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8 Northeast Atlantic Mackerel

8.1 ICES Advice and International Management Applicable to 2019

From 2001 to 2007, the internationally agreed TACs covered most of the distribution area of the Northeast Atlantic mackerel. From 2008 to 2014, no agreement was reached among the Coastal States on the sharing of the mackerel quotas. In 2014, three of the Coastal States (European Union, Norway and the Faroe Islands) agreed on a Management Strategy for 2014 to 2018. In November 2018, the agreement from 2014 was extended for two further years until 2020. However, the total declared quotas in each of 2015 to 2020 all exceeded the TAC advised by ICES. An overview of the declared quotas and transfers for 2020, as available to WGWIDE, is given in the text table below. Total removals of mackerel are expected to be approximately 1.09 million tonnes in 2020, exceeding the ICES advice for 2020 by about 169 000 t.

Estimation of 2020 catch	Tonnes	Reference
EU quota	454 482	EU-NO-FO agreement 17. Oct. 2019
Inter-annual quota transfer 2019->2020 (EU)	2 136	European Council Regulation2020/123
Norwegian quota	207 551	EU-NO-FO agreement 17. Oct. 2019
Inter-annual quota transfer 2019->2020 (NO)	-12 567	Fiskeridirektoratet 18. Dec. 2019
Russian quota	130 282	NEAFC HOD 20/15
Discards	7 807	Previous years estimate
Icelandic quota	135 428	Icelandic regulation No. 277/2020 and WGWIDE
Inter-annual quota transfer 2019->2020 (IC)	19 572	Iceland Fisheries Directorate webpage
Faroese quota	116 188	EU-NO-FO agreement 17. Oct. 2019
Greenland expected catch	30 000	Ministry of Fisheries, Hunting and Agriculture in Greenland
Total expected catch (incl. discards) [1,2]	1 090 879	

[1] No estimates of banking from 2020 to 2021.
[2] Quotas refer to claims by each party for 2020 and include exchange to other parties

The quota figures and transfers in the text table above were based on various national regulations, official press releases, and discard estimates.

Various international and national measures to protect mackerel are in operation throughout the mackerel catching countries. Refer to Table 8.2.4.1 for an overview.

8.2 The Fishery

8.2.1 Fleet Composition in 2019

A description of the fleets operated by the major mackerel catching nations is given in Table 8.2.1.

The total fleet can be considered to consist of the following components:

Freezer trawlers. These are commonly large vessels (up to 150 m) that usually operate a single mid-water pelagic trawl, although smaller vessels may also work as pair trawlers. These vessels are at sea for several weeks and sort and process the catch on board, storing the mackerel in frozen 20 kg blocks. The Dutch, German and the majority of the French and English fleets consist of these vessels which are owned and operated by a small number of Dutch companies. They fish in the North Sea, west of the UK and Ireland and also in the English Channel and further south along the western coast of France. The Russian summer fishery in Division 2.a is also prosecuted by freezer trawlers and partly the Icelandic fishery in Division 5.a and in some years in 14.b.

Purse seiners. The majority of the Norwegian catch is taken by these vessels, targeting mackerel overwintering close to the Norwegian coastline. The largest vessels (> 20 m) used refrigerated seawater (RSW), storing the catch in tanks containing RSW. Smaller purse seiners use ice to chill their catch which they take on prior to departure. A purse seine fleet is also the most important component of the Spanish fleet. They are numerous and target mackerel early in the year close to the northern Spanish coast. These are dry hold vessels, chilling the catch with ice. Denmark also has a purse seine fleet operating in the northern North Sea.

Pelagic trawlers. These vessels vary in size from 20—100 m and operate both individually and as pairs. The largest of the pelagic trawlers use RSW tanks for storage. Iceland, Greenland, Faroes, Scotland and Ireland fish mackerel using pelagic trawlers. Scottish and Icelandic vessels mostly operate as single trawlers whereas Ireland and Faroese vessels tend to use pair trawls. Spain also has a significant trawler fleet which target mackerel with a demersal trawl in Subarea 8 and Division 9.a.N.

Lines and jigging. Norway and England have handline fleets operating inshore in the Skagerrak (Norway) and in Divisions 7.e/f (England) around the coast of Cornwall, where other fishing methods are not permitted. Spain also has a large artisanal handline fleet as do France and Portugal. A small proportion of the total catch reported by Scotland (Divisions 4.a and 4.b) and Iceland (Division 5.a) is taken by a handline fleet.

Gillnets. Gillnet fleets are operated by Norway and Spain.

8.2.2 Fleet Behaviour in 2019

The northern summer fishery in Subareas 2, 5 and 14 continued in 2019. Fishing in the North Sea and west of the British Isles followed a traditional pattern, targeting mackerel on their spawning migration from the Norwegian deep in the northern North Sea, westwards around the north coast of Scotland and down the west coast of Scotland and Ireland.

The Russian freezer trawler fleet operates over a wide area in northern international waters. This fleet targets herring and blue whiting in addition to mackerel. In the third quarter of 2019 the Russian vessels took the vast majority of their catch in Division 2.a.

Total catches from Icelandic vessels were similar to those in recent years and were in excess of 100 kt. The majority of the catch was taken in Division 2.a in 2019 with catch also taken in 5.a in waters to the south, east and west of Iceland. In 2019 Greenland targeted mackerel in Division

14.b, with 1% of the total catch coming from this area. This is a decrease from 2018 when the catch accounted for 6% of the total. In 2018, Iceland and Greenland both fished in this area. Catches from Greenland have decreased in 2019 to 30 kt. In 2018 catches were almost 63 kt. This is a reduction from the peak of 78 kt in 2014 which was the highest catch by this fleet. The Faroese fleet is targeting mackerel in the Faroese EEZ during late summer and early autumn with nearly half of the catches taken there, with some catches in international waters. Later in the autumn season they switch to purse seining in EU waters where nearly the second half of the catch is taken with the remainder taken in international waters.

Concerning the Spanish fisheries, no new regulations have been implemented since 2010 when a new control regime was enforced. The 2019 fishery has started at the beginning of March, as in previous years.

8.2.3 Recent Changes in Fishing Technology and Fishing Patterns

Northeast Atlantic mackerel, as a widely distributed species, is targeted by a number of different fishing métiers. Most of the fishing patterns of these métiers have remained unchanged during the most recent years, although the timing of the spawning migration and geographical distribution can change from year to year and this affects the fishery in various areas.

The most important changes in recent years are related to the geographical expansion of the northern summer fishery (Subareas 2, 5 and 14) and changes in southern waters due to stricter TAC compliance by Spanish authorities.

As a result of this expansion, Icelandic vessels have increased effort and catch dramatically in recent years from 4 kt in 2006 to an average 160 kt annually since 2011. This fishery operates over a wide area E, NE, SE, S and SW of Iceland. Since 2011, there has been less fishing activity to the north and north-east and an increase in catches taken south and west of Iceland. Greenland has reported catches from Division 14.b since 2011, and reached the biggest catch by this fleet to date in 2014, with a catch of 78 kt.

In 2010, the Faroese fleet switched from purse-seining in Norwegian and EU waters to pair trawling in the Faroese area. The Faroese fleet used to catch their mackerel quota in Divisions 4.a and 6.a during September-October with purse-seiners. However, as no agreement has been reached between the Coastal States since 2009, the mackerel quota has been taken in Faroese waters during June-October by the same fleet using pair trawls. The mackerel distribution is more scattered during summer and pair trawls seem to be effective in such circumstances. However, since the agreement between the three of the Coastal States for the fisheries in 2015, parts of the Faroese quota are now again taken with purse-seines in Divisions 5.a and 6.a.

In Spain, part of the purse seiner fleet is using hand lines instead of nets. Although, neither the number of vessels and its evolution nor the reason for such change were deeply analysed, it seems market reasons are driving this shift.

8.2.4 Regulations and their Effects

An overview of the major existing technical measures, effort controls and management plans are given in Table 8.2.4.1. Note that there may be additional existing international and national regulations that are not listed here.

Between 2010 and 2019 no overarching Coastal States Agreement/NEAFC Agreement was in place and no overall international regulation on catch limitation was in force. Currently there is no agreement on a management strategy covering all parties fishing mackerel. In 2014, three of the Coastal States (The EU, Faroes and Norway) agreed on a Management Strategy for 2015 and the subsequent five years. In November 2018, the agreement from 2014 was extended for two more years until 2020. However, the total declared quotas taken by all parties since 2015 have greatly exceeded the TAC advised by ICES (see Section 8.1).

Management aimed at a fishing mortality in the range of 0.15—0.20 in the period 1998—2008. The current management plan aims at a fishing mortality in the range 0.20—0.22. The fishing mortality realised during 1998—2008 was in the range of 0.27 to 0.46. Implementation of the management plan resulted in a reduced fishing mortality and increased biomass. Since 2008 catches have greatly exceeded those given by the plan.

The measures advised by ICES to protect the North Sea spawning component aim at setting the conditions for making a recovery of this component possible. Before the late 1960s, the North Sea spawning biomass of mackerel was estimated at above 2.5 million tonnes. The collapse of mackerel in the North Sea in the late 1960s was most likely driven by very high catches and associated fishing mortality. However, the lack of recovery of mackerel in the North Sea was probably associated with unfavourable environmental conditions, particularly reduced temperatures (unfavourable for spawning), lower zooplankton availability in the North Sea and increased wind-stress induced turbulence (Jansen, 2014). These unfavourable environmental conditions probably led the mackerel to spawn in western waters instead of in the North Sea.

A review of the mackerel in the North Sea, carried out during WKWIDE 2017 (ICES, 2017b) concluded that Northeast Atlantic mackerel should be considered as a single population (stock) with individuals that show stronger or weaker affinity for spawning in certain parts of the spawning area. Management should ensure that fisheries do not decrease genetic and behavioural diversity, since this could reduce future production. Protection of mackerel that tend to spawn in the north-eastern parts of the spawning area is therefore still advisable to some extent.

In the southern area, a Spanish national regulation affecting mackerel catches of Spanish fisheries has been implemented since 2010. In 2015, fishing opportunities were distributed by region and gear and for the bottom trawl fleet, by individual vessel. This year, Spanish mackerel fishing opportunities in Divisions 8.c and 9.a were established at 39 674 t resulting from the quota established (Commission Regulation (EU) No 104/2015). This was reduced by 9 797 t due to the scheduling payback quota due to overfishing of the mackerel quota allocated to Spain in 2010 (Commission Regulation No 976/2012).

Within the area of the southwest Mackerel Box off Cornwall in southern England only handliners are permitted to target mackerel. This area was set up at a time of high fishing effort in the area in 1981 by Council Regulation to protect juvenile mackerel, as the area is a well-known nursery. The area of the box was extended to its present size in 1989.

Additionally, there are various other national measures in operation in some of the mackerel catching countries.

The first phase of a landing obligation came into force in 2015 for all EU vessels in pelagic and industrial fisheries. Since 2019, all species that are managed through TACs and quotas must be landed under the obligation unless there is a specific exemption such as *de minimis*. There are *de minimis* exemptions for mackerel caught in bottom-trawl fisheries in the North Western Waters (EC 2018/2034) and in the North Sea (EC 2018/2035).

8.3 Quality and Adequacy of sampling Data from Commercial Fishery

The sampling of the commercial catch of Northeast Atlantic mackerel is summarised below:

Year	WG Total Catch (t)	% catch covered by sampling programme*	No. Samples	No. Measured	No. Aged
1992	760000	85	920	77000	11800
1993	825000	83	890	80411	12922
1994	822000	80	807	72541	13360
1995	755000	85	1008	102383	14481
1996	563600	79	1492	171830	14130
1997	569600	83	1067	138845	16355
1998	666700	80	1252	130011	19371
1999	608928	86	1109	116978	17432
2000	667158	76	1182	122769	15923
2001	677708	83	1419	142517	19824
2002	717882	87	1450	184101	26146
2003	617330	80	1212	148501	19779
2004	611461	79	1380	177812	24173
2005	543486	83	1229	164593	20217
2006	472652	85	1604	183767	23467
2007	579379	87	1267	139789	21791
2008	611063	88	1234	141425	24350
2009	734889	87	1231	139867	28722
2010	869451	91	1241	124695	29462
2011	938819	88	923	97818	22817
2012	894684	89	1216	135610	38365
2013	933165	89	1092	115870	25178
2014	1394454	90	1506	117250	43475
2015	1208990	88	2132	137871	24283
2016	1094066	89	2200	149216	21456

Year	WG Total Catch (t)	% catch covered by sampling programme*	No. Samples	No. Measured	No. Aged
2017	1155944	87	2183	151548	24104
2018	1026437	83	1858	139590	20703
2019	840021	88	1835	141561	17646

Overall sampling effort in 2019 was similar to previous years with 88 % of the catch sampled. It should be noted that this proportion is based on the total sampled catch. Nations with large, directed fisheries are capable of sampling 100 % of their catch which may conceal deficiencies in sampling elsewhere.

The 2019 sampling levels by country are shown below.

Country	Official catch	% WG catch covered by sampling programme	No. Samples	No. Measured	No. Aged
Belgium	66	0%	0	0	0
Denmark	30605	75%	13	1096	1101
Faroe Islands	62665	92%	17	845	940
France	20975	0%	0	0	0
Germany	16904	83%	106	1081	11661
Greenland	30259	100%	6	59	3406
Iceland	128077	100%	122	2997	5422
Ireland	53384	94%	38	1438	7410
Netherlands	22698	71%	27	675	2792
Norway	159107	98%	61	1892	1892
Poland	3706	0%	0	0	0
Portugal	3940	18%	115	988	3919
Russia	126544	99%	190	1250	60447
Sweden	2967	0%	0	0	0
Spain	23866	96%	1025	4426	36179
UK (England & Wales)	17871	2%	63	217	3997
UK (Northern Ireland)	11879	59%	1	49	173
UK (Scotland)	124507	88%	20	633	2222

The majority of countries achieved a high level of sampling coverage. Belgian catches consist of by-catch in the demersal fisheries in the North Sea. France supplied a quantity of length-frequency data to the working group which can be utilised to characterise the selection of the fleet but requires an allocation of catch at age proportions from another sampled fleet in order to raise the data for use in the assessment. Sweden and Poland did not supply sampling information in 2019. Portugal sampled landings from 9.a only. England only samples landings from the handline fleet operating off the Cornish coast, representing only a small proportion of the national catch, the remainder reported from freezer trawlers. Cooperation between the Dutch and German sampling programmes (which sampled 71% and 83% respectively) is designed to provide complete coverage for the freezer trawlers operating under these national flags and also those of England and France. Catch sampling levels per ICES Division (for those with a WG catch of >100 t) are shown below.

Division	Official Catch (t)	WG Catch (t)	No. Samples	No. Measured	No Aged
2.a	269328	269328	280	65351	3569
3.a	501	501	0	0	0
4.a	302841	302841	128	10910	4034
4.b	3978	3978	0	0	0
4.c	703	703	0	0	0
5.a	58101	58101	56	2463	1385
5.b	10957	10957	5	497	338
6.a	123112	123112	73	12687	1828
7.b	17993	17993	16	2982	645
7.c	179	179	0	0	0
7.d	4933	4933	42	265	136
7.e	3125	3125	25	1508	53
7.f	642	642	38	2489	164
7.g	104	104	0	0	0
7.h	207	207	0	0	0
7.j	4749	4749	2	135	50
8.a	2839	2839	3	3	3
8.b	4181	4181	244	5798	472
8.c	16672	16672	272	8519	2364
8.c.E	6478	6478	213	17649	832
9.a	706	706	115	3919	988
9.a.N	921	921	291	4208	753
14.b	6651	6651	30	2176	30

In general, areas with insufficient sampling have relatively low levels of catch.

8.4 Catch Data

8.4.1 ICES Catch Estimates

The total ICES estimated catch for 2019 was 840 021 t, a decrease of 186 416 t on the estimated catch in 2018. Catches in 2019 were the lowest since 2009. Catches increased substantially from 2006—2010 and have averaged 1 050 kt since from 2011.

The combined 2019 TAC, arising from agreements and autonomous quotas, amounts to 864 000 t). The ICES catch estimate (840 021 t) represents an undershoot of this but is still above the ICES advice of 770 358 t. The combined fishable TAC for 2020, as best ascertained by the Working Group (see Section 8.1), amounts to 1 090 879 t.

Catches reported for 2019 and in previous Working Group reports are considered to be best estimates. In most cases, catch information comes from official logbook records. Other sources of information include catch processors. Some countries provide information on discards and slipped catch from observer programs, logbooks and compliance reports. In several countries discarding is illegal. Spanish data is based on the official data supplied by the Fisheries General Secretary (SGP) but supplemented by scientific estimates which are recorded as unallocated catch in the ICES estimates.

The text table below gives a brief overview of the basis for the ICES catch estimates.

Country	Official Log Book	Other Sources	Discard Information
Denmark	Y (landings)	Y (sale slips)	Y
Faroe[1]	Y (catches)	Y (coast guard)	NA
France	Y (landings)		Y
Germany	Y (landings)		Y
Greenland	Y (catches)	Y (sale slips)	Y
Iceland[1]	Y (landings)		NA
Ireland	Y (landings)		Y
Netherlands	Y (landings)	Y	Y
Norway[1]	Y (catches)		NA
Portugal		Y (sale slips)	Y
Russia[1]	Y (catches)		NA
Spain	Y	Y	Y
Sweden	Y (landings)		Y
UK	Y (landings)	Y	Y

[1]For these nations a discarding ban is in place such that official landings are considered to be equal to catches.

The Working Group considers that the estimates of catch are likely to be an underestimate for the following reasons:

- Estimates of discarding or slipping are either not available or incomplete for most countries. Anecdotal evidence suggests that discarding and slipping can occur for a number of reasons including high-grading (larger fish attract a premium price), lack of quota, storage or processing capacity and when mackerel is taken as by-catch.
- Confidential information suggests substantial under-reported landings for which numerical information is not available for most countries. A study carried out in 2010 indicated considerable uncertainty in true catch figures (Simmonds *et al.*, 2010) for the period studied.
- Estimates of the magnitude and precision of unaccounted mortality suggests that, on average for the period prior to 2007, total catch related removals were equivalent to 1.7 to 3.6 times the reported catch (Simmonds *et al.*, 2010).
- Reliance on logbook data from EU countries implies (even with 100% compliance) a precision of recorded landings of 89% from 2004 and 82% previous to this (Council Regulation (EC) Nos. 2807/83 & 2287/2003). Given that over reporting of mackerel landings is unlikely for economic reasons; the WG considers that the reported landings may be an underestimate of up to 18% (11% from 2004), based on logbook figures. Where inspections were not carried out there is a possibility of a 56 % under reporting, without there being an obvious illegal record in the logsheets. Without information on the percentage of the landings inspected it is not possible for the Working Group to evaluate the underestimate in its figures due to this technicality. EU landings represent about 65 % of the total estimated NEA mackerel catch.
- The accuracy of logbooks from countries outside the EU has not been evaluated by WGWIDE. Monitoring of logbook records is the responsibility of the national control and enforcement agencies.

The total catch as estimated by ICES is shown in Table 8.4.1.1. It is broken down by ICES area group and illustrates the development of the fishery since 1969.

Discard Estimates

With a few exceptions, estimates of discards have been provided to the Working Group for the ICES Subareas and Divisions 6, 7/8.a,b,d,e and 3/4 (see Table 8.4.1.1) since 1978. Historical discard estimates were revised during the data compilation exercise undertaken for the 2014 benchmark assessment (ICES, 2014). The Working Group considers that the estimates for these areas are incomplete. In 2019, discard data for mackerel were provided by The Netherlands, France, Germany, Ireland, Spain, Portugal, Greenland, Denmark, England, Scotland and Sweden. Total discards amounted to 7 807 t which is an increase from 2018. Higher discards were reported by France mainly due to a change in raising procedures. Other countries reported smaller increases. The German, Dutch and Portuguese pelagic discard monitoring programmes did not record any instances of discarding of mackerel. Estimates from the other countries supplying data include results from the sampling of demersal fleets.

Age-disaggregated discard data was limited but data available indicates that, in Divisions 8.a, 8.b and 8.c the majority of discarded fish were aged 0 to 3. In Division 9.a, the majority of the discarded fish were 0 group.

Discarding of small mackerel has historically been a major problem in the mackerel fishery and was largely responsible for the introduction of the south-west mackerel box. In the years prior to 1994, there was evidence of large-scale discarding and slipping of small mackerel in the fisheries in Division 2.a and Subarea 4, mainly because of the very high prices paid for larger mackerel (> 600 g) for the Japanese market. This factor was put forward as a possible reason for the very low abundance of the 1991 year-class in the 1993 catches. Anecdotal evidence from the fleet suggests that since 1994, discarding/slipping has been reduced in these areas.

In some of the horse mackerel directed fisheries, *e.g.* those in Subareas 6 and 7, mackerel is taken as by-catch. Reports from these fisheries have suggested that discarding may be significant because of the low mackerel quota relative to the high horse mackerel quota, particularly in those fisheries carried out by freezer trawlers in the fourth quarter. The level of discards is greatly influenced by the market price and by quotas.

8.4.2 Distribution of Catches

A significant change in the fishery took place between 2007 and 2009 with a greatly expanded northern fishery becoming established. This fishery has continued to the present but with a clear tendency for an eastern retraction, especially from the Greenlandic area and also western parts of the Icelandic area in the most recent three years. Of the total catch in 2019, Norway accounted for the greatest proportion (19%) followed by Scotland (15%), Iceland (15%), Russia (15%) and Faroe (7%). In the absence of an international agreement, Greenland, Iceland and Russia declared unilateral quotas in 2019. Russia and Iceland both had catches over 100 kt with Faroes catching 62 kt. Greenlandic catches decreased from 63 kt to 30 kt. Scotland had catch in excess of 100 kt and Ireland caught almost 53 kt. Denmark had catches of around 30 kt. The Netherlands and Spain caught around 23 kt while France had catches of the order of 20 kt. Germany and England had catches around 17 kt.

In 2019, catches in the northern areas (Subareas 2, 5, 14) amounted to 345 037 t (see Table 8.4.2.1), a decrease of 110 704 t on the 2018 catch. Icelandic, Norwegian and Russian catches were all over 100 kt. Catches from Division 2.a accounted for 32% of the total catch in 2019, similar to 2018. Almost all the Russian catch in 2019 was taken in Division 2.a. The wide geographical distribution of the fishery noted in previous years has continued.

The time series of catches by country from the North Sea, Skagerrak and Kattegat (Subarea 4, Division 3.a) is given in Table 8.4.2.2. Catches in 2019 amounted to 308 049 t and represents a decrease from the 2018 catch figure (342 147 t). The majority of the catch is from Subarea 4 with small catches were also reported in Divisions 3.a-d.

Catches in the western area (Subareas 6, 7 and Divisions 8.a,b,d and e) decreased again in 2019 to 162 159 t. This is a decrease of around 32 000 t from 2018. The catches are detailed in Table 8.4.2.3.

Table 8.4.2.4 details the catches in the southern areas (Divisions 8.c and 9.a) which are taken almost exclusively by Spain and Portugal. The reported catch of 24 776 t represents a decrease from 2017. The catch is lower than the long-term average.

The distribution of catches by quarter (%) is described in the text table below:

Year	Q1	Q2	Q3	Q4	Year	Q1	Q2	Q3	Q4
1990	28	6	26	40	2005	46	6	25	23
1991	38	5	25	32	2006	41	5	18	36
1992	34	5	24	37	2007	34	5	21	40
1993	29	7	25	39	2008	34	4	35	27
1994	32	6	28	34	2009	38	11	31	20
1995	37	8	27	28	2010	26	5	54	15
1996	37	8	32	23	2011	22	7	54	17
1997	34	11	33	22	2012	22	6	48	24
1998	38	12	24	27	2013	19	5	52	24
1999	36	9	28	27	2014	20	4	46	30
2000	41	4	21	33	2015	20	5	44	31
2001	40	6	23	30	2016	23	4	44	29
2002	37	5	29	28	2017	24	3	45	28
2003	36	5	22	37	2018	20	3	40	37
2004	37	6	28	29	2019	28	5	42	26

The quarterly distribution of catch in 2019 is similar to recent years (since 2010) with the northern summer fishery in Q3 accounting for the greatest proportion of the total catch.

Catches per ICES statistical rectangle are shown in Figures 8.4.2.1 to 8.4.2.4. It should be noted that these figures are a combination of official catches and ICES estimates and may not indicate the true location of the catches or represent the location of the entire stock. These data are based on catches reported by all the major catching nations and represents almost the entire ICES estimated catch.

- First quarter 2019 (233 940 t – 28 %)

The distribution of catches in the first quarter is shown in Figure 8.4.2.1. The proportion of the fishery taken in quarter 1 has increased in 2019 with the Scottish and Irish pelagic fleets targeting mackerel in Divisions 6.a, 7.b and 7.j. Substantial catches are also taken by the Dutch owned freezer trawler fleet. The largest catches were taken in Division 6.a, as in recent years. An increase in catch from 4.a and 7.b Q1 was seen in 2019 compared to 2018. The Spanish fisheries also take significant catches along the north coast of Spain during the first quarter.

- Second quarter 2019 (384 195 t – 5 %)

The distribution of catches in the second quarter is shown in Figure 8.4.2.2. The quarter 2 fishery is traditionally the smallest and this was also the case in 2019. The most significant catches where those in Division 8.c and at the start of the summer fishery in northern waters by Icelandic, Norwegian and Russian fleets.

- Third quarter 2019 (379 456 t – 42 %)

Figure 8.4.2.3 shows the distribution of the quarter 3 catches. Large catches were taken throughout Divisions 2.a (Russian, Norwegian vessels), 4.a (Norwegian, Scottish vessels), 5.a (Icelandic vessels). Catch was also taken in Division 14.b in quarter 3.

- Fourth quarter 2019 (379 757 t – 26 %)

The fourth quarter distribution of catches is shown in Figure 8.4.2.4. The proportion of the catch taken in the fourth quarter has decreased from 37% in 2018 to 26% in 2019. The summer fishery in northern waters has largely finished with very small catches reported from Division 2.a. The largest catches are taken by Norway and Scotland around the Shetland Isles. Irish vessels did not participate in the quarter 4 fishery in 4.a in 2019.

ICES cannot split the reported mackerel catches into different stock components because there is no clear distinction between components upon which a split could be determined. Mackerel with a preference for spawning in the northeast area, including the North Sea, cannot presently be identified morphometrically or genetically (Jansen and Gislason, 2013). Separation based on time and area of the catch is not a precise way of splitting mackerel with different spawning preferences, because of the mixing and migration dynamics including inter-annual (and possibly seasonal) variation of the spawning location, combined with the post-spawning immigration of mackerel from the south-west where spawning ends earlier than in the North Sea.

8.4.3 Catch-at-Age

The 2019 catches in number-at-age by quarter and ICES area are given in Table 8.4.3.1. This catch in numbers relates to a total ICES estimated catch of 840 021 t. These figures have been appended to the catch-at-age assessment table (see Table 8.7.1.2).

Age distributions of commercial catch were provided by Denmark, England, Germany, Faroes, Iceland, Ireland, the Netherlands, Norway, Portugal, Russia, Scotland, Northern Ireland and Spain. There remain gaps in the age sampling of catches, notably from France (length samples were provided), Sweden and Poland.

Catches for which there were no sampling data were converted into numbers-at-age using data from the most appropriate fleets. Accurate national fleet descriptions are required for the allocation of sample data to unsampled catches.

The percentage catch numbers-at-age by quarter and area are given in Table 8.4.3.2.

As in previous years, over 80% of the catch in numbers in 2019 consists of 3 to 9-year olds with all year classes between 2010 and 2014 contributing over 10 % to the total catch by number. The 2016 year-class was strong in the fishery in 2019 and accounts for 17 % of the catch numbers at age.

There is a small presence of juvenile (age 0) fish within the 2019 catch. As in previous years catches from Divisions 8.c and 9.a have contained a proportion of juveniles.

8.5 Biological Data

8.5.1 Length Composition of Catch

The mean length-at-age in the catch per quarter and area for 2019 are given in Table 8.5.1.1.

For the most common ages which are well sampled there is little difference to recent years. The length of juveniles is traditionally rather variable. The range of lengths recorded in 2019 for 0 group mackerel (172 mm-267 mm) are higher than those in 2018 (162 mm-254 mm) and 2017 (131 mm-212 mm). The rapid growth of 0-group fish combined with variations in sampling (in recent years more juvenile fish have been sampled in northern waters whereas previously these fish were only caught in southern waters) will contribute to the observed variability in the observed size of 0-group fish. Growth is also affected by fish density as indicated by a recent study which demonstrated a link between growth of juveniles and adults (0—4 years) and the abundance of juveniles and adults (Jansen and Burns, 2015). A similar result was obtained for mature 3- to 8-year-old mackerel where a study over 1988—2014 showed declining growth rate since the mid-2000s to 2014, which was negatively related to both mackerel stock size and the stock size of Norwegian spring spawning herring (Ólafsdóttir *et al*., 2015).

Length distributions of the 2019 catches were provided by England, France, Iceland, Ireland, Denmark, Germany, the Netherlands, Portugal, Russia, Scotland and Spain. The length distributions were available from most of the fishing fleets and account for over 90% of the catches. These distributions are only intended to give an indication of the size of mackerel caught by the various fleets and are used as an aid in allocating sample information to unsampled catches. Length distributions by country and fleet for 2019 catches are given in Table 8.5.1.2.

8.5.2 Weights at Age in the Catch and Stock

The mean weight-at-age in the catch per quarter and area for 2019 are given in Table 8.5.2.1. There is a trend towards lighter weight-at-age for the most age classes (except 0 to 2 years old) starting around 2005, continuing until 2013 (Figure 8.5.2.1). This decrease in the catch mean weight-at-age seems to have stopped since 2013 and values for the last six years do not show any particular trend for the older ages (age 6 and older) and are slightly increasing for younger ages (ages 1 to 5). These variations in weight-at-age are consistent with the changes noted in length in Section 8.5.1.

The Working Group used weight-at-age in the stock calculated as the average of the weight-at-age in the three spawning components, weighted by the relative size of each component (as estimated by the 2019 egg survey for the southern and western components and the 2017 egg survey for the North Sea component). Mean weight-at-age in 2019 for the western component are estimated from Dutch, Irish and German commercial catch data, the biological sampling data taken during the egg surveys and during the Norwegian tagging survey. Only samples corresponding to mature fish, coming from areas and periods corresponding to spawning, as defined at the 2014 benchmark assessment (ICES, 2014) and laid out in the Stock Annex, were used to compute the mean weight-at-age in the western spawning component. For the North Sea spawning component, mean weight-at-age in 2019 were calculated from samples of the commercial catches collected from Divisions 4.a and 4.b in the second quarter of 2019. Stock weights for the southern component, are based on samples from the Spanish catch taken in Divisions 8.c and 9.a in the 2nd quarter of the year. The mean weights in the three component and in the stock in 2018 are shown in the text table below.

As for the catch weights, the decreasing trend observed since 2005 for fish of age 3 and older seems to have stopped in 2013 and values in the last six years do not show any specific trend (except for weights of ages 2 to 5 which have been increasing, Figure 8.5.2.2).

	North Sea Component	Western Component	Southern Component	NEA Mackerel 2017
Age				**Weighted mean**
0				0.000
1			0.108	0.069
2	0.219	0.202	0.149	0.191
3	0.252	0.241	0.275	0.250
4	0.262	0.284	0.332	0.293
5	0.313	0.308	0.320	0.311
6	0.350	0.337	0.368	0.346
7	0.350	0.364	0.374	0.365
8	0.346	0.370	0.383	0.371
9	0.396	0.394	0.404	0.397
10	0.423	0.424	0.443	0.428
11	0.433	0.424	0.452	0.431
12+		0.471	0.510	0.481
Component Weighting	8.5%	67.9%	23.6%	
Number of fish sampled	133	777	1897	

8.5.3 Natural Mortality and Maturity Ogive

Natural mortality is assumed to be 0.15 for all age groups and constant over time.

The maturity ogive for 2019 was calculated as the average of the ogives of the three spawning components weighted by the relative size of each component calculated as described above for the stock weights. The ogives for the North Sea and Southern components are fixed over time. For the Western component the ogive is updated every year, using maturity data from commercial catch samples from Germany, Ireland, the Netherlands and the UK collected during the first and second quarters (ICES, 2014 and Stock Annex). The 2019 maturity ogives for the three components and for the mackerel stock are shown in the text table below.

Age	North Sea Component	Western Component	Southern Component	NEA Mackerel
0	0	0	0	0
1	0	0.12	0.02	0.09
2	0.37	0.41	0.54	0.43
3	1	0.92	0.70	0.87
4	1	1	1	1.00
5	1	1	1	1.00
6	1	1	1	1.00
7	1	1	1	1.00
8	1	1	1	1.00
9	1	1	1	1.00
10	1	1	1	1
11	1	1	1	1
12+	1	1	1	1
Component Weighting	8.5%	68.1%	23.4%	

A trend towards earlier maturation (increasing proportion mature at age 2) has been observed from around 2008 to 2015. A change in the opposite direction has been observed since then and the proportion of fish mature at age in 2019 are now markedly lower than in the previous years, and are now at levels comparable with the ones observed at the end of the 2000s (Figure 8.5.3.1).

8.6 Fishery Independent Data

8.6.1 International Mackerel Egg Survey

8.6.1.1 Final results of the 2019 Mackerel Egg Survey

Due to the COVID disruption the meeting of the ICES Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS) was split into two parts in 2020. The first part was held through a web conference from 28–29 April 2020, chaired by Matthias Kloppmann (Thünen Institut, Germany) and Gersom Costas (IEO, Spain), to finalize the results of the Mackerel and Horse Mackerel Egg Survey 2019 and to plan the North Sea Mackerel Egg Survey in 2020. The second part of WGMEGS will be held through a web conference from 4 -6 November in order to finalize the rest of the topics of the terms of reference.

The 2019 mackerel and horse mackerel egg survey was designed to cover the whole spawning area of the two species, within six sampling periods of differing geographical coverage (WGMEGS: ICES, 2019d; Figure 8.6.1.1.1). Nine institutes from eight countries, Germany, Ireland, the Netherlands, Scotland, Portugal, Spain, Faroes, and Norway participated. The return of Norway was welcomed and provided additional coverage in the northern area compared to 2016. The application of an alternate transect survey design made it possible to survey the increasingly wide area that became necessary due to the expansion of mackerel spawning area and season. A provisional egg production for mackerel was provided to the WGWIDE meeting in 2019 (O'Hea *et al.*, 2019).

In 2019 peak spawning was found to have occurred in period 4 for the western spawning component (Figure 8.6.1.1.2 and Figure 8.6.1.1.3) and in period 3 for the southern spawning component (Figure 8.6.1.1.4 and Figure 8.6.1.1.5). Although the northern and northwestern spawning boundaries for mackerel during periods 5 and 6 were not fully delineated the analyses of the survey results showed that the mackerel core spawning area was covered and a reliable estimate of mackerel annual egg production was delivered. The estimate of total mackerel egg production (southern and western spawning components combined) was 1.64 * 10^{15} which is a decrease of 7.6% compared to that of 2016 (Table 8.6.1.1.1 & Figure 8.6.1.1.6).

During the 2019 survey 1 391 mackerel were collected from the entire survey area during all periods and 895 ovary samples were used to estimate the mackerel fecundity parameters (Figure 8.6.1.1.7). The analyses of relative potential fecundity gave a value of 1 191 eggs per gram female for mackerel for the western and southern components combined. The overall prevalence of atresia as a percentage of the population was 28% and the potential fecundity lost in the spawning season was 20 eggs/g. This reduced the potential fecundity by 4%. (Table 8.6.1.1.2).

Total spawning stock biomass (SSB) for the NEA mackerel stock was estimated using the realised fecundity estimate of 1 147 oocytes/g female, a sex ratio of 1:1 and a raising factor of 1.08 (ICES, 1987) to convert pre-spawning to spawning fish.

This gave a final estimate of spawning-stock biomass (SSB) in 2019 of

- 2.29 million tonnes for the western component;
- 0.80 million tonnes for the southern component; and
- a combined estimate of 3.09 million tonnes. This is a decrease by 12% in comparison to the 2016 estimate (Table 8.6.1.1.1, Figure 8.6.1.1.8).

8.6.1.2 2020 Mackerel Egg Survey in the North Sea

In 2020 the planning for the North Sea mackerel egg survey was conducted prior and discussed and finalized during the WGMEGS meeting in April. The survey was due to be executed in May and June 2020 with the participation of Denmark and The Netherlands. Cindy van Damme (NL) was appointed to coordinate the survey. However, due to the COVID-19 pandemic, the survey had to be cancelled and postponed to 2021.

8.6.2 Demersal trawl surveys in October – March (IBTS Q4 and Q1)

The data and the model

An index of survivors in the first autumn-winter (recruitment index) was derived from a geostatistical model fitted to catch data from bottom trawl surveys conducted during autumn and winter. A complete description of the data and model can be found in Jansen *et al*. (2015) and the NEA mackerel Stock Annex.

The data were compiled from several bottom trawl surveys conducted between October and March from 1998—2019 by research institutes in Denmark, England, France, Germany, Ireland, Netherlands, Norway, Scotland and Sweden. Surveys conducted on the European shelf in the first and fourth quarters are collectively known as the International Bottom Trawl Survey (IBTS), although several of the surveys use different names. All surveys sample the fish community on the continental shelf and upper shelf slope. IBTS Q4 covers the shelf from the Bay of Biscay to North of Scotland, excluding the North Sea, while IBTS Q1 covers the shelf waters from north of Ireland, around Scotland, the North Sea, Skagerrak and Kattegat.

Trawl operations during the IBTS have largely been standardized through the relevant ICES working group (ICES, 2013). Furthermore, the effects of variation in wing-spread and trawl speed were included in the model (Jansen *et al*., 2015). Trawling speed was generally 3.5—4.0 knots, and trawl gear is also standardized and collectively known as the Grande Ouverture Verticale (GOV) trawl. Some countries use modified trawl gear to suit the particular conditions in the respective survey areas, although this was not expected to change catchability significantly. However, in other cases, the trawl design deviated more significantly from the standard GOV type, namely the Spanish BAKA trawl, the French GOV trawl, and the Irish mini-GOV trawl. The BAKA trawl had a vertical opening of only 2.1—2.2 m and was towed at only 3 knots. This was considered substantially less suitable for catching juvenile mackerel and, therefore, was excluded from the analysis. The French GOV trawl was rigged without a kite and typically had a reduced vertical opening, which may have reduced the catchability of pelagic species like mackerel. Catchability was assumed to equal the catchability of the standard GOV trawl because testing has shown that the recruitment index was not very sensitive to this assumption (Jansen *et al.*, 2015). Finally, the Irish mini-GOV trawl, used during 1998—2002, was a GOV trawl in reduced dimensions which was accounted for by inclusion of the wing-spread parameter in the model.

All surveys in 2018 Q4 and 2019 Q1 were conducted according to standards. Figure 8.6.2.1 provides an overview of the distribution and number of samples.

A geostatistical log-Gaussian Cox process model (LGC) with spatiotemporal correlations was used to estimate the catch rates of mackerel recruits through space and time.

Results

The index of survivors in the first autumn-winter (recruitment index) was updated with data from surveys in 2018 Q4 and 2019 Q1. Parameter estimates and standard errors in the final model are listed in Table 8.6.2.1. An overview of the IBTS survey is given in Figure 8.6.2.1. The modelled average recruitment index (squared CPUE) surfaces were mapped in Figure 8.6.2.2a and b. The time series of spatially integrated recruitment index values is used in the assessment as a relative abundance index of mackerel at age 0 (recruits). All annual index values were estimated to be slightly higher than during the previous model fit (IBPNeaMAC: ICES, 2019a), but with the same interannual pattern ($p < 0.001$, $r = 0.9986$). This increase does not affect the stock assessment because it is used in the assessment as a relative abundance index. The estimated index value for the 2019 year-class is above average (Figure 8.6.2.3).

Discussion

The combined demersal surveys have incomplete spatial coverage in some areas that can be important for the estimation of age-0 mackerel abundance, namely: (i) Since 2011, the English survey (covering the Irish sea and the central-eastern part of the Celtic sea including the area around Cornwall) has been discontinued, (ii) the Scottish survey has not consistently covered the area around Donegal Bay, (iii) the IBTS has observed high catch rates in some years at the north-eastern edge of the survey area (towards the Norwegian trench) in winter. It is therefore possible that some recruits are also overwintering on the other side of the trench along the south western shelf edge of Norway. Consequently, the NS-IBTS in Q1 should be extended to include the south-western Norwegian shelf and shelf edge in proximity to the Norwegian trench.

Finally, WGWIDE encourages studies of vertical distribution and catchability of age-0 mackerel in the Q4 and Q1 surveys, to evaluate if it is comparable in all areas (see acoustic information in Jansen et al., 2015).

8.6.3 Ecosystem surveys in the Nordic Seas in July-August (IESSNS)

The IESSNS was successfully conducted in the summer of 2020 (Figure 8.6.3.1). Six vessels sampled 315 predetermined surface trawl stations during the period from 1st July to August 4 which covered an area of 2.9 mill. km^2, excluding the North Sea. This was similar coverage to 2018 and 2019. At each surface trawl station, a standardized trawl (Multpelt 832) is deployed for 30-min according to a standardized operation protocol which is designed to catch mackerel. Additionally, abundance of herring and blue whiting was measured using acoustic methods and backscatter was verified by trawling on registrations as needed. The aim is to establish an age-segregated abundance index for blue whiting and herring to be used in stock assessment in the future. The IESSNS 2020 cruise report is available as a working document to the current report (WD03 in Annex 6) and a detailed survey description is in the NEA mackerel Stock Annex.

The IESSNS provides an annual age-segregated index for mackerel abundance for age classes 1-14+ in Nordic Seas since 2010 and in the North Sea since 2018 (ICES, 2019a). In the current chapter and the cruise report, the North Sea mackerel data are reported separately from the longer time series available from Nordic Seas.

In Nordic Seas, total stock abundance was estimated 26.4 billion and biomass was estimated 11.5 million tonnes which compared to 2019 is an increase of 0.3% and 7.0%, respectively (Table 8.6.3.1 and Figure 8.6.3.2a-b). Age classes 3-11, which are included in the stock assessment, decreased 4% in 2020 compared to 2019. Estimated stock abundance in 2020 is the second highest for the time series and the highest for estimated biomass. Abundance in 2020 was in similar range as estimates for the period from 2013 to 2019, whereas biomass has gradually increased from 2015 to 2020, excluding 2018. This suggests increasing proportion of older fish in the stock in recent years which is supported by increasing numbers-at-age for fish age 8+ and no clear trend of changing weight-at-age.

Internal consistency of year classes is highly variable with correlation values ranging from 0.10 to 0.93 (Figure 8.6.3.3). There is a good to strong internal consistency for the younger ages (1-5 years) and older ages (8-14+ years) with r between 0.73 and 0.93. However, the internal consistency is poor to moderate ($0.10 < r < 0.63$) between age 5 to 8 as in previous years. The reason for this poor consistency is not understood.

In 2020, the most abundant year classes were 2010, 2016 and 2011 respectively presenting 14%, 13% and 11% of the total stock in numbers (Figure 8.6.3.4a, b). These same three cohorts were also the most abundant in 2019. The 2010 and 2011year-classes have been the largest cohorts in the stock since they were recruited to the survey (age 3-4).

Mackerel density, per predetermined surface trawl station, ranged from 0 to 62 tonnes/km^2 with the highest densities recorded in the central and northern Norwegian See (Figure 8.6.3.5a). Mackerel geographical distribution began shifting eastward in 2018, compared to the period from 2010 to 2017 (Figure 8.6.3.5b). This eastward distributional shift continued in 2019 and in 2020 when negligible amounts of mackerel were caught west of longitude 10°W. For comparison, the westward boundary of mackerel was at longitude 43°W in 2014 which is the survey year with the largest geographical distribution range.

Catch curve analysis of cohort numbers for the period 2010 to 2020 (excl. 2011) displays “a dip” for all age classes in 2018 (Figure 8.6.3.6), indicating annual effects in the survey this particular survey year. Annual effects were not visible in the 2020 IESSNS.

The North Sea (south of latitude 60 °N) was part of the IESSNS for the third time in July 2020. 35 predetermined surface trawl stations were sampled in a survey area covering 0.26 mill. km^2 (Figure 8.6.3.5a). The mackerel abundance index was 1.3 billion and the biomass index was 0.26 million t which was represents increases of 29% and 15% compared to 2019.

8.6.4 Tag Recapture data

Steel-tags

The Institute of Marine Research in Bergen (IMR) has conducted tagging experiments on mackerel on annual basis since 1968, both in the North Sea and to the west of Ireland during the spawning season May–June. Information from steel-tagged mackerel tagged west of Ireland and British Isles was introduced in the mackerel assessment during ICES WKPELA 2014 (ICES, 2014), and data from release years 1980-2004, and recapture years 1986-2006 has been used in the update assessments after this. The steel tag experiments continued to 2009, with recaptures to 2010, but this part of the data was at the time considered less representative and was excluded.

What is used in the SAM stock assessment is a table of data showing numbers of steel tagged fish per year class in each release year, and the corresponding numbers scanned and recaptured of the same year classes in all years after release. The steel tag data and the corresponding trends in the data in terms of index of total biomass and year class abundance by year is described in (Tenningen *et al*., 2011).

The steel tag methodology involved a whole lot of manual processes, demanding a lot of effort and reducing the possibility to scan larger proportions of the landings. The tags were recovered at metal detector/deflector gate systems installed at plants processing mackerel for human consumption. This system demanded external personnel to stay at the plants supervising the systems during processing. Among the typical 50 fish deflected, the hired personnel had to find the tagged fish with a hand-hold detector and send the fish to IMR for further analysis. It was decided in the end to go for a change in methodology to radio-frequency identification (RFID), which would allow for more automatic processes and increased proportion of scanned landings.

RFID tags

The RFID tagging project on NEA mackerel was initiated in 2011 by IMR, and the data were used in update assessments after the ICES WKWIDE 2017 benchmark meeting (ICES, 2017b). The data format was the same as for steel tags, but the time series were treated with a different scaling parameter in the assessment.

RFID is a technology that uses radio waves to transfer data from an electronic tag, called an RFID tag, through a reader for the purpose of identifying and tracking the object. The tag itself is passive but information to the reader is released as it passes an electric field in the antenna system, and information is automatically updated in an IMR database over internet. When tagging and releasing the fish, information is also synced to the IMR database regularly over internet.

There is a web-based software solution and database that is used to track the different scanning systems at the factories, import data on catch information, and biological sampling data of released fish and screened catches. Based on this information the software is used to allocate the biological data to releases and catches, and to further estimate numbers released every year, and the concurrent numbers screened and recaptured over the next years (by year class).

The development of the tagging data time series is dependent on the work from each country's research institutes, fisheries authorities or industry to provide additional data about catches screened through the RFID systems, such as total catch weight, position of catch (ICES rectangle), mean weight in catch, *etc*. Regular biological sampling of the catches landed at these factories is also needed. Altogether, these data are essential for the estimation of numbers screened per year class. Responsible scientists in Norway, Iceland, Faroes and Scotland have been following up the factories, and delivering the catch data and biological data. In the future it is planned that annual workshops should occur prior to the assessment, where more scientists go through the new data being updated from new tagging experiments, as well as recaptures from all previous experiments, undertake quality assurance of the data and other analyses of the trends in the data outside of the assessment model.

The RFID tagging technology is clearly a more cost-effective than the old steel tag technology. We are now scanning about 10 times more biomass than during the period with steel tags. An overview of the RFID tagging data in terms of numbers tagged, biomass scanned, and numbers recaptured is given in Tables 8.6.4.1-3, and geographical distributions of data in Figures 8.6.4.1-2.

During the period 2011— 20th Aug 2020 as many as 457 295 mackerel have been tagged with RFID (Table 8.6.4.1). This includes an experiment off the Norwegian Coast on young mackerel in September 2011 as well as five experiments carried out in August in Iceland 2015-2019, none of which are included as input data in the assessment. Data from the releases at the spawning grounds in May-June of Ireland and the Hebrides are the only data included in the assessment.

The 5 738 RFID-tagged mackerel recaptured up to 20th August 2020 came from 24 European factories processing mackerel for human consumption (Table 8.6.4.2-3). The project started with RFID antenna reader systems connected to conveyor belt systems at 8 Norwegian factories in 2012. Now there are 5 operational systems at 4 factories in UK (Denholm has 2 RFID systems) and 3 in Iceland. Norway has installed RFID systems at 8 more factories in 2017-2018, most of which with the purpose of scanning Norwegian spring spawning herring catches (IMR started tagging herring in 2016), but some also processing mackerel. More systems are also bought by Ireland (3), which up to now has been non-operational.

There are at times problems with some of the factories that has led to the exclusion of data for use in stock assessment. The data from factories used in the 2020 assessment is marked in Tables 8.6.4.2-3. The exclusion is due to systems not working properly, or that the efficiency is found to be too low after testing. In 2018 and 2019 tests where 10 fish are tagged and mixed in 10 different catches prior to scanning, was carried out to estimate efficiency at all factories. Currently IMR is installing newly developed equipment at Norwegian factories, where antenna-reader systems are tested automatically, and their functioning monitored over internet on continuous basis. This is major step forward to reduce the manual work and monitoring needed with testing and securing quality of future data. Hopefully, this equipment will also be installed at factories in Iceland and Scotland for the 2021 catch year.

During ICES WGWIDE 2018 (ICES, 2018d) meeting bias issues were described for RFID tag data, in addition to potential weighting issues of the tag data inside the model. After the intermediate benchmark meeting ICES IBPNEAMac 2019 (ICES, 2019a), these issues were overcome by using a subset of data for release years (exclude 2011-2012), recapture years (only use recaptures from year 1 and 2 after release) and age groups (exclude youngest fish ages 2-4, use ages 5-11). This is now the subset of data to be used in update assessments. Distributions of recaptured and tagged fish now used in stock assessment are shown in Figures 8.6.4.1. Also shown in the current report are the differences between data excluded and included for distributions of catches scanned (Figure 8.6.4.2), for the age structures of tagged, recaptured and scanned fish (Figure 8.6.4.3), and for actual trends of year class abundance (Figure 8.6.4.4) and age aggregated biomass indices (Figure 8.6.4.5).

