INSTITUTO ESPAÑOL DE OCEANOGRAFÍA **SECRETARIA GENERAL DE PESCA**

Cruise Report RV "Vizconde de Eza"

Survey MEGS22 – JUREVA

04/04/2022-26/04/2022

IEO Spanish Participation in the International Mackerel and Horse Mackerel Egg Survey 2O22 (PERIOD 4)

Isabel Riveiro, Gersom Costas, Dolores Garabana, Luisa Iglesias, María Dolores García, Antonio Solla, Andrés Villaverde

---

Acknowledgements

JUREVA survey has been funded by the European Union through the European Maritime and Fisheries Fund (EMFF) within the National Program of collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

We thank the crew of the R/V “Vizconde de Eza” and R/V “Miguel Oliver” and scientific staff onboard for their professional assistance, ensuring the success of the survey.

1. INTRODUCTION

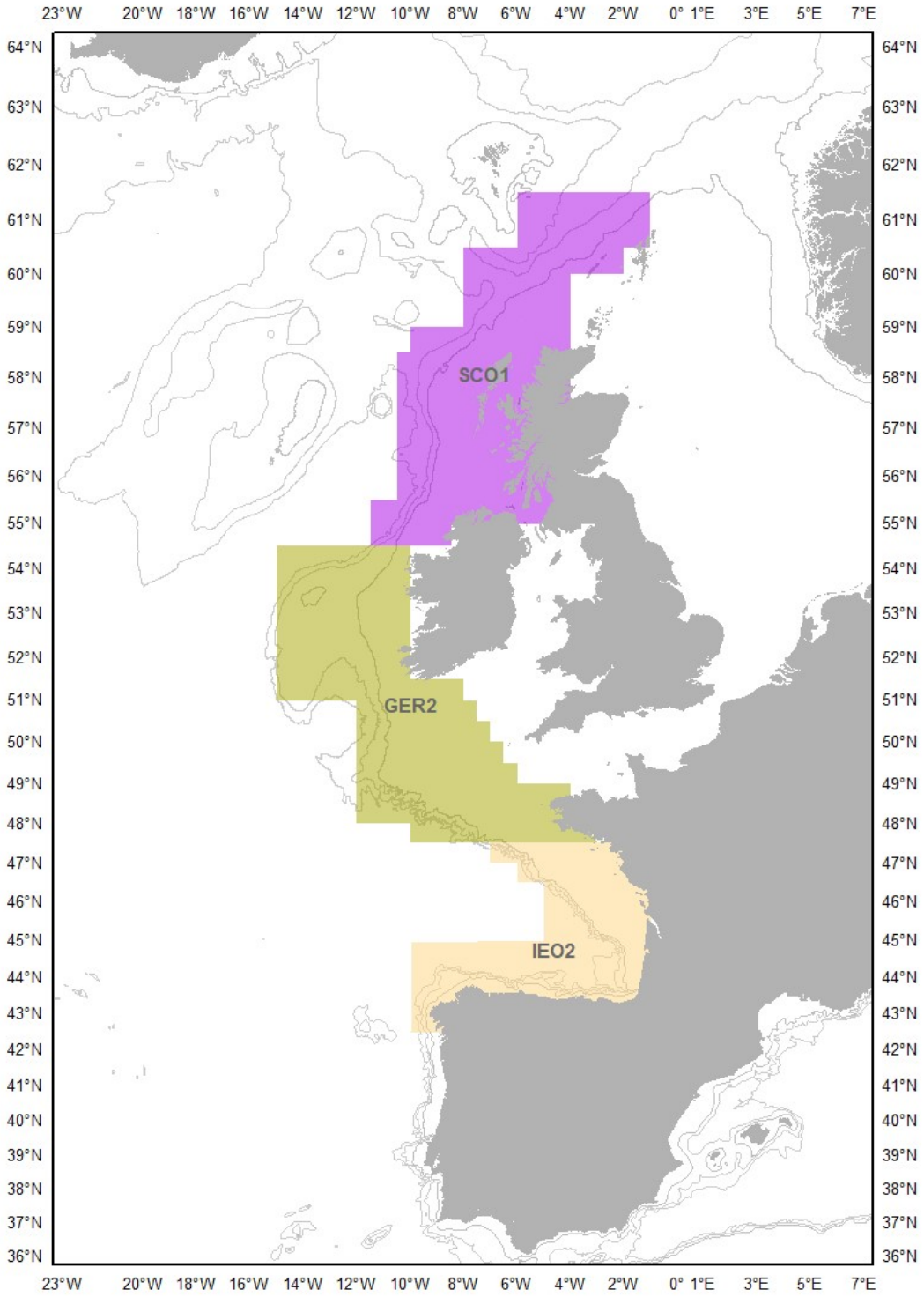
JUREVA survey (IEO2) is part of the Spanish "Data Collection Framework" program and is coordinated within the framework of the ICES Working Group on Mackerel and Horse Mackerel Egg Surveys (ICES WGMEGS).

The survey calendar for 2022 is shown in the following table (in yellow the commitment of the IEO):

Week	Starts	Area 9a	Cantabrian Sea	Biscay	Celtic sea	West of Ireland	West of Scotland	Northern area	Period
3	09-Jan-22								1
4	16-Jan-22	PO1							2
5	23-Jan-22	PO1							2
6	30-Jan-22	PO1							2
7	06-Feb-22	PO1							2
8	13-Feb-22	PO1							2
9	20-Feb -22	PO1				SCO (IBTS)	SCO (IBTS)		2
10	27-Feb-22					SCO (IBTS)	SCO (IBTS)		2
11	06-Mar-22				IRL 1	IRL 1	IRL 1		3
12	13-Mar-22		IEO1	IEO1	IRL 1	IRL 1	IRL 1		3
13	20-Mar-22		IEO1	IEO1/ AZTI1	GER1	IRL 1	IRL 1		3
14	27-Mar -22		IEO1	AZTI1	GER1	GER1			3
15	03-Apr-22		IEO1	AZTI1	GER1	GER1			3
16	10-Apr-22		IEO2	IEO2	GER2	GER 2 /SCO1	SCO1		4
17	17-Apr-22		IEO2	IEO2	GER2	GER 2 /SCO1	SCO1		4
18	24-Apr -22		IEO2	IEO2	GER2	GER 2 /SCO1	SCO1		4
19	1-May-22		AZTI2 (DEPM)						4
20	8-May-22		AZTI2 (DEPM)	AZTI2 (DEPM)/ NED1	NED1	NED1 / SCO2	SCO2	NOR	5
21	15-May-22			AZTI2 (DEPM)/ NED1	NED1	NED1 / SCO2	SCO2	NOR	5
22	22-May -22			AZTI2 (DEPM)/ NED1	NED1	NED1 / SCO2	SCO2	NOR	5
23	29-May-22							FAR	6

