SAREVA0317

Survey report

Research Institute: **Instituto Español de Oceanografía**
Vessel: **R/Vizconde de Eza (Secretaría General de Pesca)**

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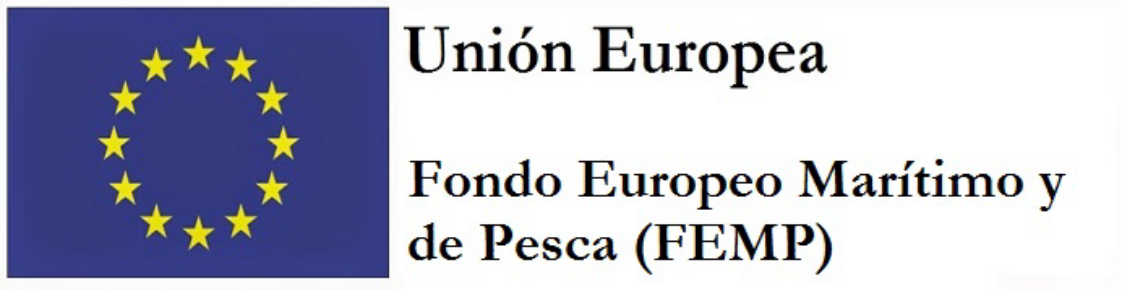
We thank the crew of the Vizconde de Eza and scientific staff onboard for their professional assistance, ensuring the success of the survey.



Abbreviations

CO. Centro Oceanográfico. Oceanographic Center
CUFES. Continuous Underway Fish Egg Sampler
DEPM. Daily Egg Production Method
ICES. International Council for the Exploration of the Sea **IEO.** Instituto Español de Oceanografía
IPMA. Instituto Português do Mar e da Atmosfera
R/V Research Vessel
SSB. Spawning Stock Biomass
{ XE "2" **}**

Introduction

SAREVA0317 is the tenth survey of the time series that *Instituto Español de Oceanografía* (IEO) began in 1988 for the evaluation of the sardine stock through the Daily Egg Production Method (DEPM).The Daily Egg Production Method started being applied to sardine in the Iberian Peninsula during the 80s but surveys were interrupted for almost 10 years.

Current DEPM surveys started in 1997 for both Spain and Portugal and have been carried out triennially since 1999. After 2002, the surveys have been conducted within the framework of ICES, with co-financing from the EU.

Spanish SAREVA survey was carried out coordinated with IPMA (Instituto Português do Mar e da Atmosfera) and sampling and analysis are standardized and review in the framework of ICES working group WGACEGG (Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES areas VII, VIII and IX).

DEPM estimates of sardine SSB were last revised in November 2016 (ICES 2017a,b).

SAREVA surveys samples Galicia and Cantabrian waters, and IPMA surveys covers Portuguese and Golfo de Cádiz waters, and jointly provide a full coverage of the Ibero-Atlantic Sardine stock area (Sar-south) (Figure 1). Results are used in the analytical assessment of this stock, carried out annually in WGHANSA (ICES Working Group on Southern Horse Mackerel, Anchovy and Sardine) (ICES. 2017a).

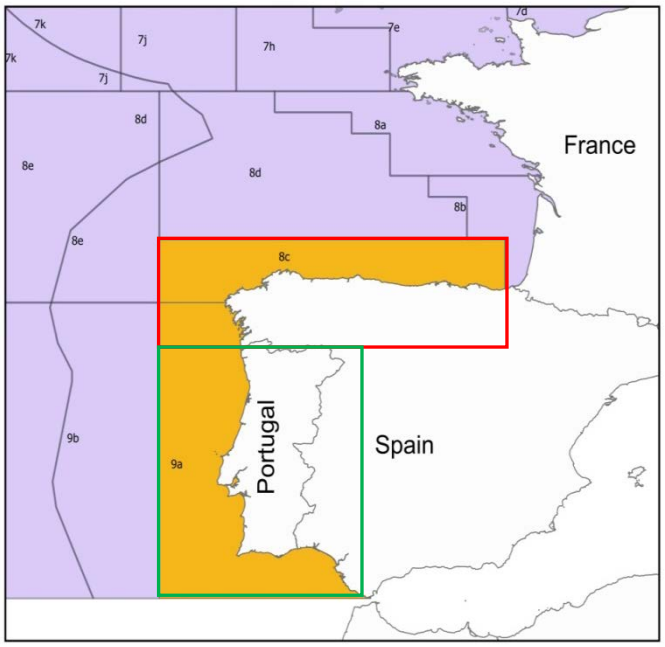


Figure 1. Delimitation of the Southern sardine stock (divisions 8.c and 9.a) (ICES, 2017). Green square shows the area sampled by DEPM Portuguese survey and red square shows area of the stock covered by Spanish IEO survey SAREVA (the survey samples the Bay of Biscay area up to 45ºN, out of this stock).

The daily egg production method (DEPM) was developed for *Engraulis mordax* stock assessment in the US (Parker 1980, Lasker, 1985) and has been used historically in a big number of small pelagic species worldwide (Stratoudakis et al. 2006). DEPM method is used in pelagic species with pelagic egg phase and multiple batches over an extended spawning season, based on the argument that spawning biomass can be easily derived from egg production (Lasker, 1985), figure 2.

