DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2025 DK”

Gifico Pelagic | Fiskeri AB Ginneton

CETON

Danmarks
Pelagiske
Producentorganisation

DTU Aqua
Section for Monitoring and Data Hirtshals

Kai Wieland

11-08-2025

Vessel: F/V Ceton S205

Cruise dates: 4/7 – 14/7 2025

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):

Alexander Fhager (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 Multpelt 832 pelagic trawl with Dynema warps, is used to catch the mackerel. The trawl fishery takes place at a combination of random stations located along transects, and fishing depth is from 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 extent the survey design is 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, it appeared to be potential in expanding the survey as this might improve the index, especially for juvenile mackerel 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 in the years 2018 - 2024, the survey was conducted in 2025 using again the fishing vessel F/V Ceton. The methods were the same as in previous years except for a slightly changed layout of the sampling locations. The stratum limits were kept unchanged and the average distance between the stations with a randomly selected initial position on the southernmost transect was about 45 nautical miles to ensure that all planned 40 stations can be covered in the available survey period of 10 days at sea.

The collection of mackerel maturity information was done for the first time this year. This should facilitate a potential update of the maturity ogive used in the assessment which is actually based on data from 1960 to 1984 for the North Sea component of the NEA mackerel stock which may be outdated considering possible earlier maturation related to the warming in the North Sea during recent years.

Itinerary (local time)

2/7		Transport of equipment from Hirtshals to Skagen
4/7	07:30	Loading of remaining scientific equipment in Hirtshals and transport to Skagen
		Preparing vessel and installing equipment
	11:15	Departure from Skagen towards Donsø for refueling
	16:00	Departure Donsø
	22:45	Start of the survey sampling (at station 1)
13/7	15:15	Survey sampling finished (at station 40)
	02:00	Arrival Hirtshals,
		Unloading equipment and samples in Hirtshals
	03:00	Storage of equipment and samples at DTU Aqua Hirtshals completed.

Achievements

Weather conditions were very good throughout most of the survey period and eight transects (with 1 to 9 stations on each) between about 54°25′ and 59°40′ N and 1°17′ W and 10°00′E were covered in the Skagerrak and the northwestern North Sea (Fig. 1) with the following activities conducted:

- 40 CTD profiles (down to 100 m or to about 5 m above bottom, prior to each fishing operation) with a memory Sea-Bird Seacat19Plus probe equipped with sensors for pressure, temperature and conductivity,
- 40 valid tows with a Multpelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 7 m^2 Thyborøn type 15 doors.

The between station length of the cruise track amounted to about 1800 nm.

Results

Sampling and gear performance

The survey was conducted with the 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 285 and 335 m with a difference between SB and BB of 5 - 10 m in general. The average depth of the SB and BB doors ranged from 4 - 32 m.

Position, course, speed (GPS) and trawl geometry (Marport sensors, acoustic data transmission) were protocolled every 5 minutes. Average values by haul for towing speed over ground (SOG), vertical net opening and door spread ranged from 4.4 to 5.7 kn, 24 to 33 m and 118 to 132 m between the stations (Fig. 2) and amounted to 4.9 kn, 28.9 m and 121 m on average for all stations.

Bottom depth and distance of footrope to bottom were between 61 and 480 m and between 29 and 450 m, respectively, during nominal tow duration. However, during setting of 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 66.7 to 72.5 m. Towed distance was received from the fishing plotter based on the continuously recorded GPS positions during the tow and ranged between 3.5 and 5.1 km per banana tow. These values were used to compute the swept area converting total catch (kg) to densities (kg/km^2) per tow.

Catches and species distribution

Mackerel was caught on almost all stations. Most catches were between 250 and 500 kg, and fifteen catches exceeded 1000 kg with the highest catch of 4.4 tons (Fig. 3). The total catch of mackerel amounted to 25.6 tons (Tab. 1) and average mackerel density was 2060 kg/km^2, which is similar to the last year's value (Fig. 4).

As in previous years, herring was the second most abundant species in the catches (Tab. 1). The herring catches, however, cannot be regarded as representative because both, during night and day, strong echo traces which presumably were herring occurred frequently below the surface layer fished.

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. In contrast, blue whiting was only found in the surface layer during night at deep water stations in the Skagerrak.

Mackerel length, weight and age distribution

Mackerel length was between 18 and 41 cm. Single fish weight was initially 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.

In total, 1090 individuals were sampled for a length-weight relationship (Fig. 5) and an age-length key (Fig. 6). The exponent of the length-weight relationship was 3.01, and the overall Fulton and Le Crens condition factors of 0.87 and 0.94, respectively, indicate a good condition of mackerel in the surveyed area.

The heads of each individual mackerel for which fish length and weight was recorded were frozen on board for later otolith extraction in the lab. Ages 1 to 12 were identified in the single fish data of which fish at age 8 and older were pooled into a plus-group (Fig. 6).

Age 1 mackerel were most abundant in the southern and eastern part of the survey whereas older fish (age 2, 3 and 4+) were more scattered (Fig. 7).

Overall, the length and age composition for the survey indicates a considerably high number of small (<25 cm, age 1) individuals this year and a pronounce peak in the length distribution at 31 to 32 cm (mainly age 2) (Fig. 8).

Mackerel maturity

The fraction of immature males and females amounted to 0.16 and 0.24 for males and females, respectively. A high number of actively spawning individuals were found, in particular for males (Fig. 9), and the proportion of this stage in the adult population amounted to 90 % for males and 24 % for the females.

At age 1, 11 % of the females and 28 % of the males were mature. Length and age at 50% maturity for both sexes combined were 28.38 cm and 1.37 yrs, respectively (Fig. 10). At age 2, already 94 % of the individuals were mature, and this value is considerable higher than the proportion mature at this age of 37 % used in the present assessments.

