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Second Interim Report of the Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS)

By correspondence



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Executive summary

The Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS) is responsible for the planning, data collection, and data analysis of the ICES triennial mackerel and horse mackerel egg surveys. 2016 is the year of the actual survey and the working group (WG) performs its duties by correspondence. As such, the outcomes from this report are restricted and focus heavily on the ToRs that are directly involved with the successful execution of the MEGS survey in 2016.

The results of the two Workshops on Egg staging, Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM) (12–16 October 2015, Hamburg, Germany and 9–12 November 2015, Bergen, Norway) were discussed with the subsequent enhancements and recommendations proposed during these workshops are outlined in the workshop report (ICES, 2015a) and have also been incorporated into both of the WGMEGS manuals (ICES, 2016a), (ICES, 2016b).

Planning for the 2016 survey was fine-tuned. Although the broad planning of the 2016 survey was undertaken during the 2015-planning meeting and reported in the 2015 WGMEGS report, amendments to the provisionally agreed plan required additional intersessional refinements. The settled plan for the 2016 survey has been included in the latest version of the WGMEGS Manual for the Mackerel and Horse Mackerel Egg Surveys (ICES SISP 6, 2016). In 2016, the survey will once again face significant challenges with regards to its ability to provide adequate geographical and temporal coverage given the limited vessel resources at our disposal. Norway's withdrawal from the MEGS survey in 2015 will be keenly felt although the inclusion of additional surveys undertaken on commercial vessels will hopefully mitigate the loss in survey effort. This is however only a short-term fix as the additional burden of the supply of scientific staff to participate on these additional surveys largely falls on existing MEGS participant nations who are already heavily committed. In 2016, Portugal, Spain (IEO and AZTI), Ireland, UK/Scotland, the Netherlands, Germany, the Faroe Islands, and Iceland are participating in the egg survey.

The mackerel egg survey in the North Sea was completed in 2015 having been abandoned in 2014 due to the withdrawal of Norway at very short notice and also technical issues with the remaining Dutch vessel. A survey carried out by the Netherlands in 2015 estimated a total annual egg production in the North Sea of 119×10^{12} eggs with an SSB estimation of 170 476 tonnes, which was slightly higher than 2011.

1 Administrative details

Working Group name

Working Group on Mackerel and Horse mackerel Egg Surveys (WGMEGS)

Year of Appointment

2015

Reporting year within current cycle (1, 2 or 3)

2

Chair(s)

Cindy van Damme, Netherlands

Finlay Burns, UK (Scotland)

Meeting venue

ICES Headquarters - Copenhagen, Denmark

Meeting dates

By correspondence (2016)

2 Terms of Reference a) – z)

f) Analyse and evaluate the results of the 2014 mackerel egg survey in the North Sea.

h) Examine the results of the Hamburg and Bergen workshops (October and November 2015) on mackerel and horse mackerel egg staging and identification and fecundity and histology, and incorporate these into the WGMEGS manuals in time for the 2016 survey.

i) Fine-tune survey execution in 2016.

3 Summary of Work plan

Year 1	Planning of the egg survey in 2016 and reporting on the North Sea egg survey of 2014.
Year 2	Survey year, the Atlantic survey is conducted in 2016, no meeting takes place in year 2. A report, by correspondence, with the updated planning and manuals is published.
Year 3	Reporting and finalizing of the results of the 2016 egg survey. Planning of the 2017 North Sea egg survey.

4 List of Outcomes and Achievements of the WG in this delivery period

- Report on the 2015 mackerel eggs survey in the North Sea (postponed from 2014).
- Fine tune and execute final plan for the 2016 Atlantic mackerel and horse mackerel egg survey.
- Review results from egg staging and fecundity workshops as reported in the 2015 WKFATHOM Report (ICES, 2015a).

