WD09 at ICES WGWIDE 2025

2025 Mackerel and Horse Mackerel Egg Survey Preliminary Results

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1 Introduction

The mackerel and horse mackerel egg survey is an ICES-coordinated international survey undertaken in the northeast Atlantic conducted during the first half of 2025. It is a combined plankton and fishery investigation formed by a series of individual surveys which have taken place triennially since the late 1970s and is coordinated by the ICES Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS). Historically a North Sea mackerel egg survey was carried out in the year after the western and southern surveys, however since 2022, with the participation of Denmark and England, all surveys are completed in the same year.

The main objective of this series of individual cruises from February until July is to produce both an index and a direct estimate of the biomass of the northeast Atlantic mackerel stock and an index for the western horse mackerel stocks. The results have been used in the assessment for mackerel since 1977 and from 1992 for horse mackerel. The mackerel and horse mackerel egg survey remains a principal source of data providing fisheries independent information for these stocks.

The general method is to quantify the freshly spawned eggs in the water column on the spawning grounds. To be able to establish a relationship between eggs and biomass of the spawning stock, the fecundity of the females must also be determined. This is undertaken by sampling ovaries before and during spawning. In cases where the annual egg production method is applied the potential fecundity is counted from whole mount volumetric subsamples using a dissecting microscope while atresia is counted histologically from slides. Realised fecundity is estimated as potential fecundity minus atresia.

The realised fecundity is used in combination with the calculated number of freshly spawned eggs in the water to estimate the spawning stock biomass.

To provide reliable estimates of spawned eggs and fecundity an extensive coverage of the spawning area is required both in time and space. The spawning of the southern horse mackerel stock and mackerel starts in late December off the Portuguese coast. Spawning proceeds further north along the continental shelf edge as water temperature increases during late winter and spring. In the past peak spawning of mackerel has normally occurred in April-May in the area of the Sole Banks with an extension to the Porcupine Bank. Whilst the distribution and timing of peak western horse mackerel spawning have remained relatively stable during recent surveys the same cannot be said for NEA mackerel. The 2010 and 2013 MEGS surveys saw peak mackerel spawning in February – March with 2013 also demonstrating a shift in the geographical centre of spawning further south within the southern Biscay region. Since then, however mackerel spawning was observed over a large region of the Northeast Atlantic both on and off the continental shelf, ranging as far west as Hatton Bank, as far north as Iceland and the Faroe Islands and in recent years around the Shetland Islands and the Norwegian coast in the Northeast.

This survey report presents the preliminary results of the 2025 mackerel and horse mackerel egg survey provided for WGWIDE in August 2025. The survey report and the analysis will be finalised during the next WGMEGS meeting in April 2026. Although every effort was made to ensure that WGWIDE were provided with the most recent and accurate dataset, WGMEGS cannot guarantee that there will not be changes prior to the analysis being finalised. This is due to the extremely large numbers of plankton and fecundity samples to be analysed following the surveys as well as the tight deadline set by WGWIDE for delivering these in-year estimates. This has resulted in a very limited timeframe within which to process the 2025 MEGS data.

2 Material and Methods

Survey effort

As a consequence of the long spawning period and the large survey area involved, the mackerel and horse mackerel egg surveys have always relied on broad international participation. Unfortunately, in 2025 both Norway and Portugal had to withdraw from the survey due to national considerations. As a result, a total of 16 individual cruises were carried out, 14 in the Atlantic and 2 in the North Sea, for a total of 307 at-sea survey days. Individual contributions were; Spain (IEO: 43 days at sea, AZTI: 30 days), Scotland (65 days), the Netherlands (40 days), Ireland (42 days), Germany (31 days), Faroe Islands (14 days), England (28 days) and Denmark (14 days). Denmark joined the group in 2020 and participated in the 2021 North Sea survey along with the Netherlands. England rejoined the group in 2021 and in 2022 conducted the North Sea survey in conjunction with Denmark.

Survey design

The aim of the triennial egg survey is to determine the annual egg production (AEP). This is calculated using the mean daily egg production rates per pre-defined sampling period for the complete spawning area of the Northeast Atlantic Mackerel and Horse Mackerel Stocks. To achieve this, one plankton haul per each half rectangle (separated by approximately 15-20 NM, depending on latitude) is conducted on alternating transects covering the complete spawning area. The 2025 egg survey was designed to maximise both the spatial and temporal coverage in each of the sampling periods. Given the very large area to be surveyed this design minimises the chances of under/overestimation of the egg production (ICES 2008).

The 2025 survey plan was split into 6 sampling periods (Table 2.1). Portugal was initially assigned to start the survey in the southern area during Period 2, with Scotland collecting GULF samples during their spring western IBTS survey. Due to the withdrawal of Portugal, no plankton sampling took place in ICES division 9a, however Portugal did collect fecundity samples. Due to the timing of their collection the Scottish stations were still assigned to period 2. The main sampling of the western area commenced in Period 3, and included coverage of the west of Scotland, west of Ireland, Biscay and the Cantabrian Sea. Surveying in the Cantabrian Sea ended at the end of Period 5. In Periods 6 and 7 the surveys were designed to identify a southern boundary of spawning and to survey all areas north of this boundary.

Maximum deployment of effort in the western area was during Periods three, four, five and six. Historically these periods would have coincided with the expected peak spawning of both mackerel and horse mackerel. Recent years have seen mackerel peak spawning taking place during Periods 3 and 5.

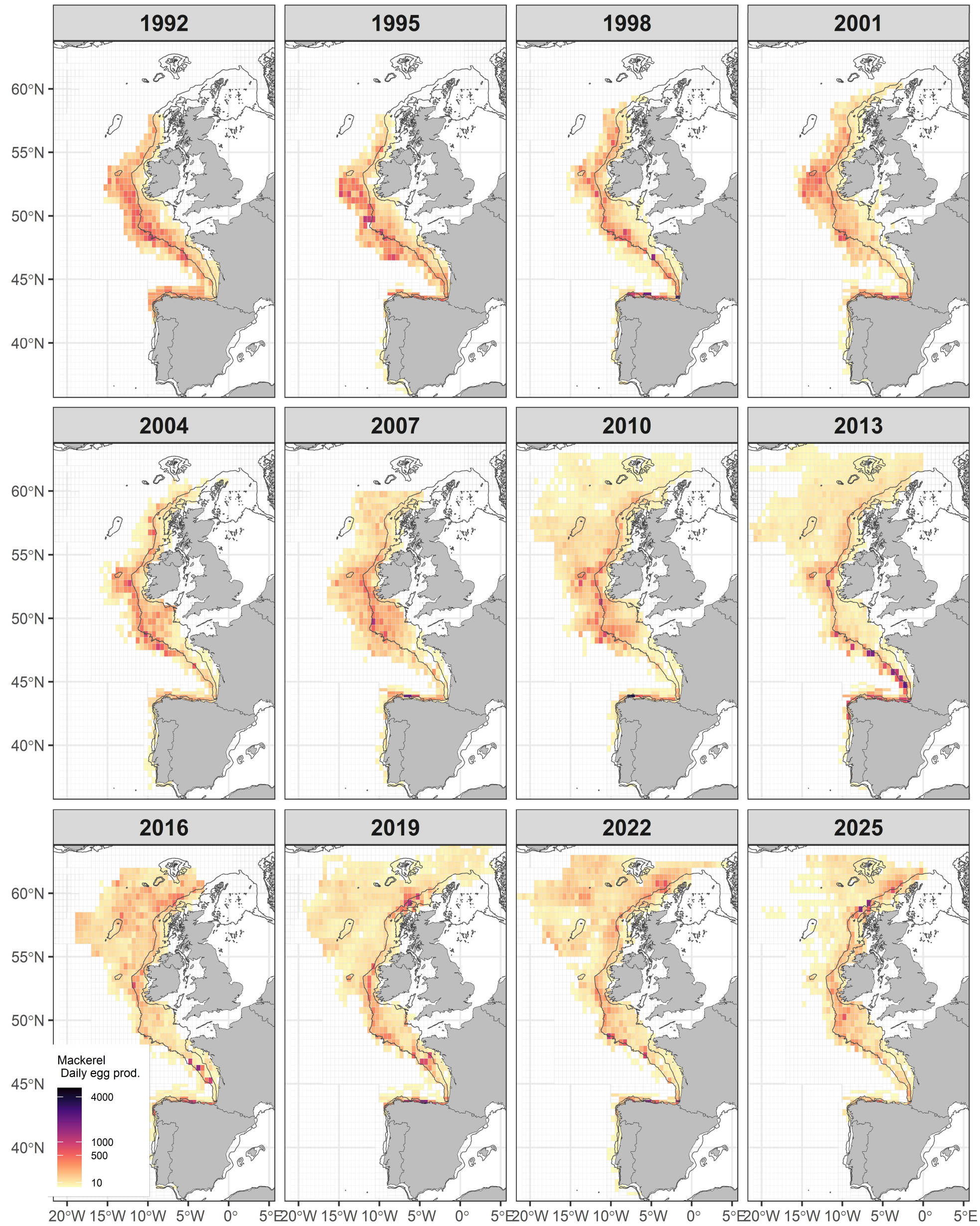


Figure 2.1. Annual distribution of daily mackerel egg production (stage I eggs per m² per day) by survey year and rectangle. The maps were generated by combining of the sampling grid of mackerel daily egg production values per period. A gradient colour scale is used to show areas of higher densities.

Due to the expansion of the spawning area which has been observed since 2007 (Figure 2.1) the emphasis was even more focused on full area coverage and delineation of the spawning boundaries. Cruise leaders had been asked to cover their entire assigned area using alternate transects and then use any remaining time to fill in the missed transects.

Table 2.1. Planned participating countries, vessels, areas covered, dates and sampling periods of the 2025 surveys.

Country	Vessel	Area	Dates	Period
Ireland	Celtic Explorer	West of Ireland, Celtic Sea, Biscay,	March 2nd – 22nd	3
	Tom Crean	West of Ireland, west of Scotland	June 11th – 18th	6
Scotland	Scotia (IBTS)	West of Scotland	Feb 15th - 28th	2
	Altaire	West of Scotland	April 12th – 27th	4
	Scotia	West of Scotland, west of Ireland	May 13th – June 2nd	5
	Altaire	West of Scotland, west of Ireland, Celtic Sea, Biscay	July 4th – 26th	7
Spain (IEO)	Miguel Oliver	Cantabrian Sea, Galicia, southern Biscay	March 6th – 27th	3
	Vizconde de Eza	Cantabrian Sea, Galicia, Biscay	April 1st – 24th	4
Spain (AZTI)	Angeles Alvariño	Northern Biscay	March 17th – April 1st	3
	Vizconde de Eza Emma Bardan	Southern Biscay, Cantabrian Sea	May 5 – May 23rd	5
Germany	Tarajoq	Celtic Sea, west of Ireland	March 26th – April 8th	3
	Tarajoq	Celtic sea, west of Ireland, west of Scotland	April 10th – 26th	4
Netherlands	Tridens	Northern Biscay, Celtic Sea, west of Ireland	May 5th – 23rd	5
	Tridens	Biscay, Celtic Sea, west of Ireland	June 2nd – 20th	6
Faroes	Jakup Sverri	Faroes, Iceland	May 19th – June 1st	5
Denmark	Dana	North Sea	June 11th – 22nd	6
England	Cefas Endeavour	North Sea	June 4th - 25th	6

Processing of samples

The analysis of the plankton and fecundity samples were carried out according to the sampling protocols as described in the WGMEGS Manuals for Survey (ICES, 2019a) and Fecundity (ICES, 2019b).

A total of 1785 plankton samples were collected and sorted. Mackerel horse mackerel, hake and ling eggs, the four target species of the survey, were identified and the egg development stages determined. In addition, counts were made of the eggs of four additional species; sardine, anchovy, boarfish and *Maurolicus*. Depending on the vessel facilities and the experience of the participants this was done either during the cruise or back in the national institutes.

Double micropipette samples and slices from ovaries of mackerel were taken during each survey. Additional samples were collected during periods 3 and 4 by participants in an effort to carry out DEPM analysis, along with AEPM analysis. Fecundity sampling for horse mackerel only took place during the expected peak spawning Periods, 6 and 7.

In order to increase the number of samples available for fecundity analysis additional mackerel gonads were collected from some Dutch pelagic vessels in periods 2 and 3. A request was also made to collect fecundity samples on the Dutch and Irish Blue whiting surveys in Periods 3 and 4. Due to the difficulty of catching mackerel during the surveys in the 8c, the sampling has been complemented by samples from the fish market.

After each survey the ovary screening samples were shared between the participating research institutes for histological analysis. These samples will be analysed in the coming months and results will be presented in 2026.