Temperature conditions

CTD profiles were successfully recorded for all the 40 stations conducted. Sea surface temperature ranged from 13.1 to 17.8 °C with the highest values in the eastern part of the survey area. A pronounced thermocline in the upper 20 to 30 m was found for all stations except for one station off the Scottish coast (Fig. 11). Below the thermocline, i.e. at depths > 40 m, temperature was mainly between 7.1 and 10.6 °C.

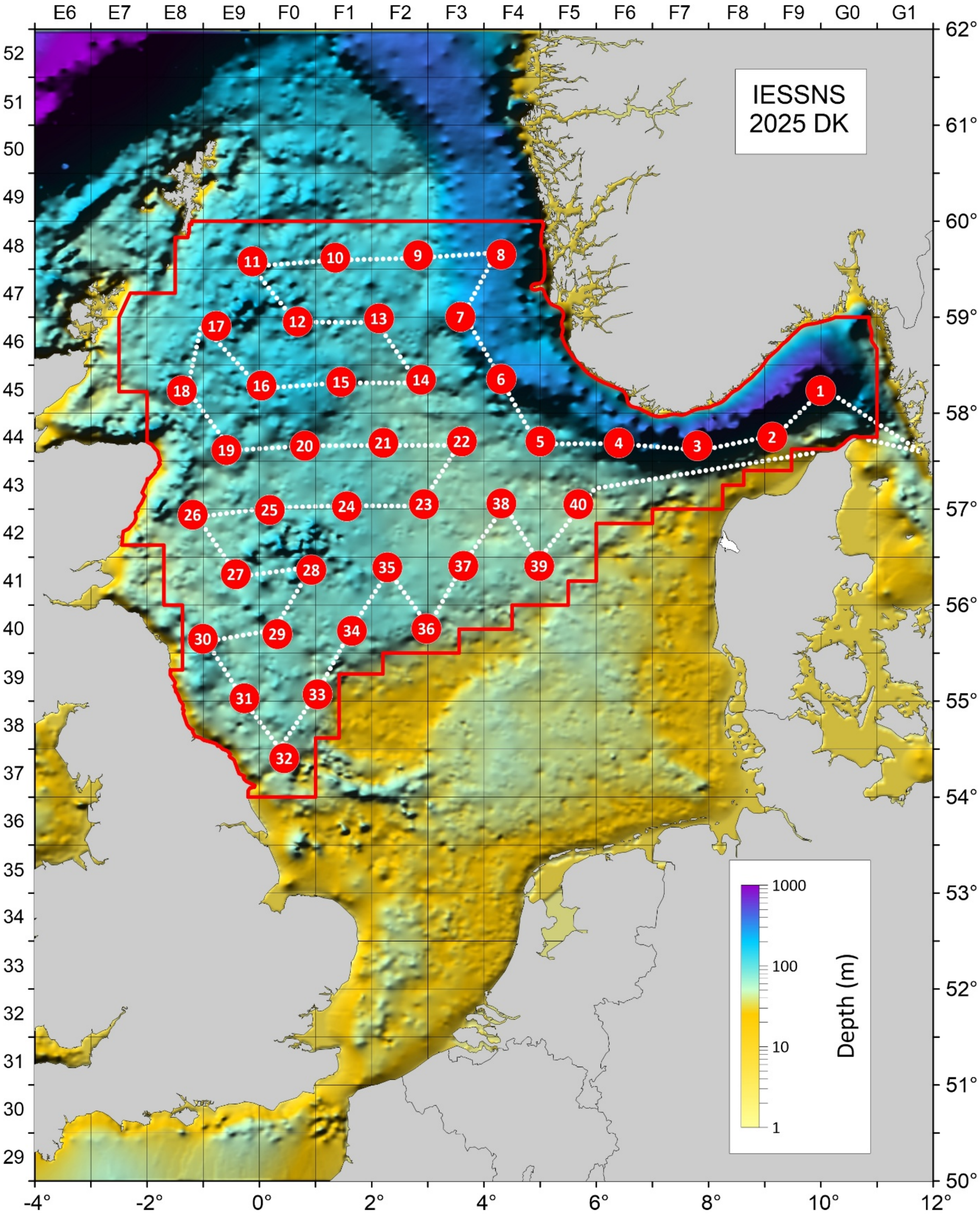


Fig. 1: Survey map with sampling locations, cruise track and stratum limit.