5 Progress report on ToRs and workplan

- ToR f) Due to several factors the mackerel egg survey in the North Sea was abandoned in 2014, being postponed until 2015. With the Netherlands now as the sole participant after Norway's withdrawal in 2014, the survey was completed in 2015 with the preliminary results being presented to WGWIDE in August 2015 (ICES, 2015c). The full results are reported in section 5.
- ToR h) The results from the egg staging and identification workshop as well as the calibrations undertaken during the fecundity, screening and atresia workshops are included in the 2015 WKFATHOM report (ICES, 2015a). The results promoted discussion and highlighted specific problem areas. This led to further development of the standard protocols, and enhancements to the species and stage descriptions. These modifications/ enhancements were subsequently included into a new updated version of the Manual for the mackerel and horse mackerel egg surveys (ICES, 2016a) and also the Manual for AEPM and DEPM fecundity (ICES, 2016b). Both updated versions of the manuals were made available to all survey participants prior to the commencement of the 2016 MEGS survey. Several recommendations were made during the workshops ahead of the 2016 survey and a response to those relevant to WGMEGS can be found in Section 6 of this report.
- ToR i) The final settled survey and adult sampling plan has been finalized and incorporated into the latest updated versions of the WGMEGS Manual for the Mackerel and Horse Mackerel Egg Surveys (ICES, 2016a). Several last minute changes to the settled survey plan that occurred subsequent to the publication of the latest version of this manual and are reported in Section 7. These changes, together with the actual survey dates will be reported in full during the final WGMEGS report of this current 3-year cycle in 2017.

6 Analysis and evaluation of the results of the 2015 mackerel egg survey in the North Sea (ToR f)

6.1 Spatial and temporal coverage

In 2014, Norway decided to withdraw its participation from the North Sea mackerel egg survey. The Netherlands was left as sole participant and at short notice and it was not possible to find another survey participant. Due to technical problems with the Dutch vessel, no North Sea mackerel egg survey could be carried out in 2014. It was then decided to postpone the North Sea mackerel egg survey to 2015.

In 2015, the Netherlands was again the sole survey participant. In order to get an adequate coverage of the spawning season in time and space, the Dutch government decided to fund one extra survey week in 2015. During the period 26 May - 17 June 2015, the Netherlands carried out an egg survey in the North Sea on board the RV *Tridens* to estimate the mackerel total annual egg production (TAEP) and spawning-stock biomass (SSB). During this period, the spawning area was covered four times (Table 6.3.1). The survey is designed to cover the entire spawning area with half ICES rectangle samples (ICES, 2014). However, with one vessel the entire spawning area can only be covered using the every other transect method (Figure 6.3.1-4).

Since 1980, the spawning area has been surveyed several times during the spawning season. Since 1996, the North Sea mackerel egg surveys have been carried out on a triennial basis. The previous mackerel egg survey in the North Sea was in 2011.

6.2 Sampling and data analysis

The samples for the 2015 survey were collected and analysed according to the WGMEGS manual (ICES, 2014). IMARES on board the RV *Tridens* carried out the survey with a Gulf VII plankton sampler with a 500 µm plankton net performing double oblique hauls from the surface to 5 m above the bottom or 20 m below the thermocline. Temperature and salinity were measured during the haul with a Sea-bird CTD mounted on top of the Gulf VII plankton sampler. Two Valeport electronic flowmeters and an altitude sensor were mounted on the plankton sampler to monitor flow, clogging and sampling depth. The timing and the results of the surveys are given in Table 6.3.1.

The eggs were sorted from each of the sampled stations using the spraying method (Eltink, 2007) and their ages were estimated according to development stage and to the observed temperature at 5 m (Lockwood *et al.*, 1981). Only eggs in development stages 1A and 1B were used in the egg production calculations. The number of eggs produced per m² per day was calculated for each statistical rectangle of 0.5° latitude x 0.5° longitude. The samples were collected from the middle of each of these rectangles. The egg production was calculated for the total investigated area for each of the three survey periods.

