DTU Aqua
Institut for Akvatiske Ressourcer

Makrelbestanden i Nordsøen (NordMak). Bilag

Bilag til DTU Aqua-rapport nr. 398-2022

Indhold

Bilag A – Rapport for forsøgstogt i 2018

F/V Ceton S205

”IESSNS 2018 DK”

Danmarks Pelagiske Producentorganisation

European Union
European Maritime and Fisheries Fund

HAV & FISK

Vessel: F/V Ceton S205

Cruise number: na

Cruise dates (planned): 2/7 – 13/7 2018

Cruise name: IESSNS 2018 DK

Port of departure:	Skagen	**Date:**	02 July
Port of return:	Hirtshals	**Date:**	13 July
Other ports:	Egersund	**Date and justification:**	6 July Collection of new crane scale

Participants

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

Kai Wieland (Cruise leader),
Per Christensen,
Dirk Tijssen

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 is 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.

Itinerary (local time)

2/7-2018	10:00 Arrival of scientific team and loading of equipment in Skagen
	16:00 Departure from Skagen
	17:00 Test of trawl and adjustments of rigging (5 trials, finished 22:00)
3/7-2018	01:30 Start of the survey sampling, interrupted (after station 17)
6/7-2018	18:25 Arrival Egersund
	18:30 Departure Egersund
7/7-2018	01:00 Survey sampling resumed (station 18)

12/7-2018 00:00 Survey sampling completed (station 39)
13/7-2018 06:30 Arrival Hirtshals, Unloading of equipment and samples (until 07:15)

Achievements

Eight transects between about 59°25' N to 54°08'N were covered with in total 39 sampling locations (Fig. 1) and the following activities:

- 39 CTD profiles (Sea-Bird SeacatPlus, down to about 5 m above bottom, prior to each fishing operation)
- 39 valid hauls with a Multipelt 832 Pelagic Trawl (cod end mesh size 20 mm).

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 curvature between 60 and 100° in total. Since no continuous digital recording system has been available (except for the Simrad ES 60 echo sounder, 38 khz), position, course, speed and trawl geometry (from Marport sensors) were protocolled every 5 minutes. Towing speed, vertical net opening and door spread ranged from 4.6 to 5.4 kn, 24 to 35 m and 116 to 127 m between the stations (Fig. 2) and amounted to 5.1 kn, 31 m and 122 m on average for all stations.

Bottom depth and distance of footrope to bottom were between 51 and 525 m and between 20 and 490 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 34 to 37).

Horizontal trawl opening (Wing spread, WS) 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 to 70 m, and towed distance calculated from towing speed and duration was between 4.2 and 5 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 3.3 tons was recorded 15 nm off the English coast (Fig. 3), and average mackerel density was 1743 kg/km^2.

Herring was restricted to the northern part of the survey area with a maximum catch of 2.7 tons and an average density of 3.1 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.

Mackerel length frequencies, mean weight and age distribution

Mackerel length was between 17 and 43 cm but with pronounced difference between the stations (Fig. 5, Tab. 2). Single fish weight was recorded for one specimen per cm group and station which yielded in total data for 602 individuals and the resulting length-weight relationship is shown in figure 6. Mean individual weight by station was highest in the western and northwestern part of the survey area whereas the lowest values were found east and north east from the Doggerbank (Fig. 7).

Otoliths (and stomachs) were collected along with the recording of single weight. Age readings for a subset of uneven station numbers indicated that the entire sample set had to be worked up at least for fish > 25 cm before numbers at age by haul as input for stock assessment can be provided. The final age length key based on 594 age readings is shown in Fig. 8. In future surveys, the number of age samples for lengths below 20 cm can be decreased to 2 individuals per 5 cm group and station in favor to increase the numbers to 2 individuals per 1 cm group for length above 30 cm.

Temperature conditions

Surface temperature ranged from about 13 and 18 °C. A pronounced thermocline in the upper 20 to 40 m was found for most of the stations (Fig. 9). Only in the northwestern part of the survey area, i.e. off the Scottish coast, such stratification was missing.

Acknowledgements

Many thanks to Skipper Jacob Claeson and his competent and efficient crew for the very successful cooperation onboard. Further thanks to Claus Sparrevohn, 'Danmarks Pelagiske Producent Organisation' (DPPO), for organizational issues and logistics prior to the survey.

This project is funded by the European Maritime and Fisheries Fund and the Danish Fisheries Agency.

Photos: Per Christensen, DTU Aqua

Kai Wieland
Head of section
Senior Researcher, PhD
Section for Monitoring and Data Hirtshals
DTU Aqua

Technical University of Denmark
National Institute of Aquatic Resources
Nordsøen Forskerpark, Willemoesvej 2,
9850 Hirtshals
Denmark
Direct +45 35883276
Mobile +45 93511160
kw@aqua.dtu.dk
www.aqua.dtu.dk

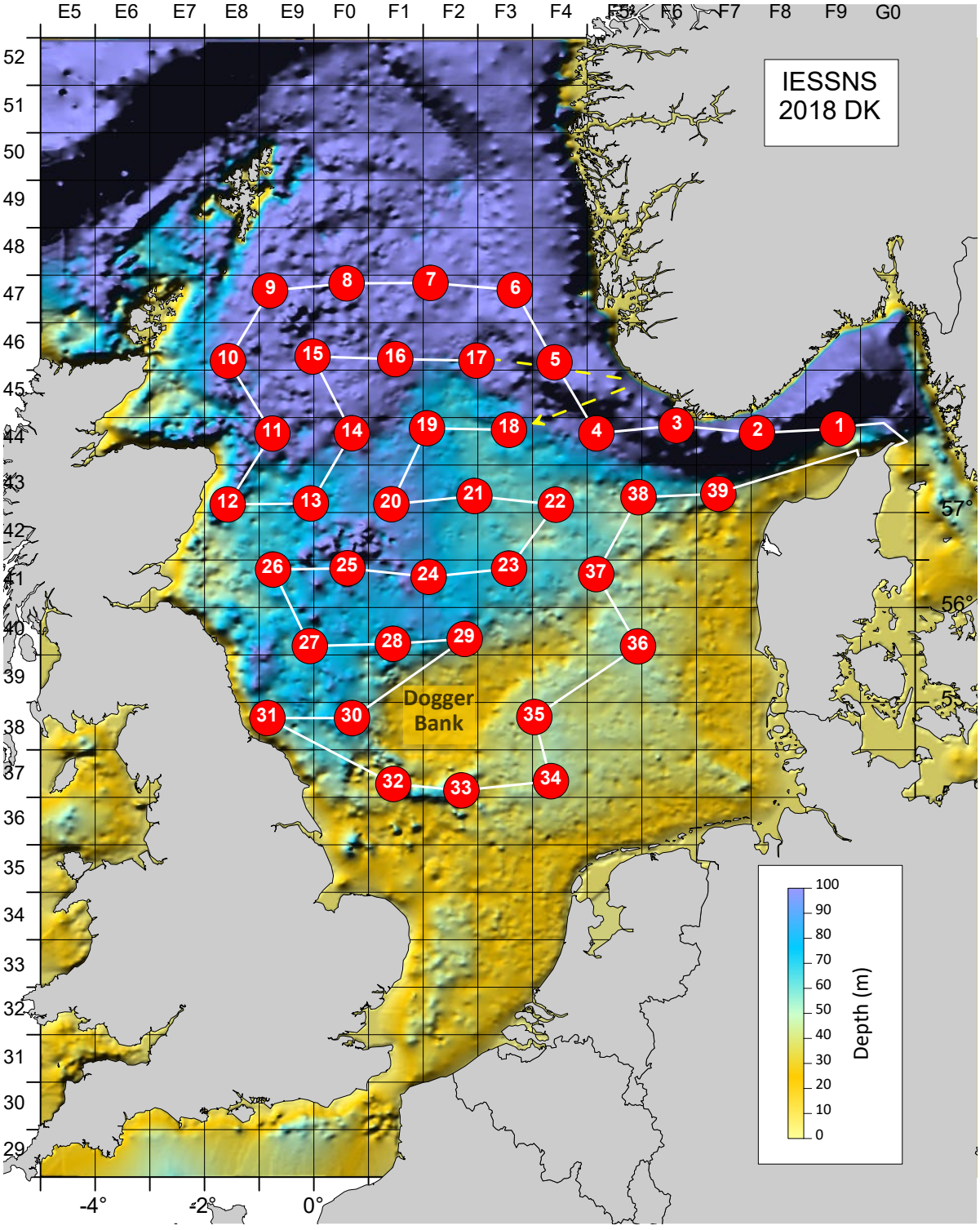


Fig. 1: Survey map with sampling locations.

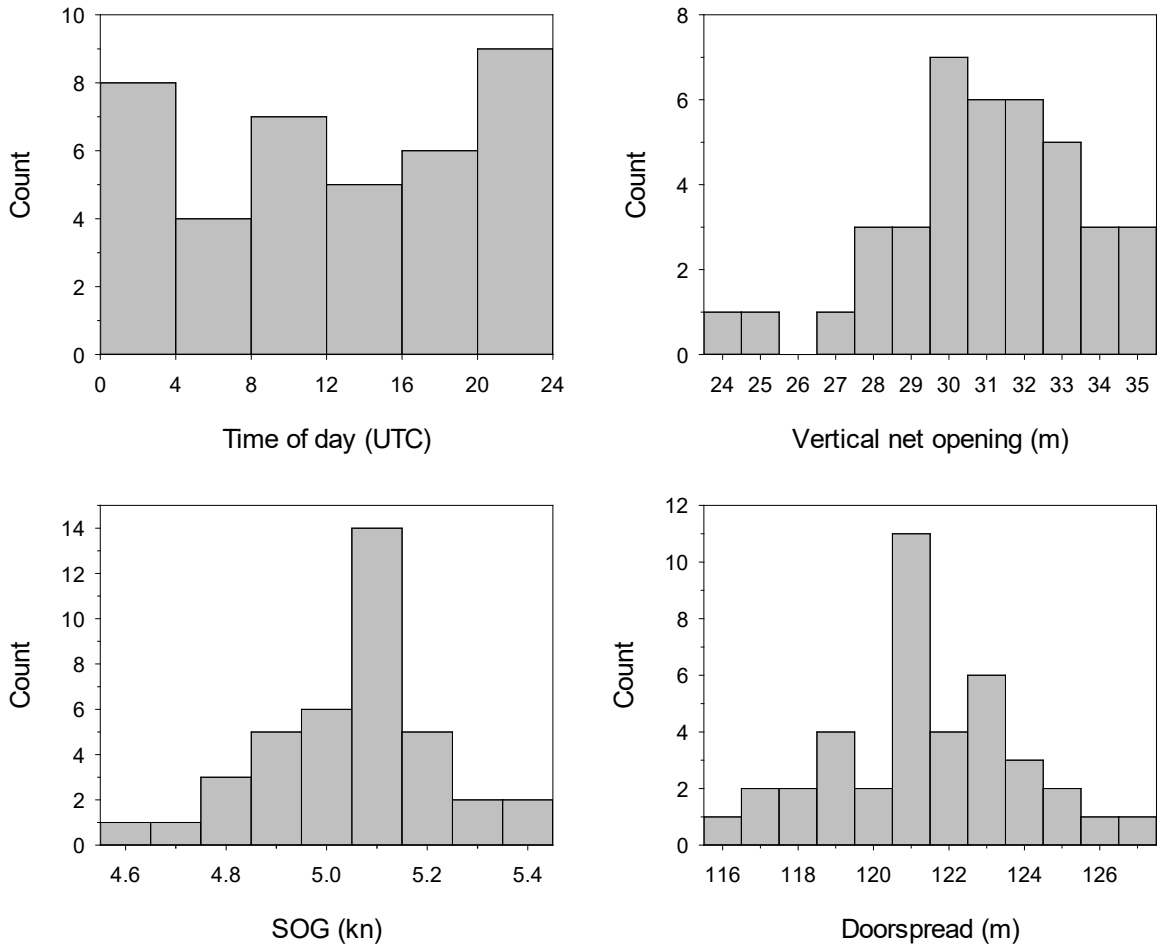


Fig 2: Times of day fished, vessel and gear performance (average values by station).