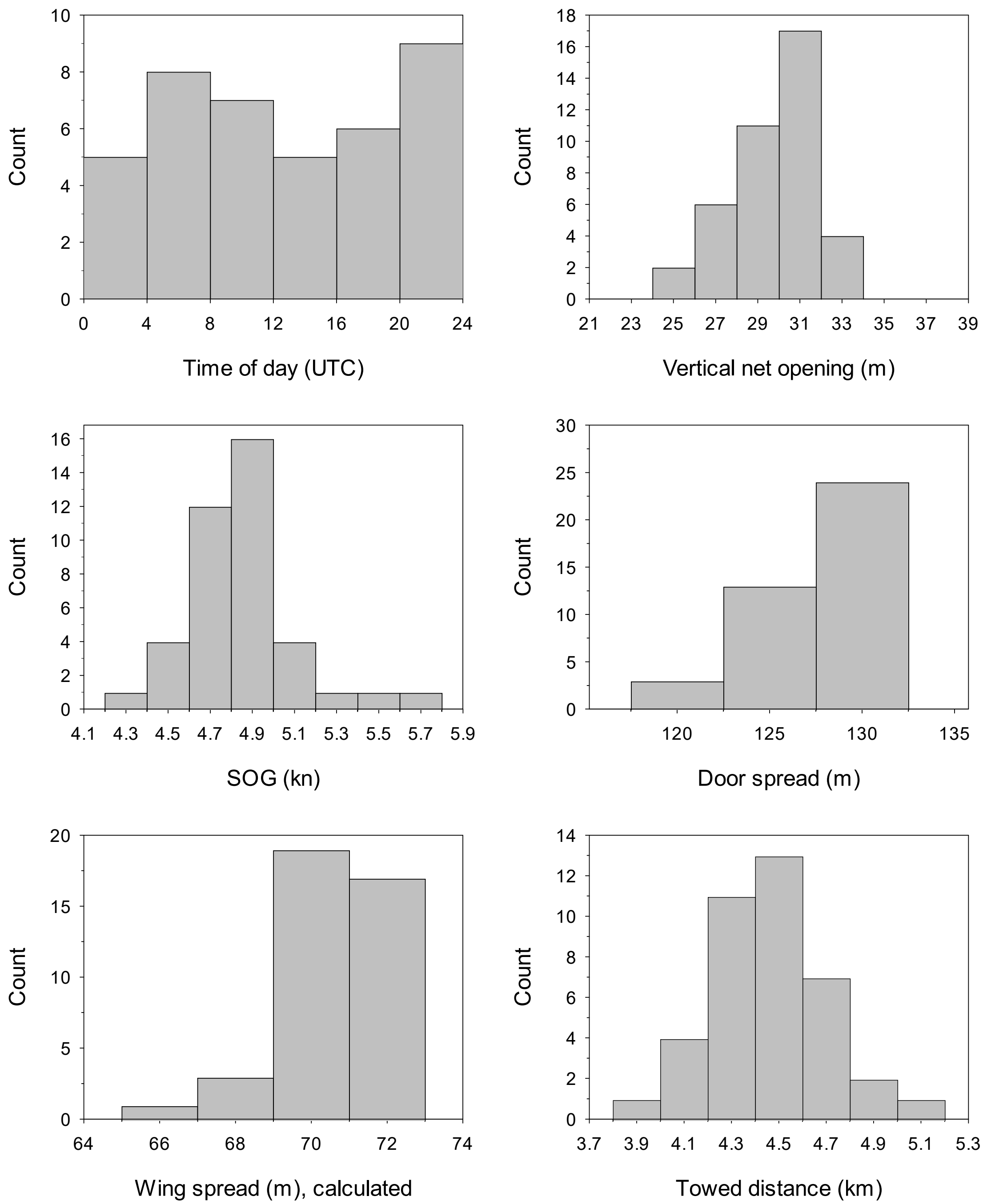


Fig 2: Times of day fished, vessel and gear performance (mean values by station).

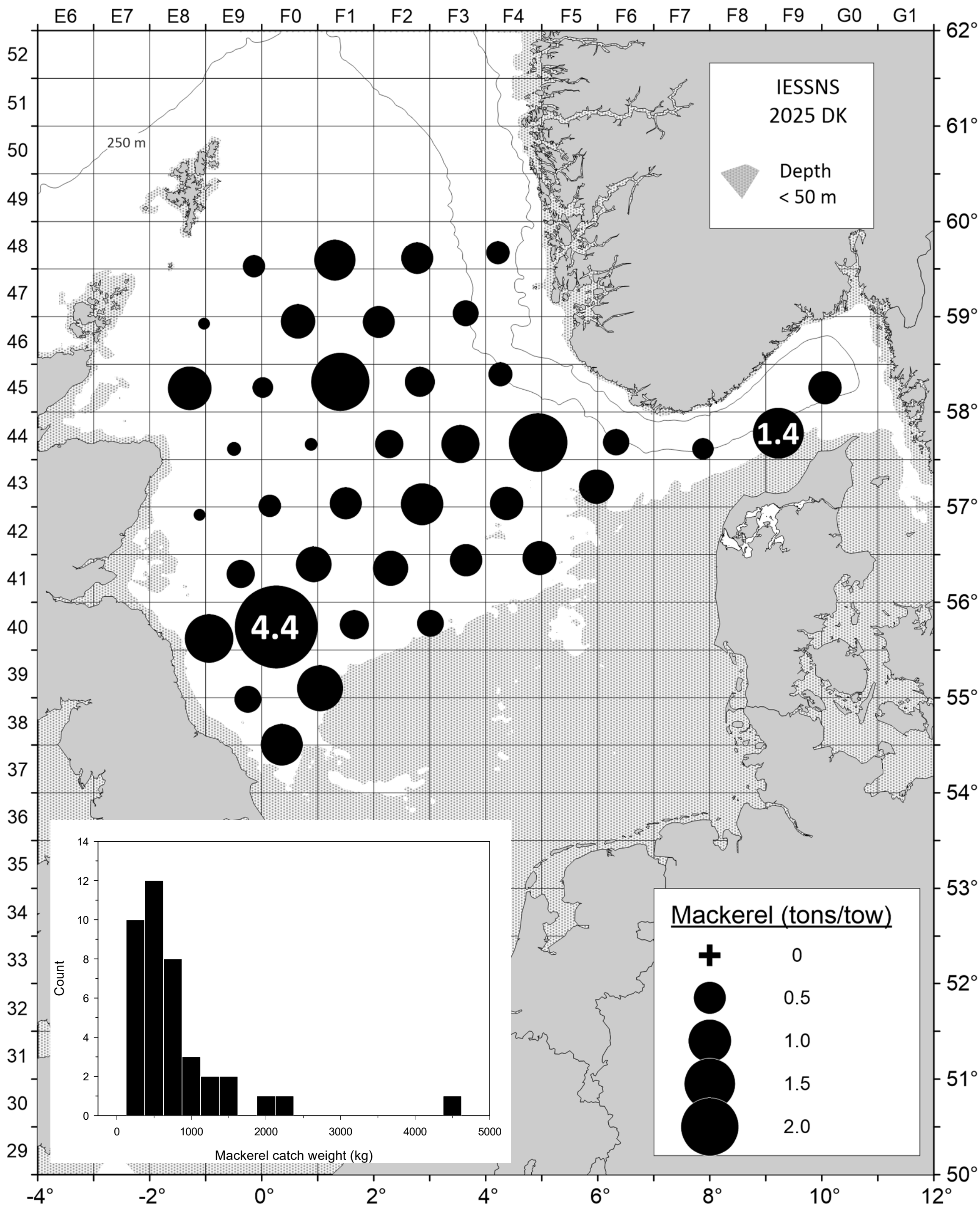


Fig. 3: Distribution of mackerel catches.