24	5-Jun-22			NED2	NED2	IRL2	IRL2	FAR	6
25	12-Jun-22			NED2	NED2	IRL2	IRL2	FAR	6
26	19-Jun -22			NED2	NED2	IRL2	IRL2		6
27	26-Jun -22								6
28	3-Jul-22				SCO3	SCO3	SCO3		7
29	10 –Jul-22				SCO3	SCO3	SCO3		7
30	17-Jul-22				SCO3	SCO3	SCO3		7
31	24-Jul-22				SCO3	SCO3	SCO3		6

The sampling scheme for the FOURTH period, in which JUREVA (IEO2) has been carried out, is shown in the following map:


23°W
20°W
18°W
16°W
14°W
12°W
10°W
8°W
6°W
4°W
2°W
0° 1°E
3°E
5°E
7°E
64°N
63°N
62°N
61°N
60°N
59°N
58°N
57°N
56°N
55°N
54°N
53°N
52°N
51°N
50°N
49°N
48°N
47°N
46°N
45°N
44°N
43°N
42°N
41°N
40°N
39°N
38°N
37°N
36°N
SCO1
GER2
IEO2

2. PARTICIPANTS AND AFFILIATION

ISABEL RIVEIRO ALARCÓN (1)
GERSOM COSTAS BASTIDA (1)
JOSE LUIS VILLAVERDE ROSALES (1)
MARIA DOLORES PAMPILLÓN LORENZO (1)
SUSANA JUNQUERA LÓPEZ (1)
LUISA IGLESIAS GARCÍA (1)
MARIA DOLORES GARCÍA CARNERO (1)
GABRIEL POMAR VERT (2)
VENICIO PITA FREIRE (3)
LAURA LEYVA (4)
FRANCISCO FERNANDEZ CORREGIDOR (5)
Mª JESÚS LAGO ROUCO (6)
CANDELA CAMARERO (7)
PATRICIA CORTEGOSO (7)
HUGO RIOBÓ (8)
CAROLA FERRONATO (9)

1: CO VIGO, IEO-CSIC, 2: CO BALEARES, IEO-CSIC, 3: CO GIJÓN, IEO-CSIC, 4: CO SANTANDER, IEO-CSIC, 5: CO MÁLAGA, IEO-CSIC, 6: CO CANARIAS, IEO-CSIC, 7: IPD, 8: TRAGSATEC, 9: STUDENT

3. ITINERARY

Date (UTC)	
04/04/2022	Vigo Harbour. Administrative issues.
04/04/2022	Start of sampling in Galicia waters at 18:00
04/04/2022-07/04/2022	Plankton stations in Galicia – Cantabrian waters (st 1-st 18)
07/04/2022	Relocation to the east of the cantabrian Sea due to bad weather conditions
07/04/2022-10/04/2022	Plankton stations in East of Cantabrian Sea waters (st 19-42)
11/04/2022-14/04/2022	Plankton stations in Northern French area (43-70)
15/04/2022	Break in Santander Harbour
15/04/2022-19/04/2022	Plankton stations in Cantabrian waters (st 71-96)
19/04/2022	Fishing hauls for fecundity samples (1-2)
19/04/2022-20/04/2022	Plankton stations in Cantabrian waters (97-111)
21/04/2022	Fishing hauls for fecundity samples (3-4)
21/04/2022-22/04/2022	Plankton stations in Cantabrian waters (112-123)
23/04/2022	Fishing hauls for fecundity samples (5)
23/04/2022	Plankton stations in Cantabrian waters (124-127)
24/04/2022	Fishing hauls for fecundity samples (6)
24/04/2022-25/04/2022	Plankton stations in Cantabrian Sea and Galicia waters (128-134)
26/04/2022 9:00	End of JUREVA survey in Vigo Harbour

JUREVA survey was planned, as well as CAREVA, onboard *R/V Vizconde de Eza (Secretaría General de Pesca*). However, due to the change of ship in the CAREVA survey, the JUREVA survey was also carried out onboard *R/V Miguel Oliver (Secretaría General de Pesca*), on the dates originally foreseen.

Figure 1 shows fishing hauls and plankton stations performed during JUREVA survey (period 4).