Horse mackerel is considered to be an indeterminate spawner and therefore since 2007 IPMA has adopted the DEPM methodology for the southern horse mackerel stock (div. 9a). In 2024 Portugal decided it would no longer participate in the WGMEGS survey. Instead, they will collect horse mackerel samples during their planned sardine and anchovy DEPM survey in 2026.

Originally, the egg survey design in the western area is directed at the AEP method for mackerel which produces an estimate of SSB. In 2012, evidence suggesting that mackerel may exhibit indeterminate fecundity caused WGMEGS to test both the AEPM and the DEPM during surveys. Since 2013, following the recommendation of WKMSPA the AEPM time series has been continued, while at the same time additional mackerel adult samples for the estimation of DEPM adult parameters of mackerel have been taken on each survey year during time of peak spawning. Fecundity samples for horse mackerel were taken during the survey in the western areas in order to develop a modified DEPM approach for estimating the biomass of the western horse mackerel stock. Additional samples were collected during the Irish WESPAS survey in the Celtic Sea and west of Ireland in Periods 6 and 7.

Partial screening of the mackerel ovary samples has been carried out. A large number of samples are valid for potential fecundity analyses and some are valid for batch fecundity analyses. No fecundity samples have been analyses yet and for this working document an average mackerel realised fecundity of the last three surveys has been used.

3 Results of NEA mackerel

3.1 Survey coverage of mackerel egg production by period in the southern and western areas.

Period 2 – Due to the withdrawal of Portugal, there was no sampling conducted in ICES area 9a in 2025. Scotland collected plankton from 23 stations during their spring IBTS survey, (Fig 3.1). Very few eggs were found.

Period 3 – Period 3 marks the commencement of the dedicated western area surveys as well as a commencement of sampling in the southern area. Sampling was undertaken by Ireland (West of Scotland, west of Ireland, Celtic Sea), Germany (Celtic Sea) and Spain (AZTI), (northern Biscay). Further south the Bay of Biscay, Cantabrian Sea and Galicia were covered by Spain (IEO).

No eggs were found by Ireland in northern waters. As there were reports of adult mackerel to the north of Ireland the survey continued up the Scottish coast collecting plankton samples as well as conducting trawl hauls for adult mackerel. The vessel finally turned south and as they had some survey days left, they continued south and sampled the Celtic Sea, (Fig.3.2).

Egg numbers were quite low to the west of Ireland, however further south large numbers of eggs were found close to the 200m contour line. In Biscay and the Cantabrian Sea IEO and AZTI recorded a number of stations with large egg numbers. 277 stations were sampled and there were only 8 interpolations.

Period 4 – This period was covered by three surveys. Scotland sampled the area from the northwest of Ireland to the Shetland islands. Germany surveyed west of Ireland, Celtic Sea and northern Biscay while IEO completed the survey coverage in southern Biscay, Cantabrian Sea and Galicia. (Fig. 3.3).

Once again moderate levels of eggs were recorded throughout the area, with the highest concentrations still being found close to the 200m contour line. Large egg numbers were recorded to the west of Shetland, and north of the Hebrides. 245 stations were sampled and there were 28 interpolations.

Period 5 – In Period 5, the entire spawning area from the Cantabrian Sea to the West of Scotland, and up to Faroese waters at around 62°N was surveyed by AZTI, the Netherlands, Scotland, and Faroes.

Spawning in the Cantabrian Sea was tailing off with only low egg numbers being found. Throughout Biscay and into the southern Celtic Sea numbers were generally low to moderate (Fig. 3.4). This pattern continued west of Ireland, to around 54°N, with spawning remaining on and around the Shelf edge. Once again Scotland recorded some large egg counts in certain areas, with one station to the north of the Hebrides producing the largest number of stage 1 eggs ever recorded by a Scottish survey.

The main surprise of this period was the lack of eggs in northwestern waters, which had become a regular presence during periods 5 and 6 since 2010. This allowed Scotland to survey further inshore and fully sample the nearshore Hebridean Shelf transects within the survey area. North of this the Faroese survey completed stations North of Hatton Bank and up towards the Icelandic coast. Egg production was found all the way to 62.5°N, however as in 2022, the largest number of eggs were encountered west of the Shetlands. In total 427 stations were sampled and there were 163 interpolations.

Period 6 – During period 6 northern Biscay, from 46°N and also the Celtic Sea were covered by the Netherlands while Ireland was to cover west of Ireland and also west of Scotland. Due to the withdrawal of Norway, the survey area assigned to Ireland was increased to encompass Shetland and Faroes waters.

Low levels of spawning were observed in Biscay and to the south to the West of Ireland and Porcupine bank, (Fig. 3.5). However, in the northern area spawning was primarily confined to the 200m contour line, with very few eggs found either side of it. The eggs encountered by Faroes during their period 5 survey were no longer in evidence. Similar to period 5 there was very little sign of any northern offshore mackerel spawning during period 6. 248 stations were sampled with 61 interpolations.

Period 7 – This period was covered entirely by Scotland sampling in the area from 46°15N in the south to south of the Hebrides as far as 57°N (Fig. 3.6). Due to the lack of eggs encountered the Scottish survey adhered very closely to the 200m contour and 138 stations were sampled with 47 interpolations. Only very low levels of spawning were observed, and these were confined to the continental shelf and shelf edge with all spawning boundaries being delineated successfully. Alternate transect surveying was employed North of 52°N due to the very low numbers of eggs encountered with the majority of sampling effort deployed in the target horse mackerel survey to the South of this.

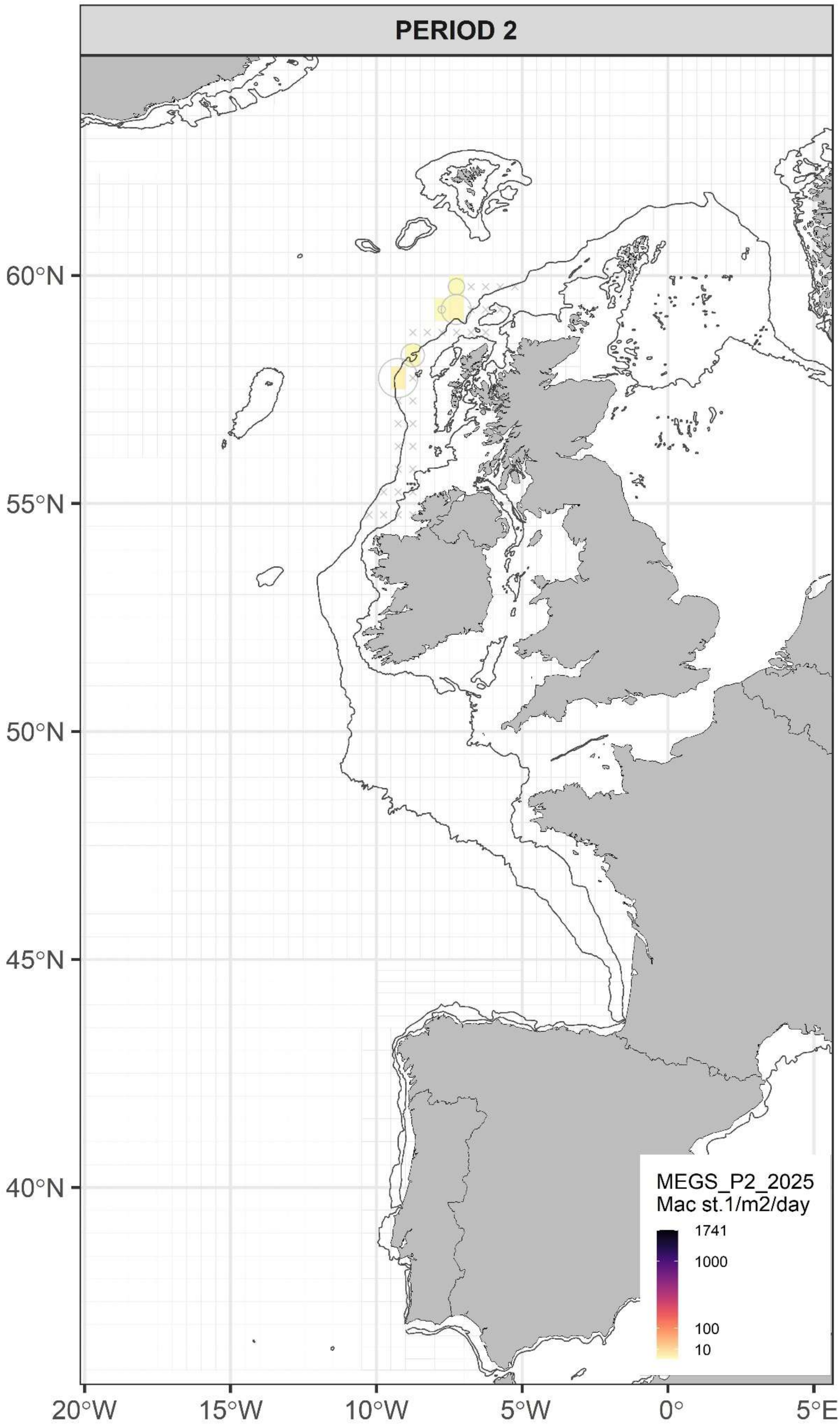


Figure 3.1: Mackerel daily egg production by half rectangle for period 2 (Feb 15th – 28th). Circle areas and colour scale represent mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values.

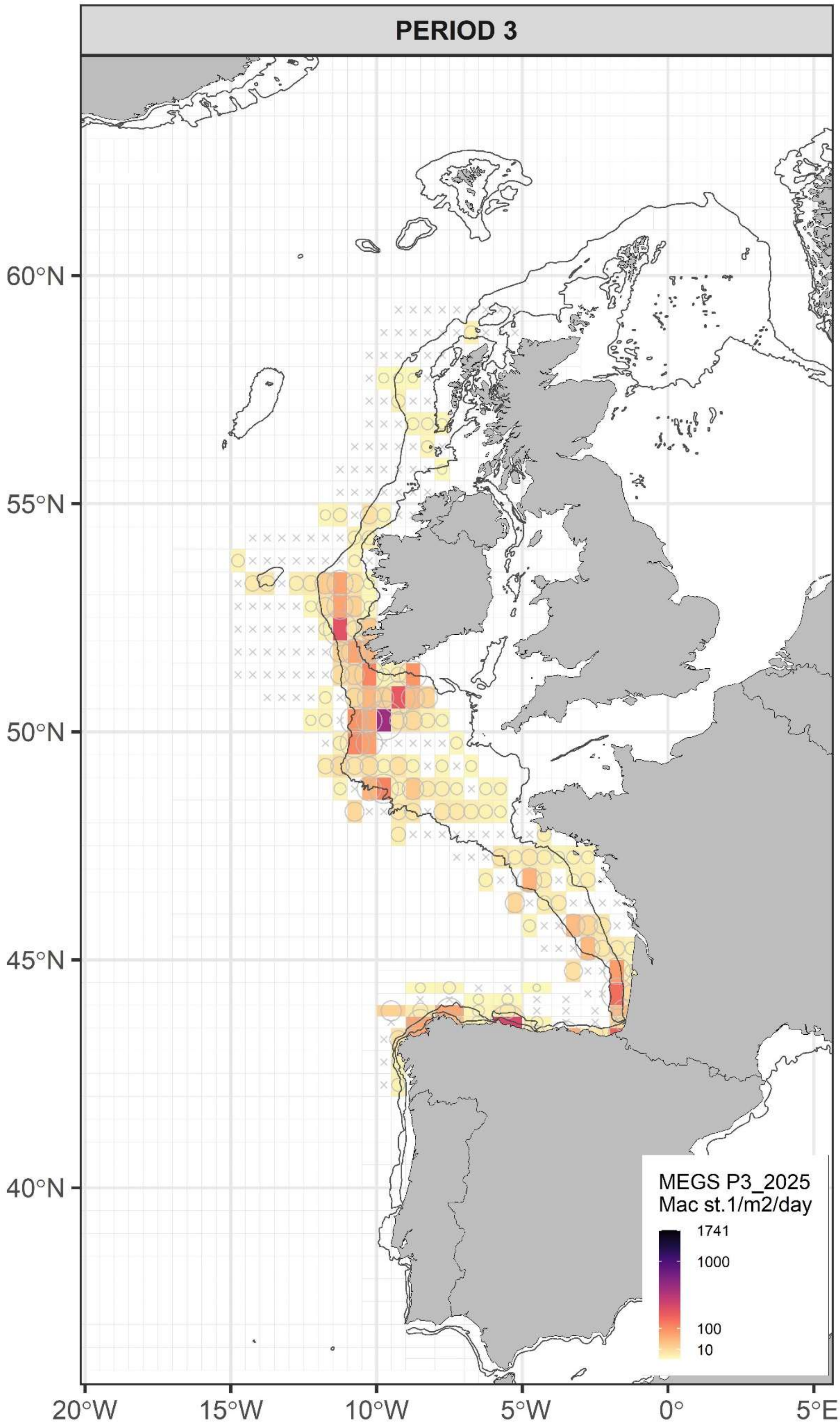


Figure 3.2: Mackerel daily egg production by half rectangle for period 3 (Mar 1st – Apr 7th). Circle areas and colour scale represent mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values.