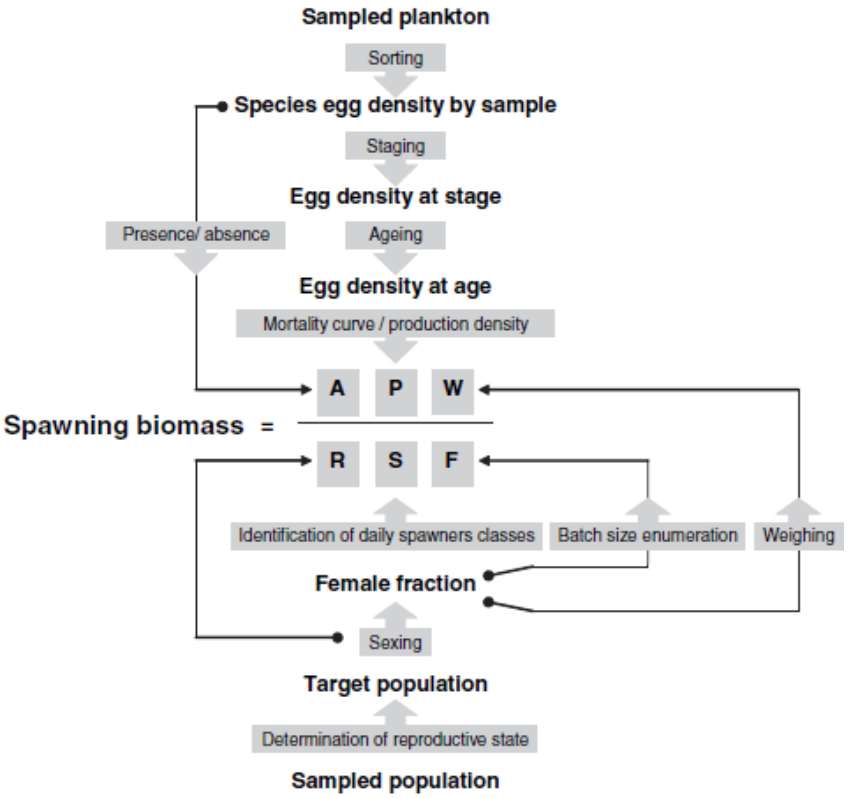


Figure 2. Schematic representation of the DEPM equation, taken from Stratoudakis et al. 2006.

Icthyoplankton samples, as well as hydrographic information, were collected during SAREVA0317 survey, while adult's samples for DEPM estimates were provided by PELACUS0317 acoustic survey, carried out in the same area at the same time, on board R/V Miguel Oliver (Secretaria General de Pesca). Both surveys are coordinated by the PELASSES project (IEO).

During SAREVA0317, eggs and larvae of other commercial species that spawn in spring are also collected and identified.

Objectives

General Objective

- Sardine (*Sardina pilchardus)* egg sampling and adult fishing hauls for the estimation of the SSB using the Daily Egg Production Method (DEPM).

Specific objectives

- Estimation of sardine spawning area
- Evaluation of the daily egg production (P0) of sardine
- Delimitation of egg spatial distribution of other commercial species, i.e. horse mackerel (*Trachurus trachurus*), mackerel (*Scomber scombrus*), anchovy (*Engraulis encrasicolus*), etc. that spawn in spring.
- Hydrographical characterization of the sampling area

Methods

Sampling area

Survey was conducted onboard RV Vizconde de Eza (Fig 3), of the Secretaría General de Pesca, during March-April 2017 (from 22th March to 15th April).

Figure 3. Survey Vessel Vizconde de Eza

Study area comprises spanish waters from the Spanish-Portuguese border in the Minho river to French waters in the Bay of Biscay, up to 45ºN (Fig.4).

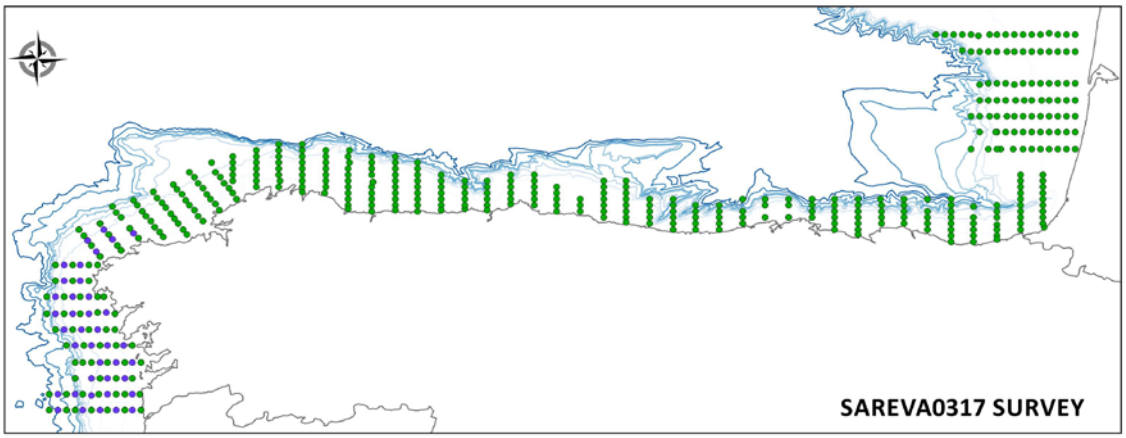


Figure 4. Sampling intensity in the study area. Green symbols show stations with seabird SB25 CTD and magenta symbols are stations with deployment of seabird SB37.

Plankton sampling

Sampling consisted of ichthyoplankton sampling on fixed (CalVET, fig. 5) and underway (CUFES) stations.

Figure 5. CALVET net used during SAREVA0317.