It is apparent from Figure 8.6.4.2 that in recapture years 2014-2019, now included in the assessment, the distribution of scanned landings is comparable, whereas the excluded years 2012-2013 do not cover the same distribution of fishery.

Figure 8.6.4.3 shows the relative distributions of year classes tagged per year and scanned/recaptured year 1 and 2 after release for the subset years used in current update assessment. The figure illustrates the problem that the tagged/recaptured fish are skewed towards older fish than scanned. Especially the large year classes 2010-2011 were tagged in low numbers at ages 2-4 compared with the scanned numbers. However, for the latest release years used in the assessment (2017-2018), it seems that this tendency is less pronounced, i.e. one is tagging on the same distribution as scanned.

Estimates of year class abundance for the subset of RFID tag-recapture data used in the current assessment also show differences in year class levels and trends over time that seems informative, and with a year class development tending to be in line with a total mortality of approximately Z=0.4 (Figure 8.6.4.4). There are also indications in these estimates that fish of younger ages not included in the assessment may have trends for recent years that are informative.

However, the information coming from the RFID tag data is easier to interpret when comparing age aggregated biomass indices estimated from the RFID data with SSB from the stock assessment, as shown in Figure 8.6.4.5. During ICES WGWIDE 2018 (ICES, 2018d) the RFID tag data had high weight, and the SSB trend in the assessment showed a clear tendency to decrease from 2011-2016. This is consistent with the observed biomass trend in the RFID tag data when using aggregated data from age 2-11. By including only release years 2013 onwards as in current assessments, and excluding ages 2-4, the biomass trend in the RFID tag data are more in line with the SSB of the assessment. However, Figure 8.6.4.5 also illustrates that from 2014 onwards the inclusion of the younger fish of ages 2-4 in the biomass indices from the RFID tag data show trends that in fact are quite in line with SSB of stock assessment. This signifies that over time, and in a future benchmark process, information of tag recaptures from these younger age groups may be included again should the bias issues tend to disappear.

8.6.5 Other surveys

8.6.5.1 International Ecosystem survey in the Norwegian Sea (IESNS)

After the mid-2000s an increasing amount of NEA mackerel has been observed in catches in the Norwegian Sea during the combined survey in May during the International Ecosystem survey in the Norwegian Sea (IESNS) targeting herring and blue whiting (Salthaug *et al*. 2019; 2020). The spatial distribution pattern of mackerel was quite similar in 2020 compared to 2019 Salthaug *et al*., 2019). Mackerel was caught within a more expended area and in more trawl stations of the Norwegian Sea in May 2020 compared to May 2019 (Salthaug *et al*., 2019; 2020). In 2020, the northernmost mackerel catch was at 69°N and the westernmost catch was around 4°W, which is further north and west than recorded in 2019 (Salthaug *et al*. 2019; 2020). Mackerel of age 4 dominated, followed by age 6 in 2020, whereas there was found more 1-year olds compared to last year, particularly in the north (Salthaug *et al*., 2020).

The IESNS survey provides valuable, although limited, quantitative information on mackerel. This acoustic based survey is not designed to monitor mackerel, and does not provide proper mackerel sampling in the vertical dimension and involves too low trawl speed for representative sampling of all size groups of mackerel. The trawl hauls are mainly targeting acoustic registrations of herring and blue whiting during the survey in May (IESNS) (Salthaug *et al*., 2019; 2020).

8.6.5.2 Acoustic estimates of mackerel in the Iberian Peninsula and Bay of Biscay (PELACUS)

Due to the Covid-19 pandemic, this year PELACUS was cancelled (as well as PELGAS surveys). Therefore, no new information from the Bay of Biscay on mackerel distribution and abundance during spawning time is available

8.7 Stock Assessment

8.7.1 Update assessment in 2019

The update assessment was carried out by fitting the state-space assessment model SAM (Nielsen and Berg, 2014) using the R library *stockassessment*, downloadable from github via

install_github("fishfollower/SAM/stockassessment")

and adopting the configuration described in the Stock Annex.

The assessment model is fitted to catch-at-age data for ages 0 to 12 (plus group) for the period 1980 to 2019 (with a strong down-weighting of the catches for the period 1980-1999) and three surveys: 1) the SSB estimates from the triennial Mackerel Egg survey (every three years in the period 1992-2019); 2) the recruitment index from the western Europe bottom trawl IBTS Q1 and Q4 surveys (1998-2019); and 3) the abundance estimates for ages 3 to 11 from the IESSNS survey (2010, 2012-2020). The model also incorporates tagging-recapture data from the Norwegian tagging program (for fish recaptured between 1980 and 2005 for the steel tags time series, and fish recaptured between 2014 and 2019 (age 5 and older at release) for the radio frequency tags time series).

Fishing mortality-at-age and recruitment are modelled as random walks, and there is a process error term on abundances at ages 1-11.

The differences in the new data used in this assessment compared to the last year's assessment were:

- Update of the recruitment index until 2019.
- The final 2019 MEGS SSB index is used instead of the preliminary value (-0.2% difference).
- Addition of the 2020 survey data in the IESSNS indices.
- Addition of the 2019 catch-at-age, weights-at-age in the catch and in the stock and maturity ogive, proportions of natural and fishing mortality occurring before spawning.
- The inclusion of data on numbers tagged per year class in 2018, as well as data on numbers scanned and recaptured in 2019 from year classes tagged in 2017 and 2018.

Input parameters and configurations are summarized in Table 8.7.1.1. The input data are given in Tables 8.7.1.2 to 8.7.1.10. Given the size of the tagging data base, only the data from the last year of recaptures is given in this report (Table 8.7.1.10). Earlier tagging data are not presented in this report, but are available on www.stockassessment.org in the data section (files named tag_steel.dat and tag_RFID.dat).

8.7.2 Model diagnostics

Parameter estimates

The estimated parameters and their uncertainty estimates are shown in Table 8.7.2.1 and Figure 8.7.2.1. The model estimates different observation standard deviations for young fish and for older fish. Reflecting the suspected high uncertainty in the catches of age 0 fish (mainly discards), the model gives a very poor fit to this data (large observation standard deviation). The standard deviation of the observation errors on catches of age 1 is lower, though still high, indicating a better fit. For the age 2 and older, the fit to the catch data is very good, with a very low observation standard deviation.

The observation standard deviations for the egg survey and the IESSNS surveys ages 4 to 11 are higher indicating that the assessment gives a lower weight to the information coming from these surveys compared to the catches. The IESSNS age 3 is very poorly fitted in the assessment (high observation standard deviation). Overdispersion of the tag recaptures has the same meaning as the observation standard deviations, but is not directly comparable.

The catchability of the egg survey is 1.26, larger than 1, which implies that the assessment considers the egg survey index to be an overestimate. The catchabilities at age for the IESSNS increase from 0.87 for age 3 to 2.37 for age 10. Since the IESSNS index is expressed as fish abundance, this also means that the assessment considers the IESSNS to provide over-estimated abundance values for the oldest ages. The post tagging mortality estimate is higher for the steel tags (around 40%) than for the RFID tags (around13 %).

The process error standard deviation (ages 1-11) is moderate as well as the standard deviation of the F random walks.

The catchability parameters for the egg survey, recruitment index and post tagging survival appear to be estimated more precisely than other parameters (Table 8.7.2.1). The catchability for the IESSNS have a slightly higher standard deviation, except for the catchability of the IESSNS at age 3 which has a much higher standard deviation. Uncertainty on the observation standard deviations is larger for the egg survey, the IESSNS age 3, for the recruitment index and for the catches at age 1 than for the other observations. Uncertainty on the overdispersion of the RFID tag data is high. The standard deviation on the estimate of process error is low, and the standard deviations for the estimates of F random walk variances of age 0 and 1 are both very high.

The estimated AR1 error correlation structure for the observations from the IESSNS survey age 3 to 11 has a high correlation between the errors of adjacent ages (r=0.81), then decreasing exponentially with age difference (Figure 8.7.2.2). This high error correlation implies that the weight of this survey in the assessment in lower than for a model without correlation structure, which is also reflects in the high observation standard deviation for this survey.

There are some correlations between parameter estimates (Figure 8.7.2.3):

- Catchabilities are positively correlated (especially for the IESSNS age 4 to 11), and negatively correlated to the survival rate for the RFID tags. This simply represents the fact that all scaling parameters are linked, which is to be expected.
- The observation variance for the IESSNS age 4-11 is positively correlated to the autocorrelation in the errors for these observations. This implies that when the model estimates highly correlated errors between age-groups, the survey is considered more noisy.

Residuals

The “one step ahead” (uncorrelated) residuals for the catches did not show any temporal pattern (Figure 8.7.2.4) except for 2014 for which they were mainly positive for 2014 (modelled catches lower than the observed ones). This may result from the random walk that constraints the variations of the fishing mortality, which prevents the model from increasing the fishing mortality suddenly (which probably happened given the sharp increase in the catches in 2014). Residuals are of a similar size for all ages, indicating that the model configuration with respect to the decoupling of the observation variances for the catches is appropriate.

The residuals for the egg survey show a strong temporal pattern with large positive residuals for the period 2007-2010-2013, followed by large negative residuals in 2016 and 2019. This pattern reflects the fact that the model, based on all the information available, does not follow the recent trend present in the egg survey (with an historical low estimate for 2019) and considers those two last years as large negative observation errors. The relatively high observation variance for this survey indicates a poor fit with the egg survey due mainly to these two observations which point towards a very different direction from the other observations. Residuals for the IESSNS indices are relatively well balanced for most of the years, except for the last 2 years, where residuals tend to be mainly positive. Residuals to the recruitment index show no particular pattern, and appear to be relatively randomly distributed, except for the recent years where residuals are mainly positive.

Finally, inspection of the residuals for the tag recaptures (Figure 8.7.2.5) did not show any specific pattern for the RFID data. For the steel tags, there is a tendency to have more positive residuals at the end of the period which could indicate that using a constant survival rate for this dataset may not be appropriate.

Leave one out runs

In order to visualise the respective impact of the different surveys on the estimated stock trajectories, the assessment was run leaving out successively each of the data sources (Figure 8.7.2.6).

All leave one out runs showed parallel trajectories in SSB and F_{bar}. For recruitment, all runs also resulted in similar trajectories, except the run without the recruitment index, which had a much less variable recruitment. This specific run corresponds to a quite different model than the other runs: as there is no information to inform the model on recruitment, the recruitment variance is estimated to be very low and the recruitment estimated is a highly correlated random walk.

Removing the IESSNS resulted in lower SSB estimates and higher F_{bar} estimates for the period covered by the survey. On the opposite, removing the egg survey results in a larger estimated stock, exploited with a lower fishing mortality. In both cases, the estimated stock trajectories are well within the confidence interval of the assessment using all data sources. The final assessment seems to make a trade-off between the information coming from the IESSNS which leads to a more optimistic perception of the stock, and the information from the egg survey which suggests a more pessimistic perception of the stock. The run leaving out the RFID data gave a perception of the SSB very similar to the assessment using all data, and slightly higher fishing mortality over the last decade. This is a contrasting situation compared to the 2018 WGWIDE assessment, in which the RFID had a very strong influence on the assessment, and is the consequence of the changes made during the interbenchmark process detailed above. Closer inspection of the results of the run without the RFID data show that estimated abundances at age are very similar to the full model, but associated uncertainties are much larger. Uncertainties on the SSB and F_{bar} in the recent years are around 30% higher when the RFID data is not included in the assessment (Figure 8.7.2.7).

8.7.3 State of the Stock

The stock summary is presented in Figure 8.7.3.1 and Table 8.7.3.1. The stock numbers-at-age and fishing mortality-at-age are presented in Tables 8.7.3.2-3. The spawning stock biomass is estimated to have increased almost continuously from just above 2 million tonnes in the late 1990s and early 2000s to 5.16 million tonnes in 2014 and subsequently declined continuously to reach a level just above 3.7 million tonnes in 2019. The fishing mortality has declined from levels between F_{pa} (0.36) and F_{lim} (0.46) in the mid-2000s to levels just below F_{MSY} since 2016. The recruitment time series from the assessment shows a clear increasing trend since the late 1990s with a succession of large year classes (2002, 2005-2006, 2011 and 2016-2018). There is insufficient information to estimate accurately the size of the 2019 year-class. The estimate is very high but highly uncertain.

There is some indication of changes in the selectivity of the fishery over the last 30 years (Figure 8.7.3.2). In the 1990s, the fishery seems to have had a steeper selection pattern (more rapid increase in fishing mortality with age). Between the end of the 1990s and the end of the 2000s, the selection pattern became less steep (decreasing selection on ages 2-5). After 2008, the pattern changed again towards a steeper selection pattern.

8.7.4 Quality of the assessment

Parametric uncertainty

Large confidence intervals are associated with the SSB in the years before 1992 (Figure 8.7.3.1 and Figure 8.7.2.7). This results from the absence of information from the egg survey index, the down-weighting of the information from the catches and the assessment being only driven by the tagging data and natural mortality in the early period. The confidence intervals become narrower from the early 1990s to the mid-2000s, corresponding to the period where information is available from the egg survey index, the tagging data and (partially) catches. The uncertainty increases slightly in the most recent years and the SSB estimate for 2019 is estimated with a precision of +/- 21% (Figure 8.7.3.1 and Table 8.7.3.1). There is generally also a corresponding large uncertainty on the fishing mortality, especially before 1995. The estimate of $F_{bar4\text{-}8}$ in 2019 has a precision of +/- 24%. The uncertainty on the recruitment is high for the years before 1998 (precision of on average +/- 45%). The precision improves for the years for which the recruitment index is available (+/- 32%) except for the most recent recruitments (+/- 48%).

Model instability

The retrospective analysis was carried out for 6 retro years, by fitting the assessment using the 2020 data, removing successively 1 year of data (Figure 8.7.4.1.). There is a systematic retrospective pattern found in F_{bar} which is revised downwards with each new year of data (Mohn's rho of 0.20). There is a retrospective pattern in the opposite direction for the SSB in the first 5 retro peels, however this pattern has disappeared in the more recent peels which explains the low value for the Mohn's rho on SSB (0.05). Recruitment appears to be quite consistently estimated.

Given that the RFID series is currently composed of only 6 years of recapture data, a degree of retrospective instability is to be expected (and retrospective runs removing 5 or more years would maybe not be meaningful as only 1 recapture year or none would be available for model fitting).

Model behaviour

The realisation of the process error in the model was also inspected. The process error expressed as annual deviations in abundances-at-age (Figure 8.7.4.2) shows indications of some pattern across time and ages. There is a predominance of positive deviations in the recent years for age-classes 5 to 8. While process error is assumed to be independent and identically distributed, there is clear evidence of correlations in the realisation of the process error in the mackerel assessment, which appears to be correlated both across age-classes and temporarily.

The temporal autocorrelation can also be visualised if the process error is expressed in term of biomass (process error expressed as deviations in abundances-at-age multiplied by weight at age and summed over all age classes, Figure 8.7.4.3). Periods with positive values (when the model globally estimates larger abundances-at-age than corresponding to the survival equation) have been alternating with periods with negative values (1991-1994 and 2004 and 2006). For the years between 2008 and 2016, the biomass cumulated process error remains positive, and large (reaching in 2013 almost the weight of the catches). The reason for this behaviour of the model could not be identified.

8.8 Short term forecast

The short-term forecast provides estimates of SSB and catch in 2021 and 2022, given assumption of the current year's (also called intermediate year) catch and a range of management options for the catch in 2021.

All procedures used this year follow those used in the benchmark of 2014 as described in the Stock Annex.

8.8.1 Intermediate year catch estimation

Estimation of catch in the intermediate year (2020) is based on declared quotas and interannual transfers as shown in the text table in Section 8.1.

8.8.2 Initial abundances at age

The recruitment estimate at age 0 from the assessment in the terminal assessment year (2019) was considered too uncertain to be used directly, because this year class has not yet fully recruited into the fishery. The last recruitment estimate is therefore replaced by predictions from the RCT3 software (Shepherd, 1997). The RCT3 software evaluates the historical performance of the IBTS recruitment index, by performing a linear regression between the index and the SAM estimates over the period 1998 to the year before the terminal year. The recruitment is then calculated as a weighted mean of the prediction from this linear regression based on the IBTS index value, and a time tapered geometric mean of the SAM estimates from 1990 to the year before the terminal year. The time tapered geometric mean gives the latest years more weight than a geometric mean. This is done because the recent productivity of the stock appears different than in the 1990's.

The weighting calculated by RCT3 was 75 % (recruitment index) and 25 % (time tapered geometric mean), which leads to an expected recruitment of 7 057 million.

8.8.3 Short term forecast

A deterministic short-term forecast was calculated using FLR (www.flr-project.org). Table 8.8.3.1 lists the input data and Tables 8.8.3.2 and 8.8.3.3 provide projections for various fishing mortality multipliers and catch constraints in 2021.

Assuming catches for 2020 of 1 091 kt, F was estimated at 0.32 (above F_{MSY}) and SSB at 3.69 Mt (above B_{pa}) in spring 2020. If catches in 2021 equal the catch in 2020, F is expected to increase to 0.34 (below F_{pa}) in 2021 with a corresponding decrease in SSB to 3.58 Mt in spring 2021. Assuming an F of 0.34 again in 2022, the SSB will further decrease to 3.40 Mt in spring 2022.

Following the MSY approach, exploitation in 2021 shall be at F_{MSY} (0.26). This is equivalent to catches of 852 kt and a decrease in SSB to 3.64 Mt in spring 2021 (1% decrease). During the subsequent year, SSB will remain at a similar level (3.63 Mt) in spring 2022.

8.9 Biological Reference Points

A management strategy evaluation Workshop on northeast Atlantic mackerel (MKMSEMAC) was conducted during 2020 (ICES, 2020) which resulted in the adoption of new reference points for NEA mackerel stock by ICES.

8.9.1 Precautionary reference points

B_{lim} **-** There is no evidence of significant reduction in recruitment at low SSB within the time series hence the previous basis for B_{lim} was retained. B_{lim} is taken as B_{loss}, the lowest estimate of spawning stock biomass from the revised assessment. This was estimated in the 2019-assessment to have occurred in 2003; B_{loss} = 2.00 Mt.

F_{lim} **-** F_{lim} is derived from B_{lim} and is determined from the long-term equilibrium simulations as the F that on average would bring the stock to B_{lim}; F_{lim} = 0.46.

B_{pa} **-** The ICES basis for advice requires that a precautionary safety margin incorporating the uncertainty in actual stock estimates leads to a precautionary reference point B_{pa}, which is a biomass reference point with a high probability of being above B_{lim}. B_{pa} was calculated as $B_{lim} \cdot exp(1.645 \cdot \sigma)$ where $\sigma = 0.15$ (the estimate of uncertainty associated with spawning biomass in the terminal year in the assessment, 2019, as estimated by WGWIDE in 2019); B_{pa} = 2 580 000 t.

F_{pa} **-**The ICES basis for advice requires that a precautionary safety margin incorporating the uncertainty in actual stock estimates leads to a precautionary reference point $F_{pa.}$ F_{pa} is the estimate of fishing mortality which is designed to ensure that the true F is above F_{lim} with a 95% probability. Following the updated Technical guidelines on ICES fisheries management reference points for category 1 and 2 stocks in 2020, F_{pa} was set equal to F_{p05} (0.36).

8.9.2 MSY reference points

The ICES MSY framework specifies a target fishing mortality, F_{MSY}, which, over the long term, maximises yield, and also a spawning biomass, MSY $B_{trigger}$, below which target fishing mortality is reduced linearly relative to the SSB $B_{trigger}$ ratio.

Following the ICES guidelines (ICES, 2017a), long term equilibrium simulations indicated that F=0.26 would be an appropriate F_{MSY} target as on average it resulted in the highest mean yields in the long term, with a low probability (less than 5%) of reducing the spawning biomass below B_{lim}.

The ICES basis for advice notes that, in general, F_{MSY} should be lower than F_{pa}, and MSY $B_{trigger}$ should be equal to or higher than B_{pa}. Simulations indicated that potential values for MSY $B_{trigger}$ were above B_{pa}. However, fishing mortality has been significantly greater than the F_{MSY} estimate for a number of years, and particularly in the most recent period. Following the ICES procedure MSY $B_{trigger}$ was set equal to $B_{pa,}$ 2 580 000 t.

Updated ICES reference points for NEA mackerel			
Type		Value	Technical basis
MSY approach	MSY $B_{trigger}$	2.58 million tonnes	B_{pa} [1]
	F_{MSY}	0.26	Stochastic simulations [1]
Precautionary approach	B_{lim}	2.00 million tonnes	B_{loss} from (2003) [1]
	B_{pa}	2.58 million tonnes	$B_{lim} \times \exp(1.654 \times \sigma)$, $\sigma_{SSB} = 0.15$ [1]
	F_{lim}	0.46	F that, on average, leads to B_{lim} [1]
	F_{pa}	0.36	F_{p05}

[1] ICES WKMSEMAC (ICES, 2020)

8.10 Comparison with previous assessment and forecast

The last assessment used to provide advice was carried out during the WGWIDE in 2019. The new 2020 WGWIDE assessment is generally consistent with the 2019 assessment (Figure 8.10.1). The SSB and F_{bar} trajectories are nearly identical with the exception of the SSB estimate in 2019. The WGWIDE 2019 assessment estimate is based primarily on the (in-year) 2019 IESSNS index and has been revised downwards in the WGWIDE 2020 assessment with the inclusion of additional data sources. The estimated recruitment time series have been revised downward in the most recent years (particularly for the 2017 and 2018 year classes). The updated recruitment index series has not been revised compared to last year's assessment, and indicates very large abundances for these year classes (also 2016 and 2019, see figure 8.6.2.3). This downward revision of the size of the 2017 and 2018 year classes in the assessment suggests that the new information available on these cohorts, (2019 catch data, 2020 IESSNS index) may be in contradiction with the perception from the recruitment index, and indicate smaller year classes. A comparison of the abundances in 2019 from the 2019 and 2020 assessments (figure 8.6.2.4) shows that these year classes are actually revised downward also at age 1 (for year-class 2018) and age 2 (for year-class 2017). Furthermore, the recent recruitment index values are considered as overestimates by the SAM model (positive residuals in 2016-2019, figure 8.7.2.4). This increased discrepancy between the signal from the recruitment index and the estimates of the SAM model is also reflected by an (although small) increase in the observation variance of this survey (figure 8.10.2), indicating a poorer fit to this data series.

The differences in the 2018 TSB and SSB estimates between the previous and the present assessments are small, at -4.8 and -3.0% respectively. The 2018 fishing mortality is almost unchanged (0.2% difference).

	TSB 2018	SSB 2018	F_{BAR4-8} 2018
Values			
2019 WGWIDE	5 684 879 tonnes	4 279 185 tonnes	0.238
2020 WGWIDE	5 410 637 tonnes	4 152 849 tonnes	0.239
% difference	-4.8%	-3.0%	0.2%

The addition of a new year of data has slightly modified the relative weight of the different data sources: the estimated observation standard deviation has increased for the IESSNS survey and the recruitment index (although not significantly), and decreased (also not significantly) for the egg survey. This decreasing influence of the IESSNS survey on the assessment may be related to the increasing conflict between the IESSNS (indicating record high biomass in 2019) and the egg survey index (at its lowest), and the fact that both the catch data and the RFID seem to point towards a decrease of the stock in the recent years. These changes in the weight of the different data sources did not this year result in a large the revision of stock trajectories, contrary to what has been observed in previous years.

The uncertainty on the parameter estimates has decreased for some parameters (standard deviations of the F random walk for age 0 and 1, Figure 8.10.2), but increased for others (recruitment variance, catchability of the IESSNS for ages 4-8, and observation variances for the IESSNS). The uncertainty on SSB and F_{bar4-8} in this year's assessment is similar to the previous assessment, except for the terminal year estimate for which the 2020 assessment has a higher uncertainty (Figure 8.10.3).

The prediction of the total catch of mackerel for 2019 used for the short-term forecast in the advice given last year was very close to the actual 2019 catch reported for WGIWIDE 2020 and used in the present assessment (text table below). The new assessment produced an estimate of the SSB in 2019 which was markedly lower than the 2019 WGWIDE forecast prediction (-15%). This large discrepancy in the SSB is explained by the revision of the perception of the abundance at age 1 and 2 (Figure 8.10.4). The estimates used last year as the basis of the short-term forecast were informed by no data (the only data from 2019 available then was the IESSNS index ages 3-11). This year's estimates of 2019 abundance at age are now based also on catch information and therefore more reliable. The fishing mortality F_{bar4-8} for 2019 estimated at the WGWIDE 2020 is 6.4% higher than the value estimated by the short-term forecast in the previous assessment.

	Catch (2019)	SSB (2019)	F_{bar4-8} (2019)
2019 WGWIDE forecast	834 954t	4 389 601t	0.21
2020 WGWIDE assessment	840 021 t	3 731 510 t	0.22
% difference	0.6%	-15.0%	6.4%

8.11 Management Considerations

Details and discussion on quality issues in this year's assessment is given in Section 8.7 above.

From 2001 to 2007, the internationally agreed TACs covered most of the distribution area of the Northeast Atlantic mackerel. From 2008 to 2014, no agreement was reached among the Coastal States on the sharing of the mackerel quotas. In 2014, three of the Coastal States (EU, NO and FO) agreed on a Management Strategy for 2014 to 2018. In November 2018, the agreement from 2014 was extended for two more years until 2020. However, the total declared quotas for 2015 to 2019 all exceed the TAC advised by ICES (Figure 8.11.1).

The mackerel in the Northeast Atlantic is traditionally characterised as three distinct 'spawning components': the southern component, the western component and the North Sea component. The basis for the components is derived from tagging experiments (ICES, 1974). However, the methods normally used to identify stocks or components (*e.g.* ectoparasite infections, blood phenotypes, otolith shapes and genetics) have not been able to demonstrate significant differences between animals from different components. The mackerel in the Northeast Atlantic appears on one hand to mix extensively whilst, on the other hand, exhibit some tendency for homing (Jansen *et al.*, 2013; Jansen and Gislason, 2013). Consequently, it cannot be considered either a panmictic population, nor a population that is composed of isolated components (Jansen and Gislason, 2013). A review of the mackerel in the North Sea, carried out during WKWIDE 2017 (ICES, 2017b) concluded that Northeast Atlantic mackerel should be considered as a single population (stock) with individuals that show stronger or weaker affinity for spawning in certain parts of the spawning area.

Nevertheless, stock components are still being used to identify the different spawning areas where mackerel are known to spawn. The trends in the different components is derived from the triennial egg survey in the western and southern area and a dedicated egg survey in the North Sea the year following the western survey.

Since the mid-1970s, ICES has continuously recommended conservation measures for the North Sea component of the Northeast Atlantic mackerel stock (*e.g.* ICES, 1974; ICES, 1981). The measures advised by ICES to protect the North Sea spawning component (*i.e.* closed areas and minimum landing size) aimed to promote the conditions that make a recovery of this component possible.

The recommended closure of Division 4.a for fishing during the first half of the year is based on the perception that the western mackerel enter the North Sea in July/August, and remain there until December before migrating to their spawning areas. Updated observations from the late 1990s suggested that this return migration actually started in mid- to late February (Jansen *et al.*, 2012). The EU TAC regulations stated that within the limits of the quota for the western component (ICES Subareas and Divisions 6, 7, 8.a,b,d,e, 5.b (EU), 2.a (non-EU), 12, 14), a certain quantity of this stock may be caught in 4.a between 1 September and 15 February. Up to 2010, 30% of the EU TAC of mackerel (MAC/2CX14-) could be taken in 4.a. From 2011 until 2014, this percentage increased to 40% and from 2015 onwards this increased to 60%.

The minimum landing size (MLS) for mackerel is currently set at 30 cm for the North Sea and 20 cm in the western area. The MLS of 30 cm in the North Sea was originally introduced by Norway in 1971 and was intended to protect the very strong 1969 year-class from exploitation in the industrial fishery (Pastoors, 2015). The 30 cm later became the norm for the North Sea MLS while the MLS for mackerel in western waters was set at 20 cm. In the early 1990s, ICES recommended that, because of mixing of juvenile and adult mackerel on western waters fishing grounds, the adoption of a 30 cm minimum landing size for mackerel was not desirable as it could lead to increased discarding (ICES, 1990; 1991). A substantial part of the catch of (western) NEA mackerel is taken in ICES division 4.a during the period October until mid-February to which the 30 cm MLS applies even though there is limited understanding on the effectiveness of minimum landing sizes in achieving certain conservation benefits (STECF, 2015).

8.12 Ecosystem considerations

An overview of the main ecosystem drivers possibly affecting the different life-stages of Northeast Atlantic mackerel and relevant observations are given in the Stock Annex. The discussion here is limited to recent features of relevance.

Production (recruitment and growth)

Mackerel recruitment (age 1) has been high since 2001 compared to previous decades, with several very large cohorts (Jansen, 2016). Increasing stock size was suggested to have an effect through density driven expansion of the spawning area into new areas with Calanus in oceanic areas west of the North European continental shelf (Jansen, 2016). There are several indications of a shift in spawning and mackerel recruitment/larvae and juvenile areas towards northern and north-eastern areas preceding the 2016 mackerel spawning (ICES, 2016; Nøttestad *et al.*, 2018;

Bjørdal, 2019). This northerly shift in spawning and recruitment pattern of NEA mackerel seems to have continued also in 2017 (Nøttestad *et al*., 2018), but has reversed in 2018 (Figure 8.6.2.2).

The recruitment index indicates high recruitment in 2016-2019. For the two first year classes, this is also indicated by high CPUE at age 1 and 2 in the IESSNS. CPUE of the 2018 year-class in the IESSNS suggests it to be of an average size, however, this could also reflect a more south-western distribution of the recruits (partly outside the IESSNS survey area) from the 2018-year class as observed in the IBTS-surveys.

During the last decade, mackerel length- and weight-at-age declined substantially for all ages (Jansen and Burns, 2015; Ólafsdóttir *et al*., 2015). Growth of 0–3 years old mackerel decreased from 1998 to 2012. Mean length at age 0 decreased by 3.6 cm, however the growth differed substantially among cohorts (Jansen and Burns, 2015). For the 3-8 years old mackerel, the average size was reduced by 3.7 cm and 175 g from 2002 to 2013 (Ólafsdóttir *et al*., 2015). The variations in growth of mackerel in all ages are correlated with mackerel density. Furthermore, the density dependent regulation of growth from younger juveniles to older adult mackerel, appears to reflect the spatial dynamics observed in the migration patterns during the feeding season (Jansen and Burns, 2015; Ólafsdóttir *et al*., 2015). Growth rates of the juveniles were tightly correlated with the density of juveniles in the nursery areas (Jansen and Burns, 2015). For adult mackerel (age 3-8) growth rates were correlated with the combined effects of mackerel and herring stock sizes (Ólafsdóttir *et al*., 2015). Conspecific density-dependence was most likely mediated via intensified competition associated with greater mackerel density. Nevertheless, weight at age of mackerel both from the catches and the surveys have increased during the last few years, particularly for the younger year classes from 2 to 5 years of age (ICES, 2019a; 2020).

The growth (mean weights per age group) has slightly increased during the last 34 years for several age groups (ICES, 2018c; ICES, 2019a). However, this does not include the 0-year olds which supports the finding of high abundance at age 0 (Figure 8.5.2.1.).

Spatial mackerel distribution and timing

In the mid-2000s, the summer feeding distribution of Northeast Atlantic mackerel (*Scomber scombrus*) in Nordic Seas began expanding into new areas (Nøttestad *et al*., 2016). During the period 2007 - 2016 the mackerel distribution range increased three-fold and the centre-of-gravity shifted westward by 1650 km and northward by 400 km. Distribution range peaked in 2014 and was positively correlated to Spawning Stock Biomass (SSB).

After a mackerel stock expansion during the feeding season in summer from 1.3 million km^2 in 2007 to at least 2.9 million km^2 in 2014, mainly towards western and northern regions of the Nordic seas (Nøttestad *et al*., 2016), a slight decrease in distribution area of mackerel in the Nordic Seas was observed in 2017 and 2018 with 2.8 million square kilometres (Nøttestad *et al*., 2017; ICES, 2018a). The mackerel distribution slightly increased to 2.9 million km^2 in 2019 (Nøttestad *et al*., 2019). However, we witnessed a substantial shift in mackerel concentrations and distribution during summer 2020, when no mackerel were registered in Greenland waters, and a substantial decline was documented in Icelandic waters, whereas increased biomasses of mackerel were distributed in the central and northern part of the Norwegian Sea (Nøttestad *et al*., 2020b). The mackerel was less patchily distributed within the survey area in 2020 compared to 2019. Overall, we have witnessed that mackerel had a much more eastern distribution in 2018 to 2020 compared to 2014-2017 (ICES, 2018a; Nøttestad *et al*., 2019; 2020b). Geographical distribution of the 2016 cohort at age 0 and 1 extended more to the north than normally along the coast and offshore areas of Norway based on various survey data and fishing data (Nøttestad *et al*., 2018; Bjørdal, 2019).

Spatial mackerel distribution related to environmental conditions

Ólafsdóttir *et al*. (2018) analysed the IESSNS data from 2007 to 2016 with the following results: Mackerel was present in temperatures ranging from 5 °C to 15 °C, but preferred areas with temperatures between 9 °C and 13 °C according to univariate quotient analysis. Generalized additive models showed that both mackerel occurrence and density were positively related to location, ambient temperature, meso-zooplankton density and SSB, explaining 47% and 32% of deviance, respectively. This seem to have changed during 2019 and particularly 2020 where higher concentrations of mackerel were caught in lower temperatures (7-8 °C) (Nøttestad *et al*., 2019; 2020b). Mackerel relative mean weight-at-length was positively related to location, day-of-year, temperature and SSB, but not with meso-zooplankton density, explaining 40% of the deviance. Geographical expansion of mackerel during the summer feeding season in Nordic Seas was driven by increasing mackerel stock size and constrained by availability of preferred temperature and abundance of meso-zooplankton. Marine climate with multidecadal variability probably impacted the observed distributional changes but were not evaluated. Our results were limited to the direct effects of temperature, meso-zooplankton abundance, and SSB on distribution range during the last two decades (1997-2016) and should be viewed as such (Olafsdottir *et al.* 2019). It is not clear what causes this distributional shift, but the SST were 1-2°C lower in the western and south-western areas as compared to a 20-years mean (1999-2009), and substantially lower zooplankton concentrations in Icelandic and Greenland waters in 2019 and 2020 than 2018, might partly explain such changes (ICES, 2018a; Nøttestad *et al*., 2019; 2020a).

Trophic interactions

There are strong indications for interspecific competition for food between NSS-herring, blue whiting and mackerel (Huse *et al*., 2012). According to Langøy *et al*. (2012), Debes *et al*. (2012), Óskarsson *et al*. (2015) and Bachiller *et al*. (2016), the herring may suffer from this competition, as mackerel had higher stomach fullness index than herring and the herring stomach composition is different from previous periods when mackerel stock size was smaller. Langøy *et al*. (2012) and Debes *et al*. (2012) also found that mackerel consumed a wider range of prey species than herring. Mackerel may thus be thriving better in periods with low zooplankton abundances. Feeding incidence increased with decreasing temperature as well as stomach filling degree, indicating that feeding activity is highest in areas associated with colder water masses (Bachiller *et al*., 2016). A bioenergetics model developed by Bachiller *et al*. (2018) estimated that the NEA mackerel, NSS herring and blue whiting can consume between 122 and 135 million tonnes of zooplankton per year (2005-2010) This is higher than that estimated in previous studies (e.g. Utne *et al*., 2012; Skjoldal *et al*., 2004). NEA mackerel feeding rate can consequently be as high as that of the NSS herring in some years. Geographical distribution overlap between mackerel and NSS herring during the summer feeding season is highest in the south-western part of the Norwegian Sea (Faroe and east Icelandic area) (Nøttestad *et al*., 2016; 2017; Ólafsdóttir *et al*., 2017). The spatio-temporal overlap between mackerel and herring was highest in the southern and south-western part of the Norwegian Sea in 2018 and 2019 (ICES, 2018a, Nøttestad *et al*., 2019). This is similar as seen in previous years (Nøttestad *et al*., 2016; 2017). A change was seen in the northern Norwegian Sea in 2019 where we had some overlap between mackerel and herring (mainly 2013- and 2016- year classes) (Nøttestad *et al*., 2019). There was, on the other hand, practically no overlap between NEA mackerel and NSSH in the central and northern part of the Norwegian Sea in 2018 and previous years, mainly because of very limited amounts of herring in this area (ICES, 2018a).

There seem to be rather limited spatial overlap between marine mammals and mackerel during summers in the Nordic Seas (Nøttestad *et al*., 2019; Løviknes, 2019). There is spatial overlap between killer whales and mackerel in the Norwegian Sea, and killer whales are actively hunting for mackerel schools close to the surface during summer (Nøttestad *et al*., 2014; Nøttestad *et al*., 2020a). The increase of 0- and 1-groups of NEA mackerel found along major coastlines of Norway both in 2016 and 2017 (Nøttestad *et al*., 2018) and 2018 (Bjørdal, 2019), has created some interesting new trophic interactions. Increasingly numbers of adult Atlantic bluefin tuna (*Thynnus thunnus*), with an average size of approximately 200 kg, have been documented to feed on 0-group mackerel from the 2016, 2017-year classes during the commercial bluefin tuna fishery in Norway (Boge, 2019; Nøttestad *et al*., 2020b). Additionally, the new situation of numerous 0- and 1-group mackerel in Norwegian coastal waters in 2018 (Bjørdal, 2019), have created favourable feeding possibilities for larger cod, saithe, marine mammals and seabirds in these waters. Repeated stomach samples from several species document that smaller sized mackerel is now eaten by different predators in northern waters (60-70°N) (Bjørdal, 2019). Although much fewer 1-groups of NEA mackerel was found along the coast in Norway during the IESSNS 2019 (Nøttestad *et al*., 2019) and to some extent in 2020 (Nøttestad *et al*., 2020b), the Atlantic bluefin tuna is still indeed targeting schools of 1-group mackerel during their intense feeding migration in Norwegian waters (Nøttestad *et al*., 2020a). The predation pressure and mortality from and increasing Atlantic bluefin tuna stock on NEA mackerel (both juveniles and adults) are unknown, but could have ecological impact on both regional and population level (ICCAT, 2019; Nøttestad *et al*., 2020b).

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8.14 Tables

Table 8.2.1. 2019 Mackerel fleet composition of major mackerel catching nations.

Country	Len (m)	Engine power (hp)	Gear	Storage	No vessels
Denmark	57-88	4077-10469	Trawl	Tank	9
Faroe Islands	60-100	3460-8000 kw	Purse Seine/Trawl	RSW	9
	60-100	3920-6005 kw	Purse Seine/Trawl	Freezer	2
	60-100	3400-7680 kw	Trawl/Pair trawl	RSW	4
	< 50	1800 kw	Trawl	Dry hold with ice	1
France		110529	Pair Trawl		56
		442400	Trawl		654
		6525	Nets		447
		7294	Lines		257
		22662	Other gears		245
Germany	90-140	3800-12000	Single Midwater Trawl	Freezer	3
Greenland	65-121	3072-9517	Midwater Trawl	Freezer	14
	70-78	3002-4076	Midwater Trawl	RSW	3
Iceland	55-70	500-1500	Single Midwater Trawl	RSW, Freezer	3
	55-70	1500-3000	Single Midwater Trawl	RSW, Freezer	9
	70-85	3500-4500	Single Midwater Trawl	RSW, Freezer	6
Ireland	50m-71	1007-3460	Single Midwater Trawl	RSW and dryhold	8
	21m-65	368-2720	Pair Midwater Trawl	RSW and dryhold	36
Netherlands	88-145	4400-10455	Single Midwater Trawl	Freezer	7
Norway	60-85 m		Purse seiner	RSW	74
	30-40 m		Purse seiner	Dryhold, RSW	16
	10-17 m		Purse seiner	Dryhold	178
	10-17 m		Hook and line/nets	Dryhold	170
	10-17 m		PS/hooks/nets	Dryhold	205
	30-40 m		Trawl	Dryhold.Tankhold	17
Portugal	0-10		Other		94
	10-20		OTB		3

Country	Len (m)	Engine power (hp)	Gear	Storage	No vessels
	10-20		Other		86
	20-30		OTB		27
	20-30		Other		16
	30-40		Trawl		7
Spain	12-18	80-294	Trawl	Dryhold with ice	2
	18-24	96-344	Trawl	Dryhold with ice	12
	24-40	191-876	Trawl	Dryhold with ice	110
	>40	353	Trawl	Dryhold with ice	2
	0-10	34-44	Purse Seine	Dryhold with ice	2
	10-12	20-106	Purse Seine	Dryhold with ice	12
	12-18	21-245	Purse Seine	Dryhold with ice	91
	18-24	70-397	Purse Seine	Dryhold with ice	169
	24-40	140-809	Purse Seine	Dryhold with ice	149
	0-10	3-74	Artisanal	Dryhold with ice	382
	10-12	12-118	Artisanal	Dryhold with ice	234
	12-18	18-239	Artisanal	Dryhold with ice	247
	18-24	59-368	Artisanal	Dryhold with ice	49
	24-40	129-368	Artisanal	Dryhold with ice	15
UK Scotland	55 - 90	2950 - 7200	Trawl	RSW	19
Russian Federation	45 -120	1766-8000	Midwater Trawl	Freezer	30

RSW = refrigerated seawater.

Table 8.2.4.1. Overview of major existing regulations on mackerel catches.

Technical measure	National/International level	Specification	Note
Catch limitation	Coastal States/NEAFC	2010-2019	Not agreed
Management strategy (EU, NO, FO agreement London 12. Oct. 2014)	European (EU, NO, FO)	If SSB >= 3.000.000t, F = 0.24 If SSB is less than 3.000.000t, F = 0.24 * SSB/3.000.000 TAC should not be changed more than 20% A party may transfer up to 10% of unutilised quota to the next year	Not agreed by all parties
Management strategy with updated reference points 2019 (EU, NO, FO agreement London 17. Oct. 2019)	European (EU, NO, FO)	If SSB >= 2.500.000t, F = 0.23 If SSB is less than 2.500.000t, F = 0.23 * SSB/2.500.000 TAC should not be changed more than +25% or -20% A party may transfer up to 10% of unutilised quota to the next year A party may fish up to 10% beyond the allocated quota, that have to be deduced from next year's quota.	Not agreed by all parties
Minimum size (North Sea)	European (EU, NO)	30 cm in the North Sea	
Minimum size (all areas except North Sea)	European (EU, NO)	20 cm in all areas except North Sea	10% undersized allowed
Minimum size	National (NO)	30 cm in all areas	
Catch limitation	European (EU, NO)	Within the limits of the quota for the western component (6, 7, 8.a-b,d,e, 5.b (EC), 2.a (nonEC), 12, 14), a certain quantity may be taken from 4.a but only during the periods 1 January to 15 February and 1 October to 31 December.	
Area closure	National (UK)	South-West Mackerel Box off Cornwall	Except where the weight of the mackerel does not exceed 15 % by liveweight of the total quantities of mackerel and other marine organisms onboard which have been caught in this area
Area limitations	National (IS)	Pelagic trawl fishery only allowed outside of 200 m depth contours around Iceland and/or 12 nm from the coast.	

Technical measure	National/International level	Specification	Note
National catch limitations by gear, semester and area	National (ES)	28.74 % of the Spanish national quota is assigned for the trawl fishery, 34.29 % for purse seiners and 36.97% for the artisanal fishery	Since 2015, the trawl fishery has the individual quotas assigned by vessel.
Discard prohibition	National (NO, IS, FO)	All discarding is prohibited for Norwegian, Icelandic and Faroese vessels	
Landing Obligation	European	From 2015 onwards a landing obligation for European Union fisheries is in place for small pelagics including mackerel, horse mackerel, blue whiting and herring. In 2016 it was extended to certain demersal fisheries and since 2019 it applies to all TAC species.	There are de minimis exemptions for mackerel caught in bottom-trawl fisheries in the North Western Waters (EC 2018/2034) and in the North Sea (EC 2018/2035).

Table 8.4.1.1. NE Atlantic Mackerel. ICES estimated catches by area (t). Discards not estimated prior to 1978 (data submitted by Working Group members).

Year	Subarea 6			Subarea 7 and Divisions 8.abde			Subareas 3 and 4			Subareas 1 2 5 and 14			Divisions 8.c and 9.a			Total		
	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch
1969	4800		4800	47404		47404	739175		739175	7		7	42526		42526	833912		833912
1970	3900		3900	72822		72822	322451		322451	163		163	70172		70172	469508		469508
1971	10200		10200	89745		89745	243673		243673	358		358	32942		32942	376918		376918
1972	13000		13000	130280		130280	188599		188599	88		88	29262		29262	361229		361229
1973	52200		52200	144807		144807	326519		326519	21600		21600	25967		25967	571093		571093
1974	64100		64100	207665		207665	298391		298391	6800		6800	30630		30630	607586		607586
1975	64800		64800	395995		395995	263062		263062	34700		34700	25457		25457	784014		784014
1976	67800		67800	420920		420920	305709		305709	10500		10500	23306		23306	828235		828235
1977	74800		74800	259100		259100	259531		259531	1400		1400	25416		25416	620247		620247
1978	151700	15100	166800	355500	35500	391000	148817		148817	4200		4200	25909		25909	686126	50600	736726
1979	203300	20300	223600	398000	39800	437800	152323	500	152823	7000		7000	21932		21932	782555	60600	843155
1980	218700	6000	224700	386100	15600	401700	87931		87931	8300		8300	12280		12280	713311	21600	734911
1981	335100	2500	337600	274300	39800	314100	64172	3216	67388	18700		18700	16688		16688	708960	45516	754476
1982	340400	4100	344500	257800	20800	278600	35033	450	35483	37600		37600	21076		21076	691909	25350	717259
1983	320500	2300	322800	235000	9000	244000	40889	96	40985	49000		49000	14853		14853	660242	11396	671638
1984	306100	1600	307700	161400	10500	171900	43696	202	43898	98222		98222	20208		20208	629626	12302	641928

Year	Subarea 6			Subarea 7 and Divisions 8.abde			Subareas 3 and 4			Subareas 1 2 5 and 14			Divisions 8.c and 9.a			Total		
	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch
1985	388140	2735	390875	75043	1800	76843	46790	3656	50446	78000		78000	18111		18111	606084	8191	614275
1986	104100		104100	128499		128499	236309	7431	243740	101000		101000	24789		24789	594697	7431	602128
1987	183700		183700	100300		100300	290829	10789	301618	47000		47000	22187		22187	644016	10789	654805
1988	115600	3100	118700	75600	2700	78300	308550	29766	338316	120404		120404	24772		24772	644926	35566	680492
1989	121300	2600	123900	72900	2300	75200	279410	2190	281600	90488		90488	18321		18321	582419	7090	589509
1990	114800	5800	120600	56300	5500	61800	300800	4300	305100	118700		118700	21311		21311	611911	15600	627511
1991	109500	10700	120200	50500	12800	63300	358700	7200	365900	97800		97800	20683		20683	637183	30700	667883
1992	141906	9620	151526	72153	12400	84553	364184	2980	367164	139062		139062	18046		18046	735351	25000	760351
1993	133497	2670	136167	99828	12790	112618	387838	2720	390558	165973		165973	19720		19720	806856	18180	825036
1994	134338	1390	135728	113088	2830	115918	471247	1150	472397	72309		72309	25043		25043	816025	5370	821395
1995	145626	74	145700	117883	6917	124800	321474	730	322204	135496		135496	27600		27600	748079	7721	755800
1996	129895	255	130150	73351	9773	83124	211451	1387	212838	103376		103376	34123		34123	552196	11415	563611
1997	65044	2240	67284	114719	13817	128536	226680	2807	229487	103598		103598	40708		40708	550749	18864	569613
1998	110141	71	110212	105181	3206	108387	264947	4735	269682	134219		134219	44164		44164	658652	8012	666664
1999	116362		116362	94290		94290	313014		313014	72848		72848	43796		43796	640311		640311
2000	187595	1	187595	115566	1918	117484	285567	165	304898	92557		92557	36074		36074	736524	2084	738608
2001	143142	83	143142	142890	1081	143971	327200	24	339971	67097		67097	43198		43198	736274	1188	737462

Year	Subarea 6			Subarea 7 and Divisions 8.abde			Subareas 3 and 4			Subareas 1 2 5 and 14			Divisions 8.c and 9.a			Total		
	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch
2002	136847	12931	149778	102484	2260	104744	375708	8583	394878	73929		73929	49576		49576	749131	23774	772905
2003	135690	1399	137089	90356	5712	96068	354109	11785	365894	53883		53883	25823	531	26354	659831	19427	679288
2004	134033	1705	134738	103703	5991	109694	306040	11329	317369	62913	9	62922	34840	928	35769	640529	19962	660491
2005	79960	8201	88162	90278	12158	102436	249741	4633	254374	54129		54129	49618	796	50414	523726	25788	549514
2006	88077	6081	94158	66209	8642	74851	200929	8263	209192	46716		46716	52751	3607	56358	454587	26594	481181
2007	110788	2450	113238	71235	7727	78962	253013	4195	257208	72891		72891	62834	1072	63906	570762	15444	586206
2008	76358	21889	98247	73954	5462	79416	227252	8862	236113	148669	112	148781	59859	750	60609	586090	37075	623165
2009	135468	3927	139395	88287	2921	91208	226928	8120	235049	163604		163604	107747	966	108713	722035	15934	737969
2010	106732	2904	109636	104128	4614	108741	246818	883	247700	355725	5	355729	49068	4640	53708	862470	13045	875515
2011	160756	1836	162592	51098	5317	56415	301746	1906	303652	398132	28	398160	24036	1807	25843	935767	10894	946661
2012	121115	952	122067	65728	9701	75429	218400	1089	219489	449325	1	449326	24941	3431	28372	879510	15174	894684
2013	132062	273	132335	49871	1652	51523	260921	337	261258	465714	15	465729	19733	2455	22188	928433	4732	933165
2014	180068	340	180408	93709	1402	95111	383887	334	384221	684082	91	684173	46257	4284	50541	1388003	6451	1394454
2015	134728	30	134757	98563	3155	101718	295877	34	295911	632493	78	632571	36899	7133	44033	1198560	10431	1208990
2016	206326	200	206526	37300	1927	39227	248041	570	248611	563440	54	563494	32987	3220	36207	1088094	5971	1094066
2017	225959	151	226110	21128	1992	23119	269404	400	269804	603806	62	603869	32815	227	33042	1153112	2832	1155944

Table 8.4.1.1. NE Atlantic Mackerel. ICES estimated catches by area (t). Discards not estimated prior to 1978 (data submitted by Working Group members). Continued.