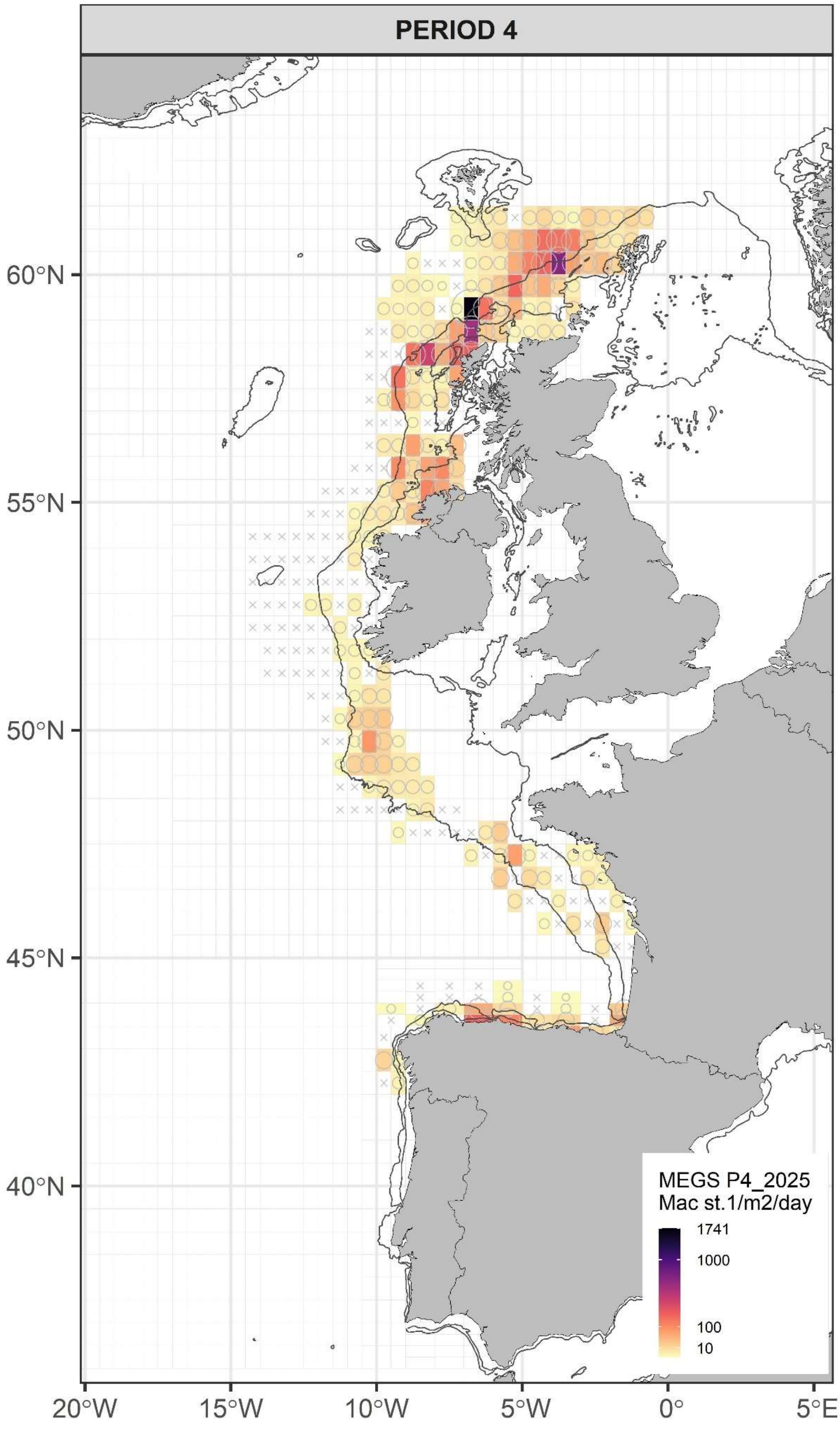


Figure 3.3: Mackerel daily egg production by half rectangle for period 4 (Apr 8th – 24th). Circle areas and colour scale represent mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values.

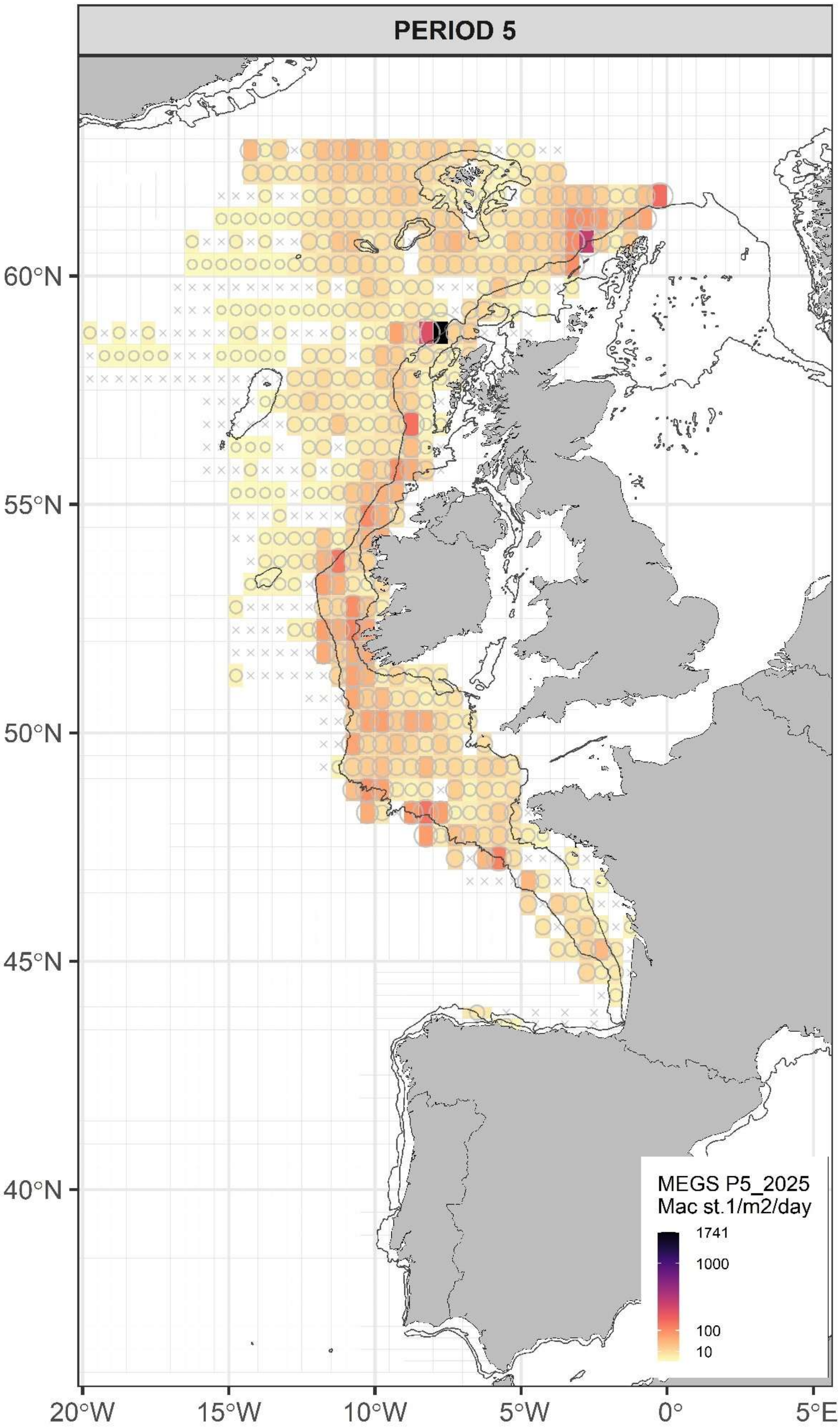


Figure 3.4: Mackerel daily egg production by half rectangle for period 5 (May 6th – June 2nd). Circle areas and colour scale represent mackerel stage I eggs/m²/day by half rectangle. Crosses represent

zero values.

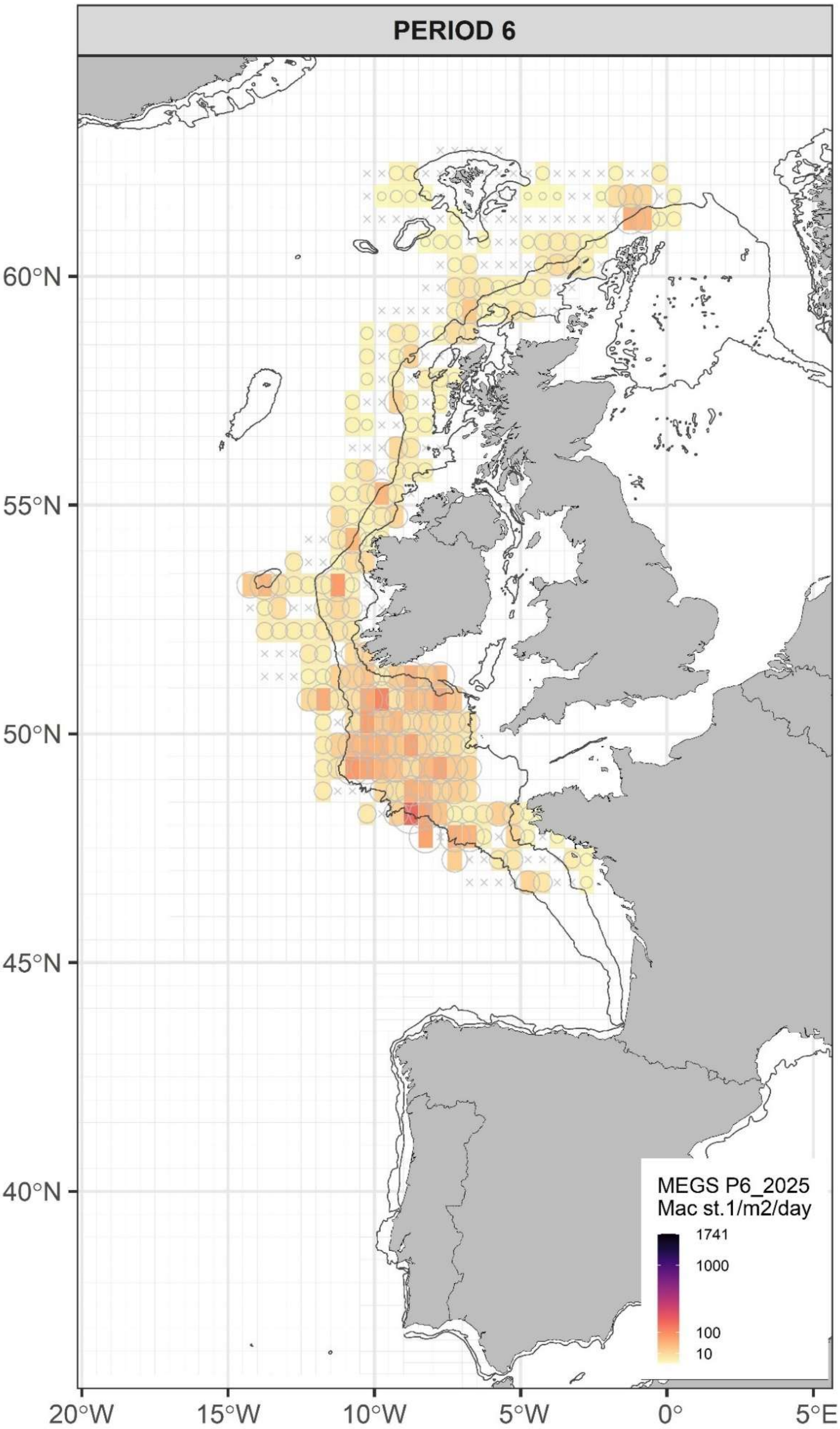
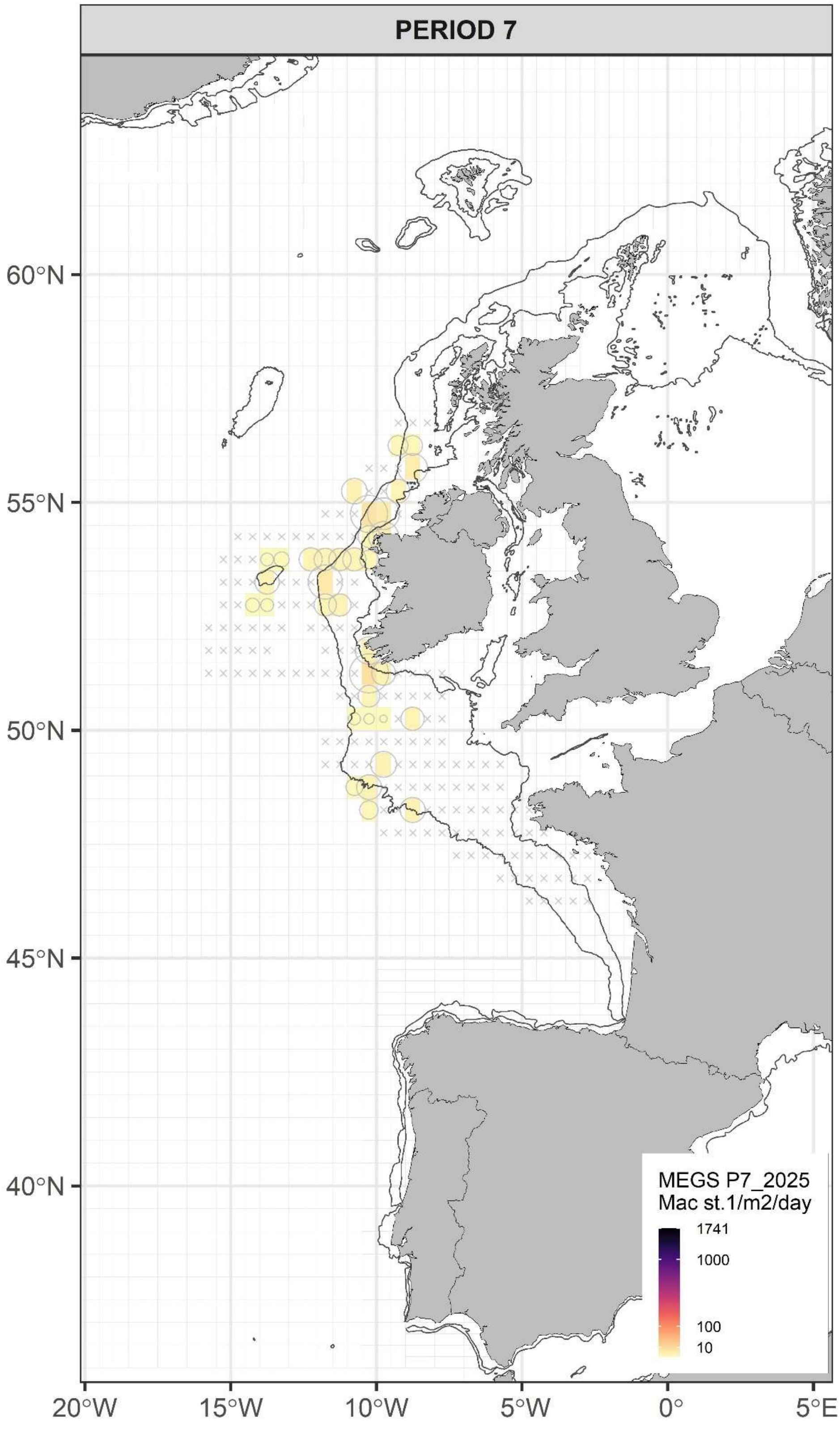


