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A PRELIMINARY ANALYSIS OF THE SEX RATIO OF THE SWORDFISH (XIPHIAS GLADIUS) IN THE NORTH ATLANTIC BY SIZE CLASS USING SPACE-TIME STRATA

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SUMMARY

This paper presents preliminary analyses and data on the time-area distributions of sex-ratio by size class of North Atlantic swordfish.

Apart from confirming the general trends in temperate zones described in earlier papers, the results also point to the existence of time-area variations in these distributions. This requires a more thorough analysis and the improvement of data bases.

RESUME

Ce document présente des données et analyses préliminaires sur la distribution spatio-temporelle du sex ratio par classe de taille de l'espadon nord-atlantique.

Outre qu'ils confirment les tendances générales des zones tempérées décrites dans les travaux antérieurs, les résultats signalent également l'existence de variations spatio-temporelles dans cette distribution. Ceci demande une analyse plus approfondie et l'amélioration des bases de données.

RESUMEN

El documento presenta análisis preliminares y datos de la distribución espacio-temporal de la proporción de sexos por clase de tallas del pez espada en el Atlántico norte.

Además de confirmar las tendencias generales en las zonas templadas, descritas en documentos anteriores, los resultados señalan hacia la existencia de variaciones espacio-temporales en dichas distribuciones. Es necesario llevar a cabo un análisis más profundo y mejorar las bases de datos.

1. INTRODUCTION.

Data reported by several authors on the sex ratio of the swordfish in the Atlantic Ocean suggest that there are substantial space-time variations in this species.

However, since the sex ratio varies in the different sizes, any comparison between area and time periods must consider the size of the individuals sexed.

HOEY (1986), GARCIA & MEJUTO (1988), HOEY (SCRS 90/34) present information on sex ratio by size class for specific areas in the North Atlantic using formats that can be compared easily.

SUZUKI & MIYABE (1990) summarized sex ratio trends and evaluated their effect on cohort analyses.

The differences in sex ratio by size have been attributed to differential growth by sex, and/or mortality by sex, and/or differences in capturability between males and females (ANONYMOUS, 1986; ANOMYNOUS, 1988) due to a possible differencial behaviour as yet unexplained.

However, we may not point to any isolated causes. Rather it is more likely that a combination of these factors is involved. The differencial growth between males and females could cause one sex to be more susceptible to predation by its natural enemies (sharks, pseudorca, etc.)

However, the different spatial distribution in the size distributions described previously (SCRS 90/33) may be another factor to consider. The relatively small individuals tend to concentrate in the warmer zones, where their natural enemies are more abundant.

2. MATERIAL AND METHODS.

Between 1986 and 1990 an intensive swordfish sexing program was carried out at various Spanish ports. This paper analyzes data compiled by the Spanish fleet which unloads their catches, normally in live weight, at ports in NW Spain. We also include data on sampling done on board vessels in equatorial zones from March to May 1990.

Sexes to be samples were not chosed at random as we had to make use of samples taken for evisceration which is done at these ports for commercial reasons. However, the trips sampled were selected at random (with the exception of the one in the tropical zone).

The size unit used was the LJFL (MIYAKE & HAYASI, 1978) obtained with a caliber. In cases where only weight was reported, it was converted to the LJFL using equations previously described (MEJUTO et al. 1988) depending on the position of the catch.

Sexing was carried out by only one sampling team that used identical criteria for sex identification.

Analyses were done in several stages. Overall analyses (all areas and months combined) on a quarterly basis and using bands of latitude were carried out.

Based on available data the latitudes analyzed were:

Band 00º + 05º latitude N. (*)
Band 20º + 25º latitude N.
Band 30º + 35º latitude N.
Band 40º + 45º latitude N.

(*) Data available only for March, April and May, areas 20º→35ºW

Quarterly temporal analyses were done for more specific zones. These zones were defined as follows:

Grand Banks: 40º+45º N Lat. and Long. >= 30º W.
Iberica : 30º+35º N Lat. and Long. < 30º W.
Azores : 40º+45º N Lat. and Long. <= 30º W.

3. RESULTS AND DISCUSSION.

An overall analysis of 5856 observations of sex by size was carried out. Figure 1 shows the number sampled by sex.