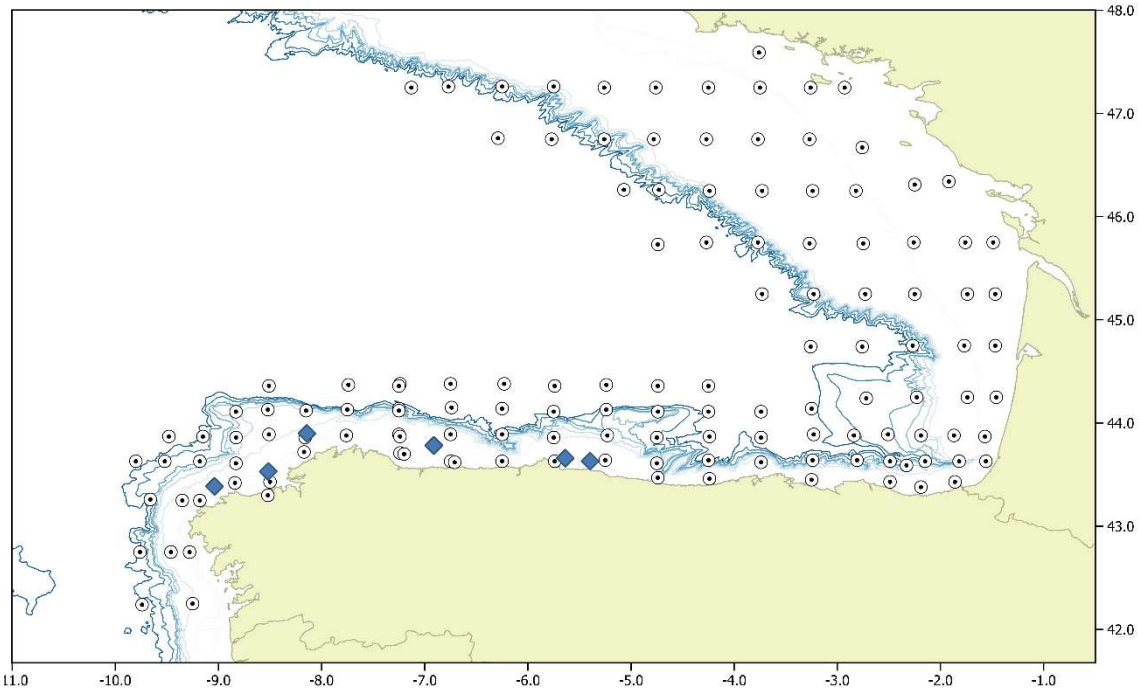


Figure 1. Sampling intensity. Fishing hauls (blue diamonds) and plankton stations (circles) during JUREVA (period 4).

4. METHODS

4.1. Plankton sampling

Sampling consisted of ichthyoplankton sampling on fixed (BONGO) stations. BONGO net consists in a double net structure of 40 cm mouth. The bongo hauls were performed using a net with 250 µm mesh size and plastic cod-ends, operating obliquely from 200 m depth to the surface. In shallower areas, the net was towed from 5 m above the bottom to the surface. *General Oceanics* and *Hydro-bios* flowmeters were used to record the towing length and estimate the sampled water volume (assuming a filtration efficiency of 100%), while a trawl sounder (*Marport*) coupled to the net was used to record maximum sampling depth.

Fish eggs from one of the nets were separated from the remaining plankton organisms onboard, by performing the spray method recommended by the WGMEGS. Fish eggs were identified using morphological criteria (egg diameter, oil globule diameter, segmentation of yolk sac and pigmentation) and counted immediately after collection.

All samples were fixed in 4% buffered formaldehyde solution for subsequent verification of egg counts and staging in the laboratory. At least sub-samples of up to 100 individuals per target species (mackerel, horse mackerel) were staged.

With the objective of performing biochemical analysis (genetics,...), the plankton of the remaining net was preserved in absolute ethanol just after the sampling, and 72 hours after fixation the ethanol was renewed. These samples will be sorted and analysed in the lab.

4.2. Hydrographic sampling

A CTD *Seabird25* was deployed in every station for the hydrographical description of the water column (until 200m depth or 5m above the bottom in shallower stations).

4.3. Fecundity

AEPM and DEPM egg production methods require fecundity samples match in time and space with plankton (egg) sampling. In previous triennials IEO obtained mackerel adult data for fecundity and sex ratio from PELACUS acoustic survey, which overlaps in space and time with CAREVA and JUREVA IEO ichthyoplankton surveys. Collecting adult samples from the fishing hauls carried out during PELACUS, reduces the number of technicians on board and allows more time to cover ichthyoplankton sampling in JUREVA. Fresh commercial samples from Santander and A Coruna fish market have been usually taken to fulfil the required number of samples.

This year PELACUS survey was interrupted by a COVID event and it was impossible to take commercial samples due to administrative internal problems. Thus, part of the requested samples were obtained from 5 fishing hauls performed during PELACUS, and

three additional fish hauls were made during JUREVA to improve sampling. In JUREVA, a demersal otter bottom 4-panel trawl (OTB_MPD) net was used, towed at about 4 knots of speed.

Fecundity sampling for both, AEPM and DEPM estimates was performed trying to follow the desired temporal and spatial distribution of the samples per survey period and institute in WKAEPM report, (ICES, 2022), but only was possible in four hauls that were taken when a high density of eggs was found (Figure 1). Following the WKAEPM guidelines, fecundity samples for the AEPM were taken from females in maturity stages 3 to 6 (Walsh scale), while for the DEPM sampled females were in maturity stages 2 to 6 (Walsh scale). The manuals SISP-5 (ICES, 2019a) and SISP-6 (ICES 2019b) were followed for sampling and data collection methodology.

RESULTS

4.4. Egg abundance and distribution

In total, 134 plankton stations were carried out during JUREVA survey (PERIOD 3).

No eggs were found in 35 of the 134 stations (26%).

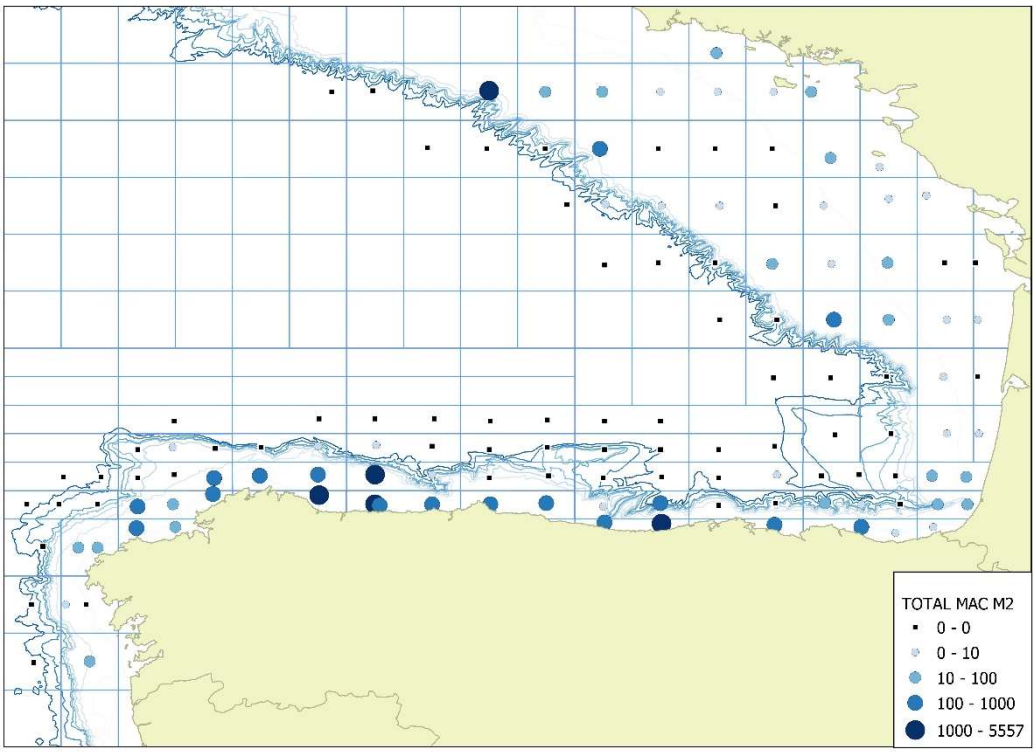
A total of 39 482 fish eggs were sampled, with an average abundance of 295 eggs/station (average density of 264 eggs m^{-2}). These mean densities represent only 60% of the mean densities recorded during the same period in 2019.

