DTU Aqua

Cruise Report

F/V Ceton S205

”IESSNS 2026 DK”

Gifico Pelagic | Fiskeri AB Ginneton

CETON

Danmarks Pelagiske Producentorganisation

DTU Aqua
Section for Monitoring and Data Hirtshals

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Participants

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

Kai Wieland (Cruise leader),
Per Christensen,
Martin Christensen
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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 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 - 2025, the survey was conducted in 2026 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 39 stations can be covered in the available survey period of 10 days at sea.

The collection of mackerel maturity information was done for the second 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 or high fishing pressure in recent years.

Itinerary (local time)

1/7 and 2/7		Transport of equipment from Hirtshals to Skagen
4/7	14:00	Loading of and installing equipment, preparing vessel
	18:15	Departure from Skagen
	21:00	Start of the survey sampling (at station 1)
13/7	08:00	Survey sampling finished (at station 39)
14/7	18:00	Arrival Hirtshals,
		Unloading equipment and samples in Hirtshals
	18:30	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°17' and 59°27' N and 2°25' W and 10°30'E were covered in the Skagerrak and the northwestern North Sea (Fig. 1) with the following activities conducted:

- 39 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,
- 39 valid tows with a Multpelt 832 Pelagic Trawl (cod end mesh size 22 mm) and 7 m^2 Thyborøn type 15 doors.

The total length of the cruise track amounted to about 1880 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 255 and 350 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 3.6 to 5.4 kn, 19 to 34 m and 110 to 128 m between the stations (Fig. 2) and amounted to 4.8 kn, 26.4 m and 121 m on average for all stations.

Low vertical net opening was observed in particular during the last part of the survey. This was due to rigging problems with the kite, which could not be resolved at sea but may partly also be inferred by misreading the quite noise signals from the Marport system.

Bottom depth and distance of footrope to bottom were between 56 and 436 m and between 29 and 404 m, respectively, during nominal tow duration. However, during setting of the trawl, the footrope came shortly 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 63.7 to 70.7 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 all stations. At 25 stations catches exceeded 1000 kg with the highest value of 11.7 tons (Fig. 3). The total catch of mackerel amounted to 59.9 tons (Tab. 1) and average mackerel biomass density was 5024 kg/km^2, which is considerable higher than 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, herring may have occurred below the fished surface layer.

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 22 and 47 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, 1076 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 2.89, and the overall Fulton and Le Crens condition factors of 0.86 and 1.04, 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 15 were identified in the single fish data of which fish at age 8 and older were pooled into a plus-group (Fig. 6).

All ages were present in the central and the eastern part of the survey area. In addition, the juveniles (Age 1) were also found in the south-eastern part close to the 50 m depth limit of the survey domain (Fig. 7).

Overall, the length and age composition for the survey indicates a considerably high number of age 1 to 3 individuals this year and pronounced peaks in the length distribution at 29 and 33 cm (age 2 and age 3 respectively) (Fig. 8).

Mackerel maturity

Results on maturity at length and age, and on the fraction of spawning adults will be presented in a separate report.

Temperature conditions

CTD profiles were successfully recorded for all the 40 stations conducted. Sea surface temperature ranged from 12.1 to 17.9 °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 two stations off the northeastern Scottish coast (Fig. 9). Below the thermocline, i.e. at depths > 40 m, temperature was mainly between 6.4 and 11.8 °C.