CalVET net consists in a double net structure of 25 cm mouth. The CalVET hauls were performed using a net with 150 µm mesh size and platic cod-ends, operating vertically from 100 m depth to the surface. In shallower areas, the net was towed from 5 m above the bottom to the surface. General Oceanics Flowmeters were used to record the towing length and estimate the sampled water volume (assuming a filtration efficiency of 100%), while a CTD Seabird SB37 (coupled to CALVET net) was used to record maximum sampling depth and to register thermal structure of the water column. In addition at the beginning, every two CALVET stations and at the end of each transect, CTD Seabird25 were deployed for a better resolution in the hydrographic description of the water column.

CUFES (Fig. 6, Continuous Underway Fish Egg Sampler) sampled at the surface (3-5 m depth) with a mesh size of 335 µm. CUFES samples were used to delimit sardine spawning grounds and to modify adaptively the intensity of CalVET sampling. Daily egg production was determined using data from the CalVET performed along transects spaced 8 nm apart. Within the same transect the distance between stations was 3 nm for CUFES sampling and varied between 3 and 6 nm for CalVET hauls.

The decision on the distance between CalVET stations was based on presence or absence of sardine eggs on the previous CalVET and/or CUFES stations.

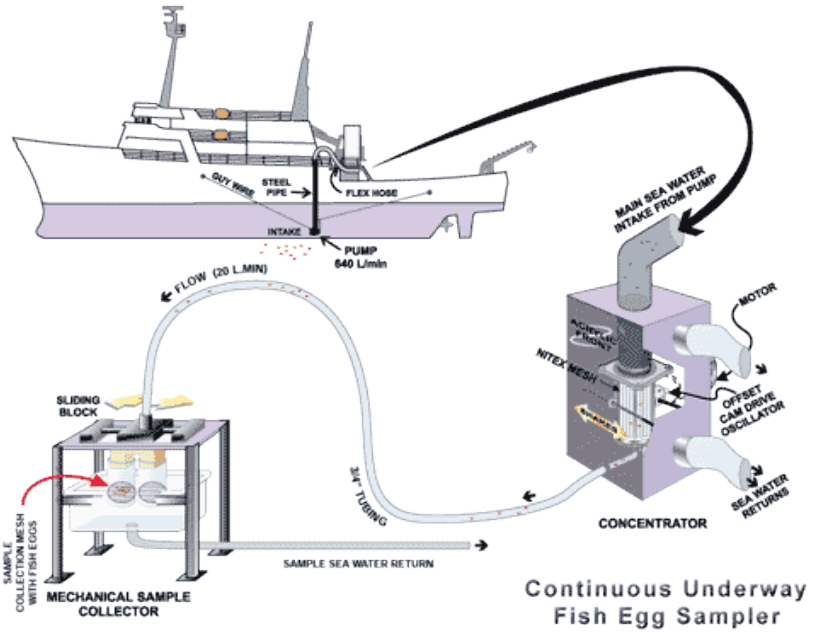


Figure 6. Schematic representation of the CUFES sampling (from CalCOFI.org).

Fish eggs were identified using morphological criteria (egg diameter, oil globule diameter, segmentation of yolk sac and pigmentation) and counted on board immediately after collection. All samples were fixed in 4% buffered formaldehyde solution for subsequent verification of egg counts and staging (following an adaptation of Gamulin & Hure 1955) in the laboratory.

Hydrographic sampling

As mentioned before, during SAREVA, a Seabird SBE37 CTD was incorporated to the CalVET structure, and allows collecting regularly conductivity (salinity)/temperature/depth profiles simultaneously to each ichthyoplankton haul.

In addition, in alternate stations and at the end of each transect, a SBE25 CTD was used (until 200m depth or 5m above the bottom in shallower stations).

Due to bad weather conditions, at station 101, CALVET net (and CTD 37 attached) was lost, and for this reason, from this station to the end, CTD25 was deployed in every CALVET station.

Chronogram and personnel

	First leg	Second leg
Dates	22nd March 3rd April	4th April 15 April
HARBOURS	Vigo-Santander	Santander-Vigo
Chief	Isabel Riveiro	Dolores Garabana
Scientists (name, affiliation)		
• Luisa Iglesias García, CO Vigo	x	
• Mar Sacau Cuadrado, CO Vigo	x	
• Venicio Pita Freire, CO Gijón	x	x
• Jose M. Alonso Campelos, CO Vigo	x	x
• José Luis Villaverde Rosales, CO Vigo	x	x
• Biel Pomar Vert, CO Baleares	x	x
• Francisco Fernández Corregidor, CO Málaga	x	x
• Jose Mª Quintanilla Hervás, CO Málaga	x	x
• Isabel Loureiro Caride, CO Santander	x	
• Olaya Fernández Zapico, CO Santander	x	
• Mª Rosario Navarro Rodríguez, CO Santander	x	
• Montserrat Pérez Rodríguez, CO Vigo	x	
• Angeles Armesto López, CO Vigo		x
• Carmen Hernández Parras, CO Vigo		x
• Hortensia Araujo Fernández, CO Vigo		x
• Mª Dolores Godoy Garrido, CO Málaga		x
• Manuel Vázquez Brañas, CO A Coruña		x
• Jose González Davila	x	x

Results

In total, 473 CalVET stations were carried out and 420 CUFES samples were collected during SAREVA0317 survey.

1.1. CALVET

During SAREVA, a total of 15914 fish eggs were collected with CalVET, corresponding to a 83.3% of positive stations and an average density of 709.12 eggs m^{-2} (851.30 egg.m^{-2} considering only positive stations).