- Mackerel egg abundance and distribution.

Figure 2 shows mackerel egg distribution during JUREVA survey.

Mackerel was the most abundant species in the area, with a total number of eggs in the samples of 23 872 (approximately the same abundance as in JUREVA in 2019).

This species was collected in the 68% of the Bongo stations (57% in 2019), with a higher abundance in the most coastal stations in the Cantabrian Sea. The average density in 2022 JUREVA survey was 152 egg/m^2 (2019= 206 egg/m^2), much lower than in the previous survey, CAREVA22, indicating that the spawning peak of this species had already ended.



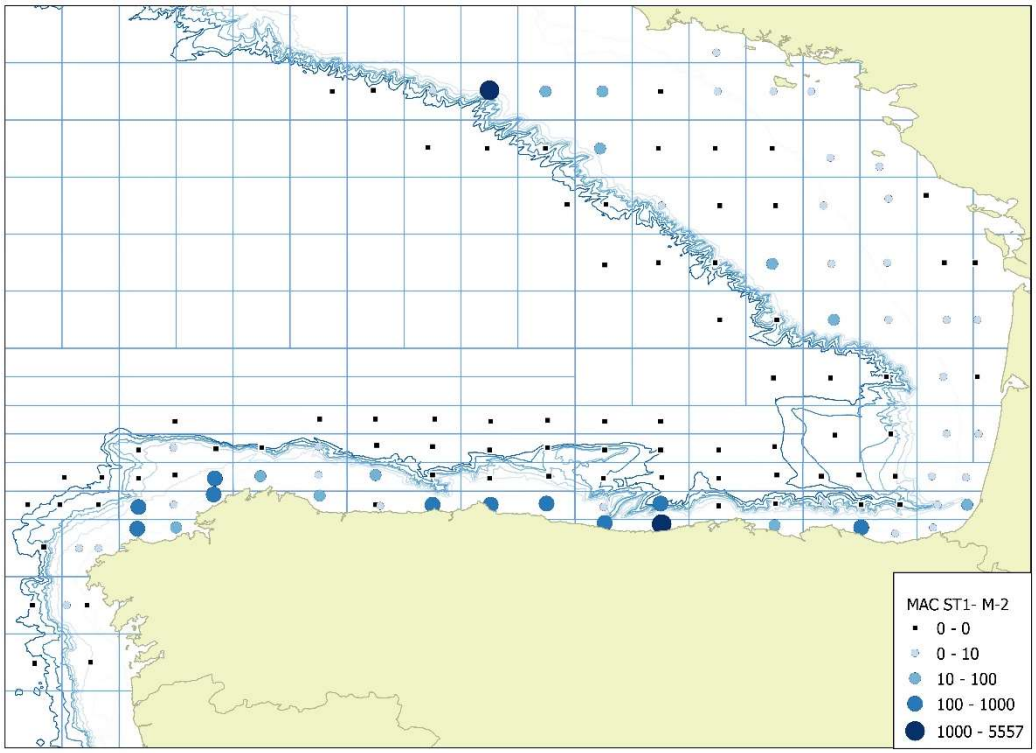


Figure 2. Mackerel abundance and distribution during JUREVA survey. 3a) Total egg distribution (eggs m^{-2}) and figure 3b) Eggs (eggs m^{-2}) in stage IA and IB.

- Horse mackerel egg abundance and distribution.

Figure 3 shows horse mackerel egg distribution during JUREVA survey.

Horse mackerel eggs were found in 51% of the stations (40% in JUREVA 2019) but the abundance (1682 eggs in total) and density (13 eggs m^{-2}) this year was scarce and lower than in the previous 2019 JUREVA survey (40 eggs m^{-2}, 4970 eggs in total).