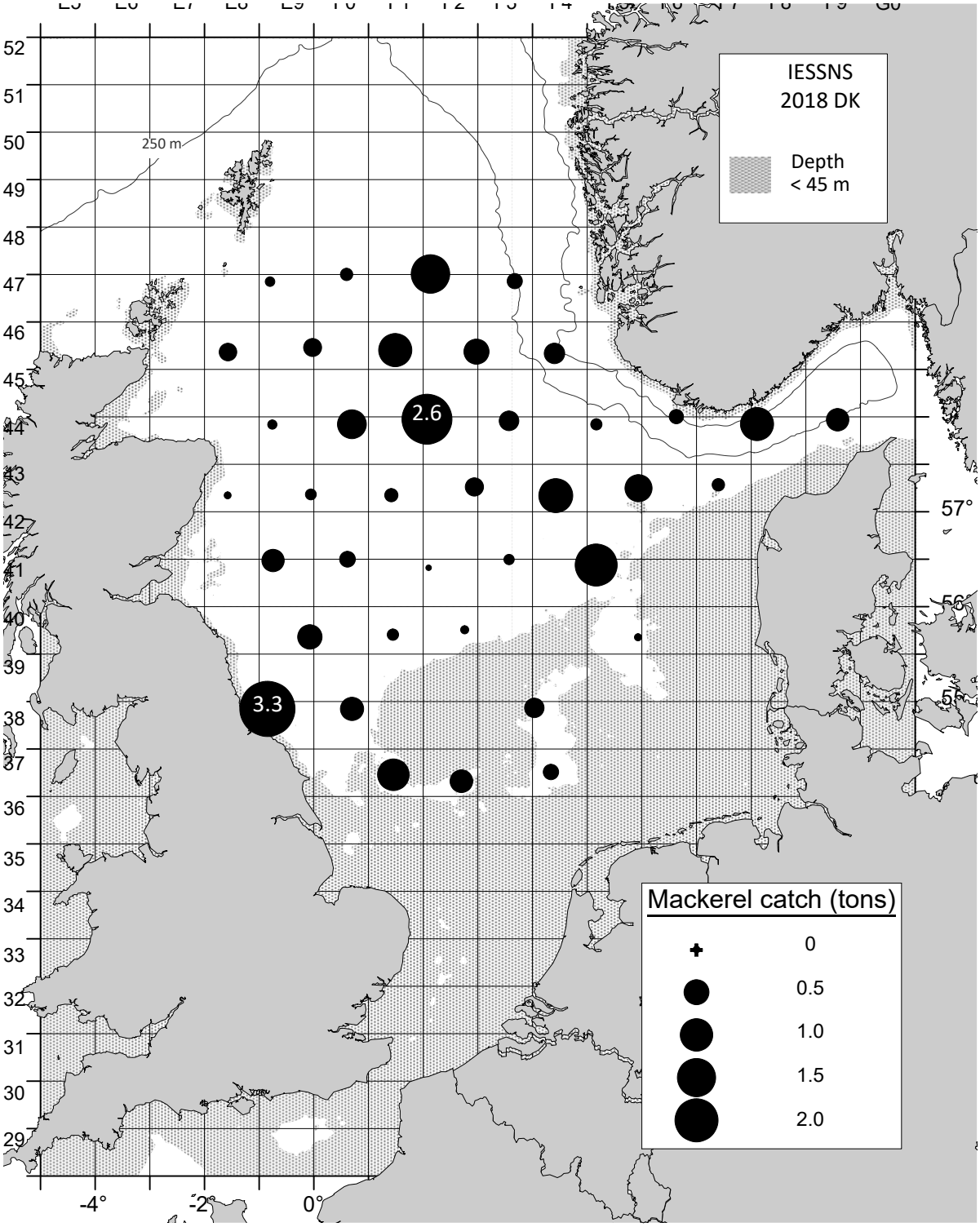


Fig. 3: Distribution of mackerel catches.

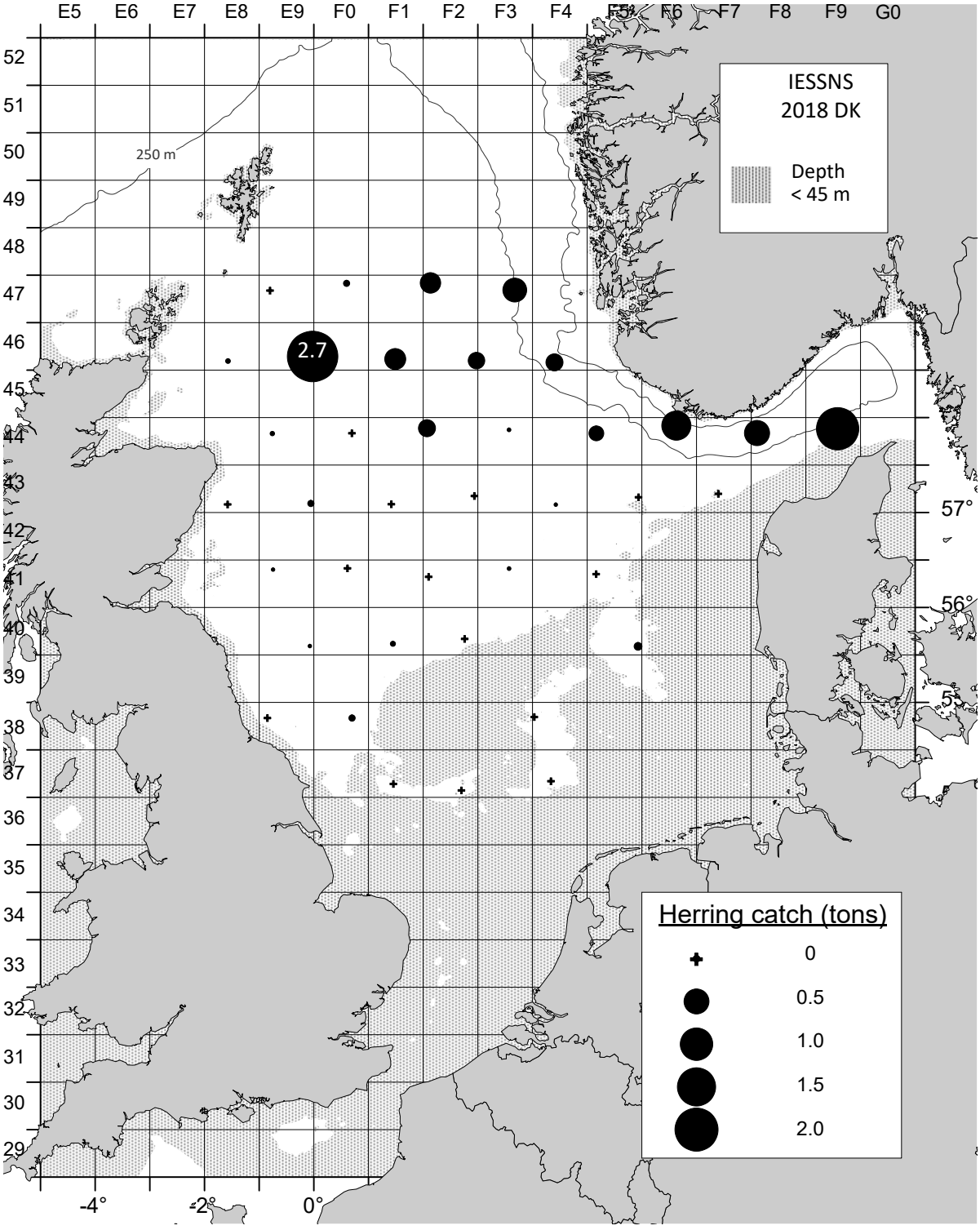


Fig. 4: Distribution of herring catches.

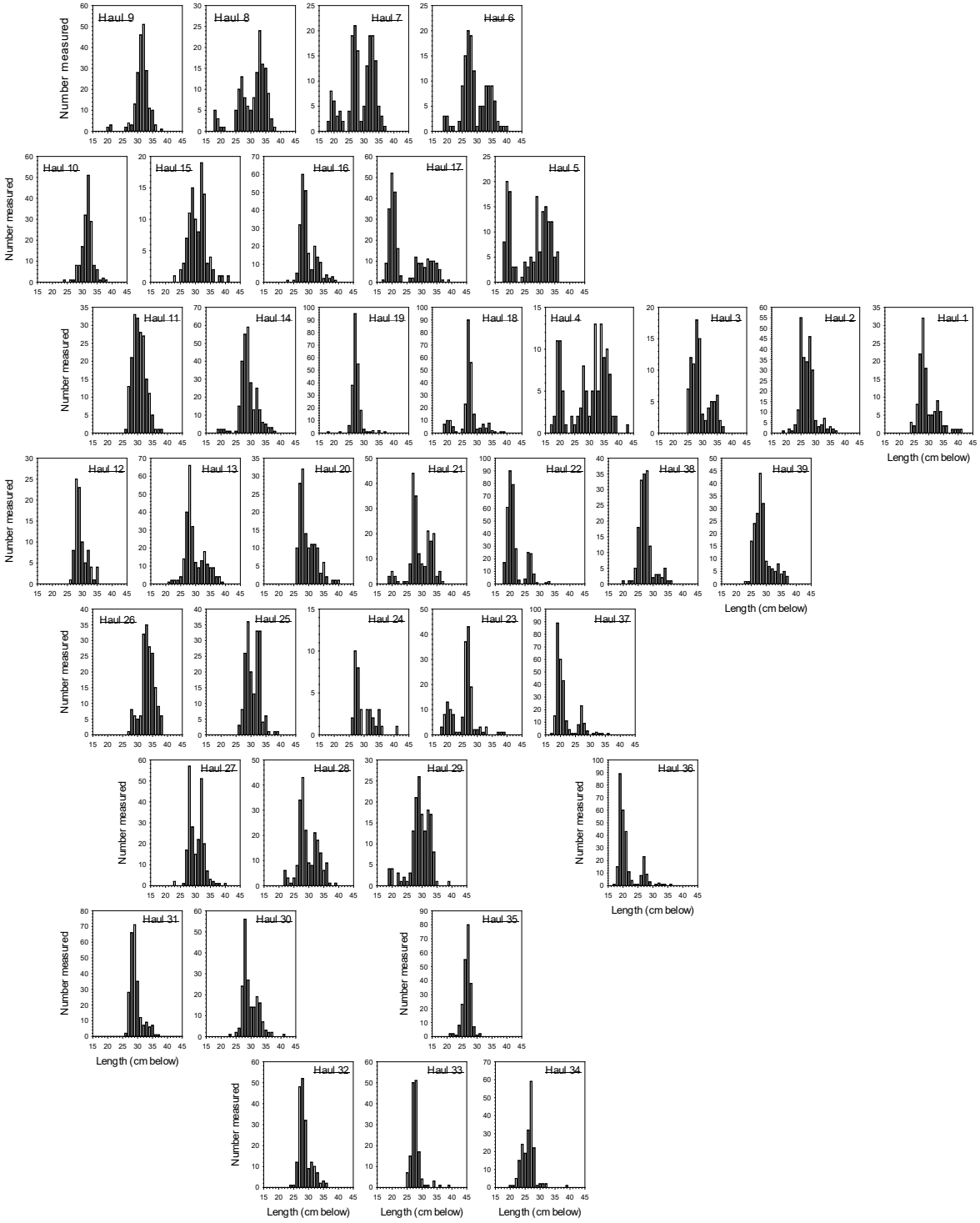


Fig. 5: Length distributions of mackerel.