7.1.1. Sardine (*Sardina pilchardus*) Egg abundance

For sardine, a total of 669 eggs were collected, corresponding to a 13.9% of positive stations (63) and an average density of 30.07 eggs m^{-2} (129.3 egg.m^{-2} considering only positive stations).

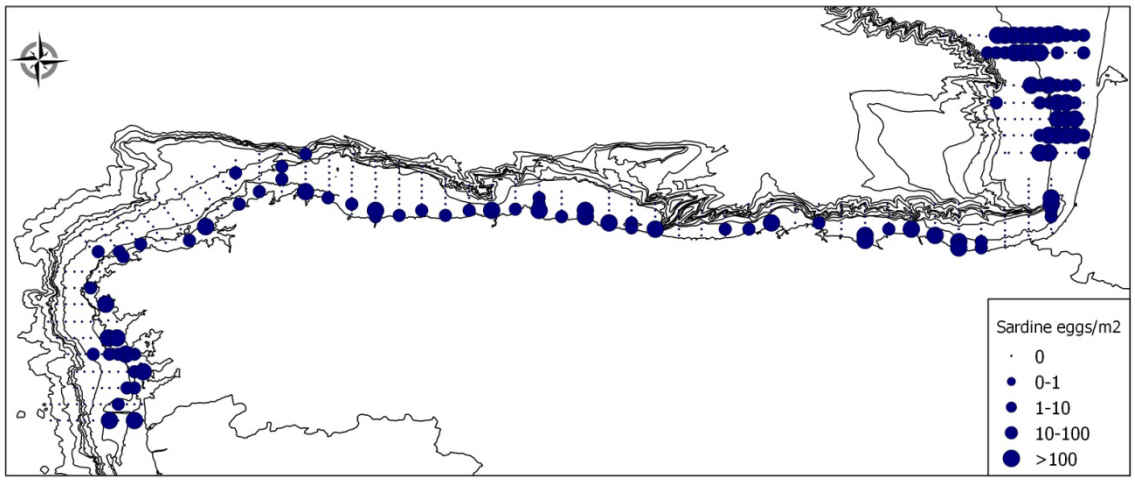


Figure 7. SAREVA0317-CALVET. Sardine egg density eggs/m^2.

Sardine eggs were found in the whole area, with a low density and very coastal area distribution, except for the French platform, where were more abundant and widespread distributed. Comparing with the previous SAREVA survey, carried out in 2014, total CALVET stations were 522, with 28% of them positive for sardine (144). Total sardine eggs collected were 1763, with a higher density in average (59 eggs/m^2). Egg distribution was not continuous in the sampled area, with some gaps in Galicia and in the Cantabrian Sea.

7.1.2. Anchovy (*Engraulis encrasicolus*) egg abundance

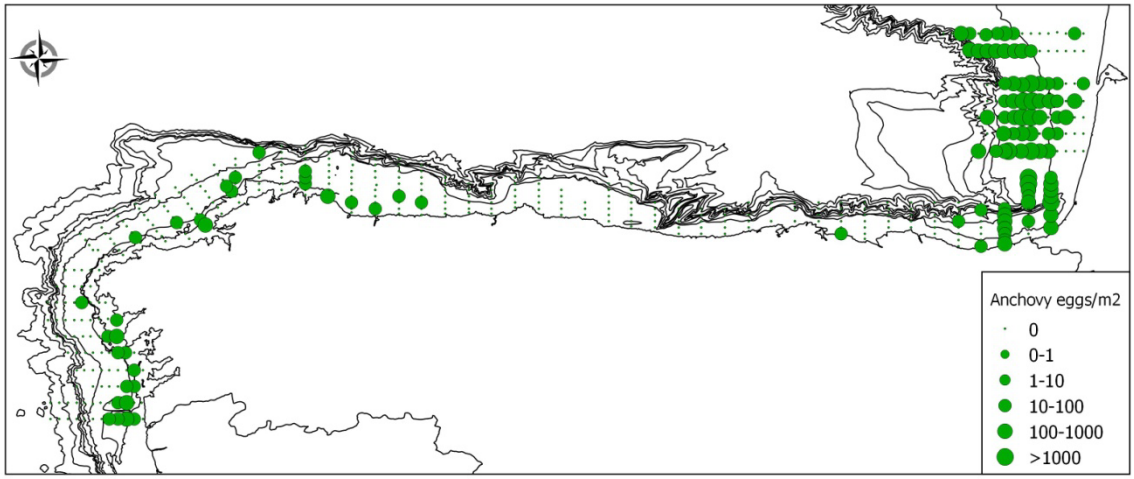


Figure 8. SAREVA0317-CALVET. Anchovy egg density eggs/m^2.

During SAREVA , a total of 1388 anchovy eggs were collected with Calvet, corresponding to a 23.0% of positive stations (109) and an average density of 73.82 eggs m^{-2} (320.35 eggs.m^{-2} considering only positive stations). Anchovy eggs were only present in Galicia and in the French coast, where adults of anchovy were also abundant during PELACUS0317 survey (Carrera&Riveiro, 2017).