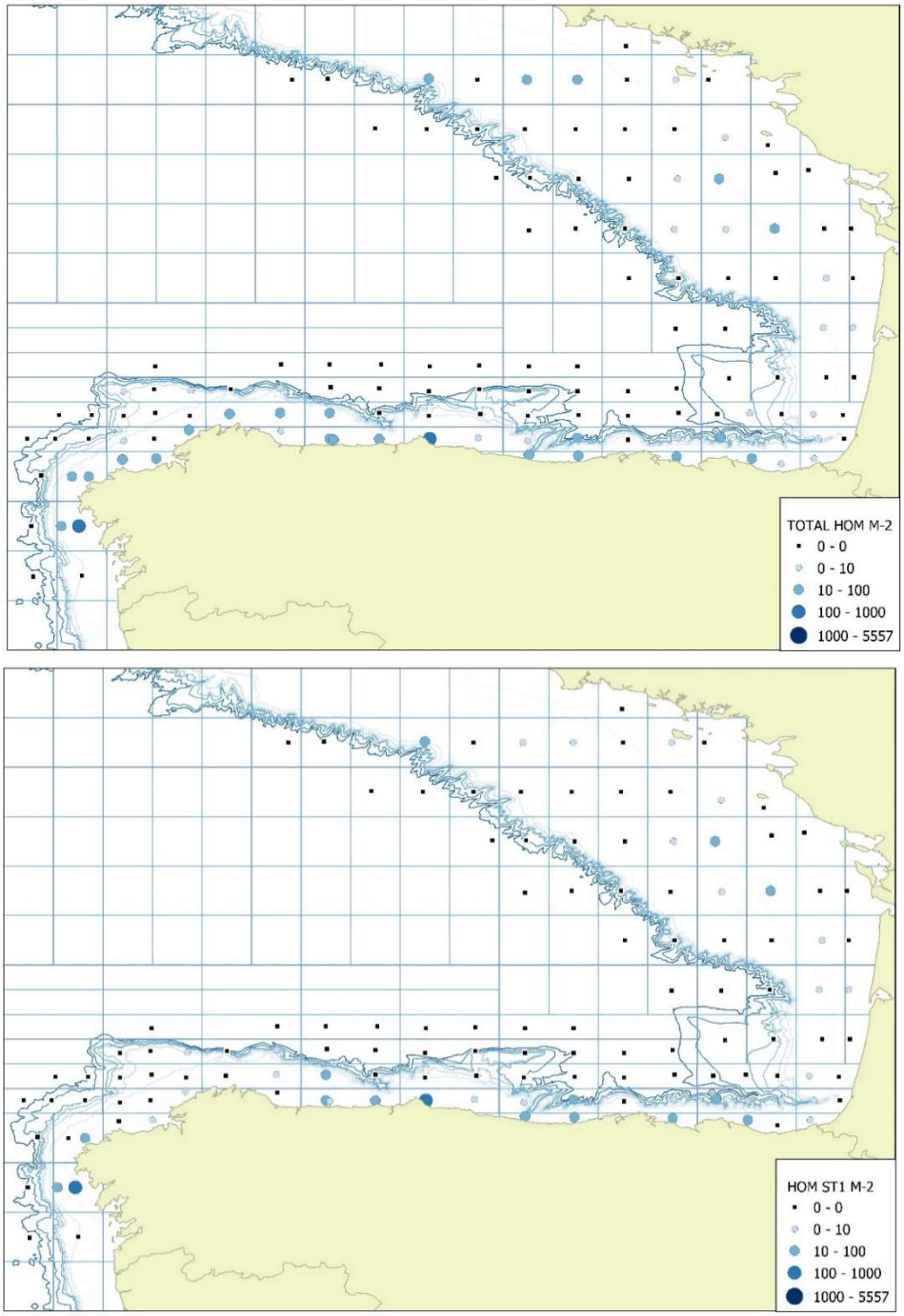


Figure 3. Horse mackerel abundance and distribution during JUREVA survey. 4a) Total egg distribution (eggs m^{-2}) and figure 4b) Eggs (eggs m^{-2}) in stage IA and IB.

- Sardine egg abundance and distribution.

Figure 4 shows sardine egg distribution during JUREVA survey.

Sardine eggs were located in the 30% of the stations, with a total of 3737 eggs (2451 eggs in 2019 survey), corresponding to an average density of 27 eggs m^{-2} (21 eggs m^{-2} in 2019 survey).

Higher sardine egg abundances were registered constantly throughout the surveyed area, especially in the most coastal stations.

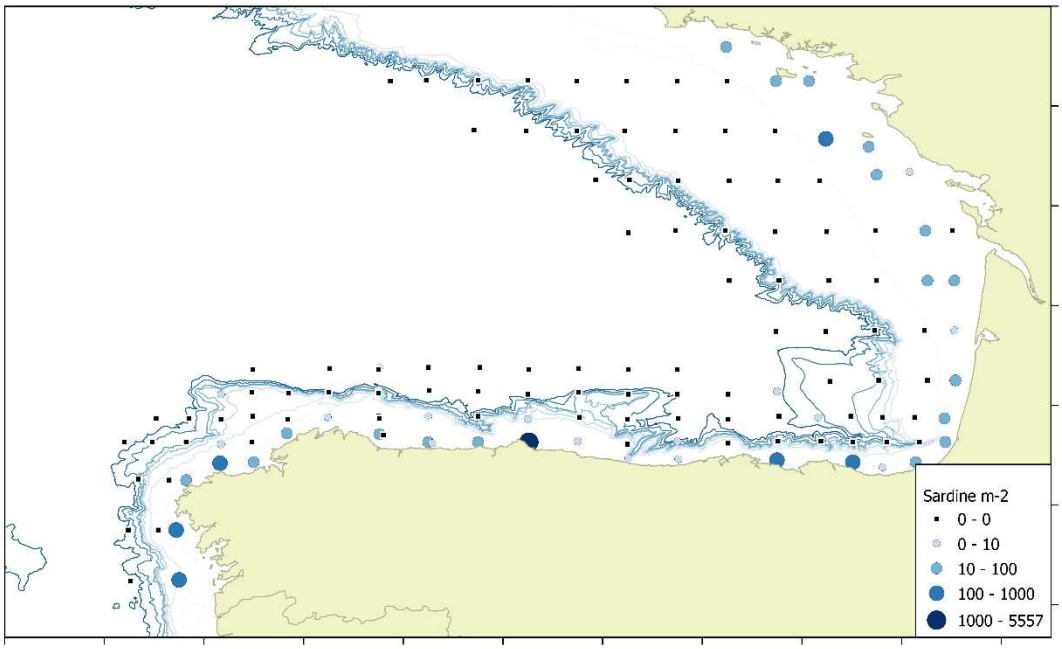


Figure 4. Sardine egg abundance and distribution during JUREVA survey.

- Anchovy egg abundance and distribution.

Figure 5 shows anchovy egg distribution during JUREVA survey.

This survey is carried out closer to the reproductive season of this species and therefore, the abundances detected are higher than in CAREVA. This year, a total of 3645 anchovy eggs were found in 42% stations (16 545 in 2019, in 41% of the plankton stations), mainly in the inner part of the Bay of Biscay.