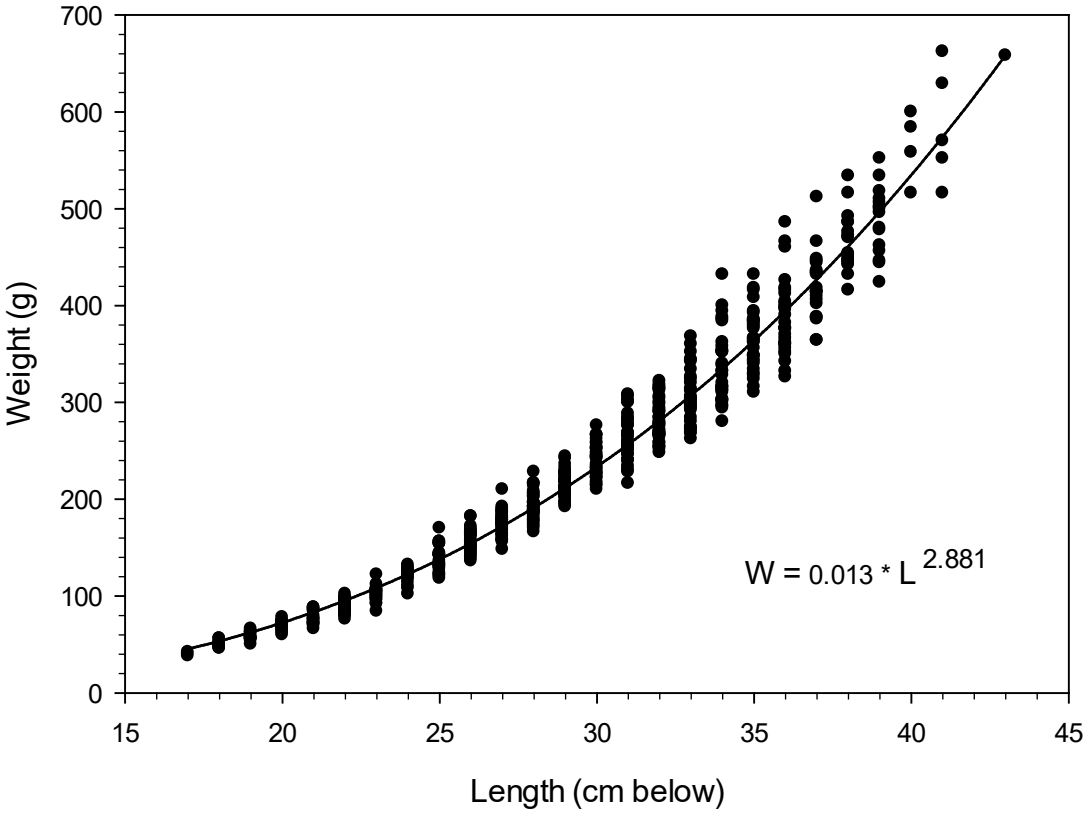


Fig. 6: Length-weight relationship for mackerel.

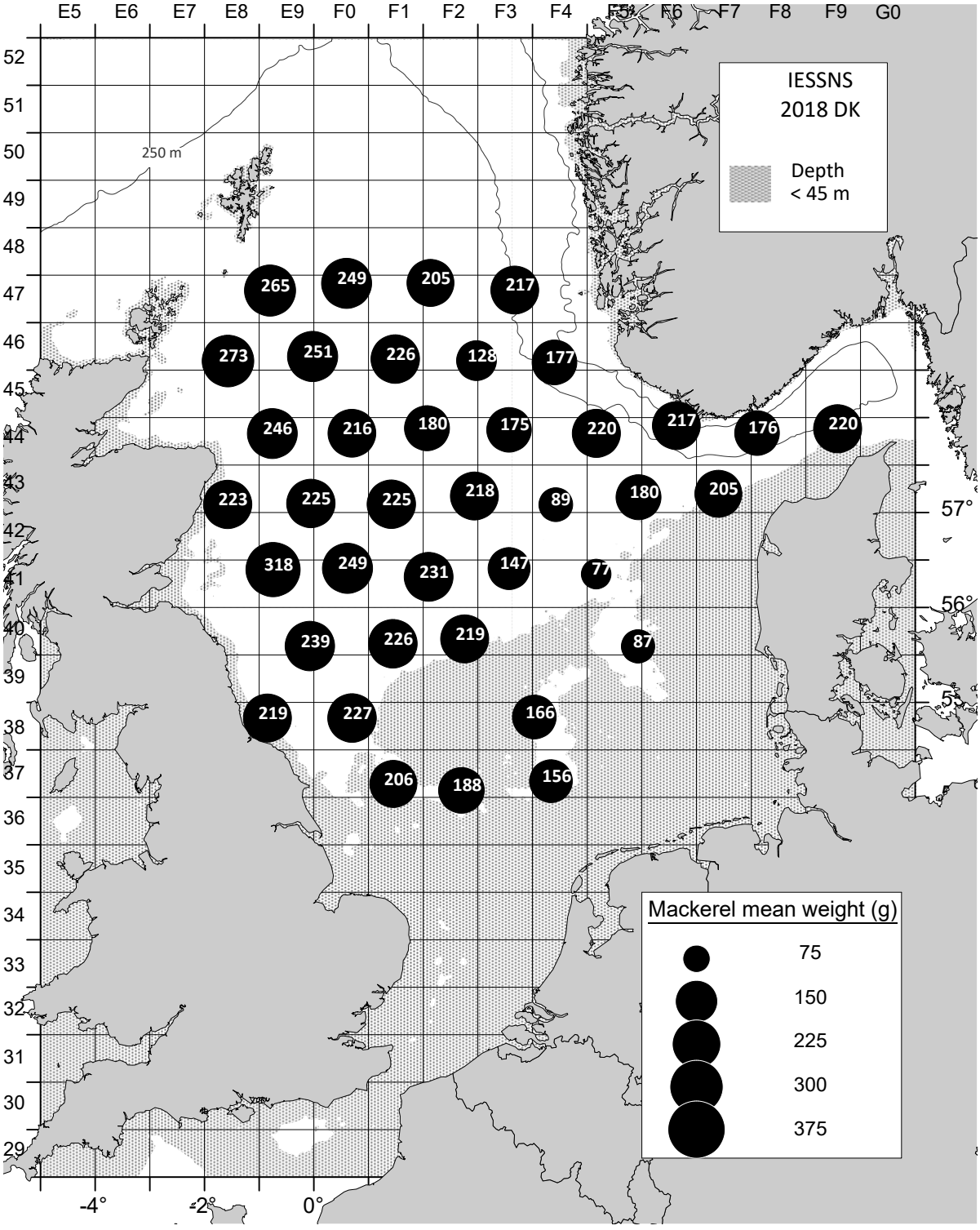


Fig. 7: Distribution of mean individual weight of mackerel.

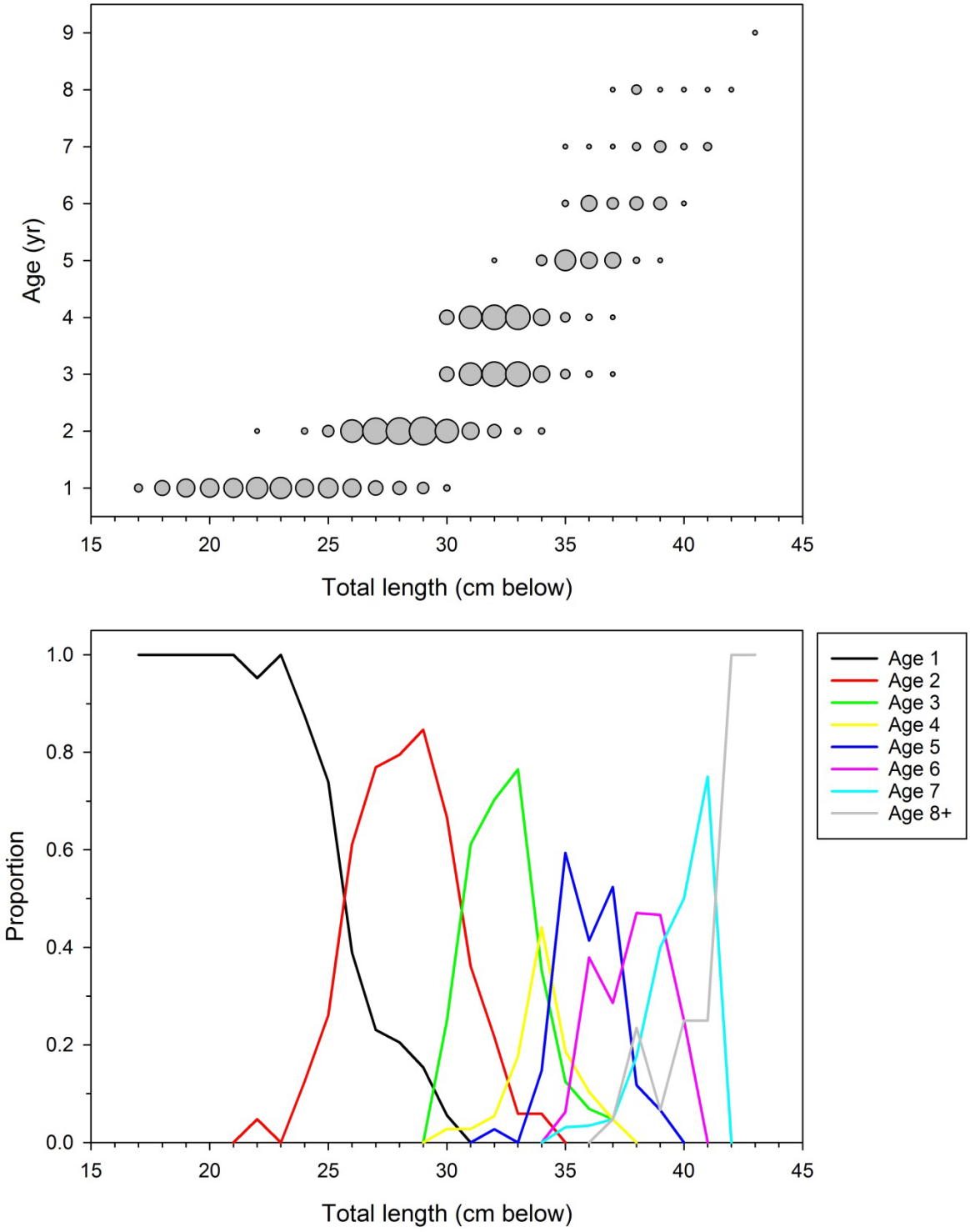


Fig. 8: Age-length key for mackerel (bubble size in upper panel refer to number of observations which ranged from 1 to 33 individuals per cm interval and age group).