1.1.3. Horse mackerel (*Trachurus trachurus*) egg abundance

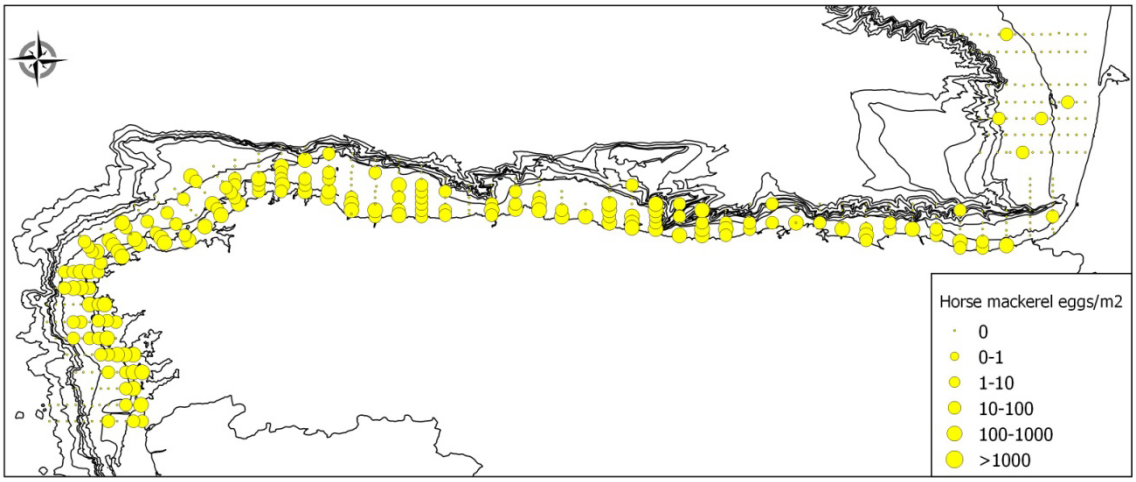


Figure 9. SAREVA0317-CALVET. Horse mackerel egg density eggs/m^2.

We found 1072 horse mackerel eggs during SAREVA. This species was present in all the area, except the French shelf, where this species was scarce. We have recorded a 35.7% of positive stations (169) and an average density of 48.17 eggs m^{-2} (134.82 eggs m^{-2} in positive stations).

1.1.4. Mackerel (*Scomber scombrus*) egg abundance

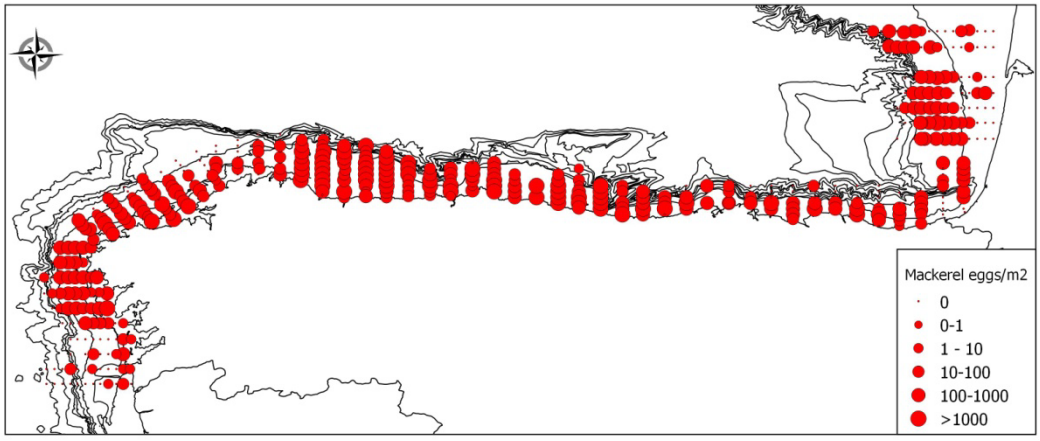


Figure 10. SAREVA0317-CALVET. Mackerel egg density eggs/m^2.

Mackerel was the more abundant and widely distributed fish species sampled along the area (except from the French platform and the south of Galicia), with 12160 eggs counted in 310 positive stations (66.5%), and an average density of 519 egg/m^2 (791.1eggs/m^2 in positive stations).

1.1.5. Other fish species eggs

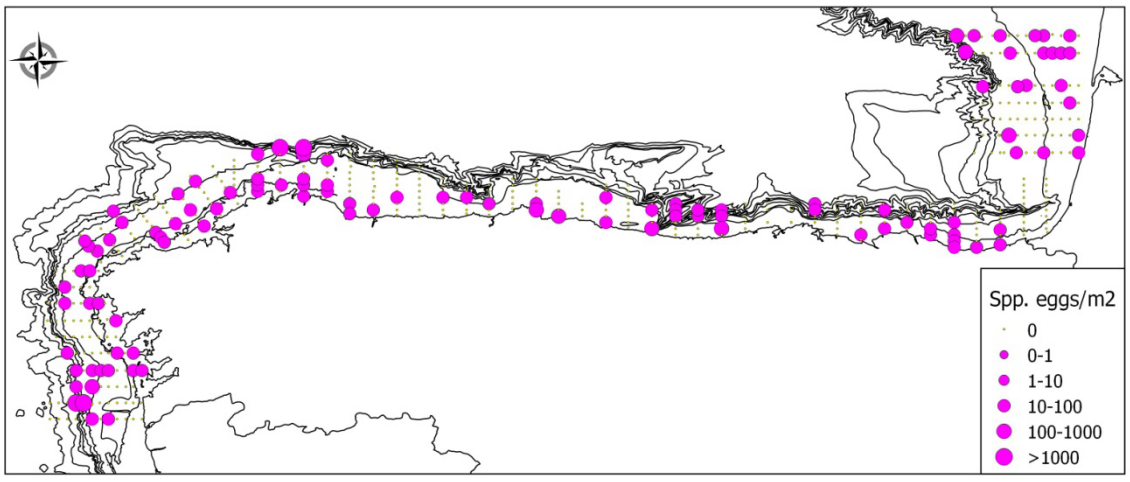


Figure 11. SAREVA0317-CALVET. Other fish species egg density eggs/m^2.