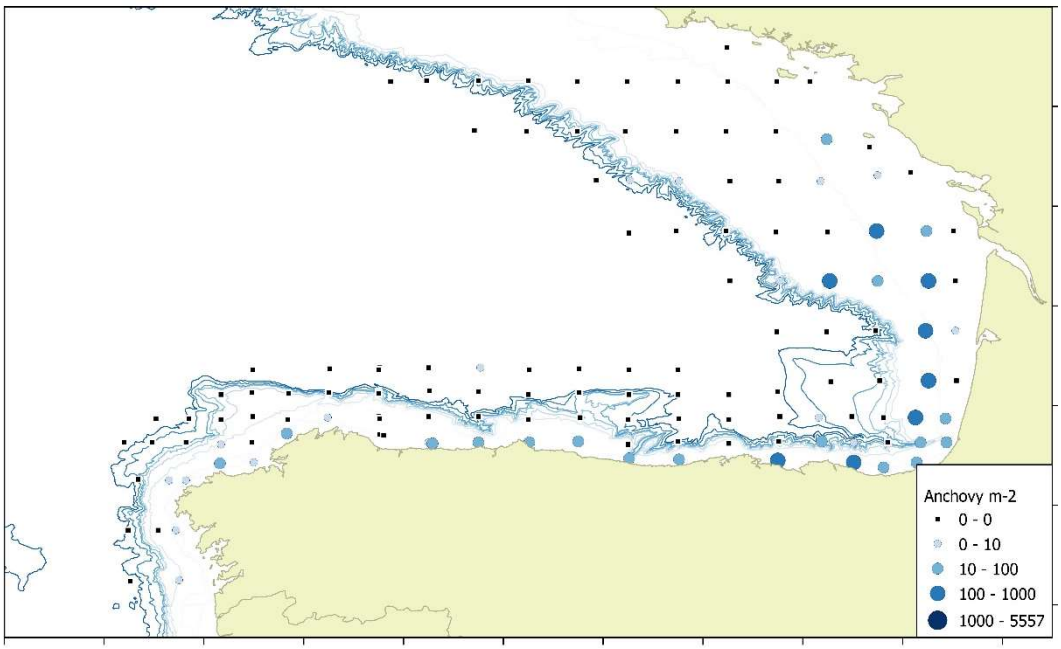


Figure 5. Anchovy egg abundance and distribution during JUREVA survey.

- Other species abundance and distribution.

Figure 6 shows egg distribution of other species during JUREVA.

6557 fish eggs of many more species (in addition to those mentioned in the previous sections) were found, mainly of the mesopelagic species: *Maurolicus muelleri* (especially in the deeper stations) and of some other species with multiple oil drops and without oil drop in shallower waters.

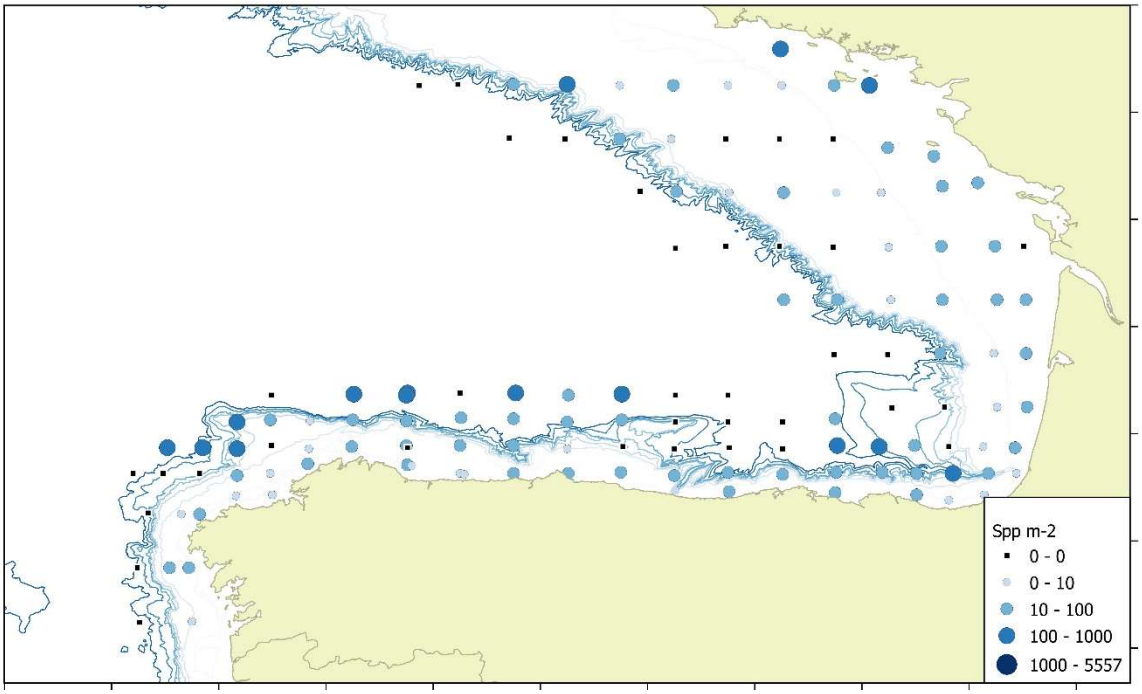


Figure 6. Egg abundance and distribution of other fish species during JUREVA survey.

4.5. Hydrography

Data from 134 CTD performed during the survey have been sent in the Excel spreadsheet to the group WGMEGS, and will be analysed in depth before the next meeting.

Figure 7 shows surface temperature (a) and temperature at 20 m depth (b), and figure 8 shows surface salinity (8a) and salinity at 20m depth, during JUREVA survey.

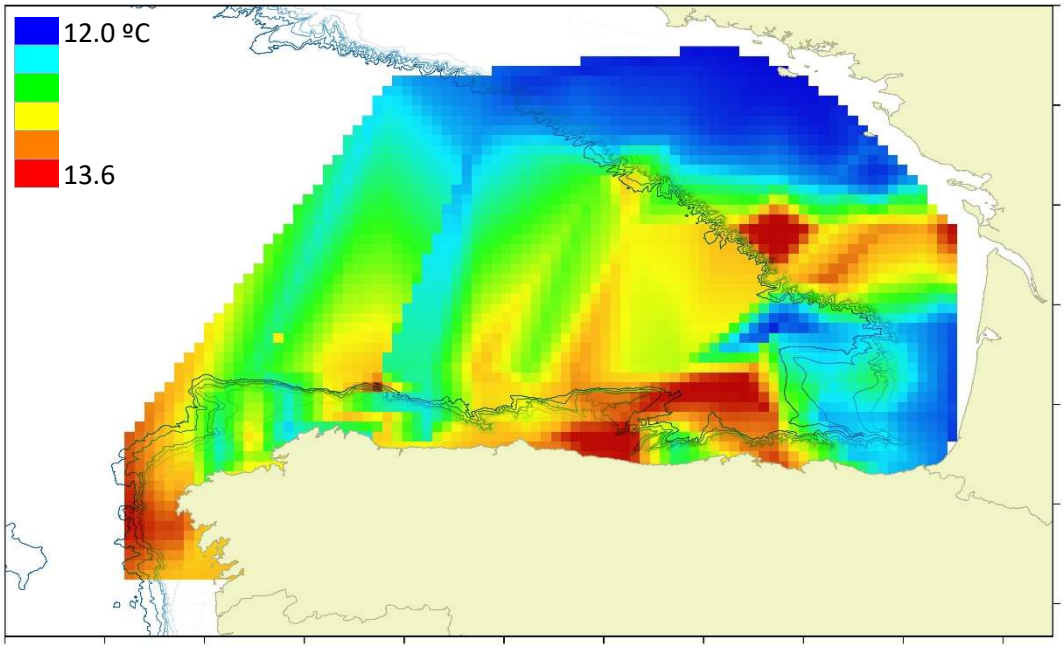


Figure 7. Sea surface temperature during JUREVA survey.

