

# Reproductive aspects of sardine (*Sardina pilchardus* Walbaum, 1792), round sardinella (*Sardinella aurita* Valenciennes, 1847), flat sardinella (*Sardinella maderensis* Lowe, 1838) and mackerel (*Scomber colias* Gmelin, 1789) in Mauritanian waters, Northwest Africa

Aspects concernant la reproduction de la sardine (*Sardina pilchardus* Walbaum, 1792), la sardinelle ronde (*Sardinella aurita* Valenciennes, 1847), la sardinelle plate (*Sardinella maderensis* Lowe, 1838) et le maquereau (*Scomber colias* Gmelin, 1789) dans les eaux mauritaniennes (Afrique du nord-ouest)  
(english only/en anglais seulement)

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## ABSTRACT

According with the European Commission Regulation (EC) No 1581/2004 of 27 August 2004 and Amending Regulation (EC) No 1639/2001 establishing the minimum and extended Community programmes for the collection of data in the fisheries sector and laying down detailed rules for the application of Council Regulation (EC) No 1543/2000, the current study presents the fishing activity of the EU fleet of pelagic trawlers in the period between 2004 and 2007 in the FAO division 34 and their landings in the port of Las Palmas, Gran Canaria (Canary Islands). Figures for effort, catches of target and accessory species as well as a comparative analysis is presented.

Satellite-derived sea-surface temperature (SST) and oscillations of SST anomalies were analysed, trying to detect analytically changes in the oceanographic conditions that may affect the level of catches.

## RÉSUMÉ

Selon la Régulation de la Commission Européenne (EC) No 1581/2004 du 27 Août 2004, et la Régulation rectificative (EC) No 1639/2001, qui établissent les programmes minimal et étendu de la Communauté pour la collecte des données dans le secteur de la pêche, et qui fournit les règles détaillées pour l'application de la régulation du Conseil (EC) N° 1543/2000, cette étude décrit l'activité de pêche de chalutage pélagique de la flotte de l'UE pour la période 2004 à 2007 dans la division 34 de la FAO, et ses débarquements dans le port de Las Palmas de Gran Canaria (Iles

Canaries). Les chiffres d'effort de pêche, de capture des espèces-cibles, des espèces accessoires, ainsi qu'une analyse comparative sont présentés.

La température de la surface de la mer (SST) enregistrée mensuellement par satellite et les oscillations de ses anomalies ont été analysées, en essayant de détecter analytiquement des changements des conditions océanographiques qui pourraient influencer sur le niveau des captures.

## 1. INTRODUCTION

The Spanish National Programme for the development of studies on small pelagics caught by the European community fleet of pelagic trawlers in Mauritanian waters began at the Instituto Español de Oceanografía (IEO), in May 2004. This fleet of about seven units makes its landings in the port of Las Palmas (Canary Islands, Spain). Target species are: sardine (*Sardina pilchardus* Walbaum, 1792); round sardinella (*Sardinella aurita* Valenciennes, 1847); flat sardinella (*Sardinella maderensis* Lowe, 1838) and mackerel (*Scomber colias* Gmelin, 1789).

The aim of the present study is to investigate, as a continuation to the FAO Small Pelagics Working Group in the area, some aspects of the reproductive biology of the four above mentioned small pelagic species, caught between 2004 and 2007: the time and duration of the spawning season; the annual reproductive cycle in terms of seasonal changes in the gonadosomatic index and maturity stages; the maturity ogive and the size at first maturity for males and females. Furthermore, some of these biological data can be related with the data of the satellite-derived sea-surface temperature (SST). In addition, we will show a set of images of the maturity stage for mackerel.

## 2. METHODOLOGY

Table 1 shows the number of sampled specimens. In the laboratory total weights (TW, 0.1 g) and total lengths (TL, 0.1 cm) were measured. Gonads and guts were removed before weighing. The description of the maturity stages was based on Arriaga, Coello and Maridueña (1983) according to an empirical scale of 5 grades: stage I (virgin), II (resting or recovering spawning), III (pre-spawning), IV (spawning) and V (post-spawning). The spawning period was determined by the presence of individuals with gonads at maturity stages III and IV. For the estimation of  $L_{50}$ , mature individuals were considered those classified at stages II to V, while those classified at stage I were considered immature for males and females. The gonadosomatic index was calculated as the ratio of gonad weight to gutted weight ( $GSI = (Gonad\ W / Gutted\ W) * 100$ ).

