

Acoustic abundance estimation of Sardine
(Sardina pilchardus Walb) off Cantabric and Galician waters
August 1985

by

Pastor, X.¹; Alvarez, F.²; Porteiro, C.²; A. Astudillo³ and J. Miquel¹

- 1.- I.E.O. C.C. Baleares. Muelle de Pelaires s/n. Palma. Spain
- 2.- I.E.O. C.C. Vigo. Orillamar 47. Vigo. Spain
- 3.- I.E.O. C.C. Santander. Promontoiro S. Martin. Santander. Spain

SUMMARY

Results of the annual acoustic survey of sardine present off Cantabric and Galician coast in August 1985 are reported. Estimations of the total biomass, abundance by age groups and the strength of 1985 year class were obtained. The total biomass estimation was 149.000 tons.

RESUME

On presente ici les resultats de la campagne acoustique sur la sardine au large des côtes Cantabrique et Galicienne dans Aôut 1985. On a obtenu estimations de la biomasse total, l'abondance para classe d'âge et la force de la classe annuelle de 1985. La biomasse total estimé a été 149.000 tonnes.

INTRODUCTION

The Sardine Stock of ICES Divisions VIIIc and IXa is evaluated by a Working Group since 1979 (Anon 1986). This Working Group has recommended the use of acoustics to estimate age class abundance and stock distribution to improve the evaluation. Annual acoustic surveys were carried out from 1982 with these purposes (Dias et al.1983; Pastor et al 1985 a,b,1986). The cruises dates were determined by the timing of recruitment to the fishery, at the beginning of the second semester (Anon, 1982).

In this paper the results of 1985 survey are given and referred to the part of stock present in N-NW Spanish coasts.

METHODS

The survey "Saracus-85" (10-31 August) was carried out following the standard methodology of previous surveys referred to instruments setting, surveys grid, sectors and strata (Pastor et al, 1985 a,b,1986).

A total of 2328 n.m. were surveyed, 27 pelagic trawl stations occupied and 8661 square n.m. have been evaluated. The coverage index was 25 (Aglen,1983). Figure 1 shows the surveyed area, cruise track, geographic sectors, the 200 and 500 m. isobaths and the fishing stations.

A 38 KHz SIMRAD EK 400 echosounder and a digital echointegrator QD were used during the survey. The acoustic instruments were calibrated using a copper standard sphere of 60 mm. Table 1 shows the results of calibration and the settings of the controls during cruise.

Fishing stations were selected in accordance with acoustic traces on the echograms. A pelagic trawling gear with a vertical opening of 8-10 m. equipped with a SIMRAD FR 500 net sonar with wire was used. Fishing speed ranged between 3 and 4 knots.

Biological samples to obtain weight/length relationship and age/length key from otoliths were made.

Abundance of sardine for each sector and strata was estimated. The biomass values were separated into length-classes according to the size distribution in the net samples. The length distributions were converted to age distributions using the age/length key.

RESULTS

The calibration constant was calculated from the weight/length relationship

$$W = 0.0074 L^{3.0179}$$

and from North Sea herring target strength recommended by the acoustic survey planning group (Anon,1983).

$$TS = 20 \log L - 71.2$$

The integration value of standard sphere at 20.6 m.depth was 346 mm. for a value of

$$SL + VR = 131.57 \text{ dB}$$

The conversion factor calculated was

$$C = 0.0476 L$$

Table 2 shows the results of the fishing stations. Table 3 shows the integrator values (M), the mean length values of sardine (L), the areas, the fishing stations to be representatives and the biomass estimated by geographical sector and depth strata.

Table 4 shows the length distributions of Sardine by fishing station.

Table 5 shows the sardine biomass estimation and the abundance in number by age-class for the whole surveyed area and for every geographic subarea.

Figure 2 shows the relative abundance distribution of sardine.

The total biomass estimated was 149000 tons. This abundance level is sustancially lower than those obtained in 1983 and 1984, with 643000 and 273000 tons. respectively.

Of the total biomass estimated during the cruise, 59% was found in north Galicia, 35% in western Cantabric, 6% in eastern Cantabric and less than 1% in south Galicia.

Figure 3 shows the demographic esturcture of the population in the different subareas in relation to the whole surveyed area.

DISCUSSION

The spacial distribution of sardine in this survey was similar to the situation found in the cruises carried out in previous years in August, with the highest biomass in North Galicia. However, a decrease of 45% compared with 1984 was estimated in the whole surveyed area. This decline was especially apparent in South Galicia, where the biomass decreased about 97% from 32800 to 1010 tons. In the Cantabrian Sea the biomass level decreased 29%, from 85500 to 60600 tons and 43% in North Galicia, from 154600 to 87500 tons.