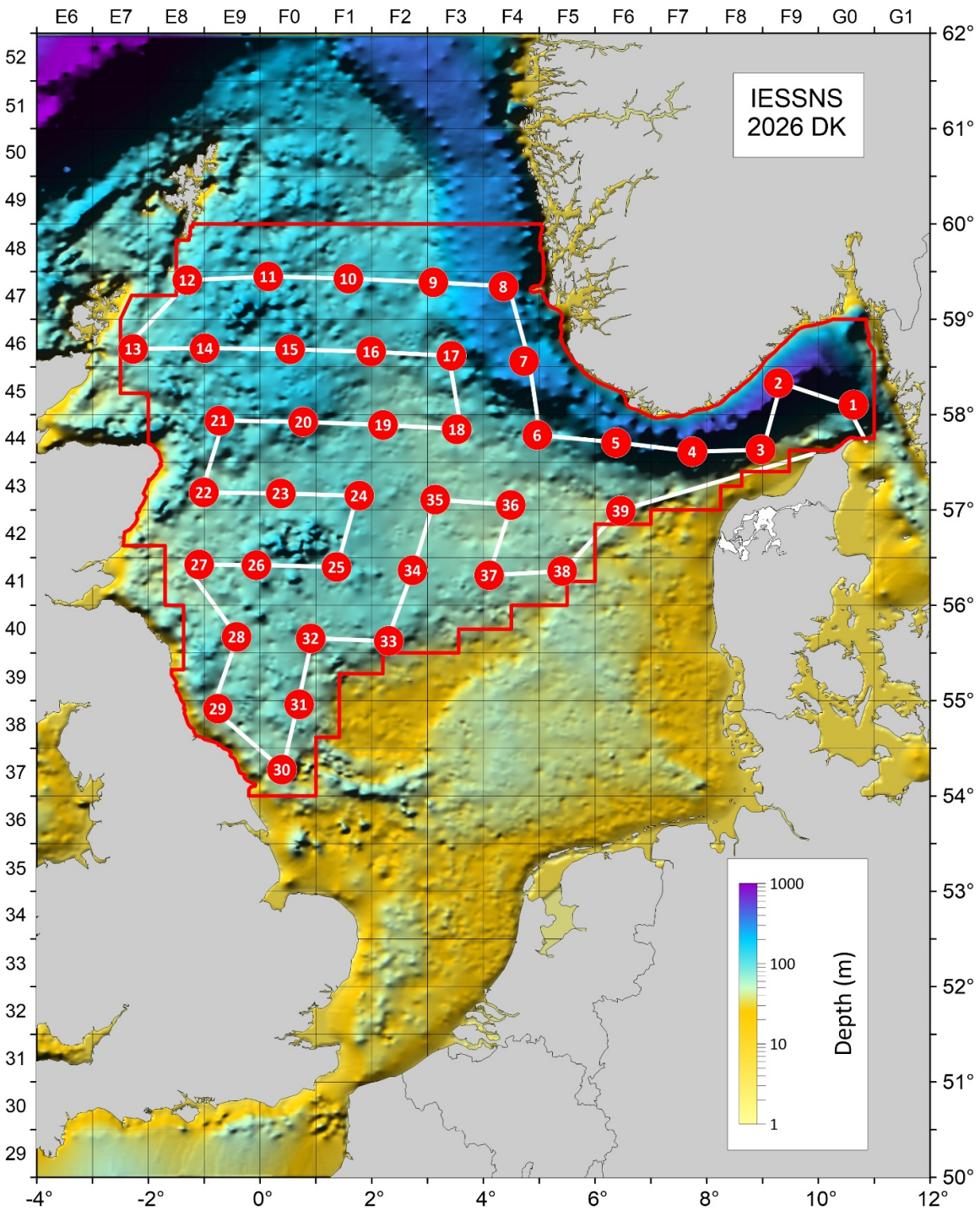

Fig. 1: Survey map with sampling locations, cruise track and stratum limit.

