North Sea mackerel total egg production for 2022 using the daily egg production method

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Introduction

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 (TAEP), 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 North Sea surveys (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 2022 the UK and Denmark conducted the North Sea survey. Whilst planning the survey it became apparent that the vessel time available from the two countries would not be sufficient to cover the area. As a result, Norway agreed to survey the four northernmost transects in the North Sea at the start of their period 6 survey.

The samples were collected and analysed according to the WGMEGS manuals (ICES 2019a, 2019b). UK and Norway sampled eggs with 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, while Norway used a 250µm mesh. 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. Either electronic or mechanical flowmeters were mounted on the plankton sampler to monitor flow.

The NSMEGS was carried out from 5th – 24th June (Table 1). During this period the spawning area between 54ºN and 62ºN was surveyed once, receiving a single coverage (Fig. 1). The survey is designed to cover the entire spawning area with samples collected every half ICES statistical rectangle (ICES, 2014). In total 259 plankton stations were sampled, with 19 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 a number of 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.

Results

Mackerel daily egg production

The spatial egg distribution is shown in Fig. 1. Standard MEGS interpolation rules (ICES, 2019a) were applied where needed. Egg distributions are comparable to 2021, however egg numbers seem to be more evenly distributed throughout the survey area this year.

The total area sampled in 2022 was slightly smaller than the area sampled in 2021, the first full transect was started at 54° 15'N compared to 53° 15'N in 2021. The two southern transects were sampled but there were issues with many of the stations re the accuracy of the flow data. This resulted in three valid stations south of 54°N with a further three being interpolated. The invalid stations do give an indication of the presence and absence (qualitative data) of mackerel stage 1A and above over this area.

The DEP was calculated for the total investigated area (Table 2). Total egg production for 2022 was $0.6699*10^{13}$ eggs. This is a 50% decrease on egg numbers reported in 2021 (Table 3).

Adult parameters

Denmark conducted 33 hauls, from which they sampled 1180 mackerel and collected ovary samples from 364 females. England conducted 20 rod and line fishing events of which 9 were positive, biologically sampling 225 mackerel and collecting ovary samples of 74 females. Norway collected 239 female mackerel samples from 5 fishing hauls, (Table 1). 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 2023.

SSB

As there are no data available from the adult parameters, WGMEGS is just reporting egg production for 2022.

References

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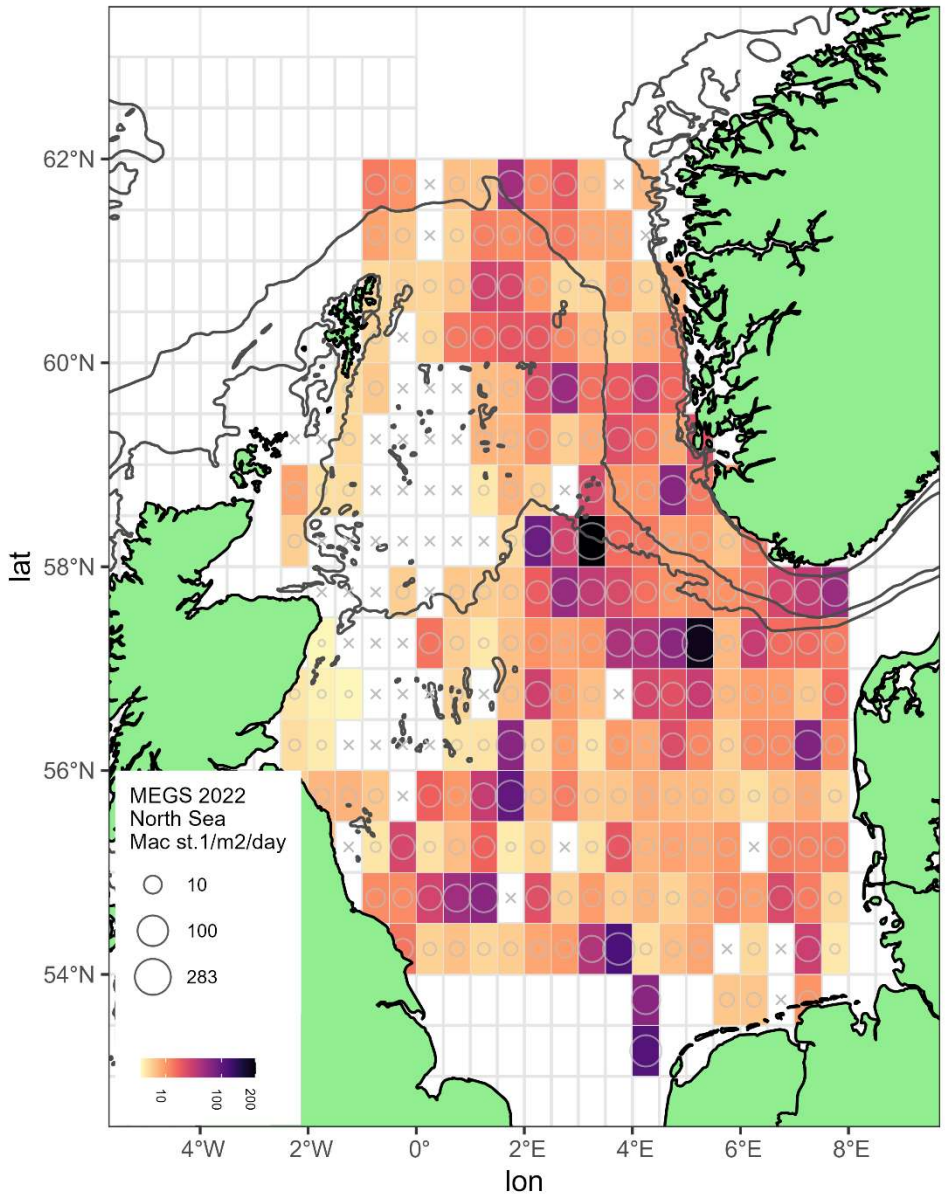

Figure 1. Heat map of Stage 1A mackerel egg production (eggs. m^{-2}. day^{-1}) by half rectangle for the North Sea, 2022. Grey circles represent observed values, crosses represent observed zeros.

Table 1. NSMEGS surveys cruise dates in 2022 (For Norway only stations used in the NSMEGS DEP calculation are shown). UK=UK England, DK=Denmark, NO=Norway.

Country	**UK**	**DK**	**NO**
Period	1	1	1
Dates (2022)	5.06-24.06	08.06-17.06	7.06-19.06
Plankton stations sampled	135	79	45
Pelagic trawl hauls		33	5
Positive rod and line events	9		

Table 2. Total egg production using the Daily egg production estimate (stage 1A abundance) in the North Sea for 2022.

Year	**DEP *10^{13}**	**CV DEP**
2022	0.67	

Table 3. Comparison of total stage 1A egg production for 2022 and 2021 in the North Sea estimated by the Daily Egg production method.

Year	**2022**	**2021**
DEP *10^{13}	0.67	1.28