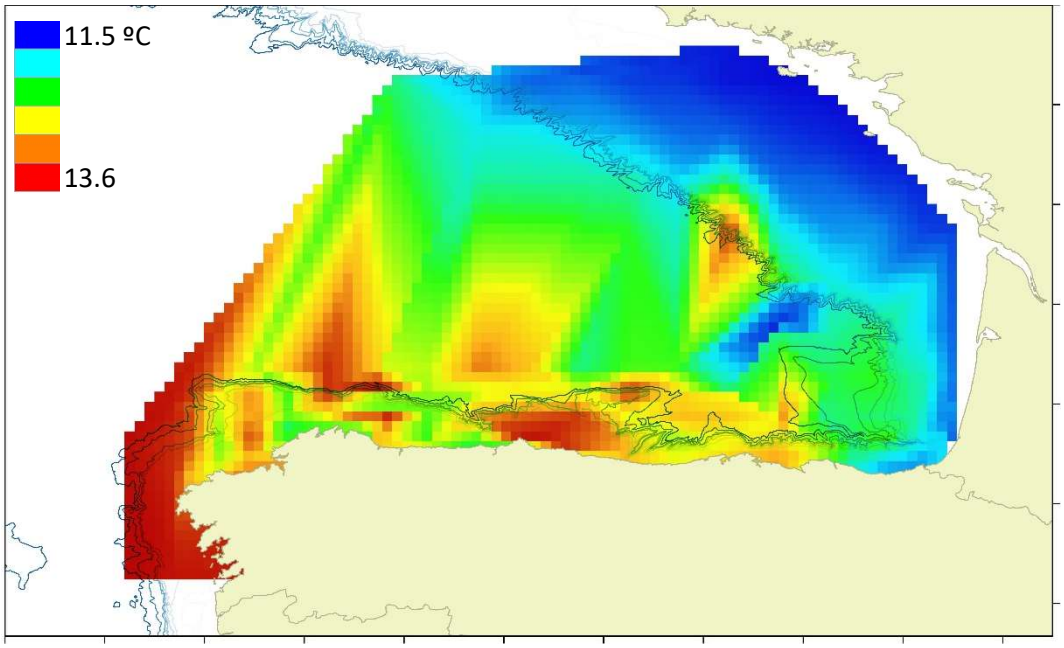


Figure 7b. Temperature at 20m depth during JUREVA survey.

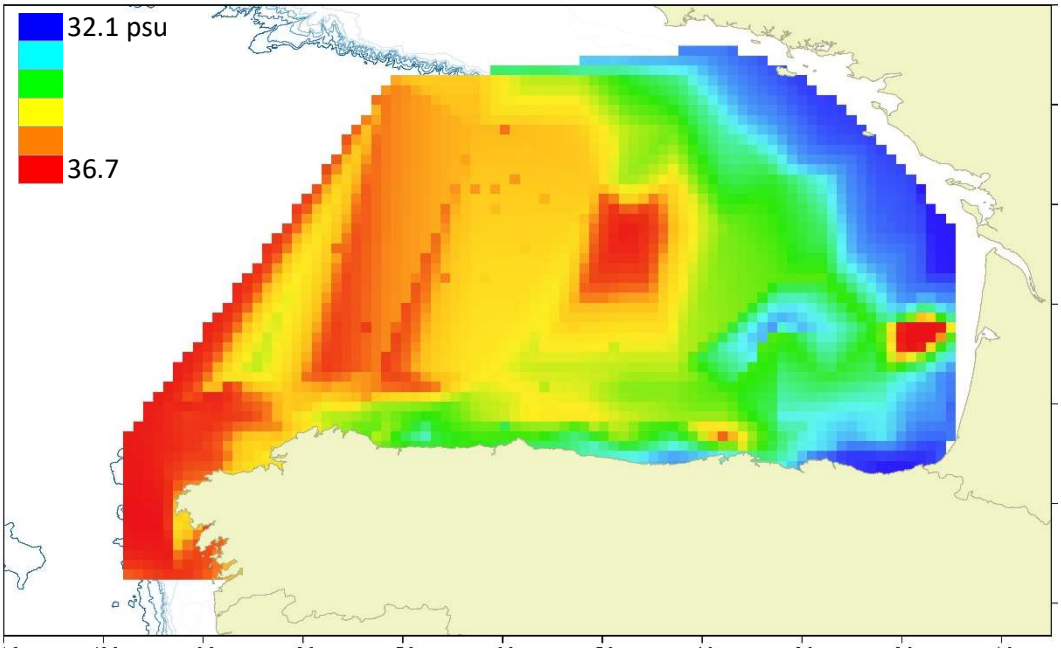


Figure 8a. Sea surface salinity during JUREVA survey.