Figure 3.5: Mackerel daily egg production by half rectangle for period 6 (June 4th – July 7th). Circle areas and colour scale represent mackerel stage I eggs/m²/day by half rectangle. Crosses represent

zero values.


PERIOD 7
60°N
55°N
50°N
45°N
40°N
20°W
15°W
10°W
5°W
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5°E
MEGS P7_2025
Mac st.1/m2/day
1741
1000
100
10

Figure 3.6: Mackerel daily egg production by half rectangle for period 7 (July 8th – 27th). Circle areas and colour scale represent mackerel stage Ieggs/m^2/day by half rectangle. Crosses represent zero values.

Mackerel adult sampling by period

Atlantic mackerel samples for fecundity were collected at the same time and covering the area of the plankton samples (Fig 1.7). A total of 3,893 Atlantic mackerel were collected, of which 1,920 were female. Of these, 1,393 ovaries were selected for fecundity studies (Table 2).

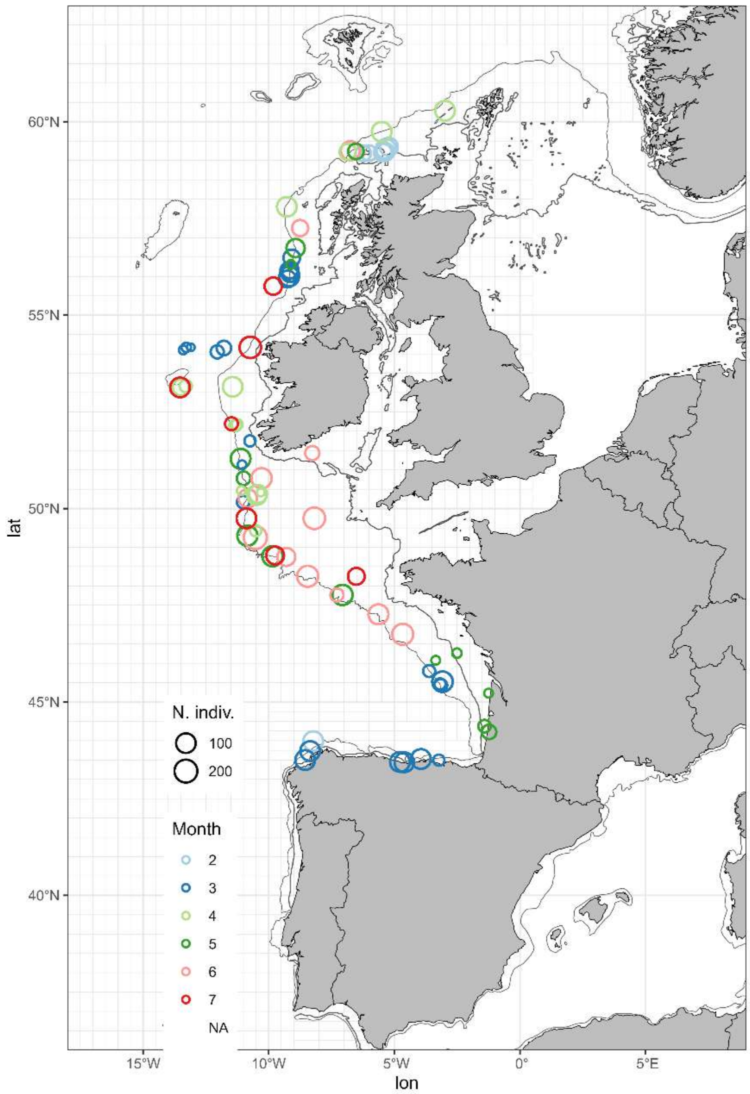

Figure 3.7: Distribution of adult mackerel samples by period (month). The number of mackerel captured by haul is represented by circles.

Table 3.1. Adult mackerel sampled by period.

Survey Period	n mackerel	n females	n ovaries
2	499	255	250
3	1590	852	667
4	419	185	140
5	735	322	164
6	591	238	125
7	149	68	47
Total	**3983**	**1920**	**1393**

Stage 1 Egg production in the Western Area

In 2016 the first survey commenced on February 5th which is five days prior to the nominal start date. That year, however, mackerel migration was later than during the previous couple of surveys and slower than that recorded in the previous two surveys.

In 2016 concern was expressed that survey coverage may have underestimated the total egg production estimate. However, the expansion that had been observed in western and northwestern offshore areas during Periods 5 and 6 in recent years was totally absent during the 2025 surveys. The 2025 mean daily egg production curve is similar to those observed in 2016 and 2022 but shows only one peak instead of two. This single peak coincides with the main spawning period previously observed, occurring again during Period 5. However, egg production in 2025 is at a much lower level and generally restricted within the shelf break (Figure 3.8). ~~A~~. Egg production by period since 1992 is shown in Figure 3.9. The nominal end of spawning date of the 31st July is the same as was used during previous survey years and the shape of the egg production curve for 2025 does not suggest that the chosen end date needs to be altered. The provisional total annual egg production (TAEP) for the western area in 2025 was calculated as $1.162 * 10^{15}$ (Table 3.3). This is a 36% decrease on the 2022 TAEP estimate which was $1.799 * 10^{15}$.

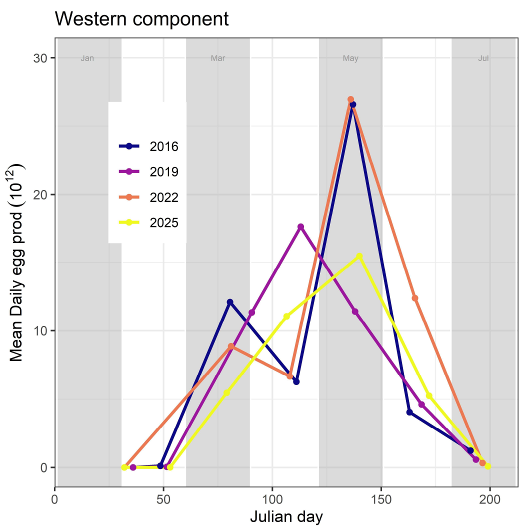

Figure 3.8: Provisional mean daily egg production curve for mackerel in the western component in 2025, (yellow line). The curves for 2016, 2019 and 2022 are included for comparison.

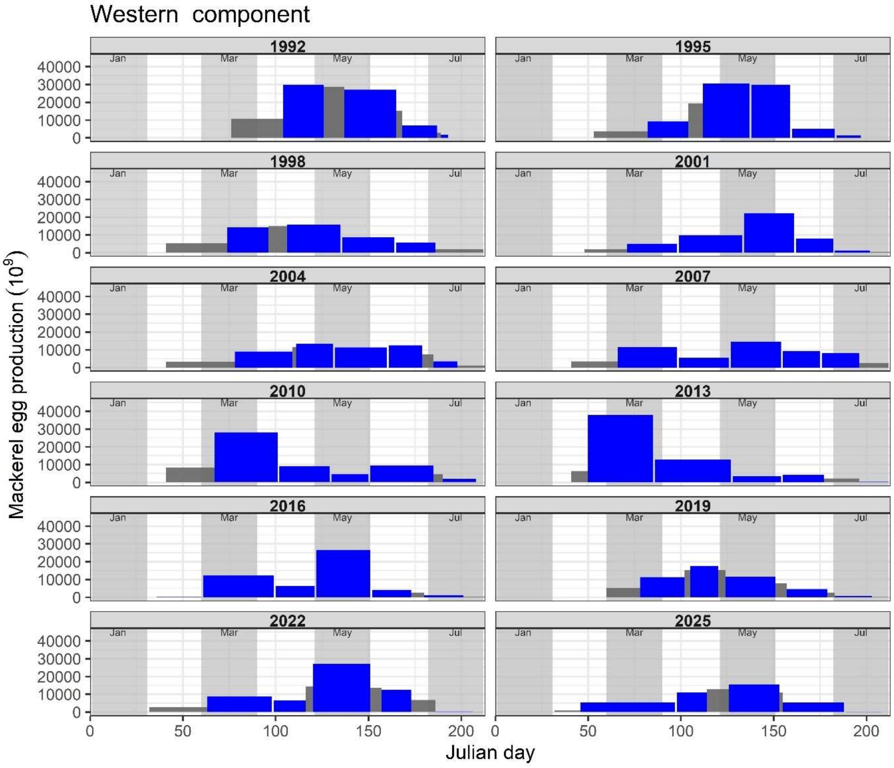

Figure 3.9: Egg production by period for the western component since 1992. Blue bars represent egg production estimated during sampling periods, while grey bars indicate production estimated for inter-period intervals using temporal interpolation. January, March, May, and July are highlighted with a grey background.

Table 3.3. Western estimate of mackerel total stage I egg production by period for 2025.