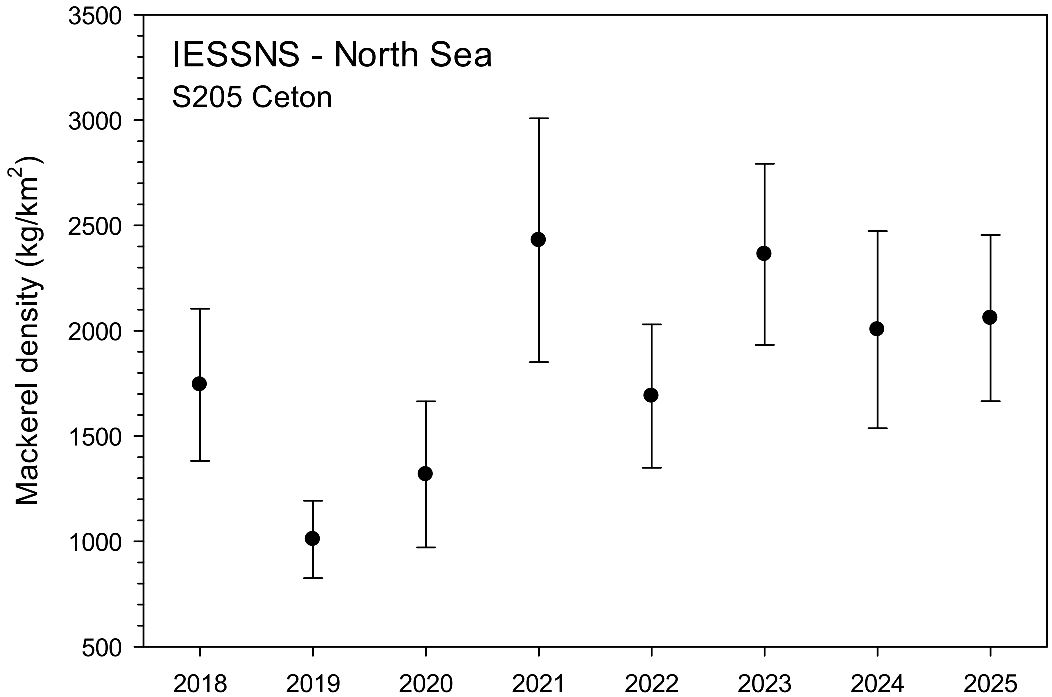


Fig. 4: Mackerel density (mean and standard error) in 2018 – 2025.

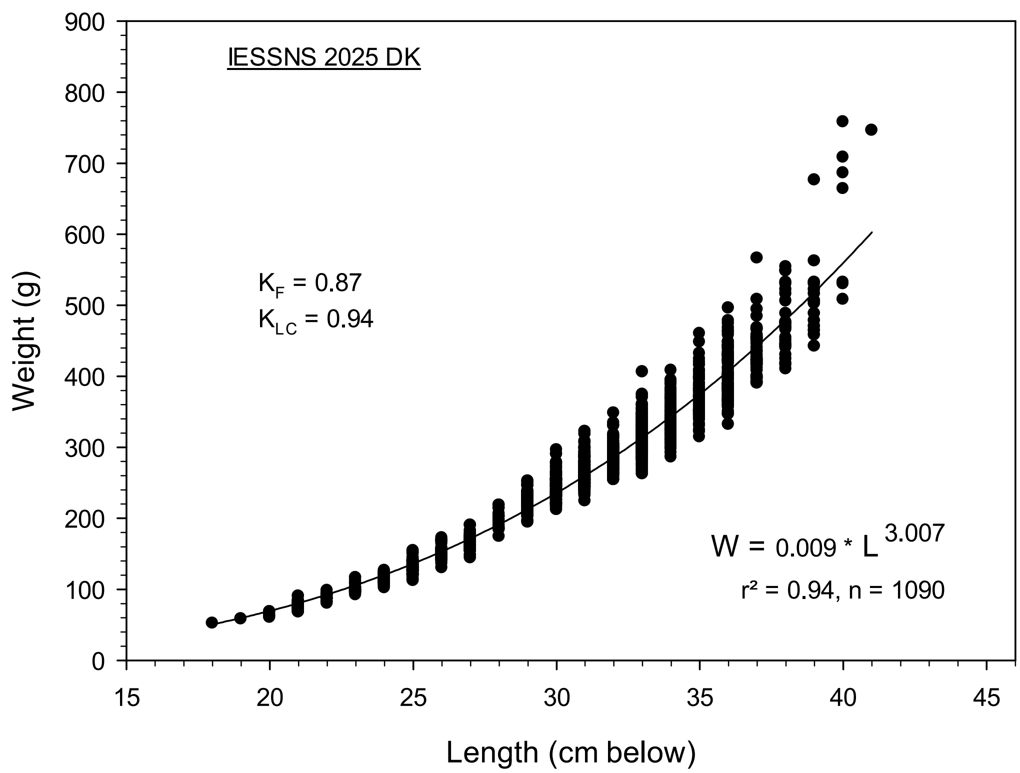


Fig. 5: Length-weight relationship for mackerel.