A weak recruitment in 1985 was estimated if it is compared with the 1983 and a similar situation was found in 1984. This is reflected in the very scarce abundance of 1 group fish during this cruise and which could be due also to a stock differential distribution by age group (Porteiro et al,1986) Nevertheless, the VPA results (Anon,1986) shown a similar trend with low recruitment levels, both in 1984 and 1985.

The good recruitment of 1983 is shown by the abundance of 2-group fish in 1985. This group has constituted about 50% of the stock total catch in 1985 (Anon,1986)

REFERENCES

- AGLEN, A. (1983). Random errors of acoustic fish abundance estimates in relation to the survey grid density applied. Symposium on fisheries acoustic. Selected papers of the ICES/FAO Symposium on fisheries acoustics. Bergen, 21-24 June 1982.
FAO Fish. Rep. (300): p.293
- ANON. (1982). Report of Working Group for the Appraisal of Sardine Stocks in Divisions VIIIC and IXa.
ICES, C.M.1982/Assess:10
- ANON. (1983). Report of the Planning Group on ICES Coordinated. Herring and Sprat acoustic surveys.
ICES, C.M.1983/H:12
- ANON. (1986). Report of the Working Group on the Appraisal of Sardine Stocks in Divisions VIIIC and IXa.
ICES, C.M.1986/Assess:23.
- DIAS, C.A.; PASTOR, X.; PESTANA, G.; PORTEIRO, C.; SOARES, E. and F. ALVAREZ. (1983). Results of the Spanish-Portuguese joint acoustic survey for pilchard (Divisions VIIIC and IXa ICES), August-September 1982.
ICES, C.M.1983/H:42
- PASTOR, X.; PORTEIRO, C. and A. LAVIN (1985a). Acoustic abundance estimation of pilchard (Sardina pilchardus Walb) in Galician and Cantabric waters. August 1983.
ICES, C.M.1985/H:52
- PASTOR, X.; ALVAREZ, F. and A. ASTUDILLO. (1985b). Acoustic estimation of sardine (Sardina pilchardus Walb.) off Cantabric and Galician waters. August 1984.
ICES, C.M. 1985/H:73.

PASTOR, X.; PORTEIRO, C. and F. ALVAREZ (1986). Acoustic abundance estimation of sardine (Sardina pilchardus Walb). off Cantabric and Galician waters.

ICES, C.M.1986/H:20

PORTEIRO, C.; ALVAREZ, F. and J.A. PEREIRO (1986). Sardine (Sardina pilchardus Walb). stock differential distribution by age class in Divisions VIIIc and IXa.

ICES, C.M.1986/H:28

| | | | |
|-------------------------------|--------|--------|-------|
| Constant (TVG) (2TL40, 2TL20) | 99.1 | 64.6 | dB |
| Loss transmission at depth r | 52.57 | 26.28 | " |
| Attenuation TVG at depth r | 46.50 | 38.31 | " |
| Gain selected | -20 | -20 | " |
| Gain measured | -20 | -20 | " |
| Power output | High | High | |
| Signal duration | 1 | 1 | m sec |
| Bandwidth | 3.3 | 3.3 | KHz |
| Echo level | 0.26 | 0.64 | Vp-p |
| 20 log U/2V2 | -20.73 | -12.90 | dB |
| SL + VR | 131.61 | 131.57 | |

| | | |
|----------------------------|-------------------|---------------|
| Frequency 38 KHz | Echosounder | EK 400-38 |
| Water temperature 16°C | Transducer | 15x30 ceramic |
| Sound velocity (c) 1500m/s | Transmitter power | High |
| | TVG/Gain | 20 log R/O dB |
| | Pulse length | 1.0 ms |
| Sphere integration | Bandwidth | 3.3 KHz |
| Upper limit 18m. | Integrator | Digital QX+QD |
| Lower limit 22m. | Gain | 0dB x 100 |
| Threshold 10mV | Threshold | 10mV |
| M (mm) 346 | | |

Table 1.- Calibration results and settings of controls during survey.

