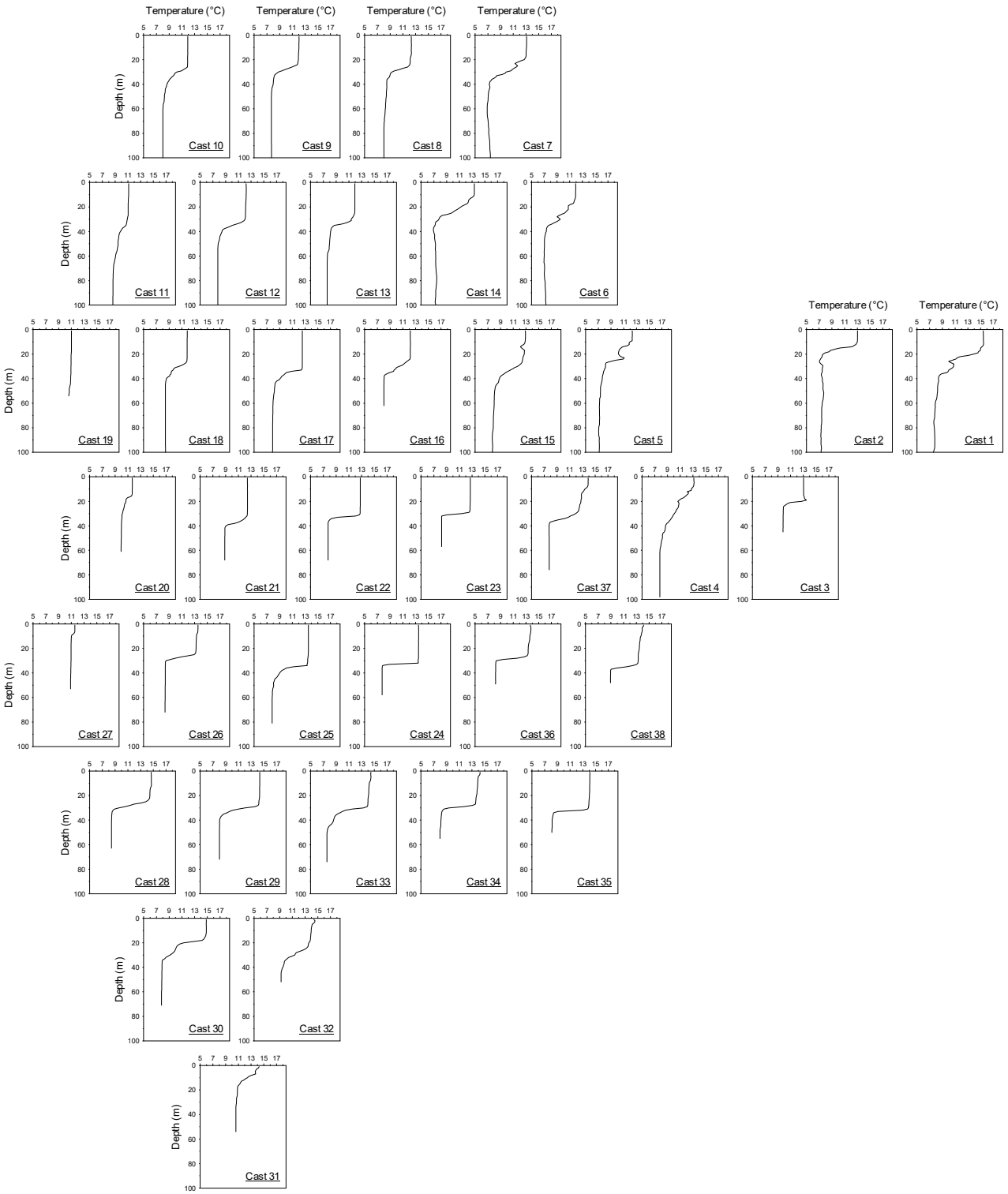

Fig. 9: Temperature conditions in the surface layer, IESSNS DK 2019.

Tab. 1: Species list (L: total length in cm below (fish); ML: mantle length (cephlapods), IESSNS DK 2019.

Latin name	Danish name	English name	Weight (kg)	Number	L_{min} (cm)	L_{max} (cm)	Remark
Scomber scombrus	Makrel	Mackerel	11608.808	56884	20	43	
Clupea harengus	Sild	Herring	9949.938	105272	14	32	
Sprattus sprattus	Brisling	Sprat	302.020	132642	1.5	16	
Cyclopterus lumpus	Stenbider	Lumpfish	134.554	125	5	42	
Micromesistius poutassou	Blåhvilling	Blue whiting	76.113	1004	18	29	
Eutrigla gurnardus	Grå knurhane	Grey gurnard	40.010	224	16	43	
Ammodytes marinus	Tobis-hav	Lesser sandeel	34.421	77613	3	6	
Belone belone	Hornfisk	Garfish	34.090	94	40	82	
Squalus acanthias	Pighaj	Picked dogfish	32.330	34	23	100	
Pollachius virens	Sej	Saithe	28.950	6	59	92	
Sardina pilchardus	Sardin	Pilchard	24.418	213	22	24	
Illex coindetii		Southern shortfin squid	11.874	111	6	27	ML
Merlangius merlangus	Hvilling	Whiting	7.529	2876	4	20	
Trachurus trachurus	Hestemakrel	Horsemackerel	7.519	20	26	40	
Melanogrammus aeglefinus	Kuller	Haddock	4.610	515	4	14	
Todaropsis eblanae		Lesser flying squid	1.540	12	6	18	ML
Pollachius pollachius	Lyssej	Pollack	1.084	2	35	42	
Todarodes sagittatus *		European flying squid	0.640	15	9	13	ML
Echiichthys vipera	Fjæsing lille	Lesser weever	0.506	16	11	15	
Limanda limanda	Ising	Common dab	0.450	3	16	18	
Lophius piscatorius	Havtaske	Monk	0.256	1	27	27	
Pleuronectes platessa	Rødspætte	Plaice	0.106	6	18	20	
Trachinus draco	Fjæsing	Greater weever fish	0.080	1	25	25	
Trisopterus esmarkii	Sperling	Norway pout	0.042	2	14	14	
Gasterosteus aculeatus	Trepigget hundestejle	Three-spined stickleback	0.018	3	7	10	
Pomatoschistus spp.	Sand kutling	Sand gobies	0.017	17	5	5	
Loligo forbesii		Northern squid	0.014	3	3	5	
Gadus morhua	Torsk	Cod	0.004	4	5	7	
Maurolicus muelleri	Laksesild	Pearlside	not measured				
*: awaits confirmation of correct species identification