Dates	Period	Days	Annual stage I egg production $* 10^{15}$
Feb 1st – 14th	1-2	14	0.00002
Feb 15th – 28th	2	14	0.0001
Mar 1st – April 7th	3	38	0.208
Apr 8th – April 24th	4	17	0.188
April 25th – May 5th	4 - 5	11	0.142
May 6th – Jun 2nd	5	28	0.434
Jun 1st – 5th	5 - 6	1	0.011
Jun 4th – July 7th	6	34	0.179
July 8th – July 27th	7	20	0.0015
July 28th – 31st	Post 7	4	0.00004
Total			1.162

Stage 1 Egg production in the Southern Area

Sampling in the Cantabrian Sea where most of the spawning occurs within the Southern area commenced on the 7th of March. The same end of spawning date of the 31st May was used again this year, and the spawning curve suggests that there is no reason for this to change (Fig. 3.10). The 2025 mean daily egg production curve for the southern component does not show a clear peak (Figure 3.10). The mackerel egg production by period since 1992 is shown in Figure 3.116. The provisional total annual egg production (TAEP) for the southern area in 2025 was calculated as **0.717 * 10^{14}** (Table 3.4). This is a 78% decrease on the 2022 TAEP estimate which was 3.21 * 10^{14} (Fig. 2.3), and is the lowest in the time series.

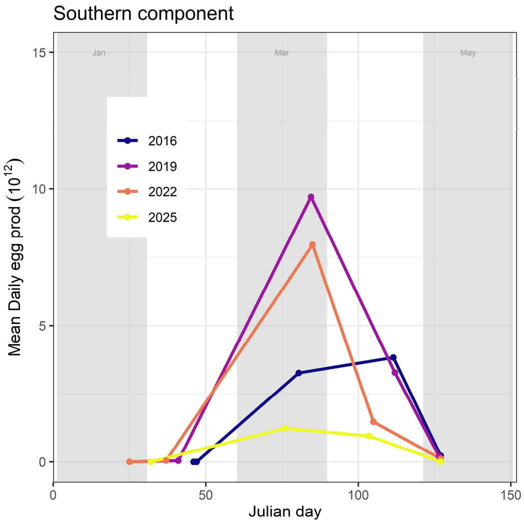

Figure 3.10: Provisional mean daily egg production curve for mackerel in the southern component for 2025, yellow line). The curves for 2016, 2019 and 2022 are included for comparison.

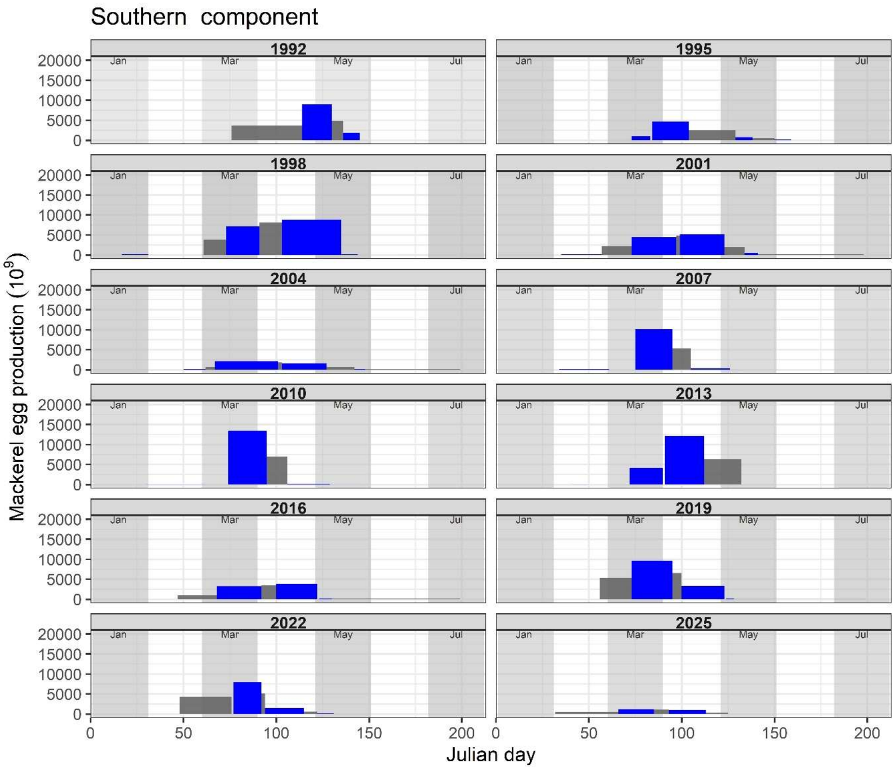

Figure 3.11: Egg production by period for the southern component since 1992. Blue bars represent egg production estimated during sampling periods, while grey bars indicate production estimated for inter-period intervals using temporal interpolation. January, March, May, and July are highlighted with a grey background.

Table 3.4 Southern estimate of mackerel total stage I egg production by period for 2025.

Dates	Period	Days	Annual stage I egg production x 10^{14}
Feb 1st – Mar 6th	0 - 3	34	0.162
March 7th – 26th	3	20	0.246
March 27th – April 2nd	3 - 4	7	0.076
April 3rd – 23rd	4	21	0.198
Apr 24th – May 4th	4 - 5	11	0.034
May 5th – 8th	5	4	0.0003
May 9th – May 31st	Post 5	23	0.0009
Total			0.717

Total egg production for southern and western areas

Figure 3.12 and Table 3.5 show the Total annual egg production (TAEP) for the western and southern components. The western and southern components combined in 2025 is **$1.234*10^{15}$**. (Fig. 2.6). This is a decrease in production of **41%** compared to 2022, $2.116*10^{15}$ (Fig. 3.13 and Table 3.6). This figure is the lowest in the time series.

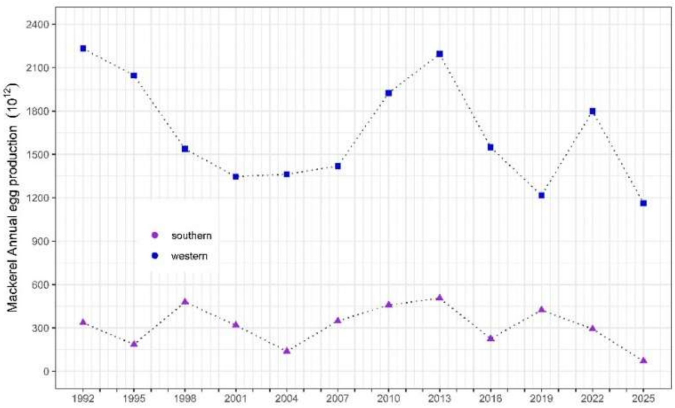

Figure 3.12: Western and Southern TAEP plot showing data since 1992

Table 3.5. Estimation of mackerel Annual Egg Production (AEP $*10^{12}$) by component for each year, using the Annual Egg Production Method .

Year	Component	AEP (10^{12})	sd
1992	Southern	359	14
1992	Western	2232	138
1995	Southern	186	69
1995	Western	2047	795
1998	Southern	541	573
1998	Western	1538	231
2001	Southern	318	201
2001	Western	1347	404
2004	Southern	138	41
2004	Western	1363	264
2007	Southern	348	341
2007	Western	1415	209
2010	Southern	459	243
2010	Western	1913	200
2013	Southern	506	579
2013	Western	2192	1572
2016	Southern	225	207
2016	Western	1523	435
2019	Southern	423	214
2019	Western	1211	237
2022	Southern	293	219
2022	Western	1639	601
2025	Southern	72	-
2025	Western	1162	-

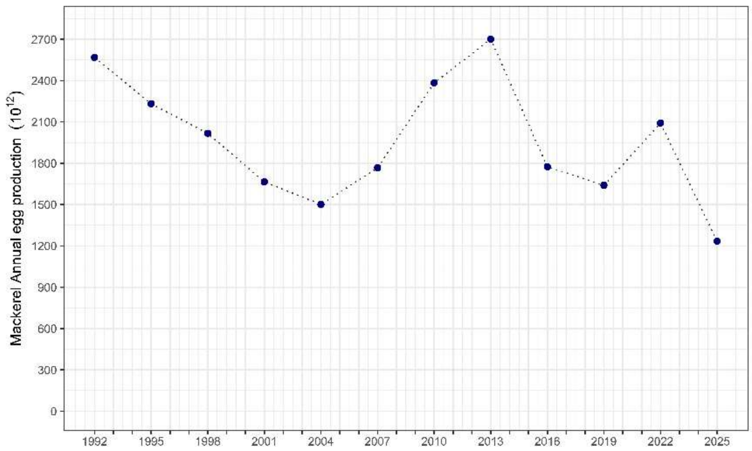

Figure 3.13: Combined Western and Southern TAEP plot showing data since 1992-

Table 3.6. Estimation of mackerel Annual Egg Production (AEP *10^{12}) for each year, using the Annual Egg Production Method.

Year	AEP (*10^{12})	sd
1992	2590	139
1995	2233	798
1998	2079	618
2001	1665	451
2004	1501	267
2007	1763	400
2010	2372	315
2013	2699	1675
2016	1748	482
2019	1634	319
2022	1932	639
2025	1234	-

Fecundity – Preliminary estimates

At the 2024 WGMEGS meeting it was decided that the workload to produce a preliminary estimate of fecundity for WGWIDE during the survey year was very onerous, especially as the final fecundity figure produced in the year after the survey could alter perceptions and affect the SSB calculation. Instead, the Group decided that for 2025 WGMEGS would provide WGWIDE with a fecundity figure based on the average of the fecundities calculated for 2016, 2019 and 2022. As a result, WGMEGS is calculating the 2025 MEGS survey SSB using a realised fecundity figure of 1167 oocytes per gram female.

Biomass estimation

Total spawning stock biomass (SSB) was estimated using a average realised fecundity figure of 1167 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 an estimate of spawning stock biomass of:

- 2.15 million tonnes for western component (2022: 3.065).
- 0.13 million tonnes for southern component (2022: 0.499).
- 2.28 million tonnes for western and southern components combined (2022: 3.563)

This is a decrease of 36% on the 2022 estimate

3.2 Survey coverage and mackerel egg production by period for North Sea area

The North Sea Mackerel Egg Survey (NSMEGS) is designed to estimate the spawning stock biomass (SSB) of mackerel of the North Sea spawning component of the Northeast-Atlantic stock on a triennial basis. Up to and including 2017 this was undertaken utilizing the annual egg production method (AEPM) and generally undertaken in the year following the survey covering the western components. This method estimates and combines total annual egg production, realized fecundity per gram female, and sex (male to female) ratio to calculate SSB.

Spatial and temporal coverage in the North Sea was reduced with the withdrawal of Norway from the NSMEGS in 2014, with the Netherlands left as the sole survey participant in 2015 and 2017. In 2020 Denmark was recruited as a new participant for the NSMEGS, and in 2021 the UK (England) announced that they were willing to participate.

An issue for the NSMEGS is that since 1982 it has been impossible to collect and sample pre-spawning mackerel, which are necessary in order to estimate the potential fecundity. For SSB estimation using the AEPM, the realized fecundity value used was from the 1982 estimate (Iversen and Adoff, 1983). For a number of years it was recognised that an AEPM survey wasn’t producing the best results for the North Sea. Therefore, at the WGMEGS meeting in 2018 a decision was made to use the Daily Egg Production Method (DEPM) for future surveys in the North Sea (ICES 2018). The DEPM requires only one full sweep, in a short time period, over the entire mackerel spawning area, preferably during peak spawning time. A disadvantage of the DEPM is that it requires many more mackerel ovary samples to be collected to estimate batch fecundity and spawning fraction.

Survey

In 2025 the UK and Denmark conducted the North Sea survey. The samples were collected and analysed according to the WGMEGS manuals (ICES 2019a, 2019b). UK collected plankton samples using a Gulf VII plankton sampler while Denmark used a Nackthai sampler. The UK and Denmark utilised a 500 µm plankton net which is standard protocol for the North Sea due to issues with clogging. At each station a double oblique haul was performed from the surface to 5 m above the bottom, a maximum depth of 200 m, or 20 m below the thermocline in case of stratification of the water column. Temperature and salinity were measured during the haul with a CTD mounted on top of the plankton sampler. Electronic flowmeters were mounted on the plankton sampler to monitor flow.

The NSMEGS was carried out from 31st May – 25th June (Table 3.5). During this period the spawning area between 54ºN and 61ºN was surveyed once, receiving a single coverage. The survey is designed to cover the entire spawning area with samples collected every half ICES statistical rectangle (ICES, 2014). In total 199 plankton stations were sampled, with 44 stations interpolated. On each of the Danish transects at least one pelagic trawl haul was performed for the collection of mackerel adult samples. Due to problems with their fishing gear CEFAS carried out 21 rod and line fishing events.

Following the WGMEGS manual temperature at 5m depth was used to estimate egg development (ICES 2019a). For the DEPM only the mackerel eggs in development stage 1A are used to estimate daily egg production.

Mackerel Daily egg production

The spatial egg distribution is shown in Figures 3.14 and 3.15. Standard MEGS interpolation rules (ICES, 2019a) were applied where needed. Egg distributions are comparable to 2022 survey, however egg numbers seem to be more evenly distributed throughout the survey area this year.