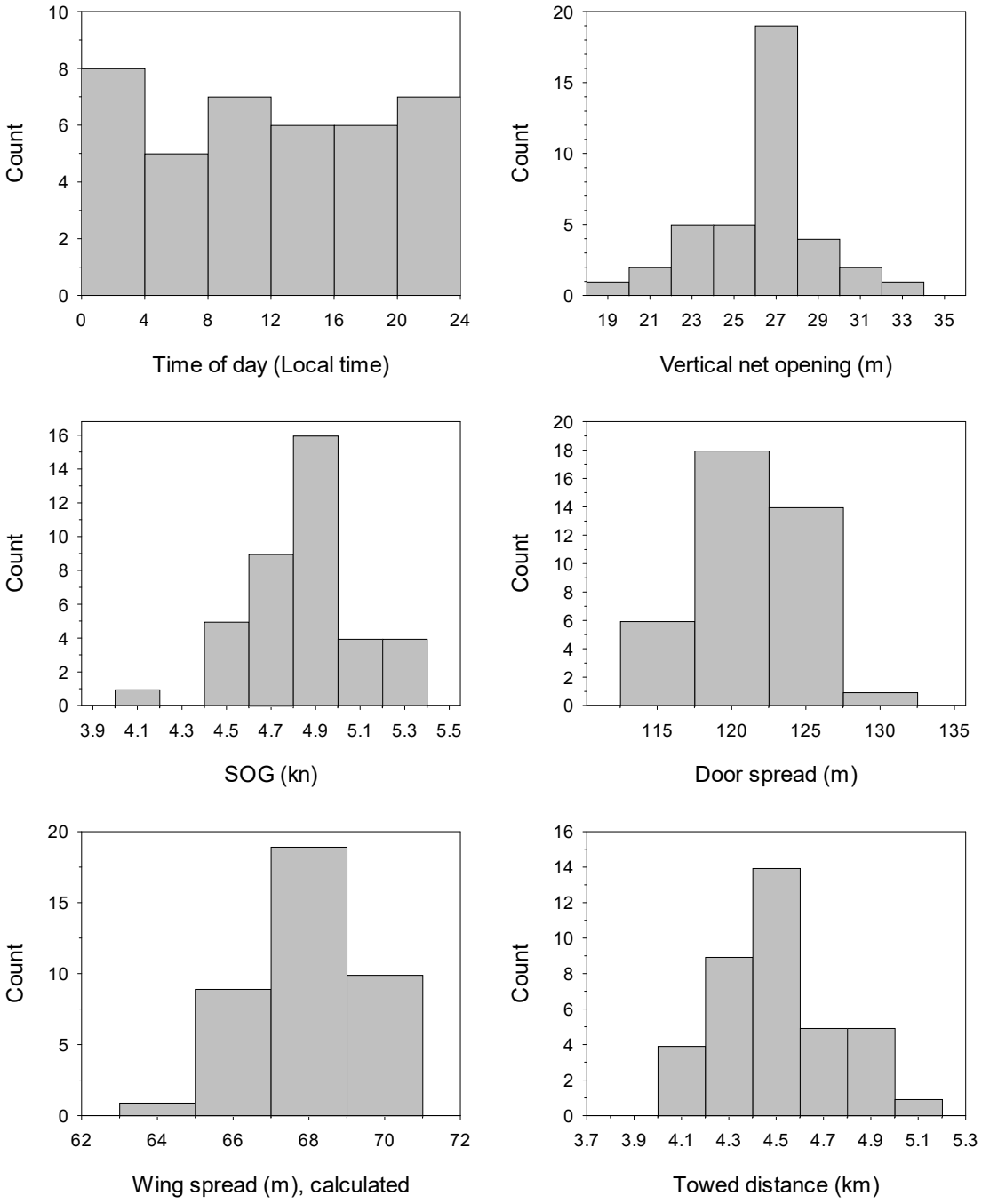

Fig 2: Times of day fished and vessel / gear performance (mean values by station).