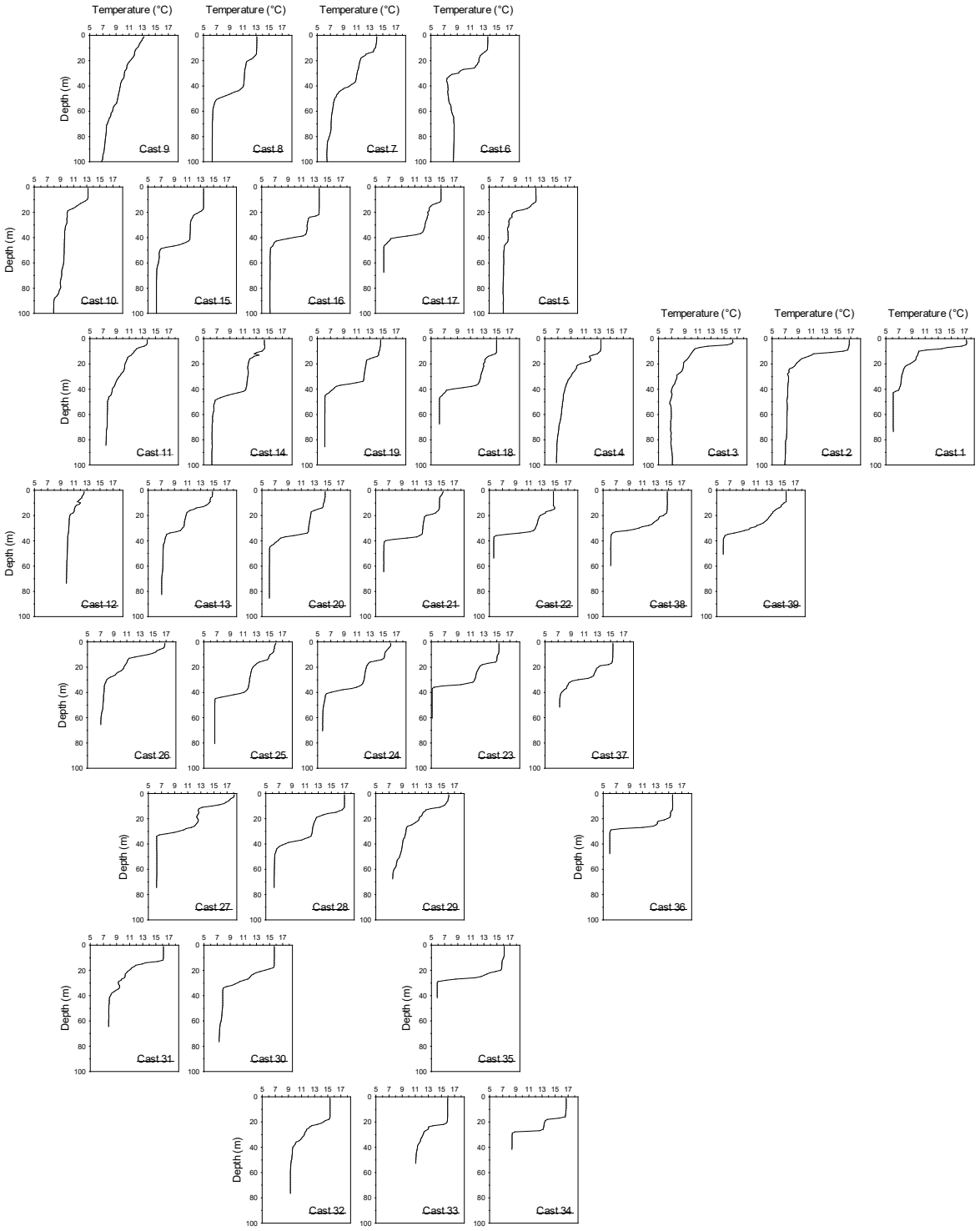


Fig. 9: Temperature conditions in the surface layer.

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

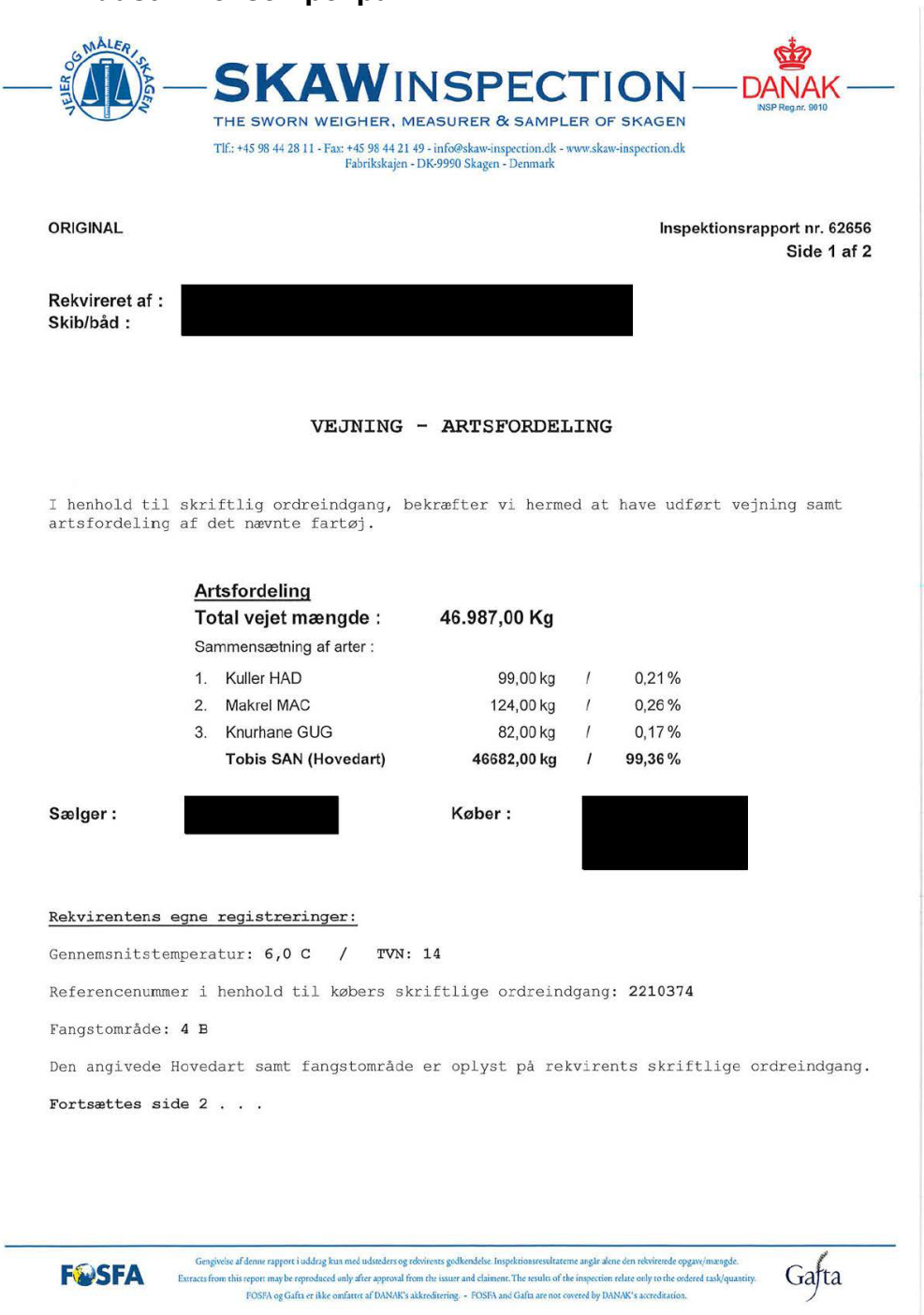
Latin name	Danish name	English name	Weight (kg)	Number	Lmin (cm)	Lmax (cm)	Remark
Scomber scombrus	Makrel	Mackerel	21972.66	129901	17	43	
Clupea harengus	Sild	Herring	8622.31	73535	13.5	32.5	
Eutrigla gurnardus	Grå knurhane	Grey gurnard	264.92	2060	15	40	
Cyclopterus lumpus	Stenbider	Lumpfish	81.01	82	7	39	
Belone belone	Hornfisk	Garfish	41.95	65	50	82	
Sprattus sprattus	Brisling	Sprat	19.77	1343	8	15	
Squalus acanthias	Pighaj	Picked dogfish	11.89	14	28	122	
Merlangius merlangus	Hvilling	Whiting	7.35	893	3	39	
Merluccius merluccius	Kulmule	Hake	7.10	3	40	83	
Trachurus trachurus	Hestemakrel	Horsemackerel	6.58	24	20	42	
Echiichthys vipera	Fjæsing lille	Lesser weever	3.82	228	9	15	
Pollachius virens	Sej	Saithe	3.20	2	53	59	
Todaropsis eblanae	Todaropsis eblanae	Lesser flying squid	1.92	30	6	20	ML
Illex coindetii	Illex coindetii	Southern shortfin squid	1.39	21	6	28	ML
Limanda limanda	Ising	Common dab	1.19	20	15	27	
Chelidonichthys lucerna	Rød knurhane	Tub gurnard	0.98	4	24	36	
Sardina pilchardus	Sardin	Pilchard	0.93	10	3	23	
Melanogrammus aeglefinus	Kuller	Haddock	0.69	96	5	11	
Maurolicus muelleri	Laksesild	Sheppy argentine / Pearlside	0.62	28	5	6	
Anarhichas lupus	Stribet havkat	Catfish	0.41	1	36	36	
Loligo forbesii	Loligo forbesii	Northern squid	0.29	28	3	6	ML
Lophius piscatorius	Havtaske	Monk	0.19	1	22	22	
Pleuronectes platessa	Rødspætte	Plaice	0.15	1	25	25	
Ammodytes marinus	Tobis-hav	Lesser sandeel	0.10	3	21.5	25.5	
Agonus cataphractus	Panser ulk	Pogge	0.00	1	8	8	

Tab. 2: Mackerel length frequencies raised to total catch and swept area by haul.