The total area sampled in 2025 was similar to the area sampled in 2022, however the two most northerly transects were not sampled. In 2025 the Skagerrak was sampled for the first time. Previous exploratory work had shown that mackerel eggs were present in these waters. For the DEPM calculation the stations are restricted to the traditional North Sea boundaries, however the Skagerrak data was calculated at an additional ~2% of the North Sea production. Similar to 2022 the highest area of production was found in the west of the North Sea, just off the English coast.

The DEP was calculated for the total investigated area (Table 3.8). Total daily egg production for 2025 was $0.79*10^{13}$ eggs. This is an 14% increase on egg numbers reported in 2022 (Table 3.9).

Adult parameters

Denmark conducted 18 hauls, from which they collected ovary samples from 178 females. England conducted 21 rod and line fishing events of which 10 were positive, and two fishing hauls, collecting ovary samples of 109 females (Table 3.7). As these samples were collected in June no analysis has been carried out on them. Batch fecundity and POF counting will take place before the end of the year, with the results to be delivered prior to the WGMEGS meeting in April 2026.

SSB

As there are currently no data available from the DEPM adult parameters, WGMEGS is just reporting egg production for 2025.

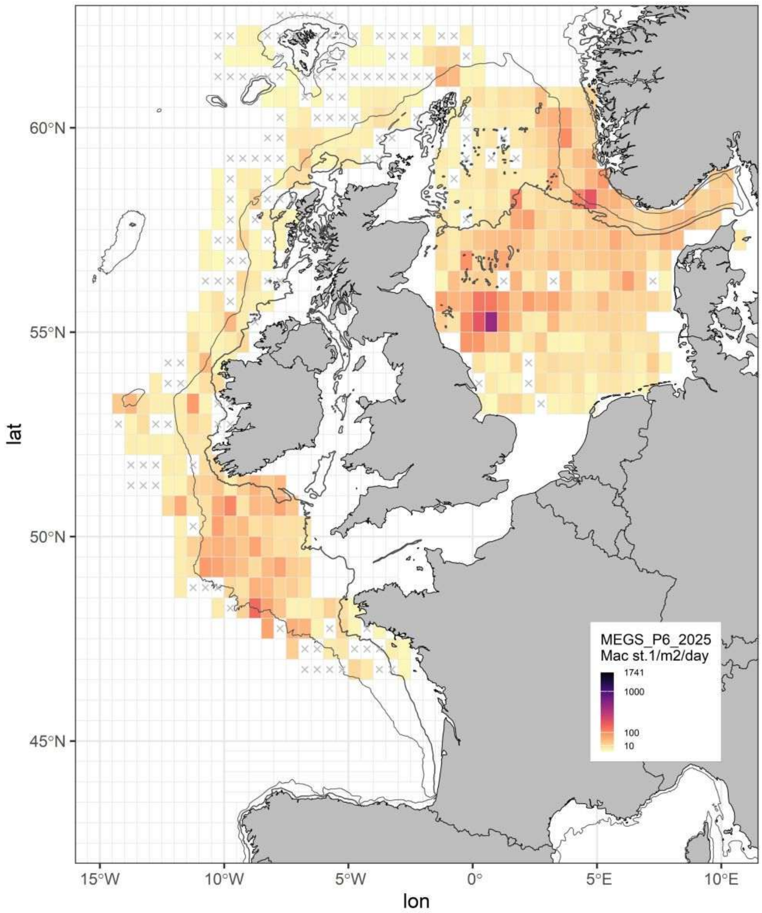

Figure 3.14. The heat map shows mackerel daily egg production by half rectangle (eggs m⁻² day⁻¹) for the combined areas of the North Sea, including the Skagerrak, and the Southern and Western components, for the period 6. Crosses represent zeros values.

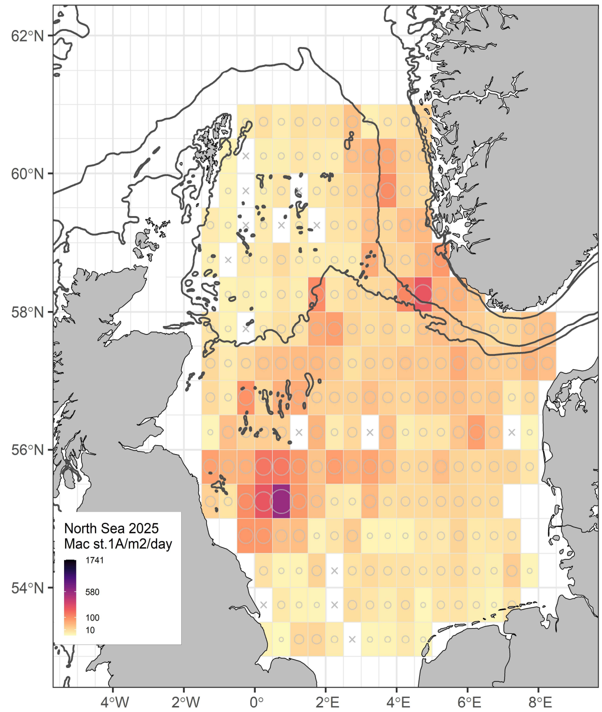

Figure 3.15: Heat map of Stage 1A mackerel daily egg production (eggs. m^{-2}. day^{-1}) by half rectangle for the North Sea areas, 2025, excluding the Skagerrak. Grey circles represent daily egg production values, crosses represent zeros values.

Table 3.7. Dates for North Sea mackerel surveys in 2025. UK = England; DK = Denmark.

Country	**UK**	**DK**
Period	6	6
Dates (2025)	31.05 -25.06	11.06-21.06
Plankton stations sampled	132	101
Pelagic trawl hauls	~~2~~	18
Positive rod and line events	21	

Table 3.8. Total egg production using the Daily egg production estimate (stage 1A abundance) in the North Sea for 2025.

Year	DEP $*10^{13}$	CV DEP
2025	0.79	-

Table 3.7. Daily egg production (DEP Stage 1A) estimates for the North Sea in 2022 and 2025 by DEPM..

Year	2025	2022
DEP $*10^{13}$	0.79	0.67

4 Results for western horse mackerel

Horse mackerel egg production by period

Period 3 – In period 3 horse mackerel spawning started in the Cantabrian Sea and southern Biscay, with the number of eggs found being higher than reported in 2022. Higher spawning took place in the Celtic Sea but numbers were still low (Fig. 4.1).

Period 4 – Horse mackerel spawning continued in the Cantabrian Sea, extending into southern Biscay again showing higher numbers than 2022. Eggs were again found in the Celtic Sea, but numbers were lower than in period 3 (Fig. 4.2).

Period 5 – Horse mackerel spawning continues in the Cantabrian Sea, Celtic Sea and northern Bay of Biscay, but still in low numbers. Some eggs were also found south and west of Ireland (Fig. 4.3).

Period 6 –Spawning continued in northern Biscay, the Celtic Sea and to the southwest of Ireland. For the first time in a few years large numbers of eggs were reported in several stations close to the 200m contour south of Ireland and west of France. Peak spawning took place during this period (Fig. 4.4).

Period 7 – Eggs were found from northern Biscay to west of Scotland, being concentrated off the southwest of Ireland. In general egg numbers were low but occasional stations with moderate to high counts were observed (Fig. 4.5).

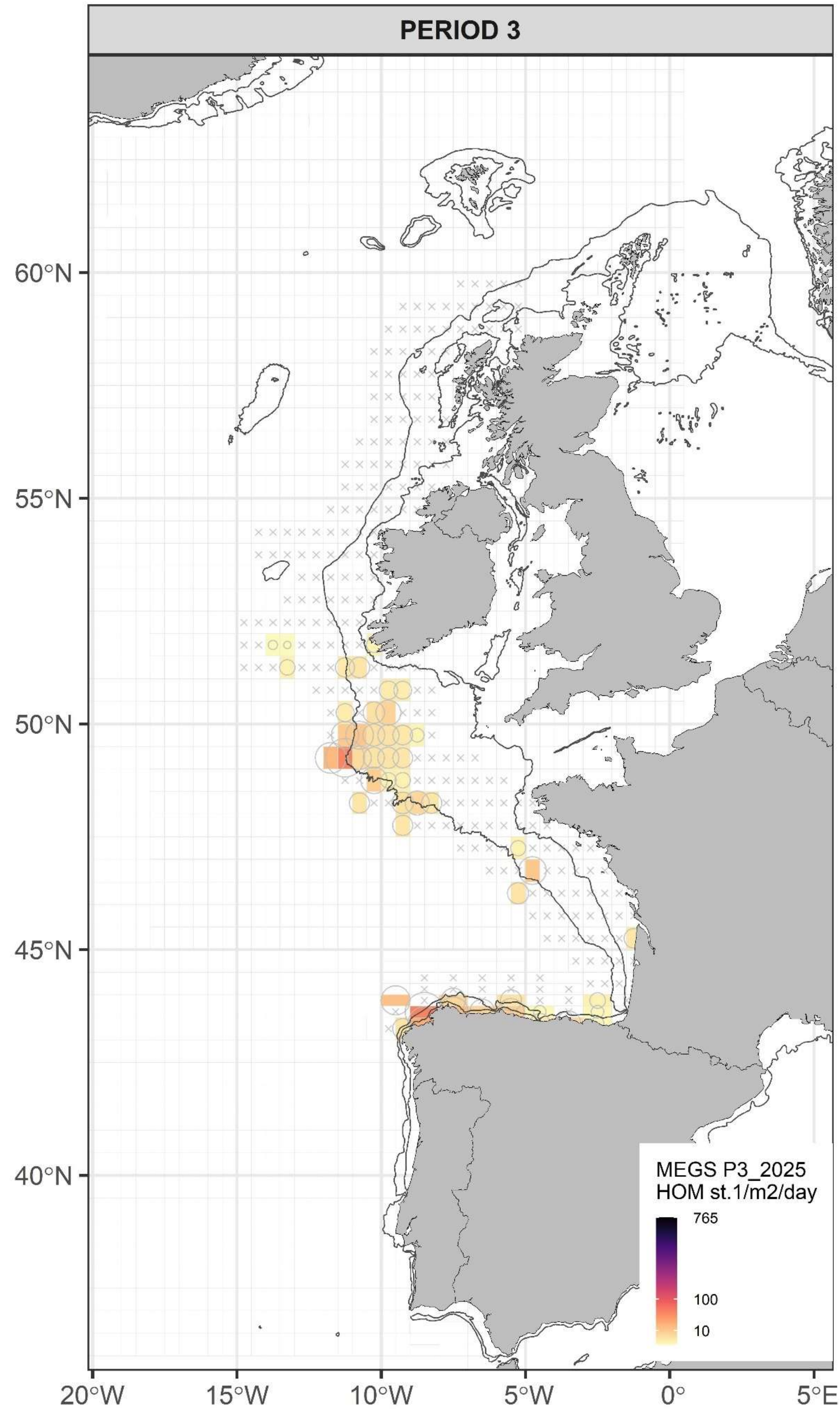

Figure 4.1: Horse mackerel daily egg production by half rectangle for period 3 (March 1st – April 2nd). Circle areas and colour scale represent horse mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values.