Figure 2 shows the tendencies of percentage of females by size class, which are very similar to those described earlier in the NE Atlantic (GARCIA & MEJUTO o.c.). However the decrease in % of females is more evident at 150 cm LJFL. This is probably due to the concentration of males in these size classes as a result of the effect of samples from some areas, which will be discussed later on. At 150 cm the percentage of females continues to increase until it reaches 100% at around the 200 cm size class.

In the latitude band analysis (Table 1) (Figure 3) it is important to note the sex ratio distribution found in band 00º + 05º N. The percentage of females between 120 and 170 cm LJFL is very low in the areas/time periods mentioned earlier. The distribution is very different from the pattern obtained in other bands studied and even in relation to the distributions obtained in the quarterly data (Figure 4).

In bands (20º + 25º N) a very small number of observations was made and (30º + 35º N) shows similar distributions. If we compare band (30º + 35º N) and (40º + 45º N), the latter appears to have a lower percentage of females between the 125 and 185 cm size class LJFL.

The quarterly analysis of the data (Table 2) (Figure 4) points to the existence of considerable variations in sex ratio. Quarters 1 and 3 (Q1 and Q3) offer a view similar to what is seen in the overall data. However, the differences, especially between quarters 2 and 4 (Q2, Q4) should be pointed out.

In Quarter 2 (Q2) the percentage of females is clearly lower for the 100-125 cm size class LJFL, which is probably due to the effect of the great amount of samples taken from the tropical zones. The percentage of females between 125 and 175 , however, is higher here than in the other quarters analyzed.

Despite these early attempts at global analyses, it is necessary to point out that any type of comparison or conclusion must consider the possible combined effect of space-time. Thus, the effect of a particular area having a high number of samples, could give us an unrealistic view when we analyze data by quarters. (For example, the distribution of Q2, Figure 4).

Since the samples by trip have in general been selected at random, the would theoretically be influenced by the time-space movements of the fleet under study.

Therefore we carried out preliminary analyses by quarter for 3 zones, described earlier, which had a substantial sampling level. (Table 3).

GRAND BANKS ZONE

Figure 5 shows a graph of the sex ratio by size class for each quarter analyzed.

Although Quarter 1 (Q1) has a limited number of samples (26 males, 84 females), the sex ratio points to the possible greater presence of females by size class in quarters 2 and 3 (Q2 and Q3) and is very similar to the distribution found in quarter 4 (Q4).

In Quarter 3 (Q3) there is a "hole" that appears between sizes 155 and 190, with a low percentage of females, even though the number of samples taken for these sizes is considerable.

Except in Quarter 3 (Q3) sex distribution by size is similar to earlier finding in this zone (HOEY o.c., GARCIA & MEJUTO, o.c.).

IBERIAN ZONE

Figure 6 shows the graphs of sex ratio by size class and quarter. Although the number of fish sampled in quarters 2 and 3 is not very high, the results indicate that this zone has similar distributions between quarters 1, 2, and 3 (Q1, Q2 and Q3). Quarter 4 (Q4), however, has a higher percentage of females in the 130-200 cm size class LJFL, which is quite obvious if we make a direct comparison between Q1 and Q4.

AZORES ZONE

Figure 7 shows sex distribution by sixe class for quarters 1 and 4 (Q1, Q4). Quarters 2 and 3 were not analyzed due to the small number of observations.

The data suggest that quarters 1 and 4 have similar distributions.

If we compare these distributions with those obtained in the IBERIAN zone, we see that they are similar to Quarter 1 (Q1) in the IBERIAN zone but differ from Quarter 4 (Q4) in the IBERIAN zone.

4. CONCLUSIONS.

Apart from confirming the space-time differences in the size distributions described by several authors, the results of the temporal analysis of sex ratio by size class for specific areas point to the possible existence of temporal variations in sex ratio by size class. This could imply that males and females have differential behaviour, especially in certain size ranges.

Other more accurate statistical analyses must be carried out based on data taken from the increased sampling of areas already under study as well as the start of sampling in new areas.

BANDS	MALE	FEMALE
00º + 05º N	1258	203
20º + 25º N	38	61
30º + 35º N	777	1088
40º + 45º N	1073	1091

Table 1. Number of fish sampled by size-sex for each band analized.

	MALES	FEMALES
Q 1	927	901
Q 2	1631	821
Q 3	240	192
Q 4	353	541

Table 2. Number of fish sampled by size-sex and quarter.