| DATE | TIME | STATION | GEAR | DEPTH (m) | | POSITION (START) | | CATCH TOTAL | DOMINANT SPECIES | WEIGHT (Kg) | |
|-------|---------|---------|------|-----------|------|------------------|---------|-------------|--|--|--|
| | | | | BOTTOM | GEAR | LAT.N. | LONG.W | | | P/HOUR | % |
| 11/08 | 19h | 1 | PT | 50 | 32 | 43°20'06 | 2°00'90 | 277.35 | <u>Trachurus trachurus</u> <u>Scomber scombrus</u> <u>Engraulis encrasicolus</u> <u>Micromesistius poutassou</u> | 133.15 1.71 0.83 0.61 | 63.26 0.81 0.39 0.29 |
| 12/08 | 18h 47' | 2 | PT | 46 | 20 | 43°29'45 | 3°24'72 | 100.2 | <u>Trachurus trachurus</u> <u>Engraulis encrasicolus</u> <u>Sardina pilchardus</u> <u>Scomber Scombrus</u> Other species | 21.8 16.59 3.22 0.34 6.93 | 44.61 33.93 6.59 0.70 14.17 |
| 12/08 | 21h 16' | 3 | PT | 100 | 68 | 43°31'16 | 3°16'93 | 39.0 | <u>Scomber scombrus</u> <u>Engraulis encrasicolus</u> <u>Micromesistius poutassou</u> Other species | 30.46 4.62 0.17 0.69 | 84.77 12.84 0.46 1.92 |
| 13/08 | 20h 18' | 5 | PT | 52 | 4 | 45°26'0 | 4°41'0 | 325.55 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> Other species | 592.5 10.31 7.58 | 97.07 1.69 1.24 |
| 13/08 | 21h 99' | 6 | PT | 67 | 10 | 43°29'7 | 4°47'4 | 84.76 | <u>Trachurus trachurus</u> <u>Sardina pilchardus</u> <u>Engraulis encrasicolus</u> Other species | 60.97 8.71 1.07 11.30 | 74.33 10.62 1.27 13.78 |
| 14/08 | 19h 38' | 7 | PT | 54 | 20 | 43°35'0 | 6°20'0 | 70.66 | <u>Sardina pilchardus</u> Other species | 22.08 34.45 | 39.06 60.94 |
| 14/08 | 22h 51' | 8 | PT | 57 | 26 | 43°37'4 | 6°24'5 | 105.78 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> <u>Scomber scombrus</u> Other species | 98.00 9.33 0.19 33.52 | 69.48 6.62 0.15 23.75 |
| 15/08 | 00h 19' | 9 | PT | 104 | 36 | 43°40'0 | 6°32'2 | 5.33 | <u>Scomber scombrus</u> <u>Sardina pilchardus</u> <u>Engraulis encrasicolus</u> <u>Trachurus trachurus</u> Other species | 3.64 2.38 1.18 0.60 1.89 | 37.52 24.58 12.20 6.15 19.51 |
| 15/08 | 21h 48' | 10 | PT | 38 | 6 | 43°43'5 | 7°35'6 | 54.83 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> Other species | 40.54 1.23 0.41 | 96.12 2.97 0.91 |
| 15/08 | 23h 30' | 11 | PT | 88 | 10 | 43°46'2 | 7°37'0 | 176.5 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> <u>Scomber scombrus</u> Other species | 506.67 78.33 1.00 2.43 | 86.10 13.33 0.17 0.41 |
| 17/08 | 20h 35' | 12 | PT | 29 | 8 | 43°24'8 | 8°17'6 | 49.42 | <u>Trachurus trachurus</u> <u>Sardina pilchardus</u> <u>Engraulis encrasicolus</u> <u>Scomber scombrus</u> Other species | 19.86 19.05 0.65 0.11 0.32 | 49.68 47.6 1.6 0.26 0.79 |
| 17/08 | 22h 24' | 13 | PT | 55 | 20 | 43°26'5 | 8°22'7 | 42.79 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> <u>Engraulis encrasicolus</u> Other species | 11.69 0.17 0.08 0.11 | 96.99 1.40 0.7 0.31 |

Table 2.- Results of the pelagic fishing stations.