6.3 Mackerel egg distribution

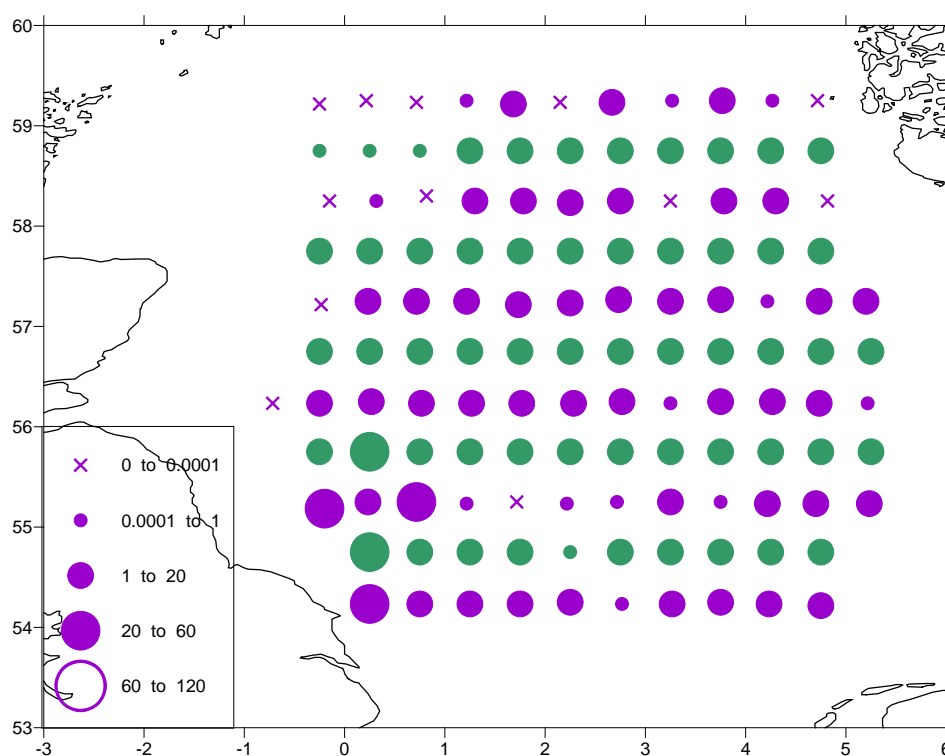


Figure 6.3.1. Mackerel egg production (eggs/m²/day) by half rectangle for period 1. Filled purple circles represent observed values, filled green circles represent interpolated values, and crosses represent observed zeroes.

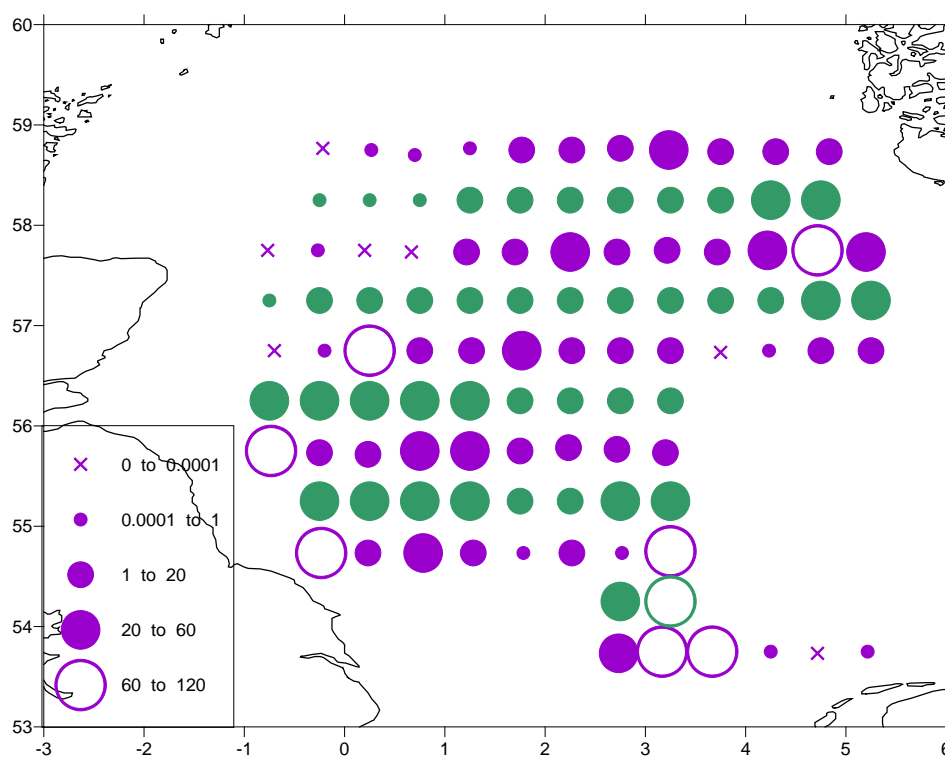


Figure 6.3.2. Mackerel egg production (eggs/m²/day) by half rectangle for period 2. Filled purple circles represent observed values, filled green circles represent interpolated values, and crosses represent observed zeroes.