	Q 1		Q 2		Q 3		Q 4	
ZONES	M	F	M	F	M	F	M	F
GRAND BANKS	26	84	491	450	198	129	66	79
IBERICA	500	633	134	151	8	33	119	246
AZORES	95	118	5	3	34	30	158	198

Table 3. Number of fish sampled by size-sex, for each area and quarter.

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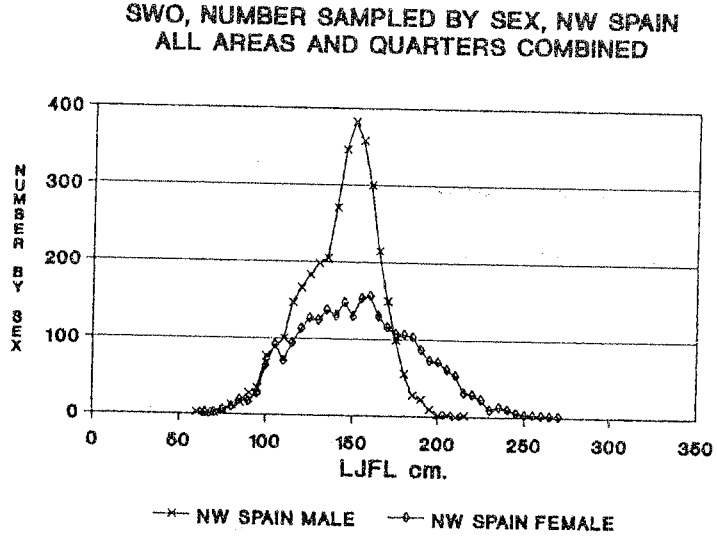


Figure 1. Number of fish sampled by size and sex for all areas and quarters combined.

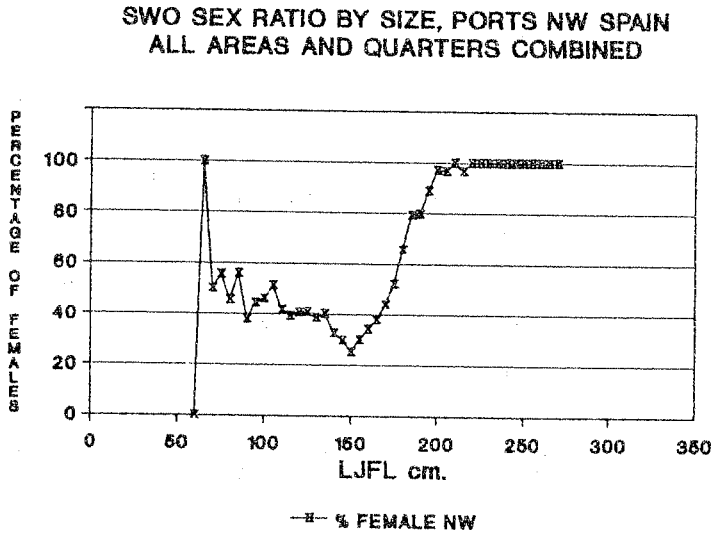
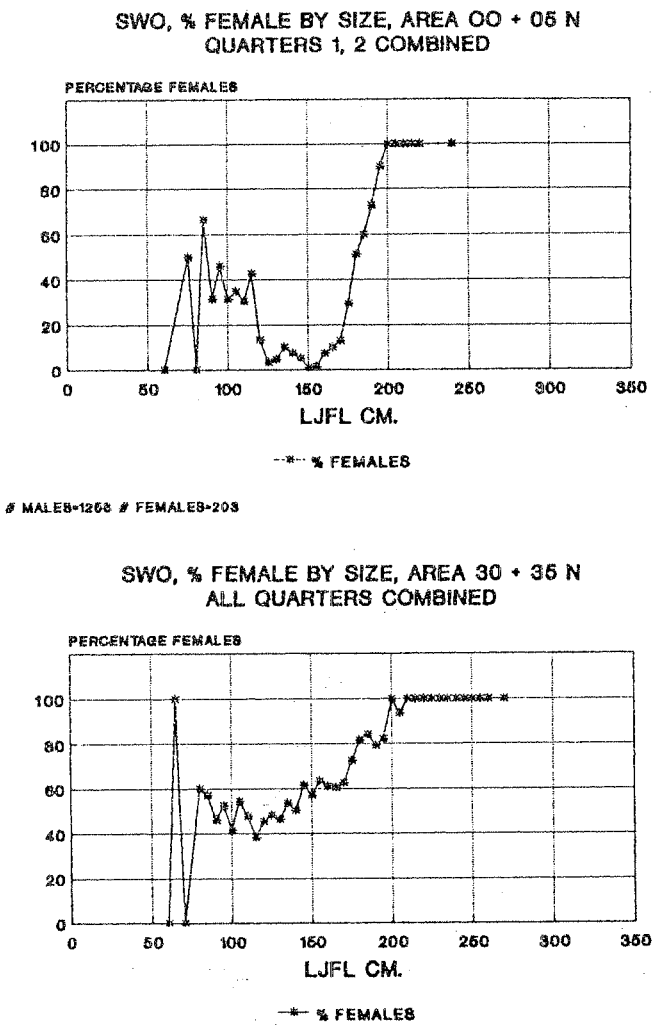