| DATE | TIME | STATION | GEAR | DEPTH (m) | | POSITION(START) | | | CATCH TOTAL | DOMINANT SPECIES | WEIGHT (Kg) | |
|-------|---------|---------|------|-----------|------|-----------------|----------|--------|--|---------------------------------------|---------------------------------------|--|
| | | | | BOTTOM | GEAR | LAT.N. | LONG.W. | P/HOUR | | | % | |
| 18/08 | 23h 56' | 14 | PT | 63 | 10 | 43°23' | 8°28'9" | 12.46 | <u>Sardina pilchardus</u> Other species | 11.0 1.46 | 88.28 11.72 | |
| 20/08 | 21h 39' | 15 | PT | 118 | 80 | 42°19'8" | 9°4'7" | 4.6 | Other species | 7.2 | 100. | |
| 21/08 | 21h 50' | 16 | PT | 43 | 20 | 42°1'0" | 8°54'6" | 77.7 | <u>Trachurus trachurus</u> Other species | 1.33 57.68 | 2.25 97.75 | |
| 22/08 | 12h 18' | 17 | PT | 245 | 8 | 42°19'59" | 9°17'82" | 8.1 | <u>Micromesistius poutassou</u> Other species | 6.72 0.54 | 92.59 3.00 | |
| 23/08 | 19h 25' | 18 | PT | 28 | 4 | 42°15'5" | 8°42'6" | 25.22 | <u>Trachurus trachurus</u> <u>Sardina pilchardus</u> <u>Scomber scombrus</u> | 4.03 3.08 2.31 | 35.69 7.36 20.42 | |
| 23/08 | 22h 36' | 19 | PT | 43 | 20 | 42°22'0" | 8°50'9" | 1.89 | <u>Sardina pilchardus</u> <u>Trachurus trachurus</u> Other species | 0.54 0.30 0.73 | 34.48 19.10 46.42 | |
| 24/08 | 8h 30' | 20 | PT | 261 | 8 | 42°21'0" | 9°21'5" | 16.00 | <u>Micromesistius poutassou</u> Other species | 6.09 0.87 | 87.50 12.50 | |
| 24/08 | 12h 20' | 21 | PT | 588 | 500 | 42°32'4" | 9°30'2" | 3.00 | Other species | 1.15 | 1.00 | |
| 24/08 | 15h 15' | 22 | PT | 162 | 4 | 42°39'31" | 9°27'01" | 5.85 | <u>Micromesistius poutassou</u> Other species | 2.08 0.13 | 94.02 5.98 | |
| 24/08 | 19h 53' | 23 | PT | 27 | 8 | 42°46'17" | 8°58'05" | 36.7 | <u>Sardina pilchardus</u> <u>Scomber scombrus</u> <u>Trachurus trachurus</u> <u>Engraulis encrasicolus</u> Other species | 17.53 0.38 0.15 0.06 1.64 | 88.75 1.90 0.76 0.28 8.31 | |
| 24/08 | 23h 50' | 24 | PT | 48 | 22 | 42°54'3" | 9°13'5" | 3.55 | <u>Sardina pilchardus</u> <u>Micromesistius poutassou</u> Other species | 1.68 0.12 0.49 | 73.24 5.39 21.41 | |
| 25/08 | 9h 50' | 25 | PT | 98 | 4 | 42°52'6" | 9°34'0" | 399.6 | <u>Micromesistius poutassou</u> Other species | 232.43 0.38 | 99.84 0.16 | |
| 25/08 | 22h 22' | 26 | PT | 45 | 8 | 42°59'4" | 9°18'2" | 14.2 | <u>Sardina pilchardus</u> Other species | 28.00 0.40 | 98.59 1.41 | |
| 26/08 | 20h 30' | 27 | PT | 54 | 8 | 43°36'8" | 8°15'4" | 3.21 | <u>Sardina pilchardus</u> <u>Scomber scombrus</u> | 8.09 0.21 | 97.48 2.52 | |

Table 2.- Results of the pelagic fishing stations.