Year	**Subarea 6**			**Subarea 7 and Divisions 8.abde**			**Subareas 3 and 4**			**Subareas 1 2 5 and 14**			**Divisions 8.c and 9.a**			**Total**		
	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch	Ldg	Disc	Catch
2018	157239	90	157329	35240	1611	36851	341527	620	342147	455689	51	455740	33851	518	34369	1023547	2890	1026437
2019	122995	144	123139	33118	5902	39020	307238	812	308049	345019	18	345037	23844	932	24776	832214	7807	840021

Table 8.4.2.1. NE Atlantic Mackerel. ICES estimated catch (t) in Subareas 1, 2, 5 and 14, 1984–2019 (Data submitted by Working Group members).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992
Denmark	11787	7610	1653	3133	4265	6433	6800	1098	251
Estonia									216
Faroe Islands	137				22	1247	3100	5793	3347
France		16				11		23	6
Germany Fed. Rep.			99		380				
Germany Dem. Rep.			16	292		2409			
Iceland									
Ireland									
Latvia									100
Lithuania									
Netherlands									
Norway	82005	61065	85400	25000	86400	68300	77200	76760	91900
Poland									
Sweden									
United Kingdom			2131	157	1413		400	514	802
USSR/Russia	4293	9405	11813	18604	27924	12088	28900	13361	42440
Misreported (Area 4.a)									
Misreported (Area 6.a)									
Misreported (Unknown)									
Unallocated									
Discards									
Total	98222	78096	101112	47186	120404	90488	118700	97819	139062

Table 8.4.2.1. NE Atlantic Mackerel. ICES estimated catch (t) in Areas 1, 2, 5 and 14, 1984 – 2019. Continued.

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001
Denmark			4746	3198	37	2090	106	1375	7
Estonia		3302	1925	3741	4422	7356	3595	2673	219
Faroe Islands	1167	6258	9032	2965	5777	2716	3011	5546	3272
France	6	5	5		270				
Germany									
Greenland				1					
Iceland				92	925	357			
Ireland							100		
Latvia	4700	1508	389	233					
Lithuania								2085	
Netherlands				561			661		
Norway	100500	141114	93315	47992	41000	54477	53821	31778	21971
Poland					22				
Sweden									8
United Kingdom		1706	194	48	938	199	662		54
Russia	49600	28041	44537	44545	50207	67201	51003	491001	41566
Misreported (Area 4.a)		-109625	-18647			-177	-40011		
Misreported (Area 6.a)							-100		
Misreported (Un-known)									
Unallocated									
Discards									
Total	165973	72309	135496	103376	103598	134219	72848	92557	67097

Table 8.4.2.1. NE Atlantic Mackerel. ICES estimated catch (t) in Areas 1, 2, 5, and 14, 1984 – 2019. Continued.

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010
Denmark	1								4845
Estonia									
Faroe Islands	4730		650	30		278	123	2992	66312
France			2	1					
Germany						7			
Greenland									
Iceland	53	122		363	4222	36706	112286	116160	121008
Ireland		495	471						
Latvia									
Lithuania									
Netherlands	569	44	34	2393		10	72		90
Norway	22670	125481	10295	13244	8914	493	3474	3038	104858
Poland									
Sweden									
United Kingdom	665	692	2493				4		
Russia	45811	40026	49489	40491	33580	35408	32728	41414	58613
Misreported (Area 4.a)									
Misreported (Area 6.a)									
Misreported (Unknown)	-570		-553						
Unallocated		-44	32	-2393		-10	-18		
Discards			9				112		5
Total	73929	53883	62922	54129	46716	72891	148781	163604	355729

Table 8.4.2.1. NE Atlantic Mackerel. ICES estimated catch (t) in Areas 1, 2, 5, and 14, 1984 – 2019. Continued.

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019
Denmark	269		391	2345	4321	1	2	289	
Estonia			13671		0				
Faroe Islands	121499	107198	142976	103896	76889	61901	66194	52061	37418
France	2		197	8	36			733	
Germany		107	74		2963	3499	4064	577	190
Greenland	621	74021	541481	875811	30351	36142	46388	62973	30241
Iceland	159263	149282	151103	172960	169333	170374	167366	168330	128008
Ireland	90			1725	6	2			
Latvia									
Lithuania				1082		1931			
Netherlands	178	5	1	5887	6996	8599	7671	2697	13
Norway	43168	110741	33817	192322	204574	153228	167739	46853	22605
Poland								2	
Sweden		4	825	3310	740	730	1720	910	
United Kingdom			2	5534	7851	5240	4601	2009	
Russia	73601	74587	80812	116433	128433	121614	138061	118255	126543
Misreported (Area 4.a)									
Misreported (Area 6.a)									
Misreported (Unknown)									
Unallocated									
Discards	28	1	151	911	78	54	62	51	18
Total	398160	449326	465729	684173	632571	563315	603869	455740	345036

Table 8.4.2.2. NE Atlantic Mackerel. ICES estimated catch (t) in the North Sea, Skagerrak and Kattegat (Subarea 4 and Division 3.a), 1988-2019 (Data submitted by Working Group members).

Country	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	20	37		125	102	191	351	106
Denmark	32588	26831	29000	38834	41719	42502	47852	30891
Estonia					400			
Faroe Islands		2685	5900	5338		11408	11027	17883
France	1806	2200	1600	2362	956	1480	1570	1599
Germany Fed. Rep.	177	6312	3500	4173	4610	4940	1497	712
Iceland								
Ireland		8880	12800	13000	13136	13206	9032	5607
Latvia					211			
Lithuania								
Netherlands	2564	7343	13700	4591	6547	7770	3637	1275
Norway	59750	81400	74500	102350	115700	112700	114428	108890
Poland								
Romania							2903	
Sweden	1003	6601	6400	4227	5100	5934	7099	6285
United Kingdom	1002	38660	30800	36917	35137	41010	27479	21609
USSR (Russia from 1990)								
Misreported (Area 2.a)							109625	18647
Misreported (Area 6.a)	180000	92000	126000	130000	127000	146697	134765	106987
Misreported (Unknown)								
Unallocated	29630	6461	-3400	16758	13566			983
Discards	29776	2190	4300	7200	2980	2720	1150	730
Total	338316	281600	305100	365875	367164	390558	472397	322204

Table 8.4.2.2. NE Atlantic Mackerel. ICES estimated catch (t) in the North Sea, Skagerrak and Kattegat (Sub-area 4 and Division 3.a), 1988-2019. Continued.

Country	1996	1997	1998	1999	2000	2001	2002
Belgium	62	114	125	177	146	97	22
Denmark	24057	21934	25326	29353	27720	21680	343751
Estonia							
Faroe Islands	13886	32882	4832	4370	10614	18751	12548
France	1316	1532	1908	2056	1588	1981	2152
Germany	542	213	423	473	78	4514	3902
Iceland				357			
Ireland	5280	280	145	11293	9956	10284	20715
Latvia							
Lithuania							
Netherlands	1996	951	1373	2819	2262	2441	11044
Norway	88444	96300	103700	106917	142320	158401	161621
Poland							
Romania							
Sweden	5307	4714	5146	5233	49941	5090	52321
United Kingdom	18545	19204	19755	32396	58282	52988	61781
Russia		3525	635	345	1672	1	
Misreported (Area 2.a)				40000			
Misreported (Area 6.a)	51781	73523	98432	59882	8591	39024	49918
Misreported (Unknown)							
Unallocated	236	1102	3147	17344	34761	24873	22985
Discards	1387	2807	4753		1912	24	8583
Total	212839	229487	269700	313015	304896	339970	394878

Table 8.4.2.2. NE Atlantic Mackerel. ICES estimated catch (t) in the North Sea, Skagerrak and Kattegat (Subarea 4 and Division 3.a), 1988-2019. Continued.

Country	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	2	4	1	3	1	2	3	27
Denmark	275081	25665	232121	242191	252171	26716	23491	36552
Estonia								
Faroe Islands	11754	11705	9739	12008	11818	7627	6648	4639
France	1467	1538	1004	285	7549	490	1493	686
Germany	4859	4515	4442	2389	5383	4668	5158	25621
Iceland								
Ireland	17145	18901	15605	4125	13337	11628	12901	14639
Latvia								
Lithuania								
Netherlands	6784	6366	3915	4093	5973	1980	2039	1300
Norway	150858	147068	106434	113079	131191	114102	118070	129064
Poland			109					
Romania								
Sweden	4450	4437	3204	3209	38581	36641	73031	34291
United Kingdom	67083	62932	37118	28628	46264	37055	47863	52563
Russia			4					696
Misreported (Area 2.a)								
Misreported (Area 6.a)	62928	23692	37911	8719		17280	1959	
Misreported (Unknown)								
Unallocated	-730	-783	7043	171	2421	2039	-629	660
Discards	11785	11329	4633	8263	4195	8862	8120	883
Total	365894	317369	254374	209192	257208	236111	235049	247700

Table 8.4.2.2. NE Atlantic Mackerel. ICES estimated catch (t) in the North Sea, Skagerrak and Kattegat (Subarea 4 and Division 3.a), 1988-2019. Continued.

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belgium	21	39	62	56	38	99	107	110	13
Denmark	32800	36492	31924	21340	35809	21696	27457	22207	25374
Estonia									
Faroe Islands	543	432	25	42919	25672	18193	12915	15475	17460
France	1416	5736	1788	4912	7827	3448	5942	6714	5455
Germany	52911	4560	5755	4979	6056	10172	11185	12091	7778
Iceland									
Ireland	15810	20422	13523	45167	34167	24437	35957	24567	1678
Latvia									
Lithuania				8340		596			
Netherlands	9881	6018	4863	24536	17547	11434	17401	13844	8957
Norway	162878	64181	130056	85409	36344	55089	51960	135715	135083
Poland					24		0.721	4041	1394
Romania									
Sweden	32481	4560	2081	1112	3190	2933	1981	3056	2155
United Kingdom	69858	75959	70840	145119	129203	99945	104499	103707	101890
Russia			4						0.12
Misreported (Area 2.a)									
Misreported (Area 6.a)									
Misreported (Unknown)									
Unallocated									
Discards	1906	1089	337	334	34	559	400	620	812
Total	303652	219489	261258	384221	295911	248611	269804	342147	308049

Table 8.4.2.3. NE Atlantic Mackerel. ICES estimated catch (t) in the Western area (Subareas 6 and 7 and Divisions 8.a,b,d,e), 1985 – 2019 (Data submitted by Working Group members).

Country	1985	1986	1987	1988	1989	1990	1991	1992
Belgium								
Denmark	400	300	100		1000		1573	194
Estonia								
Faroe Islands	9900	1400	7100	2600	1100	1000		
France	7400	11200	11100	8900	12700	17400	4095	
Germany	11800	7700	13300	15900	16200	18100	10364	9109
Guernsey								
Ireland	91400	74500	89500	85800	61100	61500	17138	21952
Isle of Man								
Jersey								
Lithuania								
Netherlands	37000	58900	31700	26100	24000	24500	64827	76313
Norway	24300	21000	21600	17300	700		29156	32365
Poland								
Spain				1500	1400	400	4020	2764
United Kingdom	205900	156300	200700	208400	149100	162700	162588	196890
Misreported (Area 4.a)		-148000	-117000	-180000	-92000	-126000	-130000	-127000
Misreported (Unknown)								
Unallocated	75100	49299	26000	4700	18900	11500	-3802	1472
Discards	4500			5800	4900	11300	23550	22020
Total	467700	232599	284100	197000	199100	182400	183509	236079

Table 8.4.2.3. NE Atlantic Mackerel. ICES estimated catch (t) in the Western area (Subareas 6 and 7 and Divisions 8.a,b,d,e), 1985–2019 (Data submitted by Working Group members). Continued.

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belgium									
Denmark		2239	1143	1271			552	82	835
Estonia			361						
Faroe Islands		4283	4284		24481	3681	4239	4863	2161
France	2350	9998	10178	14347	19114	15927	14311	17857	18975
Germany	8296	25011	23703	15685	15161	20989	19476	22901	20793
Guernsey									
Ireland	23776	79996	72927	49033	52849	66505	48282	61277	60168
Isle of Man									
Jersey									
Lithuania									
Netherlands	81773	40698	34514	34203	22749	28790	25141	30123	33654
Norway	44600	2552			223				
Poland	600								
Spain	3162	4126	4509	2271	7842	3340	4120	4500	
United Kingdom	215265	208656	190344	127612	128836	165994	127094	126620	4063
Misreported (Area 4.a)	-146697	-134765	-106987	-51781	-73523	-98255	-59982	-3775	139589
Misreported (Unknown)									-39024
Unallocated		4632	28245	10603	4577	8351	21652	31564	37952
Discards	15660	4220	6991	10028	16057	3277		1920	1164
Total	248785	251646	270212	213272	196110	218599	204885	297932	280553

Table 8.4.2.3. NE Atlantic Mackerel. ICES estimated catch (t) in the Western area (Subareas 6 and 7 and Divisions 8.a,b,d,e), 1985 – 2019 (Data submitted by Working Group members). Continued.

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium			1					1	2
Denmark		113				6	10		48
Estonia									
Faroe Islands	2490	2260	674		59	1333	3539	4421	36
France	19726	21213	18549	15182	14625	12434	14944	16464	10301
Germany	22630	19200	18730	14598	14219	12831	10834	17545	16493
Guernsey					10				
Ireland	51457	49715	41730	30082	36539	35923	33132	48155	43355
Isle of Man									14
Jersey				9	8	6	7	8	6
Lithuania					95	7			
Netherlands	21831	23640	21132	18819	20064	18261	17920	20900	21699
Norway						7	3948	121	30
Poland				461	1368	978			
Russia									1
Spain	3483			4795	4048	2772	7327	8462	6532
United Kingdom	131599	167246	149346	115586	67187	87424	768821	109147	107840
Misreported (Area 4a)	-43339	-62928	-23139	-37911	-8719		-17280	-1959	
Misreported (Unknown)									
Unallocated	27558	5587	9714	13412	4783	10042	-952	490	4503
Discards	15191	7111	7696	20359	14723	10177	27351	6848	7518
Total	252620	233157	244432	190597	169009	192201	177662	230603	218377

Table 8.4.2.3. NE Atlantic Mackerel. ICES estimated catch (t) in the Western area (Subareas 6 and 7 and Divisions 8.a,b,d,e), 1985 – 2019 (Data submitted by Working Group members). Continued.

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belgium					14	44	21	58	53
Denmark	2889	8	903	18538	6741	19443	12569	8194	5189
Estonia									
Faroe Islands	8			3421	5851	13173	20559	13543	7787
France	11304	14448	12438	16627	17820	16634	16925	13974	12646
Germany	18792	14277	15102	23478	19238	9740	9608	7214	8936
Guernsey	10	5	9	9	4			12	9
Iceland									69
Ireland	45696	42627	42988	56286	54571	52087	48957	42181	51637
Isle of Man	11	11	8	3		8	2	3	3
Jersey	7	8	8	7	3	3	0.003	3	2
Lithuania	23			176	554	13			
Netherlands	18336	19794	16295	16242	15264	17896	18694	13851	13727
Norway	2019	1101	734		1313	1035	2657	4639	1420
Poland								14	2312
Portugal									46
Russia						30			1
Spain	1257	773	635	1796	951	1253	786	4471	1220
Sweden									805
United Kingdom	111103	93775	92957	137195	110932	112268	116308	84309	50253
Misreported (Area 4.a)									
Misreported (Unknown)									
Unallocated	399	16	-144		34			13	
Discards	7153	10654	2105	1742	3185	2126	2142	1701	6046
Total	219007	197496	183857	275519	236475	245754	249229	194180	162159

Table 8.4.2.4. NE Atlantic Mackerel. ICES estimated catch (t) in Divisions 8.c and 9.a, 1977 – 2019 (Data submitted by Working Group members).

Country	Div	1977	1978	1979	1980	1981	1982	1983	1984	1985
France	8.c									
Poland	9.a	8								
Portugal	9.a	1743	1555	1071	1929	3108	3018	2239	2250	4178
Spain	8.c	19852	18543	15013	11316	12834	15621	10390	13852	11810
Spain	9.a	2935	6221	6280	2719	2111	2437	2224	4206	2123
USSR	9.a	2879	189	111						
Total	9.a	7565	7965	7462	4648	5219	5455	4463	6456	6301
Total		27417	26508	22475	15964	18053	21076	14853	20308	18111
Country	**Div**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
France	8.c									
Poland	9.a									
Portugal	9.a	6419	5714	4388	3112	3819	2789	3576	2015	2158
Spain	8.c	16533	15982	16844	13446	16086	16940	12043	16675	21246
Spain	9.a	1837	491	3540	1763	1406	1051	2427	1027	1741
USSR	9.a									
Total	9.a	8256	6205	7928	4875	5225	3840	6003	3042	3899
Total		24789	22187	24772	18321	21311	20780	18046	19719	25045
Country	**Div**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
France	8.c									226
Poland	9.a									
Portugal	9.a	2893	3023	2080	2897	2002	2253	3119	2934	2749
Spain	8.c	23631	28386	35015	36174	37631	30061	38205	38703	17384
Spain	9.a	1025	2714	3613	5093	4164	3760	1874	7938	5464
Discards	8.c									531
Discards	9.a	3918	5737	5693	7990	6165	6013	4993	10873	8213
Total	9.a	27549	34123	40708	44164	43796	36074	43198	49575	26354

Table 8.4.2.4. NE Atlantic Mackerel. ICES estimated catch (t) in Divisions 8.c and 9.a, 1977 – 2019 (Data submitted by Working Group members). Continued.

Country	Div	2004	2005	2006	2007	2008	2009	2010	2011	2012
France	8.c	177	151	43	55	168	383	392	44	283
Poland	9.a									
Portugal	9.a	2289	1509	2620	2605	2381	1753	2363	962	824
Spain	8.c			43063	53401	50455	91043	38858	14709	17768
Spain	9.a			7025	6773	6855	14569	7347	2759	845
Discards	8.c	928	391	3606	156	73	725	4408	563	2187
Discards	9.a		405	1	916	677	241	232	1245	1244
Unallo-cated	8.c	28429	42851						4691	4144
Unallo-cated	9.a	3946	5107					108	871	1076
Total	9.a	6234	7021	9646	10293	9913	16562	10049	5836	3989
Total		35768	50414	56358	63906	60609	108713	53708	25843	28372

Country	Div	2013	2014	2015	2016	2017	2018	2019		
France	8.c	220	171	21	106	83	50	43		
Portugal	8.c						3709	3188		
Portugal	9.a	254	618	1456	619	634	855	706		
Spain	8.c	14617	33783	29726	26553	30893	27250	19158		
Spain	9.a	1162	2227	3853	2229	1206	1687	749		
Discards	8.c	1428	2821	4724	2469	84	324	760		
Discards	9.a	1027	1463	2409	751	143	194	172		
Unallo-cated	8.c	-573	8795	11	1357		300			
Unallo-cated	9.a	4053	662	1831	2123					
Total	9.a	6497	4308	9550	5722	1983	2736	1627		
Total		22188	45570	44033	36207	33042	34369	24776		

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019. Quarters 1-4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	847.0	0	0	0	0	137.5	0	0	0
1	1786.6	4.8	0.1	0.0	0	6240.0	14.6	5.9	0
2	51845.8	138.8	5.1	4.1	0.5	41844.6	858.6	196.5	1604.1
3	144470.2	233.4	7.5	5.3	0.8	112758.4	3626.5	1212.1	2204.2
4	50771.1	147.8	5.5	4.6	0.6	34015.6	2244.7	464.3	3221.2
5	77189.7	196.9	5.7	4.8	0.6	113726.0	1511.1	248.1	12355.3
6	69343.9	143.0	3.8	3.7	0.4	83835.4	2063.0	297.8	18857.3
7	53972.8	88.7	1.9	1.5	0.2	79852.9	731.8	43.5	25447.2
8	67967.7	81.4	1.2	0.6	0.1	99790.1	350.3	72.0	20729.8
9	54028.2	61.3	0.6	0.1	0.1	80399.5	224.0	75.6	19553.1
10	32790.2	18.1	0.1	0	0	30335.9	84.7	23.3	8772.2
11	15450.9	20.6	0.3	0	0	25839.8	39.3	9.3	6861.5
12	12366.3	31.6	0.8	0	0	17799.5	30.4	6.6	2808.8
13	4188.6	13.1	0.3	0	0	7448.4	9.6	4.7	689.6
14	884.9	6.8	0.2	0	0	3016.3	3.1	1.3	0
15+	1799.3	3.3	0.1	0	0	2766.9	7.1	6.9	0
Catch	269329	500	14	11	1	303065	3997	703	58101
SOP	269328	501	14	11	1	302841	3978	703	58101
SOP%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q 1-4

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0	0.16	0	0.84	0	0	126.6	271.3	436.75
1	1044.8	261.7	0.1	7.3	232.3	0.1	1715.5	3586.6	1670.1
2	12071.1	5195.1	3.6	4.4	1949.8	41.6	2148.9	1688.9	574.8
3	7413.1	47233.1	23.8	43.6	13223.7	278.3	2131.5	1289.1	324.6
4	1020.4	12037.9	3.4	4.8	1637.2	28.1	211.0	586.2	166.2
5	1131.2	53981.4	10.6	9.7	8081.5	47.7	2865.3	656.3	82.4
6	1300.1	30454.9	8.0	5.9	3941.5	63.5	928.5	896.0	20.0
7	1302.4	46411.5	7.3	5.0	3877.8	38.3	1339.4	505.9	28.4
8	1782.8	52556.6	10.8	4.8	7601.6	54.5	134.3	1204.0	11.2
9	3383.7	30240.8	6.3	3.1	5951.4	25.1	821.5	683.0	43.8
10	648.6	23427.4	4.7	0.9	2805.6	18.2	11.8	346.8	4.2

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
11	1360.4	12044.3	2.7	0.8	2228.0	11.3	354.5	105.3	8.99
12	1428.2	8340.7	1.3	0.1	774.4	0.3	182.4	0.7	2.86
13	718.8	4494.1	0.7	0.2	671.2	0.2	0.0	0.0	0.01
14	346.3	647.9	0.2	0.0	448.7	0.2	0.0	0.0	0
15+	664.1	769.6	0.1	0.0	68.8	0.0	0.0	0.0	0
Catch	10957	123112	28	24	17993	179	4933	3125	642
SOP	10953	123339	28	24	17994	179	4933	3126	642
SOP%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q 1-4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	1.4	0.5	0.0	0.0	3322.4	836.2	1.0	4.4
1	218.9	272.6	8949.1	0.6	8485.1	3864.9	555.5	1103.1
2	29.8	10.7	245.1	0.0	911.0	808.1	1444.1	13.6
3	34.6	39.1	1798.7	0.2	2721.3	2785.9	3663.0	524.3
4	5.2	15.9	393.3	0.0	335.9	477.9	2678.8	468.4
5	49.6	93.1	1968.7	0.4	1376.1	2546.3	10685.3	3952.2
6	23.0	65.2	1374.3	0.1	451.5	1135.5	6328.3	2422.0
7	29.4	57.7	1076.3	0.2	514.6	1559.7	8266.6	3698.1
8	17.5	88.7	1862.1	0.3	443.2	1307.4	7057.4	2988.8
9	20.8	71.9	1514.1	0.3	283.0	843.0	4505.8	2043.7
10	4.8	30.7	677.4	0.1	92.3	301.0	1776.6	786.4
11	6.7	20.5	473.6	0.1	47.3	165.0	1061.6	443.7
12	2.6	4.4	102.6	0.0	17.2	79.4	481.3	203.2
13	0.4	3.6	88.9	0.0	7.1	38.1	165.5	88.4
14	0.2	2.3	59.4	0.0	1.3	12.5	52.8	35.6
15+	0.0	0.4	9.1	0.0	0.0	0.0	0.0	0.0
Catch	104	207	4749	1	2839	4181	16672	6478
SOP	104	207	4748	1	2846	4186	16680	6478
SOP%	100%	100%	100%	99%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q 1-4

Age	8.d	9.a	9.a.N	14.b	All
0	0	125.0	327.5	0	6439
1	50.6	165.8	2160.8	0	42398
2	18.6	337.7	2050.7	61.2	126107
3	79.0	720.5	347.3	1494	350687
4	9.0	283.6	146.7	3245	114630
5	30.2	250.0	195.2	2637	295888
6	5.4	106.0	86.3	2564	226728
7	2.5	70.4	96.7	810	229838
8	2.2	31.3	83.9	1354	267591
9	1.2	25.1	56.3	19	204885
10	0.1	26.7	24.4	2	103015
11	0.0	3.5	16.8	414	66990
12	0.0	0.0	10.0	0.0	44676
13	0.0	0.0	2.8	0.0	18634
14	0.0	0.0	1.2	0.0	5521
15+	0.0	0.0	0.0	0.0	6096
Catch	43	706	921	6651	840021
SOP	43	706	920	6651	840526
SOP%	100%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q1

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	0.0	0.0		0.00	0.00	0.0		0.0	
1	0.0	0.1		0.00	0.00	1590.6		0.1	
2	0.1	0.2		0.00	0.00	5146.0		0.2	
3	0.1	0.6		0.01	0.02	17833.3	0.3	0.7	
4	0.0	0.3		0.00	0.01	11278.6	0.1	0.4	
5	0.1	0.8		0.01	0.03	33863.1	0.4	1.5	
6	0.1	0.5		0.01	0.02	28168.9	0.4	1.0	
7	0.1	0.3		0.01	0.03	27374.8	0.4	0.8	

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
8	0.1	1.3		0.01	0.02	24253.8	0.3	1.2	
9	0.1	1.2		0.00	0.01	13170.9	0.1	0.5	
10	0.1	0.4		0.00	0.00	5751.9		0.3	
11	0.0	0.3		0.00	0.01	5840.2	0.1	0.4	
12	0.0	0.2		0.00	0.02	8328.7	0.2	0.3	
13	0.0	0.2		0.00	0.01	3081.6	0.1	0.1	
14	0.0	0.1		0.00	0.00	1389.6		0.0	
15+	0.0	0.0		0.00	0.00	811.6		0.1	
Catch	0.377	2.375		0.022	0.072	71655.271	0.972	2.855	
SOP	0.375	2.372		0.018	0.071	71646.705	0.966	2.852	
SOP%	99%	100%		83%	98%	100%	99%	100%	

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q1

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0	0	0	0	0	0	34	45	47
1	0	258	0	3	230	0	456	422	449
2	83	5121	3	1	1703	30	571	203	209
3	1531	45069	22	1	11607	199	574	167	127
4	0	11335	2	1	1483	19	58	80	65
5	554	52360	4	1	7804	25	761	79	6
6	389	27967	4	0	3625	38	254	83	2
7	116	45269	3	1	3674	22	358	54	2
8	116	50678	4	1	7307	31	57	98	0
9	556	29345	2	1	5809	11	223	74	11
10	140	23320	1	0	2704	10	8	32	1
11	47	11877	1	0	2156	6	93	14	1
12	240	8304	0	0	765	0	49	0	0
13	233	4474	0	0	663	0	0	0	0
14	0	644	0	0	443	0	0	0	0
15+	93	766	0	0	68	0	0	0	0
Catch	1265	119524	14	3	16987	111	1327	351	180
SOP	1265	119722	14	3	16988	111	1327	351	180
SOP%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q1

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	0	0	0	0	0	0	0	0
1	200	268	8932	0	8408	3077	269	0
2	6	8	204	0	512	614	361	11
3	8	36	1150	0	1435	2508	1272	425
4	1	15	174	0	187	369	1176	379
5	11	90	1030	0	873	1727	5705	3221
6	7	62	449	0	358	640	3419	1995
7	10	56	454	0	466	786	4645	3051
8	9	86	1067	0	401	658	4044	2469
9	6	69	807	0	259	408	2689	1679
10	2	30	373	0	88	130	1131	638
11	1	20	260	0	46	67	687	358
12	0	4	100	0	17	31	327	164
13	0	4	87	0	7	14	113	72
14	0	2	58	0	1	3	37	26
15+	0	0	9	0	0	0	0	0
Catch	35	199	2722	0	2010	2640	9147	5261
SOP	35	199	2721	0	2010	2640	9150	5262
SOP%	100%	100%	100%	99%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q1

Age	8.d	9.a	9.a.N	14.b	All
0	0	0	0		125.6
1	50.5	0.0	1189.6		25802.3
2	17.3	72.7	532.6		15410.7
3	73.6	325.6	41.4		84407.1
4	8.4	130.9	8.1		26772.1
5	28.1	140.4	16.1		108301.8
6	5.0	20.2	7.9		67496.3

Age	8.d	9.a	9.a.N	14.b	All
7	2.3	17.3	10.1		86374.3
8	2.1	6.8	8.8		91301.1
9	1.1	2.7	5.9		55131.7
10	0.1	2.7	2.6		34365.7
11	0.0	0.0	1.3		21476.3
12	0.0	0.0	1.1		18333.1
13	0.0	0.0	0.3		8749.4
14	0.0	0.0	0.1		2604.3
15+	0.0	0.0	0.0		1748.6
Catch	40	252	212		233940
SOP	40	252	212		234133
SOP%	100%	100%	100%		100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q2

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	0	0	0	0	0	0	0	0	
1	17	3	0	0	0	41	2	0	
2	142	19	1	1	0	184	534	18	
3	3251	71	2	1	0	599	3049	808	
4	779	25	1	1	0	248	2036	448	
5	2843	73	2	1	0	585	1139	21	
6	3562	57	1	1	0	443	1900	286	
7	5804	59	1	1	0	337	655	20	
8	4071	54	1	0	0	802	268	20	
9	5780	41	1	0	0	716	176	50	
10	3676	12	0	0	0	241	78	23	
11	1232	16	0	0	0	201	35	9	
12	1401	29	1	0	0	158	28	6	
13	23	12	0	0	0	87	4	0	
14	103	6	0	0	0	28	2	0	
15+	9	3	0	0	0	23	1	0	
Catch	12917	194	4	2	0	1787	3269	410	

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
SOP	12918	193	4	2	0	1795	3289	411	
SOP%	100%	100%	99%	101%	100%	100%	101%	100%	

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q2

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0	0	0	0.2	0	0	24	114	30
1	0.0	0.5	0.1	1.9	2.5	0.1	321	1071	278
2	46.8	32.0	0.1	1.9	221.8	0.8	402	508	132
3	668.1	1679.1	1.2	41.1	1450.5	5.9	398	626	80
4	23.2	550.4	0.8	3.1	136.8	0.8	39	267	41
5	325.3	1028.0	4.9	7.1	244.2	2.7	534	257	4
6	301.7	2018.0	2.3	2.2	277.3	1.9	172	448	1
7	232.9	801.3	2.9	3.3	178.9	1.5	249	235	2
8	198.9	1469.5	4.7	1.8	258.5	3.3	23	839	1
9	377.8	617.1	3.4	1.5	123.4	2.1	152	361	7
10	122.8	55.5	2.2	0.5	89.1	1.1	1	217	1
11	69.3	73.9	1.2	0.5	63.3	0.7	66	12	1
12	122.4	14.0	0.8	0.0	8.4	0.2	34	0	0
13	104.1	10.2	0.5	0.1	7.3	0.2	0	0	0
14	0.0	1.3	0.2	0.0	4.9	0.1	0	0	0
15+	39.7	1.3	0.1	0.0	0.8	0.0	0	0	0
Catch	957.9	2636.8	9.7	17.0	891.6	7.1	919	1395	114
SOP	958	2659	10	16.99	892	7	919	1395	114
SOP%	100%	101%	100%	100%	100%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q2

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	0	1	0	0	3107	0	0	0
1	0	5	1	0	51	770	266	1103
2	0	2	41	0	216	38	976	2
3	1	2	597	0	572	262	2268	96
4	1	1	179	0	66	103	1438	88
5	4	2	689	0	226	800	4954	729

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
6	2	2	732	0	43	482	2887	427
7	2	2	475	0	25	751	3615	647
8	4	2	750	0	22	629	3009	520
9	3	2	554	0	13	420	1805	364
10	1	1	259	0	3	165	646	148
11	1	1	146	0	1	95	375	85
12	0	0	2	0	1	47	154	39
13	0	0	2	0	0	23	52	17
14	0	0	1	0	0	9	16	10
15+	0	0	0	0	0	0	0	0
Catch	7	7	1621	0	454	1421	7399	1213
SOP	7	7	1622	0	462	1423	7404	1213
SOP%	100%	100%	100%	99%	102%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q2

Age	8.d	9.a	9.a.N	14.b	All
0	0.0	0.0	0.0		3275.5
1	0.2	1.6	284.3		4221.6
2	1.2	89.5	335.7		3944.8
3	5.1	236.9	130.1		16902.8
4	0.6	92.2	67.3		6636.4
5	2.0	77.2	164.2		14719.8
6	0.4	58.5	70.3		14180.5
7	0.2	50.5	83.9		14233.6
8	0.2	22.4	73.0		13046.7
9	0.1	21.1	47.3		11639.0
10	0.0	23.9	21.9		5788.7
11	0.0	3.5	15.4		2502.1
12	0.0	0.0	8.9		2053.6
13	0.0	0.0	2.6		345.3

Age	8.d	9.a	9.a.N	14.b	All
14	0.0	0.0	1.1		183.7
15+	0.0	0.0	0.0		77.3
Catch	3	240	299		38195
SOP	3	240	299		38258
SOP%	100%	100%	100%		100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q3

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	0	0	0	0	0	0	0	0	0
1	1746	1	0	0	0	596	10	3	0
2	51275	111	4	3	0	5093	286	94	1604
3	140944	150	5	4	1	12215	498	212	2204
4	49903	108	4	3	0	2027	186	8	3221
5	74248	100	3	3	0	8808	306	117	12355
6	65703	68	2	2	0	5937	134	4	18857
7	48078	19	0	0	0	4360	56	11	25447
8	63739	21	0	0	0	9246	65	26	20730
9	48109	16	0	0	0	9442	37	13	19553
10	28997	5	0	0	0	3052	5	0	8772
11	14139	4	0	0	0	2346	3	0	6862
12	10929	2	0	0	0	1436	2	0	2809
13	4088	1	0	0	0	785	4	2	690
14	745	0	0	0	0	231	1	1	0
15+	1736	1	0	0	0	331	5	4	0
Catch	255689	262	8	7	1	27335	601	150	58101
SOP	255688	262	8	7	1	27336	601	150	58101
SOP%	100%	100%	100%	100%	99%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q3

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0	0	0	0.27	0	0	45.4	78.510	25.95
1	71.0	0.1	0.0	2.5	0.1	0	615.6	739.3	243.6
2	823.3	10.8	0.0	1.2	24.7	10.4	771.1	352.7	115.5
3	572.6	96.1	0.2	1.6	165.4	73.1	760.0	240.1	69.9
4	67.8	62.2	0.2	1.1	16.9	8.8	74.0	123.6	35.8
5	96.1	283.3	0.8	1.7	31.2	19.5	1023.9	95.6	3.4
6	96.9	214.7	0.48	3.14	38.4	23.7	326.1	75.7	1.1
7	81.3	125.0	0.620	1.19	23.9	14.7	476.9	57.0	1.40
8	116.3	159.4	0.8	2.21	33.4	20.5	35.7	41.5	0.03
9	245.8	117.0	0.5	1.07	16.9	12.1	289.5	76.1	6.34
10	46.2	5.6	0.4	0.01	11.5	7.0	1.0	22.4	0.7
11	91.2	33.3	0.2	0.14	7.6	4.4	126.9	22.8	0.68
12	106.6	1.9	0.1	0.00	0.4	0.0	65.5	0.3	0
13	59.1	0.9	0.1	0.00	0.4	0.0	0.0	0.0	0
14	23.5	0.2	0.0	0.00	0.3	0.0	0.0	0.0	0
15+	49.4	0.2	0.0	0.00	0.0	0.0	0.0	0.0	0
Catch	774	332	2	4.50	110	61	1755	458	99
SOP	769	334	2	4.53	111	62	1755	458	99
SOP%	99%	100%	100%	101%	101%	101%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q3

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	0	0	0	0	4	132	1	4
1	0	0	16	1	14	0	0	0
2	0	0	0	0	105	1	31	0
3	1	0	52	0	452	5	56	1
4	0	0	40	0	52	2	28	0
5	1	0	250	0	175	13	12	1
6	1	0	193	0	32	9	10	0
7	1	0	148	0	15	16	3	0
8	1	0	46	0	13	14	2	0

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
9	1	0	153	0	7	11	5	0
10	0	0	45	0	1	4	0	0
11	0	0	68	0	0	3	0	0
12	0	0	0	0	0	1	0	0
13	0	0	0	0	0	1	0	0
14	0	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0	0
Catch	3	0	406	0	228	35	53	1
SOP	3	0	406	0	228	35	53	1
SOP%	100%	100%	100%	98%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q3

Age	8.d	9.a	9.a.N	14.b	All
0	0.0	73.5	327.0	0.0	692.9
1	0.0	5.9	231.1	0.0	4297.1
2	0.1	86.0	458.1	61.2	61323.8
3	0.3	108.6	135.6	1494.1	160516.6
4	0.0	43.7	58.7	3245.0	59321.4
5	0.1	24.7	13.1	2636.5	100622.4
6	0.0	21.9	7.5	2564.4	94327.3
7	0.0	2.6	2.4	810.0	79751.0
8	0.0	2.1	1.8	1354.3	95670.7
9	0.0	1.3	3.0	18.6	78134.4
10	0.0	0.0	0.0	2.0	40978.8
11	0.0	0.0	0.0	413.7	24125.8
12	0.0	0.0	0.0	0.0	15353.9
13	0.0	0.0	0.0	0.0	5631.3
14	0.0	0.0	0.0	0.0	1002.5
15+	0.0	0.0	0.0	0.0	2125.5
Catch	0	119	210	6651	353456

Age	8.d	9.a	9.a.N	14.b	All
SOP	0	119	210	6651	353476
SOP%	99%	100%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	847.0	0.0	0.0	0.0	0.0	137.2	0.0	0.0	
1	23.3	0.4	0.0	0.0	0.0	4012.1	2.2	2.8	
2	429.1	8.5	0.3	0.3	0.1	31421.6	38.3	84.0	
3	275.1	11.5	0.4	0.4	0.1	82110.7	78.9	191.4	
4	88.9	15.3	0.6	0.6	0.2	20461.6	22.5	7.6	
5	98.7	23.2	0.8	0.9	0.2	70469.9	65.6	108.6	
6	78.8	17.7	0.6	0.7	0.2	49286.6	28.5	6.2	
7	90.9	10.6	0.4	0.4	0.1	47780.8	19.7	12.1	
8	157.2	4.8	0.1	0.2	0.0	65488.3	17.3	24.9	
9	139.7	2.9	0.1	0.1	0.0	57070.8	10.6	12.4	
10	117.2	0.8	0.0	0.0	0.0	21291.6	1.9	0.3	
11	79.2	0.6	0.0	0.0	0.0	17453.1	1.4	0.3	
12	36.8	0.2	0.0	0.0	0.0	7877.2	0.5	0.0	
13	78.0	0.1	0.0	0.0	0.0	3494.7	1.0	2.2	
14	36.7	0.1	0.0	0.0	0.0	1367.8	0.3	0.6	
15+	54.6	0.0	0.0	0.0	0.0	1601.6	1.1	3.2	
Catch	721	43	1	2	0	202064	107	140	
SOP	721	43	1	2	0	202278	107	140	
SOP%	100%	100%	100%	100%	99%	100%	100%	100%	

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q4

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0	0	0	0	0	0	24	34	334
1	974	3	0	0	0	0	323	1354	699
2	11118	31	0	0	0	0	404	626	118
3	4641	389	0	0	0	0	400	256	48

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
4	929	90	0	0	0	0	40	116	25
5	155	311	1	0	2	0	545	224	70
6	513	255	1	0	1	0	177	289	16
7	872	216	1	0	1	0	255	160	23
8	1352	249	1	0	2	0	19	225	10
9	2204	162	1	0	2	0	157	172	19
10	340	47	1	0	1	0	2	75	1
11	1153	60	0	0	1	0	69	56	7
12	960	21	0	0	0	0	34	0	3
13	323	9	0	0	0	0	0	0	0
14	323	2	0	0	0	0	0	0	0
15+	482	2	0	0	0	0	0	0	0
Catch	7960	619	3	0.09	4	0	933	922	248
SOP	7961	629	3	0.09	4	0	933	922	248
SOP%	100%	102%	100%	96%	100%	98%	100%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers (‘000s) -at-age by area for 2019 (cont.). Q4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	1	0	0	0	210	704	0	0
1	19	0	0	0	12	18	19	0
2	24	0	0	0	78	156	77	1
3	25	0	0	0	263	11	67	2
4	3	0	0	0	30	3	36	1
5	34	0	0	0	102	6	14	1
6	13	0	0	0	18	4	12	0
7	16	0	0	0	9	7	4	0
8	4	0	0	0	8	6	2	0
9	11	0	0	0	4	4	6	0
10	1	0	0	0	0	2	0	0
11	4	0	0	0	0	1	0	0
12	2	0	0	0	0	1	0	0
13	0	0	0	0	0	0	0	0

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
14	0	0	0	0	0	0	0	0
15+	0	0	0	0	0	0	0	0
Catch	59	1	0	0	147	85	73	2
SOP	59	1	0	0	147	88	73	2
SOP%	100%	100%	97%	84%	100%	104%	100%	100%

Table 8.4.3.1. NE Atlantic Mackerel. Catch numbers ('000s) -at-age by area for 2019 (cont.). Q4

Age	8.d	9.a	9.a.N	14.b	All
0		51.5	0.5		2344.6
1		158.4	455.8		8076.7
2		89.5	724.4		45427.5
3		49.4	40.2		88860.6
4		16.8	12.6		21900.1
5		7.7	1.9		72243.9
6		5.5	0.7		50724.3
7		0.0	0.3		49479.6
8		0.0	0.3		67572.3
9		0.0	0.2		59980.1
10		0.1	0.0		21882.1
11		0.0	0.0		18886.2
12		0.0	0.0		8935.2
13		0.0	0.0		3908.2
14		0.0	0.0		1730.9
15+		0.0	0.0		2144.2
Catch		95	199		214430
SOP		95	199		214666
SOP%		100%	100%		100%

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1%.

Quarters 1-4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	0%					0%			
1	0%	0%	0%	0%	0%	1%	0%	0%	
2	8%	12%	15%	16%	15%	6%	7%	7%	1%
3	23%	20%	23%	21%	24%	15%	31%	45%	2%
4	8%	12%	17%	19%	16%	5%	19%	17%	3%
5	12%	17%	17%	20%	19%	15%	13%	9%	10%
6	11%	12%	12%	15%	13%	11%	17%	11%	15%
7	8%	7%	6%	6%	6%	11%	6%	2%	21%
8	11%	7%	4%	2%	3%	13%	3%	3%	17%
9	8%	5%	2%	0%	1%	11%	2%	3%	16%
10	5%	2%	0%	0%	0%	4%	1%	1%	7%
11	2%	2%	1%	0%	0%	3%	0%	0%	6%
12	2%	3%	2%		1%	2%	0%	0%	2%
13	1%	1%	1%		0%	1%	0%	0%	1%
14	0%	1%	1%		0%	0%	0%	0%	
15+	0%	0%	0%			0%	0%	0%	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0	0%	0%		1%			1%	2%	13%
1	3%	0%	0%	8%	0%	0%	13%	30%	49%
2	34%	2%	4%	5%	4%	7%	17%	14%	17%
3	21%	14%	28%	48%	25%	46%	16%	11%	10%
4	3%	4%	4%	5%	3%	5%	2%	5%	5%
5	3%	16%	13%	11%	15%	8%	22%	6%	2%
6	4%	9%	10%	6%	7%	10%	7%	8%	1%
7	4%	14%	9%	6%	7%	6%	10%	4%	1%
8	5%	16%	13%	5%	14%	9%	1%	10%	0%
9	10%	9%	8%	3%	11%	4%	6%	6%	1%
10	2%	7%	6%	1%	5%	3%	0%	3%	0%
11	4%	4%	3%	1%	4%	2%	3%	1%	0%
12	4%	3%	2%	0%	1%	0%	1%	0%	0%
13	2%	1%	1%	0%	1%	0%			0%
14	1%	0%	0%	0%	1%	0%			
15+	2%	0%	0%	0%	0%	0%			

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarters 1-4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	0%	0%			17%	5%	0%	0%
1	49%	35%	43%	24%	45%	23%	1%	6%
2	7%	1%	1%	1%	5%	5%	3%	0%
3	8%	5%	9%	7%	14%	17%	8%	3%
4	1%	2%	2%	2%	2%	3%	5%	2%
5	11%	12%	10%	15%	7%	15%	22%	21%
6	5%	8%	7%	5%	2%	7%	13%	13%
7	7%	7%	5%	6%	3%	9%	17%	20%
8	4%	11%	9%	14%	2%	8%	14%	16%
9	5%	9%	7%	12%	1%	5%	9%	11%
10	1%	4%	3%	5%	0%	2%	4%	4%
11	2%	3%	2%	4%	0%	1%	2%	2%
12	1%	1%	0%	2%	0%	0%	1%	1%
13	0%	0%	0%	2%	0%	0%	0%	0%
14	0%	0%	0%	1%	0%	0%	0%	0%
15+	0%	0%	0%					

Age	8.d	9.a	9.a.N	14.b	All
0		6%	6%		0%
1	25%	8%	39%		2%
2	9%	16%	37%	0%	6%
3	40%	34%	6%	12%	17%
4	5%	13%	3%	26%	5%
5	15%	12%	3%	21%	14%
6	3%	5%	2%	20%	11%
7	1%	3%	2%	6%	11%
8	1%	1%	1%	11%	13%
9	1%	1%	1%	0%	10%
10	0%	1%	0%	0%	5%
11	0%	0%	0%	3%	3%
12	0%		0%		2%
13			0%		1%
14			0%		0%
15+					0%

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 1

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0									
1	1%	1%				1%	1%	1%	
2	6%	3%				3%	1%	3%	
3	16%	9%		20%	11%	9%	12%	9%	
4	2%	4%			6%	6%	5%	5%	
5	12%	12%		20%	17%	18%	18%	19%	
6	10%	7%		20%	11%	15%	14%	14%	
7	8%	4%		20%	17%	15%	17%	10%	
8	16%	21%		20%	11%	13%	10%	16%	
9	16%	19%			6%	7%	6%	7%	
10	6%	6%				3%	1%	4%	
11	4%	5%			6%	3%	3%	5%	
12	2%	4%			11%	4%	8%	4%	
13	1%	3%			6%	2%	3%	1%	
14	0%	1%				1%	2%	0%	
15+	0%	1%				0%	1%	1%	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				3%			1%	3%	5%
1	0%	0%	0%	27%	0%	0%	13%	31%	49%
2	2%	2%	7%	13%	3%	8%	16%	15%	23%
3	37%	14%	47%	10%	23%	51%	16%	12%	14%
4	0%	4%	5%	6%	3%	5%	2%	6%	7%
5	14%	17%	8%	9%	16%	6%	22%	6%	1%
6	9%	9%	9%	5%	7%	10%	7%	6%	0%
7	3%	14%	6%	6%	7%	6%	10%	4%	0%
8	3%	16%	8%	8%	15%	8%	2%	7%	0%
9	14%	9%	4%	6%	12%	3%	6%	5%	1%
10	3%	7%	3%	4%	5%	3%	0%	2%	0%
11	1%	4%	2%	2%	4%	2%	3%	1%	0%
12	6%	3%	0%	1%	2%	0%	1%	0%	0%
13	6%	1%	0%	1%	1%	0%			0%
14	0%	0%	0%	0%	1%	0%			
15+	2%	0%	0%	0%	0%	0%			

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 1

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					0%			
1	76%	36%	59%	1%	64%	28%	1%	0%
2	2%	1%	1%	1%	4%	6%	1%	0%
3	3%	5%	8%	10%	11%	23%	5%	3%
4	1%	2%	1%	2%	1%	3%	5%	3%
5	4%	12%	7%	19%	7%	16%	22%	22%
6	3%	8%	3%	7%	3%	6%	13%	14%
7	4%	7%	3%	8%	4%	7%	18%	21%
8	3%	11%	7%	19%	3%	6%	16%	17%

9	2%	9%	5%	16%	2%	4%	10%	12%
10	1%	4%	2%	7%	1%	1%	4%	4%
11	0%	3%	2%	6%	0%	1%	3%	2%
12	0%	1%	1%	2%	0%	0%	1%	1%
13	0%	0%	1%	2%	0%	0%	0%	0%
14	0%	0%	0%	1%	0%	0%	0%	0%
15+		0%	0%	0%	0%	0%	0%	0%

Age	8.d	9.a	9.a.N	14.b	All
0					0%
1	27%	0%	65%		4%
2	9%	10%	29%		2%
3	39%	45%	2%		13%
4	4%	18%	0%		4%
5	15%	20%	1%		17%
6	3%	3%	0%		10%
7	1%	2%	1%		13%
8	1%	1%	0%		14%
9	1%	0%	0%		9%
10	0%	0%	0%		5%
11	0%		0%		3%
12	0%		0%		3%
13			0%		1%
14			0%		0%
15+					0%

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 2

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0									
1	0%	1%	1%			1%	0%	0%	
2	0%	4%	7%	10%	4%	4%	5%	1%	
3	10%	15%	19%	13%	32%	13%	31%	47%	
4	2%	5%	9%	15%	21%	5%	21%	26%	
5	9%	15%	15%	23%	11%	12%	11%	1%	
6	11%	12%	9%	22%	18%	9%	19%	17%	
7	18%	12%	11%	12%	7%	7%	7%	1%	
8	12%	11%	8%	4%	4%	17%	3%	1%	
9	18%	9%	5%		4%	15%	2%	3%	
10	11%	2%	1%			5%	1%	1%	
11	4%	3%	3%			4%	0%	1%	
12	4%	6%	7%			3%	0%	0%	
13	0%	2%	3%			2%	0%		
14	0%	1%	2%			1%	0%		
15+	0%	1%	1%			0%	0%		

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				0%			1%	2%	5%
1	0%	0%	0.0	3%	0%	0%	13%	22%	48%
2	2%	0%	0.0	3%	7%	4%	17%	10%	23%
3	25%	20%	0.0	63%	47%	27%	16%	13%	14%
4	1%	7%	0.0	5%	4%	4%	2%	5%	7%
5	12%	12%	0.2	11%	8%	13%	22%	5%	1%
6	11%	24%	0.1	3%	9%	9%	7%	9%	0%
7	9%	10%	0.1	5%	6%	7%	10%	5%	0%
8	8%	18%	0.2	3%	8%	15%	1%	17%	0%
9	14%	7%	0.1	2%	4%	10%	6%	7%	1%
10	5%	1%	0.1	1%	3%	5%	0%	4%	0%
11	3%	1%	0.0	1%	2%	3%	3%	0%	0%
12	5%	0%	0.0	0%	0%	1%	1%		
13	4%	0%	0.0	0%	0%	1%			
14		0%	0.0		0%	1%			
15+	2%	0%	0.0		0%	0%			

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 2

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0		2%			72%			
1	0%	20%	0%	1%	1%	17%	1%	26%
2	0%	10%	1%	0%	5%	1%	4%	0%
3	6%	11%	13%	4%	13%	6%	10%	2%
4	3%	5%	4%	1%	2%	2%	6%	2%
5	19%	10%	16%	22%	5%	17%	22%	17%
6	12%	10%	17%	6%	1%	10%	13%	10%
7	10%	7%	11%	8%	1%	16%	16%	15%
8	19%	10%	17%	19%	1%	14%	13%	12%
9	16%	8%	13%	18%	0%	9%	8%	9%
10	7%	4%	6%	7%	0%	4%	3%	3%
11	5%	2%	3%	6%	0%	2%	2%	2%
12	1%		0%	3%	0%	1%	1%	1%
13	1%		0%	3%	0%	1%	0%	0%
14	1%		0%	1%	0%	0%	0%	0%
15+	0%		0%					

Age	8.d	9.a	9.a.N	14.b	All
0					3%
1	2%	0%	22%		4%
2	12%	13%	26%		3%
3	52%	35%	10%		15%
4	6%	14%	5%		6%
5	20%	11%	13%		13%
6	4%	9%	5%		12%
7	2%	7%	6%		13%
8	2%	3%	6%		11%
9	1%	3%	4%		10%
10		4%	2%		5%
11		1%	1%		2%
12			1%		2%
13			0%		0%
14					0%
15+					0%

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 3

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0						0%			
1	0%	0%				1%	1%	1%	0%
2	8%	18%	21%	21%	20%	8%	18%	19%	1%
3	23%	25%	26%	26%	30%	19%	31%	43%	2%
4	8%	18%	21%	21%	17%	3%	12%	2%	3%
5	12%	16%	17%	17%	19%	13%	19%	24%	10%
6	11%	11%	11%	12%	9%	9%	8%	1%	15%
7	8%	3%	2%	2%	2%	7%	4%	2%	21%
8	11%	3%	1%	1%	2%	14%	4%	5%	17%
9	8%	3%			1%	14%	2%	3%	16%
10	5%	1%				5%	0%		7%
11	2%	1%				4%	0%		6%
12	2%	0%				2%	0%		2%
13	1%	0%				1%	0%	0%	1%
14	0%	0%				0%	0%	0%	
15+	0%	0%				1%	0%	1%	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				2%			1%	4%	5%
1	3%	0%		16%	0%	0%	13%	38%	48%
2	32%	1%	1%	7%	7%	5%	17%	18%	23%
3	22%	9%	5%	10%	45%	38%	16%	12%	14%
4	3%	6%	4%	7%	5%	5%	2%	6%	7%
5	4%	26%	18%	11%	8%	10%	22%	5%	1%
6	4%	19%	11%	19%	10%	12%	7%	4%	0%
7	3%	11%	14%	7%	6%	8%	10%	3%	0%
8	5%	14%	19%	14%	9%	11%	1%	2%	0%
9	10%	11%	11%	7%	5%	6%	6%	4%	1%
10	2%	1%	9%	0%	3%	4%	0%	1%	0%
11	4%	3%	4%	1%	2%	2%	3%	1%	0%
12	4%	0%	3%		0%	0%	1%		
13	2%	0%	1%		0%				
14	1%	0%	0%		0%				
15+	2%	0%	0%		0%				

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 3

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					1%	63%	1%	64%
1			2%	95%	2%	0%	0%	0%
2			0%	2%	12%	0%	21%	1%
3	8%	8%	5%	3%	52%	2%	38%	16%
4	4%	4%	4%		6%	1%	19%	5%
5	18%	17%	25%		20%	6%	8%	7%
6	18%	18%	19%		4%	4%	7%	0%
7	12%	12%	15%		2%	8%	2%	1%
8	17%	17%	5%		2%	7%	1%	1%
9	14%	14%	15%		1%	5%	4%	4%
10	6%	6%	4%		0%	2%	0%	
11	4%	4%	7%		0%	1%	0%	
12					0%	1%	0%	
13						0%		
14						0%		
15+								

Age	8.d	9.a	9.a.N	14.b	All
0		20%	26%		0%
1	2%	2%	19%		1%
2	12%	23%	37%	0%	7%
3	53%	29%	11%	12%	19%
4	7%	12%	5%	26%	7%
5	20%	7%	1%	21%	12%
6	3%	6%	1%	20%	11%
7	2%	1%	0%	6%	10%
8	2%	1%	0%	11%	12%
9		0%	0%	0%	9%
10				0%	5%
11				3%	3%
12					2%
13					1%
14					0%
15+					0%

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	32%					0%			
1	1%	0%	0%	0%	0%	1%	1%	1%	
2	16%	9%	9%	9%	9%	7%	13%	18%	
3	10%	12%	12%	11%	12%	17%	27%	42%	
4	3%	16%	17%	16%	16%	4%	8%	2%	
5	4%	24%	24%	24%	25%	15%	23%	24%	
6	3%	18%	19%	19%	19%	10%	10%	1%	
7	3%	11%	11%	11%	12%	10%	7%	3%	
8	6%	5%	4%	5%	4%	14%	6%	5%	
9	5%	3%	2%	2%	2%	12%	4%	3%	
10	4%	1%	1%	1%	1%	4%	1%	0%	
11	3%	1%	0%	1%		4%	0%	0%	
12	1%	0%				2%	0%	0%	
13	3%	0%				1%	0%	0%	
14	1%	0%				0%	0%	0%	
15+	2%	0%				0%	0%	1%	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		0%		16%			1%	1%	24%
1	4%	0%	0%	58%	1%		13%	38%	51%
2	42%	2%	1%	16%	0%		17%	17%	9%
3	18%	21%	4%	4%	4%	3%	16%	7%	3%
4	4%	5%	4%	2%	2%	3%	2%	3%	2%
5	1%	17%	18%	2%	22%	28%	22%	6%	5%
6	2%	14%	11%	2%	6%	22%	7%	8%	1%
7	3%	12%	13%	0%	9%	16%	10%	4%	2%
8	5%	14%	19%		20%	0%	1%	6%	1%
9	8%	9%	11%		18%	16%	6%	5%	1%
10	1%	3%	9%		7%	3%	0%	2%	0%
11	4%	3%	5%		6%	9%	3%	2%	0%
12	4%	1%	3%		3%		1%	0%	0%
13	1%	0%	1%		2%				
14	1%	0%	0%		1%				
15+	2%	0%	0%		0%				

Table 8.4.3.2. NE Atlantic Mackerel. Percentage catch numbers-at-age by area for 2019. Zeros represent values <1% (cont.).