Figure 2. Sex ratio by size class, for all areas and quarters combined.



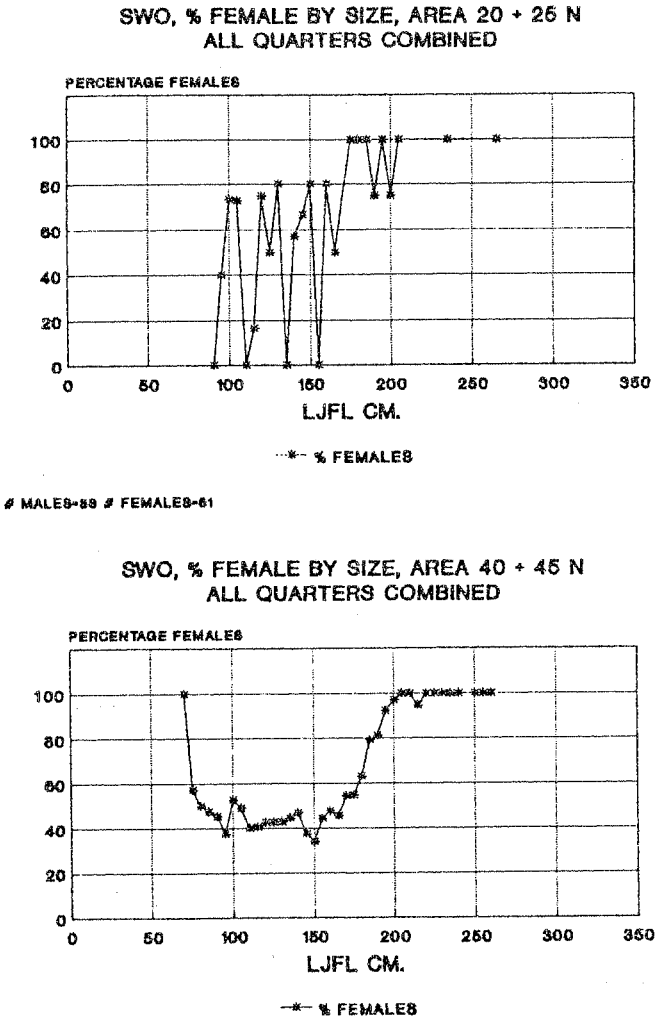
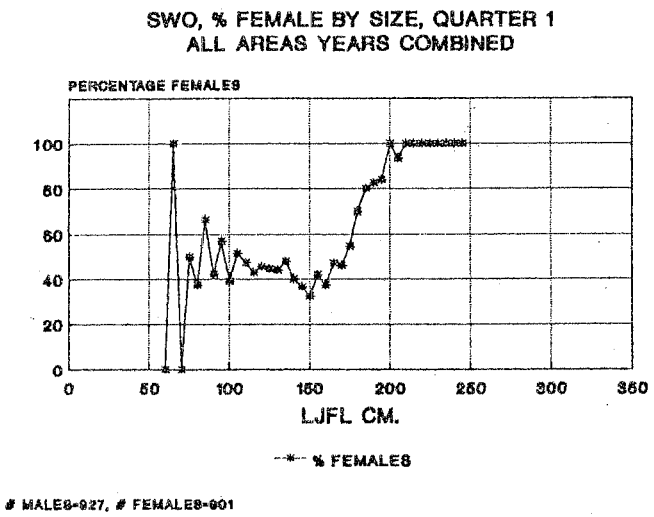
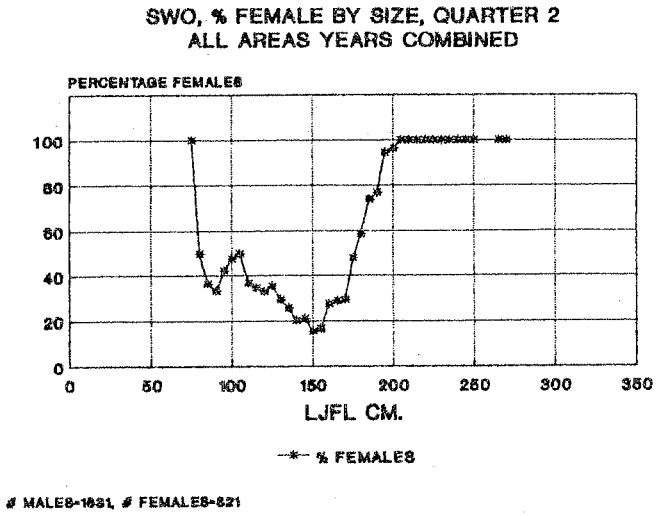
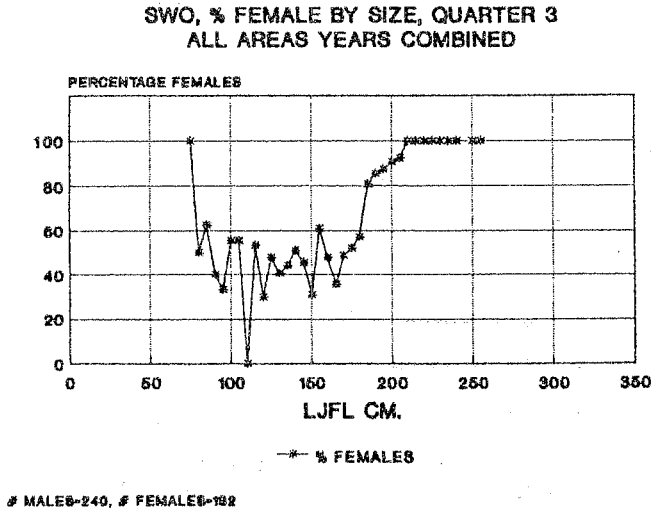