	Number caught per haul																																				
TL_cm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
17	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18	0	0	0	6	98	0	79	14	0	0	0	0	0	0	0	0	147	0	66	0	0	656	8	0	0	0	0	0	0	0	0	0	0	0	0	15	1029	0	0
19	0	27	0	32	245	17	315	8	0	0	0	0	0	26	0	0	574	54	0	0	19	2355	21	0	0	0	0	0	4	0	0	0	0	0	0	89	5400	0	0
20	0	0	0	32	221	17	236	3	2	0	0	0	0	26	0	0	852	77	0	0	31	3475	35	0	0	0	0	0	4	0	0	0	0	7	0	60	9515	24	0
21	0	54	0	14	37	6	118	3	3	0	0	0	1	26	0	0	705	77	0	0	19	3050	27	0	0	0	0	0	0	0	0	0	0	7	19	43	6750	0	0
22	0	27	0	3	37	6	157	0	0	0	0	0	3	13	0	0	262	38	66	0	6	1081	21	0	0	0	0	12	3	0	0	0	0	34	19	11	1800	24	0
23	0	107	0	0	0	0	79	0	0	0	0	0	3	13	11	20	49	8	0	0	0	116	3	0	0	0	20	6	1	11	0	0	0	101	9	4	64	24	3
24	50	295	0	6	12	11	0	0	0	5	0	0	3	0	0	0	0	0	0	0	6	0	3	0	0	0	0	2	2	0	0	24	0	162	76	1	0	118	3
25	33	1474	56	3	49	50	157	14	0	0	0	0	5	13	21	20	0	23	397	0	6	154	19	0	0	0	0	6	1	23	0	24	119	128	218	1	0	424	46
26	132	965	95	6	37	83	747	28	2	5	1	1	19	197	32	102	33	176	2517	39	50	965	99	2	13	0	10	16	3	46	125	292	255	216	522	8	193	778	65
27	363	911	87	9	61	111	826	36	4	5	13	8	53	527	74	653	33	690	6294	109	277	927	115	10	36	8	174	66	13	274	1753	1169	851	398	760	23	386	825	75
28	528	1233	143	23	49	106	629	22	3	42	21	25	88	724	116	1225	197	429	3644	125	220	309	51	8	117	65	583	84	21	640	4133	1266	868	148	361	9	257	848	118
29	297	804	119	14	208	67	79	17	13	42	33	23	43	777	158	1041	147	115	1192	55	75	39	5	3	161	49	286	43	26	309	4446	779	289	7	66	3	64	283	86
30	83	161	24	6	74	6	197	14	28	89	32	10	16	369	105	327	147	23	199	39	50	0	5	0	90	41	153	18	17	160	2192	219	68	13	9	0	0	47	24
31	83	80	16	14	172	28	511	22	46	168	28	5	12	171	84	143	115	31	66	43	44	0	8	3	58	49	225	16	13	160	751	292	17	13	19	1	0	71	19
32	99	107	32	37	184	28	747	39	51	268	27	8	17	329	200	408	180	54	66	43	132	39	3	3	148	261	521	41	18	217	438	244	17	13	0	2	0	71	16
33	149	188	40	14	147	50	747	67	29	152	15	4	24	171	148	286	164	31	132	39	107	77	8	2	148	285	204	35	17	183	564	170	0	0	0	1	0	47	13
34	99	54	40	37	147	50	551	45	11	42	11	1	15	79	32	225	164	61	0	12	126	0	0	1	18	228	72	25	8	80	376	49	51	0	0	1	0	118	22
35	33	80	48	26	61	50	197	42	10	32	5	4	12	66	42	41	147	15	132	23	19	0	0	3	27	212	31	12	1	34	438	73	0	0	0	0	0	24	11
36	33	54	16	29	74	33	118	25	3	5	1	0	12	39	21	82	98	8	0	8	31	0	0	1	4	122	20	18	0	23	63	49	17	0	0	1	0	24	13
37	0	27	8	20	0	11	39	8	0	11	1	0	5	39	0	41	16	0	66	0	6	0	3	0	0	73	10	2	0	23	63	0	0	0	0	0	0	0	8
38	17	0	0	6	0	6	0	3	1	5	1	0	5	13	11	61	0	8	0	4	0	0	3	0	4	49	10	0	0	0	0	0	0	0	0	0	0	0	0
39	17	0	0	6	0	6	0	0	0	0	0	0	1	0	11	20	16	8	0	4	0	0	3	0	4	0	0	2	1	0	0	0	17	7	0	0	0	0	0
40	17	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
41	17	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	1	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Swept area_km^2	0.3056	0.3187	0.3202	0.3306	0.3261	0.3303	0.3098	0.3121	0.3261	0.3151	0.3337	0.3085	0.3061	0.3295	0.3217	0.3270	0.3236	0.3020	0.3174	0.3195	0.3254	0.3265	0.3205	0.3201	0.3258	0.3202	0.3292	0.3085	0.3065	0.3414	0.3164	0.2991	0.3034	0.3095	0.3283	0.3287	0.3411	0.3038	0.3231

Bilag B – Eksempler på inspektionsrapporter

1.1 Industri – eksempel på PDF fil



VEJER OG MÅLER I SKAGEN

SKAW INSPECTION

THE SWORN WEIGHER, MEASURER & SAMPLER OF SKAGEN

DANAK INSP Reg.nr. 9010

Tlf.: +45 98 44 28 11 - Fax: +45 98 44 21 49 - info@skaw-inspection.dk - www.skaw-inspection.dk
Fabrikskajen - DK-9990 Skagen - Denmark

ORIGINAL

Inspektionsrapport nr. 62656
Side 1 af 2

Rekvireret af : [redacted]
Skib/båd :

VEJNING - ARTSFORDELING

I henhold til skriftlig ordreindgang, bekræfter vi hermed at have udført vejning samt artsfordeling af det nævnte fartøj.

Artsfordeling

Total vejet mængde : 46.987,00 Kg

Sammensætning af arter :

1.	Kuller HAD	99,00 kg	/	0,21 %
2.	Makrel MAC	124,00 kg	/	0,26 %
3.	Knurhane GUG	82,00 kg	/	0,17 %
	Tobis SAN (Hovedart)	**46682,00 kg**	**/**	**99,36 %**

Sælger : [redacted] Køber : [redacted]

Rekvirentens egne registreringer:

Gennemsnitstemperatur: 6,0 C / TVN: 14

Referencenummer i henhold til købers skriftlige ordreindgang: 2210374

Fangstområde: 4 B

Den angivede Hovedart samt fangstområde er oplyst på rekvirents skriftlige ordreindgang.

Fortsættes side 2 . . .

FOSFA

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SKAWINSPECTION
THE SWORN WEIGHER, MEASURER & SAMPLER OF SKAGEN
DANAK INSP Reg.nr. 9010
Tlf.: +45 98 44 28 11 - Fax: +45 98 44 21 49 - info@skaw-inspection.dk - www.skaw-inspection.dk
Fabrikskajen - DK-9990 Skagen - Denmark

ORIGINAL

Der kan forekomme op- og nedrundings korrektioner på procentsatserne, i henhold til "Artsfordeling - Prøveoversigt" arket og den endelige rapporterede fordeling.

Bilag: "Artsfordeling - Prøveoversigt" (Bilag 1) + "Skawinspection Vejelog" (Bilag 2).

Lastested : [redacted]
Sted for kontrol :

Inspektion udført : 17.05.2021
Anvendt udstyr : V24
Inspektion udført af : 13.AC,17.JB,19.OM

Procedure : K 5.1,K 5.9

Dato : 17-05-2021

SKAW INSPECTION A/S
VEJER & MÅLER I SKAGEN
Uvildig Inspektør

SKAWINSPECTION
THE SWORN WEIGHER, MEASURER & SAMPLER OF SKAGEN
DANAK INSP Reg.nr. 9010
Tlf.: +45 98 44 28 11 - Fax: +45 98 44 21 49 - info@skaw-inspection.dk - www.skaw-inspection.dk
Fabrikskajen - DK-9990 Skagen - Denmark

Artsfordeling - Prøveoversigt

Skib: [redacted] **Køber:** [redacted]

Total vejet fisk: 46.987 kg. **Dato:** 17.05.21

Hovedart																	
Fiskeart: Kode:	Tobis SAN	Kuller HAD	Makrel MAC	Knurhane GUG								Total bi-fangst (kg)	Total hele prøven (kg)	Procent Prøven	Procent Gennem-snit	Tid	Inspektor(s)
Prøve nr.	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)						
1	12,75											0,00	12,75	0,00	0,00	08.55	JB
2	17,32	0,12	0,15									0,27	17,59	1,53	0,89	09.08	JB
3	13,81			0,10								0,10	13,91	0,72	0,84	09.15	JB
4	12,79											0,00	12,79	0,00	0,65	09.22	JB
5																	
6																	
7																	
8																	
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47																	
48																	
49																	
50																	
Total (kg.)	56,67	0,12	0,15	0,10								0,37	57,04	Snit (%):	0,65		
Fordeling i %		0,21	0,26	0,18								0,65					
Fordeling i kg.		99	124	82								305					

Printdate: 17-05-2021 10:21:14

Facility [redacted]

Veje. nr.	Licenseplate	Trailer	Reciver	Buyer	Seller	Article	Date 2. weighing	Netto kg
941	XT 97 190	AM 63 07		[redacted]		Tobis	17-05-2021 09:06	13.070
944	XT 93 828	ED37 35				Tobis	17-05-2021 09:46	33.860
945	PRØVETAGET					Tobis	17-05-2021 10:19	57
	Total rows printed:	3				**Totalt for facility:** [redacted]		46.987

SKAW INSPECTION A/S
VEJER & MÅLER I SKAGEN

1.2 Konsum – eksempel på PDF fil

SKAWINSPECTION

THE SWORN WEIGHER, MEASURER & SAMPLER OF SKAGEN

DANAK INSP Reg.nr. 9010

Tlf.: +45 98 44 28 11 - Fax: +45 98 44 21 49 - info@skaw-inspection.dk - www.skaw-inspection.dk
Fabrikskajen - DK-9990 Skagen - Denmark

ORIGINAL

Inspektionsrapport nr. 56662
Side 1 af 2

Rekvireret af : [redacted]

Akkrediteret Vejer & Måler i Skagen bekræfter hermed at have vejet, temp. målt samt prøvetaget følgende:

SILD / HERRING

Fra skib : [redacted]