During SAREVA we have collected 456 eggs from other non-identified fish species all along the sampled area. Most of them belonged to deep sea species (such as *Maurolicus muelleri*), but some other species could not be identified by their morphological characters and size.

1.2. CUFES

With CUFES, the higher volume filtered for any sample, allowed us to better establish the spawning distribution of the fish species. Even when this sampler is commonly used only for sardine and anchovy sampling, results for mackerel and horse mackerel are promising, showing a good coincidence with CALvet samples.

7.2.1. Sardine Egg abundance

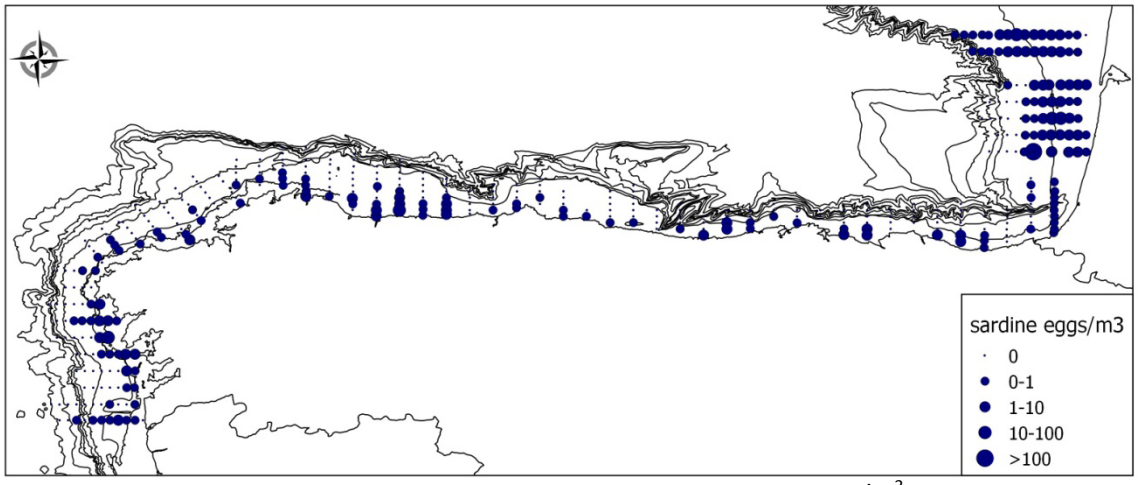


Figure 12. SAREVA0317-CUFES. Sardine egg density eggs/m^3.

A total of 3414 sardine eggs were collected with CUFES, with a 41.2% of positive stations (173). Highest densities were observed in South Galicia (Rias Baixas) and in the French area sampled. In the Cantabrian Sea, sardine eggs were scarce and showed a more coastal distribution. Average density was 11.30 eggs. $10m^{-3}$ (27.44 eggs. $10m^{-3}$ considering only positive stations).

7.2.2. Anchovy egg abundance

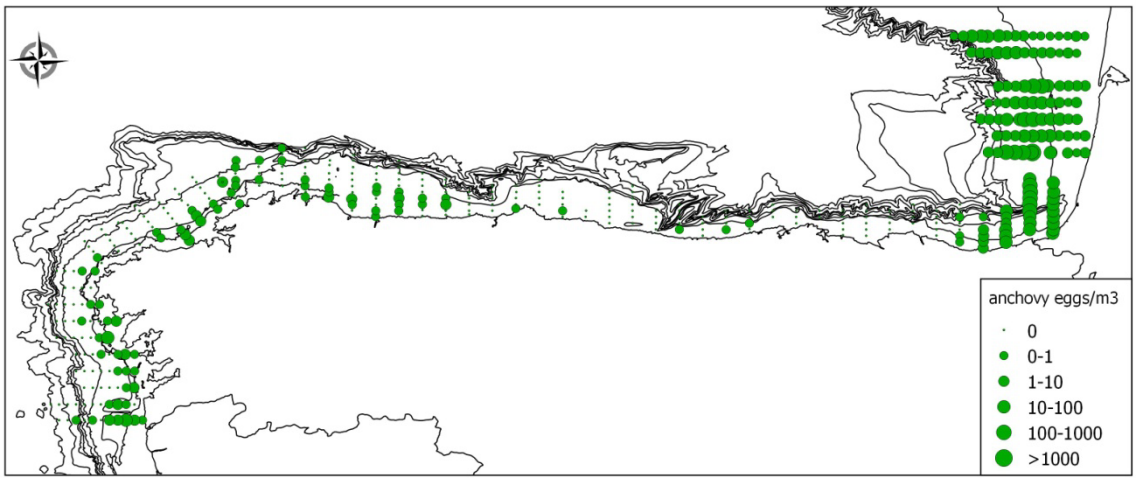


Figure 13. SAREVA0317-CUFES. Anchovy egg density eggs/m^3.

A total of 53047 anchovy eggs were collected, with a 46.2% of positive stations (194).Highest densities were observed in South Galicia (Rias Baixas) and especially in the French area

sampled. Anchovy eggs were practically absent between Cudillero (Asturias) and the inner part of the Bay of Biscay (8b subdivision). This fact can be due to the dates of the survey, very early for the anchovy spawning season.