Quarter 4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	1%				29%	76%	0%	
1	12%				2%	2%		0%
2	15%				11%	17%	32%	13%
3	16%	8%	17%	50%	36%	1%	28%	44%
4	2%	4%	0%	0%	4%	0%	15%	15%
5	22%	18%	17%	0%	14%	1%	6%	17%
6	8%	18%	17%	25%	2%	0%	5%	0%
7	10%	12%	17%	0%	1%	1%	2%	2%
8	3%	16%	17%	25%	1%	1%	1%	2%
9	7%	14%	17%		1%	0%	3%	8%
10	1%	6%			0%	0%		
11	3%	4%			0%	0%		
12	1%				0%	0%		
13						0%		
14						0%		
15+								

Age	8.d	9.a	9.a.N	14.a	14.b	All
0		14%	0%		0%	
1		42%	37%		2%	
2		24%	59%		9%	
3		13%	3%		17%	
4		4%	1%		4%	
5		2%	0%		14%	
6		1%	0%		10%	
7		0%	0%		9%	
8		0%	0%		13%	
9		0%			11%	
10					4%	
11					4%	
12					2%	
13					1%	
14					0%	
15+					0%	

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019.

Quarters 1-4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	187					190	190	190	
1	280	277	256	305	283	280	243	264	
2	310	324	321	325	320	310	315	291	300
3	321	340	343	347	333	325	297	290	341
4	333	357	358	357	354	347	330	315	359
5	352	364	369	371	366	354	362	343	360
6	362	372	378	379	375	363	360	340	367
7	365	372	379	384	379	370	379	358	368
8	369	374	375	384	378	372	376	362	371
9	371	375	374	390	373	377	358	351	373
10	374	384	393	412	399	385	375	374	381
11	382	382	378	405	388	387	371	365	385
12	388	387	386	386	386	389	386	385	389
13	392	393	393	393	386	393	378	356	399
14	389	390	388	401	389	396	388	376	
15+	395	391	385	385	384	394	383	383	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		190		218			254	217	216
1	295	215	202	259	223	223	290	260	259
2	304	296	291	291	292	292	326	289	291
3	319	317	315	315	315	316	343	319	327
4	344	348	340	340	337	334	360	341	340
5	348	352	352	351	354	353	367	358	349
6	359	365	370	362	371	374	370	362	368
7	368	370	369	374	368	374	378	389	378
8	374	373	373	367	372	374	374	371	359
9	367	377	376	382	373	387	406	387	383
10	381	387	384	393	380	386	379	379	362
11	384	387	387	392	387	387	414	372	402
12	387	394	393	395	386	386	395	395	395
13	391	390	394	395	391	391		392	395
14	391	404	398	398	396	396		399	409
15+	407	410	402	406	397	397		397	

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarters 1-4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	254	220			184	191	177	177
1	204	197	187	187	197	195	232	177
2	319	291	293	292	296	299	293	315
3	336	324	320	320	322	324	323	337
4	356	356	350	346	335	340	343	349
5	363	358	357	354	344	349	354	354
6	368	366	367	366	358	362	367	366
7	376	380	380	368	369	371	372	372
8	372	371	372	371	370	371	375	373
9	392	381	380	373	374	377	381	379
10	381	378	378	378	384	387	390	389
11	400	379	380	387	390	393	393	393
12	393	387	386	386	389	399	402	399
13	393	391	391	391	396	404	396	401
14	398	396	396	396	409	428	409	416
15+	397	397	397	397				

Age	8.d	9.a	9.a.N	14.b	All
0		256	198		192
1	190	297	236		227
2	303	307	276	295	307
3	322	334	328	355	322
4	333	364	339	375	341
5	339	373	348	373	354
6	343	378	366	380	364
7	355	382	374	390	369
8	354	382	376	395	372
9	349	391	384	425	375
10	357	398	396	435	381
11	365	405	394	425	386
12	365		410		390
13			405		392
14			409		396
15+					398

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 1

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0									
1	296	278		245	245	232	245	210	
2	316	303		265	265	283	266	306	
3	330	319		316	316	316	316	321	
4	341	332		349	349	346	348	347	
5	350	342		351	351	351	351	351	
6	358	351		361	361	363	362	360	
7	365	359		367	367	369	368	364	
8	371	364		374	374	371	376	372	
9	376	369		372	372	371	372	369	
10	382	374		390	390	382	390	382	
11	386	379		377	377	380	377	375	
12	390	384		386	386	386	386	378	
13	395	388		393	393	393	393	398	
14	397	391		388	388	391	388	410	
15+	401	347		385	385	382	385	397	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				220			254	220	220
1		214	203	259	223	223	290	260	258
2	271	295	292	289	292	292	326	290	290
3	310	317	314	324	315	315	343	325	325
4		348	332	345	337	331	360	344	339
5	344	352	352	351	354	352	367	357	302
6	357	365	375	365	371	376	370	364	361
7	362	370	370	369	368	372	378	388	381
8	361	373	374	372	372	375	373	371	371
9	367	377	382	374	373	388	406	386	373
10	383	387	386	383	379	388	380	378	362
11	383	387	389	386	387	390	415	373	383
12	380	394	393	395	386	386	395	395	389
13	384	390	394	396	391	391		395	395
14		404	398	398	396	396		409	409
15+	387	410	404	406	397	397			

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 1

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					254			
1	196	196	187	223	196	196	232	
2	292	292	293	291	297	302	294	315
3	317	324	318	318	321	323	328	336
4	346	357	342	345	337	338	346	349
5	355	358	353	354	347	346	354	354
6	366	366	366	366	361	360	367	366
7	371	379	370	368	370	369	373	372
8	372	371	372	372	371	369	376	373
9	378	380	374	373	376	374	382	379
10	386	378	379	378	385	384	391	388
11	390	379	387	387	390	391	395	393
12	389	387	386	386	389	397	404	398
13	395	391	391	391	395	402	400	401
14	409	396	396	396	409	409	410	414
15+		397	397	397				

Age	8.d	9.a	9.a.N	14.b	All
0					229
1	190		227		201
2	303	316	269		291
3	322	332	304		317
4	333	368	329		346
5	339	374	348		352
6	343	375	367		364
7	355	393	375		370
8	354	396	376		372
9	349	400	385		375
10	357	400	395		385
11	365		391		386
12	365		415		390
13			403		391
14			407		396
15+					395

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 2

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0									
1	296	267	245		245	277	257	210	
2	298	315	296	326	309	301	318	256	
3	310	325	327	335	290	315	291	279	
4	326	351	353	353	324	333	327	313	
5	341	353	359	365	363	347	364	355	
6	352	362	370	375	355	353	359	339	
7	358	367	374	383	377	364	380	358	
8	362	373	372	387	373	367	377	355	
9	367	374	372		359	372	356	353	
10	365	384	390		377	378	374	374	
11	377	381	377		372	382	368	363	
12	385	386	386		386	387	386	385	
13	395	393	393		393	391	392	405	
14	391	389	388		388	394	392		
15+	401	390	385		385	367	373		

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		190		220			254	220	220
1		197	203	260	223	223	290	260	260
2	278	295	276	293	292	292	326	290	290
3	311	316	320	314	314	316	343	322	325
4	359	352	355	338	331	340	360	346	339
5	349	361	353	350	352	354	367	353	307
6	361	366	364	366	376	370	370	358	363
7	366	376	368	377	370	372	378	390	384
8	369	367	372	379	374	373	374	371	371
9	369	389	373	387	380	377	406	387	374
10	382	389	382	402	385	381	378	380	364
11	384	361	386	414	389	387	414	372	381
12	381	396	391	395	386	386	395	396	
13	385	395	393	395	391	391		399	
14		403	397	398	396	396		460	
15+									

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 2

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0		220			183			
1	223	260	223	223	242	189	232	177
2	285	290	292	290	291	311	291	315
3	327	326	321	323	322	332	319	337
4	358	348	356	350	333	348	340	348
5	358	360	361	354	339	354	353	353
6	366	366	367	364	346	366	367	366
7	380	389	387	367	360	372	372	372
8	371	371	372	371	359	373	373	373
9	379	387	387	372	359	379	379	380
10	377	377	378	378	378	389	388	390
11	380	370	372	387	394	394	391	395
12	386		386	386	399	401	399	400
13	391		391	391	407	405	389	401
14	396		396	396	409	434	408	421
15+	397		397	397				

Age	8.d	9.a	9.a.N	14.b	All
0					185
1	269	250	231		224
2	303	305	268		297
3	322	332	323		311
4	333	355	334		334
5	339	371	347		352
6	343	379	365		361
7	355	379	373		367
8	354	379	376		368
9	349	390	383		373
10	357	397	396		372
11	365	405	395		381
12	365		409		387
13			405		391
14			409		397
15+					383

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 3

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0						190			
1	280	296			265	295	237	265	
2	310	325	326	326	320	312	312	294	300
3	322	348	350	350	340	328	329	314	341
4	333	359	359	359	359	348	358	357	359
5	353	372	375	375	367	351	357	342	360
6	362	380	383	383	383	360	378	367	367
7	366	381	390	390	384	365	372	355	368
8	369	373	380	380	372	371	371	364	371
9	372	376			346	376	363	346	373
10	375	382				382	383		381
11	383	386				386	386		385
12	388	391				391	391		389
13	392	395			355	393	367	355	399
14	388	398			375	398	381	375	
15+	395	401			383	399	385	383	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				220			254	220	220
1	295	199	193	260	223	223	290	260	260
2	296	324	280	290	292	292	326	290	290
3	320	289	316	317	316	319	343	326	325
4	344	311	350	340	335	341	360	342	339
5	352	322	349	357	353	354	367	359	309
6	358	339	361	359	374	372	371	370	365
7	367	340	367	369	374	377	377	387	384
8	372	328	371	356	374	374	375	371	360
9	367	337	372	379	385	387	406	385	374
10	380	384	386	360	385	384	375	375	362
11	384	330	384	327	387	384	414	372	380
12	387	395	396		386	386	395	395	
13	395	395	394		391	391		391	
14	391	400	403		396	396		396	
15+	407	407	409		397	397		397	

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 3

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					172	172	177	177
1			187	187	264	245	296	
2			295	295	303	338	309	331
3	327	325	331	321	322	347	343	360
4	360	360	364	325	333	355	355	360
5	362	363	367	326	339	360	373	376
6	367	366	373	328	343	369	380	
7	389	389	388		355	376	379	385
8	371	371	371		354	376	368	375
9	388	388	388	335	349	384	398	404
10	377	378	376		357	391	455	
11	370	370	370		367	396		
12			386		366	404	455	
13			391		395	408		
14			396		409	409		
15+			397					

Age	8.d	9.a	9.a.N	14.b	All
0		248	198		205
1	269	325	256		277
2	303	317	287	295	310
3	322	340	339	355	323
4	333	368	345	375	337
5	339	378	365	373	354
6	343	381	380	380	363
7	355	385	378	390	367
8	354	370	360	395	370
9	349	380	395	425	373
10	357			435	376
11	365			425	384
12	365				389
13					393
14					391
15+					396

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	187					190	190	190	
1	235	306	308	307	307	297	260	266	
2	311	323	324	324	324	314	302	294	
3	323	336	337	336	336	326	318	313	
4	335	357	357	356	356	347	356	355	
5	347	367	368	368	368	356	353	342	
6	356	373	374	373	373	364	372	367	
7	363	381	382	381	381	371	374	360	
8	371	382	385	385	385	373	373	365	
9	374	386	391	391	391	379	370	349	
10	386	399	413	412	412	387	394	400	
11	378	398	408	408	408	389	396	398	
12	388	392				393	392	400	
13	390	394				394	367	355	
14	395	403	410	410	410	400	386	376	
15+	395	400				399	385	383	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		190		203			254	195	215
1	295	269	196	258	223		290	260	258
2	305	306	275	285	289		326	287	296
3	323	315	321	311	325	335	343	303	341
4	344	336	357	322	350	365	361	328	343
5	355	352	353	354	354	368	367	362	357
6	359	357	365	360	364	375	371	365	370
7	369	367	368	374	367	388	378	387	377
8	376	358	372	358	371		375	370	358
9	367	375	374	382	372	388	406	388	395
10	380	387	384	360	377	375	375	377	361
11	384	378	386	383	387	370	413	372	409
12	390	388	395		386		395	395	395
13	398	392	396		391				
14	391	401	398		396				
15+	413	397	406		397				

Table 8.5.1.1. NE Atlantic Mackerel. Mean length (mm) -at-age by area for 2019 (cont.).

Quarter 4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	254				193	195	231	
1	290				260	245	251	
2	326			292	296	285	294	315
3	342	327	327	319	322	342	345	352
4	360	360	360	342	333	349	355	356
5	367	362	361	355	339	358	372	371
6	370	367	366	373	343	369	379	
7	379	389	389	378	355	379	380	385
8	372	371	371	374	354	375	366	375
9	403	388	388	388	349	385	396	398
10	378	377	378	384	357	391		
11	409	370	370	385	365	396		
12	395				365	404		
13						408		
14						409		
15+								

Age	8.d	9.a	9.a.N	14.b	All
0		267	206		197
1		297	256		284
2		294	279		310
3		343	332		326
4		369	340		347
5		372	357		356
6		372	374		364
7			373		371
8			358		373
9			393		378
10		410			387
11					389
12					393
13					394
14					398
15+					402

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1%. Handline Fleet. UKE=UK England and Wales.

	UKE lines							
	7.e				7.f			
Length cm	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
15								
16								
17					0%			
18					0%			0%
19					0%			0%
20					0%		0%	3%
21					4%		0%	4%
22	1%	0%	0%	1%	10%	0%	1%	7%
23	2%	2%	1%	3%	6%	1%	3%	9%
24	0%	5%	2%	2%	3%	1%	1%	6%
25	0%	8%	8%	3%	1%	3%	2%	5%
26	0%	15%	20%	2%	0%	5%	16%	20%
27	1%	9%	27%	3%	2%	7%	17%	21%
28	7%	6%	14%	3%	7%	10%	8%	11%
29	15%	5%	10%	13%	13%	13%	6%	5%
30	31%	5%	6%	20%	22%	17%	7%	3%
31	16%	6%	4%	14%	19%	16%	13%	3%
32	12%	6%	3%	9%	6%	8%	12%	2%
33	6%	5%	1%	6%	3%	6%	7%	1%
34	3%	8%	1%	6%	1%	3%	2%	0%
35	2%	4%	1%	6%	1%	5%	2%	0%
36	1%	5%	0%	4%	0%	2%	1%	0%
37	1%	4%	0%	3%	0%	1%	1%	0%
38	1%	3%	0%	1%	0	1%	0%	0%
39	0%	1%	0%	1%	0%	1%	0%	
40		0%	0%	0%			0%	

	UKE lines							
	7.e				7.f			
Length cm	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
41		0%	0	0%		0%		
42		0%						

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Southern Fleets. ES=Spain.

	ES All fleets			
length cm	Q1	Q2	Q3	Q4
16				
17			0%	
18			0%	
19			0%	
20			0%	
21			0%	
22	0%		0%	
23	1%	0%	0%	
24	1%	1%	2%	5%
25	1%	1%	8%	20%
26	1%	1%	11%	27%
27	1%	1%	8%	9%
28	0%	1%	9%	11%
29	1%	2%	12%	8%
30	1%	3%	7%	3%
31	2%	5%	4%	2%
32	2%	5%	5%	3%
33	4%	4%	8%	2%
34	10%	9%	9%	2%
35	16%	15%	6%	2%
36	17%	18%	4%	1%
37	16%	16%	3%	2%

	ES All fleets			
length cm	Q1	Q2	Q3	Q4
38	12%	9%	2%	1%
39	9%	5%	1%	0%
40	4%	2%	0%	0%
41	1%	1%	0%	0%
42	1%	0%	0%	0%
43	0%	0%	0%	0%
44	0%	0%		

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Southern Fleets (cont.). BQ=Basque

	BQ Purse Seine				BQ Artisanal		BQ Trawl		
length cm	Q1	Q2	Q3	Q4	Q1	Q2	Q1	Q2	Q4
14		2%	2%						
15		7%	8%						
16		11%	13%						
17		11%	12%						
18		11%	13%						
19		7%	8%						
20		4%	4%	0%					
21		1%	2%	0%					
22		1%	1%						
23				1%					
24				1%					2%
25				3%					15%
26				11%			0%		22%
27				15%			0%		20%
28	0%			12%			1%		18%
29	0%		0%	6%			1%		11%
30	0%	0%	0%	3%	0%	0%	1%		7%

	BQ Purse Seine				BQ Artisanal		BQ Trawl		
length cm	Q1	Q2	Q3	Q4	Q1	Q2	Q1	Q2	Q4
31	0%	0%	0%	3%	0%	0%	4%		3%
32	1%	1%	1%	6%	1%	1%	10%		1%
33	4%	2%	2%	7%	3%	4%	12%	1%	
34	10%	5%	4%	10%	8%	11%	15%	4%	
35	18%	8%	5%	7%	16%	17%	12%	14%	
36	23%	9%	8%	6%	24%	24%	20%	16%	0%
37	21%	9%	7%	4%	22%	22%	10%	26%	0%
38	13%	5%	3%	2%	14%	11%	9%	15%	0%
39	7%	3%	2%	1%	7%	6%	3%	13%	0%
40	2%	1%	1%	1%	3%	2%	0%	8%	0%
41	1%	2%	1%	0%	1%	1%	1%	1%	0%
42	0%	0%	0%		1%	0%		1%	
43	0%	0%	0%		0%	0%		0%	
44		0%	0%		0%		0%		
45					0%	0%			

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Southern Fleets (cont.). PT=Portugal.

	PT All			
length cm	**Q1**	**Q2**	**Q3**	**Q4**
20				
21				
22			3%	1%
23				
24		0%	2%	0%
25		0%	10%	3%
26	0%	0%	3%	3%
27	0%	0%	0%	5%
28	0%	0%	5%	17%

	PT All			
length cm	**Q1**	**Q2**	**Q3**	**Q4**
29	2%	3%	5%	22%
30	4%	6%	2%	14%
31	6%	11%	5%	5%
32	13%	8%	0%	3%
33	10%	6%	19%	7%
34	11%	3%	7%	3%
35	2%	5%	9%	7%
36	5%	9%	2%	1%
37	28%	20%	16%	6%
38	7%	14%	8%	2%
39	6%	9%	2%	1%
40	3%	4%	2%	1%
41	1%	1%	0%	0%
42	0%			
43	0%			
44			0%	

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Pelagic Trawl Fleets. IE=Ireland, UKS=UK Scotland, IS=Iceland

	IE			**UKS**			**IS**
	6.a	7.b	4.a	4.a	6.a	2.a	5.a
Length cm	Q1	Q1	Q1	Q4	Q1	Q3	Q3
15							
16							
17	0%						
18	0%		0%	0%			
19	0%	0%	0%	0%			
20		0%	0%	0%			
21	0%	0%	0%	0%			
22		0%	0%	0%			

	IE			UKS			IS
	6.a	7.b	4.a	4.a	6.a	2.a	5.a
Length cm	Q1	Q1	Q1	Q4	Q1	Q3	Q3
23	0%	0%	0%	0%			
24	0%	0%	0%	0%			
25	0%		1%	0%			
26	0%		1%	0%	0%	0%	
27	0%	0%	1%	0%	0%	0%	
28	0%	0%	1%	0%	0%	0%	0%
29	0%		2%	0%	1%	1%	1%
30	1%	0%	4%	1%	1%	2%	0%
31	1%	0%	3%	2%	1%	4%	0%
32	1%	1%	3%	5%	2%	6%	0%
33	3%	2%	5%	5%	3%	5%	0%
34	7%	8%	11%	6%	5%	5%	3%
35	16%	17%	18%	12%	13%	11%	8%
36	26%	27%	20%	20%	18%	20%	26%
37	21%	22%	14%	21%	22%	21%	29%
38	13%	12%	7%	14%	17%	15%	19%
39	7%	6%	5%	8%	10%	7%	9%
40	3%	2%	2%	3%	4%	2%	4%
41	1%	1%	1%	1%	2%	1%	1%
42	0%	0%	0%	0%	1%	0%	0%
43	0%	0%	0%	0%		0%	0%
44	0%						0%

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Pelagic Trawl Fleets. DK=Denmark, RU=Russia

		DK			RU
	4.a	4.a	4.a	2.a	2.a
length cm	Q1	Q3	Q4	Q3	Q4
23					
24					0%
25					0%
26				0%	0%
27				0%	0%
28				1%	1%
29				1%	2%
30	0%	1%	2%	1%	5%
31	0%	2%	2%	2%	8%
32	1%	6%	4%	2%	10%
33	2%	10%	6%	4%	9%
34	7%	10%	6%	8%	9%
35	18%	14%	9%	19%	12%
36	22%	21%	20%	28%	17%
37	25%	15%	23%	21%	14%
38	13%	11%	17%	9%	8%
39	6%	8%	8%	3%	3%
40	4%	0%	3%	1%	1%
41	1%	1%	1%	0%	0%
42	0%	0%	0%	0%	0%
43	0%	0%	0%	0%	0%
44					0%
45					0%

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Freezer Trawlers. DE=Germany,

		DE		
length cm	6.a	4.a	4.a	4.a
	Q1	Q1	Q2	Q3
16				
17				
18				
19				
20		0%		
21	0%	0%		
22	0%	0%		
23	0%	0%	0%	
24	0%	0%	1%	
25	0%	0%	6%	
26	0%	0%	10%	0%
27	0%	1%	11%	1%
28	0%	1%	6%	5%
29	1%	1%	5%	8%
30	2%	2%	7%	9%
31	2%	3%	12%	15%
32	3%	3%	8%	16%
33	3%	3%	10%	9%
34	7%	6%	9%	15%
35	14%	14%	8%	11%
36	22%	20%	2%	5%
37	21%	20%	1%	4%
38	12%	14%	1%	1%
39	7%	8%	1%	1%
40	3%	3%	0%	0%
41	1%	1%	0%	

		DE		
length cm	6.a	4.a	4.a	4.a
	Q1	Q1	Q2	Q3
42	0%	0%		
43	0%	0%		
44				
45		0%		

Table 8.5.1.2. NE Atlantic Mackerel. Percentage length composition in catches by country and fleet in 2019. Zeros represent values <1% (cont.). Freezer Trawlers. NL=The Netherlands.

		NL					
	4.a	6.a	6.a	6.a	7.b	7.j	7.j
length cm	Q1	Q1	Q2	Q3	Q1	Q2	Q3
24	0%						
25	0%			4%			
26	1%						
27	1%			4%	2%		
28	1%	0%		4%	2%		
29	1%	5%		4%	3%		
30	2%	17%	2%	16%	18%		
31	3%	30%	2%	20%	25%	8%	
32	3%	14%	2%	20%	8%	4%	
33	4%	8%	0%	24%	4%		8%
34	9%	4%	0%	4%	5%	8%	12%
35	18%	5%	6%		6%	12%	4%
36	22%	5%	24%		7%	24%	20%
37	15%	5%	28%		9%	12%	8%
38	9%	2%	18%		6%	24%	16%
39	4%	3%	10%		2%	8%	20%
40	2%	1%	6%		2%		12%
41	1%	1%	0%		2%		
42		0%	2%				

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019.

Quarters 1-4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	47					46	46	46	
1	193	175	121	234	193	191	124	176	
2	288	314	307	322	306	262	294	226	280
3	327	372	385	404	352	299	229	208	373
4	362	428	429	430	419	364	317	261	436
5	429	444	471	482	459	390	435	354	442
6	462	455	483	487	476	424	409	334	463
7	478	457	511	543	509	443	509	403	465
8	495	457	459	511	481	457	459	405	479
9	500	469	432	541	460	481	392	370	485
10	518	509	514	628	559	511	448	439	511
11	553	488	447	629	515	517	439	414	526
12	577	492	478	478	478	519	493	485	541
13	602	525	511	511	487	540	476	391	582
14	568	504	490	591	500	546	503	451	
15+	613	530	472.7	473	473	565	489	474	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		46		80			118	78	86
1	192	71	52	146	69	69	184	149	147
2	212	194	163	222	163	164	284	231	237
3	247	234	228	219	229	230	338	249	275
4	322	325	302	293	290	285	407	309	304
5	322	340	331	321	332	326	431	354	331
6	372	378	398	350	399	410	440	342	427
7	407	406	384	405	379	391	474	449	473
8	430	412	398	366	392	388	446	374	376
9	406	431	410	422	399	426	610	428	477
10	454	472	432	500	413	394	368	364	389
11	469	471	449	472	448	426	671	431	596
12	473	504	483	493	453	453	567	567	566
13	494	491	487	488	470	470		468	435
14	490	544	503	506	488	488		496	474
15+	569	580	519	537	494	494		494	

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarters 1-4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	118	81			48	54	43	43
1	82	73	62	62	73	71	98	55
2	266	205	180	174	206	212	186	241
3	310	256	237	235	255	260	247	287
4	364	340	327	312	284	294	294	315
5	398	348	349	334	303	315	318	326
6	396	363	373	374	336	348	355	356
7	431	412	417	381	363	368	370	372
8	381	380	384	392	366	370	376	375
9	495	415	417	397	378	385	394	391
10	396	395	396	415	405	412	423	417
11	569	436	439	452	421	428	432	430
12	535	449	453	453	419	448	462	446
13	455	468	470	470	437	461	443	453
14	486	488	488	488	474	541	482	498
15+	494	494	494	494				

Age	8.d	9.a	9.a.N	14.b	All
0		141	55		56
1	67	225	102		112
2	218	249	163	214	260
3	256	312	279	452	297
4	278	401	305	524	360
5	291	427	309	507	388
6	302	452	359	552	429
7	328	454	375	503	441
8	326	453	381	578	453
9	314	485	410	730	472
10	334	506	442	832	497
11	353	534	438	736	514
12	353		488		530
13			472		537
14			482		539
15+					

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 1

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	225	167		96	96	87	96	55	
1	278	220		127	127	171	128	217	
2	319	259		246	246	245	246	262	
3	355	295		344	344	340	347	338	
4	386	324		354	354	359	359	344	
5	415	352		386	386	400	394	378	
6	440	378		410	410	416	415	391	
7	465	393		428	428	417	432	420	
8	488	412		418	418	421	418	412	
9	509	432		498	498	463	498	463	
10	528	449		440	440	454	440	442	
11	544	467		478	478	478	478	453	
12	564	484		511	511	511	511	561	
13	575	498		490	490	503	490	597	
14	615	460		473	473	494	473	538	
15+									

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				81			118	82	81
1		70	53	145	69	69	184	146	144
2	133	194	163	234	163	164	284	237	236
3	214	235	227	261	229	226	336	261	265
4		327	279	315	291	276	404	311	299
5	298	341	322	335	332	319	431	360	298
6	341	382	418	376	397	419	435	354	381
7	356	407	380	389	379	382	474	450	469
8	356	415	393	402	392	389	419	374	375
9	387	432	419	410	399	427	606	434	419
10	446	472	411	444	414	396	355	371	388
11	446	472	434	457	449	426	675	440	475
12	427	504	482	493	453	453	567	567	418
13	448	491	488	496	470	470		435	435
14		544	502	506	488	488		474	474
15+	446	580	528	537	494	494			

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 1

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					118			
1	72	72	62	69	72	72	94	
2	198	197	184	163	208	217	188	240
3	246	256	232	228	254	257	258	286
4	310	342	302	311	289	289	301	315
5	328	348	330	334	310	308	320	326
6	356	363	369	376	344	341	356	357
7	369	411	387	382	366	363	372	372
8	373	380	390	392	369	365	379	375
9	387	414	400	398	382	378	398	391
10	408	395	408	414	406	405	426	416
11	421	437	451	452	421	423	436	429
12	418	449	453	453	418	441	467	444
13	435	468	470	470	435	455	453	452
14	474	488	488	488	474	475	484	492
15+		494	494	494				

Age	8.d	9.a	9.a.N	14.a	14.b	All
0					91	
1	66		89		75	
2	218	260	143		187	
3	256	300	205		238	
4	278	403	259		329	
5	291	422	304		344	
6	301	432	353		387	
7	328	490	377		405	
8	326	500	379		410	
9	314	515	407		422	
10	334	515	439		462	
11	353		425		463	
12	353		506		488	
13			466		494	
14			476		510	
15+					529	

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 2

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0									
1	227	153	96		96	174	137	55	
2	239	284	226	323	276	224	303	158	
3	264	297	300	348	205	260	210	172	
4	307	380	380	399	295	310	306	256	
5	349	377	405	447	433	350	442	396	
6	387	404	433	465	389	371	404	330	
7	399	419	471	529	499	406	514	405	
8	411	445	436	501	446	421	464	380	
9	431	459	418		387	439	383	372	
10	432	506	498		449	462	441	437	
11	473	475	440		428	479	425	408	
12	492	487	478		479	495	487	486	
13	567	520	511		511	514	516	640	
14	519	498	490		490	526	515		
15+	619	514	473		473	515	509		

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		46		81			118	81	81
1		51	53	146	69	69	184	146	146
2	169	177	147	206	164	163	284	236	236
3	218	224	240	217	227	222	339	233	265
4	436	302	342	290	276	297	408	313	299
5	338	322	335	321	322	331	432	329	305
6	396	337	372	373	420	387	441	316	379
7	442	375	385	426	379	391	474	454	479
8	448	330	399	419	391	389	455	373	375
9	424	401	405	456	412	405	612	420	421
10	480	480	437	550	403	403	377	357	385
11	503	398	455	528	434	446	672	433	469
12	446	500	477	493	453	453	567	438	
13	455	491	483	484	470	470		446	
14		532	500	506	488	488		656	
15+	446	558	506	537	494	494			

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 2

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0		81			48			
1	69	146	69	69	120	65	100	55
2	160	236	164	162	196	235	182	240
3	261	263	241	243	256	277	236	287
4	345	323	341	322	278	313	284	314
5	349	363	360	335	292	327	316	325
6	365	365	367	369	307	356	353	355
7	419	446	440	380	341	372	366	373
8	383	373	375	393	340	374	372	375
9	414	434	433	396	340	391	388	393
10	398	377	379	416	387	417	417	422
11	441	424	424	453	431	431	426	434
12	453		453	453	447	452	451	451
13	470		470	470	471	464	421	453
14	488		488	488	475	562	478	514
15+	494		494	494				

Age	8.d	9.a	9.a.N	14.b	All
0					50
1	160	130	96		104
2	219	233	141		220
3	256	302	245		237
4	278	368	270		300
5	291	412	300		342
6	302	438	347		370
7	328	438	372		396
8	326	438	381		387
9	314	480	402		421
10	334	505	442		427
11	353	534	439		462
12	353		486		486
13			473		477
14			482		516
15+					492

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 3

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0						46			
1	194	227			179	225	113	179	
2	288	320	323	323	307	275	281	233	280
3	329	411	421	421	381	319	337	279	373
4	363	439	440	440	440	390	429	409	436
5	432	491	505	505	466	389	417	349	442
6	466	491	504	504	502	422	471	439	463
7	488	543	604	604	564	443	465	391	465
8	500	476	504	504	456	464	441	412	479
9	509	488			361	486	418	361	485
10	529	510				510	506		511
11	561	530				530	530		526
12	588	549				549	549		541
13	603	567			387	561	443	387	582
14	576	585			447	580	484	447	
15+	616	618			473	600	485	473	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0				81			118	81	81
1	192	49	45	146	69	69	184	146	146
2	194	316	162	236	164	164	284	236	236
3	250	220	243	244	232	240	339	267	265
4	320	269	337	290	287	305	409	307	299
5	342	293	335	314	328	335	432	380	312
6	371	323	375	329	411	399	443	389	398
7	394	325	390	356	391	404	474	445	478
8	416	297	406	310	388	385	472	374	386
9	403	320	414	380	423	428	614	440	421
10	448	451	460	386	396	390	400	384	388
11	463	322	460	317	429	424	671	433	466
12	473	495	500		453	453	567	567	
13	514	493	493		470	470		470	
14	490	514	535		488	488		488	
15+	564	547	560		494	494		494	

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 3

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0					39	39	43	43
1			62	62	154	115	206	
2			206	206	219	294	241	297
3	263	245	297	253	256	317	340	384
4	354	352	368	260	278	335	382	385
5	367	374	398	264	291	347	447	442
6	368	366	407	268	302	364	474	
7	444	444	437		328	389	469	473
8	373	373	373		326	387	425	436
9	436	436	448	282	314	413	554	555
10	378	373	392		334	423	862	
11	423	423	423		359	437		
12			453		355	461	862	
13			470		435	472		
14			488		474	475		
15+			494					

Age	8.d	9.a	9.a.N	14.a	14.b	All
0		128	55		68	
1	160	301	127		181	
2	219	284	188	214	284	
3	256	349	326	452	329	
4	278	447	345	524	377	
5	291	491	419	507	431	
6	302	502	474	552	464	
7	328	517	466	503	477	
8	326	454	397	578	492	
9	314	495	538	730	499	
10	334			832	523	
11	353			736	550	
12	353				575	
13					594	
14					575	
15+					611	

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 4

Age	2.a	3.a	3.b	3.c	3.d	4.a	4.b	4.c	5.a
0	47					46	46	46	
1	111	238	238	237	237	227	157	181	
2	248	306	309	309	309	275	251	232	
3	304	346	353	348	348	308	290	277	
4	342	427	428	424	424	375	413	402	
5	385	461	466	465	465	405	398	350	
6	426	484	487	485	485	438	466	448	
7	434	516	523	516	516	459	476	410	
8	464	521	535	535	535	471	462	417	
9	480	526	548	546	546	494	453	372	
10	518	580	634	633	633	525	558	575	
11	479	595	651	649	649	537	582	576	
12	530	553				558	554	584	
13	517	565				561	443	387	
14	533	617	659	659	659	584	515	452	
15+	534	605				594	486	473	

Age	5.b	6.a	6.b	7.a	7.b	7.c	7.d	7.e	7.f
0		46		66			118	56	88
1	192	161	49	151	69		184	153	150
2	214	231	148	223	162		284	222	241
3	262	237	246	291	252	324	339	263	333
4	320	302	350	289	323	374	408	301	328
5	357	337	337	289	335	406	431	369	336
6	381	349	376	383	369	420	442	368	438
7	406	396	388	448	379	435	473	443	473
8	435	357	403	376	393		472	375	376
9	408	413	410	471	396	452	609	436	551
10	449	494	446	394	417	400	400	378	395
11	469	454	457	470	453	423	662	426	642
12	489	498	494		453		567	567	567
13	536	498	496		470				
14	490	556	508		488				
15+	604	536	540		494				

Table 8.5.2.1. NE Atlantic Mackerel. Mean weight (g) -at-age by area for 2019 (cont.).

Quarter 4

Age	7.g	7.h	7.j	7.k	8.a	8.b	8.c	8.c.E
0	118				56	57	96	
1	184				144	115	120	
2	284			164	206	187	204	255
3	335	264	261	241	256	323	344	359
4	396	355	353	305	278	339	381	372
5	427	370	364	336	291	359	443	425
6	425	371	365	400	302	364	469	
7	471	444	445	405	328	420	475	473
8	401	373	373	386	326	406	419	436
9	579	437	435	430	314	438	544	528
10	377	379	377	389	334	423		
11	641	423	423	425	353	437		
12	567				353	461		
13						472		
14						475		
15+								

Age	8.d	9.a	9.a.N	14.b	All
0		161	64		60
1		223	127		195
2		222	170		257
3		359	304		306
4		453	329		372
5		466	389		404
6		464	453		437
7			447		457
8			390		470
9			531		491
10		633			523
11					532
12					550
13					558
14					565
15+					595

Table 8.6.1.1.1. NE Atlantic Mackerel SSB (kt) and Total Annual egg production (TAEP) derived from the mackerel egg surveys for the Southern, Western and combined survey area.

Year	Component	TAEP	SSB (kt)
1992	Combined	2.57*e15	3874.5
1995	Combined	2.23*e15	3766.4
1998	Combined	2.02*e15	4198.6
2001	Combined	1.67*e15	3233.8
2004	Combined	1.50*e15	3106.8
2007	Combined	1.77*e15	3783.0
2010	Combined	2.38*e15	4810.8
2013	Combined	2.70*e15	4831.9
2016	Combined	1.77*e15	3524.1
2019	Combined	1.64*e15	3087.5

Year	Component	TAEP	SSB (kt)
1992	Southern	3.36*e14	507.2
1995	Southern	1.86*e14	370.4
1998	Southern	4.79*e14	882.9
2001	Southern	3.18*e14	417.5
2004	Southern	1.38*e14	309.2
2007	Southern	3.48*e14	744.7
2010	Southern	4.59*e14	926.3
2013	Southern	5.06*e14	904.0
2016	Southern	2.25*e14	447.3
2019	Southern	4.23*e14	796.7
1992	Western	2.23*e15	3367.2
1995	Western	2.05*e15	3396.0
1998	Western	1.54*e15	3315.8
2001	Western	1.35*e15	2816.4
2004	Western	1.36*e15	2797.6
2007	Western	1.42*e15	3038.3
2010	Western	1.92*e15	3884.4
2013	Western	2.20*e15	3927.9
2016	Western	1.55*e15	3076.8
2019	Western	1.22*e15	2290.8

Table 8.6.1.1.2. Fecundity and atresia for the assessment years, from 1998 to 2019. n is the number of samples used, n/g refers to the number of oocytes or atretic oocytes by gram of fish

Parameter	1998	2001	2004	2007	2010	2013	2016	2019
Fecundity samples (n)	96	187	205	176	74	132	97	*62*
Prevalence of atresia (n)	112	290	348	416	511	735	713	*895*
Intensity of atresia (n)	112	290	348	416	511	56	66	*64*
Relative potential fecundity (n/g)	1206	1097	1127	1098	1140	1257	1159	*1191*
Prevalence of atresia	0.55	0.2	0.28	0.38	0.33	0.22	0.3	*0.28*
Geometric mean intensity of atresia (n/g)	46	40	33	30	26	27	30	*19*

Parameter	1998	2001	2004	2007	2010	2013	2016	2019
Potential fecundity lost per day (n/g)	3.37	1.07	1.25	1.48	1.16	0.8	1.2	*0.73*
Potential fecundity lost (n/g)	202	64	75	89	70	48	72	*44*
Relative potential fecundity lost (%)	17	6	7	9	6	4	6	*4*
Realised fecundity (n/g)	1002	1033	1052	1009	1070	1209	1087	*1147*

Table 8.6.2.1. Model parameter estimates and standard errors.

Symbol	Description	Unit	Estimate	Std.Error
T	Decorrelation time	year	2	0.4
H	Spatial decorrelation distance	km	466	88
WS	Log Wing spread	nmi	-1.1	0.6
σ_N^2	Variance of the nugget effect	1	3.8	
σ_{xy}^2	Spatial variance parameter (year specific surfaces)	1	5.4	
σ_x^2	Spatial variance parameter (intercept surface)	1	5.5	

Table 8.6.3.1. Mackerel abundance index, mean weight-at-age, and biomass index from the IESSNS in 2007 and from 2010 to 2020, excluding North Sea. Values in 2007 and from 2010 to 2019 are the old StoX baseline whereas value from 2020 are the new StoX baseline values.

	2007			2010			2011			2012		
Age	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (million)
1	1.33	133	0.18	0.01	248	0.00	0.21	133	0.03	0.92	107	0.10
2	1.86	233	0.43	3.58	208	0.74	0.26	278	0.07	5.42	186	1.01
3	0.9	323	0.29	1.62	289	0.47	0.87	318	0.28	1.28	289	0.37
4	0.24	390	0.09	4.04	351	1.42	1.11	371	0.41	2.38	351	0.84
5	1	472	0.47	3.06	390	1.19	1.64	412	0.67	2.16	390	0.84
6	0.16	532	0.09	1.59	439	0.70	1.22	440	0.54	2.85	414	1.18
7	0.06	536	0.03	0.69	511	0.35	0.57	502	0.29	1.78	434	0.77
8	0.04	585	0.02	0.41	521	0.22	0.28	537	0.15	0.74	466	0.35
9	0.03	591	0.02	0.20	572	0.11	0.12	564	0.07	0.30	474	0.14

Age	2007 Number (billions)	W (g)	Biom. t (million)	2010 Number (billions)	W (g)	Biom. t (million)	2011 Number (billions)	W (g)	Biom. t (million)	2012 Number (billions)	W (g)	Biom. t (million)
10	0.01	640	0.01	0.07	584	0.04	0.07	541	0.04	0.15	542	0.08
11	0.01	727	0.01	0.02	652	0.02	0.06	570	0.03	0.08	491	0.04
12	0	656	0	0.03	673	0.02	0.02	632	0.01	0.04	582	0.02
13	0.01	685	0.01	0.01	660	0.01	0.01	622	0.01	0.00	525	0.00
14+	0	671	0	0.01	520**	0.00	0	612	0	0.00	577**	0.00
TOTAL	**5.65**	**512**	**1.64**	**15.32**	**345*****	**5.29**	**6.42**	**467**	**2.69**	**18.12**	**317*****	**5.75**
	2013			**2014**			**2015**			**2016**		
Age	**Number (billions)**	**W (g)**	**Biom. t (million)**	**Number (billions)**	**W (g)**	**Biom. t (million)**	**Number (billions)**	**W (g)**	**Biom. t (million)**	**Number (billions)**	**W (g)**	**Biom. t (million)**
1	0.04	107	0.00	0.01	206	0.00	0.86	111	0.10	<0.01	95	<0.01
2	6.39	187	1.19	0.56	275	0.15	0.84	283	0.24	4.98	231	1.15
3	9.20	259	2.39	7.03	287	2.02	2.54	325	0.83	1.37	324	0.45
4	2.46	323	0.79	4.90	336	1.65	6.41	335	2.15	2.64	360	0.95
5	3.07	379	1.16	2.66	402	1.07	4.80	379	1.82	5.24	371	1.95
6	3.22	403	1.30	2.63	433	1.14	1.80	434	0.78	4.37	394	1.72
7	2.54	432	1.10	2.77	455	1.26	1.63	463	0.75	1.89	440	0.83
8	1.09	447	0.49	1.91	471	0.90	1.25	470	0.59	1.66	458	0.76
9	0.38	488	0.18	0.85	492	0.42	0.73	485	0.35	1.11	479	0.53
10	0.14	524	0.08	0.38	534	0.20	0.27	498	0.13	0.75	488	0.37
11	0.15	478	0.07	0.10	534	0.05	0.07	548	0.04	0.45	494	0.22
12	0.04	564	0.02	0.07	610	0.04	0.06	541	0.04	0.2	523	0.1
13	0.01	654	0.00	0.04	503	0.02	0.01	563	0.00	0.07	511	0.04
14+	0.02	626**	0.01	0.00	665**	0.00				0.07	664	0.04
TOTAL	28.74	306***	8.79	23.91	373***	8.93	21.28	367***	7.81	24.81	367	9.11

Table 8.6.3.1. Mackerel abundance index, mean weight-at-age, and biomass index from the IESSNS in 2007 and from 2010 to 2020, excluding North Sea. Values in 2007 and from 2010 to 2019 are the old StoX baseline whereas value from 2020 are the new StoX baseline values. Cont.