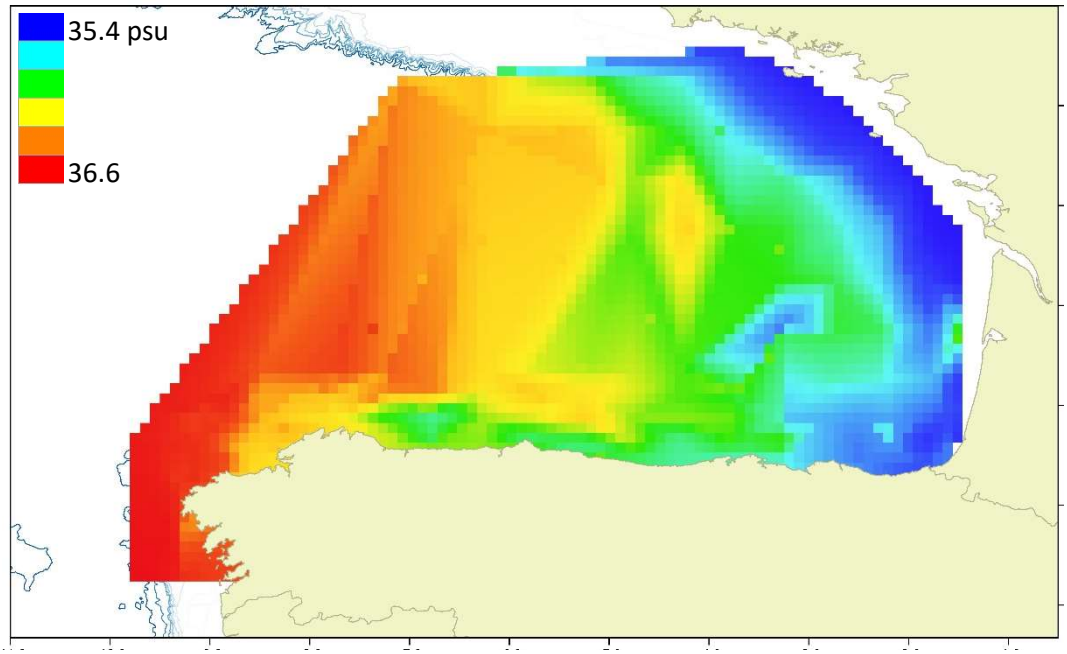


Figure 8b. Salinity at 20m depth during JUREVA survey.

4.6. Fecundity

Fecundity

At the time of writing this report, the fecundity samples have not yet been processed in the laboratory, so only data derived from biological sampling on board are available.

A total of 694 fish were taken for AEPM and DEPM estimations (Table 1). Fish (male and female) were collected during eight fishing hauls conducted between 21 and 29 of April. In 5 out of 9 catches it was possible to get 100 mackerel for biological sampling, and in those hauls with less than 100 individuals, all of them were sampled. In all hauls, except one it was possible to take 30 or more ovary samples for fecundity. Biological data (length, weight, sex and macroscopic maturity) were taken on board from 694 individuals and from 139 selected females, ovary samples were taken for fecundity estimations.

Table 1. Number of total fish (nFish) and fecundity samples (nFec) for AEPM and DEPM estimations by date in the four fishing hauls during CAREVA survey.

Hauls	Date	n Fish	n Fec
Jureva0422-0003	21 /04	58	33
Jureva0422-0005	23/04	100	32
Jureva0422-0006	24/04	86	37
Pelacus0322-0010	10/04	100	31
Pelacus0322-0014	12/04	40	1
Pelacus0322-0020	27/04	100	35
Pelacus0322-0024	29/04	103	39
Pelacus0322-0026	29/04	107	39
Total		**694**	**247**

Examining fish maturity stages with the naked eye, there was fish in all stages of maturation, but most of them were either in stages 4 to 6, that is, in spawning or post-spawning (Table 2).

Table 2. Size distribution of total fish catch, by maturity stage in males and females. (Maturity by Walsh scale).

	FEMALE maturity							MALE maturity						
Fish Size	**1**	**2**	**3**	**4**	**5**	**6**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
23-25	6						6	3						3
25-27	4						4	1					1	2
27-29		9	3		3	4	19	2	3	2		8	13	28
29-31		10	3		11	15	39	6	5	4		13	16	44
31-33		3	1		4	1	9					1	1	2
33-35				1	8		9				2	7	1	10
35-37			3	7	22	5	37				10	34	2	46
37-39			9	25	71	5	110			3	18	104	11	136
39-41			3	30	42	1	76			3	24	64	3	94
41-43			2	3	6		11				2	6		8
43-45											1			1
Total	**10**	**22**	**24**	**66**	**167**	**31**	**320**	**12**	**8**	**12**	**57**	**237**	**48**	**374**

Ovarian sampling for fecundity was performed in 247 random selected females (table 3).

Table 3. Number of ovaries sampled for Fecundity

Cuenta de OvaryID	**Female Matutiry Walsh Scale**						
Rótulos de fila	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
23-25							
25-27							
27-29		9	3		3	4	19
29-31		10	3		11	15	39
31-33		3	1		4	1	9
33-35				1	4		5
35-37			3	7	14	3	27
37-39			9	24	43	4	80
39-41			3	29	25	1	58
41-43			2	3	5		10
43-45							
Total	**22**	**24**	**64**	**109**	**28**		**247**

At stage 3 (pre-spawning advanced maturity) 24 females were collected (Table 3). At this maturity stage, the female has not started to laid eggs and thus are valid for total fecundity calculations for the annual method. In practice, the number of females suitable for this calculation is reduced after the histological analysis of the gonad, as microscopically is possible to identify structures that indicate that the female has already started to spawn, the post ovulatory follicles (POFs), and thus the gonad cannot be included in the total fecundity analysis.

109 females were collected showing oocytes at a maturity stage of Hydration (stage 5) (Table 3). Hydrated females are selected for batch fecundity calculations as hydration leads to a growth in size that result in the separation in size of the group of oocytes that form the batch. Only when the batch is completely separated from the rest of the oocytes and no fresh POFs are found in the ovary, we can use these samples to calculate batch fecundity. These requirements can only be checked after sample analysis, but usually result in the number of valid samples being considerably lower than the number of samples collected.

Bibliography:

ICES. 2019 a). Manual for the AEPM and DEPM estimation of fecundity in mackerel and horse mackerel. Series of ICES Survey Protocols SISP 5. 89 pp. ttp://doi.org/10.17895/ices.pub.5139.

ICES. 2019 b). Manual for mackerel and horse mackerel egg surveys, sampling at sea. Series of ICES Survey Protocols SISP 6. 82 pp. http://doi.org/10.17895/ices.pub.5140

ICES. 2022. Workshop on Adult Egg Production Methods Parameters estimation in Mackerel and Horse Mackerel (WKAEPM). ICES Scientific Reports. 4:28. 43 pp. http://doi.org/10.17895/ices.pub.19430855