Nr.	Transport	Vægt	Antal	Prøve	Ant. per kg.	Initialer	Temperatur	Tid
1.	0-25 T.		124	28,02 kg	4,43 stk/kg	MM	-0,5 / 0,0	14.30
2.	25-50 T.		111	25,64 kg	4,33 stk/kg	MM	-0,2 / 0,1	14.45
3.	50-75 T.		114	25,18 kg	4,53 stk/kg	MM	-0,4 / 0,2	15.00
4.	75-100 T.		119	27,48 kg	4,33 stk/kg	MM	-1,0 / -0,1	15.20
5.	100-125 T.		118	26,90 kg	4,39 stk/kg	MM	-1,0 / -0,2	15.40
6.	125-150 T.		111	25,62 kg	4,33 stk/kg	MM	0,0 / 0,4	16.20
7.	150-175 T.		128	29,56 kg	4,33 stk/kg	MM	-0,4 / 0,6	16.35
8.	175-200 T.	197481 kg	127	28,60 kg	4,44 stk/kg	MM	0,0 / 0,9	16.55
9.	0-25 T.		115	26,77 kg	4,30 stk/kg	TT	-0,9 / -0,6	05.25
10.	25-50 T.		111	25,44 kg	4,36 stk/kg	TT	-0,7 / -0,5	05.45
11.	50-75 T.		114	26,10 kg	4,37 stk/kg	TT	-0,6 / -0,3	06.05
12.	75-100 T.		132	30,10 kg	4,39 stk/kg	TT	-0,3 / 0,0	06.20
13.	100-125 T.		130	29,56 kg	4,40 stk/kg	TT	0,0 / 0,4	06.40
14.	125-150 T.		118	27,52 kg	4,29 stk/kg	TT	-0,9 / -0,4	07.10
15.	150-175 T.		136	31,56 kg	4,31 stk/kg	TT	-0,6 / 0,0	07.25
16.	175-200 T.		116	25,76 kg	4,50 stk/kg	TT	-1,1 / -0,8	07.45
17.	200-225 T.		131	30,18 kg	4,34 stk/kg	TT	-1,1 / -0,7	08.05
18.	225-250 T.		133	30,78 kg	4,32 stk/kg	TT	-0,9 / -0,7	08.25
19.	250-275 T.		128	28,94 kg	4,42 stk/kg	TT	-0,8 / -0,4	08.40
20.	275-300 T.		131	29,54 kg	4,43 stk/kg	TT	-0,6 / -0,4	08.55
21.	300-325 T.		136	31,22 kg	4,36 stk/kg	TT	-0,9 / -0,4	09.15
22.	325-350 T.		139	32,50 kg	4,28 stk/kg	TT	-0,7 / -0,3	09.45
23.	350-375 T.		113	25,78 kg	4,38 stk/kg	CS	-0,5 / -0,1	10.00
24.	375-400 T.		111	25,48 kg	4,36 stk/kg	CS	-1,1 / -0,6	10.15
25.	400-425 T.		109	25,04 kg	4,35 stk/kg	CS	-0,7 / -0,3	10.40
26.	425-450 T.		114	25,34 kg	4,50 stk/kg	CS	-0,2 / 0,3	11.00
27.	450-475 T.		120	27,58 kg	4,35 stk/kg	CS	-1,0 / -0,5	11.15
28.	475-500 T.		110	25,14 kg	4,38 stk/kg	CS	-0,9 / -0,6	11.30
29.	500-525 T.		117	27,04 kg	4,33 stk/kg	CS	-0,8 / -0,4	11.50
30.	525-550 T.		116	27,08 kg	4,28 stk/kg	CS	-0,7 / -0,5	12.10
31.	550-575 T.		110	25,20 kg	4,37 stk/kg	CS	-0,6 / -0,2	12.30
32.	575-600 T.		110	25,38 kg	4,33 stk/kg	CS	-0,5 / 0,0	12.50
33.	600-625 T.		117	26,60 kg	4,40 stk/kg	MM	-0,1 / 0,4	13.05
34.	625-650 T.		116	27,02 kg	4,29 stk/kg	MM	-1,2 / -0,9	13.25
35.	650-675 T.		118	27,34 kg	4,32 stk/kg	MM	-0,9 / 0,0	13.40
36.	675-700 T.		121	27,54 kg	4,39 stk/kg	MM	-0,5 / -0,3	14.10
37.	700-725 T.		140	32,08 kg	4,36 stk/kg	MM	-0,6 / -0,2	14.30

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ORIGINAL

Inspektionsrapport nr. 56662

38.	725-750 T.		126	28,00 kg	4,50 stk/kg	MM	-0,5 / -0,2	14.45
39.	750-775 T.		113	25,98 kg	4,35 stk/kg	MM	-0,3 / 0,1	15.00
40.	775-800 T.		137	30,94 kg	4,43 stk/kg	MM	-0,9 / -0,5	15.20
41.	800-825 T.		122	28,00 kg	4,36 stk/kg	MM	-1,1 / -0,7	15.40
42.	825-850 T.		111	25,12 kg	4,42 stk/kg	MM	-0,9 / -0,5	16.00
43.	850-875 T.	860297 kg	128	28,82 kg	4,44 stk/kg	MM	-0,5 / -0,1	16.20
Total (BRUTTO) :		**1057778 kg**	**5201 stk.**	**1189,47 kg**	**4,37 stk/kg**			

Agent : [redacted]

Køber : [redacted]

Sælger : [redacted]

Inspektion udført : 03.09.2019 - 04.09.2019
Anvendt udstyr : V9,V11,V12,TM9.,PU37.
Inspektion udført af : 11.TT,15.MM,3.CS

Procedure : K 5.1,K 5.7,K 5.9

Dato : 04-09-2019

SKAWINSPECTION VEJER & MÅLER I SKAGEN

Uvildig Inspektør

SKAWINSPECTION
THE SWORN WEIGHER, MEASURER & SAMPLER OF SKAGEN
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Fabrikskajen - DK-9990 Skagen - Denmark

ORIGINAL

Inspektionsrapport nr. 56663
Side 1 af 1

Rekvireret af : [redacted]
Skib/båd :

BIFANGSTOPGØRELSE

Akkrediteret Vejer & Måler i Skagen bekræfter hermed at have prøvetaget følgende:

Artsfordeling

Total vejet mængde : 1.057.778,00 Kg

Sammensætning af arter :

*1.	Sperling	423,00 kg	/	0,04 %
*2.	Makrel	423,00 kg	/	0,04 %
#3.	Kuller	746,00 kg	/	0,07 %
#4.	Hvilling	18,00 kg	/	0,00 %
	Sild (Hovedart)	**1056168,00 kg**	**/**	**99,85 %**

Agent : [redacted] **Køber :** [redacted]

Sælger : [redacted]

*Total vægt er baseret på prøvetagning under losning/vejning af fisk.
#Total vægt er baseret på den aktuelle vægt af de frasorterede fisk.

Lastested : [redacted]
Sted for kontrol :

Inspektion udført : 03.09.2019
Anvendt udstyr : V9,PU37.
Inspektion udført af : 11.TT,15.MM,3.CS

Procedure : K 5.1,K 5.9

Dato : 03-09-2019

SKAWINSPECTION VEJER & MÅLER I SKAGEN

Uvildig Inspektør

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Fabrikskajen - DK-9990 Skagen - Denmark

Skib: [redacted] Køber: [redacted]

Total vejet fisk: **1.057.778** kg. Dato: 03-04.09.2019

Prøve nr:	Sild (kg)	Sperling (kg)	Makrel (kg)	(kg)	(kg)	(kg)	Total bi-fangst(kg)	Total hele prøve (kg)	Procent Prøve	Procent Gen.snit
1	28,02						0,00	28,02	0,00	0,00
2	25,64						0,00	25,64	0,00	0,00
3	25,18						0,00	25,18	0,00	0,00
4	27,48	0,03					0,03	27,51	0,11	0,03
5	26,90						0,00	26,90	0,00	0,02
6	25,62	0,08					0,08	25,70	0,31	0,07
7	29,56	0,08					0,08	29,64	0,27	0,10
8	28,60						0,00	28,60	0,00	0,09
9	26,77	0,04	0,33				0,37	27,14	1,36	0,23
10	25,44	0,06	0,16				0,22	25,66	0,86	0,29
11	26,10						0,00	26,10	0,00	0,26
12	30,10	0,08					0,08	30,18	0,27	0,26
13	29,56	0,10					0,10	29,66	0,34	0,27
14	27,52						0,00	27,52	0,00	0,25
15	31,56						0,00	31,56	0,00	0,23
16	25,76						0,00	25,76	0,00	0,22
17	30,18						0,00	30,18	0,00	0,20
18	30,78						0,00	30,78	0,00	0,19
19	28,94						0,00	28,94	0,00	0,18
20	29,54						0,00	29,54	0,00	0,17
21	31,22						0,00	31,22	0,00	0,16
22	32,50						0,00	32,50	0,00	0,15
23	25,78						0,00	25,78	0,00	0,15
24	25,48						0,00	25,48	0,00	0,14
25	25,04						0,00	25,04	0,00	0,14
26	25,34						0,00	25,34	0,00	0,13
27	27,58						0,00	27,58	0,00	0,13
28	25,14						0,00	25,14	0,00	0,12
29	27,04						0,00	27,04	0,00	0,12
30	27,08						0,00	27,08	0,00	0,12
31	25,20						0,00	25,20	0,00	0,11
32	25,38						0,00	25,38	0,00	0,11
33	26,60						0,00	26,60	0,00	0,11
34	27,02						0,00	27,02	0,00	0,10
35	27,34						0,00	27,34	0,00	0,10
36	27,54						0,00	27,54	0,00	0,10
37	32,08						0,00	32,08	0,00	0,09
38	28,00						0,00	28,00	0,00	0,09
39	25,98						0,00	25,98	0,00	0,09
40	30,94						0,00	30,94	0,00	0,09
41	28,00						0,00	28,00	0,00	0,08
42	25,12						0,00	25,12	0,00	0,08
43	28,82						0,00	28,82	0,00	0,08
44										
45										
46										
47										
48										
49										
50										
Total kg.	**1.189,47**	**0,47**	**0,49**	**0,00**	**0,00**	**0,00**	**0,96**	**1.190,43**	**Snit (%):**	**0,08**
Bifangst i %		**0,04**	**0,04**	**0,00**	**0,00**	**0,00**	**0,08**			
Bifangst i kg.		**423**	**423**				**846**			

Bilag C – Age reading comparison for NordMak

Quality assurance of biological data such as age has a high priority as this data is used to estimate growth parameters such as length and catch at age, which are important data input for stock assessment purposes. Age calibration exercises are carried out both at an international and national level. The ICES Working Group on Biological Parameters (WGBIOP) coordinates international calibration exercises for age readers. The general aim being to ensure a high level of agreement and precision between age readers of specific stocks, training new readers, identify where age reading issues exists and plan future work with the aim to solve these issues.