| | (DEPTH - m) | (n.m. ²) | | (cm) | STAT. n° | BIOBIASS (Tons) |
|-------|-------------|-----------------------|-----|--------|-------------|-----------------|
| 20 | 1 | 20.55 | - | - | - | - |
| | 2 | 54.35 | - | - | - | - |
| | 3 | 279.79 | - | - | - | - |
| 21 | 1 | 20.90 | 7 | 12.52 | 18,19,23 | 105.2 |
| | 2 | 76.30 | 1 | 18.71 | 24,24 | 81.7 |
| | 3 | 208.71 | - | - | - | - |
| 22 | 1 | 28.91 | 15 | 12.52 | 18,19,23 | 312.0 |
| | 2 | 95.47 | 5 | 18.71 | 24,22 | 511.1 |
| | 3 | 191.28 | - | - | - | - |
| 23 | 1 | 28.91 | 173 | 19.04 | 24,26 | 5 448.5 |
| | 2 | 49.47 | 59 | 20.19 | 13,14,24,26 | 3 372.0 |
| | 3 | 155.05 | 1 | " | " | 179.1 |
| 24 | 1 | 29.96 | 175 | 19.04 | 24,26 | 5 711.7 |
| | 2 | 74.21 | 9 | 20.19 | 13,14,24,26 | 771.6 |
| | 3 | 192.33 | - | - | - | - |
| 25 | 1 | 59.93 | 85 | 14.47 | 12 | 4 219.3 |
| | 2 | 105.57 | 77 | 20.19 | 13,14,24,26 | 9 409.2 |
| | 3 | 317.07 | 6 | " | " | 2 197.9 |
| 26 | 1 | 17.42 | 424 | 19.95 | 10,11 | 8 431.4 |
| | 2 | 79.79 | 93 | 20.17 | 27 | 8 585.6 |
| | 3 | 275.95 | 2 | " | " | 637.0 |
| 27 | 1 | 58.53 | 230 | 19.95 | 10,11 | 15 367.2 |
| | 2 | 57.49 | 247 | 20.17 | 27, | 16 388.6 |
| | 3 | 363.41 | - | - | - | - |
| 28 | 1 | 33.10 | 145 | 19.95 | 10,11 | 5 478.8 |
| | 2 | 55.05 | 3 | 20.17 | 27 | 190.6 |
| | 3 | 429.61 | 2 | " | " | 991.6 |
| 29 | 1 | 24.04 | 47 | 20.60 | 5,6,7,8 | 1 334.4 |
| | 2 | 64.80 | 26 | " | " | 1 989.8 |
| | 3 | 363.06 | 1 | " | " | 428.8 |
| 30 | 1 | 18.81 | 81 | 20.60 | 5,6,7,8 | 1 799.5 |
| | 2 | 94.77 | 102 | " | " | 11 416.7 |
| | 3 | 134.49 | 1 | " | " | 158.8 |
| 31 | 1 | 35.88 | 111 | 20.60 | 5,6,7,8 | 4 703.7 |
| | 2 | 29.09 | 5 | " | " | 171.8 |
| | 3 | 160.27 | - | - | - | - |
| 32 | 1 | 22.99 | 14 | 20.60 | 5,6,7,8 | 380.1 |
| | 2 | 79.44 | - | - | - | - |
| | 3 | 267.59 | 1 | 20.60 | 5,6,7,8 | 316.0 |
| 33 | 1 | 24.04 | 161 | 20.60 | 5,6,7,8 | 4 571.2 |
| | 2 | 66.05 | 83 | " | " | 6 523.7 |
| | 3 | 206.96 | - | - | - | - |
| 34 | 1 | 26.69 | 338 | 20.60 | 5,6,7,8 | 10.654.5 |
| | 2 | 43.55 | 144 | " | " | 7 406.6 |
| | 3 | 157.49 | - | - | - | - |
| 35 | 1 | 29.61 | - | - | - | - |
| | 2 | 50.52 | - | - | - | - |
| | 3 | 98.96 | - | - | - | - |
| 36 | 1 | 68.69 | 88 | 20.70 | 1,2,3 | 7 191.3 |
| | 2 | 65.50 | 15 | " | " | 1 164.0 |
| | 3 | 58.18 | - | - | - | - |
| 37 | 1 | 31.35 | 1 | 20.70 | 1,2,3 | 37.1 |
| | 2 | 116.72 | 2 | " | " | 276.6 |
| | 3 | 72.12 | - | - | - | - |
| 38 | 1 | 26.82 | - | - | - | - |
| | 2 | 65.50 | - | - | - | - |
| | 3 | 81.18 | - | - | - | - |
| 39 | 1 | 14.28 | 4 | 20.70 | 1,2,3 | 67.7 |
| | 2 | 131.01 | - | - | - | - |
| | 3 | 135.54 | - | - | - | - |
| 40 | 1 | 36.58 | - | - | - | - |
| | 2 | 102.09 | - | - | - | - |
| | 3 | 160.97 | - | - | - | - |
| TOTAL | | | | | | 148.928.4 |

Table 3. Integrator values (M); mean length values of sardine (L) geographical sectors and fishing stations to be representatives. Stratum 1=0-50m, 2= 50-100m and 3=100-200m.

| 1 (cm) | 2 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 18 | 19 | 23 | 24 | 26 | 27 |
|----------|----|------|----|-----|-----|---|-----|-----|-----|-----|----|-----|----|----|----|-----|----|
| 5 | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | 8 | 1 | 2 | | | |
| 8 | | | | | | | | | | | | 101 | 7 | 92 | | | |
| 9 | | | | | | | | | | | | 156 | 3 | 90 | | | |
| 10 | | | | | | | | | | | | 210 | | 40 | | | |
| 11 | | | | | | | | | 14 | | | 59 | | 4 | | | |
| 12 | | | | | | | | | 311 | | | | | | | | |
| 13 | | | | | | | | | 226 | | | 4 | | | | | |
| 14 | | | | | | | | | 23 | | | 1 | | 1 | | | |
| 15 | | | | | | | | | | | | 1 | | | | | |
| 16 | | | | | | | | | | | | 1 | | | | | |
| 17 | | | | | | | | | 2 | | | 13 | | 1 | 7 | | |
| 18 | | | | 4 | | | 53 | 95 | 5 | 5 | 1 | 25 | | 43 | 13 | 31 | 1 |
| 19 | 9 | 712 | 5 | 20 | 31 | 2 | 191 | 912 | 12 | 5 | 11 | 7 | | 82 | 12 | 149 | 13 |
| 20 | 37 | 1581 | 33 | 64 | 281 | 2 | 270 | 570 | 14 | 15 | 26 | 1 | | 45 | 4 | 31 | 13 |
| 21 | 33 | 1659 | 55 | 142 | 325 | 8 | 172 | 418 | 25 | 105 | 47 | | | 30 | 4 | 6 | 9 |
| 22 | 13 | 514 | 29 | 110 | 337 | 4 | 33 | 209 | 56 | 165 | 29 | | | 13 | 1 | | 5 |
| 23 | 1 | 119 | 3 | 28 | 18 | | 14 | 19 | 38 | 180 | 13 | | | 9 | | | 1 |
| 24 | 3 | | 1 | | 12 | | | 21 | 9 | 45 | 4 | | | 2 | | | |
| 25 | | 40 | | | | | | | 2 | 5 | | | | | | | |
| 26 | | | | 4 | | | | | | | | | | | | | |