	2017			2018			2019			2020*		
Age	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (million)	Number (billions)	W (g)	Biom. t (milion)
1	0.86	86	0.07	2.18	67	0.15	0.08	153	0.01	0.04	99	0.00
2	0.12	292	0.03	2.5	229	0.57	1.35	212	0.29	1.10	213	0.23
3	3.56	330	1.18	0.5	330	0.16	3.81	325	1.24	1.43	315	0.45
4	1.95	373	0.73	2.38	390	0.93	1.21	352	0.43	3.36	369	1.24
5	3.32	431	1.43	1.2	420	0.5	2.92	428	1.25	2.13	394	0.84
6	4.68	437	2.04	1.41	449	0.63	2.86	440	1.26	2.53	468	1.18
7	4.65	462	2.15	2.33	458	1.07	1.95	472	0.92	2.53	483	1.22
8	1.75	487	0.86	1.79	477	0.85	3.91	477	1.86	2.03	507	1.03
9	1.94	536	1.04	1.05	486	0.51	3.82	490	1.87	2.90	520	1.51
10	0.63	534	0.33	0.5	515	0.26	1.50	511	0.77	3.84	529	2.03
11	0.51	542	0.28	0.56	534	0.3	1.25	524	0.65	1.50	539	0.81
12	0.12	574	0.07	0.29	543	0.16	0.58	564	0.33	1.18	567	0.67
13	0.08	589	0.05	0.14	575	0.08	0.59	545	0.32	0.92	575	0.53
14+	0.04	626	0.03	0.09	643	0.05	0.57	579	0.32	0.98	593**	0.58
TOTAL	24.22	425	10.29	16.92	368	6.22	26.40	436	11.52	26.47	466***	12.33

***individuals of unknown age are estimated 0.01% of total stock size and are included in total estimates of abundance and biomass but excluded from abundance/biomass per age.**

****average weight for 14+ is mean weight per age weighted by numbers per age.**

*****average weight for all age classes including individuals of unknown age, calculated in StoX.**

Table 8.6.4.1. Overview of numbers released in the different RFID tagging experiments, and numbers recaptured per year (year 2020 shows update per 20th August to demonstrate ongoing process). Recaptures from experiments and recapture years used in 2020 stock assessment, based on decisions in the ICES IBPNEAMac 2019 (ICES, 2019a) are outlined and marked grey. However, note that these numbers also include recaptures from some factories excluded in the final estimation of tag table used in the stock assessment 2020 (see Tables 8.6.4.2-3), due to low efficiency or misfunctions.

Survey	N-Released	2012	2013	2014	2015	2016	2017	2018	2019	2020	All years
Iceland2015	806	0	0	0	6	2	3	0	0	0	11
Iceland2016	4884	0	0	0	0	59	48	28	19	4	158
Iceland2017	3890	0	0	0	0	0	28	27	9	9	73
Iceland2018	1872	0	0	0	0	0	0	5	16	3	24
Iceland2019	3614	0	0	0	0	0	0	0	5	13	18
Ireland-Hebrides2011	18645	27	24	31	24	17	5	9	7	2	146
Norway2011	31253	9	31	24	34	26	16	20	5	5	170
Ireland-Hebrides2012	32136	31	57	60	67	34	21	12	5	1	288
Ireland-Hebrides2013	22792	0	26	**89**	**109**	61	31	21	10	5	352
Ireland-Hebrides2014	55184	0	0	112	**321**	**277**	139	91	44	24	1008
Ireland-Hebrides2015	43905	0	0	0	117	**219**	**177**	93	49	26	681
Ireland-Hebrides2016	43956	0	0	0	0	124	**326**	**185**	121	59	815
Ireland-Hebrides2017	56073	0	0	0	0	0	137	**344**	**175**	69	725
Ireland-Hebrides2018	38136	0	0	0	0	0	0	204	**249**	131	584
Ireland-Hebrides2019	51179	0	0	0	0	0	0	0	293	270	563
Hebrides2020	48970	0	0	0	0	0	0	0	0	122	122
All surveys	457295	67	138	316	678	819	931	1039	1007	743	5738

Table 8.6.4.2. Overview of numbers of tonnes scanned for RFID tags per factory per year. Data from years used in 2020 stock assessment (2014 and onwards), based on decisions in the ICES IBPNEAMac 2019 (ICES, 2019a), are outlined and marked grey. Based on an evaluation of efficiency of the scanners, data from some factories are excluded as they were not functioning or having poor data quality, and these are not marked grey.

Factory	2012[1]	2013[1]	2014	2015	2016	2017	2018	2019	All years
FO01 Vardin Pelagic	0	0	**10460**	**11565**	**7895**	**4844**	0	0	34763
GB01 Denholm Coldstore	0	0	0	**4377**	**4710**	**5365**	**7806**	**5191**	27449
GB01 Denholm Factory	0	0	**14939**	**17509**	**18840**	**17913**	**13609**	**12018**	94829
GB02 Lunar Freezing Peterhead	0	0	**22586**	**17830**	**16473**	**9745**	**9857**	**14300**	90791
GB03 Lunar Freezing Fraserburgh	0	0	0	8797	14282	12684	**9452**	**5729**	50943
GB04 Pelagia Shetland	0	0	**21436**	**41117**	**40200**	**26935**	**25350**	**15128**	170166
GB05 Northbay Pelagic	0	0	0	0	0	0	**15353**	**12667**	28020
IC01 Vopnafjord	0	0	**18577**	**18772**	**21716**	**22935**	**18869**	**18547**	119416
IC02 Neskaupstad	0	0	0	**6288**	**21887**	**19558**	**16757**	**26633**	91123
IC03 Höfn	0	0	0	**0**	**0**	**0**	**0**	**10592**	10592
NO01 Pelagia Egersund Seafood	20930	21442	36724	14375	15905	0	**48373**	**25404**	183152
NO02 Skude Fryseri	7546	8250	**16719**	**14172**	**8671**	**16760**	3108	1285	76511
NO03 Pelagia Austevoll	6405	6134	10314	4203	2216	0	**7293**	**3533**	40097
NO04 Pelagia Florø	9986	12838	**17379**	**12592**	**7749**	0	0	0	60544
NO05 Pelagia Måløy	13344	14632	**13942**	**21051**	**15762**	**22405**	**13341**	**8591**	123068
NO06 Pelagia Selje	17731	26878	**39525**	**41209**	**29897**	**35416**	**28972**	**32047**	251676
NO07 Pelagia Liavågen	9442	10968	**22395**	**18144**	**13911**	**19989**	**12398**	**11888**	119136
NO08 Brødrene Sperre	14425	15048	**20182**	**34307**	**36736**	**18814**	33960	8515	181988
NO09 Lofoten Viking	0	0	0	0	0	0	3380	2457	5837
NO14 Nils Sperre	0	0	0	0	0	0	**28304**	**26272**	54576
NO15 Grøntvedt Pelagic	0	0	0	0	0	0	6411	0	6411
NO16 Vikomar	0	0	0	0	0	0	12512	**6480**	18992
All factories	99808	116190	265178	286310	276850	233363	315105	247277	1840082

[1] In years 2012-2013 all factories except NO03Austevoll had acceptable efficiency. However, data from these years are not used for stock assessment as distribution of catches scanned were different than in years 2014 onwards in addition to other bias issues.

Table 8.6.4.3. Overview of numbers of RFID tagged mackerel recaptured per factory per year. Only recaptures from Ireland surveys (Table 8.6.4.1) that are used as basis stock assessment are shown. Recaptures from years used in 2020 stock assessment from 2014 and onwards, based on decisions in the ICES IBPNEAMac 2019 (ICES, 2019a), are outlined and marked grey. Based on an evaluation of efficiency of the scanners, data from some factories are excluded as they were not functioning or having poor data quality, and these are not marked grey.

Factory	2013[1]	2014[1]	2015	2016	2017	2018	2019	2020[2]	All years
FO01 Vardin Pelagic	0	**13**	**35**	**20**	**12**	0	0	0	80
GB01 Denholm Coldstore	0	0	**10**	**10**	**25**	**36**	**19**	21	121
GB01 Denholm Factory	0	**25**	**62**	**77**	**113**	**54**	**54**	35	420
GB02 Lunar Freezing Peterhead	0	**32**	**49**	**60**	**38**	**41**	**54**	68	342
GB03 Lunar Freezing Fraserburgh	0	0	9	14	7	**25**	**34**	0	89
GB04 Pelagia Shetland	0	**21**	**124**	**148**	**138**	**98**	**82**	60	671
GB05 Northbay Pelagic	0	0	0	0	0	**57**	**62**	33	152
IC01 Vopnafjord	0	**22**	**55**	**65**	**59**	**62**	**54**	96	413
IC02 Neskaupstad	0	0	**19**	**65**	**54**	**35**	**115**	98	386
IC03 Höfn	0	0	1	0	1	1	**44**	50	97
NO01 Pelagia Egersund Seafood	22	18	7	1	0	**137**	**80**	62	337
NO02 Skude Fryseri	6	**21**	**17**	**25**	**51**	14	3	0	142
NO03 Pelagia Austevoll	1	7	4	1	0	**28**	**17**	0	59
NO04 Pelagia Florø	12	**27**	**21**	**17**	0	0	0	0	82
NO05 Pelagia Måløy	13	**20**	**43**	**37**	**79**	**36**	**28**	35	296
NO06 Pelagia Selje	27	**37**	**76**	**59**	**85**	**87**	**153**	59	598
NO07 Pelagia Liavågen	11	**29**	**31**	**26**	**97**	**48**	**51**	12	315
NO08 Brødrene Sperre	15	**20**	**56**	**107**	**77**	52	12	0	346
NO09 Lofoten Viking	0	0	0	0	0	10	3	5	18
NO12 Pelagia Lødingen	0	0	0	0	0	0	0	1	1
NO13 Pelagia Tromsø	0	0	0	0	0	0	0	1	1
NO14 Nils Sperre	0	0	0	0	0	**109**	**68**	48	225
NO15 Grøntvedt Pelagic	0	0	0	0	0	11	0	0	11
NO16 Vikomar	0	0	0	0	0	18	**20**	25	63
All factories	107	292	619	732	836	959	953	709	5265

[1] In years 2012-2013 all factories except NO03Austevoll had acceptable efficiency. However, data from these years are not used for stock assessment as distribution of catches scanned were different than in years 2014 onwards in addition to other bias issues.

[2] Preliminary by 20th August.

Table 8.7.1.1. NE Atlantic mackerel. Input data and parameters and the model configurations for the assessment.

Input data types and characteristics:			
Name	Year range	Age range	Variable from year to year
Catch in tonnes	1980 -2019		Yes
Catch-at-age in numbers	1980 -2019	0-12+	Yes
Weight-at-age in the commercial catch	1980 –2019	0-12+	Yes
Weight-at-age of the spawning stock at spawning time.	1980 –2019	0-12+	Yes
Proportion of natural mortality before spawning	1980 -2020	0-12+	Yes
Proportion of fishing mortality before spawning	1980 -2020	0-12+	Yes
Proportion mature-at-age	1980 -2020	0-12+	Yes
Natural mortality	1980 -2020	0-12+	No, fixed at 0.15

Tuning data:			
Type	Name	Year range	Age range
Survey (SSB)	ICES Triennial Mackerel and Horse Mackerel Egg Survey	1992, 1995, 1998, 2001, 2004, 2007, 2010, 2013,2016,2019.	Not applicable (gives SSB)
Survey (abundance index)	IBTS Recruitment index (log transformed)	1998-2019	Age 0
Survey (abundance index)	International Ecosystem Summer Survey in the Nordic Seas (IESSNS)	2010, 2012-2020	Ages 3-11
Tagging/recapture	Norwegian tagging program	Steal tags : 1980 (release year)-2006 (recapture years) RFID tags : 2013 (release year) 2019 (recapture year)	Ages 5 and older (age at release)

SAM parameter configuration		
Setting	Value	Description
Coupling of fishing mortality states	1/2/3/4/5/6/7/8/8/8/8/8/8	Different F states for ages 0 to 6, one same F state for ages 7 and older
Correlated random walks for the fishing mortalities	0	F random walk of different ages are independent
Coupling of catchability parameters	0/0/0/0/0/0/0/0/0/0/0/0/0 1/0/0/0/0/0/0/0/0/0/0/0/0 2/0/0/0/0/0/0/0/0/0/0/0/0 0/0/0/3/4/5/6/7/8/9/10/10/0	No catchability parameter for the catches One catchability parameter estimated for the egg One catchability parameter estimated for the recruitment index One catchability parameter for each age group estimated for the IESSNS (age 3 to11)
Power law model	0	No power law model used for any of the surveys
Coupling of fishing mortality random walk variances	1/2/3/3/3/3/3/3/3/3/3/3	Separate F random walk variances for age 0, age 1 and a same variance for older ages
Coupling of log abundance random walk variances	1/2/2/2/2/2/2/2/2/2/2/2	Same variance used for the log abundance random walk of all ages except for the recruits (age 0)
Coupling of the observation variances	1/2/3/3/3/3/3/3/3/3/3/3 0/0/0/0/0/0/0/0/0/0/0/0/0 4/0/0/0/0/0/0/0/0/0/0/0/0 0/0/0/5/6/6/6/6/6/6/6/0	Separate observation variances for age 0 and 1 than for the older ages in the catches One observation variance for the egg survey One observation variance for the recruitment index 2 observation variances for the IESSNS (age 3 and ages 4 and older)
Stock recruitment model	0	No stock-recruiment model
Correlation structure	"ID", "ID", "ID", "AR"	Auto-regressive correlation structure for the IESSNS index, independent observations assumed for the other data sources

Table 8.7.1.2. NE Atlantic Mackerel. CATCH IN NUMBER

Units : thousands

age \ year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	33101	56682	11180	7333	287287	81799	49983	7403	57644	65400
1	411327	276229	213936	47914	31901	268960	58126	40126	152656	64263
2	393025	502365	432867	668909	86064	20893	424563	156670	137635	312739
3	64549	231814	472457	433744	682491	58346	38387	663378	190403	207689
4	328206	32814	184581	373262	387582	445357	76545	56680	538394	167588
5	254172	184867	26544	126533	251503	252217	364119	89003	72914	362469
6	142978	173349	138970	20175	98063	165219	208021	244570	87323	48696
7	145385	116328	112476	90151	22086	62363	126174	150588	201021	58116
8	54778	125548	89672	72031	61813	19562	42569	85863	122496	111251
9	130771	41186	88726	48668	47925	47560	13533	34795	55913	68240

10	39920	146186	27552	49252	37482	37607	32786	19658	20710	32228
11	56210	31639	91743	19745	30105	26965	22971	25747	13178	13904
12	104927	199615	156121	132040	69183	97652	81153	63146	57494	35814

	year									
age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	24246	10007	43447	19354	25368	14759	37956	36012	61127	67003
1	140534	58459	83583	128144	147315	81529	119852	144390	99352	73597
2	209848	212521	156292	210319	221489	340898	168882	186481	229767	132994
3	410751	206421	356209	266677	306979	340215	333365	238426	264566	223639
4	208146	375451	266591	398240	267420	275031	279182	378881	323186	261778
5	156742	188623	306143	244285	301346	186855	177667	246781	361945	281041
6	254015	129145	156070	255472	184925	197856	96303	135059	207619	244212
7	42549	197888	113899	149932	189847	142342	119831	84378	118388	159019
8	49698	51077	138458	97746	106108	113413	55812	66504	72745	86739
9	85447	43415	51208	121400	80054	69191	59801	39450	47353	50613
10	33041	70839	36612	38794	57622	42441	25803	26735	24386	30363
11	16587	29743	40956	29067	20407	37960	18353	13950	16551	17048
12	27905	52986	68205	68217	57551	39753	30648	24974	22932	32446

	year									
age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	36345	26034	70409	14744	11553	12426	75651	19302	25886	17615
1	102407	40315	222577	187997	31421	46840	149425	88439	59899	36514
2	142898	158943	70041	275661	453133	135648	173646	190857	167748	113574
3	275376	234186	367902	91075	529753	668588	159455	220575	399086	455113
4	390858	297206	350163	295777	147973	293579	470063	215655	284660	616963
5	295516	309937	262716	235052	258177	120538	195594	455131	260314	319465
6	241550	231804	237066	183036	145899	121477	97061	203492	255675	224848
7	175608	195250	151320	133595	89856	63612	73510	77859	124382	194326
8	106291	120241	118870	94168	65669	38763	33399	59652	57297	73171
9	52394	72205	79945	75701	40443	23947	18961	30494	32343	29738
10	31280	42529	43789	45951	35654	18612	13987	16039	19482	14989
11	18918	20546	21611	25797	16430	7955	8334	11416	6798	7470
12	34202	40706	40280	30890	19509	10669	10186	12801	9581	5003

	year									
age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	23453	30429	23872	11325	62100	6732	716	28306	9453	6439
1	78605	62708	66196	47020	43173	104019	45199	43458	46107	42398
2	137101	115346	200167	235411	137788	124411	203753	87739	238898	126107
3	303928	322725	214043	399751	669949	248852	257293	458301	137575	350687
4	739221	469953	415884	370551	829399	579835	424843	351779	378240	114630
5	611729	654395	456404	442597	564508	646894	589549	396862	257689	295888
6	284788	488713	511270	429324	549985	450344	532890	503601	295537	226728
7	143039	244210	323835	336701	503300	415107	340155	431014	425922	229838
8	102072	113012	142948	188910	339538	355997	269962	261959	317671	267591
9	45841	53363	69551	112765	141344	205691	170373	188950	198527	204885
10	21222	25046	30619	45938	63614	107685	94778	138143	140781	103015
11	6255	12311	11603	18928	21294	26939	33896	59211	83063	66990
12	8523	10775	11678	17857	13136	22700	24420	51090	60587	74927

Table 8.7.1.3. NE Atlantic Mackerel. WEIGHTS AT AGE IN THE CATCH

Units : Kg

year

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.057	0.060	0.053	0.050	0.031	0.055	0.039	0.076	0.055	0.049	0.085	0.068
1	0.131	0.132	0.131	0.168	0.102	0.144	0.146	0.179	0.133	0.136	0.156	0.156
2	0.249	0.248	0.249	0.219	0.184	0.262	0.245	0.223	0.259	0.237	0.233	0.253
3	0.285	0.287	0.285	0.276	0.295	0.357	0.335	0.318	0.323	0.320	0.336	0.327
4	0.345	0.344	0.345	0.310	0.326	0.418	0.423	0.399	0.388	0.377	0.379	0.394
5	0.378	0.377	0.378	0.386	0.344	0.417	0.471	0.474	0.456	0.433	0.423	0.423
6	0.454	0.454	0.454	0.425	0.431	0.436	0.444	0.512	0.524	0.456	0.467	0.469
7	0.498	0.499	0.496	0.435	0.542	0.521	0.457	0.493	0.555	0.543	0.528	0.506
8	0.520	0.513	0.513	0.498	0.480	0.555	0.543	0.498	0.555	0.592	0.552	0.554
9	0.542	0.543	0.541	0.545	0.569	0.564	0.591	0.580	0.562	0.578	0.606	0.609
10	0.574	0.573	0.574	0.606	0.628	0.629	0.552	0.634	0.613	0.581	0.606	0.630
11	0.590	0.576	0.574	0.608	0.636	0.679	0.694	0.635	0.624	0.648	0.591	0.649
12	0.580	0.584	0.582	0.614	0.663	0.710	0.688	0.718	0.697	0.739	0.713	0.708

year

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.051	0.061	0.046	0.072	0.058	0.076	0.065	0.062	0.063	0.069	0.052	0.081
1	0.167	0.134	0.136	0.143	0.143	0.143	0.157	0.176	0.135	0.172	0.160	0.170
2	0.239	0.240	0.255	0.234	0.226	0.230	0.227	0.235	0.227	0.224	0.256	0.267
3	0.333	0.317	0.339	0.333	0.313	0.295	0.310	0.306	0.306	0.305	0.307	0.336
4	0.397	0.376	0.390	0.390	0.377	0.359	0.354	0.361	0.363	0.376	0.368	0.385
5	0.460	0.436	0.448	0.452	0.425	0.415	0.408	0.404	0.427	0.424	0.424	0.438
6	0.495	0.483	0.512	0.501	0.484	0.453	0.452	0.452	0.463	0.474	0.461	0.477
7	0.532	0.527	0.543	0.539	0.518	0.481	0.462	0.500	0.501	0.496	0.512	0.522
8	0.555	0.548	0.590	0.577	0.551	0.524	0.518	0.536	0.534	0.540	0.536	0.572
9	0.597	0.583	0.583	0.594	0.576	0.553	0.550	0.569	0.567	0.577	0.580	0.612
10	0.651	0.595	0.627	0.606	0.596	0.577	0.573	0.586	0.586	0.603	0.600	0.631
11	0.663	0.647	0.678	0.631	0.603	0.591	0.591	0.607	0.594	0.611	0.629	0.648
12	0.669	0.679	0.713	0.672	0.670	0.636	0.631	0.687	0.644	0.666	0.665	0.715

year

age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	0.067	0.048	0.038	0.089	0.051	0.104	0.048	0.029	0.089	0.091	0.043	0.051
1	0.156	0.151	0.071	0.120	0.105	0.153	0.118	0.113	0.123	0.173	0.127	0.154
2	0.263	0.268	0.197	0.215	0.222	0.213	0.221	0.231	0.187	0.234	0.232	0.242
3	0.323	0.306	0.307	0.292	0.292	0.283	0.291	0.282	0.285	0.277	0.282	0.294
4	0.400	0.366	0.357	0.372	0.370	0.331	0.331	0.334	0.340	0.336	0.324	0.320
5	0.419	0.434	0.428	0.408	0.418	0.389	0.365	0.368	0.375	0.360	0.362	0.351
6	0.485	0.440	0.479	0.456	0.444	0.424	0.418	0.411	0.401	0.386	0.395	0.392
7	0.519	0.496	0.494	0.512	0.497	0.450	0.471	0.451	0.431	0.406	0.422	0.420
8	0.554	0.539	0.543	0.534	0.551	0.497	0.487	0.494	0.469	0.431	0.444	0.443
9	0.573	0.556	0.584	0.573	0.571	0.538	0.515	0.540	0.503	0.454	0.468	0.465
10	0.595	0.583	0.625	0.571	0.620	0.586	0.573	0.580	0.537	0.472	0.482	0.489
11	0.630	0.632	0.636	0.585	0.595	0.599	0.604	0.611	0.538	0.493	0.523	0.522
12	0.684	0.655	0.689	0.666	0.662	0.630	0.630	0.664	0.585	0.554	0.583	0.560

year

age	2016	2017	2018	2019
0	0.035	0.018	0.055	0.056
1	0.158	0.178	0.133	0.112
2	0.240	0.266	0.246	0.260
3	0.297	0.312	0.319	0.297

4	0.329	0.356	0.354	0.360
5	0.356	0.377	0.396	0.388
6	0.383	0.397	0.410	0.429
7	0.411	0.415	0.426	0.441
8	0.438	0.444	0.446	0.453
9	0.453	0.466	0.469	0.472
10	0.479	0.484	0.491	0.497
11	0.499	0.497	0.507	0.514
12	0.520	0.531	0.537	0.537

Table 8.7.1.4. NE Atlantic Mackerel. WEIGHTS AT AGE IN THE STOCK

Units : Kg

	year											
age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.063	0.063	0.063	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.114	0.112	0.112	0.111	0.108	0.111	0.104	0.075	0.099	0.058	0.096	0.174
2	0.205	0.179	0.159	0.179	0.204	0.244	0.184	0.157	0.181	0.162	0.166	0.184
3	0.287	0.258	0.217	0.233	0.251	0.281	0.269	0.234	0.238	0.230	0.247	0.243
4	0.322	0.312	0.300	0.282	0.293	0.308	0.301	0.318	0.298	0.272	0.290	0.303
5	0.356	0.335	0.368	0.341	0.326	0.336	0.350	0.368	0.348	0.338	0.332	0.347
6	0.377	0.376	0.362	0.416	0.395	0.356	0.350	0.414	0.392	0.392	0.383	0.392
7	0.402	0.415	0.411	0.404	0.430	0.407	0.374	0.415	0.445	0.388	0.435	0.423
8	0.434	0.431	0.456	0.438	0.455	0.455	0.434	0.431	0.442	0.449	0.447	0.492
9	0.438	0.454	0.455	0.475	0.489	0.447	0.428	0.483	0.466	0.432	0.494	0.500
10	0.484	0.450	0.473	0.467	0.507	0.519	0.467	0.487	0.506	0.429	0.473	0.546
11	0.520	0.524	0.536	0.544	0.513	0.538	0.506	0.492	0.567	0.482	0.495	0.526
12	0.532	0.530	0.542	0.528	0.566	0.590	0.541	0.581	0.594	0.556	0.536	0.619

	year											
age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.130	0.145	0.114	0.116	0.097	0.084	0.083	0.087	0.093	0.113	0.109	0.112
2	0.201	0.190	0.163	0.200	0.185	0.196	0.170	0.210	0.194	0.190	0.206	0.181
3	0.260	0.266	0.240	0.278	0.250	0.257	0.251	0.260	0.253	0.246	0.245	0.251
4	0.308	0.323	0.306	0.327	0.322	0.310	0.300	0.317	0.301	0.303	0.288	0.277
5	0.360	0.359	0.368	0.385	0.372	0.356	0.348	0.356	0.357	0.342	0.333	0.341
6	0.397	0.410	0.418	0.432	0.425	0.401	0.384	0.392	0.394	0.398	0.360	0.401
7	0.419	0.432	0.459	0.458	0.446	0.460	0.409	0.424	0.415	0.417	0.418	0.407
8	0.458	0.459	0.480	0.491	0.471	0.473	0.455	0.456	0.438	0.451	0.429	0.489
9	0.487	0.480	0.496	0.511	0.513	0.505	0.475	0.489	0.464	0.484	0.458	0.490
10	0.513	0.515	0.550	0.517	0.508	0.511	0.530	0.508	0.489	0.521	0.511	0.488
11	0.543	0.547	0.592	0.560	0.538	0.546	0.500	0.545	0.514	0.535	0.523	0.521
12	0.572	0.580	0.608	0.603	0.573	0.583	0.549	0.575	0.551	0.572	0.558	0.540

	year											
age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.112	0.114	0.114	0.095	0.133	0.112	0.096	0.080	0.089	0.076	0.107	0.078
2	0.157	0.140	0.164	0.148	0.160	0.162	0.159	0.175	0.155	0.144	0.165	0.207
3	0.258	0.221	0.236	0.206	0.207	0.214	0.199	0.223	0.216	0.179	0.199	0.247
4	0.319	0.328	0.291	0.285	0.260	0.268	0.246	0.274	0.255	0.249	0.238	0.254
5	0.356	0.378	0.333	0.329	0.346	0.295	0.296	0.332	0.288	0.280	0.291	0.288
6	0.406	0.403	0.400	0.363	0.354	0.351	0.345	0.369	0.312	0.319	0.321	0.336
7	0.449	0.464	0.413	0.448	0.393	0.386	0.389	0.389	0.360	0.341	0.341	0.350
8	0.482	0.481	0.437	0.452	0.448	0.437	0.407	0.430	0.390	0.375	0.387	0.381

```
  9  0.506 0.547 0.455 0.514 0.452 0.461 0.439 0.452 0.453 0.416 0.416 0.412
  10 0.519 0.538 0.469 0.538 0.478 0.517 0.489 0.495 0.498 0.441 0.466 0.447
  11 0.579 0.509 0.531 0.542 0.487 0.548 0.532 0.518 0.503 0.496 0.472 0.485
  12 0.588 0.603 0.566 0.585 0.510 0.557 0.572 0.525 0.558 0.522 0.517 0.551
    year
age  2016  2017  2018  2019
  0  0.000 0.000 0.000 0.000
  1  0.059 0.058 0.063 0.069
  2  0.182 0.204 0.190 0.191
  3  0.238 0.237 0.266 0.250
  4  0.282 0.278 0.283 0.293
  5  0.298 0.308 0.314 0.311
  6  0.340 0.308 0.327 0.346
  7  0.368 0.338 0.346 0.365
  8  0.385 0.377 0.364 0.371
  9  0.404 0.394 0.389 0.397
  10 0.424 0.426 0.419 0.428
  11 0.440 0.430 0.437 0.431
  12 0.473 0.499 0.491 0.481
```

Table 8.7.1.5. NE Atlantic Mackerel. NATURAL MORTALITY

```
Units  :  NA
    year
age  1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993
  0  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  1  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  2  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  3  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  4  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  5  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  6  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  7  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  8  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  9  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  10 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  11 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  12 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
    year
age  1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
  0  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  1  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  2  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  3  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  4  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  5  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  6  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  7  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  8  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  9  0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  10 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  11 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
  12 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
    year
```

age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
2	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
3	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
5	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
7	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
8	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
9	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
10	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
11	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Table 8.7.1.6. NE Atlantic Mackerel. PROPORTION MATURE

year

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.093	0.097	0.097	0.098	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102
2	0.521	0.497	0.498	0.485	0.467	0.516	0.522	0.352	0.360	0.372	0.392	0.435
3	0.872	0.837	0.857	0.863	0.853	0.885	0.926	0.922	0.901	0.915	0.909	0.912
4	0.949	0.934	0.930	0.940	0.938	0.940	0.983	0.994	0.989	0.994	0.996	0.991
5	0.972	0.976	0.969	0.972	0.966	0.966	0.965	0.997	0.994	0.996	0.998	0.996
6	0.984	0.984	0.987	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.996
7	0.990	0.987	0.985	0.984	0.975	0.976	1.000	1.000	1.000	1.000	1.000	1.000
8	1.000	0.999	0.999	0.999	0.999	0.999	0.991	0.992	0.991	0.993	0.995	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

year

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.102	0.102	0.102	0.102	0.102	0.097	0.097	0.097	0.104	0.104	0.104	0.106
2	0.520	0.534	0.621	0.599	0.586	0.621	0.688	0.669	0.692	0.675	0.710	0.690
3	0.928	0.934	0.938	0.931	0.936	0.880	0.886	0.876	0.909	0.909	0.937	0.940
4	0.996	0.996	0.994	0.993	1.000	0.993	0.994	0.989	0.989	0.987	0.992	0.988
5	0.997	0.997	0.997	0.994	1.000	0.998	0.999	0.999	0.998	0.998	1.000	1.000
6	0.994	0.994	0.993	0.987	0.994	0.999	0.999	0.999	0.999	0.999	1.000	1.000
7	1.000	1.000	0.999	0.999	0.999	1.000	1.000	1.000	1.000	0.999	1.000	0.999
8	1.000	1.000	1.000	1.000	1.000	0.994	0.995	0.996	0.997	0.997	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

year

age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.106	0.106	0.095	0.095	0.095	0.096	0.096	0.096	0.094	0.092	0.092	0.104
2	0.761	0.616	0.589	0.546	0.524	0.541	0.667	0.655	0.604	0.683	0.675	0.763
3	0.962	0.959	0.928	0.921	0.917	0.919	0.930	0.927	0.926	0.921	0.916	0.944
4	0.993	0.993	0.994	0.994	0.999	0.999	0.999	0.999	0.999	0.998	0.999	0.998

age												
5	0.999	0.999	1.000	1.000	0.999	1.000	1.000	1.000	0.999	1.000	1.000	0.999
6	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	0.999	0.999	0.999	1.000
7	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

year

age	2016	2017	2018	2019
0	0.000	0.000	0.000	0.000
1	0.103	0.101	0.086	0.086
2	0.632	0.624	0.459	0.434
3	0.937	0.931	0.877	0.873
4	0.997	0.997	0.998	0.997
5	0.999	1.000	1.000	1.000
6	1.000	1.000	1.000	1.000
7	0.999	1.000	1.000	1.000
8	1.000	1.000	1.000	0.999
9	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000

Table 8.7.1.7. NE Atlantic Mackerel. FRACTION OF HARVEST BEFORE SPAWNING

year

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.166	0.166	0.166	0.166	0.166	0.166	0.166	0.166	0.166	0.166	0.139	0.111
2	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.240	0.272
3	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.240	0.272
4	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.240	0.272
5	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
6	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
7	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
8	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
9	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
10	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
11	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406
12	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.393	0.406

year

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.084	0.165	0.249	0.331	0.269	0.206	0.144	0.125	0.106	0.088	0.142	0.197
2	0.304	0.301	0.298	0.296	0.295	0.295	0.295	0.320	0.347	0.373	0.360	0.347
3	0.304	0.301	0.298	0.296	0.295	0.295	0.295	0.320	0.347	0.373	0.360	0.347
4	0.304	0.301	0.298	0.296	0.295	0.295	0.295	0.320	0.347	0.373	0.360	0.347
5	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
6	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
7	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
8	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
9	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
10	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
11	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425
12	0.419	0.444	0.469	0.494	0.494	0.494	0.495	0.461	0.426	0.392	0.408	0.425

	year											
age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.251	0.262	0.274	0.285	0.206	0.125	0.047	0.092	0.138	0.183	0.170	0.156
2	0.334	0.317	0.300	0.284	0.266	0.249	0.232	0.176	0.119	0.064	0.117	0.171
3	0.334	0.317	0.300	0.284	0.266	0.249	0.232	0.176	0.119	0.064	0.117	0.171
4	0.334	0.317	0.300	0.284	0.266	0.249	0.232	0.176	0.119	0.064	0.117	0.171
5	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
6	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
7	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
8	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
9	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
10	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
11	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189
12	0.441	0.409	0.376	0.344	0.310	0.275	0.242	0.233	0.225	0.216	0.203	0.189

	year			
age	2016	2017	2018	2019
0	0.000	0.000	0.000	0.000
1	0.143	0.232	0.393	0.581
2	0.224	0.153	0.179	0.182
3	0.224	0.153	0.179	0.182
4	0.224	0.153	0.179	0.182
5	0.176	0.292	0.194	0.298
6	0.176	0.292	0.194	0.298
7	0.176	0.292	0.194	0.298
8	0.176	0.292	0.194	0.298
9	0.176	0.292	0.194	0.298
10	0.176	0.292	0.194	0.298
11	0.176	0.292	0.194	0.298
12	0.176	0.292	0.194	0.298

Table 8.7.1.8. NE Atlantic Mackerel. FRACTION OF NATURAL MORTALITY BEFORE SPAWNING

	year											
age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
1	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
2	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
3	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
4	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
5	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
6	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
7	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
8	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
9	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
10	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
11	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345
12	0.397	0.396	0.394	0.392	0.394	0.396	0.397	0.388	0.378	0.369	0.357	0.345

	year											
age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.333	0.341	0.349	0.357	0.339	0.322	0.304	0.325	0.346	0.366	0.361	0.355
1	0.333	0.341	0.349	0.357	0.339	0.322	0.304	0.325	0.346	0.366	0.361	0.355

```
  2  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  3  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  4  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  5  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  6  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  7  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  8  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  9  0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  10 0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  11 0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
  12 0.333 0.341 0.349 0.357 0.339 0.322 0.304 0.325 0.346 0.366 0.361 0.355
    year
age  2004  2005  2006  2007  2008  2009  2010  2011  2012  2013  2014  2015
  0  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  1  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  2  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  3  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  4  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  5  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  6  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  7  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  8  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  9  0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  10 0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  11 0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
  12 0.350 0.346 0.342 0.339 0.311 0.283 0.255 0.252 0.249 0.246 0.278 0.311
    year
age  2016  2017  2018  2019
  0  0.343 0.327 0.312 0.296
  1  0.343 0.327 0.312 0.296
  2  0.343 0.327 0.312 0.296
  3  0.343 0.327 0.312 0.296
  4  0.343 0.327 0.312 0.296
  5  0.343 0.327 0.312 0.296
  6  0.343 0.327 0.312 0.296
  7  0.343 0.327 0.312 0.296
  8  0.343 0.327 0.312 0.296
  9  0.343 0.327 0.312 0.296
  10 0.343 0.327 0.312 0.296
  11 0.343 0.327 0.312 0.296
  12 0.343 0.327 0.312 0.296
```

Table 8.7.1.9. NE Atlantic Mackerel. SURVEY INDICES

```
Some random text

103

SSB-egg-based-survey

1992           2019

1              1              0              0
```

-1	-1		
1	3874476.93		
1	-1		
1	-1		
1	3766378.516		
1	-1		
1	-1		
1	4198626.531		
1	-1		
1	-1		
1	3233833.244		
1	-1		
1	-1		
1	3106808.703		
1	-1		
1	-1		
1	3782966.707		
1	-1		
1	-1		
1	4810751.571		
1	-1		
1	-1		
1	4831948.353		
1	-1		
1	-1		
1	3524054.85		
1	-1		
1	-1		
1	3087517.078		
R-idx			
1998	2019		
1	1	0	0
0	0		
1	0.009803925		
1	0.014577022		
1	0.010404596		
1	0.016275242		
1	0.020658814		
1	0.010053545		
1	0.023450373		
1	0.030321897		
1	0.027468238		
1	0.017962249		
1	0.016393821		
1	0.011593404		
1	0.017765551		
1	0.029744946		
1	0.021683204		

```
1               0.023765241
1               0.017731574
1               0.019571796
1               0.034173138
1               0.034918376
1               0.03092552
1               0.034394165
Swept-idx

2010            2020

1               1               0.58            0.75

3               11

1               1617005         4035646         3059146         1591100         691936          413253
                198106          65803           24747
1               -1              -1              -1              -1              -1              -1
                -1              -1              -1
1               1283247         2383260         2164365         2850847         1783942         740361
                299490          149282          84344
1               9201746         2456618         3073772         3218990         2540444         1087937
                377406          144695          146826
1               7034162         4896456         2659443         2630617         2768227         1910160
                849010          379745          95304
1               2539963         6409324         4802298         1795564         1628872         1254859
                727691          270562          72410
1               1374705         2635033         5243607         4368491         1893026         1658839
                1107866         754993          450100
1               3562908         1953609         3318099         4680603         4653944         1754954
                1944991         626406          507546
1               496595          2384310         1200541         1408582         2330520         1787503
                1049868         499295          557573
1               3814661         1211770         2920591         2856932         1948653         3906891
                3824410         1499778         1248160
1               1430995         3361778         2134411         2528651         2525460         2032783
                2904239         3835479         1495649
```

Table 8.7.1.10. NE Atlantic Mackerel. RFID recapture data for the year 2019

Release Yr	Recapture Yr	Year-class	age at release	Numbers scanned in recapture Yr	Numbers Released in Release Year	Numbers recaptured
2017	2019	2012	5	47038270	2628	8.13
2017	2019	2011	6	87331478	8210	26.31
2017	2019	2010	7	77710596	9859	31.43
2017	2019	2009	8	29651341	4146	13.10
2017	2019	2008	9	22475425	7259	22.19
2017	2019	2007	10	15337423	3585	10.87
2017	2019	2006	11	7230909	5351	14.01
2018	2019	2013	5	50910310	3049	15.74
2018	2019	2012	6	47038270	2290	14.29
2018	2019	2011	7	87331478	7924	56.24
2018	2019	2010	8	77710596	6506	45.99
2018	2019	2009	9	29651341	3274	19.60
2018	2019	2008	10	22475425	4093	25.13
2018	2019	2007	11	15337423	1670	7.65

Table 8.7.2.1. NE Atlantic Mackerel. SAM parameter estimates for the 2020 update.

	estimate	std.dev	confidence interval lower bound	confidence interval upper bound
observation standard deviations				
Catches age 0	0.94	0.18	0.65	1.36
Catches age 1	0.36	0.24	0.22	0.58
Catches age 2-12	0.11	0.16	0.08	0.15
Egg survey	0.30	0.26	0.18	0.50
Recruitment index	0.22	0.32	0.12	0.42
IESSNS age 3	0.69	0.27	0.41	1.18
IESSNS ages 4-11	0.41	0.17	0.29	0.58
Recapture overdispersion tags	1.22	0.25	1.37	1.13
random walk standard deviation				
F age 0	0.24	0.58	0.07	0.76
F age 1	0.17	0.48	0.07	0.45
F age 2+	0.12	0.20	0.08	0.17
N@age0	0.27	0.29	0.15	0.49
process error standard deviation				
N@age1-12+	0.20	0.09	0.17	0.24

	estimate	std.dev	confidence interval lower bound	confidence interval upper bound
catchabilities				
egg survey	1.26	0.11	1.01	1.56
recruitment index	3.84E-09	1.15E-01	3.06E-09	4.83E-09
IESSNS age 3	0.87	0.25	0.53	1.44
IESSNS age 4	1.29	0.17	0.91	1.83
IESSNS age 5	1.82	0.17	1.28	2.58
IESSNS age 6	2.11	0.18	1.48	3.00
IESSNS age 7	2.30	0.18	1.61	3.28
IESSNS age 8	2.29	0.18	1.60	3.28
IESSNS age 9	2.37	0.18	1.66	3.37
IESSNS ages 10-11	2.10	0.17	1.48	2.97
post tagging survival steal tags	0.40	0.11	0.35	0.45
post tagging survival RFID tags	0.13	0.11	0.11	0.15

Table 8.7.3.1. NE Atlantic Mackerel. STOCK SUMMARY. Low = lower limit and High = higher limit of 95% confidence interval.

Year	Recruitment (age0)			SSB***			Total Catch	Fbar4-8		
	Value	High	Low	Value	High	Low		Value	High	Low
	thousands			tonnes			tonnes			
1980	5572936	10727303	2895194	4130557	8637217	1975347	734950	0.23	0.34	0.150
1981	4966060	8515561	2896081	3611497	6693109	1948707	754045	0.23	0.34	0.153
1982	3741521	6513628	2149183	3475871	5772932	2092815	716987	0.23	0.33	0.156
1983	3519462	6220803	1991160	3707488	5520614	2489845	672283	0.23	0.33	0.159
1984	4307916	6952674	2669209	3991764	5565543	2863006	641928	0.23	0.32	0.163
1985	4132124	6519946	2618802	3973102	5311215	2972115	614371	0.23	0.32	0.168
1986	4112682	6370616	2655026	3558998	4661684	2717144	602201	0.24	0.32	0.174
1987	4298594	6652654	2777525	3522335	4610074	2691246	654992	0.24	0.32	0.180
1988	3765039	5710694	2482277	3465632	4427463	2712751	680491	0.25	0.32	0.188
1989	3574276	5425495	2354706	3239641	4073462	2576499	585920	0.26	0.33	0.198
1990	3257247	5026441	2110769	3327113	4111708	2692234	626107	0.27	0.34	0.21

Year	Recruitment (age0)			SSB***			Total Catch	Fbar4-8		
	Value	High	Low	Value	High	Low		Value	High	Low
	thousands			tonnes			tonnes			
1991	3345760	5058755	2212820	3223833	3943199	2635703	675665	0.28	0.35	0.22
1992	3415441	5168969	2256783	2967654	3595659	2449334	760690	0.29	0.36	0.23
1993	3114294	4680828	2072032	2648249	3189148	2199089	824568	0.30	0.37	0.24
1994	2954974	4437266	1967849	2328879	2785266	1947274	819087	0.31	0.38	0.25
1995	2820793	4267666	1864456	2304722	2734993	1942141	756277	0.31	0.38	0.26
1996	2978741	4516989	1964339	2188968	2589632	1850294	563472	0.31	0.37	0.26
1997	2921373	4340664	1966156	2152980	2515835	1842459	573029	0.30	0.36	0.26
1998	2960497	4093330	2141176	2125366	2488697	1815079	666316	0.31	0.36	0.26
1999	3368150	4639896	2444976	2307589	2695494	1975508	640309	0.32	0.37	0.28
2000	2984820	4295521	2074056	2282430	2607157	1998149	738606	0.34	0.38	0.29
2001	4620927	6454857	3308046	2169060	2473101	1902397	737463	0.36	0.42	0.31
2002	5395320	7791439	3736085	2070613	2389340	1794402	771422	0.38	0.45	0.33
2003	3744163	5676313	2469694	1995321	2304925	1727304	679287	0.40	0.48	0.34
2004	5033082	7034533	3601080	2606407	3054854	2223791	660491	0.37	0.44	0.32
2005	6498029	9816243	4301480	2352444	2765016	2001432	549514	0.32	0.37	0.27
2006	6383515	9361051	4353065	2140762	2513446	1823339	481181	0.30	0.35	0.26
2007	5015005	6967214	3609804	2254547	2628082	1934102	586206	0.33	0.38	0.28
2008	4550703	6385587	3243069	2618575	3097246	2213881	623165	0.32	0.37	0.28
2009	4285860	6372587	2882439	3230003	3830012	2723991	737969	0.30	0.35	0.26
2010	5444074	7656107	3871150	3579017	4213284	3040233	875515	0.29	0.34	0.25
2011	6714868	9956508	4528641	4063019	4795796	3442207	946661	0.29	0.34	0.25
2012	5749246	8016197	4123380	3730890	4436867	3137246	892353	0.28	0.33	0.23
2013	5542105	7748556	3963955	4123080	4934630	3444998	931732	0.28	0.34	0.23
2014	5649315	7903794	4037904	5161009	6170029	4316999	1393000	0.28	0.34	0.23
2015	5094374	7187990	3610557	5148898	6210213	4268960	1208990	0.27	0.33	0.22
2016	6599783	10111607	4307638	4884807	5943050	4014998	1094066	0.24	0.30	0.194
2017	7085600	10816190	4641720	4747484	5819768	3872767	1155944	0.24	0.30	0.191

Year	Recruitment (age0)			SSB***			Total Catch	Fbar4-8		
	Value	High	Low	Value	High	Low		Value	High	Low
	thousands			tonnes			tonnes			
2018	7451634	11259749	4931447	4152849	5193354	3320813	1026437	0.24	0.31	0.185
2019	7057000*			3731510	4924356	2827612	840021	0.22	0.30	0.165
2020	4430112**			3681413†						

*** RCT3 estimate.**

**** Geometric mean 1990–2018.**

***** SSB at spawning time.**

† Estimated value from the forecast.