Age reading of different fish species is carried out by observing and counting the growth structures which are laid down in the ear stones of the fish. These ears stone are calcified structures called otoliths. Each year a fish will experience both a growth and non-growth period, these patterns are identified in the otolith and used to determine the age of the fish in years. Traditionally age reading is carried out by examining the otolith under a microscope and calibration exercises carried out by sending the otoliths between age reading laboratories for readers to record their estimated ages on a data sheet. More recently, calibration between laboratories is carried out based on otolith images.
The SmartDots platform https://www.ices.dk/data/tools/Pages/smartdots.aspx has been developed for this purpose. Age readers can view and annotate a series of otolith images in an application that has been developed in close cooperation with the users. Readers can make multiple annotations, enhance image contrast and magnification and give a quality score for their age reading. Once the readers have completed an exercise it is possible to view and compare multiple readers annotations and ages, making it easier to discuss and rectify disagreements. In addition, a reporting module produces a standardised data output and an internationally agreed statistical analysis (based on an r-script). The platform is hosted at ICES and is being widely used as quality assurance tool, currently there are 661 users registered from 36 countries.

Mackerel in the North Sea is part of the widely distributed North Atlantic mackerel stock. The most recent age calibration exercise for this stock was carried out in 2021 using the SmartDots platform (Report of the Small-Scale Otolith Exchange of Northeast Atlantic Mackerel (Scomber scombrus) 2020-2021 (SmartDots event 280)) under the remit of WGBIOP. The full exercise was completed by 37 readers from 12 countries across Europe. Otolith images (n=237) were provided by 12 of the participating laboratories with the aim to provide a set of images representative of the temporal and spatial coverage of otoliths read for stock assessment purposes (including the southern component, western component, North Sea component and the northern distribution). Otoliths were photographed immersed in water on a black background under reflected light, using a standardised setup of stereomicroscope and camera.

For the purpose of this report only the samples from the North Sea component (n=45) are included in the analysis (Table 1). The age readers from countries who are fishing on the North Sea component of the stock and who provide age data for stock assessment purposes (advanced readers) are included (Scotland, Iceland, Norway, Ireland, Denmark, Netherlands, Faroes, Germany and France).

Table 1.

ICES SubArea	No. of images		Total	Length range
	Quarter 1	Quarter 4		
4a	5	15	20	19-43cm
4b	6	14	20	19-39 cm
4c	5	0	5	19-24 cm

The analysis of reader agreement, precision and bias was carried out using the Guus Eltink Excel workbook 'Age Reading Comparisons' (Eltink, A.T.G.W. 2000) and tables presented below are a direct output from the workbook. The same statistics are applied in the SmartDots reporting module but given that this analysis only uses a subset of the full exchange set, the relevant readers age estimations have been extracted from the SmartDots output and analysed separately. The following statistics were calculated:

- percentage agreement (PA) (nmodal age/ntotal*100)
- coefficient of variation (CV) (Standard deviation/average*100)
- relative bias tests

Table 2 gives an overview of all fish data, all age estimations, the modal age and the percentage agreement (PA) and coefficient of variation (CV) for each Sample ID. The modal age range was 1-15 years. Overall percentage agreement was 79% and the coefficient of variation 19%. Table 3 gives the CV by modal age and age reader. The highest CV is 26.3 % at modal age 1 which indicates that there are issues when correctly identifying the first winter ring when assigning an age to these fish, with individual reader CV's at modal age 1 ranging from 0% - 61% and readers assigning ages 1, 2 or 3 years to some of these fish. There is a decrease in CV with an increase in age that indicates that the readers are more precise in their age estimations of the fish with modal age 2-5. At modal ages 6 and 8 the CV increases again meaning the range of ages given to these fish is large, for example a fish with modal age 6 has been estimated to be age 3, 4 , 5 and 6. Table 4 shows that PA is highest at modal ages 1, 2 and 3, ranging from 82% – 88% but there are some individual reader PA's as low as 50%. Relative bias is the difference between the mean age and modal age (calculated per modal age per reader) and is shown in Table 5. This indicates if there is a tendency for the fish to be overestimated (positive bias) or underestimated (negative bias) in comparison to the modal age. At modal age 1 and 2 the overall bias is positive at 0.11 and 0.12 respectively, indicating an overall tendency for readers to overestimate the age of the youngest fish.

ICES Sub Area	Sample ID	Fish length	Landing month	R01 SCT	R02 IS	R03 NO	R04 NO	R07 IE	R08 DK	R10 NL	R11 IE	R12 FO	R13 FO	R14 NL	R15 NO	R17 DE	R18 NO	R19 NO	R20 IE	R22 DE	R24 NO	R25 NO	R32 DK	**Modal Age**	**PA**	**CV**
27.4.a	MACex2020_086	245	2	2	2	2	2	2	2	2	2	2	2	2	-	2	2	2	2	2	2	2	2	**2**	100%	0%
27.4.a	MACex2020_087	295	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	**3**	95%	8%
27.4.a	MACex2020_088	255	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	**2**	100%	0%
27.4.a	MACex2020_089	195	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	**1**	95%	21%
27.4.a	MACex2020_090	335	2	5	5	5	5	5	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	**5**	95%	4%
27.4.a	MACex2020_091	345	7	4	5	5	4	4	5	4	5	5	5	4	5	4	4	5	4	5	4	5	5	**5**	55%	11%
27.4.a	MACex2020_092	225	7	0	1	1	0	0	0	1	1	0	1	1	0	1	0	1	1	1	1	-	2	**1**	58%	85%
27.4.a	MACex2020_093	415	7	12	15	15	12	12	14	7	15	14	16	6	14	14	15	14	11	15	14	15	13	**15**	30%	20%
27.4.a	MACex2020_094	365	7	8	8	8	7	9	7	7	11	8	9	7	8	8	8	8	7	10	9	8	6	**8**	45%	14%
27.4.a	MACex2020_095	255	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	**1**	95%	41%
27.4.a	MACex2020_096	325	8	3	4	4	4	3	3	3	4	3	4	4	4	3	4	4	3	4	4	4	4	**4**	65%	13%
27.4.a	MACex2020_097	295	8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	**2**	95%	11%
27.4.a	MACex2020_098	365	11	6	6	6	6	6	6	6	7	6	7	6	6	6	6	7	6	6	6	6	7	**6**	80%	7%
27.4.a	MACex2020_099	435	11	9	11	11	10	10	11	10	11	11	11	10	10	10	11	10	10	11	12	12	11	**11**	45%	7%
27.4.a	MACex2020_100	385	11	7	7	7	7	8	7	7	8	7	8	7	7	7	9	7	7	7	7	7	12	**7**	75%	16%
27.4.a	MACex2020_101	295	11	1	1	1	1	1	2	1	3	1	2	2	1	1	1	1	2	1	1	1	3	**1**	70%	49%
27.4.a	MACex2020_102	305	11	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**3**	100%	0%
27.4.a	MACex2020_103	305	11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	**2**	95%	11%
27.4.a	MACex2020_104	325	11	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	**4**	95%	6%
27.4.a	MACex2020_105	345	11	8	9	8	8	7	7	7	9	8	8	8	8	8	9	8	8	8	11	8	7	**8**	60%	11%
27.4.b	MACex2020_183	277	9	2	1	1	1	3	1	1	2	1	1	2	1	1	1	1	2	2	1	1	1	**1**	70%	43%
27.4.b	MACex2020_184	289	9	-	1	1	1	2	1	1	2	1	2	2	1	1	1	1	2	1	1	1	1	**1**	74%	36%
27.4.b	MACex2020_185	295	9	2	1	1	1	2	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	**1**	75%	36%
27.4.b	MACex2020_186	296	9	2	1	1	1	3	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	**1**	75%	44%
27.4.b	MACex2020_187	302	9	2	1	1	1	3	1	1	2	2	2	2	1	1	1	1	2	1	1	1	1	**1**	65%	43%
27.4.b	MACex2020_188	305	9	3	2	2	2	4	2	1	2	3	4	3	2	2	2	2	2	2	2	2	2	**2**	70%	32%
27.4.b	MACex2020_189	303	9	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	2	3	2	3	2	**3**	75%	16%
27.4.b	MACex2020_190	304	9	-	2	2	2	5	2	1	-	4	3	-	2	2	-	-	3	2	-	2	2	**2**	64%	42%
27.4.b	MACex2020_191	310	9	2	2	2	2	3	2	1	3	3	2	3	2	2	2	2	2	2	2	2	2	**2**	75%	23%
27.4.b	MACex2020_192	334	9	3	3	3	2	3	1	3	4	4	3	3	3	3	3	3	2	3	3	3	3	**3**	75%	22%
27.4.b	MACex2020_193	336	9	4	4	4	3	4	3	3	5	4	4	4	4	3	5	4	4	4	4	4	3	**4**	65%	15%
27.4.b	MACex2020_194	333	9	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	2	**3**	90%	11%
27.4.b	MACex2020_195	353	9	3	4	5	3	4	3	3	5	4	3	3	3	3	4	4	3	3	4	4	3	**3**	55%	19%
27.4.b	MACex2020_196	352	9	4	6	6	6	6	3	6	7	6	6	5	6	7	6	6	6	6	6	6	3	**6**	70%	19%
27.4.b	MACex2020_197	204	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	**1**	95%	24%
27.4.b	MACex2020_198	212	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.b	MACex2020_199	198	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.b	MACex2020_200	211	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.b	MACex2020_201	286	1	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	**2**	95%	11%
27.4.b	MACex2020_202	391	1	-	8	9	8	8	6	7	9	9	10	7	7	9	10	8	9	10	8	9	5	**9**	32%	17%
27.4.c	MACex2020_203	242	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	**1**	95%	21%
27.4.c	MACex2020_204	198	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.c	MACex2020_205	215	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.c	MACex2020_206	195	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	100%	0%
27.4.c	MACex2020_207	210	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	2	**1**	85%	32%
Overall																									**79%**	**19%**

Table 2 Data overview, for each sample ID the ICES SubArea, fish length (cm) and landing month is given, followed by each readers estimated age, the calculated modal age, percentage agreement (PA) and coefficient of variation (CV)

Table 3. Coefficient of variation (CV) by modal age and age reader. The CV of all readers combined per modal age and a weighted mean of the CV per reader.