Figure 3. Sex ratio by size class and bands of latitude, for all years and months combined.







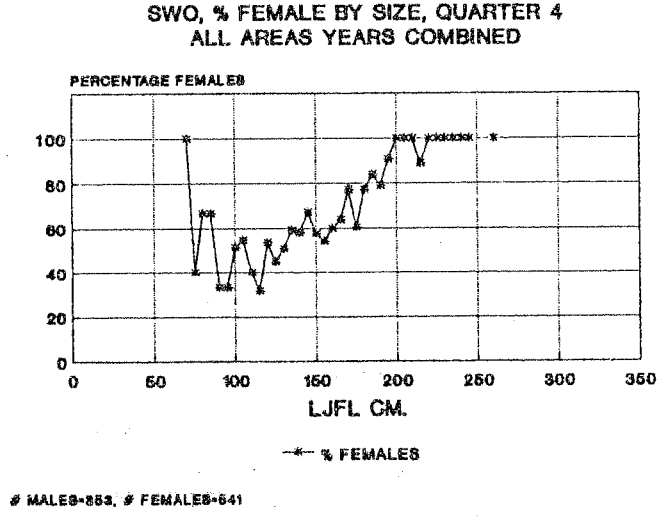
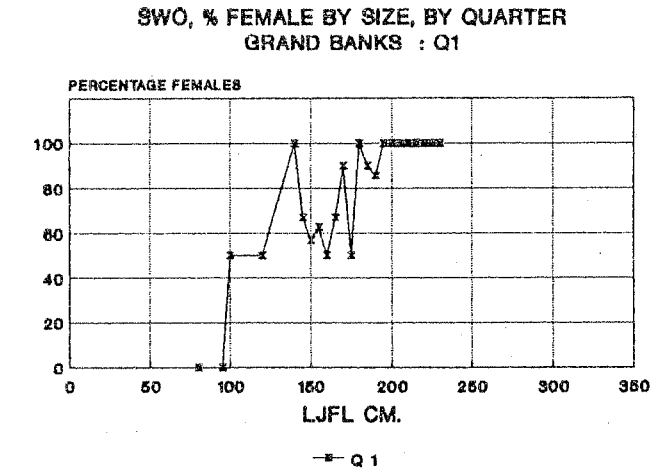
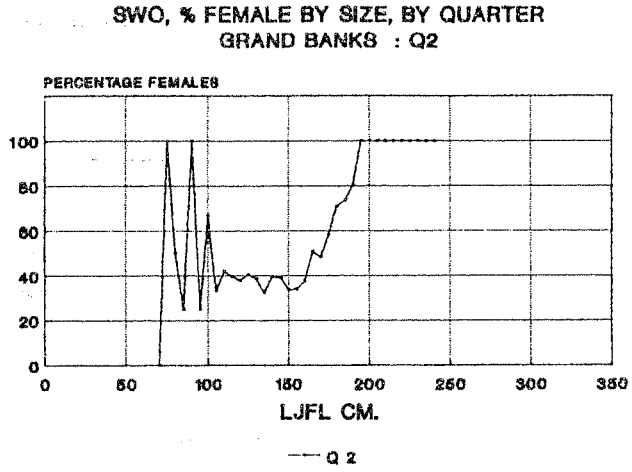
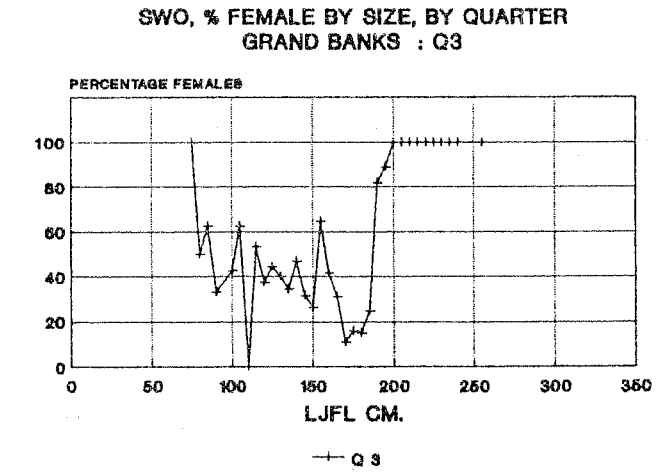