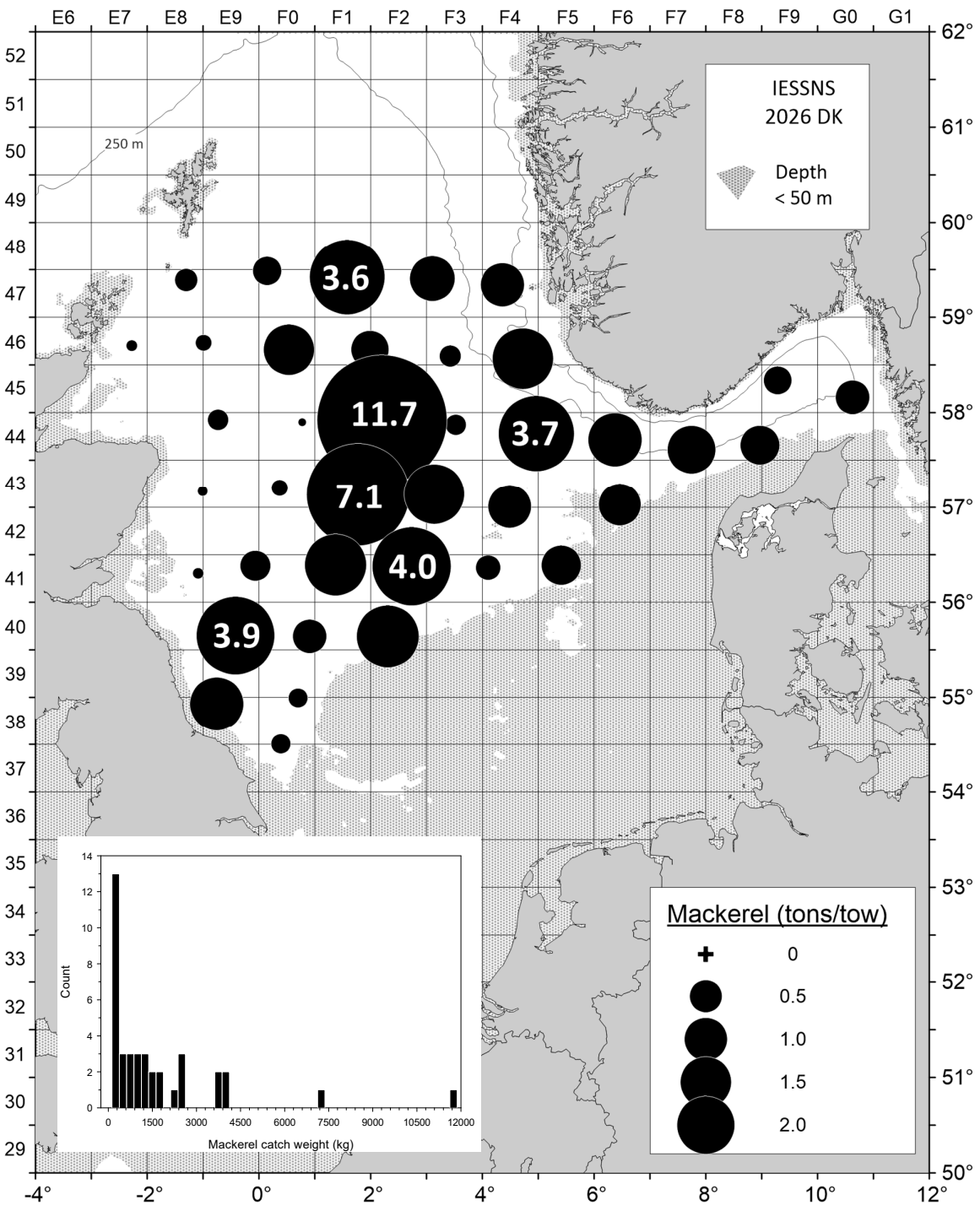

Fig. 3: Distribution of mackerel catches.

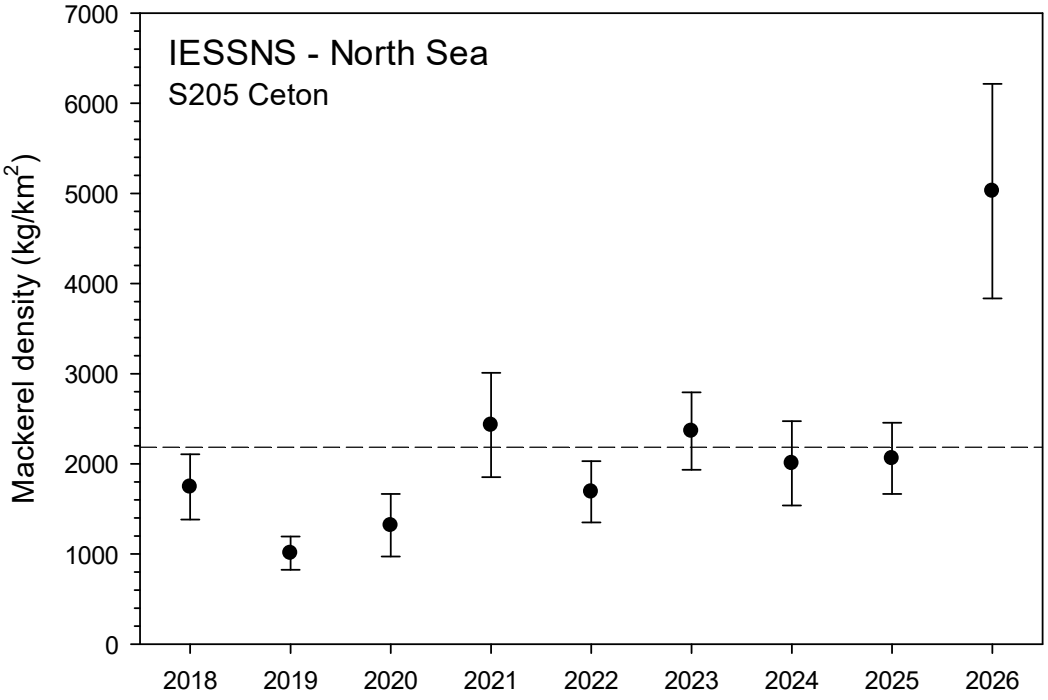

Fig. 4: Mackerel density (mean and standard error) in 2018 – 2026.