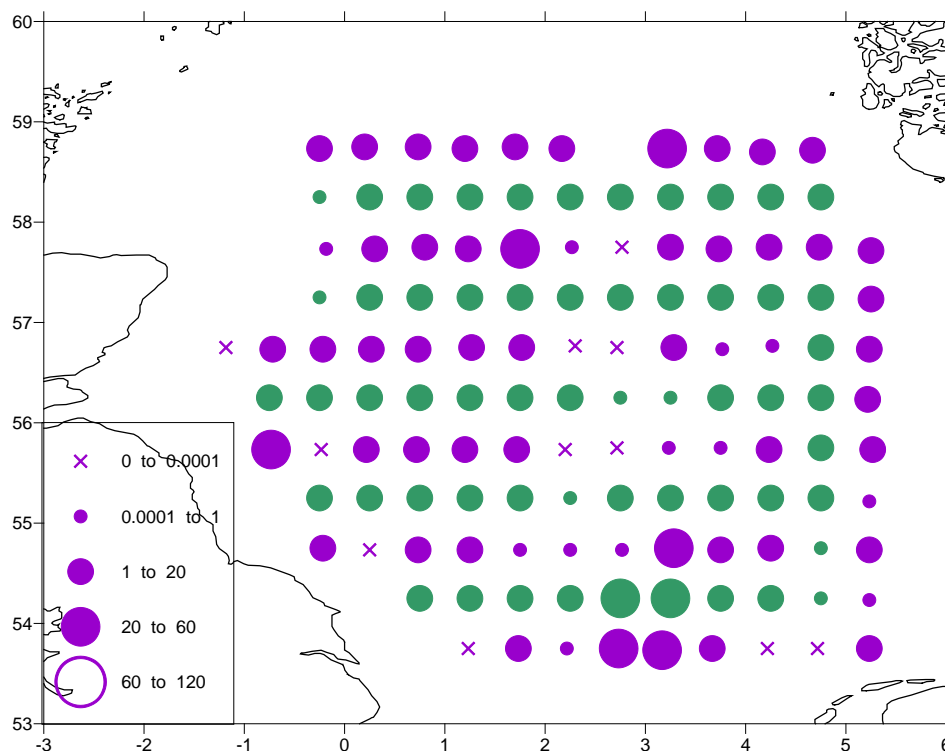


Figure 6.3.3. Mackerel egg production (eggs/m²/day) by half rectangle for period 3. Filled purple circles represent observed values, filled green circles represent interpolated values, and crosses represent observed zeroes.