Table 4.- Length distribution of sardines in each sample.

| AGE | EAST CANTABRIC | WEST CANTABRIC | NORTH GALICIA | SOUTH GALICIA | TOTAL |
|-------------------|----------------|----------------|---------------|---------------|-----------|
| 0 | | | 103 060 | 9 171 | 112 231 |
| 1 | | 23 | 7 725 | 580 | 8 328 |
| 2 | 37 196 | 225 460 | 622 910 | 9 494 | 895 060 |
| 3 | 24 401 | 143 850 | 173 600 | 1 331 | 343 182 |
| 4 | 22 466 | 129 440 | 151 950 | 1 085 | 304 941 |
| 5 | 24 072 | 143 670 | 140 620 | 831 | 309 193 |
| 6 | 11 284 | 65 794 | 64 026 | 365 | 141 469 |
| 7 | 4 362 | 23 265 | 29 160 | 131 | 56 918 |
| 8 | 2 472 | 7 442 | 13 374 | 53 | 23 341 |
| 9 | 1 341 | 7 372 | 10 711 | 43 | 19 467 |
| 10 | 328 | 3 540 | 2 431 | 9 | 6 308 |
| TOTAL | 127 922 | 749 856 | 1 319 567 | 23 093 | 2 220 438 |
| BIOMASS (tons) | 8 737 | 51 856 | 87 485 | 1 010 | 149 090 |

Table 5.- Abundance in number by age-class ($\times 10^{-3}$) for the whole surveyed area and for every geographic subarea, and biomass in tons.