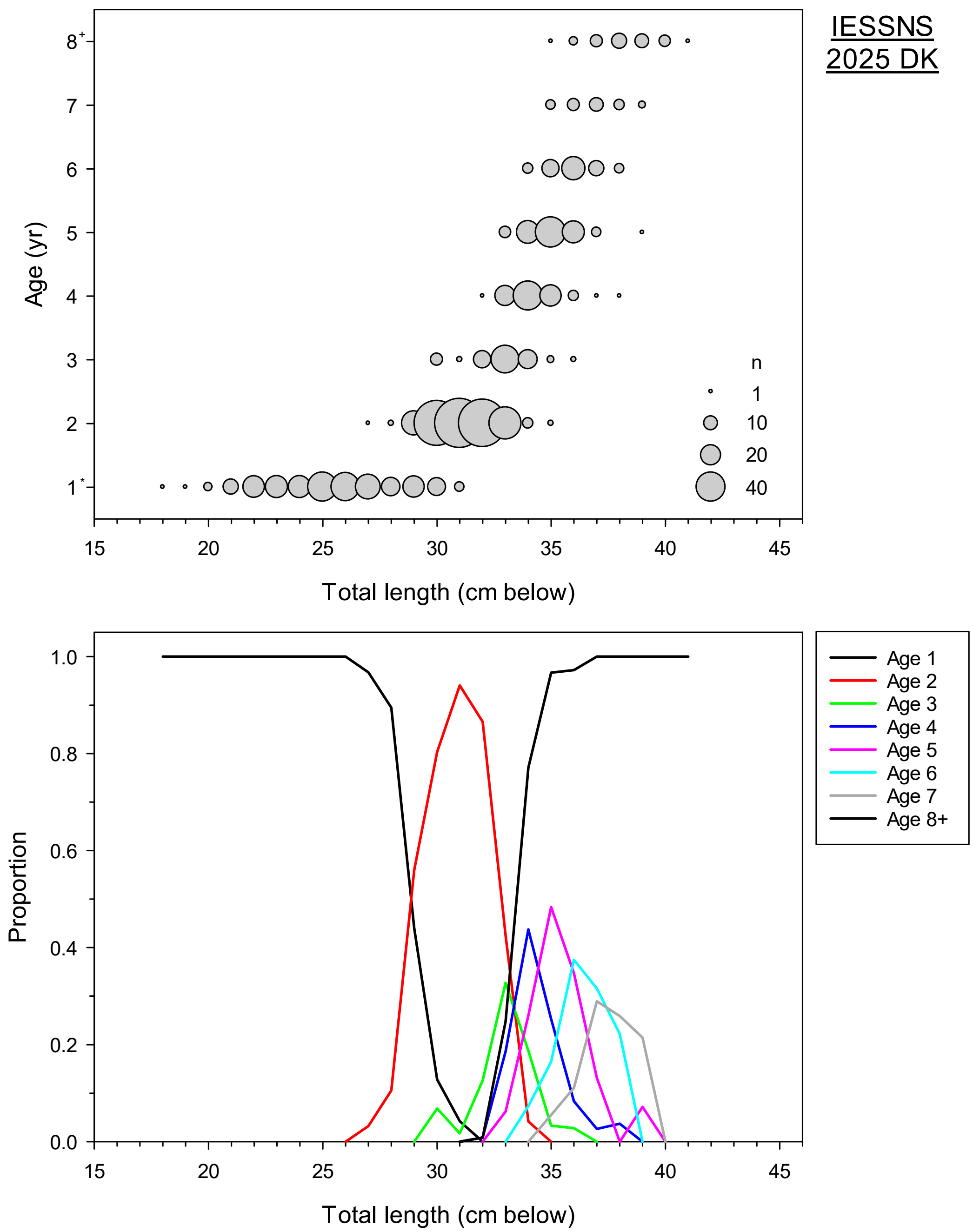


Fig. 6: Age-length key for mackerel (bubble size in upper panel refers to number of otoliths analyzed (n)).