Table 8.7.3.2. NE Atlantic Mackerel. ESTIMATED POPULATION ABUNDANCE

Units : Thousands

year

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	5572936	4966060	3741521	3519462	4307916	4132124	4112682	4298594	3765039	3574276
1	5059703	5156096	4751452	2751455	2519004	4312198	3425431	3388021	4169732	3032119
2	2366103	4200755	4647301	4432318	1980390	1767144	4204690	2780853	2737326	3948713
3	972617	1907207	3505106	4330549	4401661	1382422	1248325	4094916	2194615	2365721
4	1670355	745579	1432234	2919114	3854844	4070008	1031163	852185	3742853	1691953
5	3540051	1229675	533788	982660	2204833	3102217	3165340	803289	539280	2968855
6	2724560	2460783	872768	387809	669542	1620563	2243664	2163825	606646	347333
7	795585	1809916	1632974	583760	268437	459435	1071907	1496891	1404158	459843
8	294394	541619	1234353	1111319	394264	190575	306124	749740	1025700	1043380
9	816193	200404	368380	841506	754654	270488	132877	203092	522697	706760
10	218593	555943	136360	250270	572819	511456	186991	90031	134082	353101
11	320045	148814	378130	92744	169926	388461	344831	125898	60645	86320
12	669213	674165	559725	635942	493458	448983	563036	606425	487099	362287

year

age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	3257247	3345760	3415441	3114294	2954974	2820793	2978741	2921373	2960497	3368150
1	3127474	2560910	2879523	3145471	2589204	2511345	2250092	2670847	2434188	2624697
2	2389105	2669178	1969105	2420713	2826323	2097342	2081206	1749338	2334228	1975858
3	3918840	2126393	2540092	1628246	1980730	2396165	2165389	1936745	1253369	2364122
4	1843359	3033656	1518849	2022140	1095400	1427237	1810909	1782181	1636758	1257978
5	1089708	1256098	1920333	986309	1382150	684726	976060	1210849	1506954	1262950
6	1959594	773918	937302	1148175	586521	964922	494013	727274	859894	903537
7	215222	1210244	470372	563212	643228	345096	571441	323347	479061	610664
8	343803	137143	726816	307980	336370	286160	216051	345632	261630	308553
9	706915	241483	88432	412727	183495	179555	141082	152011	210399	178852
10	457129	477034	155305	53267	220945	111202	95698	88336	101807	129818
11	233709	287577	299699	95445	30455	135687	64911	51296	54276	62748
12	294216	341835	400351	436829	326384	216495	214492	173874	143032	125690

year

age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	2984820	4620927	5395320	3744163	5033082	6498029	6383515	5015005	4550703	4285860

1	3088791	1828992	5174297	6383423	2756758	3914370	5964390	5567172	4142420	3948696
2	2274794	2606397	1155531	4810464	6804138	2336716	3368928	4796576	4781373	3396133
3	1843905	1759278	2508150	795368	3916446	5307049	1669941	2431298	4331205	4889319
4	1841696	1311896	1544963	1562621	744657	1846932	3111634	1427964	1911146	3811730
5	1032173	1247383	986326	913096	994532	528705	1008728	2023714	1190342	1537271
6	858325	675176	805658	575942	473550	472208	365594	727922	1072750	867800
7	613370	599291	410775	381031	266168	227947	274604	249178	409959	660334
8	371066	407858	345897	241823	184146	132334	128547	179731	172411	253059
9	188910	237187	228067	194603	116354	85856	71562	92336	98870	104916
10	112064	126085	127339	117360	91727	61308	51346	46143	56778	50443
11	69372	67936	62992	66566	47317	30879	31147	33350	21459	27569
12	120860	125630	111587	81515	56940	39751	37502	38743	30481	19779

	year									
age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	5444074	6714868	5749246	5542105	5649315	5094374	6599783	7085600	7451634	8076757
1	3969788	5399307	6504051	4548831	4237175	5805860	3470984	5728555	4839044	5942755
2	3823419	3228433	5435066	6545156	3691941	3334168	5174081	2223628	5361504	3268565
3	3282211	3548370	2613722	5124994	6758175	2888362	2676402	4491903	1451594	3837308
4	4549133	2937621	2867672	2312816	4839479	4502280	2662097	2110303	2942207	1003149
5	2831488	3222021	2255704	2300062	2196323	3332275	3164784	2029934	1405068	1670009
6	1196460	1994304	2226237	1989501	2070860	1729451	2516843	2548650	1366488	1173744
7	538050	851652	1246767	1450411	1767781	1599255	1344641	2178284	1797655	950071
8	354723	385010	545776	765779	1174371	1303366	1146203	1054256	1416843	1257321
9	160305	193316	243234	363435	528759	834725	767930	900159	803881	1032645
10	70064	88237	114403	148229	237245	398262	454963	553315	537506	488384
11	24090	42879	48010	72986	80740	119204	195565	306993	378265	338521
12	30218	36536	45081	61342	55925	87406	115353	219148	276903	367467

Table 8.7.3.3. NE Atlantic Mackerel. ESTIMATED FISHING MORTALITY

	year													
age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
1	0.032	0.032	0.032	0.032	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
2	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.060	0.060	0.060	0.061	0.062
3	0.115	0.115	0.115	0.115	0.116	0.118	0.120	0.121	0.123	0.126	0.128	0.131	0.134	0.136
4	0.186	0.186	0.187	0.187	0.188	0.190	0.194	0.199	0.203	0.209	0.214	0.219	0.222	0.225
5	0.214	0.214	0.215	0.216	0.218	0.220	0.224	0.227	0.233	0.237	0.242	0.247	0.255	0.261
6	0.261	0.261	0.262	0.263	0.266	0.270	0.274	0.279	0.284	0.293	0.302	0.311	0.319	0.326
7	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348
8	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348
9	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348
10	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348
11	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348
12	0.235	0.235	0.235	0.236	0.237	0.240	0.244	0.250	0.257	0.268	0.284	0.305	0.327	0.348

	year													
age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.006	0.005	0.005	0.005	0.005
1	0.031	0.031	0.031	0.031	0.030	0.030	0.030	0.028	0.028	0.024	0.020	0.019	0.019	0.017
2	0.062	0.063	0.064	0.065	0.066	0.067	0.068	0.068	0.067	0.066	0.067	0.062	0.055	0.046
3	0.139	0.141	0.143	0.146	0.149	0.155	0.162	0.158	0.158	0.144	0.146	0.136	0.117	0.108
4	0.228	0.229	0.230	0.231	0.235	0.242	0.254	0.261	0.258	0.237	0.224	0.200	0.186	0.181
5	0.264	0.269	0.276	0.287	0.301	0.314	0.331	0.323	0.328	0.323	0.313	0.284	0.262	0.268
6	0.330	0.331	0.332	0.334	0.340	0.351	0.368	0.401	0.399	0.403	0.386	0.351	0.340	0.337