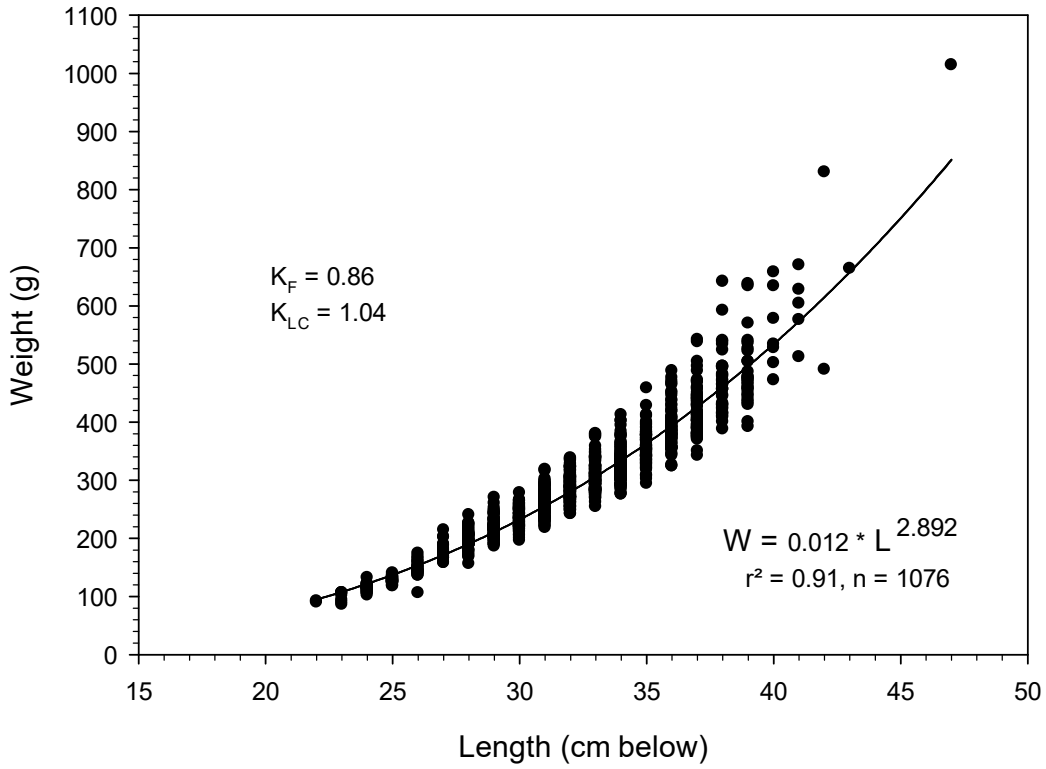

Fig. 5: Length-weight relationship for mackerel.

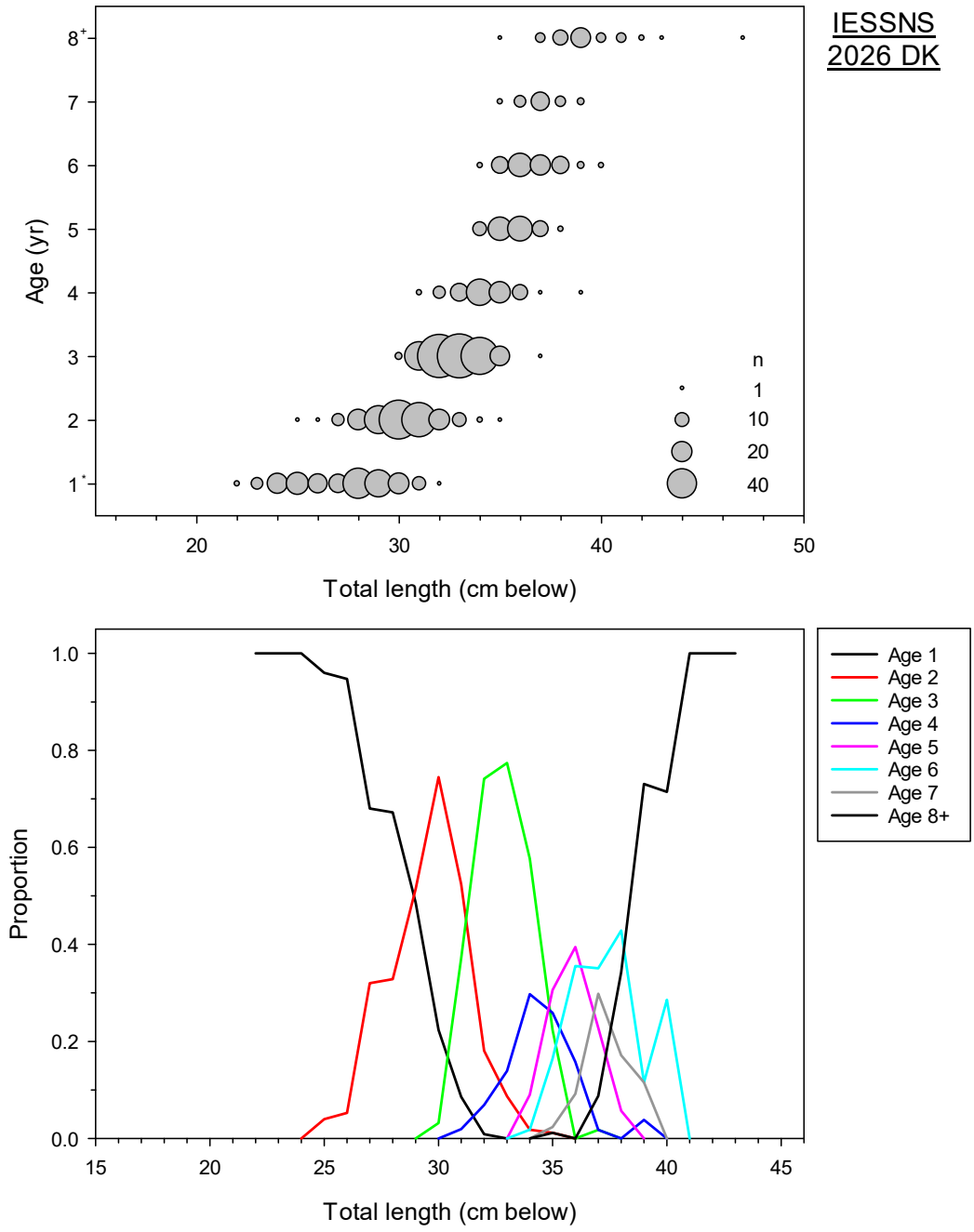

Fig. 6: Age-length key for mackerel (bubble size in upper panel refers to number of otoliths analyzed (n)).