Modal age	R01 SCT	R02 IS	R03 NO	R04 NO	R07 IE	R08 DK	R10 NL	R11 IE	R12 FO	R13 FO	R14 NL	R15 NO	R17 DE	R18 NO	R19 NO	R20 IE	R22 DE	R24 NO	R25 NO	R32 DK	**All Readers**
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
1	45%	0%	0%	25%	61%	39%	0%	44%	44%	36%	36%	25%	0%	25%	0%	35%	22%	22%	0%	50%	**26.3%**
2	18%	0%	0%	0%	42%	0%	32%	21%	30%	31%	21%	0%	0%	0%	0%	17%	0%	0%	0%	21%	**16.1%**
3	0%	13%	24%	14%	13%	33%	14%	22%	15%	0%	0%	0%	0%	13%	13%	19%	0%	21%	13%	22%	**12.7%**
4	16%	0%	0%	16%	16%	17%	17%	13%	16%	0%	0%	0%	17%	13%	0%	16%	0%	0%	0%	25%	**11.4%**
5	16%	0%	0%	16%	16%	0%	16%	13%	0%	0%	16%	0%	16%	16%	0%	16%	0%	16%	0%	0%	**7.8%**
6	28%	0%	0%	0%	0%	47%	0%	0%	0%	11%	13%	0%	11%	0%	11%	0%	0%	0%	0%	57%	**13.0%**
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
8	0%	8%	0%	9%	18%	0%	0%	14%	0%	8%	9%	0%	0%	8%	0%	9%	16%	14%	0%	11%	**12.7%**
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Weighted mean 0-15	**24.3 %**	**2.1%**	**3.3%**	**14.1 %**	**36.3 %**	**23.5 %**	**9.4%**	**26.5 %**	**26.1 %**	**21.0 %**	**20.0 %**	**10.2 %**	**2.3%**	**14.0 %**	**2.3%**	**21.7 %**	**9.6%**	**13.4 %**	**1.8%**	**31.3 %**	**19 %**

Table 4. Percentage agreement (PA) by modal age and reader. The PA of all readers combined per modal age and a weighted mean of the PA per reader

Modal age	R01 SCT	R02 IS	R03 NO	R04 NO	R07 IE	R08 DK	R10 NL	R11 IE	R12 FO	R13 FO	R14 NL	R15 NO	R17 DE	R18 NO	R19 NO	R20 IE	R22 DE	R24 NO	R25 NO	R32 DK	**All Readers**
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
1	71%	100 %	100 %	94%	67%	83%	100 %	67%	83%	67%	67%	94%	100 %	94%	100 %	78%	94%	94%	100 %	72%	**86%**
2	86%	100 %	100 %	100 %	63%	100 %	63%	71%	63%	75%	71%	100 %	100 %	100 %	100 %	88%	100 %	100 %	100 %	75%	**88%**
3	100 %	83%	83%	83%	83%	67%	83%	50%	67%	100 %	100 %	100 %	100 %	83%	83%	67%	100 %	67%	83%	50%	**82%**
4	67%	100 %	100 %	67%	67%	33%	33%	67%	67%	100 %	100 %	100 %	33%	67%	100 %	67%	100 %	100 %	100 %	33%	**75%**
5	50%	100 %	100 %	50%	50%	100 %	50%	50%	100 %	100 %	50%	100 %	50%	50%	100 %	50%	100 %	50%	100 %	100 %	**75%**
6	50%	100 %	100 %	100 %	100 %	50%	100 %	0%	100 %	50%	50%	100 %	50%	100 %	50%	100 %	100 %	100 %	100 %	0%	**75%**
7	100 %	100 %	100 %	100 %	0%	100 %	100 %	0%	100 %	0%	100 %	100 %	100 %	0%	100 %	100 %	100 %	100 %	100 %	0%	**75%**
8	100 %	50%	100 %	50%	0%	0%	0%	0%	100 %	50%	50%	100 %	100 %	50%	100 %	50%	50%	0%	100 %	0%	**53%**
9	-	0%	100 %	0%	0%	0%	0%	100 %	100 %	0%	0%	0%	100 %	0%	0%	100 %	0%	0%	100 %	0%	**-**
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
11	0%	100 %	100 %	0%	0%	100 %	0%	100 %	100 %	100 %	0%	0%	0%	100 %	0%	0%	100 %	0%	0%	100 %	**45%**
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
15	0%	100 %	100 %	0%	0%	0%	0%	100 %	0%	0%	0%	0%	0%	100 %	0%	0%	100 %	0%	100 %	0%	**30%**

Weigh-ted mean 0-15	**73.8 %**	**93.3 %**	**97.8 %**	**82.2 %**	**60.0 %**	**73.3 %**	**73.3 %**	**59.1 %**	**77.8 %**	**71.1 %**	**68.2 %**	**90.9 %**	**86.7 %**	**84.1 %**	**88.6 %**	**73.3 %**	**93.3 %**	**79.5 %**	**95.5 %**	**57.8 %**	**79 %**

Table 5. Relative bias table shows the relative bias per modal age per age reader. The relative bias of all readers combined per modal age and a weighted mean of the relative bias per reader. Red or black values indicate negative or positive overall bias, respectively.

Modal age	R01 SCT	R02 IS	R03 NO	R04 NO	R07 IE	R08 DK	R10 NL	R11 IE	R12 FO	R13 FO	R14 NL	R15 NO	R17 DE	R18 NO	R19 NO	R20 IE	R22 DE	R24 NO	R25 NO	R32 DK	**ALL Re-aders**
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
1	0.18	0.00	0.00	-0.06	0.39	0.06	0.00	0.39	-0.06	0.33	0.33	-0.06	0.00	-0.06	0.00	0.22	0.06	0.06	0.00	0.39	**0.11**
2	0.14	0.00	0.00	0.00	0.75	0.00	-0.38	0.29	0.50	0.38	0.29	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.25	**0.12**
3	0.00	0.17	0.33	-0.17	0.17	-0.50	-0.17	0.67	0.33	0.00	0.00	0.00	0.00	0.17	0.17	-0.33	0.00	0.00	0.17	-0.50	**0.02**
4	-0.33	0.00	0.00	-0.33	-0.33	-0.67	-0.67	0.33	-0.33	0.00	0.00	0.00	-0.67	0.33	0.00	-0.33	0.00	0.00	0.00	0.00	**-0.15**
5	-0.50	0.00	0.00	-0.50	-0.50	0.00	-0.50	0.50	0.00	0.00	-0.50	0.00	-0.50	-0.50	0.00	-0.50	0.00	-0.50	0.00	0.00	**-0.20**
6	-1.00	0.00	0.00	0.00	0.00	-1.50	0.00	1.00	0.00	0.50	-0.50	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	-1.00	**-0.08**
7	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	5.00	**0.50**
8	0.00	0.50	0.00	-0.50	0.00	-1.00	-1.00	2.00	0.00	0.50	-0.50	0.00	0.00	0.50	0.00	-0.50	1.00	2.00	0.00	-1.50	**0.07**
9	-	-1.00	0.00	-1.00	-1.00	-3.00	-2.00	0.00	0.00	1.00	-2.00	-2.00	0.00	1.00	-1.00	0.00	1.00	-1.00	0.00	-4.00	**-**
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
11	-2.00	0.00	0.00	-1.00	-1.00	0.00	-1.00	0.00	0.00	0.00	-1.00	-1.00	-1.00	0.00	-1.00	-1.00	0.00	1.00	1.00	0.00	**-0.40**
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
15	-3.00	0.00	0.00	-3.00	-3.00	-1.00	-8.00	0.00	-1.00	1.00	-9.00	-1.00	-1.00	0.00	-1.00	-4.00	0.00	-1.00	0.00	-2.00	**-1.85**
Weigh-ted mean 0-15	**-0.12**	**0.02**	**0.04**	**-0.22**	**0.18**	**-0.29**	**-0.44**	**0.50**	**0.07**	**0.31**	**-0.16**	**-0.11**	**-0.09**	**0.09**	**-0.02**	**-0.11**	**0.09**	**0.07**	**0.05**	**0.00**	**0.01**

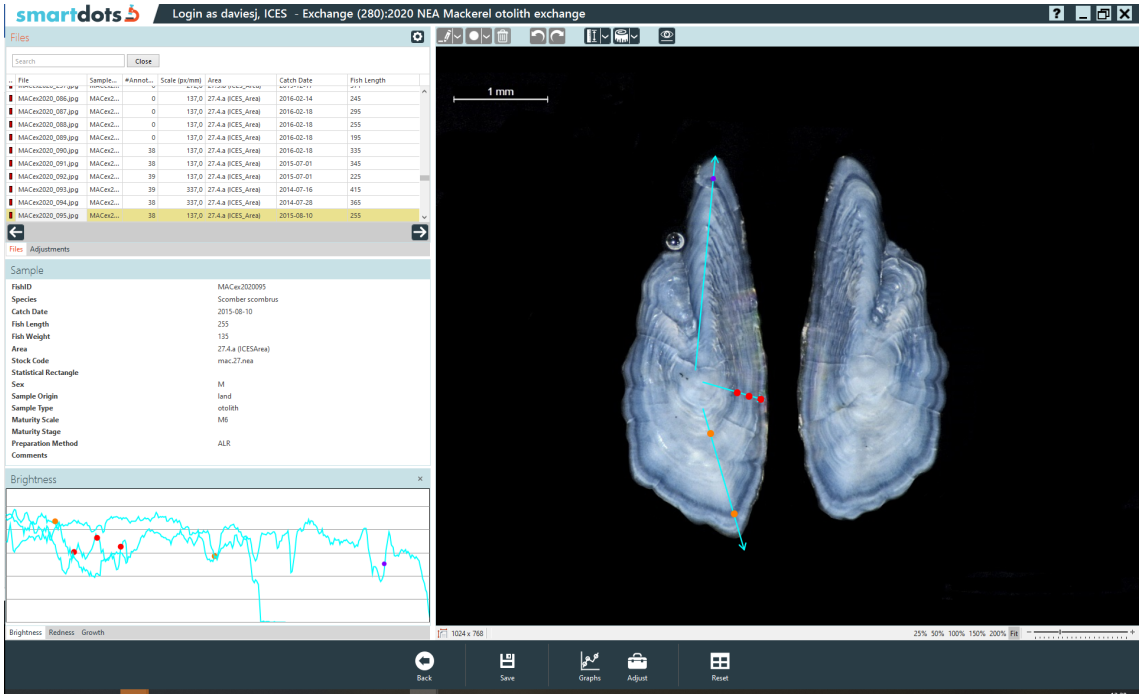

Figure 1. Screendump from the SmartDots application showing a pair of otoliths from sample ID MACex2020095, fish length 255 mm, capture date 10-08-2015. Modal age based on only the advanced age readers = 1. Three readers annotations are shown for demonstration purposes, purple dots = age 1, orange dots = age 2 and red dots = age 3.

Figure 1 describes some of the age reading issues identified when looking at the results in combination with the annotated images in the SmartDots application. Three readers annotations are shown on an otolith images from a fish caught in the North Sea area, which exemplify annotations of the 37 readers who took part in the full exchange. There is one true winter ring on the otolith which should be included in the count of age (modal age =1) and is identified by the purple dot. Some readers are identifying another winter ring close to the otolith nucleus (red and orange dots) and including it in the count of age, this is leading to an overestimation in the age of the fish. In addition, others are identifying an additional winter ring between the 2 mentioned previously, which is resulting in an estimated age of 3 years, this is an overestimation compared to the modal age by 2 years. Readers can often mis-identify false annuli (winter rings) to be true annuli when they are not very experienced with age reading a specific species or stock. Age readers for mackerel are advised to follow the set of agreed criteria for ageing mackerel which were outlined in the 2018 Report of the Workshop on Age Estimation of Atlantic Mackerel (*scomber scombrus*) (WKARMAC2).

Overall, the level of agreement and precision between age readers of the North Sea component of the Northeast Atlantic mackerel stock is good. In comparison to the results based only on advanced readers in the full exchange, PA = 67.8%, the PA for the North Sea component (79%) is higher. When comparing the overall CV = 24.1%, the results for the North Sea component (19%) are also better. For both the full exchange and the North Sea component exchange the CV's are high at modal ages 1 and 2. It is likely that the reasons outlined above could be common issues related to the age reading of mackerel.