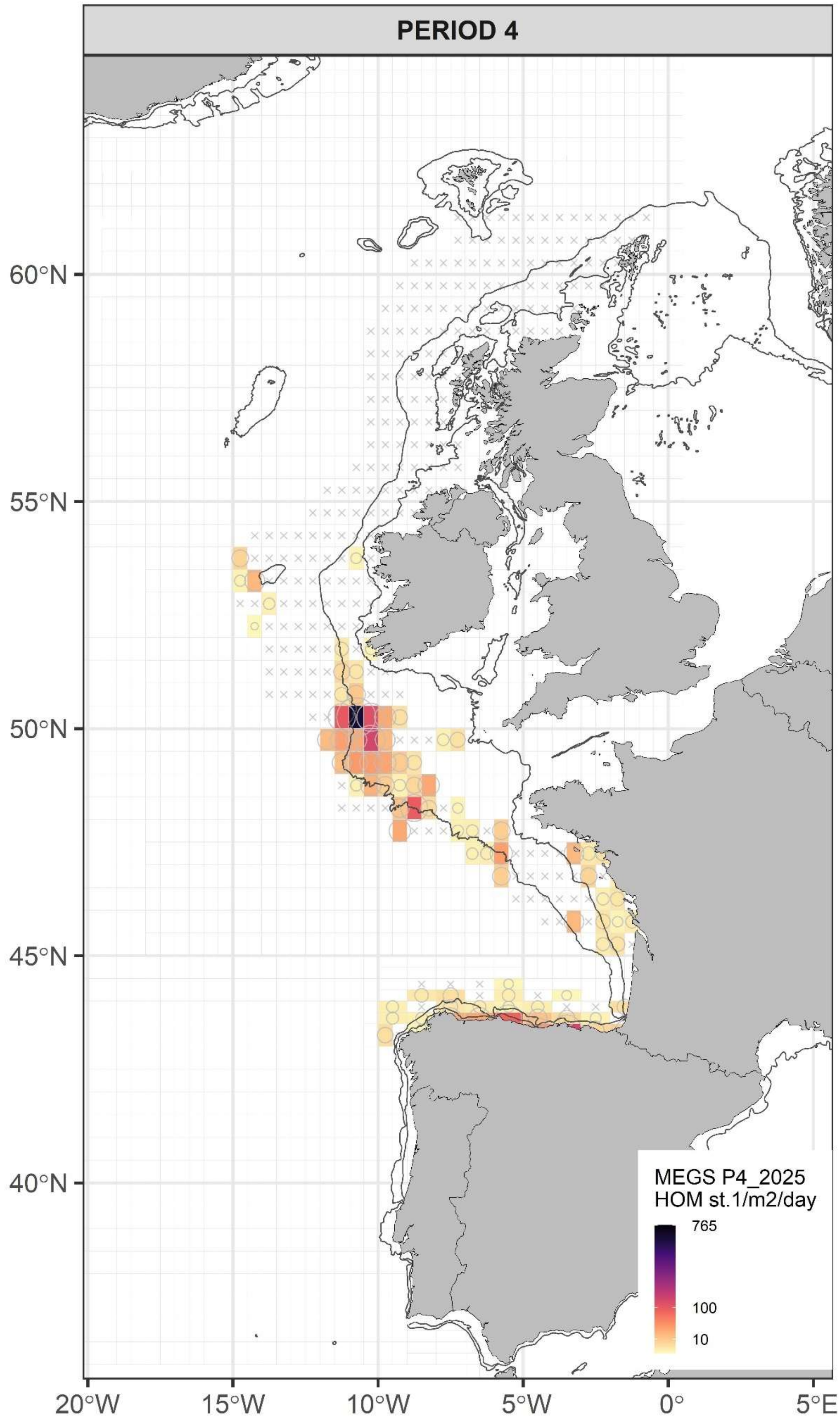

Figure 4.2: Horse mackerel daily egg production by half rectangle for period 4 (April 3rd – 24th). Circle areas and colour scale represent horse mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values.

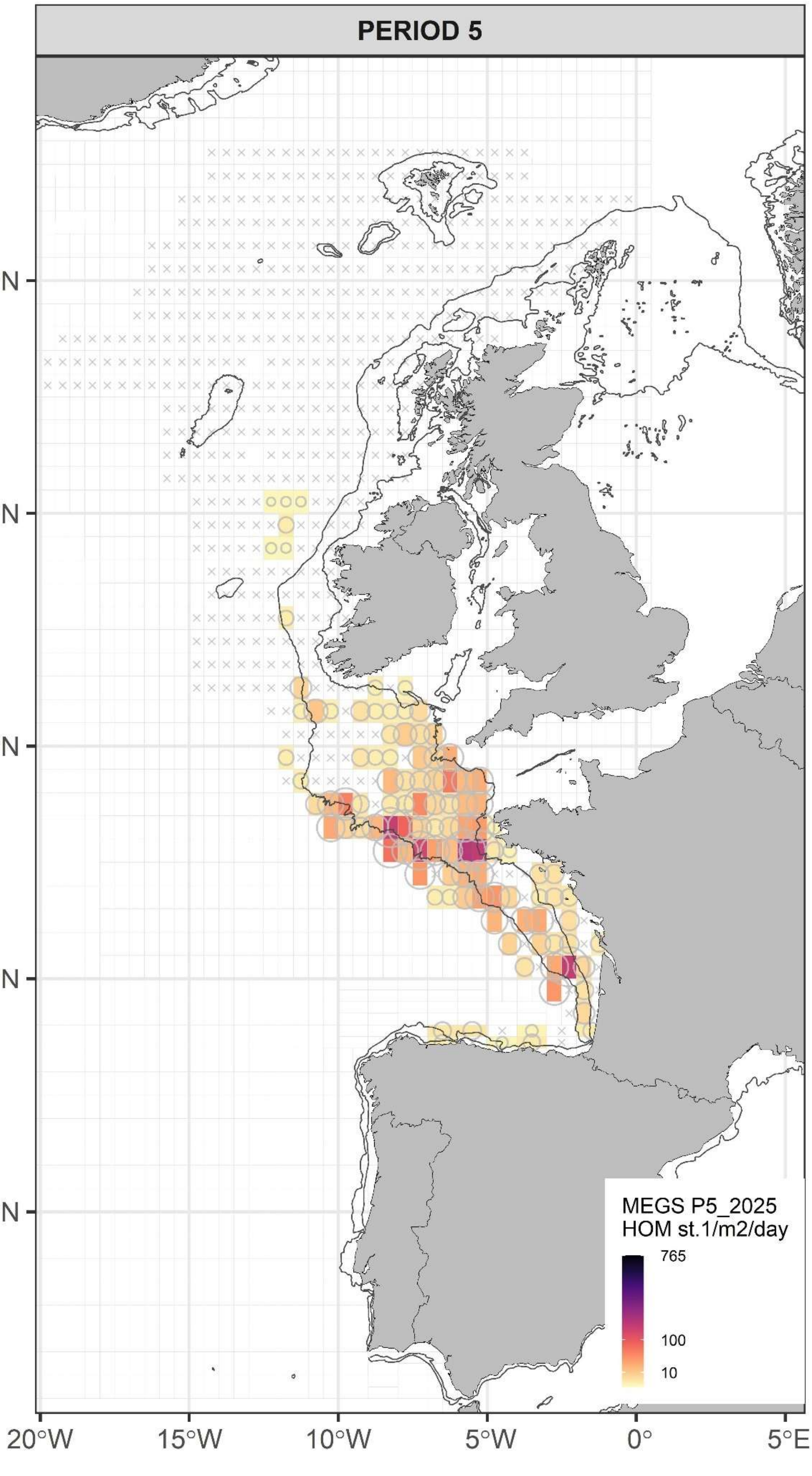

Figure .3: Horse mackerel daily egg production by half rectangle for period 5 (May 5th – June 2nd). Circle areas and colour scale represent horse mackerel stage I eggs/m²/day by half rectangle. Crosses represent zero values.

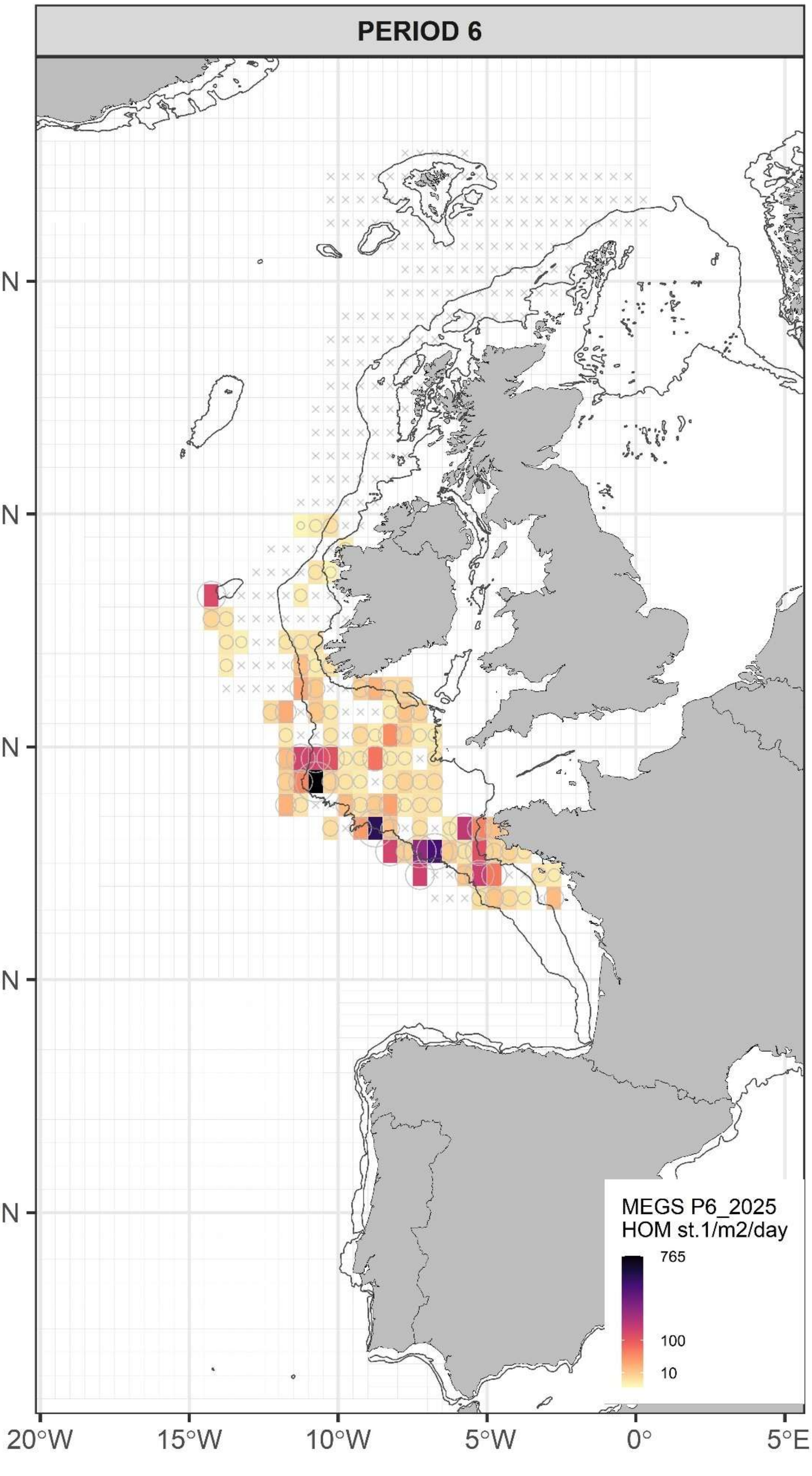

Figure .4: Horse mackerel daily egg production by half rectangle for period 6 (June 4th – July 7th). Circle areas and colour scale represent horse mackerel stage I eggs/m²/day by half rectangle. Crosses represent zero values.

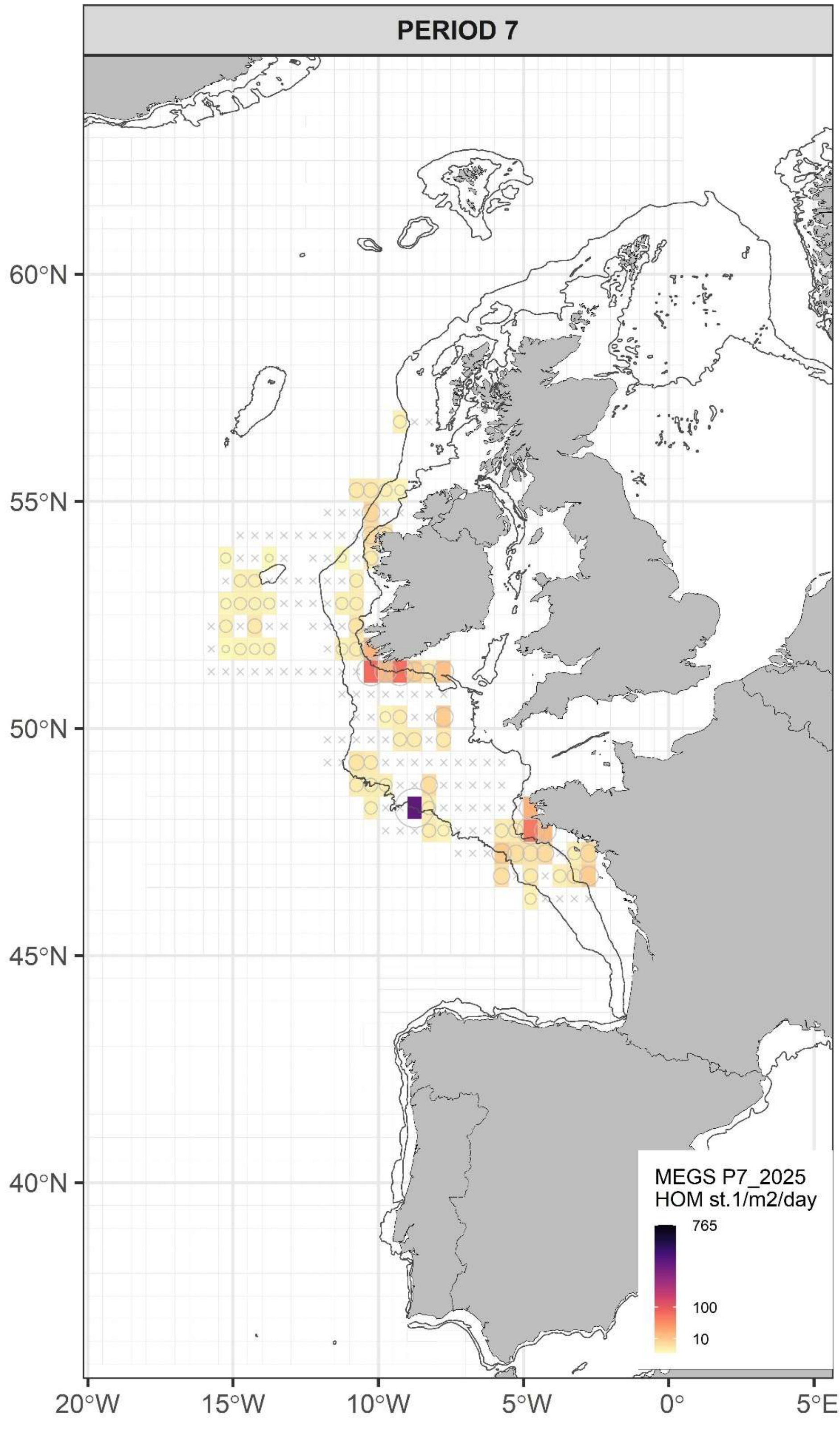

Figure 4.5: Horse mackerel daily egg production by half rectangle for period 7 (July 8th – 27th). Circle areas and colour scale represent horse mackerel stage I eggs/m^2/day by half rectangle. Crosses represent zero values