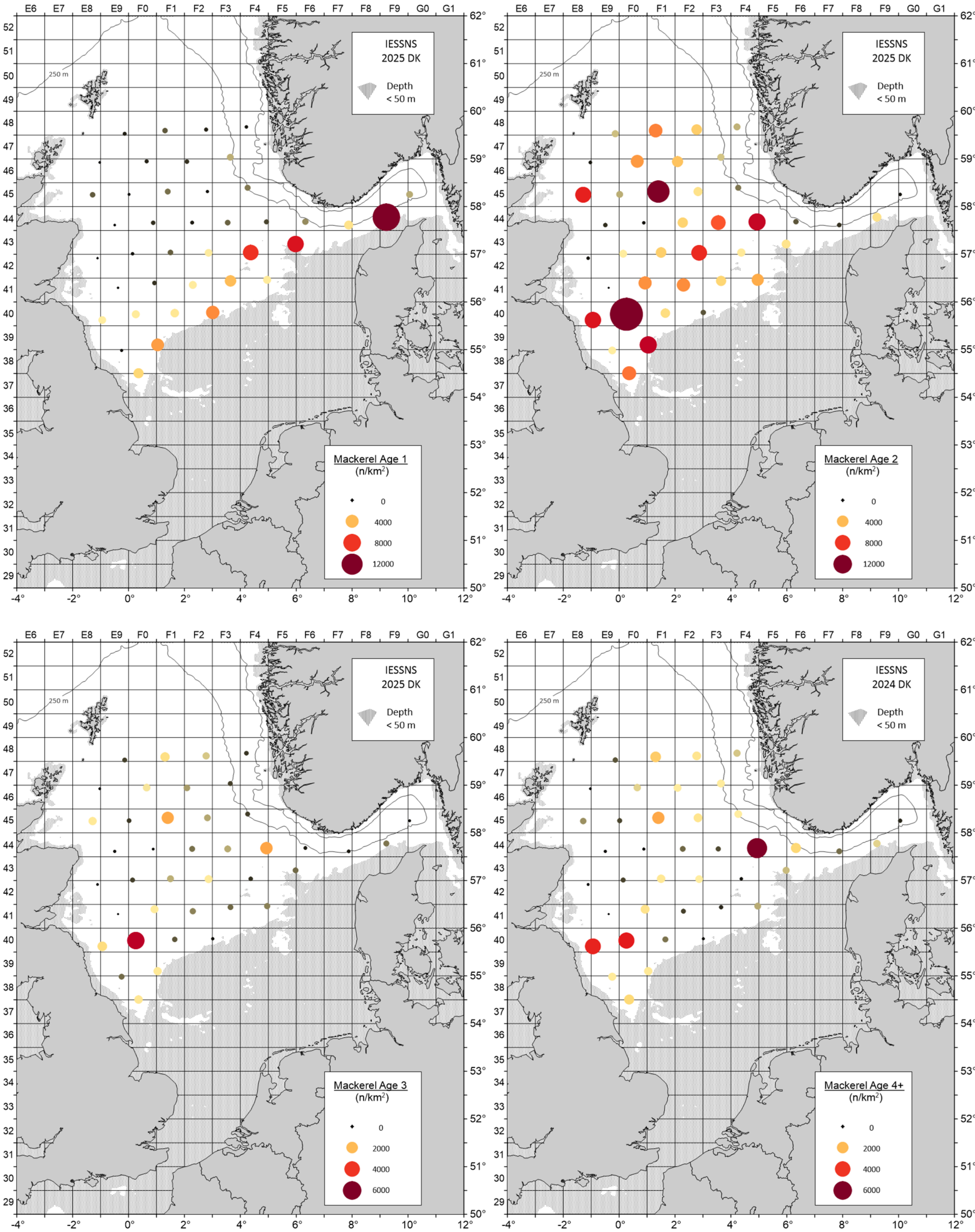


Fig. 7: Mackerel distribution by age.

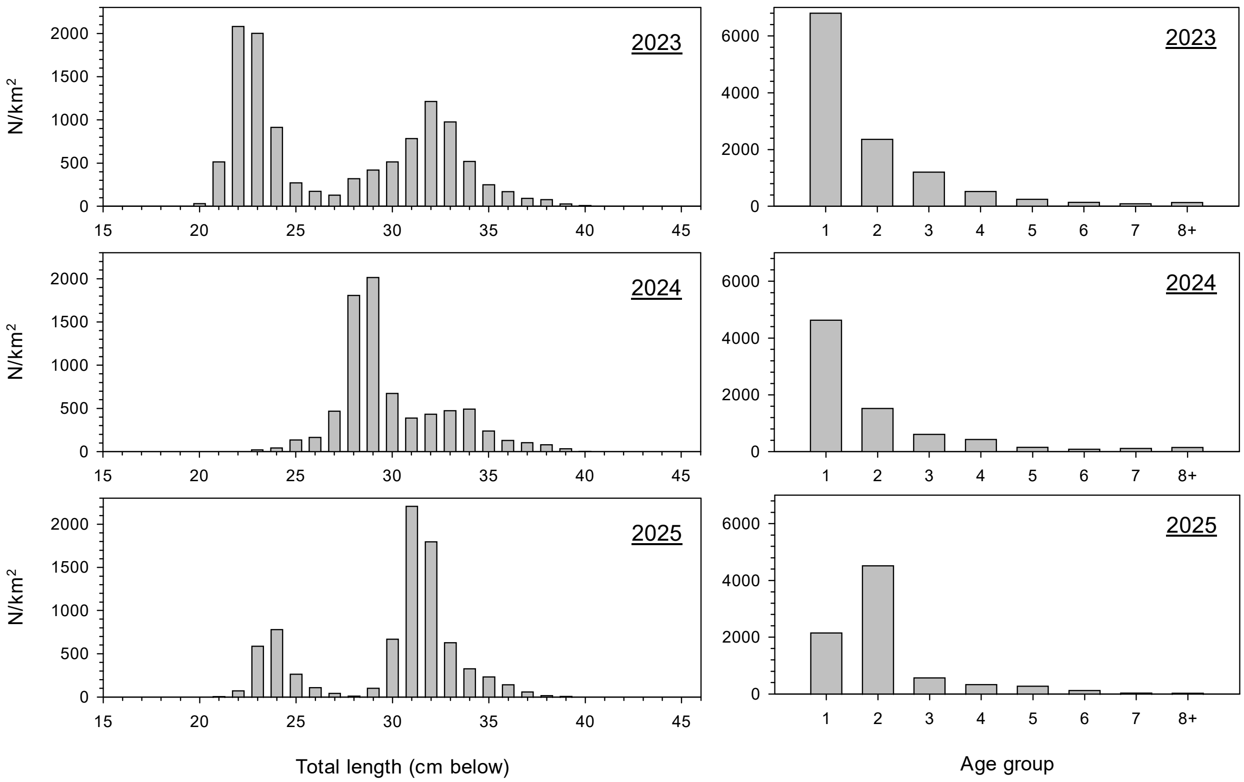


Fig. 8: Length and age composition of mackerel, 2023 - 2025.