1.2.3. Horse mackerel eggs: presence/absence

Horse mackerel eggs were collected in 268 stations, representing a 63.8% of the total stations in the survey.

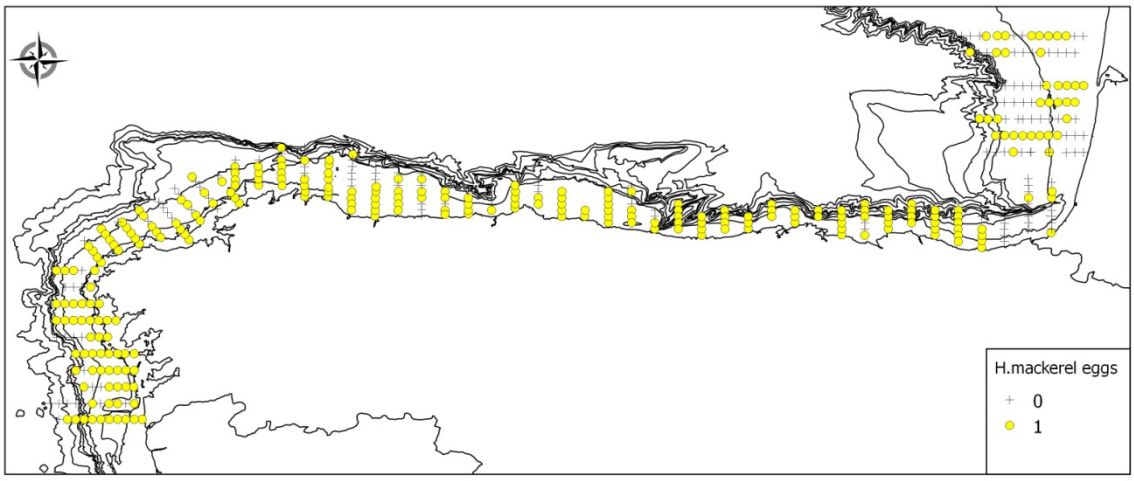


Figure 14. SAREVA0317-CUFES. Horse mackerel eggs presence/absence.

1.2.4. Mackerel eggs: presence/absence

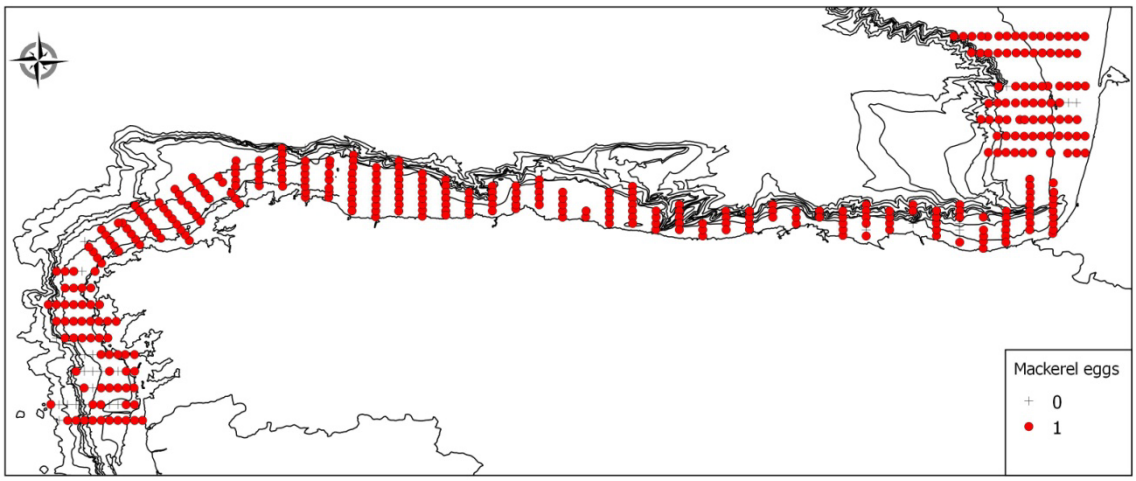


Figure 15. SAREVA0317-CUFES. Mackerel eggs presence/absence.

For mackerel, 389 positive stations were register and this species was present in almost all the stations in the entire survey (92.6%).

1.2.5. Other spp. egg presence/absence

Non-identified species (and other as *Maurolicus muelleri*, etc.) were collected in the 42.9% of the analyzed stations (180 positive stations).

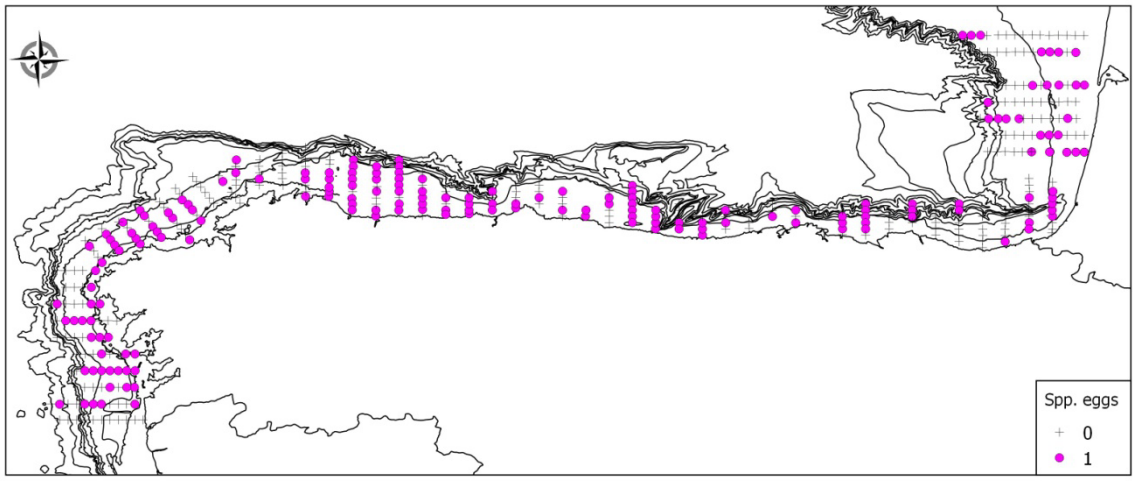


Figure 16. SAREVA0317-CUFES. Other fish species eggs presence/absence.