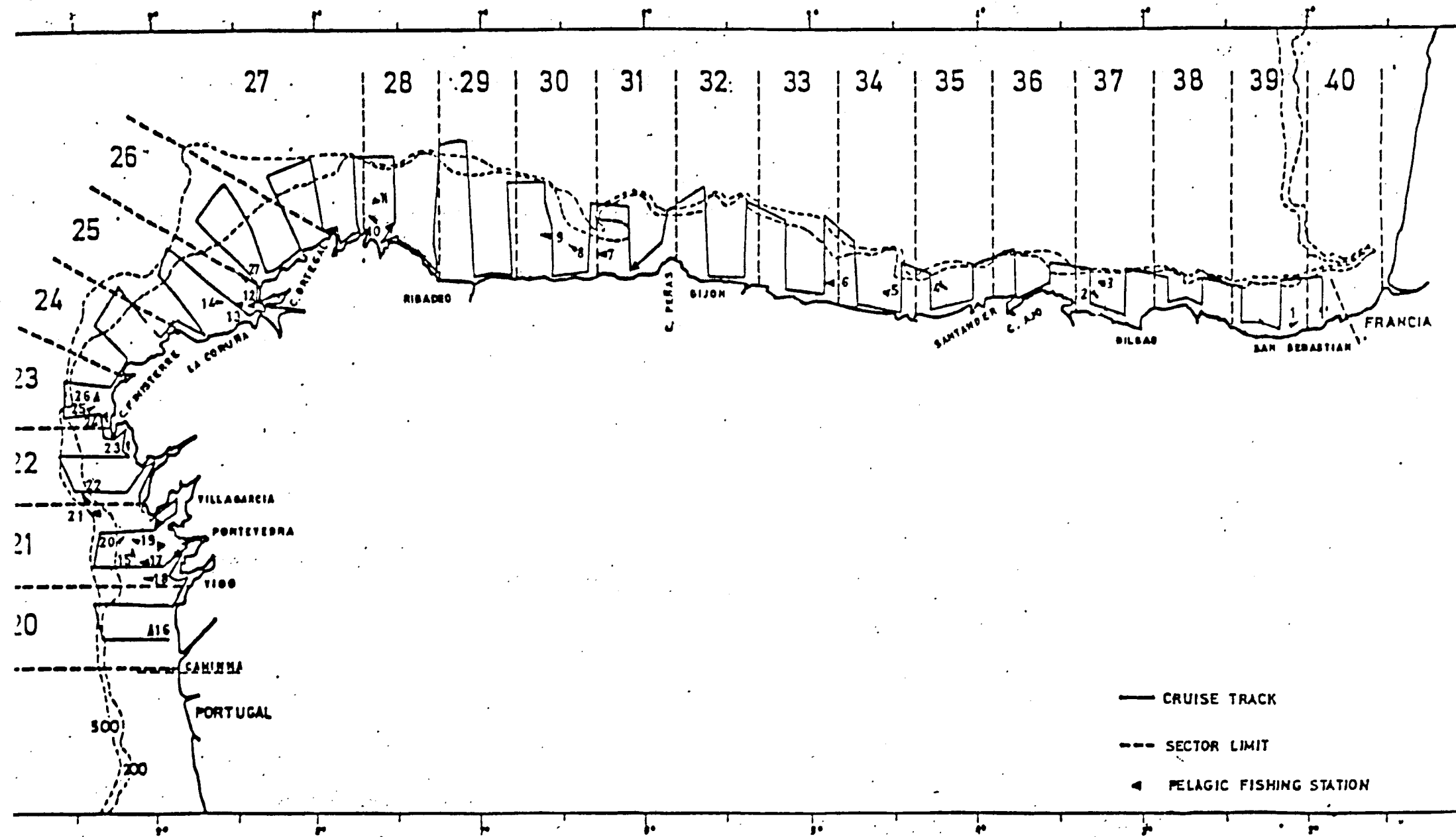


Figure 1.-Area surveyed showing cruise track, geographical sectors, 200 and 500 m. contour and pelagic fishing stations.

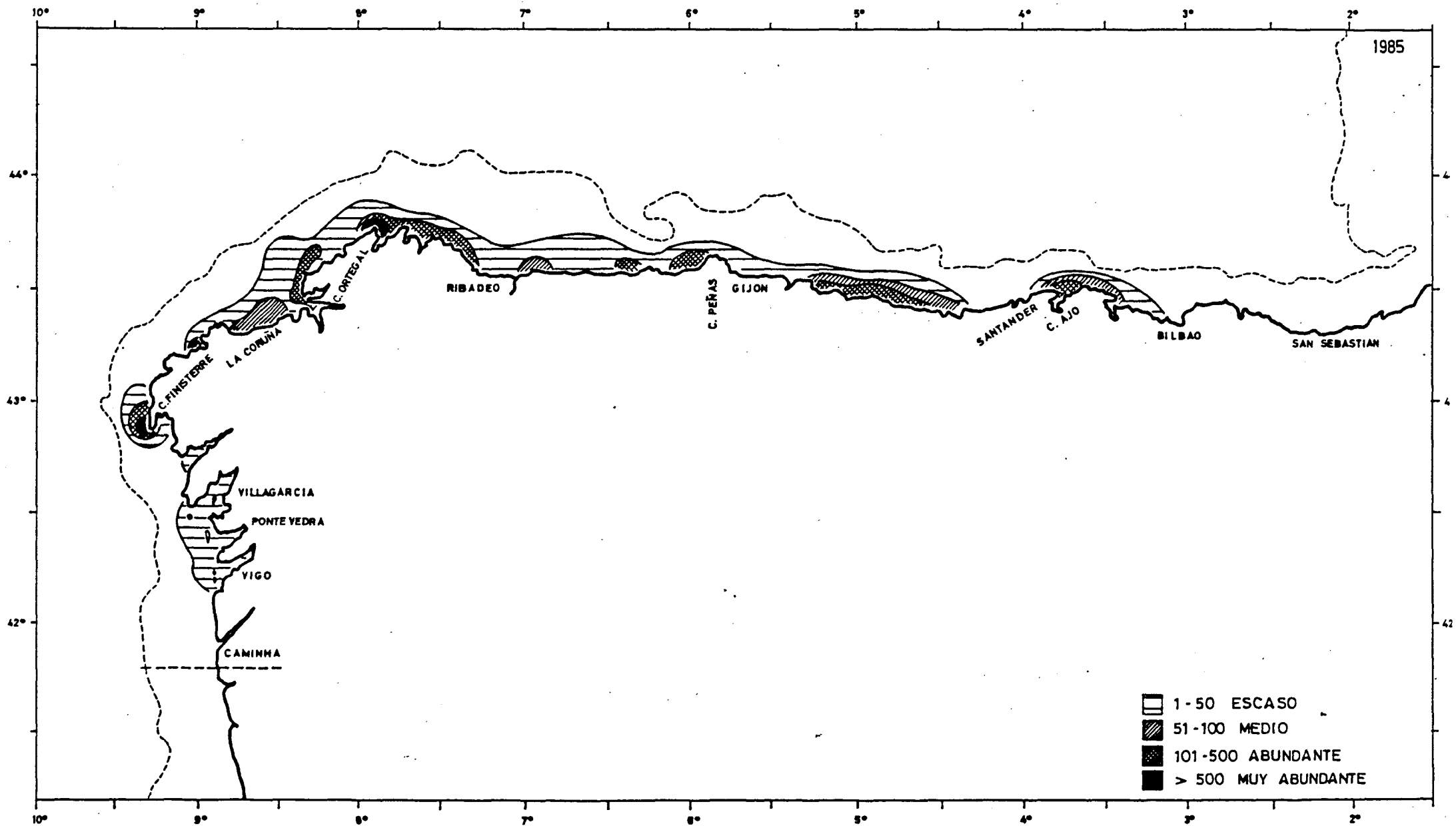


Figure 2.- Relative abundance distribution of sardine.