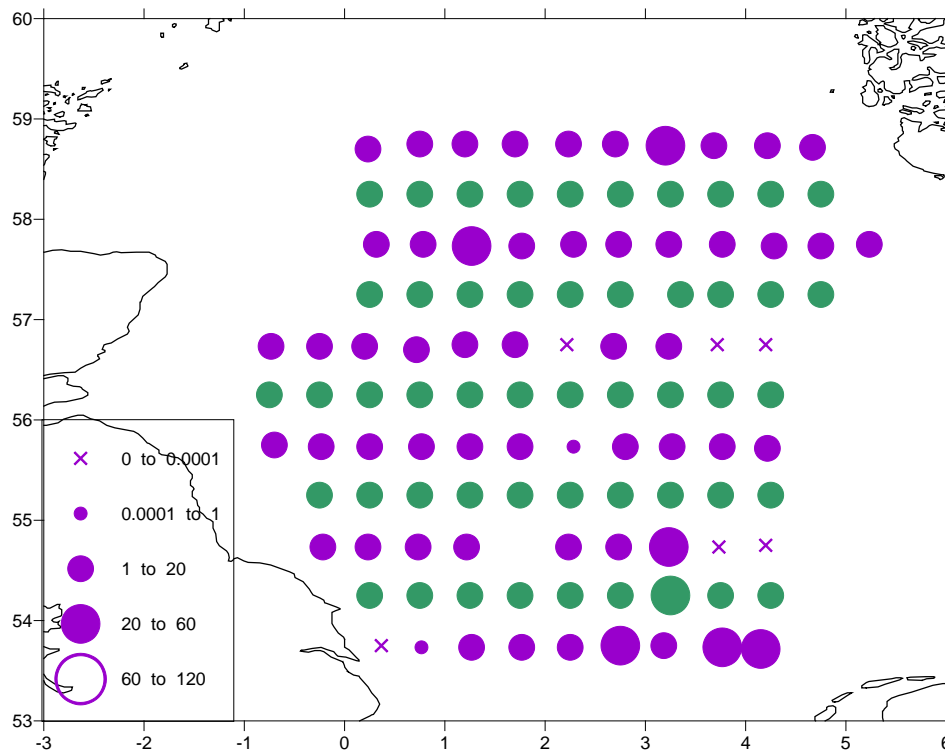


Figure 6.3.4. Mackerel egg production (eggs/m²/day) by half rectangle for period 4. Filled purple circles represent observed values, filled green circles represent interpolated values, and crosses represent observed zeroes.

The egg production was calculated for the total investigated area for each of the periods (Table 6.3.1 and Figure 6.3.5). The peak in egg production occurred during the second sampling period (Figure 6.3.5). Egg production decreased from period 2 to 3, but increased slightly again in period 4. The survey probably covered the peak of spawning, but some spawning may have been missed after period 4. The standard interpolation rules (ICES, 2014) were applied (see interpolated rectangles in Figures 6.3.1-4). The interpolated egg production values accounted for 45%, 40%, 44%, and 43% for the four periods respectively. The spawning distribution is comparable to previous surveys and the main spawning still occurs in the southwestern area. The peak of spawning was at the same time as in 2011. However, this year one period before the spawning peak was sampled, showing low production (Figure 6.3.5). In 2011, it was unclear if the peak in the production was actually the peak or if considerable spawning was missed in that year. The low production in the first period this year, suggests only little spawning was missed in 2011.

Table 6.3.1. Timing of the survey and the egg production obtained during the four survey periods in 2015.

PERIOD	1	2	3	4
Dates	26–31 May	01–06 June	08–13 June	13–17 June
Midpoint of survey (Julian day)	149	155	161	166
Total daily egg production ($\times 10^{12}$)	1.31	3.69	1.53	1.69
Interpolated daily egg production ($\times 10^{12}$)	0.59	1.49	0.67	0.73

Based on the four coverages the spawning curve was drawn (Figure 6.3.5). Usually the egg production is underestimated because neither the spawning area nor the spawning period can be fully covered during the available ship time.