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  7  0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
  8  0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
  9  0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
  10 0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
  11 0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
  12 0.362 0.360 0.346 0.335 0.338 0.350 0.362 0.413 0.470 0.516 0.475 0.375 0.353 0.423
    year
age  2008  2009  2010  2011  2012  2013  2014  2015  2016  2017  2018  2019
  0  0.004 0.004 0.004 0.004 0.003 0.003 0.003 0.002 0.002 0.002 0.002 0.002
  1  0.016 0.015 0.015 0.014 0.013 0.012 0.012 0.013 0.012 0.011 0.010 0.010
  2  0.041 0.039 0.039 0.039 0.040 0.040 0.041 0.042 0.043 0.044 0.046 0.044
  3  0.105 0.104 0.103 0.100 0.096 0.095 0.103 0.102 0.107 0.111 0.108 0.106
  4  0.180 0.186 0.187 0.184 0.179 0.183 0.185 0.170 0.177 0.176 0.156 0.143
  5  0.263 0.256 0.256 0.249 0.246 0.245 0.263 0.241 0.229 0.228 0.221 0.216
  6  0.316 0.313 0.300 0.297 0.287 0.281 0.299 0.294 0.265 0.252 0.252 0.241
  7  0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
  8  0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
  9  0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
  10 0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
  11 0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
  12 0.419 0.368 0.359 0.362 0.336 0.343 0.333 0.317 0.270 0.272 0.282 0.259
```

Table 8.8.3.1. NE Atlantic Mackerel. Short-term prediction: INPUT DATA

	Stock Numbers	M	Maturity ogive	Prop of F before spw.	Prop of M before spw.	Weights in the stock	Exploita-tion pat-tern	Weights in the catch
2020								
0	4430112	0.15	0.000	0.000	0.312	0.000	0.002	0.043
1	6064337	0.15	0.091	0.402	0.312	0.063	0.010	0.141
2	5065488	0.15	0.506	0.171	0.312	0.195	0.045	0.257
3	2450408	0.15	0.894	0.171	0.312	0.251	0.108	0.309
4	2822877	0.15	0.998	0.171	0.312	0.285	0.158	0.357
5	949832	0.15	1.000	0.261	0.312	0.311	0.221	0.387
6	1045059	0.15	1.000	0.261	0.312	0.327	0.248	0.412
7	836320	0.15	1.000	0.261	0.312	0.350	0.271	0.427
8	625709	0.15	0.999	0.261	0.312	0.371	0.271	0.448
9	771079	0.15	1.000	0.261	0.312	0.393	0.271	0.469
10	859918	0.15	1.000	0.261	0.312	0.424	0.271	0.491
11	356221	0.15	1.000	0.261	0.312	0.433	0.271	0.506
12+	469103	0.15	1.000	0.261	0.312	0.490	0.271	0.535

	Stock Numbers	M	Maturity ogive	Prop of F before spw.	Prop of M before spw.	Weights in the stock	Exploita-tion pat-tern	Weights in the catch
2021								
0	4430112	0.15	0.000	0.000	0.312	0.000	0.002	0.043
1	-	0.15	0.091	0.402	0.312	0.063	0.010	0.141
2	-	0.15	0.506	0.171	0.312	0.195	0.045	0.257
3	-	0.15	0.894	0.171	0.312	0.251	0.108	0.309
4	-	0.15	0.998	0.171	0.312	0.285	0.158	0.357
5	-	0.15	1.000	0.261	0.312	0.311	0.221	0.387
6	-	0.15	1.000	0.261	0.312	0.327	0.248	0.412
7	-	0.15	1.000	0.261	0.312	0.350	0.271	0.427
8	-	0.15	0.999	0.261	0.312	0.371	0.271	0.448
9	-	0.15	1.000	0.261	0.312	0.393	0.271	0.469
10	-	0.15	1.000	0.261	0.312	0.424	0.271	0.491
11	-	0.15	1.000	0.261	0.312	0.433	0.271	0.506
12+	-	0.15	1.000	0.261	0.312	0.490	0.271	0.535
2022								
0	4430112	0.15	0.000	0.000	0.312	0.000	0.002	0.043
1	-	0.15	0.091	0.402	0.312	0.063	0.010	0.141
2	-	0.15	0.506	0.171	0.312	0.195	0.045	0.257
3	-	0.15	0.894	0.171	0.312	0.251	0.108	0.309
4	-	0.15	0.998	0.171	0.312	0.285	0.158	0.357
5	-	0.15	1.000	0.261	0.312	0.311	0.221	0.387
6	-	0.15	1.000	0.261	0.312	0.327	0.248	0.412
7	-	0.15	1.000	0.261	0.312	0.350	0.271	0.427
8	-	0.15	0.999	0.261	0.312	0.371	0.271	0.448
9	-	0.15	1.000	0.261	0.312	0.393	0.271	0.469
10	-	0.15	1.000	0.261	0.312	0.424	0.271	0.491
11	-	0.15	1.000	0.261	0.312	0.433	0.271	0.506
12+	-	0.15	1.000	0.261	0.312	0.490	0.271	0.535

Table 8.8.3.2. NE Atlantic Mackerel. Short-term prediction: Multi-option table for 1 090 879 t catch in 2020 and a range of F-values in 2021.

2020			
TSB	SSB	F_{bar}	Catch
5 004 319	3 681 413	0.316	1 090 879

2021				2022		
TSB	SSB	Fbar	Catch	TSB	SSB	Implied change in the catch
4818501	3810530	0	0	5327305	4458501	-100.0%
-	3803628	0.01	36401	5297077	4421805	-96.7%
-	3796743	0.02	72490	5267114	4385520	-93.4%
-	3789874	0.03	108269	5237412	4349641	-90.1%
-	3783023	0.04	143741	5207969	4314161	-86.8%
-	3776188	0.05	178909	5178782	4279077	-83.6%
-	3769370	0.06	213776	5149848	4244383	-80.4%
-	3762568	0.07	248346	5121166	4210074	-77.2%
-	3755784	0.08	282621	5092732	4176146	-74.1%
-	3749015	0.09	316603	5064545	4142593	-71.0%
-	3742264	0.10	350297	5036601	4109412	-67.9%
-	3735528	0.11	383704	5008899	4076597	-64.8%
-	3728809	0.12	416828	4981435	4044144	-61.8%
-	3722107	0.13	449670	4954209	4012048	-58.8%
-	3715421	0.14	482235	4927216	3980304	-55.8%
-	3708751	0.15	514525	4900455	3948910	-52.8%
-	3702097	0.16	546541	4873924	3917859	-49.9%
-	3695460	0.17	578288	4847621	3887148	-47.0%
-	3688839	0.18	609768	4821542	3856772	-44.1%
-	3682233	0.19	640982	4795687	3826728	-41.2%
-	3675644	0.20	671935	4770052	3797011	-38.4%
-	3669071	0.21	702628	4744635	3767617	-35.6%

2021				2022		
TSB	**SSB**	**Fbar**	**Catch**	**TSB**	**SSB**	**Implied change in the catch**
-	3662514	0.22	733063	4719436	3738543	-32.8%
-	3655973	0.23	763244	4694450	3709783	-30.0%
-	3649448	0.24	793173	4669677	3681335	-27.3%
-	3642939	0.25	822852	4645113	3653194	-24.6%
-	3636445	0.26	852284	4620758	3625357	-21.9%
-	3629967	0.27	881471	4596609	3597820	-19.2%
-	3623505	0.28	910416	4572663	3570579	-16.5%
-	3617059	0.29	939120	4548920	3543630	-13.9%
-	3610628	0.30	967586	4525377	3516970	-11.3%
-	3604213	0.31	995817	4502032	3490595	-8.7%
-	3597813	0.32	1023814	4478883	3464503	-6.1%
-	3591429	0.33	1051581	4455928	3438688	-3.6%
-	3585061	0.34	1079118	4433165	3413148	-1.1%
-	3578708	0.35	1106429	4410593	3387880	1.4%
-	3572370	0.36	1133515	4388209	3362880	3.9%
-	3566047	0.37	1160380	4366012	3338145	6.4%
-	3559740	0.38	1187023	4344000	3313672	8.8%
-	3553448	0.39	1213449	4322172	3289457	11.2%
-	3547172	0.40	1239659	4300524	3265497	13.6%
-	3540910	0.41	1265655	4279056	3241789	16.0%
-	3534664	0.42	1291439	4257766	3218331	18.4%
-	3528433	0.43	1317014	4236653	3195118	20.7%
-	3522216	0.44	1342380	4215713	3172148	23.1%
-	3516015	0.45	1367541	4194946	3149419	25.4%
-	3509829	0.46	1392498	4174351	3126926	27.6%
-	3503658	0.47	1417253	4153924	3104668	29.9%
-	3497501	0.48	1441807	4133666	3082641	32.2%
-	3491360	0.49	1466164	4113574	3060843	34.4%

2021				2022		
TSB	SSB	Fbar	Catch	TSB	SSB	Implied change in the catch
-	3485233	0.50	1490325	4093646	3039270	36.6%
-	3479121	0.51	1514291	4073881	3017921	38.8%
-	3473024	0.52	1538065	4054278	2996792	41.0%
-	3466941	0.53	1561648	4034834	2975880	43.2%
-	3460874	0.54	1585042	4015549	2955184	45.3%
-	3454820	0.55	1608249	3996420	2934700	47.4%
-	3448782	0.56	1631271	3977447	2914426	49.5%
-	3442757	0.57	1654110	3958627	2894359	51.6%
-	3436748	0.58	1676766	3939960	2874497	53.7%
-	3430753	0.59	1699243	3921444	2854838	55.8%
-	3424772	0.60	1721541	3903077	2835378	57.8%
-	3418805	0.61	1743662	3884858	2816116	59.8%
-	3412853	0.62	1765609	3866785	2797049	61.9%
-	3406915	0.63	1787382	3848858	2778175	63.8%
-	3400992	0.64	1808983	3831074	2759492	65.8%
-	3395083	0.65	1830414	3813433	2740996	67.8%
-	3389187	0.66	1851677	3795933	2722687	69.7%
-	3383306	0.67	1872772	3778572	2704562	71.7%
-	3377440	0.68	1893703	3761350	2686618	73.6%
-	3371587	0.69	1914469	3744265	2668853	75.5%
-	3365748	0.70	1935073	3727316	2651266	77.4%
-	3359923	0.71	1955517	3710501	2633854	79.3%
-	3354112	0.72	1975801	3693819	2616614	81.1%
-	3348315	0.73	1995927	3677270	2599546	83.0%
-	3342532	0.74	2015898	3660850	2582647	84.8%
-	3336763	0.75	2035713	3644561	2565915	86.6%
-	3331008	0.76	2055375	3628399	2549348	88.4%
-	3325266	0.77	2074885	3612365	2532944	90.2%

2021				2022		
TSB	**SSB**	**Fbar**	**Catch**	**TSB**	**SSB**	**Implied change in the catch**
-	3319538	0.78	2094244	3596456	2516701	92.0%
-	3313824	0.79	2113454	3580672	2500617	93.7%
-	3308123	0.80	2132517	3565011	2484691	95.5%
-	3302436	0.81	2151433	3549472	2468920	97.2%
-	3296763	0.82	2170204	3534055	2453303	98.9%
-	3291103	0.83	2188832	3518758	2437837	100.6%
-	3285456	0.84	2207317	3503579	2422522	102.3%
-	3279824	0.85	2225661	3488518	2407355	104.0%
-	3274204	0.86	2243865	3473574	2392335	105.7%
-	3268598	0.87	2261931	3458745	2377459	107.3%
-	3263005	0.88	2279860	3444031	2362726	109.0%
-	3257426	0.89	2297653	3429430	2348135	110.6%
-	3251860	0.90	2315311	3414941	2333684	112.2%
-	3246307	0.91	2332836	3400564	2319371	113.8%
-	3240767	0.92	2350228	3386297	2305195	115.4%
-	3235241	0.93	2367490	3372139	2291154	117.0%
-	3229728	0.94	2384622	3358089	2277246	118.6%
-	3224227	0.95	2401626	3344146	2263470	120.2%
-	3218740	0.96	2418502	3330310	2249824	121.7%
-	3213266	0.97	2435252	3316578	2236307	123.2%
-	3207805	0.98	2451877	3302951	2222917	124.8%
-	3202357	0.99	2468378	3289427	2209654	126.3%
-	3196922	1.00	2484756	3276006	2196515	127.8%
-	3191500	1.01	2501012	3262685	2183498	129.3%
-	3186090	1.02	2517148	3249465	2170604	130.7%
-	3180694	1.03	2533165	3236345	2157829	132.2%
-	3175310	1.04	2549063	3223323	2145174	133.7%
-	3169939	1.05	2564844	3210399	2132635	135.1%

2021				2022		
TSB	SSB	Fbar	Catch	TSB	SSB	Implied change in the catch
-	3164580	1.06	2580509	3197571	2120213	136.6%
-	3159235	1.07	2596059	3184839	2107906	138.0%
-	3153902	1.08	2611494	3172202	2095712	139.4%
-	3148582	1.09	2626817	3159660	2083630	140.8%

Table 8.8.3.3. NE Atlantic Mackerel. Short-term prediction: Management option table for 1 090 879 t catch in 2020 and a range of catch options in 2021.

Rationale	Catch (2021)	F_{bar} (2021)	SSB (2021)	SSB (2022)	% SSB change	% catch change	% advice change
MSY approach: F = FMSY	852284	0.26	3636445	3625357	-0.3	-21.9	-7.6
Norway-EU-Faroes LTMS Catch(2021) = 2020 TAC -20%^	737651	0.22	3661522	3734166	2.0	-32.4	-20.0
Fbar(2021) = 0.21(LTMS target F)	702628	0.21	3669071	3767617	2.7	-35.6	-23.8
Catch(2021) = 2020 TAC	922064	0.28	3620894	3559635	-1.7	-15.5	0.0
Catch(2021) = 2020 TAC +25%	1152580	0.37	3567887	3345321	-6.2	5.7	25.0
Catch(2021) = Zero	0	0	3810530	4458501	17.0	-100.0	-100.0
Catch(2021) = 2020 catch -20%	872703	0.27	3631917	3606085	-0.7	-20.0	-5.4
Catch(2021) = 2020 catch	1090879	0.34	3582329	3402260	-5.0	0.0	18.3
Catch(2021) = 2020 catch +25%	1363599	0.45	3516989	3152976	-10.4	25.0	47.9
Fbar(2021) = Fbar(2020)	1012503	0.32	3600404	3475037	-3.5	-7.2	9.8
Fbar(2021) = 0.36 (Fpa)	1133515	0.36	3572370	3362880	-5.9	3.9	22.9
Fbar(2021) = 0.46 (Flim)	1392498	0.46	3509829	3126926	-10.9	27.6	51.0

*** SSB 2022 relative to SSB 2021.**

**** Catch in 2021 relative to estimated catches in 2020 (1 090 879 t). There is no internationally agreed TAC for 2020.**

***** Advice value for 2021 relative to the advice value for 2020 (922 064 t).**

^ Following the consultations between Norway, the European Union, and the Faroe Islands on the management of mackerel in the northeast Atlantic, a total catch of 922 064 t was set for 2020 (Anon., 2019).

8.15 Figures

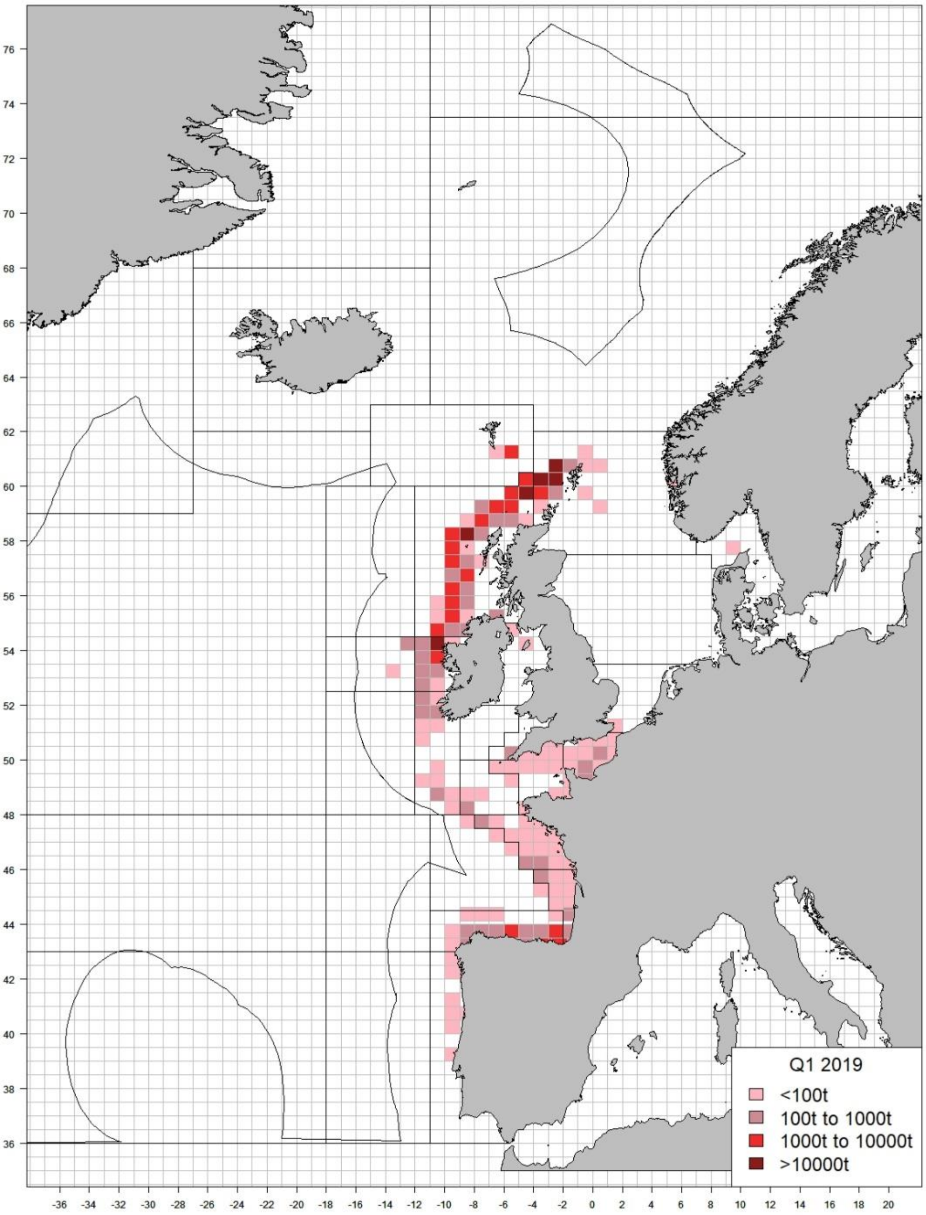

Figure 8.4.2.1. NE Atlantic Mackerel. Commercial catches in 2019, quarter 1.

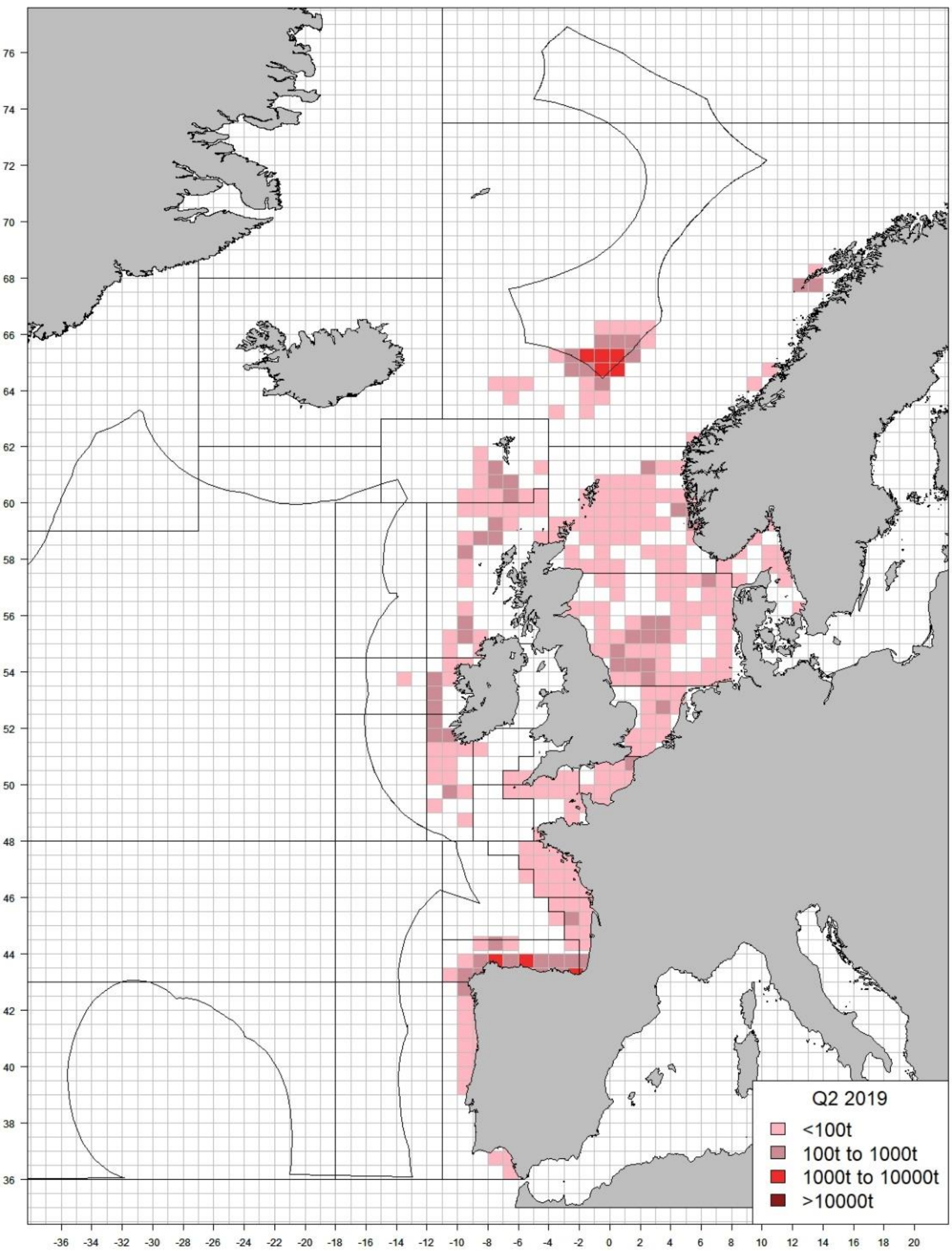

Figure 8.4.2.2. NE Atlantic Mackerel. Commercial catches in 2019, quarter 2.

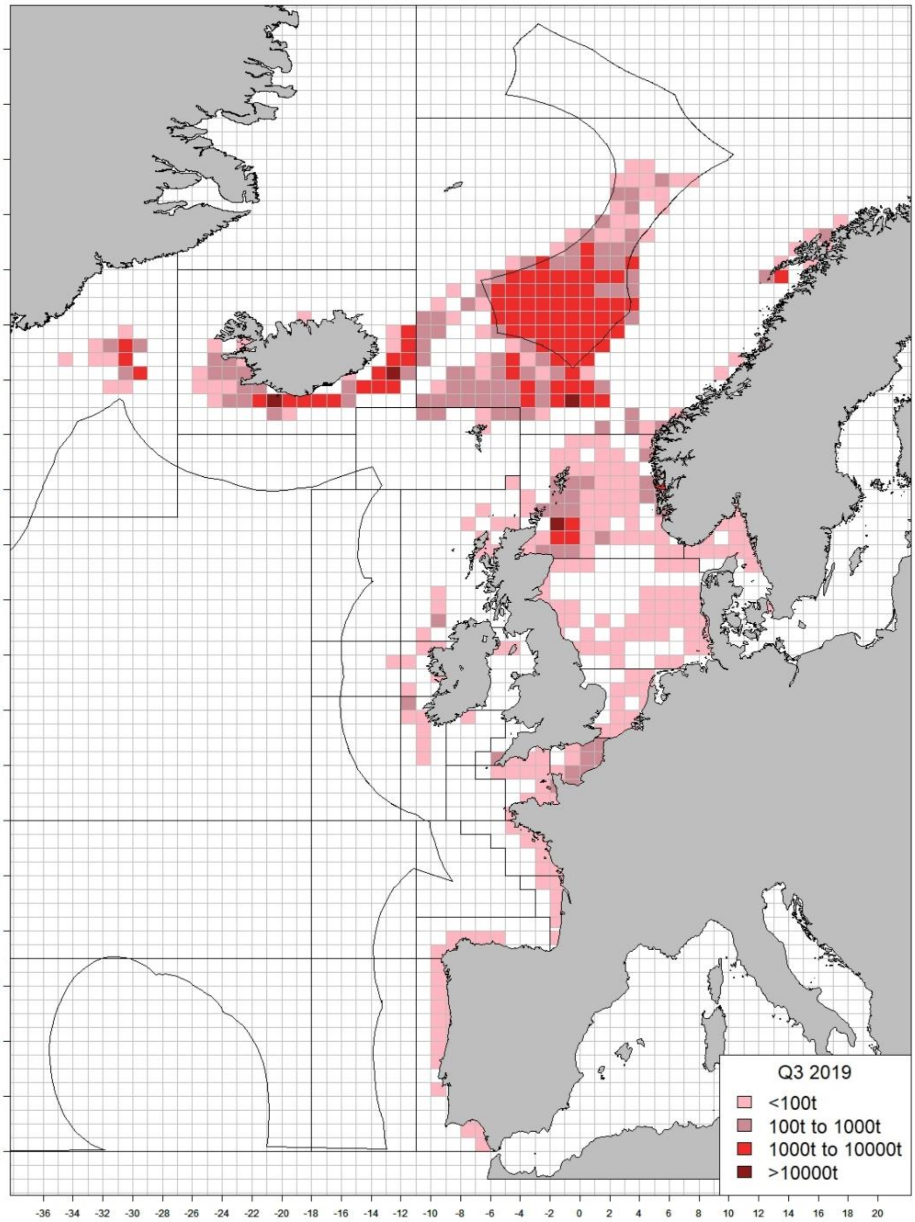

Figure 8.4.2.3. NE Atlantic Mackerel. Commercial catches in 2019, quarter 3.

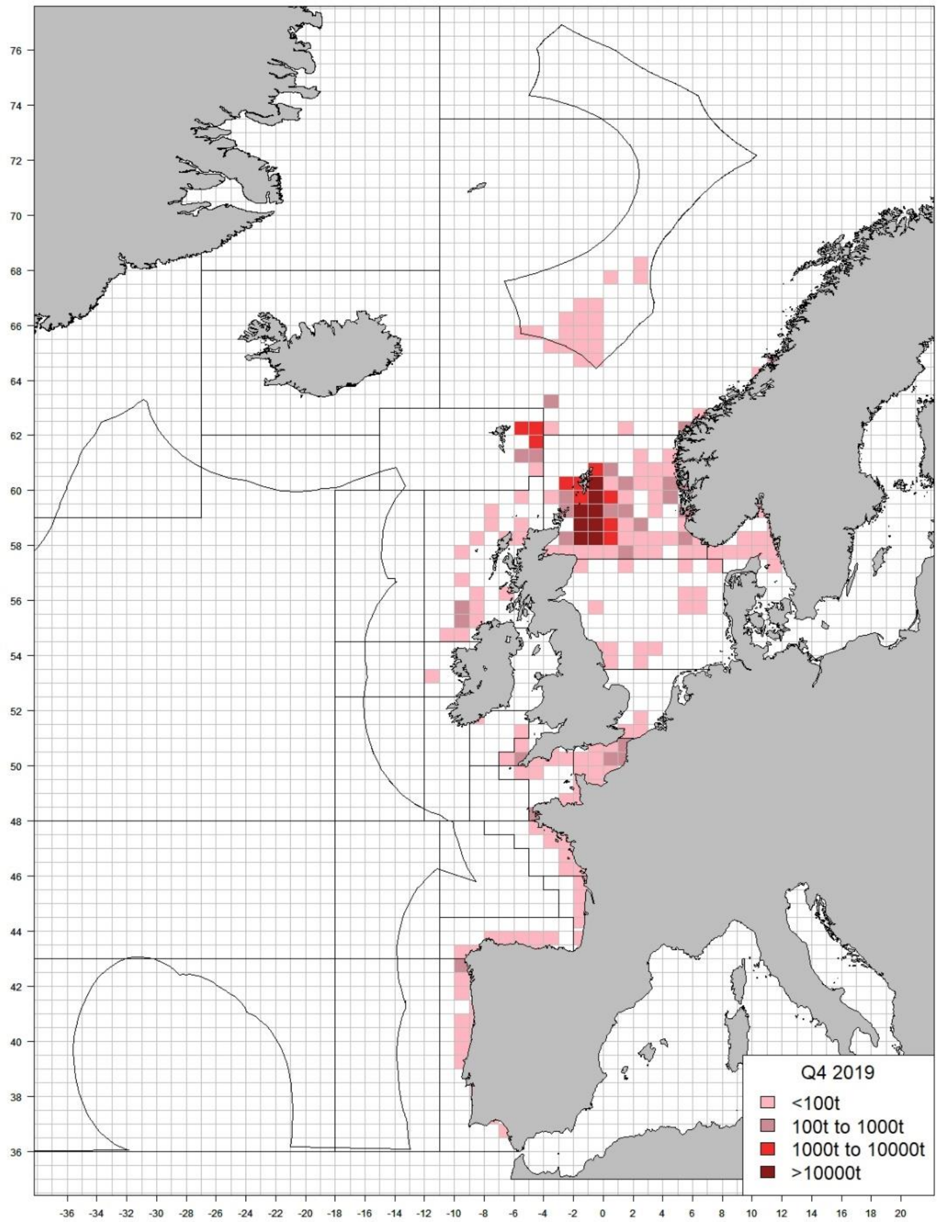

Figure 8.4.2.4. NE Atlantic Mackerel. Commercial catches in 2019, quarter 4.

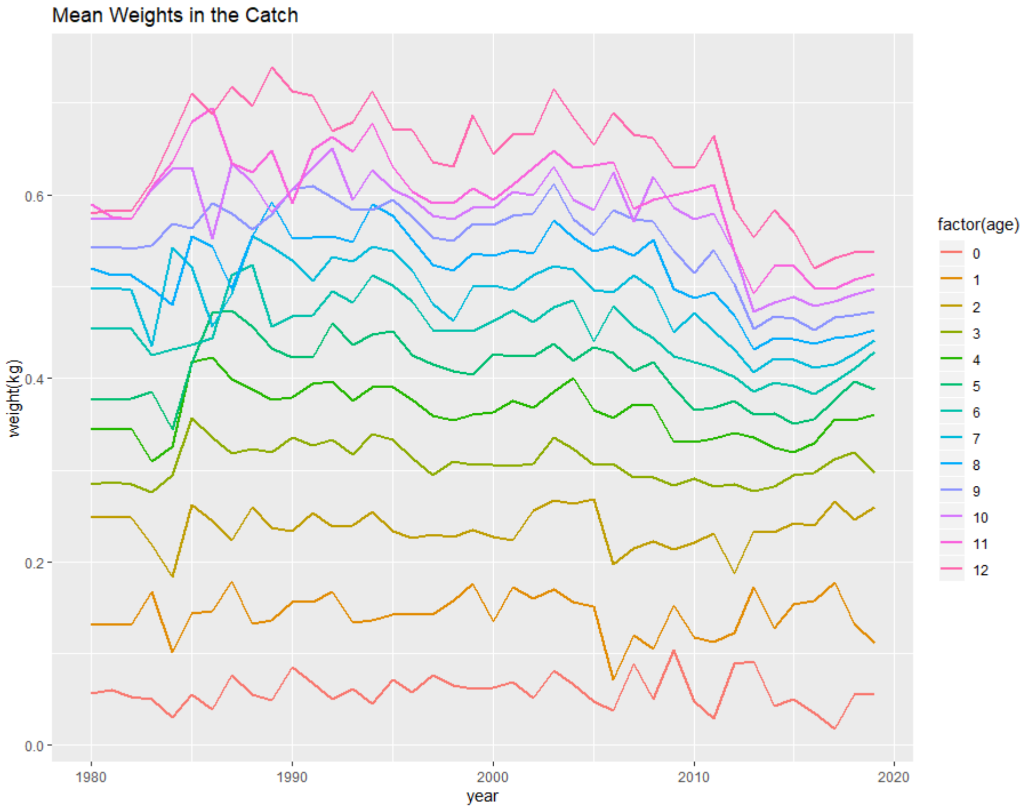

Figure 8.5.2.1. NE Atlantic mackerel. Weights-at-age in the catch.

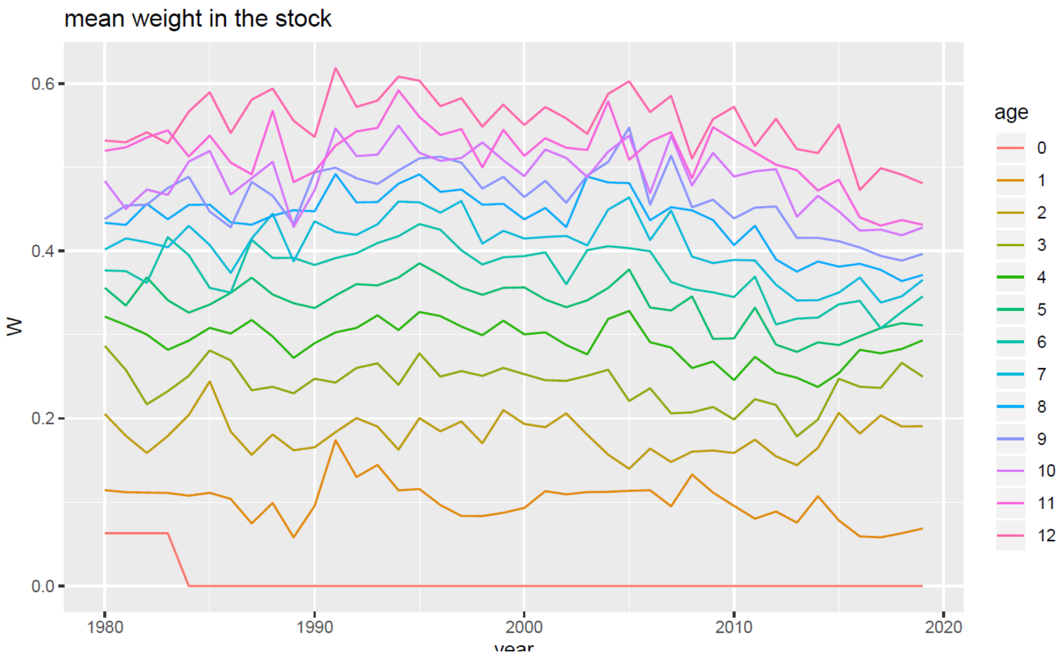

Figure 8.5.2.2. NE Atlantic mackerel. Weights-at-age in the stock.

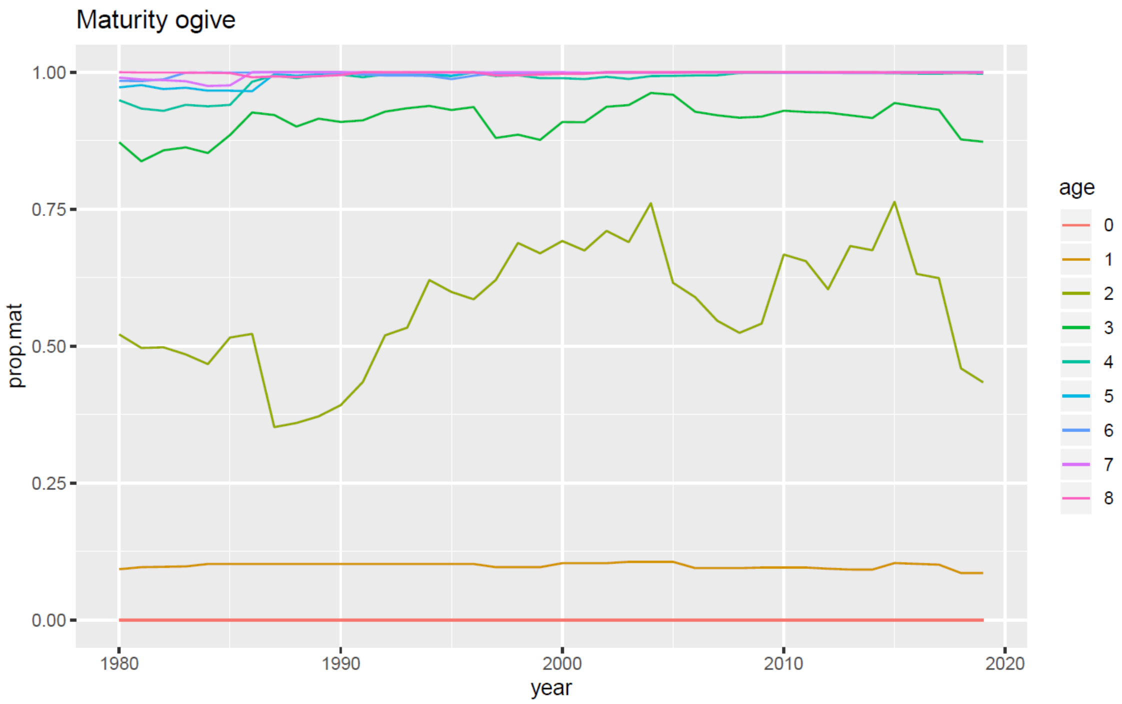

Figure 8.5.3.1. NE Atlantic mackerel. Proportion of mature fish at age.

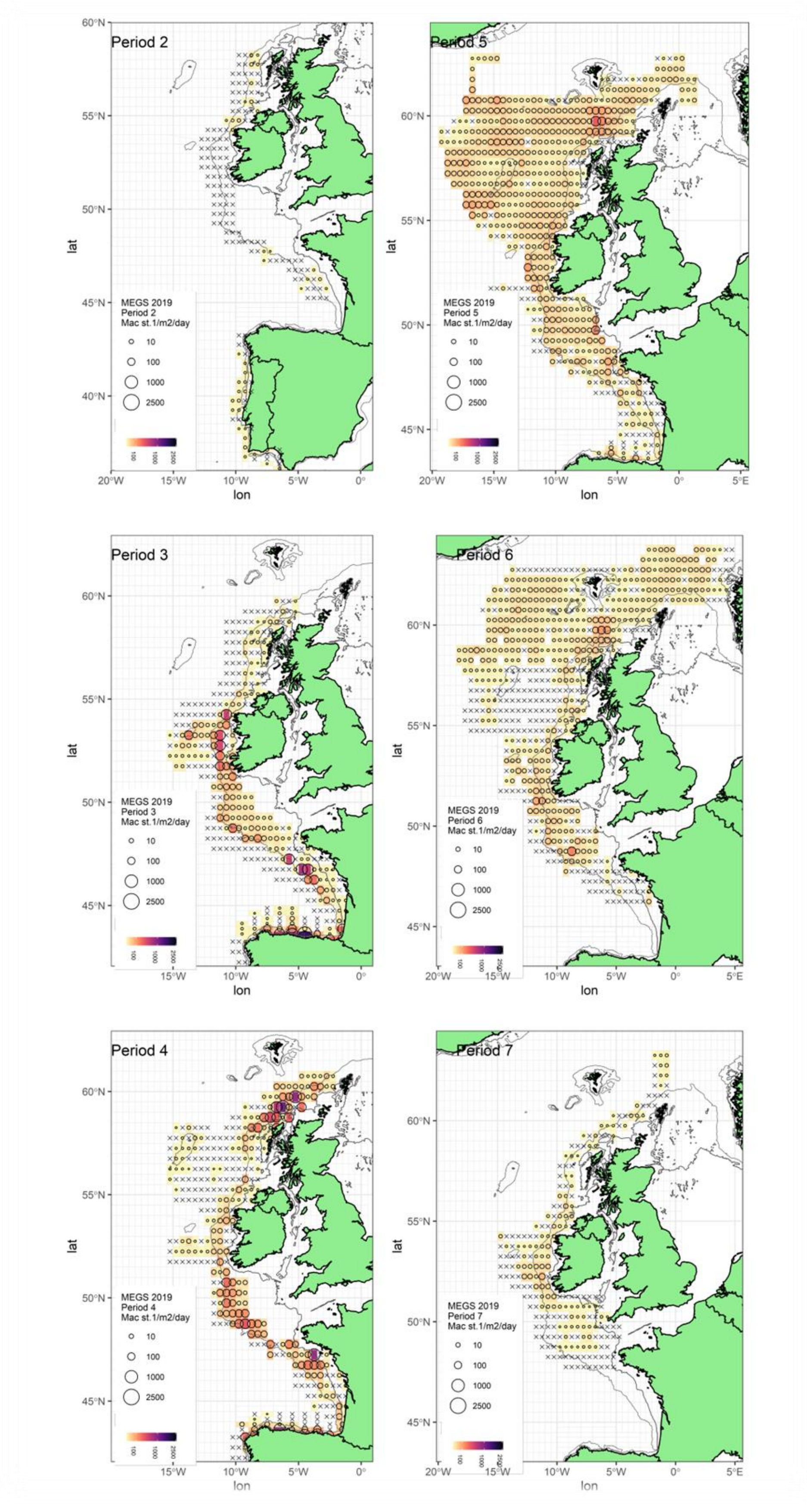

Figure 8.6.1.1.1. Mackerel egg production by half rectangle for all periods from MEGS survey in 2019. Circle areas and colour scale represent mackerel stage I eggs/m²/day by half rectangle. Crosses represent zero values.

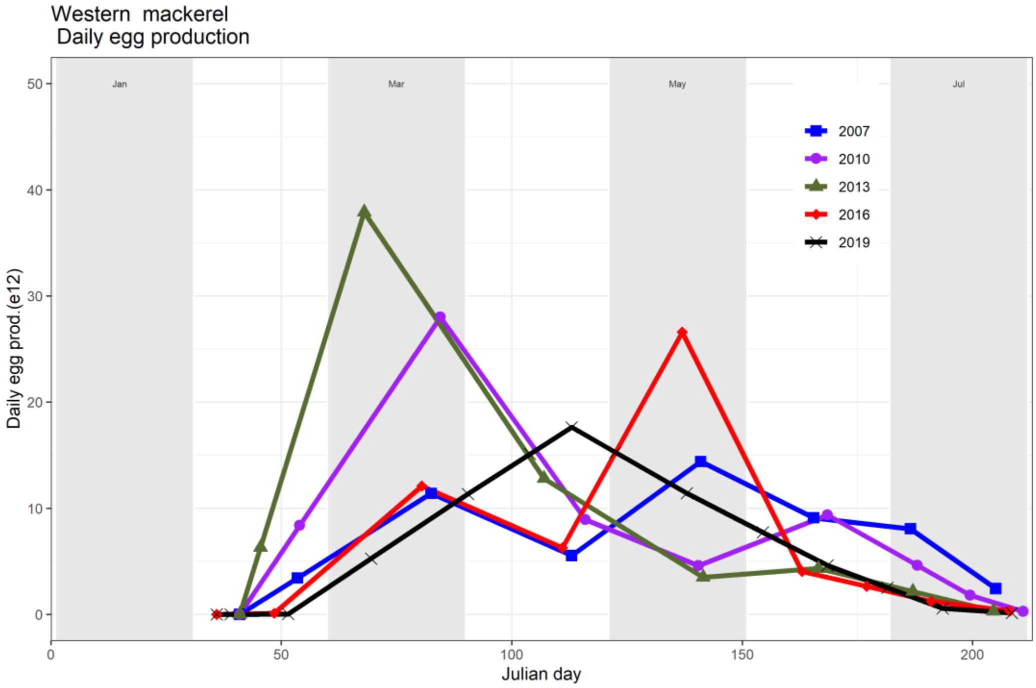

Figure 8.6.1.1.2. The mean daily stage I egg production estimates (DEP) in the mackerel western spawning component for each survey period plotted against the mid-period. The curves for 2007, 2010 2013 and 2016 are included for comparison. Odd months are highlighted in grey background.

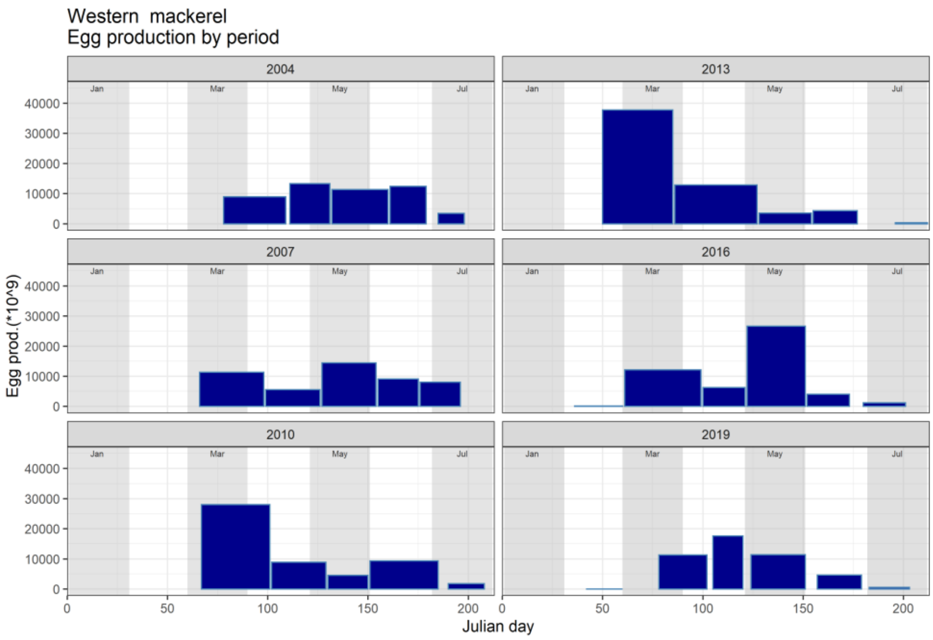

Figure 8.6.1.1.3. Egg production by period for NEA mackerel in the western spawning component. Bar area represents egg production by period. Odd months are highlighted in grey background.

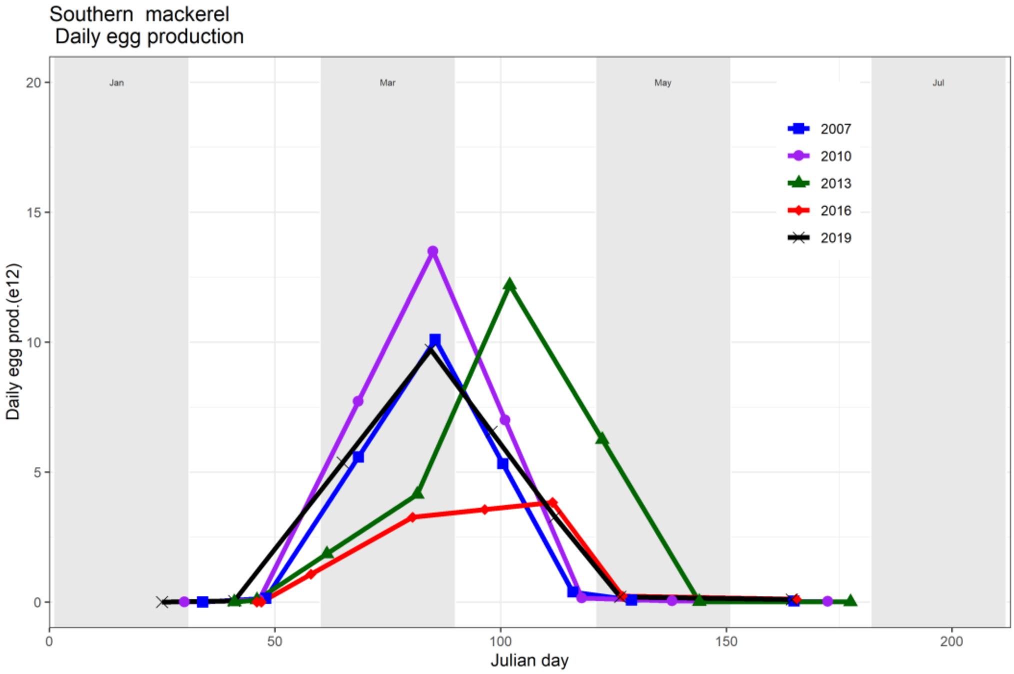

Figure 8.6.1.1.4. The mean daily stage I egg production estimates (DEP) in the mackerel southern spawning component for each survey period plotted against the mid-period. The curves for 2007, 2010 2013 and 2016 are included for comparison. Odd months are highlighted in grey background.