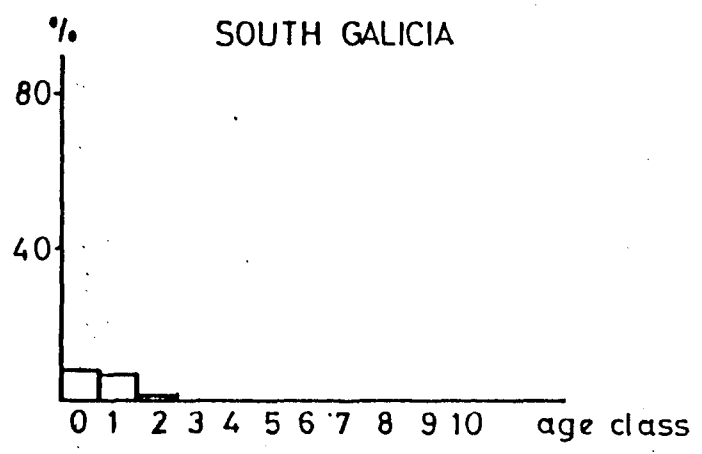
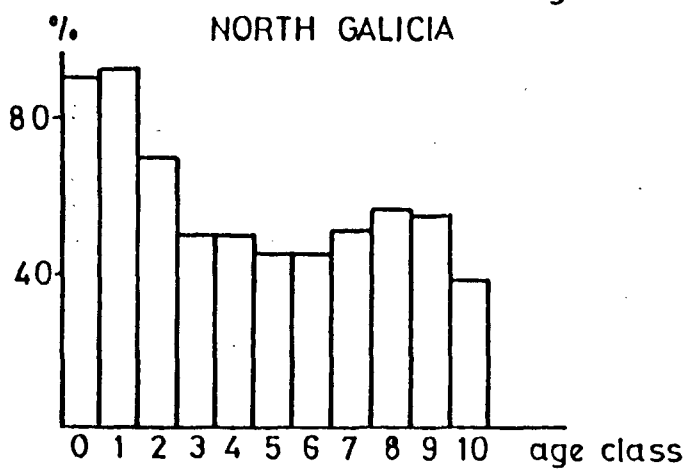
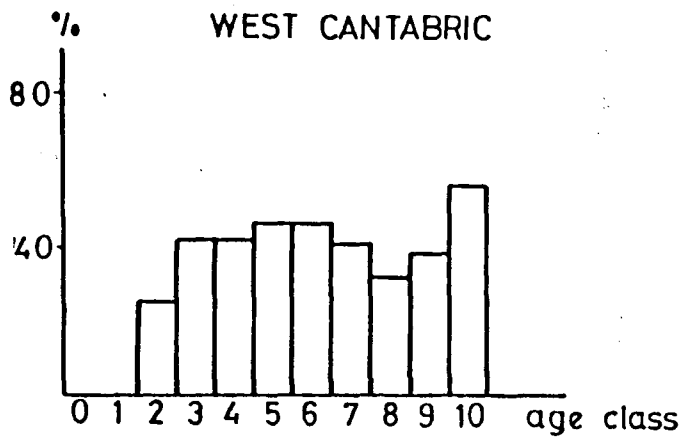
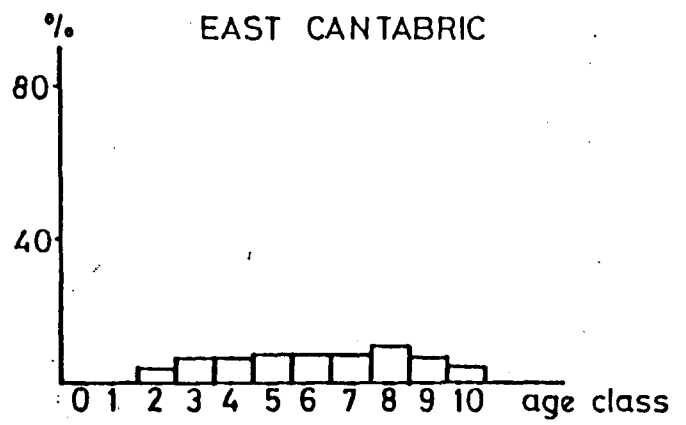


Figure 3.- Demographic structure of the population in the different subareas, in relation to the whole surveyed area.