Round sardinella has a wide range of GSI values during the spawning season. Due to this, the critical gonadosomatic index ( $GSI_{50}$ ) for that species was calculated by a logistic regression, considering as active females those with gonads at maturity stage IV, and as inactive all the rest. We used only data from samples taken during the spawning period (May, June, July and August). The ratio of active (FA) and inactive females was also analysed, and the size distribution of active (FA) and inactive females during this period, using only the females with  $GSI > GSI_{50}$ .

Data of sea surface temperature (SST) were obtained from the IGOSS database located at the International Research Institute for Climate Prediction (IRI) based at Columbia University. These data were processed for the geographical area comprised between 16.5°N–20.5°N and -17°W–21.5°W, assigning the SST values to the midpoint of each 1°x1° grid. The relationship between SST and GSI were analysed first with the Spearman's rank correlation coefficient and later both values were illustrated in the same graphic.

**Table 1:** Size range and number of specimens studied from 2004 to 2007, by species

|                         | Size range TL (cm) | 2004 | 2005  | 2006  | 2007 | Total |
|-------------------------|--------------------|------|-------|-------|------|-------|
| <b>Sardine</b>          | 11.4 – 28.8        | 514  | ---   | 690   | 633  | 1 837 |
| <b>Round sardinella</b> | 18.3 – 39.5        | 21   | 1 934 | 1 401 | 730  | 4 086 |
| <b>Flat sardinella</b>  | 22.9 – 37.4        | ---  | ---   | 889   | 517  | 1 406 |
| <b>Mackerel</b>         | 18.8 – 49.0        | 25   | 704   | 518   | 921  | 2 168 |

### 3. RESULTS

#### Spawning season

**Table 2:** Spawning intensity by species

|                         | J  | F | M | A | M  | J  | J  | A  | S | O  | N  | D  |
|-------------------------|----|---|---|---|----|----|----|----|---|----|----|----|
| <b>Sardine</b>          |    |   |   |   |    |    |    |    |   | •• | •• | •• |
| <b>Round sardinella</b> | •  |   |   |   |    | •• | •• | •• |   |    | •  | •  |
| <b>Flat sardinella</b>  |    |   |   |   | •• | •• | •• |    |   |    |    |    |
| <b>Mackerel</b>         | •• |   |   |   |    |    |    |    |   |    |    | •  |

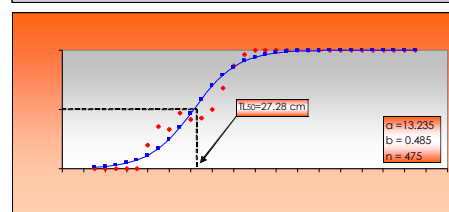
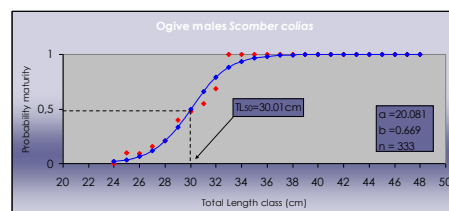
- lower intensity
- maximum intensity

The sardinella species have a principal spawning period in summer. Flat sardinella, even in the absence of samples from the first four months of the year, shows a single peak during the summer period while the spawning season of the round sardinella is extended: a principal period in summer and another one in winter. On the other hand, for sardine (even with the absence of samples from the first and third quarters) and for mackerel, it seems that the period of spawning could take place mainly in the winter months.

#### First maturity

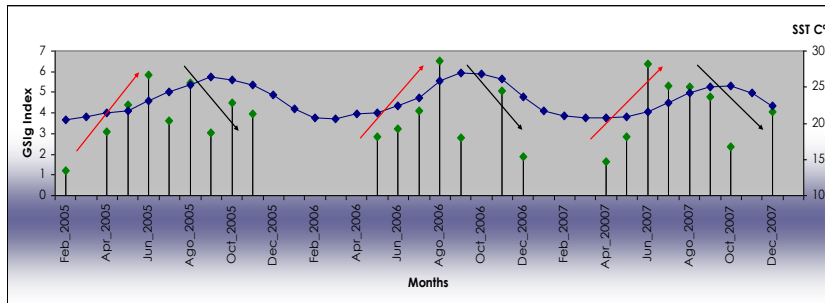
The length (cm) of the first maturity for both males and females of the main species, and the maturity ogives for mackerel (as example) were:

|                         |   | TL <sub>50</sub> | a      | b     | n     |
|-------------------------|---|------------------|--------|-------|-------|
| <b>Sardine</b>          | ♂ | 17.01            | 15.209 | 0.894 | 704   |
|                         | ♀ | 16.89            | 30.427 | 1.801 | 930   |
| <b>Round sardinella</b> | ♂ | 22.37            | 18.243 | 0.728 | 1 042 |
|                         | ♀ | 20.19            | 15.077 | 0.738 | 2 044 |
| <b>Flat sardinella</b>  | ♂ | 24.46            | 12.204 | 0.499 | 496   |
|                         | ♀ | 24.66            | 10.531 | 0.427 | 614   |
| <b>Mackerel</b>         | ♂ | 30.01            | 20.081 | 0.669 | 333   |
|                         | ♀ | 27.28            | 13.235 | 0.485 | 475   |



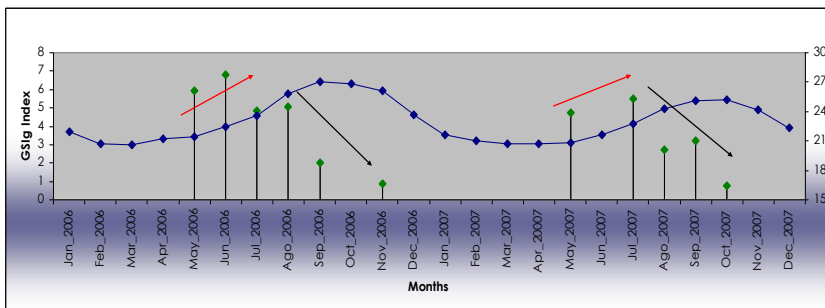
**Sea surface temperature (SST)/Gonadosomatic Index (GSI)**

*Round sardinella*



The Spearman's rank correlation coefficient was +0.539 (2005), +0.418 (2006) and +0.117 (2007) so the beginning of the ripeness (green dot) starts with the rising of SST (red arrows). On the other hand, IGS decreases during the hottest months (black arrows).

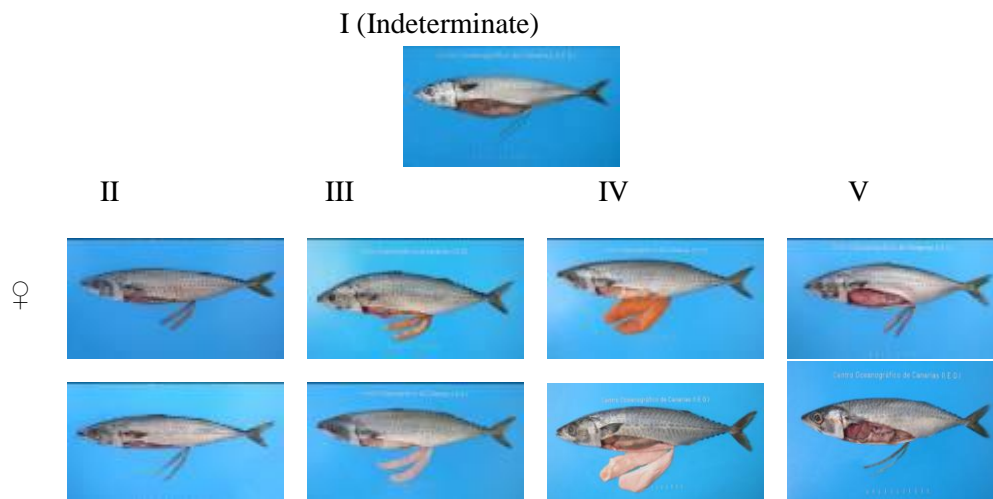
*Flat sardinella*



The Spearman's rank correlation coefficient was +0.588 (2006) and +0.250 (2007). It means that the beginning of the ripeness starts with the rising of SST and the GSIg decreases during the hottest months (black arrows).

**Images of the maturity stages**

Finally, we took pictures to complete all the different maturity stages (I-V) for both males and females of the different species. The below pictures present mackerel as an example:



#### **4. REFERENCES**

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