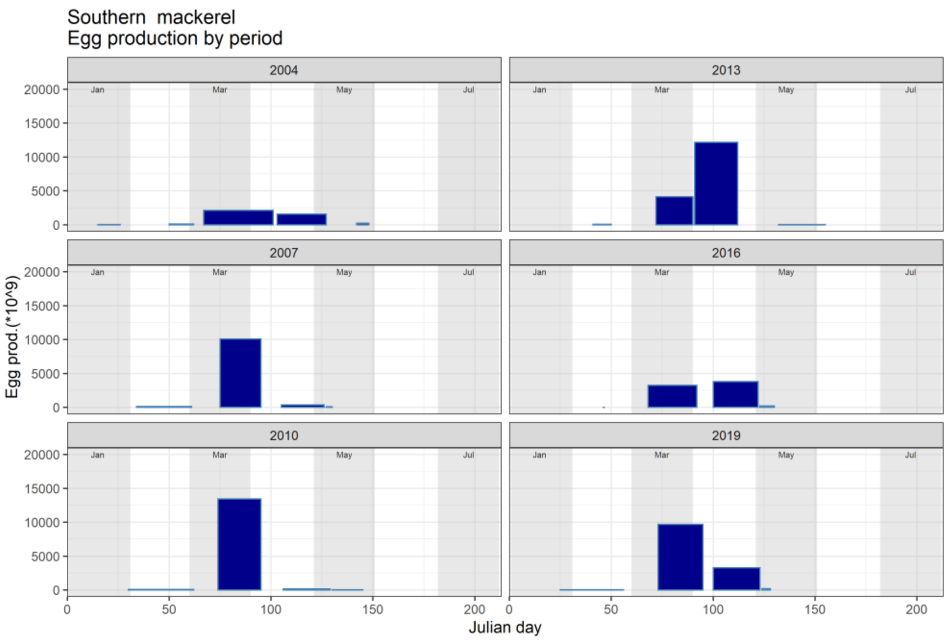

Figure 8.6.1.1.5. Egg production by period for NEA mackerel in the southern spawning component. Bar area represents egg production by period. Odd months are highlighted in grey background.

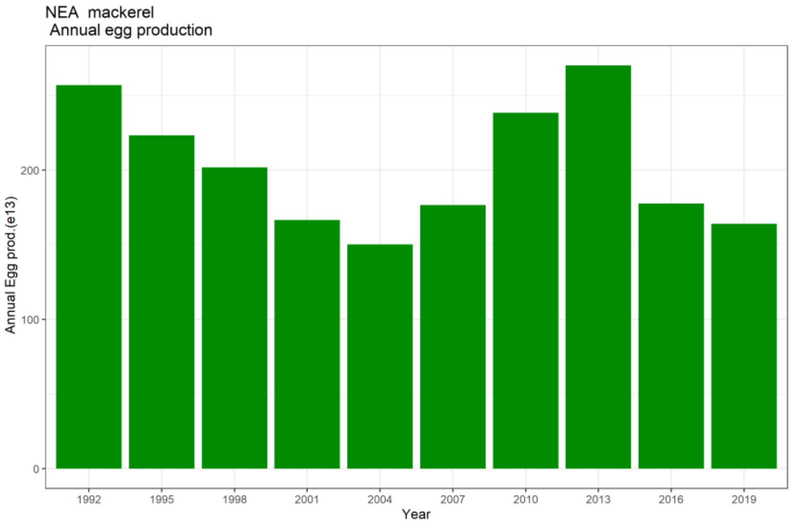

Figure 8.6.1.1.6. Combined NEA mackerel Total Annual Egg Production estimates (*10^{13}) - 1992 – 2019.

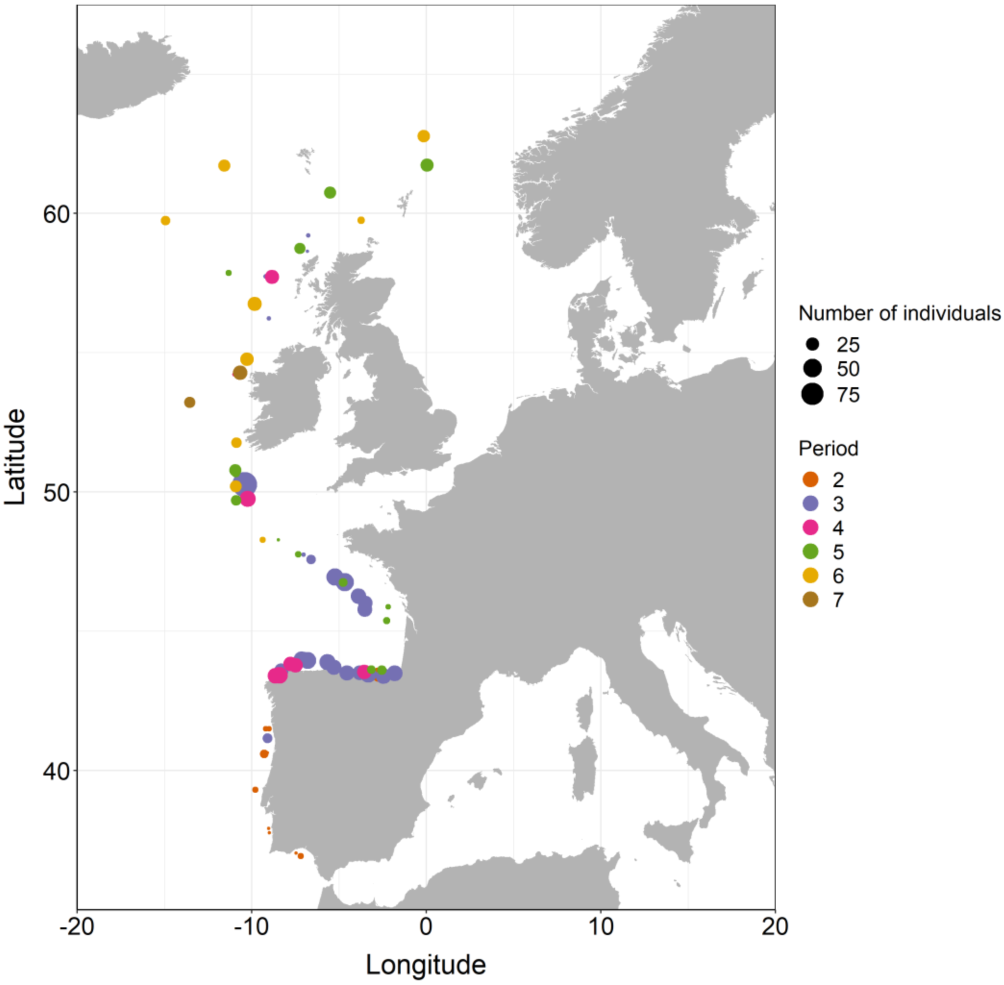

Figure 8.6.1.1.7. Adult females sampled by period for mackerel during 2019 survey.

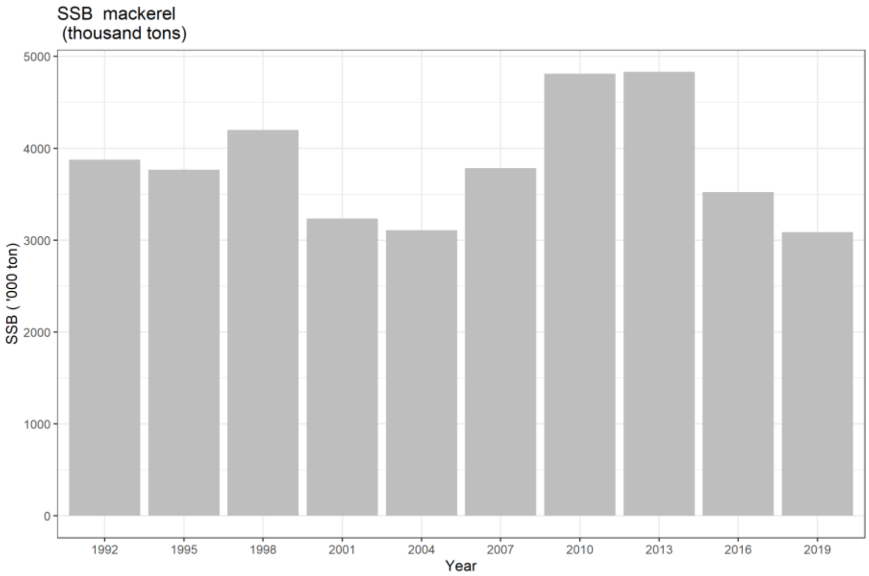

Figure 8.6.1.1.8. Mackerel SSB estimates derived from the mackerel egg surveys for the combined survey area (1992-2019).

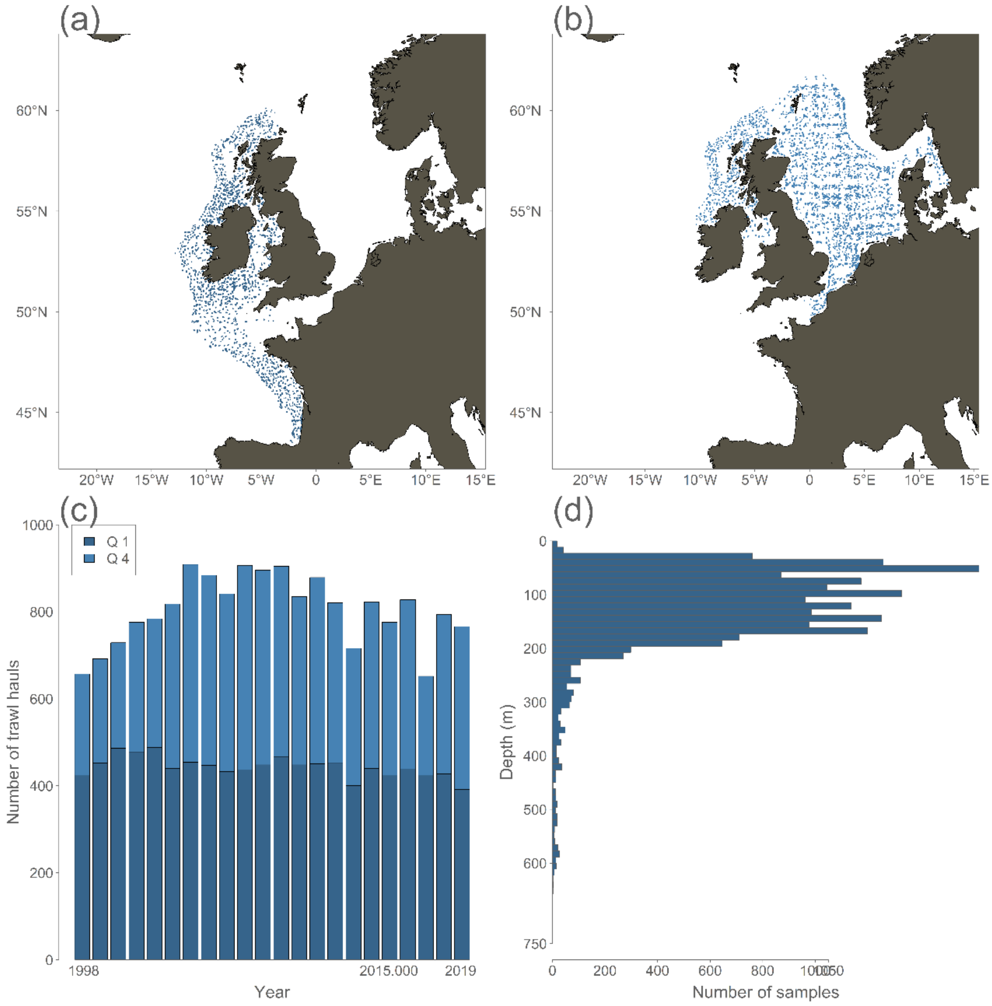

Figure 8.6.2.1. Demersal trawl survey data used to derive the abundance index of age-0 mackerel. (a) Trawl sample locations in the fourth quarter (Q4, October - November, blue dots); (b) trawl sample locations in the first quarter (Q1, January - March, light blue dots); (c) number of samples by year and quarter; and (d) depth.

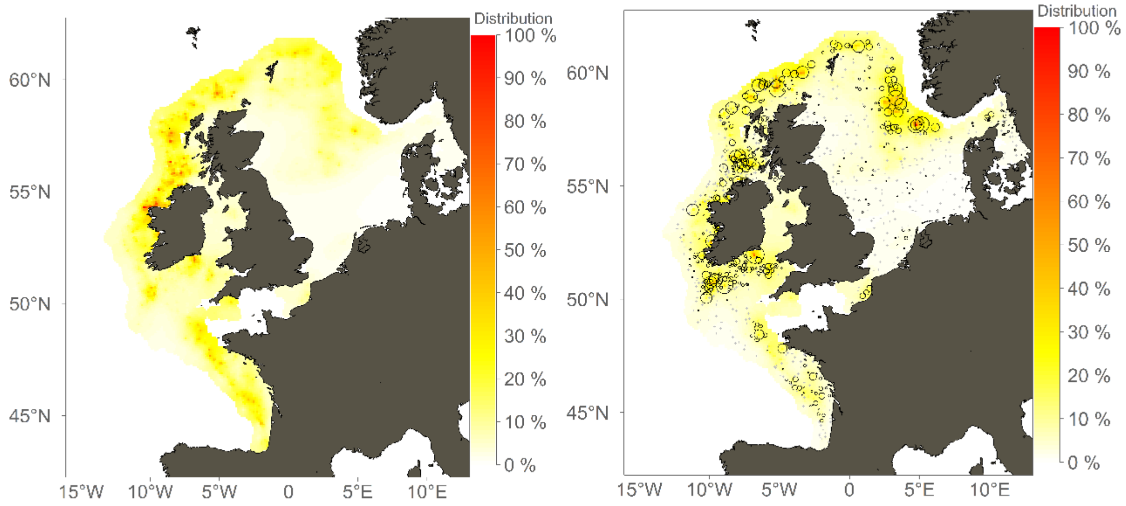

Figure 8.6.2.2. Spatial distribution of mackerel juveniles at age 0 in October to March. Left) average for cohorts from 1998-2019; and Right) 2019 cohort. Mackerel squared catch rates by trawl haul (circle areas represent catch rates in kg/km2) overlaid on modelled squared catch rates per 10 x 10 km rectangle. Each rectangle is coloured according to the expected squared catch rate in percent of the highest value for that year. See Jansen *et al.* (2015) for details.

Figure 8.6.2.3. Index of mackerel juveniles at age 0 in October to March proxied by annual integration of square root of expected catch in demersal trawl surveys (Blue lines). See Jansen *et al.* (2015) for details. * Rescaled

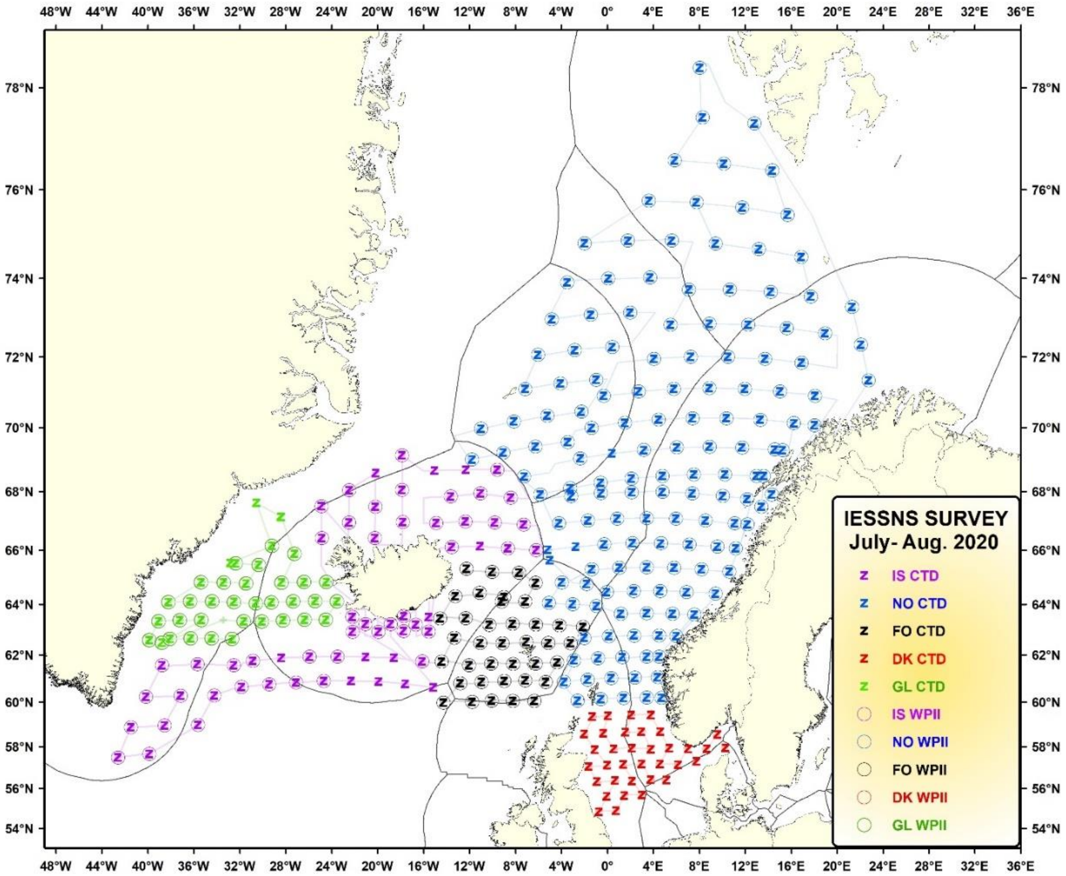

Figure 8.6.3.1. Fixed predetermined trawl stations (shown for CTD and WP2) included in the IESSNS 1st July – 4th August 2020. At each station a 30 min surface trawl haul, a CTD station (0-500 m) and WP2 plankton net samples (0-200 m depth) were performed. The colour codes, Árni Friðriksson (purple), Tróndur í Gøtu (black), Kings Bay and Vendla (blue), Eros (green) and Ceton (red).

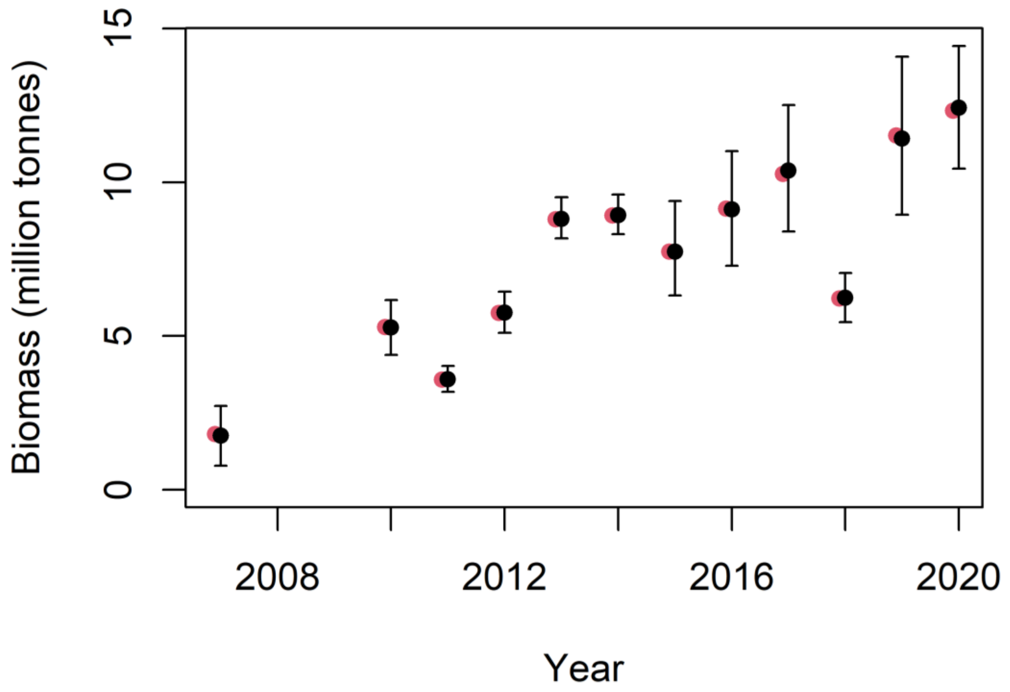

Figure 8.6.3.2a. Estimated total stock biomass of mackerel from IESSNS calculated using StoX for the years 2010 and from 2012 to 2020. Displayed is StoX baseline estimate (red dot) and a bootstrap estimate (black dot), calculated using 1000 replicates, with 90% confidence intervals (vertical line) based on the bootstrap. Analysis excludes the North Sea.

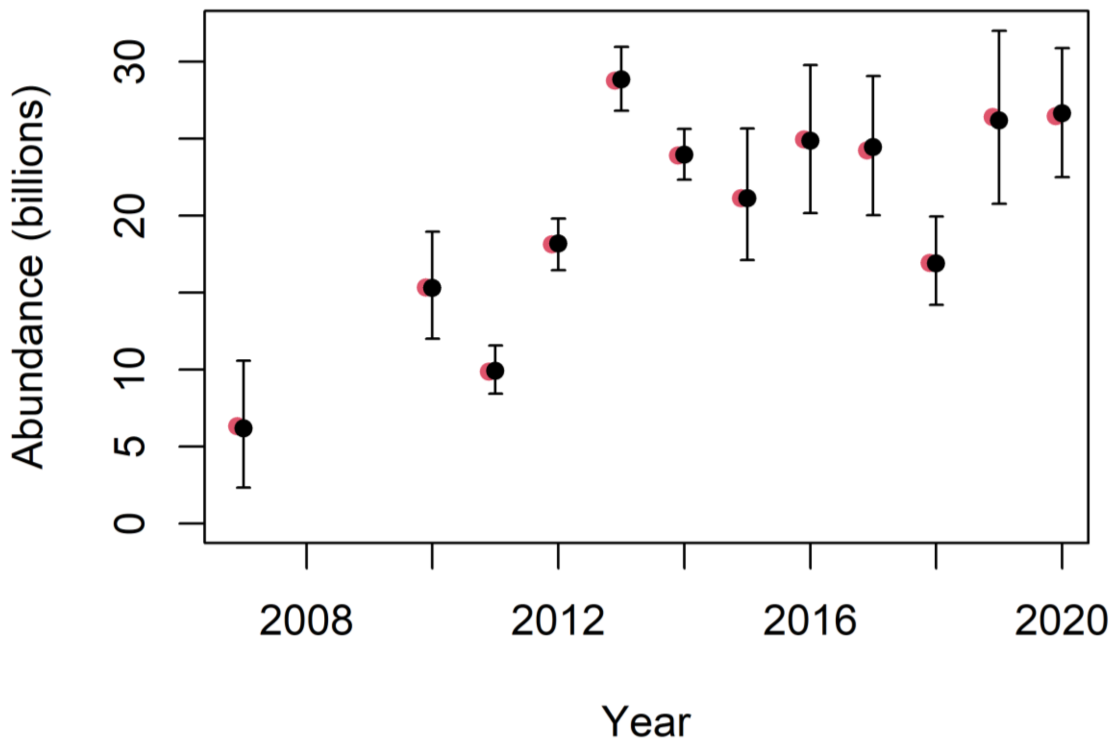

Figure 8.6.3.2b. Estimated total stock numbers (TSN) of mackerel from IESSNS calculated using StoX for the years 2010 and from 2012 to 2020. Displayed is StoX baseline estimate (red dot) and a bootstrap estimate (black dot), calculated using 1000 replicates, with 90% confidence intervals (vertical line) based on the bootstrap. Analysis excludes the North Sea.

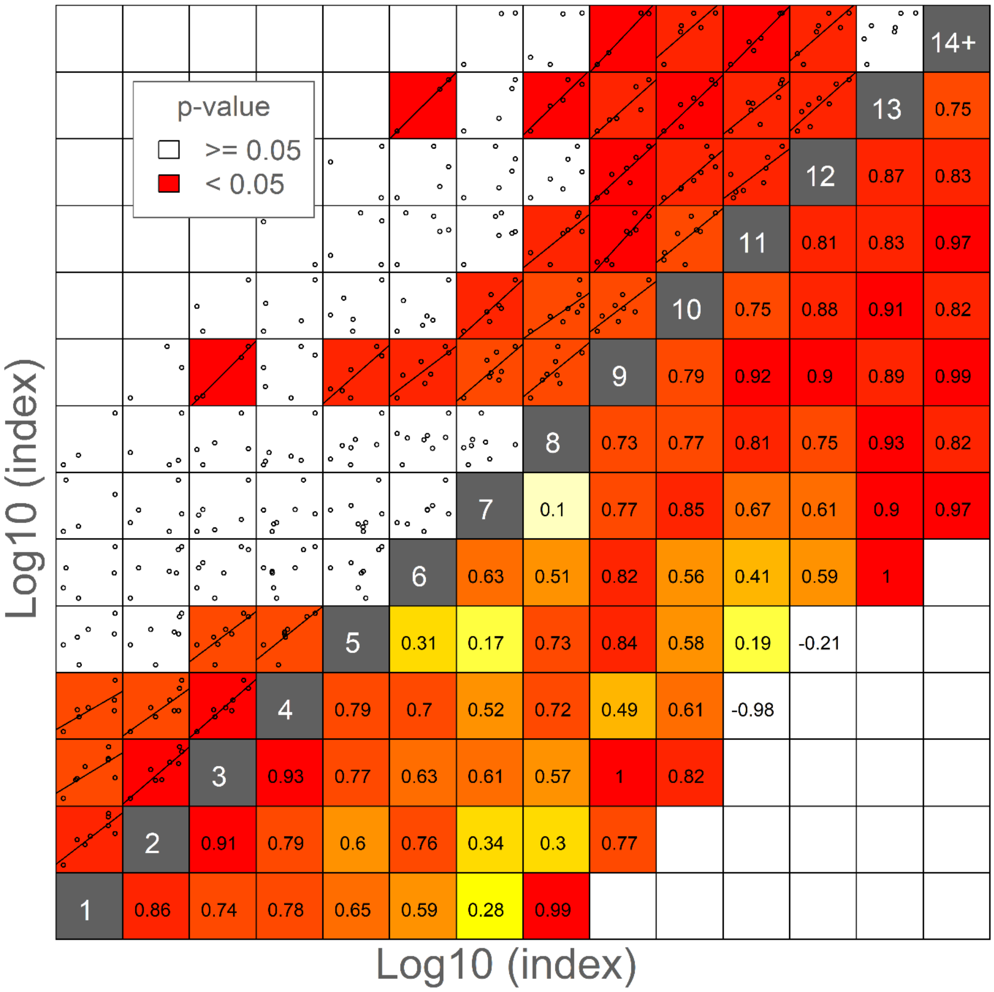

Figure 8.6.3.3. Internal consistency of the mackerel abundance index from the IESSNS surveys including data from 2012 to 2020, excluding North Sea. Ages indicated by white numbers in grey diagonal cells. Statistically significant positive correlations (*p<0.05*) are indicated by regression lines and red cells in upper left half. Correlation coefficients (r) are given in the lower right half.

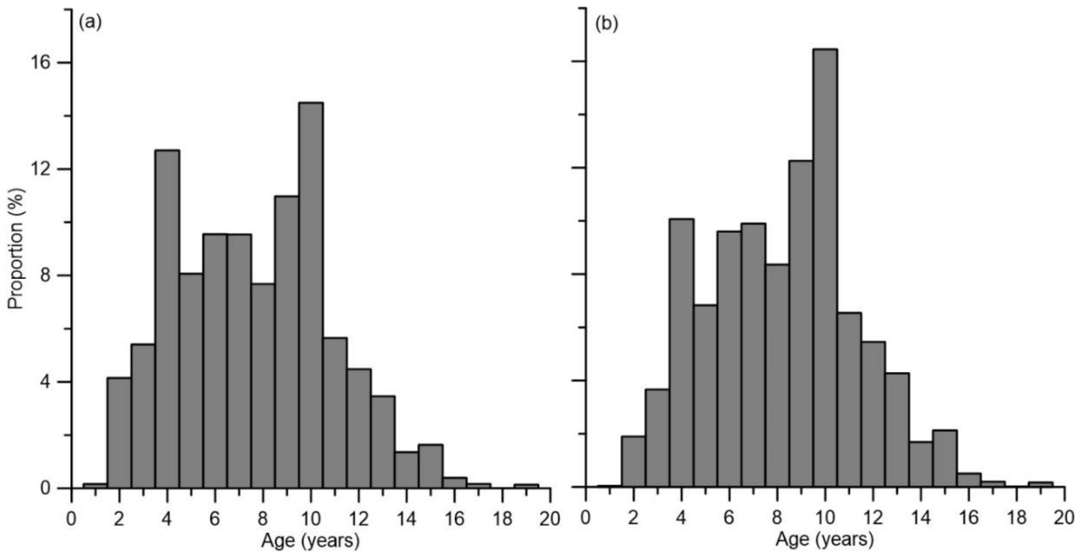

Figure 8.6.3.4a. Mackerel age distribution from IESSNS 2020 represented for abundance (a: % in numbers) and for biomass (b: % in biomass). Age index in calculated using the baseline estimate in StoX and excluding the North Sea.

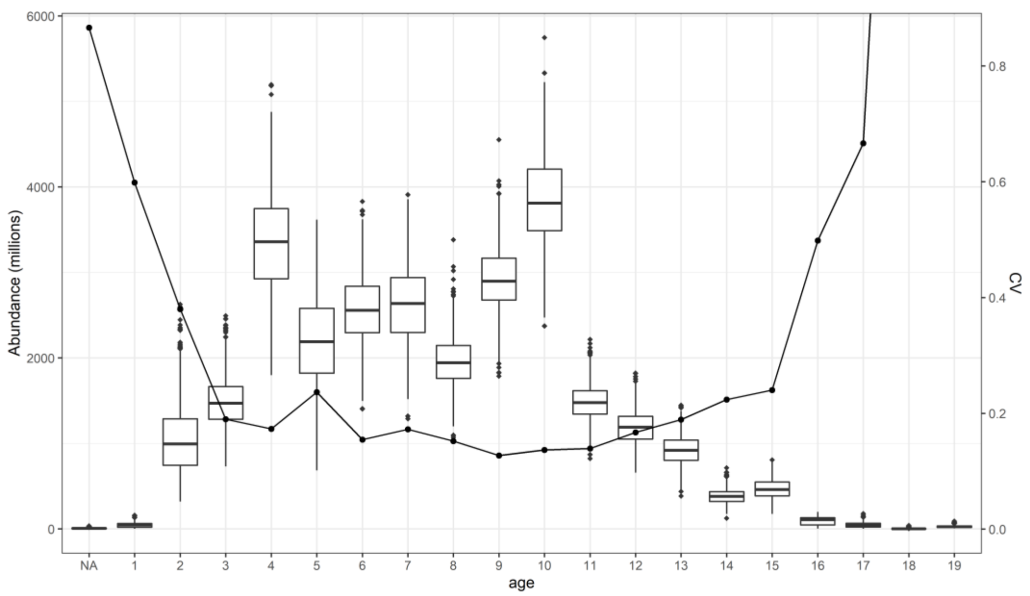

Figure 8.6.3.4b. Mackerel numbers by age from the IESSNS survey in 2020, excluding North Sea. Boxplot of abundance and relative standard error (CV) obtained by bootstrapping with 1000 replicates using the StoX software (http://www.imr.no/forskning/prosjekter/stox/nb-no).

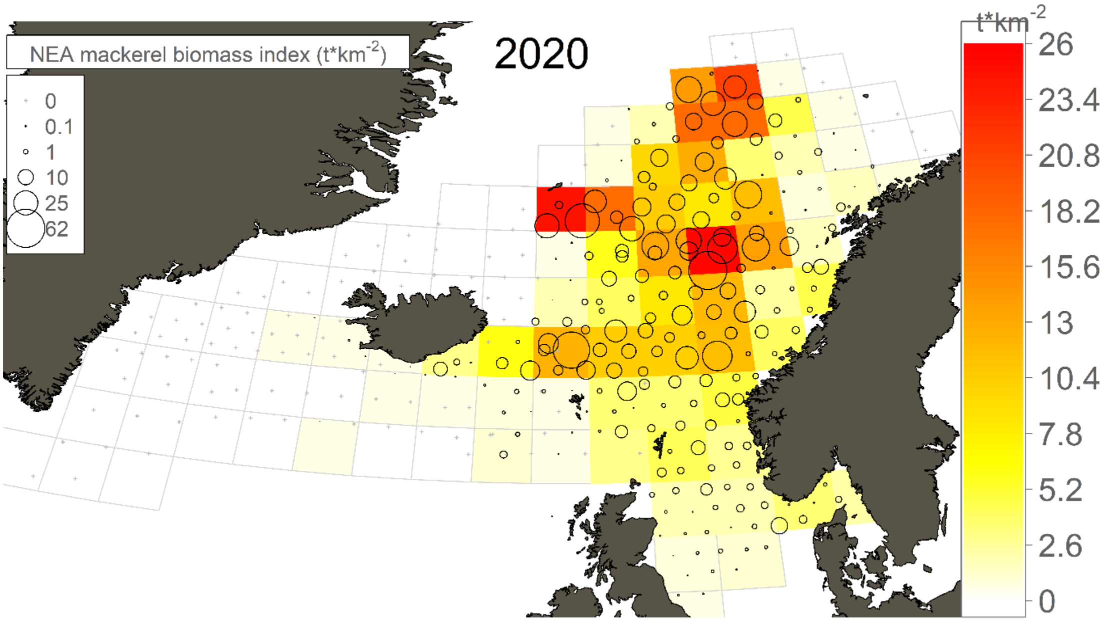

Figure 8.6.3.5a. Mackerel catch rates from predetermined surface trawl stations (circle size represents catch rate in kg/km2) overlaid on mean catch rate per standardized rectangle (2° lat. x 4° lon.) from the 2020 IESSNS, including North Sea.

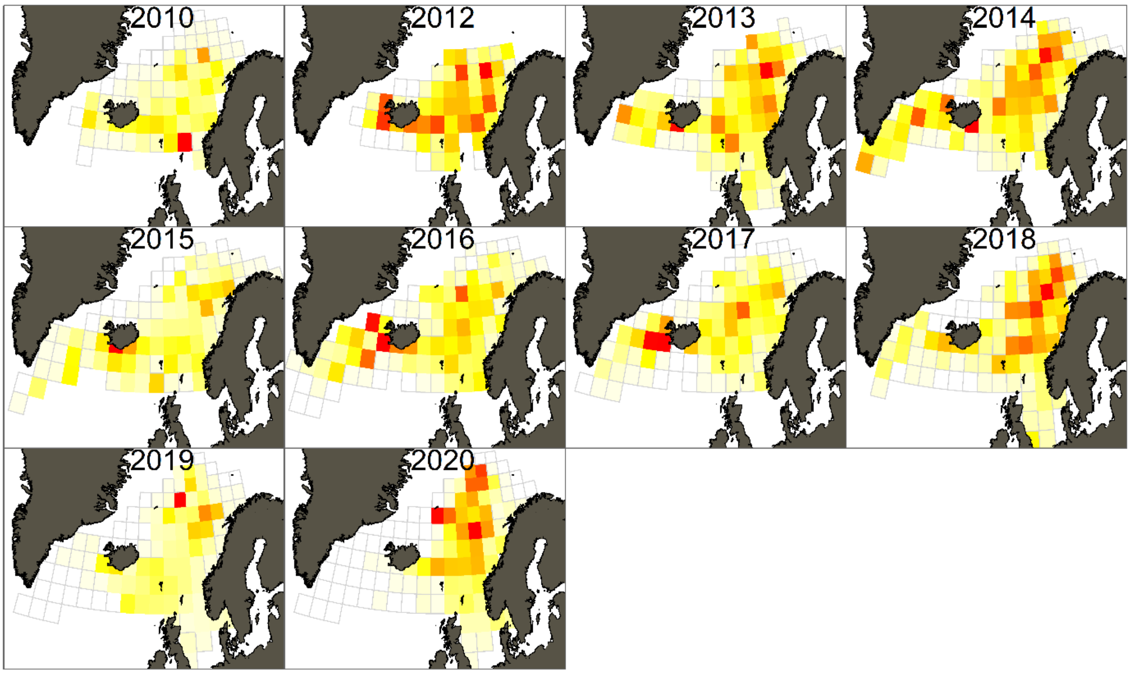

Figure 8.6.3.5b. Mackerel annual distribution proxied by the absolute distribution of mean mackerel catch rates per standardized rectangles (2° lat. x 4° lon.), from predetermined surface trawl stations from IESSNS in 2010 to 2020, including North Sea. Colour scale goes from white (= 0) to red (= maximum value for the given year).

Figure 8.6.3.6. Mackerel catch curves from the estimate stock size at age from the IESSNS in 2010 and from 2012 to 2020, excluding the North Sea. Each cohort is marked by a uniquely coloured line that connects the estimates indicated by the respective ages.

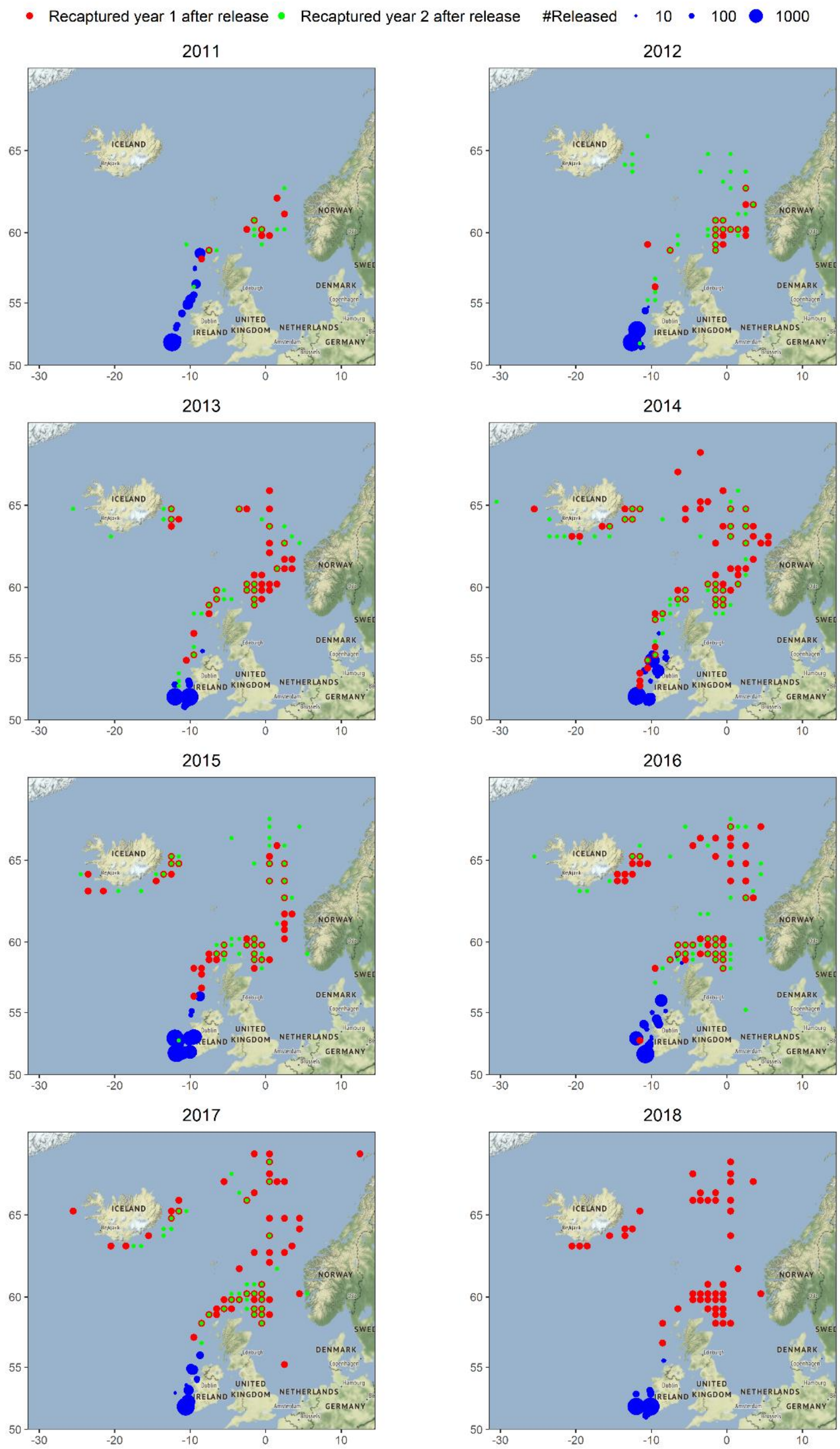

Figure 8.6.4.1. Distribution of RFID tagged mackerel from experiments west of Ireland-Hebrides during 2011-2018, and the distribution of recaptures year 1 and year 2 after release. Positions are per ICES rectangle. See Table 8.6.4.1 for details on numbers released and recaptured, Table 8.6.4.2 for details on scanned biomass, and Figure 8.6.4.2 for distribution of catches scanned. Note that data from releases 2011–2012 are not used in the stock assessment, based on decisions in the ICES IBPNEAMac 2019 meeting (ICES, 2019a).

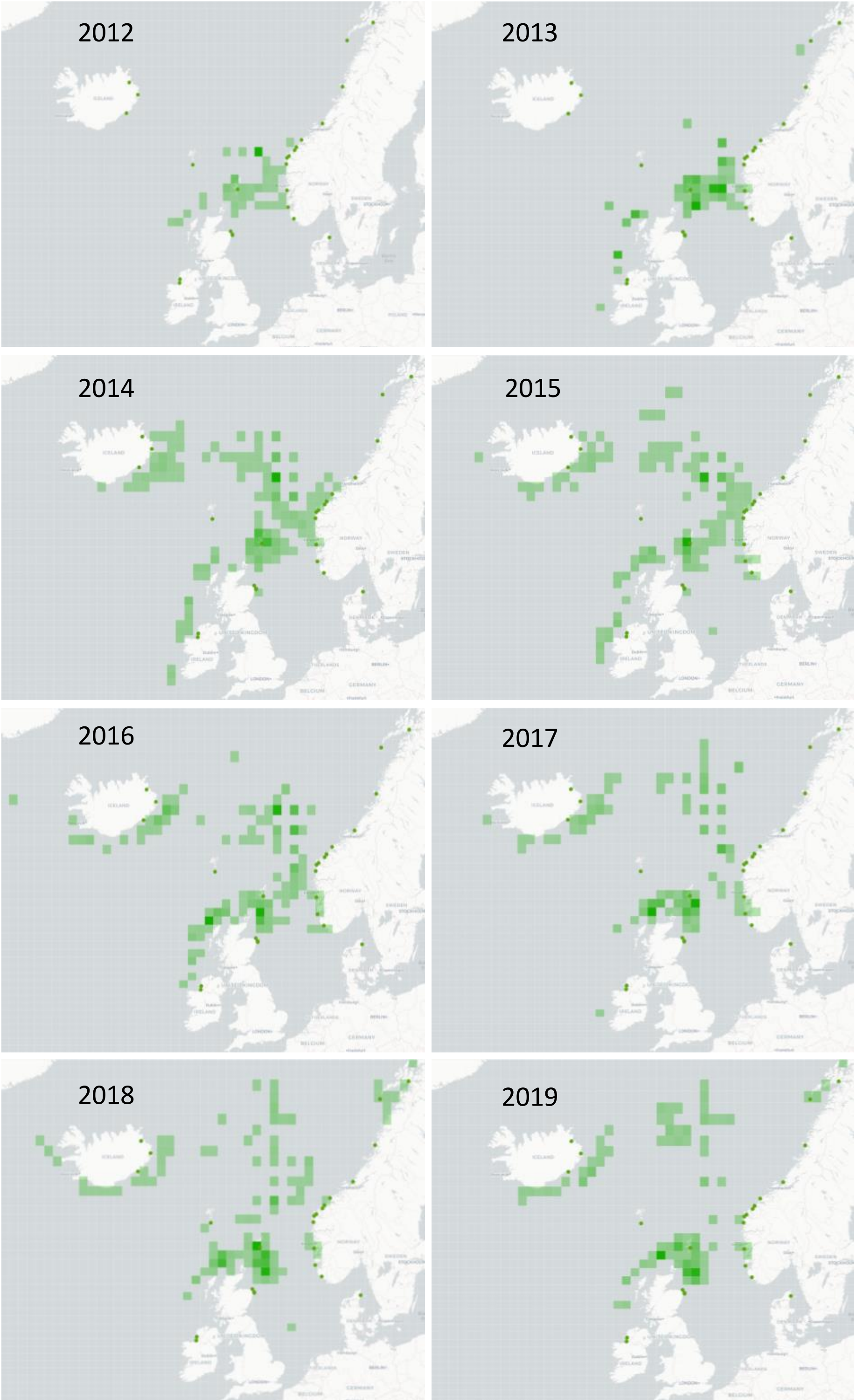

Figure 8.6.4.2. Distribution (summed per ICES rectangle) of catches scanned for RFID tagged mackerel during 2012-2019. Darker colors mean means higher biomass. Note that data on scanned catches and recaptures from 2012-2013 are not used in the stock assessment based on decisions in the ICES IBPNEAMac 2019 meeting (ICES, 2019a). Positions of factories with RFID scanners are shown as green dots on map (Irish scanners are not operational). Detailed data on scanned catch and recaptures per factory are given in Tables 8.6.4.2-3.

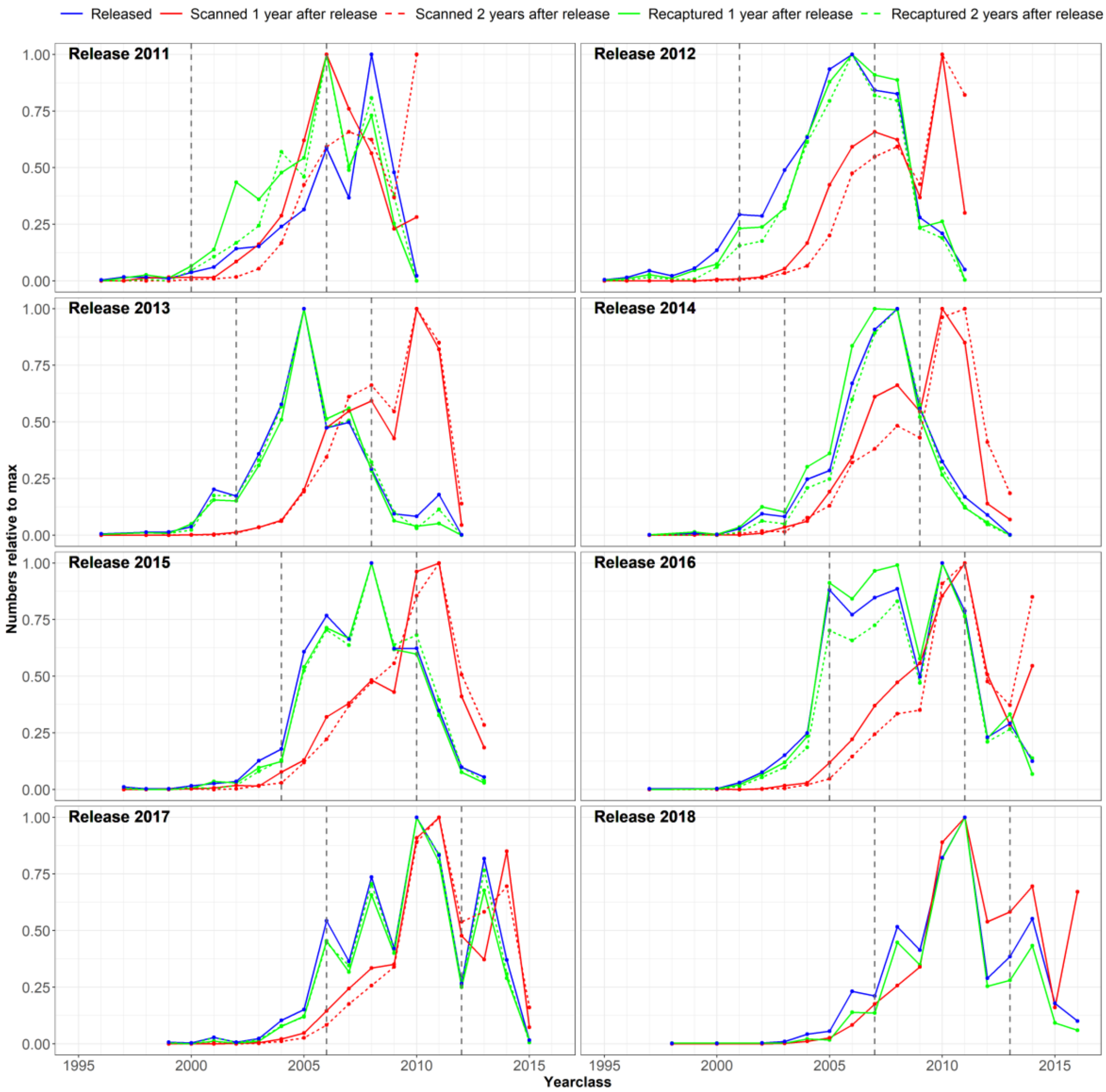

Figure 8.6.4.3. Overview of the relative year class distribution among RFID tagged mackerel per release year from experiments west of Ireland-Hebrides in May-June, compared with the number scanned and recaptured in year 1 and 2 after release of the same year classes. See Figures 8.6.4.1 for distribution of the tagged fish in year 1 and 2 after release, respectively. See Figure 8.6.4.3 for distribution of the scanned fish. Note that data from releases in 2011-2012 are not used in the stock assessment based on decisions in the ICES IBPNEAMac 2019 meeting (ICES, 2019a). Note also that it was decided to only use ages 5-11 in updated assessments, and limits for this age span is marked (vertical grey dotted lines) for each release year. Details on actual numbers released and recaptured are given in Table 8.6.4.1, also for other tagging experiments not included in the stock assessment.

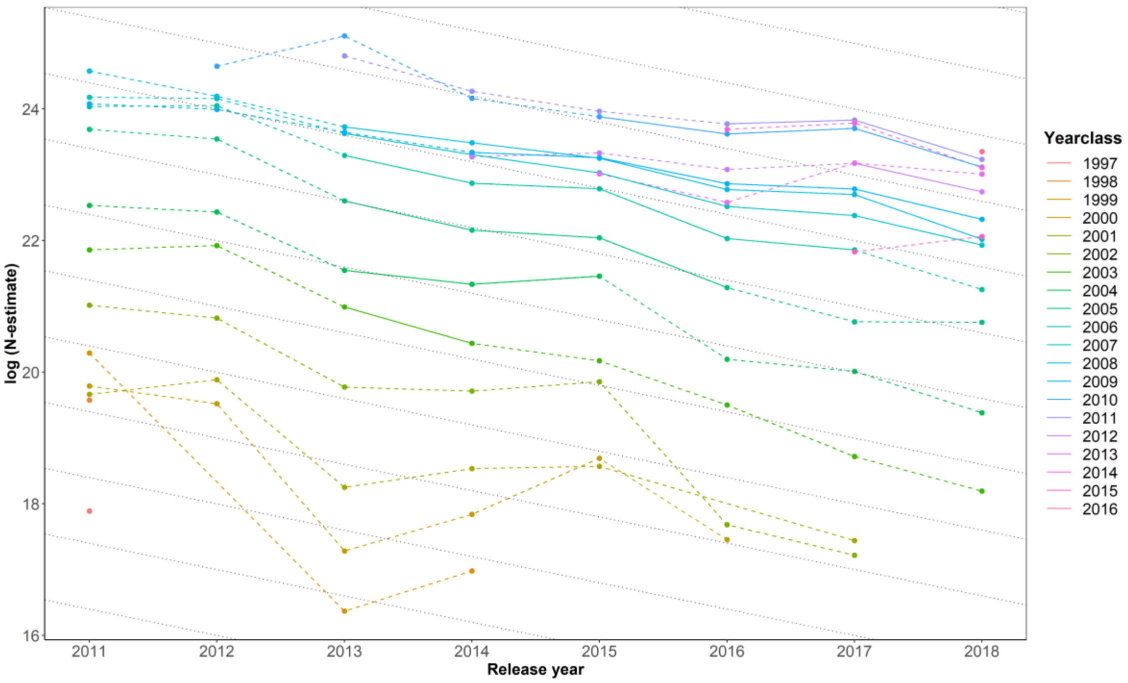

Figure 8.6.4.4. Trends in year class abundance (N=numbers released/numbers recaptured*numbers scanned) from RFID tag-recapture data using aggregated data on recaptures and scanned numbers in year 1 and 2 after release. Data excluded in the stock assessment based on decisions in the ICES IBPNEAMac 2019 meeting (ICES, 2019a), release years 2011-2012 and ages 2-4 and 12+, are marked with dotted lines in year class trends. Note that dotted grey lines are showing a total mortality Z=0.4 for comparison with year class trends.

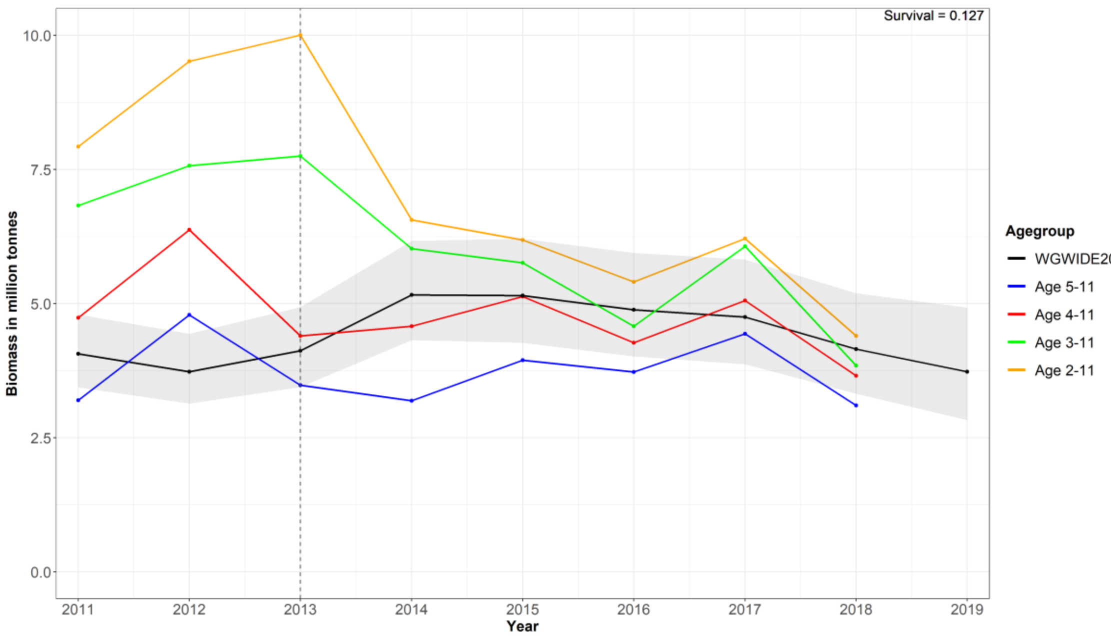

Figure 8.6.4.5. Trends various age aggregated biomass indices from RFID tag-recapture data compared with the SSB (±95 confidence intervals) from the WGWIDE 2020 stock assessment. Data are based on estimated numbers by year class from Figure 8.6.4.4 scaled by the survival parameter estimated by SAM in WGWIDE 2020 (0.1272129), and mean weight of the tagged fish in release year of these year classes. Vertical dotted line marks the starting year where RFID tagging experiments are used in the stock assessment based on decisions in the ICES IBPNEAMac 2019. meeting (ICES, 2019a). Note also that the trend of ages 5-11 is representing the subset of ages used in the assessment after this meeting.

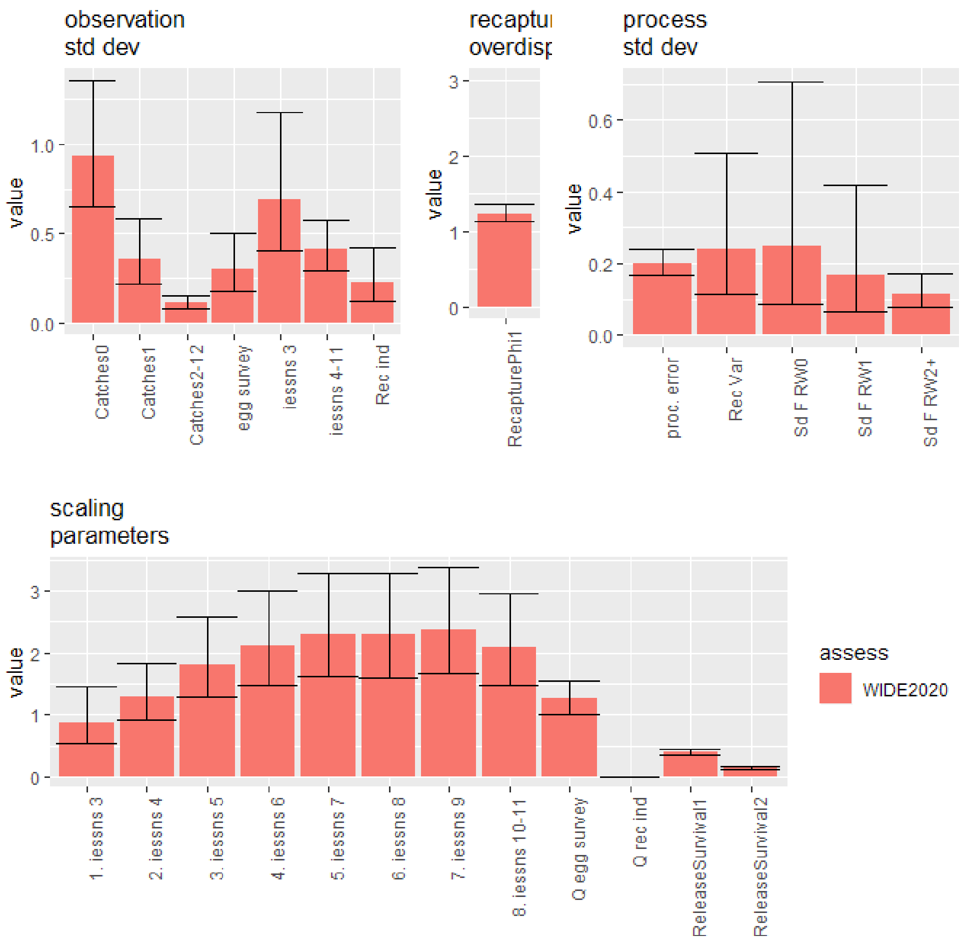

Figure 8.7.2.1. NE Atlantic mackerel. Parameter estimates from the SAM model (and associated confidence intervals) for the WGWIDE 2020 update assessment. top left: estimated standard deviation for the observation errors, top centre: estimated overdispersion for the errors on the tag recaptures, top right: standard deviation for the processes, bottom: survey catchabilities and post-release survival of tagged fish.

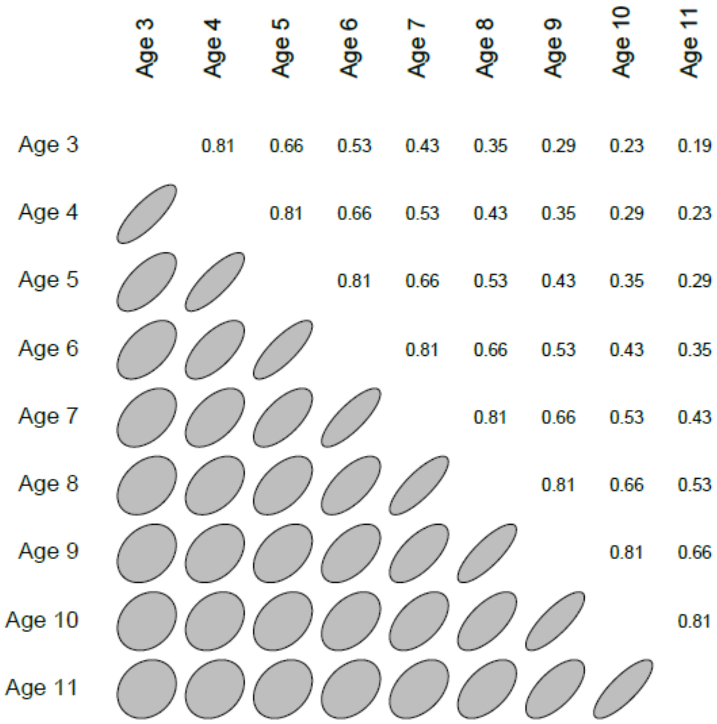

Figure 8.7.2.2. NE Atlantic mackerel. Estimated AR1 error correlation structure for the observations from the IESSNS survey age 3 to 11.

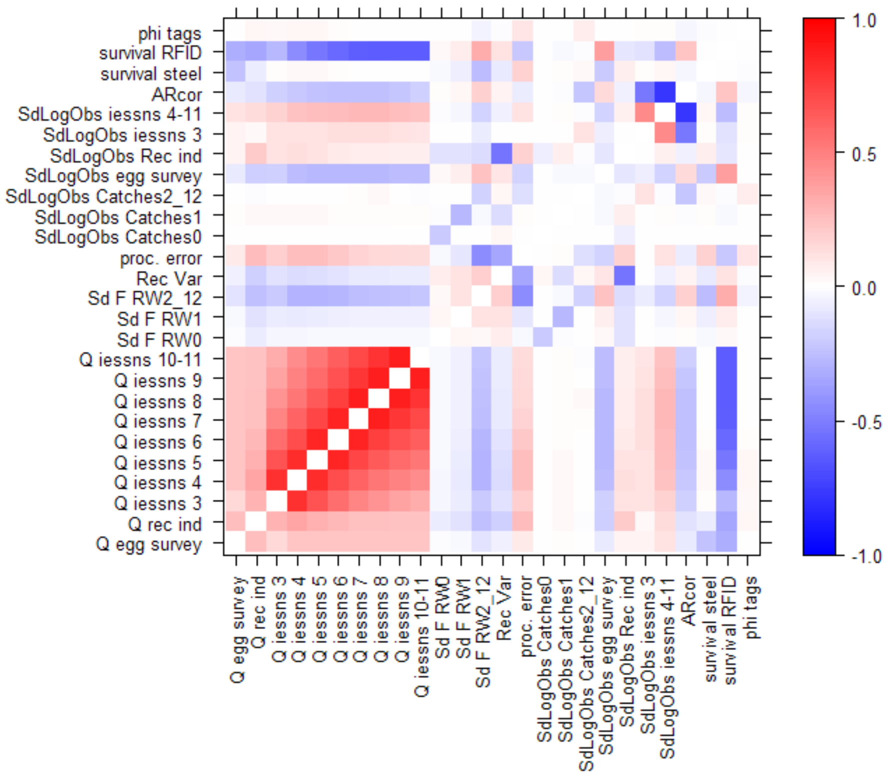

Figure 8.7.2.3. NE Atlantic mackerel. Correlation between parameter estimates from the SAM model for the WGWIDE 2020 update assessment

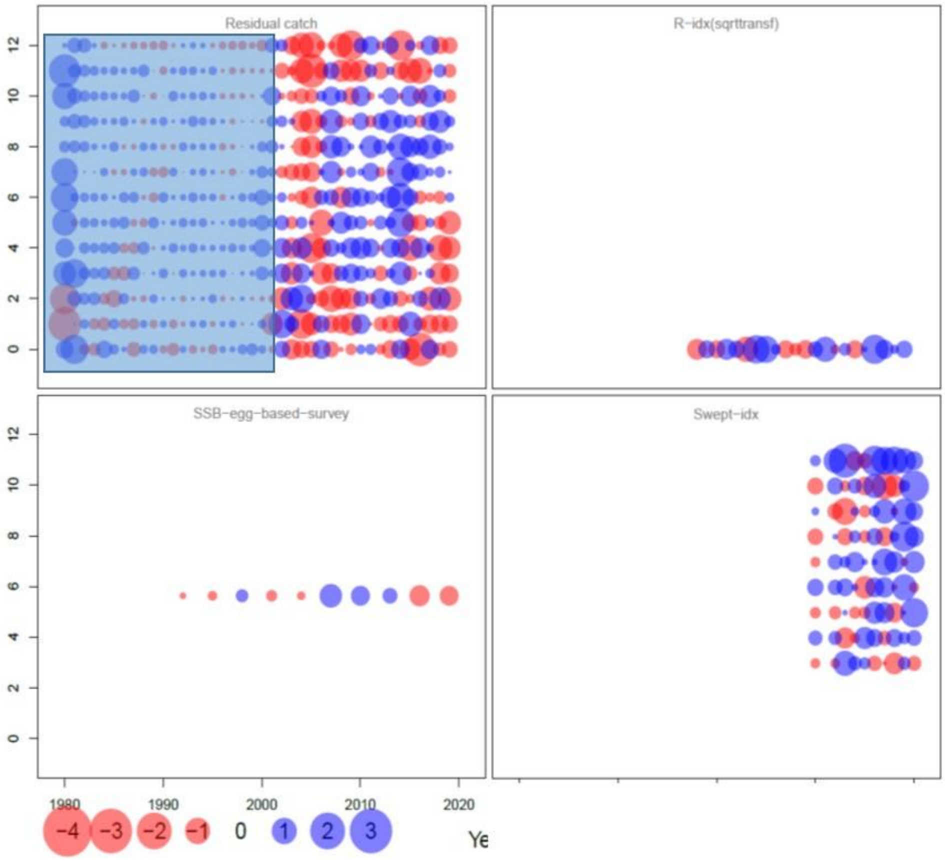

Figure 8.7.2.4. NE Atlantic mackerel. One Step Ahead Normalized residuals for the fit to the catch data (catch data prior to 2000 in blue rectangle were not used to fit the model). Blue circles indicate positive residuals (observation larger than predicted) and filled red circles indicate negative residuals.

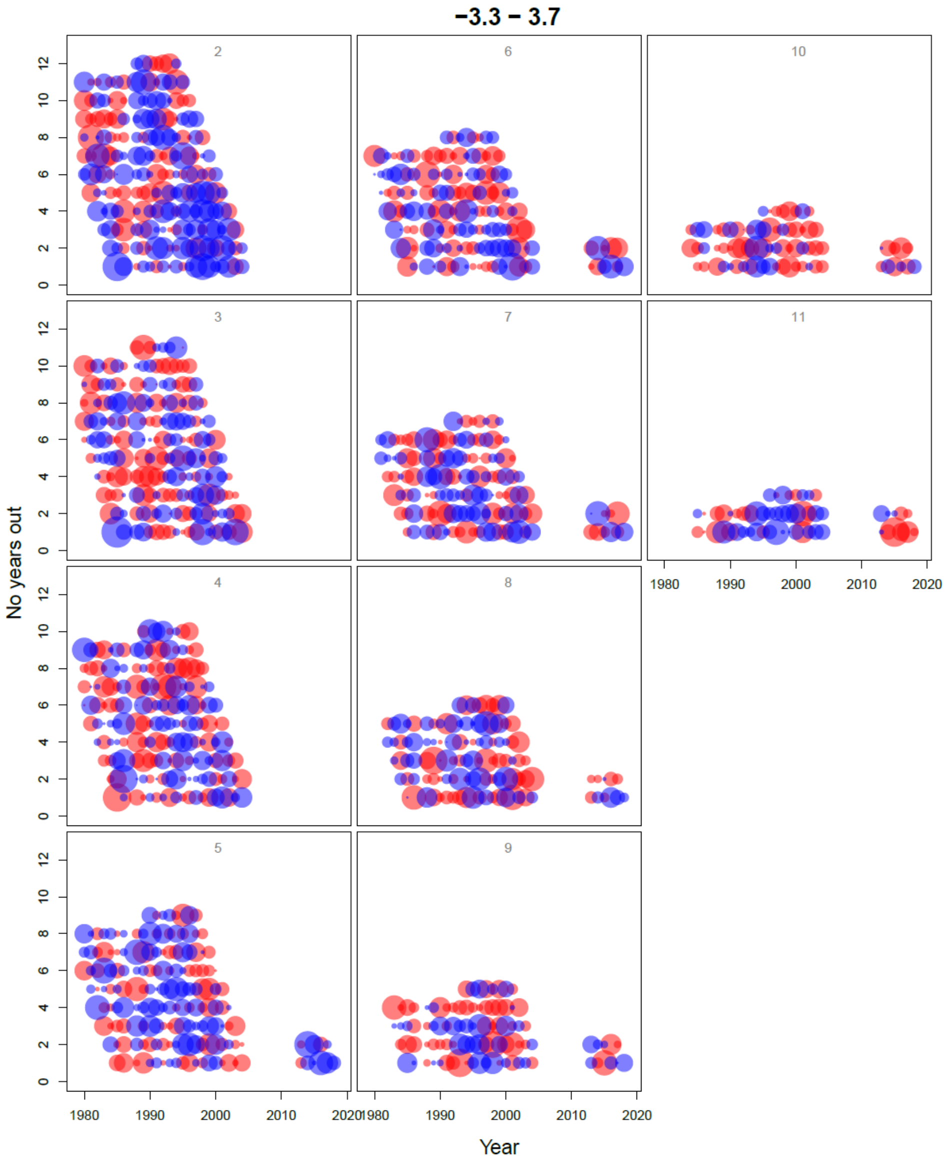

Figure 8.7.2.5. NE Atlantic mackerel. One step ahead residuals for the fit to the recaptures of tags in the final assessment. The x-axis represents the release year, and the y-axis is the number of years between tagging and recapture. Each panel correspond to a given age at release. Blue circles indicate positive residuals (observation larger than predicted) and filled red circles indicate negative residuals.

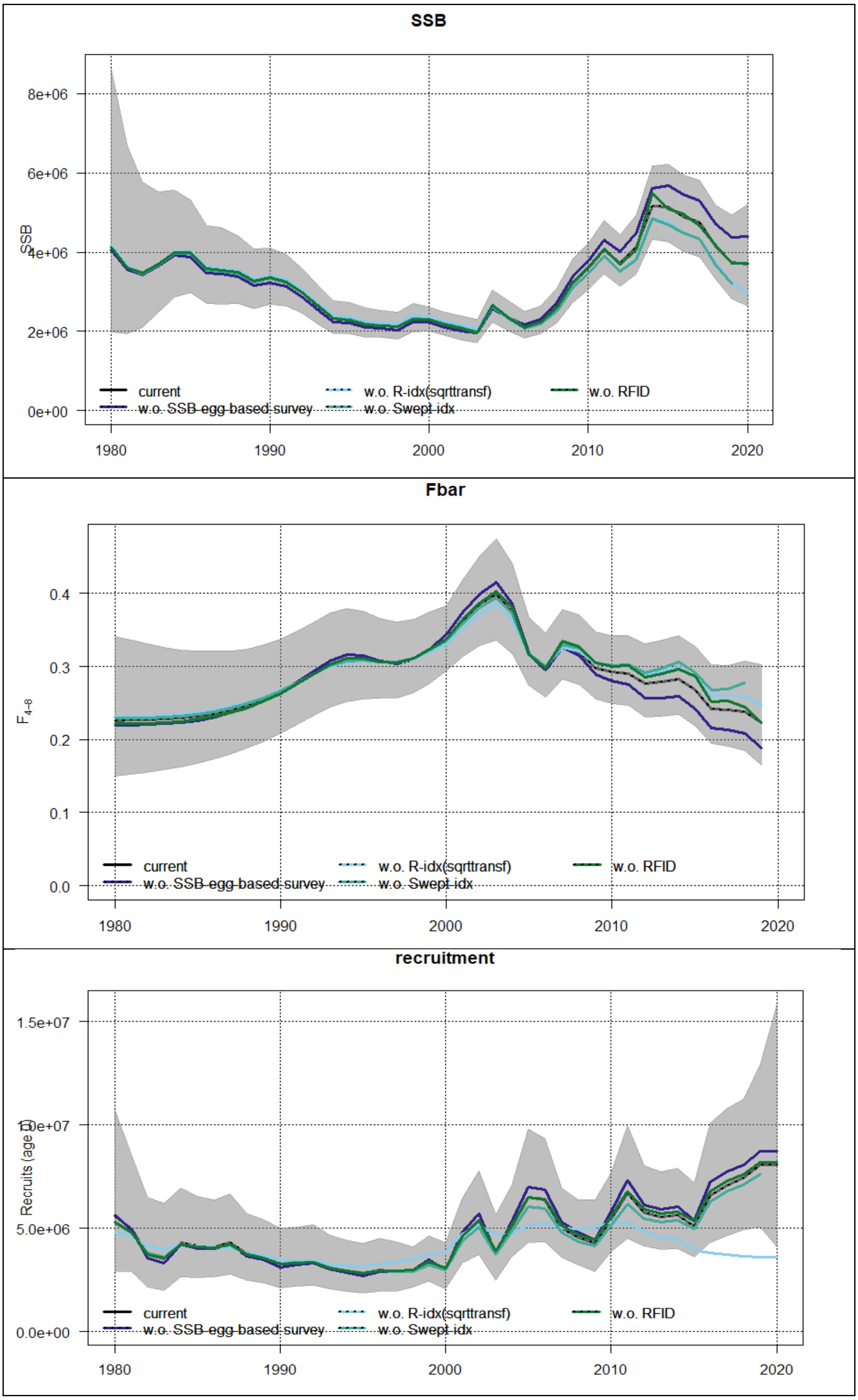

Figure 8.7.2.6. NE Atlantic mackerel. Leave one out assessment runs. SAM estimates of SSB, Fbar and recruitment, for assessments runs leaving out one of the observation data sets.

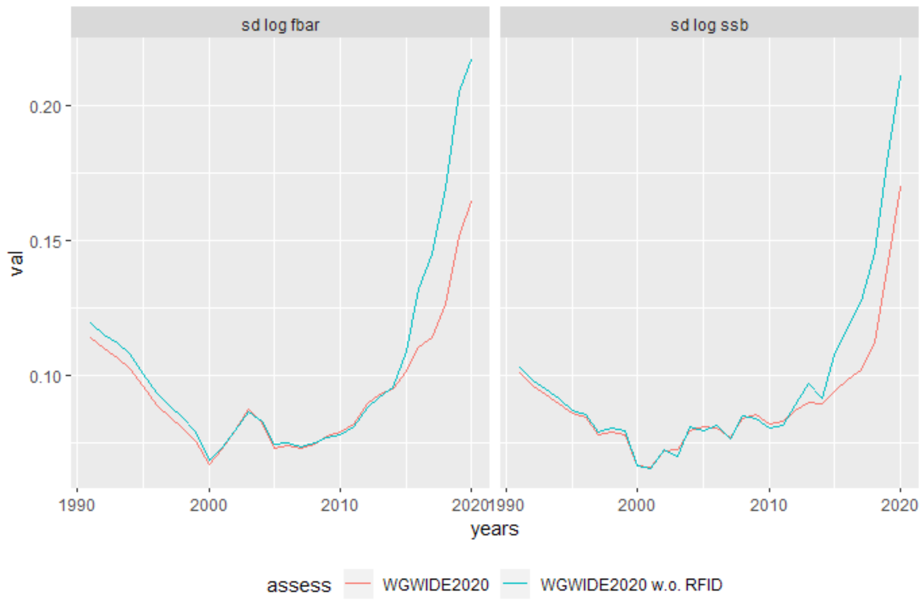

Figure 8.7.2.7. NE Atlantic mackerel. Uncertainty (standard deviation of the log values) of the estimates of SSB and F_{bar} from the SAM for the 2020 WGWIDE assessment and from the SAM assessment run without the RFID tagging information.

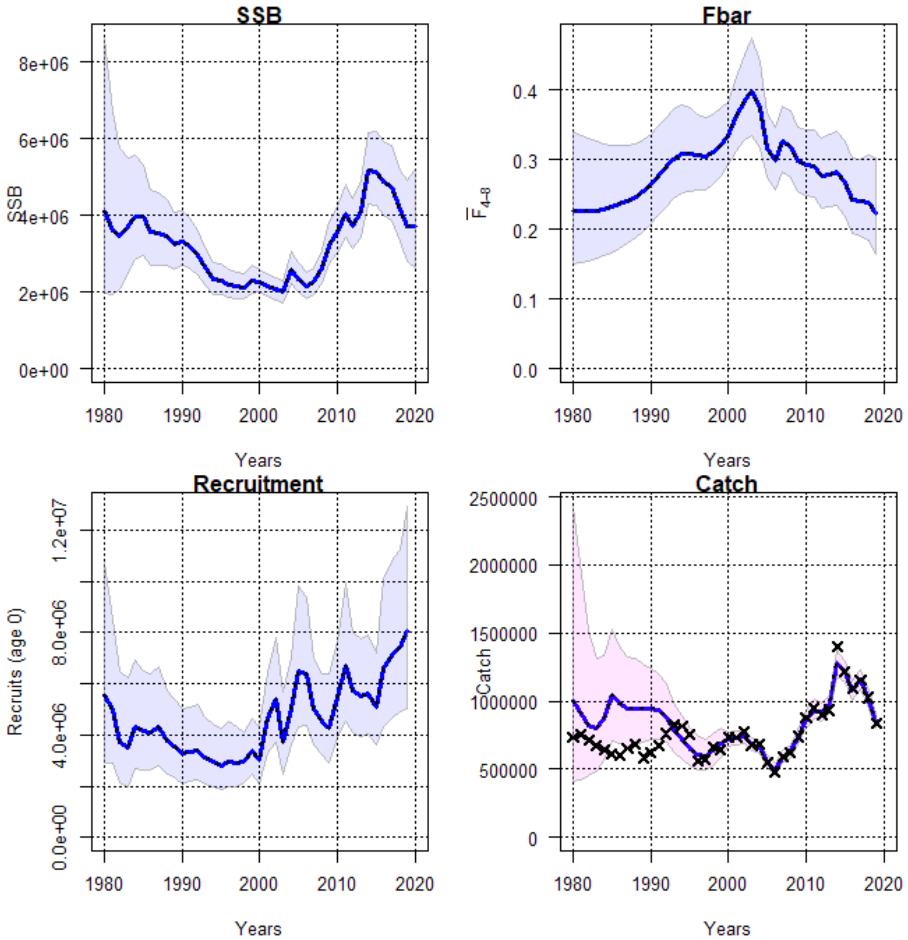

Figure 8.7.3.1. NE Atlantic mackerel. Perception of the NEA mackerel stock, showing the SSB, F_{bar4-8} and recruitment (with 95% confidence intervals) from the SAM assessment.

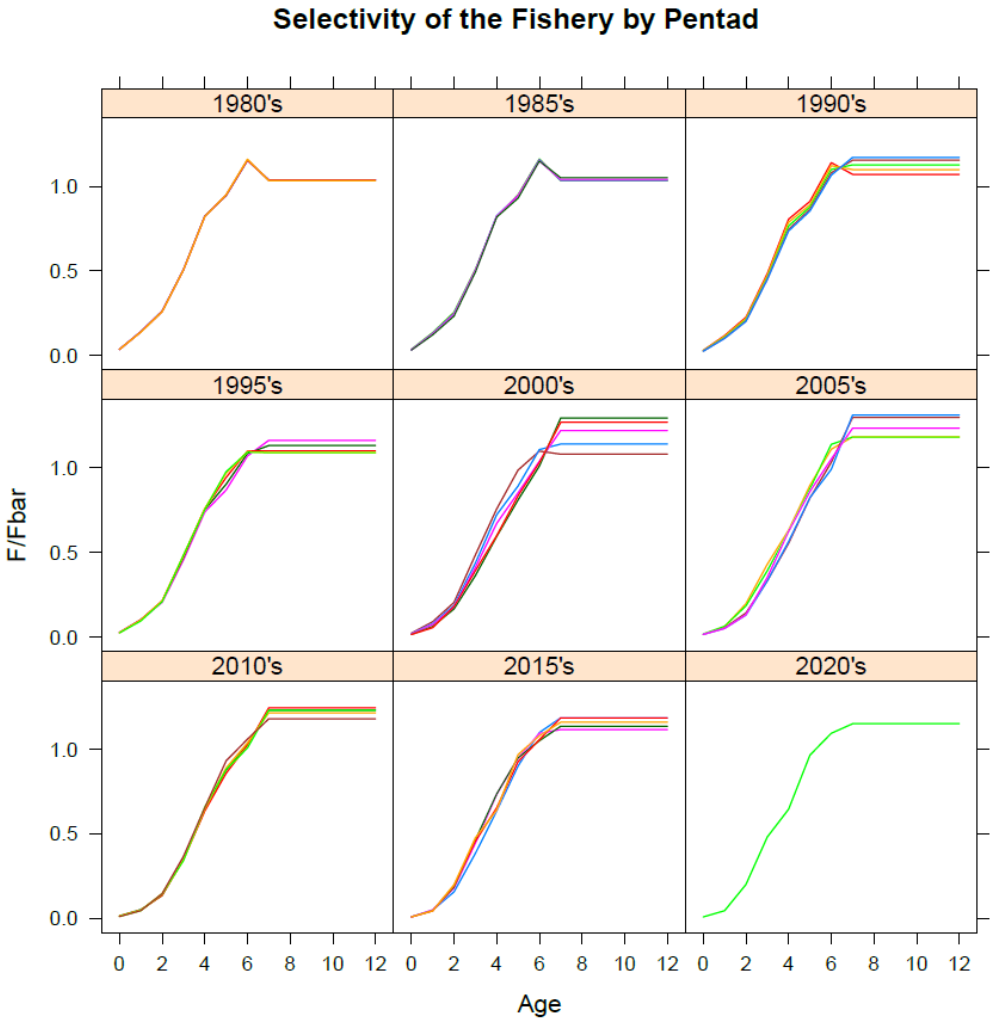

Figure 8.7.3.2. NE Atlantic mackerel. Estimated selectivity for the period 1990 to 2020, calculated as the ratio of the estimated fishing mortality-at-age and the Fbar4-8 value in the corresponding year.

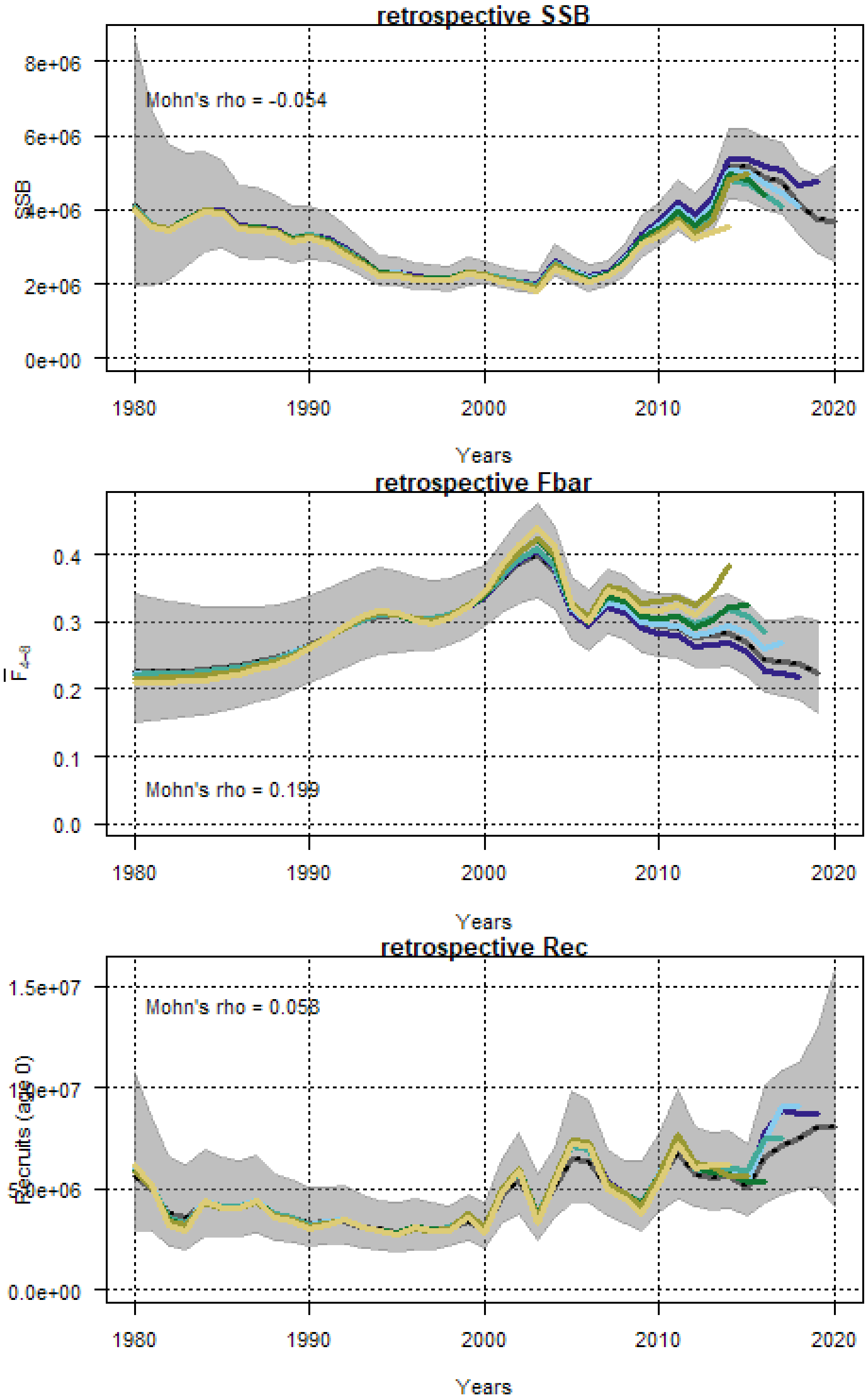

Figure 8.7.4.1. NE Atlantic mackerel. Analytical retrospective patterns (3 years back) of SSB, F_{bar4-8} and recruitment from the WGWIDE 2020 update assessment.

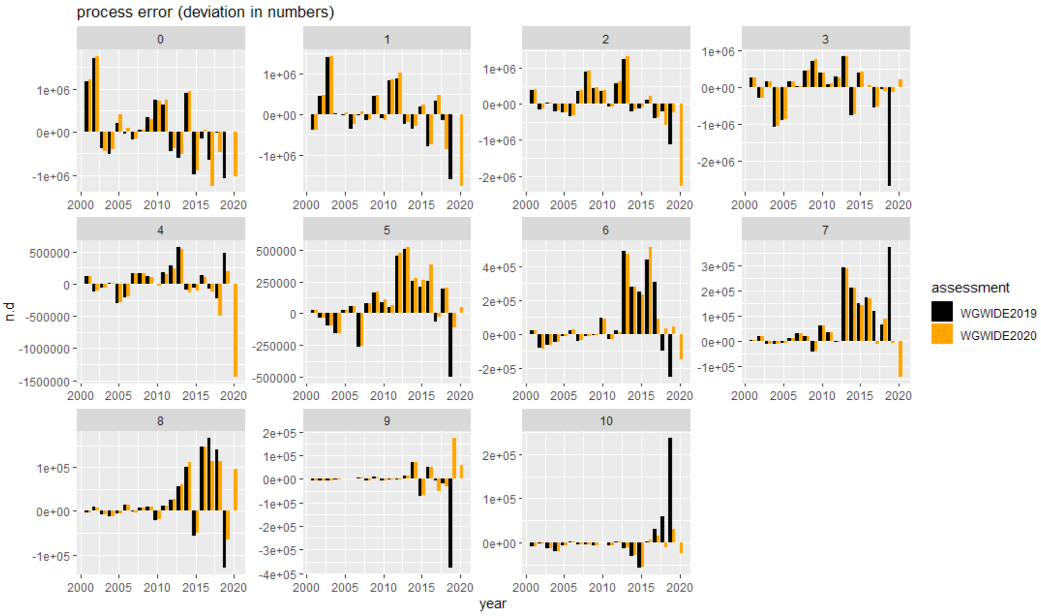

Figure 8.7.4.2. NE Atlantic mackerel. Process error expressed as annual deviations of abundances at age, for the 2020 WGWIDE assessment and from the 2019 WGWIDE assessment.

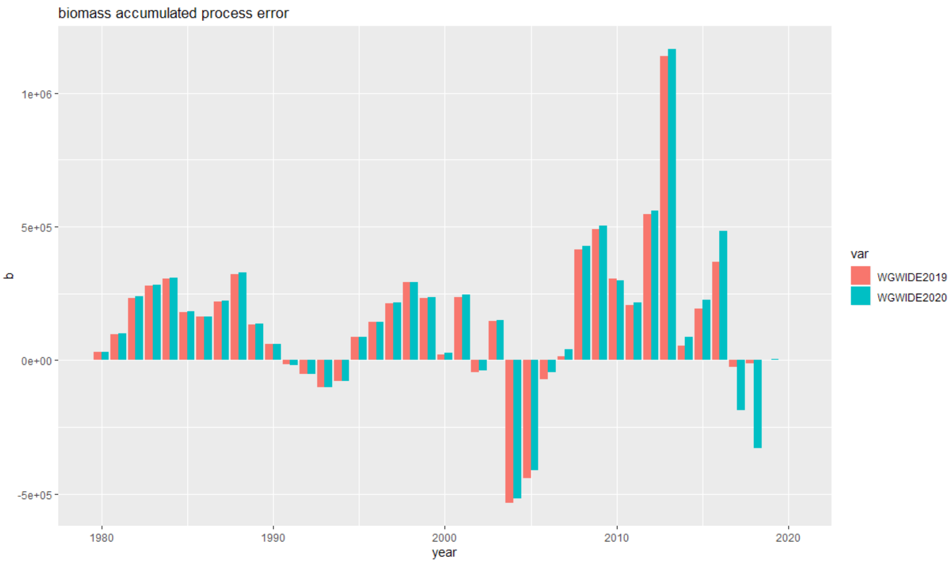

Figure 8.7.4.3. NE Atlantic mackerel. Model process error expressed in biomass cumulated across age-group for the 2020 WGWIDE assessment and for the 2019 WGWIDE assessment.

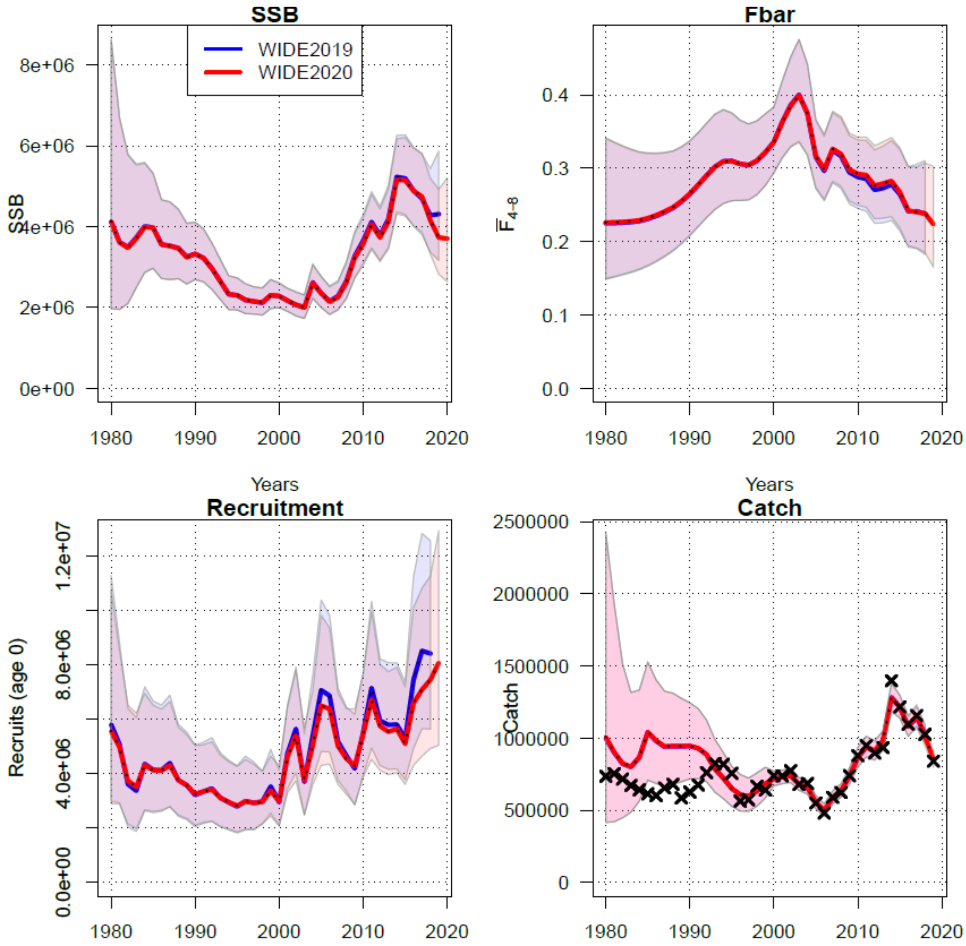

Figure 8.10.1. NE Atlantic mackerel. Comparison of the stock trajectories between the 2020 WGWIDE assessment and the 2019 WGWIDE assessment.

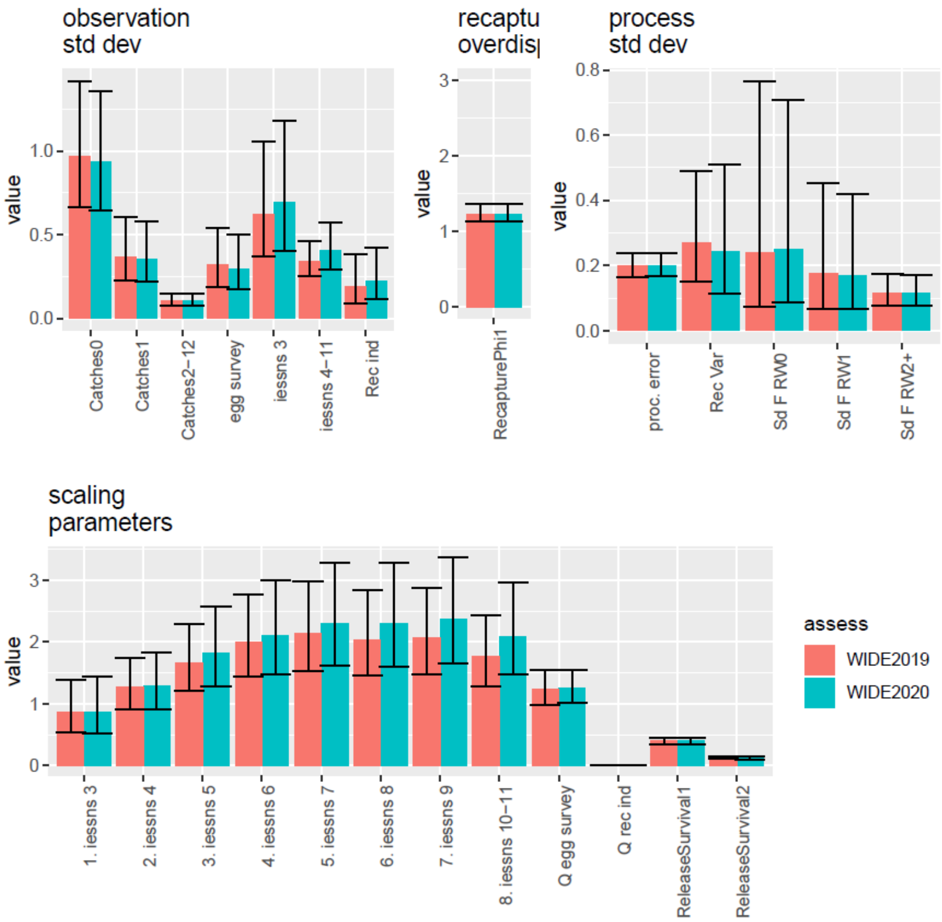

Figure 8.10.2. NE Atlantic mackerel. Comparison of model parameters and their uncertainty for the 2020 WGWIDE and the 2019 WGWIDE assessment

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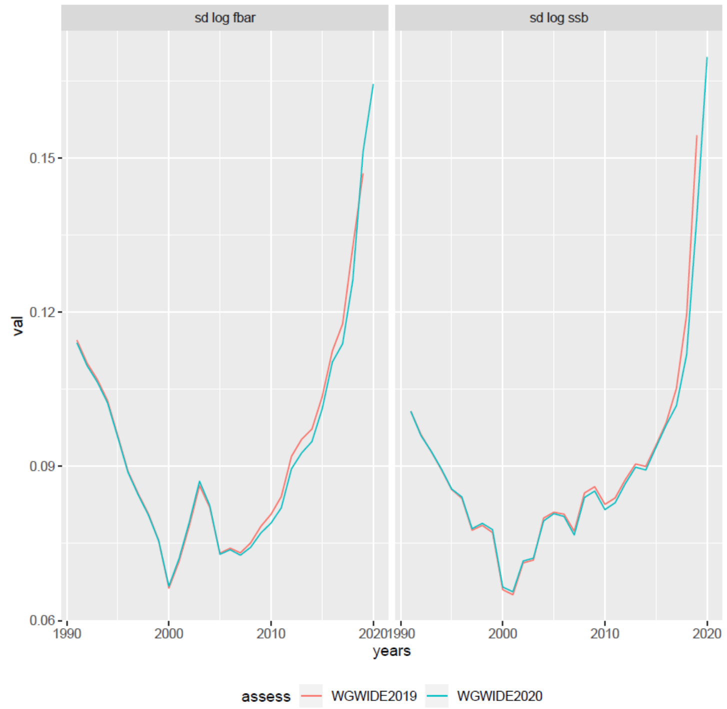

Figure 8.10.3. NE Atlantic mackerel. Comparison of the uncertainty on estimates of SSB and F_{bar} for the WGWIDE 2020 update assessment and the 2019 WGWIDE.

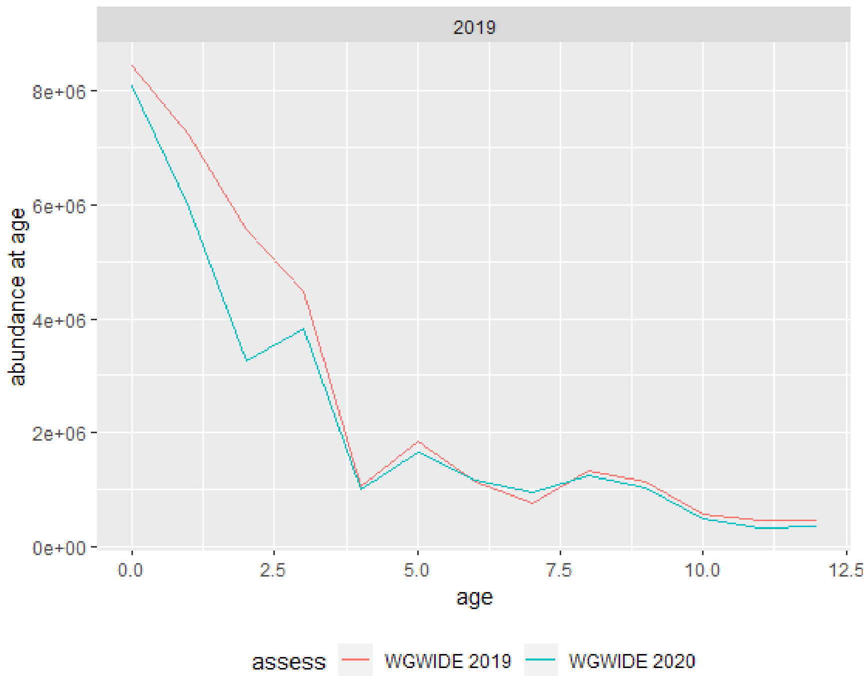

Figure 8.10.4. NE Atlantic mackerel. Comparison of the abundances at age in 2019 estimated from the 2019 and 2020 assessments.

Figure 8.11.1. NE Atlantic mackerel. Top: comparison of the ICES advice, the agreed TAC (or the sum of the unilateral quota) and total catch. Bottom: calculated percentage of Catch over Advice (CoA) and TAC over Advice (ToA).