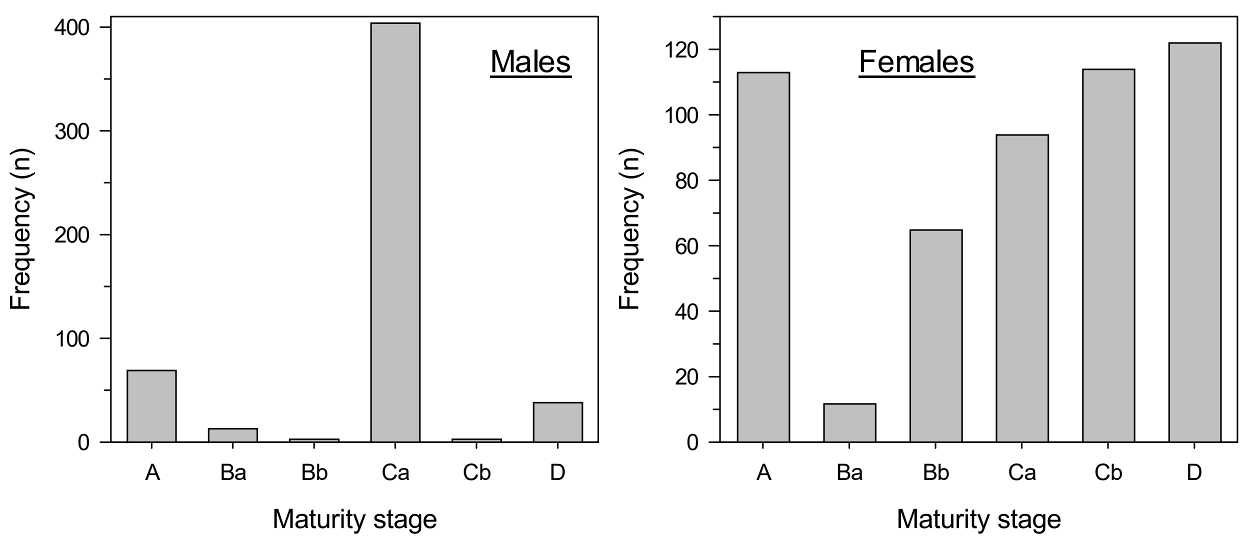


Fig. 9: Maturity stage distribution (A-Ba: Immature, Ca: actively spawning).

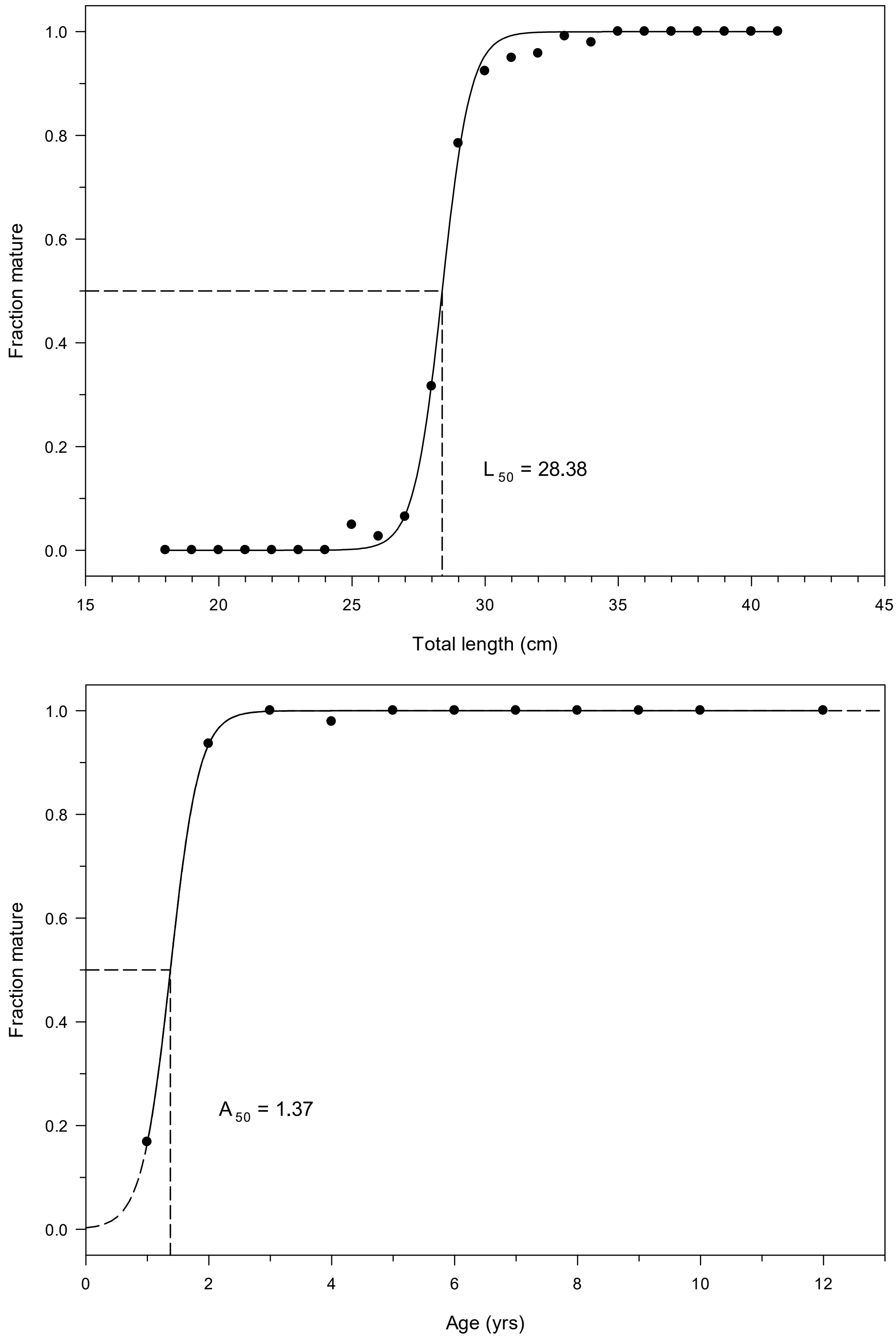


Fig. 10: Maturity ogives by length and age for both sexes combined.