TAEP results for Western Horse Mackerel

Period number and duration are the same as those used to estimate the western mackerel stock, as are the dates defining the start and end of spawning (Table 4.1). The shape of the mean daily egg production curve does not suggest that those dates should be altered for 2025 (Fig. 4.6). The total annual egg production was estimated at **5.67 x 10^{14}**. This is a 3% increase on 2022 which was 5.15 × 10^{14} (Fig. 4.7, Table 4.2). Horse mackerel egg production by period since 1992 is shown in Figure 4.8.

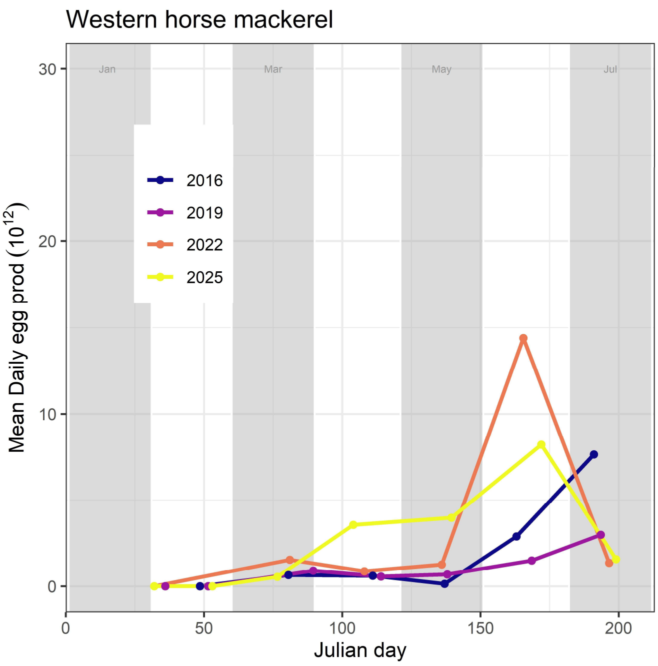

Figure 4.6: Provisional mean daily egg production curve for western horse mackerel stock for 2025, (yellow line). The curves for 2016, 2019 and 2022 are included for comparison.

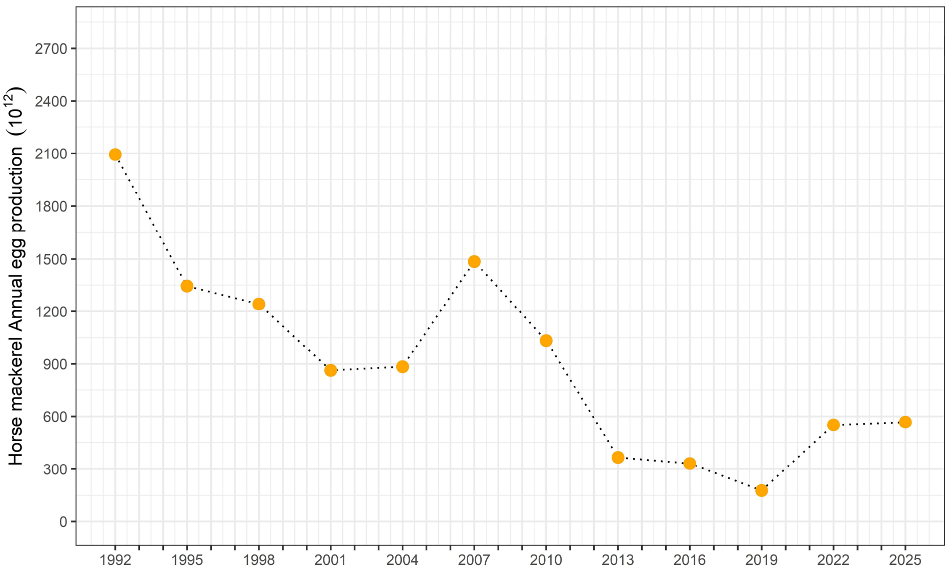

Figure 4.7: Provisional total annual egg production for western horse mackerel. Production figures back to 1992 are included for comparison.

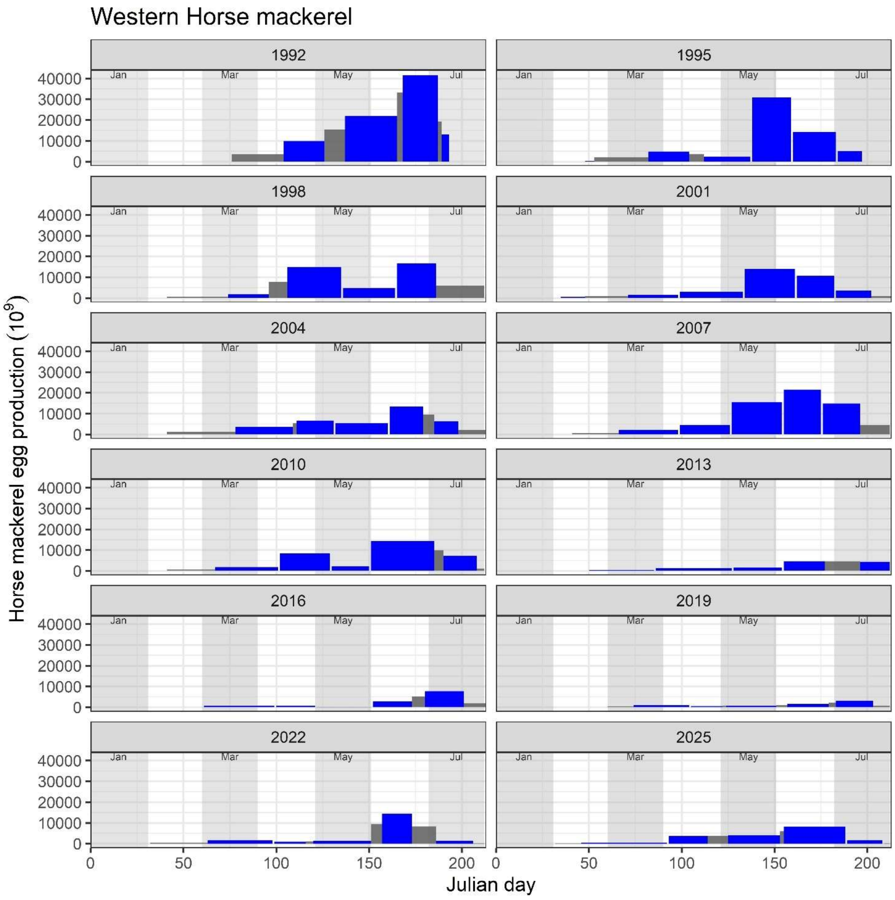

Figure 4.8: Egg production by period for the western horse mackerel spawning stock since 1992. Blue bars represent egg production estimated during sampling periods, while grey bars indicate production estimated for inter-period intervals using temporal interpolation. January, March, May, and July are highlighted with a grey background.

Table 4.1: Estimate of Western horse mackerel stage I egg production b y period using the histogram method for 2025.

Dates	Period		Days	Annual stage I egg production * 10^{15}
Mar 1st – April 2nd	3		33	0.018
Apr 3rd – 24th	4		22	0.079
Apr 25th – May 4th	4 - 5		10	0.038
May 5th – June 2nd	5		29	0.115
Jun 3rd – 3rd	5 - 6		1	0.006
Jun 4th – July 7th	6		34	0.28
July 8th – 27th	7		20	0.031
July 28th – 31st	Post 7		3	0.0009
Total				0.567

Table 4.2, Estimation of horse mackerel Annual Egg Production (AEP *10^{12}) for each year, using the Annual Egg Production Method.

Year	TAEP (*10^{12})
1992	2094
1995	1344
1998	1242
2001	864
2004	884
2007	1486
2010	1033
2013	366
2016	331
2019	178
2022	551
2025	567

Fecundity investigations

This year for horse mackerel only DEPM ovary samples were collected during Periods 6 and 7, during peak of spawning. In addition to those samples collected during the MEGS surveys additional samples were collected from the Irish WESPAS surveys in periods 6 and 7. A total of 992 horse mackerel were collected, of which 540 were female. Of these, 356 ovaries were selected for fecundity studies. Since horse mackerel fecundity is at this moment not used for estimating the spawning stock biomass, the focus of the fecundity analysis has been on mackerel. Therefore, at this time no horse mackerel fecundity results are ready to be presented. All samples will be analysed and results presented at the 2026 WGMEGS meeting.

DEPM results –Western Horse Mackerel

The horse-mackerel egg data of the DEPM survey are still under revision. Samples will be analyzed before and results will be presented to the 2026 WGMEGS meeting.

5 Discussion

Since 2004 and subsequent to demands for up-to-date data for the assessment, WGMEGS has endeavored to provide an estimate of NEA mackerel biomass and western horse mackerel egg production within the same calendar year as the survey and in time for the assessment meetings taking place. This report represents the preliminary results of the 2025 egg survey. WGMEGS cannot guarantee that there will be no changes prior to the presentation of the final survey results at WGMEGS in April 2026. However, despite the tight deadline nearly all plankton samples were analyzed for mackerel (southern and western area) and horse mackerel (western area only) stage 1 eggs.

At the 2024 WGMEGS meeting it was decided that the workload to produce a preliminary estimate of fecundity for WGWIDE during the survey year was very onerous, especially as the final fecundity figure produced in the year after the survey could alter perceptions, and affect the SSB calculation. Instead, the Group decided that for 2025 WGMEGS would provide WGWIDE with a fecundity figure based on the average of the fecundities calculated for 2016, 2019 and 2022. As a result, WGMEGS is calculating the 2025 MEGS survey SSB using a realised fecundity figure of 1167 oocytes per gram female.

Previous surveys in 2010 and 2013 were dominated by the issue of the early peak of western mackerel spawning and its close proximity to the nominal start date. In 2016 peak spawning reverted to May / June, a time that would traditionally be considered normal. In 2019, peak spawning in the western area was found to have occurred slightly earlier in Period 4. For 2025 the spawning pattern is remarkably similar to that reported for 2016 and 2022, although at a much lower level.

During 2016, high levels of spawning were recorded over a large area of the Northeast Atlantic with a large number of stations being reported over deepwater and well away from the continental shelf. In 2019 numbers of stage 1 eggs recorded on these northerly and western boundary stations were much reduced, although still present. The expansion was repeated in 2022 during Periods 5 and 6, however spawning densities recorded in these areas were significantly lower than reported in 2016 and 2019. In 2025 very little spawning was recorded in these offshore areas. The majority of spawning took place close to the 200m contour line and egg numbers dropped significantly within two to three stations east or west of this line.

Once again in 2025 western horse mackerel has shown an increase in egg production, albeit at a much smaller level than 2022, increasing by 3%.

The MEGS group is confident that this survey accurately reflects the spawning patterns as exhibited by both species and as presented in this working document.

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