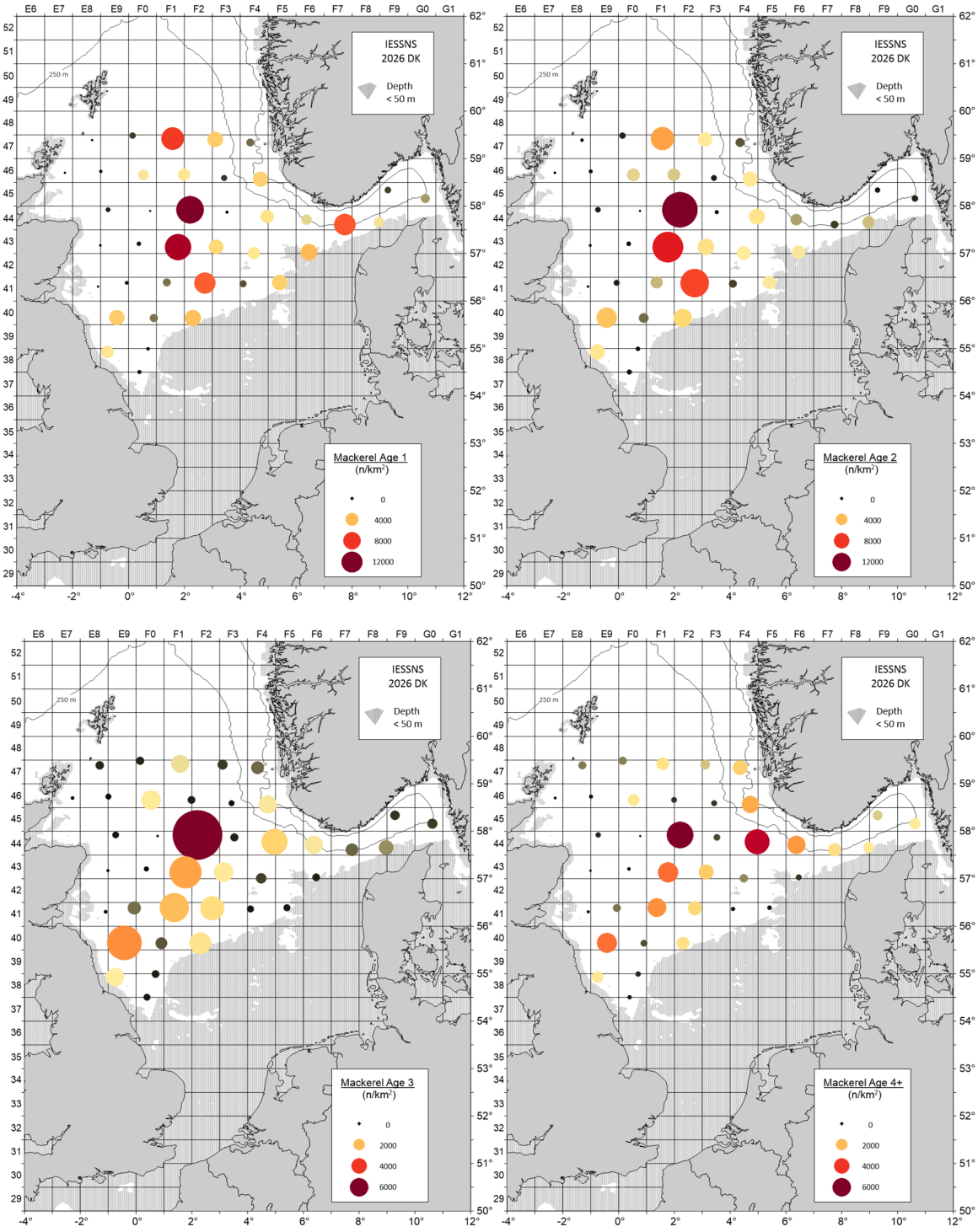

Fig. 7: Mackerel distribution by age.