Figure 4. Sex ratio by size class and quarter, for all years and areas combined.







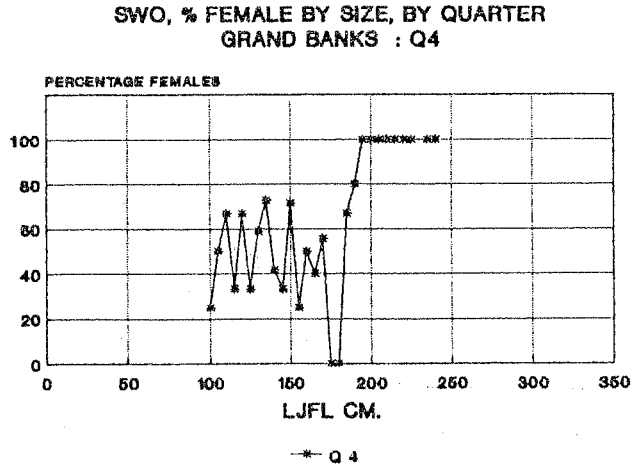
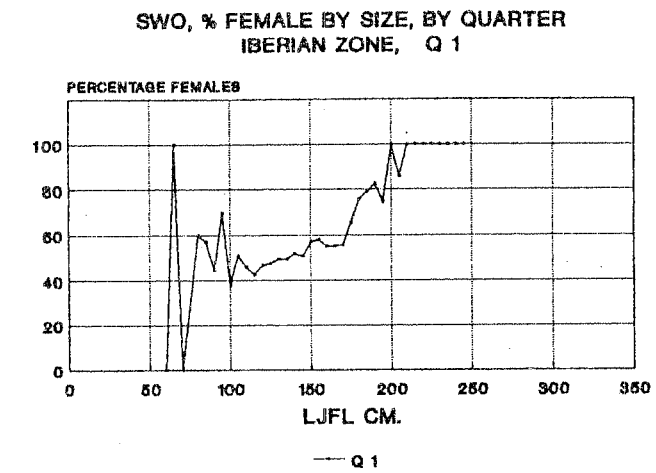
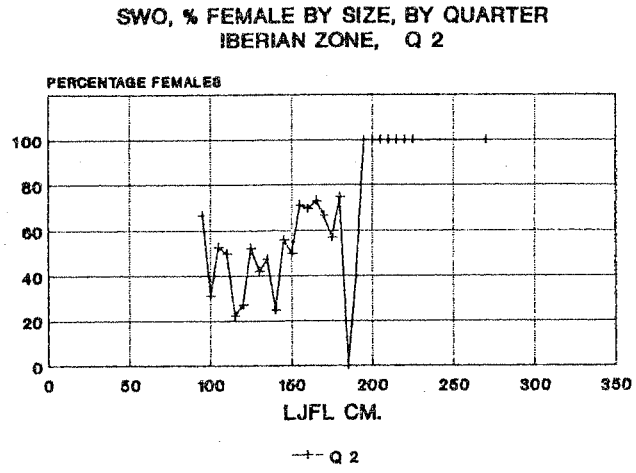
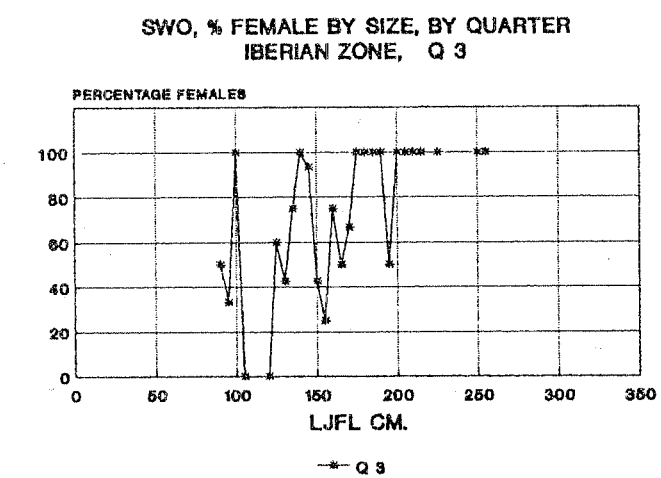