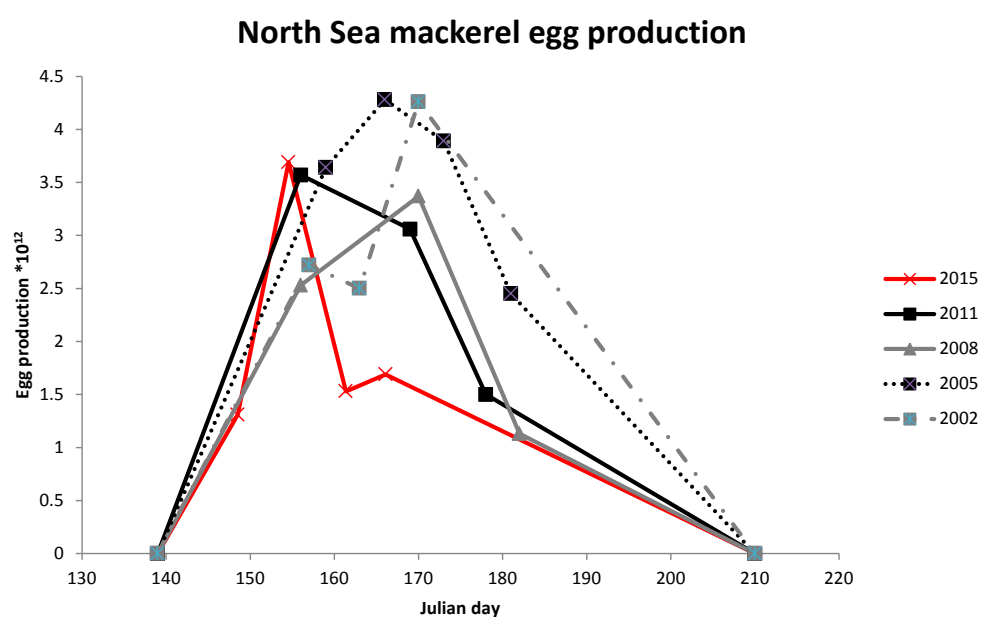


Figure 6.3.5. Annual egg production curves for North Sea mackerel (prior to 2015 the Lockwood egg development equation was used, for 2015 the Mendiola equation was used).

6.4 Potential fecundity and atresia of North Sea mackerel

Two trawl hauls were carried out by RV Tridens to collect adult mackerel fecundity and atresia samples. A total of 100 mackerel ovaries were sampled. However, spawning had already commenced during the first cruise of this survey, and screening of the ovary samples showed that only three could be used for potential fecundity. This number is too low to give a statistically reliable potential fecundity estimate. It was decided to use the total fecundity estimate, 1401 eggs/g female, from previous surveys for the calculation of SSB (Iversen and Adoff, 1983).

6.5 Mackerel egg production and spawning stock estimate

By integrating the egg production curve over the “standard spawning time”, 17 May-27 July, the total egg production was estimated at 119×10^{12} eggs. This was comparable to the estimations of 2011 and 2008. (Table 6.5.1). The egg production is still underestimated because the sampling was never carried out until zero values were obtained in any of the four periods. Particularly the unsampled areas outside the central western part- and south of the survey area might be important spawning areas. The Skagerrak was not part of the investigated area and earlier surveys have indicated that the egg production in the Skagerrak might be 5% of the total production. Additional uncertainties in the estimates occur in years without enough survey time to define the peak spawning period.

The SSB was estimated at 170 476 tonnes (Table 6.5.1). SSB was slightly higher compared to 2011 (Table 6.5.1).

Table 6.5.1. Egg production estimates from egg surveys in the North Sea and corresponding SSB based on a standard fecundity of 1401 eggs/g/female since 1980.

YEAR	EGG PROD $\times 10^{12}$	SSB $\times 10^3$ TONS	OBSERVED PEAK OF SPAWNING (MIDPOINT OF THE COVERAGE GIVING THE HIGHEST PRODUCTION)
1980	60	86	25 June
1981	40	57	17 June
1982	126	180	23 June
1983	160	228	13 June
1984	78	111	12 June
1986	30	43	23 June
1988	25	36	20 June
1990 ²	53	76	24 June
1996	77	110	19 June
1999	48	68	Peak might occur later than last coverage
2002	147	210	Peak might occur later than last coverage
2005	155	223	22 June
2008	108	154	18 June
2011	116	165	Peak might occur before first coverage
2015	119	170	4 June

The WG recommends that the survey effort should be increased to secure a proper coverage of spawning area and time and to carry out a sampling program for fecundity.

7 Incorporation of WKFATHOM recommendations (ToR h)

Two workshops for quality assurance of the mackerel and horse mackerel egg surveys were held in autumn 2015. The first workshop dealt with mackerel and horse mackerel egg staging and identification (12–16 October 2015 in Hamburg, Germany), the second workshop with fecundity and atresia estimation (9–12 October 2015 in Bergen, Norway). Based on the outcome of these workshops a number of recommendations were made which relate to the 2016 survey.

Below the recommendations and consequent actions are described. The original recommendations are in italics and the response is in normal face.