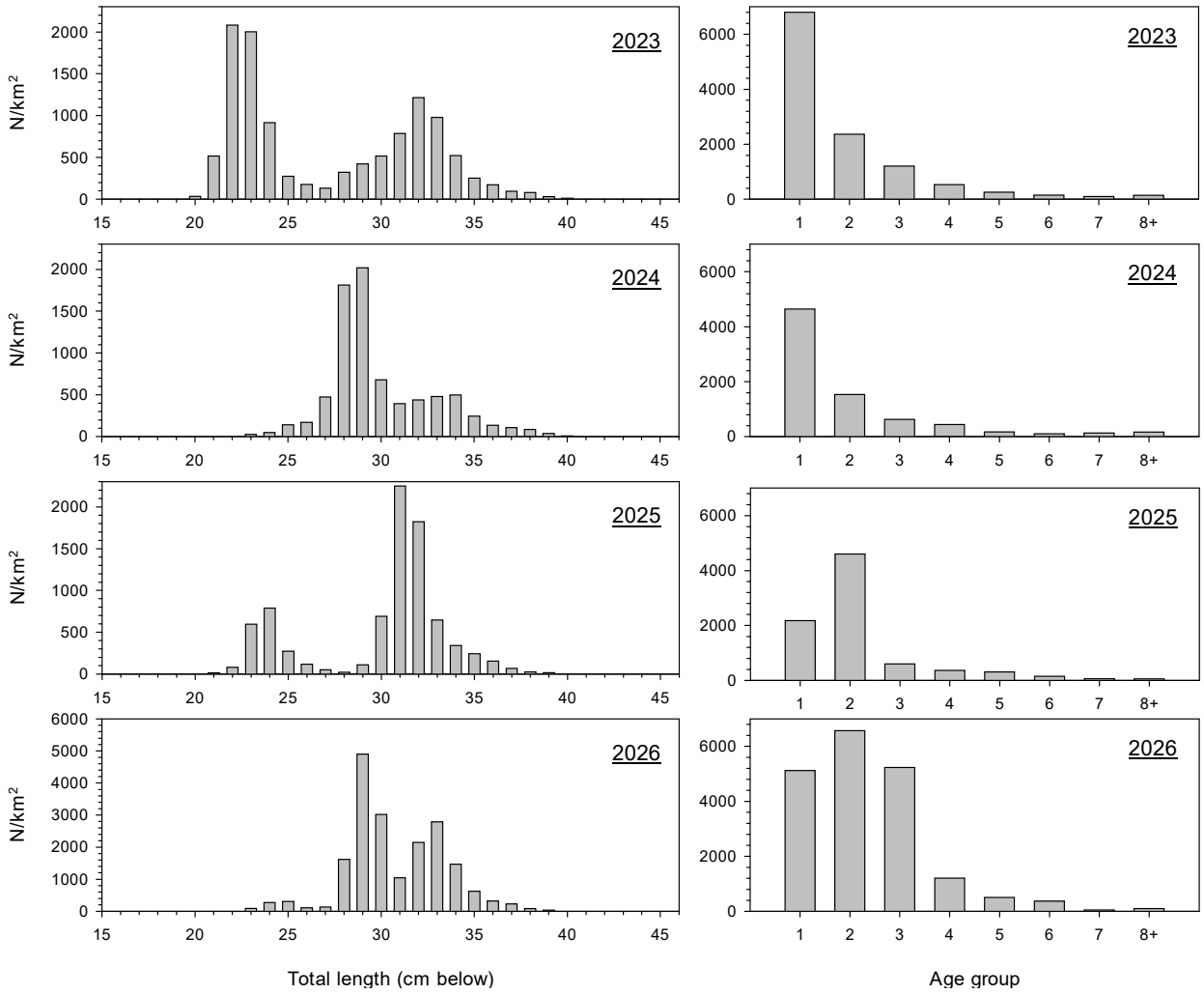

Fig. 8: Length and age composition of mackerel, 2023 - 2026.