Figure 5. Sex ratio by size class and quarter, for the area Grand Banks.







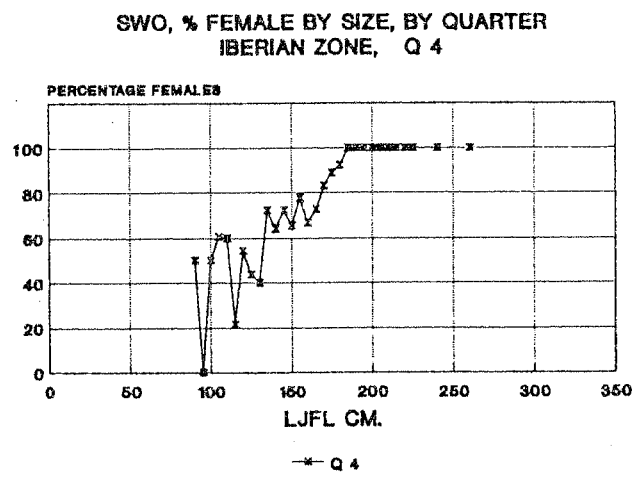


Figure 6. Sex ratio by size class and quarter for the area Iberica.

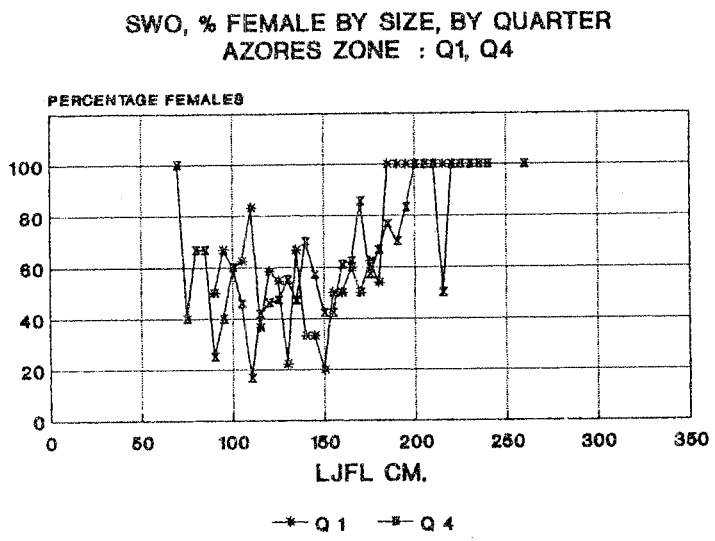


Figure 7. Sex ratio by size class and quarters (1 and 4), for the area Azores.