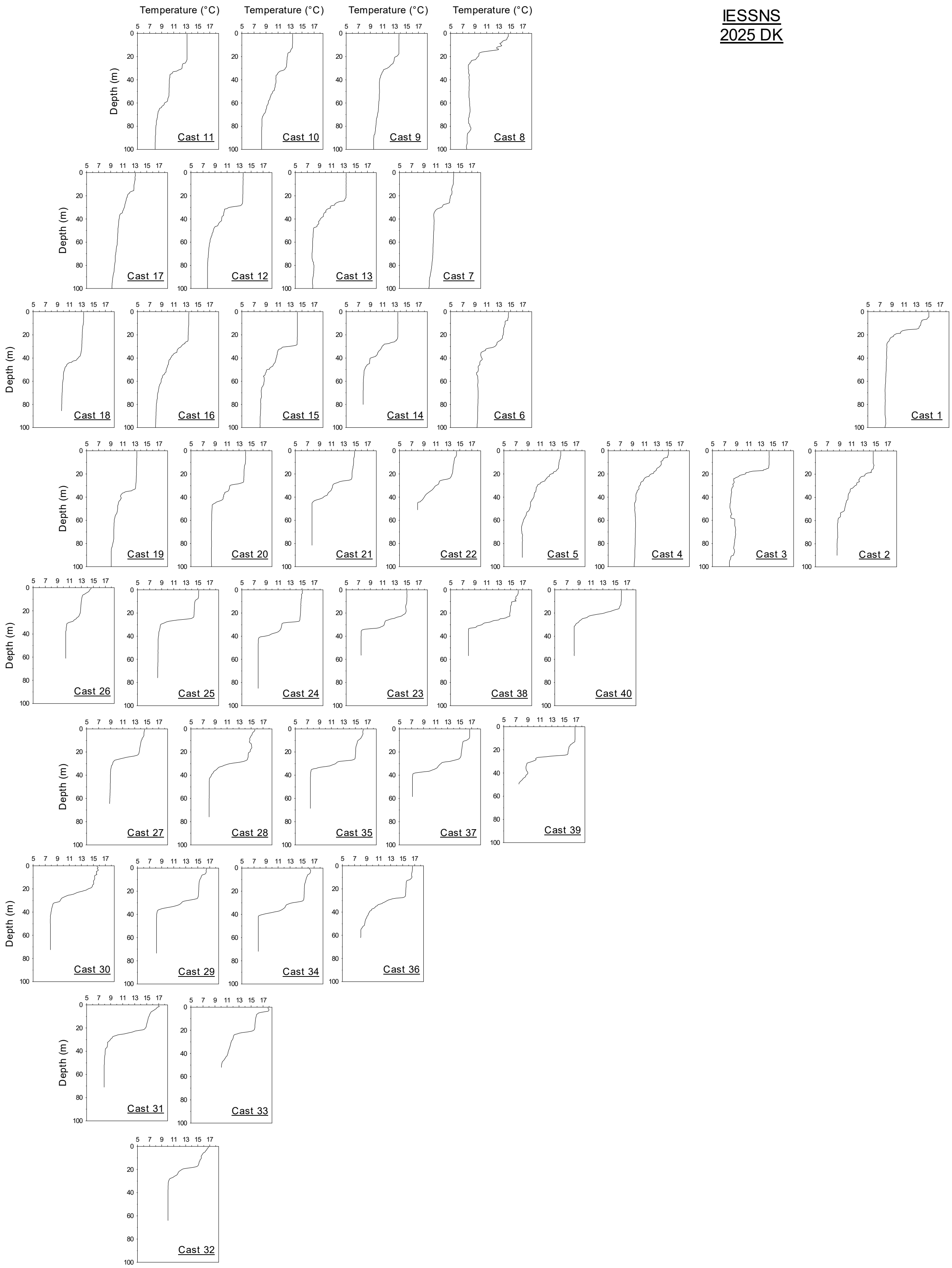
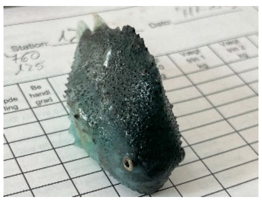


Fig. 11: Temperature conditions in the surface layer.

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

Latin name	Danish name	English name	Weight (kg)	Number	L_{min} (cm)	L_{max} (cm)	Remark
Scomber scombrus	Makrel	Mackerel	25594.299	103602	18	41	
Clupea harengus	Sild	Herring	24743.423	232698	17	32	
Lamna nasus	Sildehaj	Porbeagle	286.000	2	208	214	both from station 31
Merlangius merlangus	Hvilling	Whiting	230.490	2459	19	34	
Squalus acanthias	Pighaj	Spurdog	211.010	159	26	125	present in 7 hauls
Aurelia aurita	Vandmand	Common jellyfish	184.088				
Cyanea capillata	Rød brandmand	Lions mane	80.659				
Cyclopterus lumpus	Stenbider	Lumpfish	60.486	56	5	39	present in 13 hauls
Galeorhinus galeus	Gråhaj	Tope	27.800	1	171	171	station 34
Micromesistius poutassou	Blåhvilling	Blue whiting	21.606	227	21	27	all from station 1 (night haul)
Eutrigla gurnardus	Grå knurhane	Grey gurnard	20.205	149	17	32	
Melanogrammus aeglefinus	Kuller	Haddock	12.053	29	9	39	
Salmo trutta	Ørred	Sea trout	4.100	2	55	65	both from station 7
Illex coindetii		Southern shortfin squid	4.090	27	13	25	
Trachurus trachurus	Hestemakrel	Horse mackerel	3.060	9	25	40	
Todaropsis eblanae		Lesser flying squid	2.352	18	11	18	
Belone belone	Hornfisk	Garfish	1.080	4	41	69	
Sprattus sprattus	Brisling	Sprat	0.148	8	13	15	
Trisopterus esmarkii	Sperling	Norway pout	0.028	1	15	15	
Agonus cataphractus	Panserulk	Pogge	0.010	1	10	10	



Acknowledgements

Many thanks to skipper Alexander Fhager and in all aspects his competent crew for the good atmosphere and the very successful cooperation onboard. Further thanks to Claus Sparrevohn, 'Danmarks Pelagiske Producent Organisation' (DPPO), for organizational issues and logistics prior to the survey. Despite some severe irritations concerning missing deadlines and the extremely late decision to conduct the survey and at which dates, the present cruise is considered the best in the time series.

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