1.3. TEMPERATURE AND SALINITY

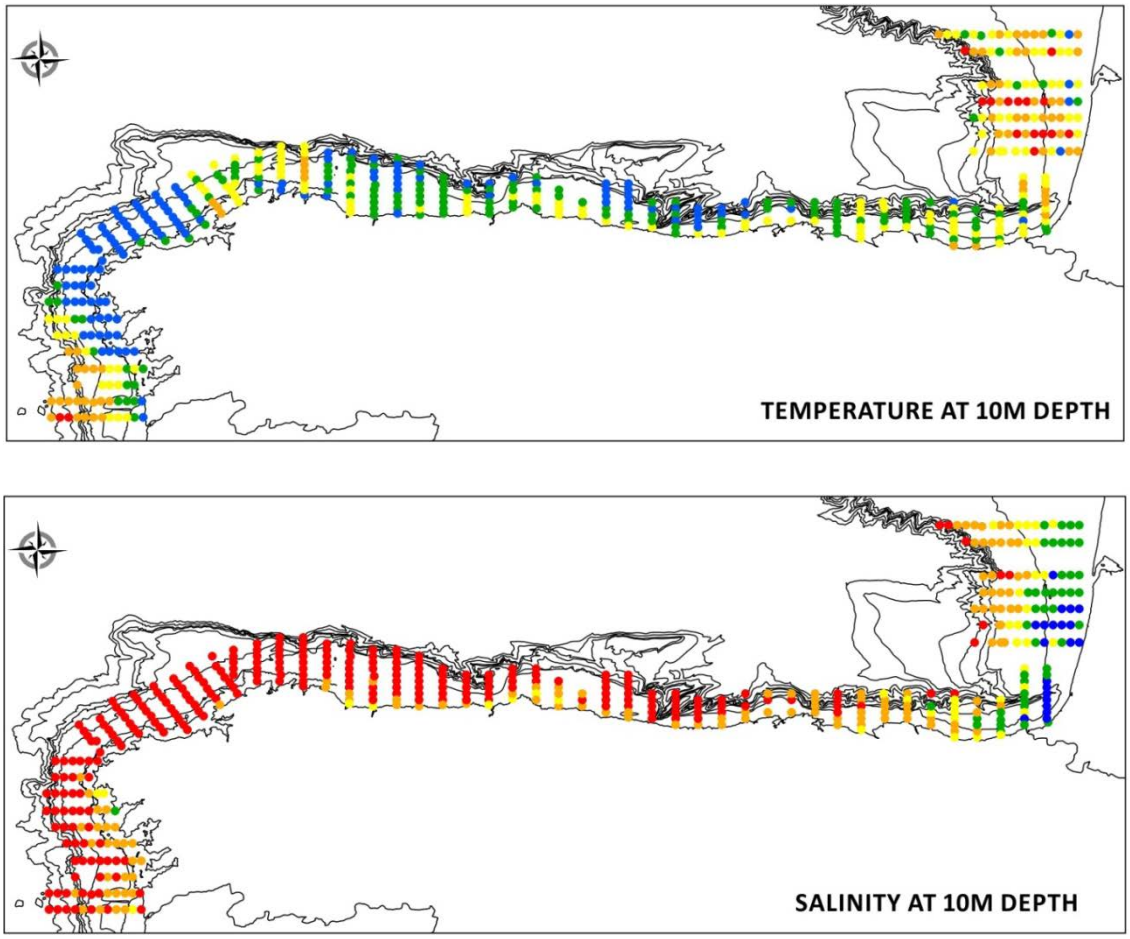


Figure 17. Temperature (a) and salinity (b) at 10m depth during SAREVA0317 survey.

Sea temperature at 10m depth ranged between 12.64 and 14.62 ºC, during SAREVA survey. Higher values were register in Bay of Biscay and in southern area of Galicia, outside the Rias, indicating the influence of poleward current in this period.

Salinity at 10m depth ranged between 34.38 and 35.75 g/kg. Lower values were observed in the inner part of the Bay of Biscay and in front of the Rias in south Galicia (influence of rivers outflow).

References

Carrera P and Riveiro I 2017 Preliminary results of the Pelacus0317 survey: estimates of sardine abundance and biomass in galicia and cantabrian waters. Working document for the WGHANSA 24-29/06/2017,Bilbao, Spain.

Gamulin T and Hure H 1955. Sur l'ecologie de la ponte de la sardine dans l'Adriatique. FAO 1955 - in Proc. Gen. Fish. Coun. Medit. no 3 - Tech. Pap no 10 - p. 141-143, 1 fig, abstr. in E, F - cf /53704/

ICES. 2017a. Report of the Benchmark Workshop on Pelagic Stocks, 6–10 February 2017, Lisbon, Portugal. ICES CM 2017/ACOM:35. 278 pp.