

REPRODUCTIVE ASPECTS OF SARDINE, ROUND SARDINELLA, FLAT SARDINELLA AND MACKEREL OFF MAURITANIAN WATERS (NW AFRICA)

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INTRODUCTION



Location of the main fishing zone for small pelagics

The Spanish National Programme for the development of the studies of Small Pelagics caught by the community fleet of pelagic trawlers in Mauritanian waters (figure 1) began through the Instituto Español de Oceanografía, in May, 2004. This fleet of about seven units makes its landings at the port of Las Palmas (Canary Islands, Spain), whose 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, like FAO WG of small pelagic contribution in the area, some aspects of the reproductive biology of four 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 give and the size of the 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 all species according to an empirical scale of 5 degrees.

METHODOLOGY

Table 1 shows the sampling intensity by species during the studied period and Table 2 shows the number of sampled specimens. In the laboratory there were measured total weights (TW, 0.1 g) and total lengths (TL, 0.1 cm). Gonads and guts were removed for weighing and considering. The description of the maturity stages is based on Ariaga et al., 1983: 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 (GSIg= (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_c) 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 analyzed, and the size distribution of active (FA) and inactive females during this period, using only the females with GSI > GSI_c.

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

TABLE 1. DISTRIBUTION OF SAMPLES BY MONTHS DURING 2004-2007 BY SPECIES

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Sardine													1,837
Round Sardinella													4,084
Flat Sardinella													494
Mackerel													2,148

With samples Without samples

TABLE 2. NUMBER OF SPECIMENS STUDIED FROM 2004 TO 2007, BY SPECIES

Common name	TL (cm)	2004	2005	2006	2007	TOTAL
Sardine	11.4 - 29.3	n=799	n=516	n=600	n=942	n=2,857
Round Sardinella	14.5 - 31.8	n=412	n=1,044	n=850	n=1,478	n=3,784
Flat Sardinella	18.5 - 37.3	n=250	n=187	n=60	n=143	n=540
Mackerel	18.8 - 40.2	n=228	n=515	n=187	n=374	n=1,304

(In total specimens used for size range/mean; in total specimens used for biological parameters)

REFERENCES

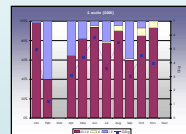
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RESULTS

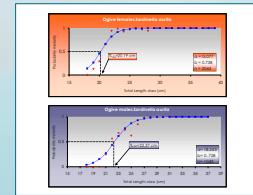
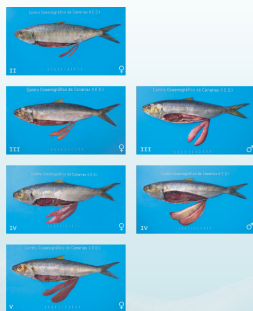
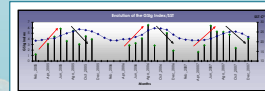
Round sardinella

Sardinella aurita Valenciennes, 1847

The spawning of round sardinella in the studied zone is extended with a principal period in summer (June, July and August) according to the monthly variation of the GSI and the maturity stages of the fish. There is another peak in winter (November and December) caused by the spawning of large size specimens.



Figures 1 to 4 show the monthly distribution of length for both active and inactive females. During all the spawning the biggest percentage of active females is concentrated in August, although we find remarkable that there is a significant presence of large inactive specimens as well.

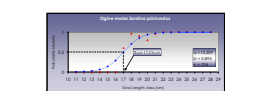
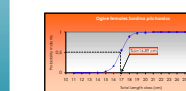
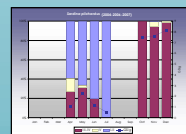


The Spearman's rank correlation coefficient was 2005=+0.539, 2006=+0.418 and 2007=+0.117, so the beginning of the ripeness (green dots) starts with the rising of SST (red arrow). On the other hand, GSIg decreases during the hottest months (black arrows).

Sardine

Sardina pilchardus (Walbaum, 1792)

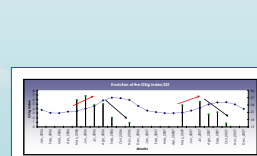
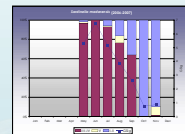
Even with the absence of samples on some months, it seems that the period of spawning for sardine could take place mainly in the winter months.



Flat sardinella

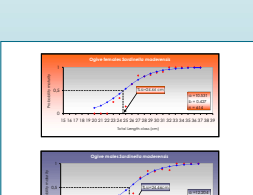
Sardinella maderensis (Lowe, 1838)

Even with the absence of samples on some months, it seems that Flat Sardinella has a single peak of spawning throughout the first months of summer, unlike the round sardinella whose maximum happens in the last months of summer.



The Spearman's rank correlation coefficient was 2006=+0.588 and 2007=+0.250. By this means, the beginning of the ripeness (green dots) starts with the rising of SST (red arrows) and the GSIg decrease during the hottest months (black arrows) as it happens with round sardinella.

The Spearman's rank correlation coefficient was 2006=+0.588 and 2007=+0.250. By this means, the beginning of the ripeness (green dots) starts with the rising of SST (red arrows) and the GSIg decrease during the hottest months (black arrows) as it happens with round sardinella.



Mackerel

Scomber colias Gmelin, 1789

It seems that the spawning of mackerel happens mainly in the winter months. Mackerel has a wide period of sexual rest during summer and autumn.