- *It is recommended that all WGMES participants carry out artificial fertilizations of any species, which have eggs similar to those of mackerel and horse mackerel. It would be useful if egg and oil globule diameters are measured and that photographs are taken of as many stages as possible. It would also be beneficial if the eggs were preserved at various stages of development and any morphological changes noted following fixation. These eggs should be made available for analysis during the next workshop (scheduled for 2018).*

Several species have eggs that are very similar in size and structure to those of the survey target species. All participants therefore agreed that this would be extremely useful as the ability to discriminate between eggs of different species and stages of development is a crucial one and has a major impact on the overall results of the survey.

- *All survey participants are reminded that the procedures described in the WGMES survey manual (ICES, 2016a) should be followed during the 2016 surveys. Participants are particularly reminded that 4% formaldehyde, buffered with sodium acetate tri-hydrate, is the standard survey fixative and that plankton samples should never come into contact with formaldehyde of a concentration greater than 4%. All participants are encouraged to check the pH of their fixative on a regular basis.*

The use of correct buffered formaldehyde for the conservation of the plankton samples is fundamental to minimize damage and distortion of the eggs. All participants agreed to use the described chemicals and also undertake to periodically check the pH of their fixative.

- *All survey participants are requested to measure formaldehyde preserved egg diameters and oil droplet diameters of 100 hake, 100 mackerel and 100 horse mackerel eggs during each individual cruise, to identify changes in egg diameter over spawning time and area. Also the development stage should be reported.*

There was broad agreement among participants that this would be undertaken during the forthcoming survey in 2016.

- *All survey participants are requested to investigate genetic analyses of fish eggs to aid species identification*

WGMES fully endorses this type of work although the group accepts that its successful progression relies heavily on the relevant resources and expertise being present and also available within the national institutes. Where they exist, every effort should be made to progress this type of study.

- *WKFATHOM recommends that institutes provide continuity of staff to carry out the plankton identification and staging to ensure high quality standard of the survey. It is the institutes' responsibility to provide appropriate training for new staff in advance of the survey. This should be done through institute workshops, as one week of WKFATHOM is not enough to turn trainees into experts.*

WGMEGS also recommends that there is continuity of staff when it comes to the staging and identification of eggs during the survey. The continued delivery of high quality egg abundance data is of crucial importance to the continued success of the survey.

- *WKFATHOM encourages exchanges of staff between participating institutes, to allow exchange of knowledge and increase expertise among survey participants.*

This is also endorsed by WGMEGS and provides an invaluable opportunity to broaden one's own experience and share expertise on different survey platforms.

- *All survey participants should take pictures of mackerel, horse mackerel, and also species with similarly sized eggs in the different development stages of formaldehyde fixed eggs.*

There was broad agreement among participants that this would be undertaken and the images provided in time for the next staging and identification workshop in 2018.

8 Amendments to the 2016 mackerel and horse mackerel egg survey in the western and southern areas (ToR i)

Although the broad planning of the 2016 survey was undertaken during the 2015 planning meeting and reported in the 2015 WGMEGS report (ICES, 2015b), amendments to the provisionally agreed plan required additional intersessional planning and coordination. Once finalized these were incorporated into the WGMEGS Manual for the Mackerel and Horse Mackerel Egg Surveys (ICES, 2016a). This is the newly revised version of this manual that contains the survey planning sections updated for the 2016 survey.

Subsequent to the publication of this updated manual, several issues have arisen during the 2016 survey that significantly affected the finalized survey plan. These issues are detailed below according to period and will be reported fully in the 2017 WGMEGS report.

Period 1: Start of Portuguese survey in the southern area delayed by over a month.

Period 3: Abandonment of proposed period 3 Danish industry survey in the western area. This was resolved by moving the start of sampling period 3 forward by one week to commence at week 7. This allowed the Scottish period 2 survey (SCO1) to cover both periods 2 and 3 using the alternate transect methodology.

Period 4: German vessel suffered major problem resulting in inability to deploy the gulf sampler during her period 4 survey (GER2). Between them Scotland (SCO2) and the Netherlands (NED1) were able to adequately cover the remaining area within this period.

9 Next meetings

The next WGMEGS meeting (year 3) will be the final one in the current 3-year cycle. It is scheduled to take place in Vigo, Spain, from 24 to 28 April 2017.

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