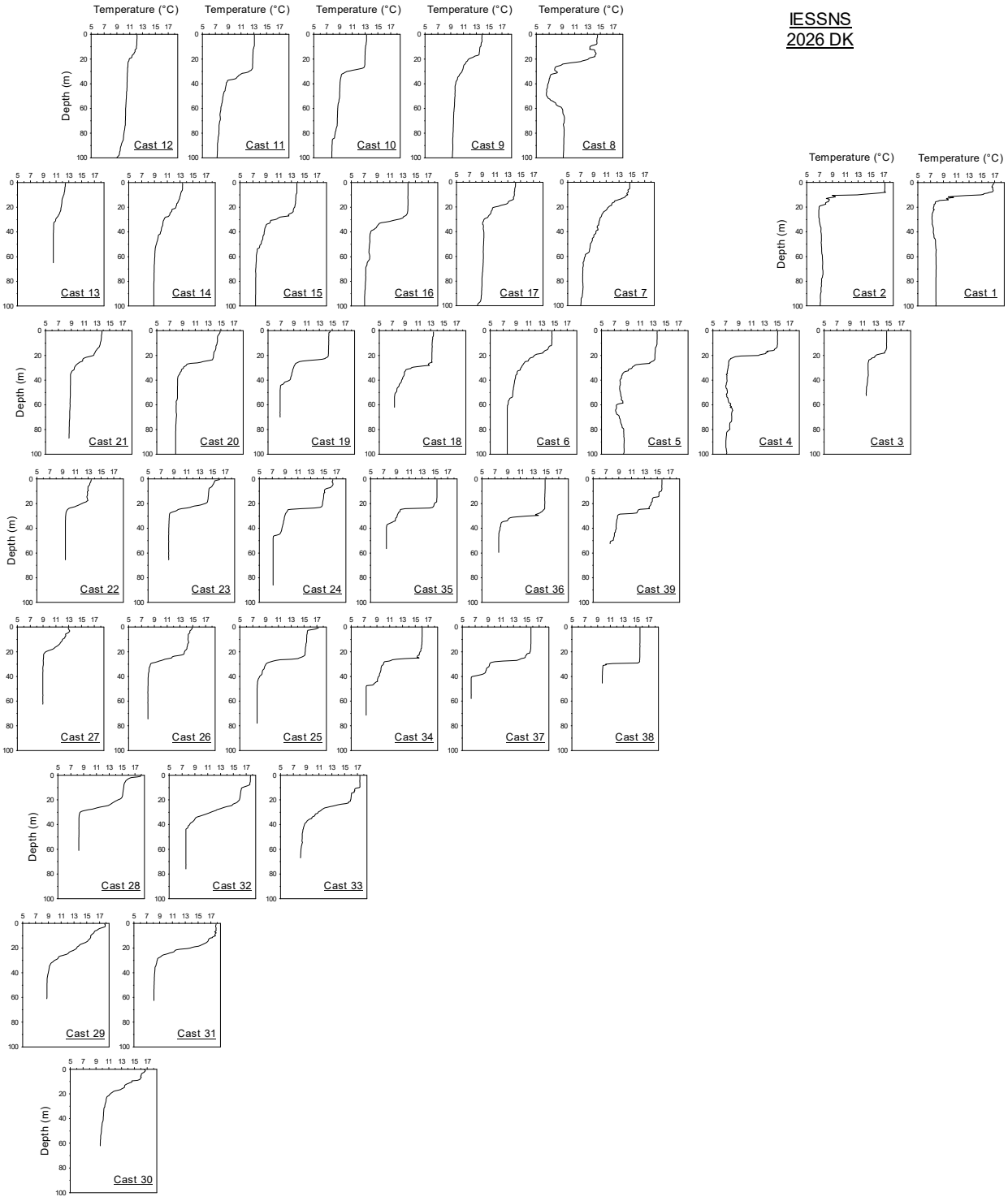

Fig. 9: Temperature conditions in the surface layer.

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	59502.148	228167	22	47		
Clupea harengus	Sild	Herring	35571.265	267649	9	34		
Squalus acanthias	Pighaj	Spurdog	346.896	1465	26	93		
Lamna nasus	Sildehaj	Porbeagle	85.660	1	200	200		Station 26
Micromesistius poutassou	Blåhvilling	Blue whiting	69.927	589	23	30		all from Station 1
Merlangius merlangus	Hvilling	Whiting	29.279	451	4	38		
Cyclopterus lumpus	Stenbider	Lumpfish	26.796	26	6	33		
Melanogrammus aeglefinus	Kuller	Haddock	22.154	50	9	40		
Belone belone	Hornfisk	Garfish	6.790	23	49	69		
Illex coindetii	Rød blæksprutte	Southern shortfin squid	4.360	17	13	25		
Todaropsis eblanae	Todaropsis eblanae	Lesser flying squid	3.462	17	7	20		
Trachurus trachurus	Hestemakrel	Horse mackerel	3.282	9	32	37		
Pollachius pollachius	Lyssej	Pollack	2.080	6	31	41		
Eutrigla gurnardus		Grey gurnard	1.360	8	18	36		
Sprattus sprattus	Brisling	Sprat	1.217	71	11	14		
Pollachius virens		Saithe	0.808	1	44	44		
Loligo forbesii	Loligoblæksprutte	Northern squid	0.340	1	23	23		
Todarodes sagittatus	Flyveblæksprutte	European flying squid	0.286	1	23	23		
Pleuronectes platessa	Rødspætte	Plaice	0.246	1	29	29		
Sardina pilchardus	Sardin	Pilchard	0.164	2	20	22		

Acknowledgements

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