International Council for the
Exploration of the Sea

C.M. 1986/H:20
Pelagic Fish Committee

Acoustic abundance estimation of sardine (Sardina pilchardus Walb). off Cantabric and Galician waters. March 1986

by

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SUMMARY

Results of the acoustic survey "Saracus 86-1" are reported in this paper. This cruise was carried out in March off the Cantabric and Galician coast (North of Spain), to evaluate the sardine biomass present in that area.

This period is included in the spawning season. Abundance by age group was estimated. The total biomass estimation was 155.000 tons.

RESUME

On present ici les resultats de la campagne acoustic sur la sardine au large des côtes Cantabrique et Galicienne dans Mars 1986. Cette periode est dans l'époque de la ponte. On a obtenu estimations de la biomasse total et par class d'âge. La biomasse total estimé a été 155.000 tonnes.

INTRODUCTION

Part of the Sardine stock of ICES divisions VIIIc and IXa is found in Cantabric and Galician waters. This stock is evaluated by a WG since 1979 (Anon, 1986b) which has recommended the use of acoustics for the estimation of age class abundance and distribution.

Annual acoustic surveys were carried out from 1982 with these aims (Dias et al.1983; Pastor et al. 1985 a,b,1986). The cruise dates were determined by the timing of recruitment to the fishery, at the beginning of the second semester. (Anon,1982)

The acomplishment of two surveys during two seasons in the year was considered to be the most convenient since 1986. The objective of the first would be the evaluation of the spawning stock during the spawning season, the second to estimate the recruitment.

In this report we present the results of the first survey, carried out in March 1986.

METHODS

The survey "Saracus-86-1" (5-21 March) was carried out following the standard methodology of previous surveys refered to instruments setting, surveys grid, sectors and strata (Pastor et al, 1985a, 1985b, 1986).

A total of 2.080 n.m. were surveyed, 23 pelagic trawl stations occupied and 8661 square n.m have been evaluated. The coverage index was 22.4 (Aglen, 1983). Figure 1 shows the surveyed area, cruise track, geographic sectors, the 200 and 500 m. isobaths and the pelagic 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. diameter.

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. equiped with a SIMRAD FR 500 net sonder with wire was used. Fishing speed ranged between 3 and 4 knots.

Biological samples to obtain weight/length relationships 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

$$W = 0.0039\ L^{3.1952}$$

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 15m. depth was 509 mm. for a value of

$$SL + VR = 130.8\ d\ B$$

The conversion factor calculated was

$$C = 0.0536\ L$$

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 representa-

tive and the biomass estimates 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 155.000 tons. That level of abundance is very similar to the estimation made half a year before (Pastor et al, 1986), but sustancially lower than those obtained in 1983 and 1984.

Of the total biomass estimated during the cruise, 59% was found in Western Cantabric, 24% in North Galicia, 11% in Eastern Cantabric and 6% in South Galicia. Most of the total biomass of sardine was found in waters shallover than 130m.

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

DISCUSSION

The spacial distribution of sardine in this survey was different from the situation found in the cruises carried out in previous years in August. While in those years the highest concentrations of biomass were in North Galicia, in March 1986 they were found in Western Cantabric. Biomass for the whole Cantabrian Sea was estimated in 109.000 tons, and 37.000 tons for Galicia North.

The abundance estimation for Cantabrian Sea was 48.000 tons higher than in August 1985, while North Galicia showed a reduction

of 50.000 tons in its biomass estimation with respect to the previous year.

The highest proportions of the spawning stock and older age classes (III+) are also concentrated in West Cantabrian (figures 3 and 4). The presence of individuals of longer size in the fishing stations shows a gradual increase of length towards the east part of the Cantabrian Sea.

Age-classes I and II were very poorly represented in the surveyed area, while age-class III was clearly the most dominant.

The low abundance levels of age-classes I and II can be a consequence of the week year-classes strength detected in 1984 and 1985 (Pastor et al,1985,a,b,1986; Anon,1986,a,b,) but also it could be due to a possible migration of the younger year-classes as suggested by Pereiro (com.pers.) out of surveyed area.

The high abundance of age-class III, confirms the good level of the 1983 year-class strength, that was also detected in the surveys carried out in August 1983,1984 and 1985, and by the ICES Sardine Working Group (Anon 1984,1985,1986).

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Constant (TVG) (2TL40, 2TL20)	99.6	64.6	dB
Loss transmission at depth r	46.69	23.52	"
Gain selected	-20	-20	"
Gain measured	-20	-20	"
Power out put	High	High	
Signal duration	1	1	m sec
Bandwidth	3.3	3.3	KHz
Echo level	0.24	0.8	Vp-p
20 log U/2V2	-21.42	-10.96	dB
SL + VR	131.70	130.76	

Frequency 38 KHz		Echosounder	EK 400-38
Water temperature 14ºC		Transducer	15x30 ceramic
Sound veolcity (c)1500m/s		Transmitter power	High
		TVG/Gain	20 log R/0 dB
		Pulse length	1.0 ms
Sphre integration		Bandwidth	3.3 KHz
Upper limit	13m.	Integrator	Digital QX + QD
Lower limit	16m.	Gain	0dB x 100
Threshold	10mV	Threshold	10mV
M (mm)	509		

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

DATE	TIME	STATION Nº	GEAR	DEPTH (m)		POSITION (START)		CATCH TOTAL	DOMINANT SPECIES	WEIGHT (Kg)	
				BOTTOM	GEAR	LAT.N	LONG.W			P/HOUR	%
06/03	21h	1	PT	49		43º20'85	2º22'05	1.74	Sardina pilchardus	7.6	65.52
									Other species	4.0	34.48
06/03	22h40'	2	PT	54	30	43º19'92	2º14'50	1.64	Sardina pilchardus	0.4	85.07
									Engraulis encrasicolus	0.07	14.93
06/03	23h57'	3	PT	67	6	43º20'96	2º21'21	8.34	Sardina pilchardus	12.63	94.9
									Trachurus trachurus	0.83	0.11
									Scomber scombrus	0.06	0.47
									Other species	0.51	3.80
07/03	19h38'	4	PT	56	6	43º27'54	3º20'41	7.24	Sardina pilchardus	2.84	94.89
									trachurus trachurus	0.10	3.31
									Other species	0.05	1.8
07/03	21h19'	5	PT	43	4	43º26'21	3º19'41	88.29	Sardina pilchardus	32.92	[illegible].71
									Engraulis encrasicolus	0.33	0.96
									Scomber scombrus	0.14	0.40
									Trachurus trachurus	0.04	0.11
08/03	13h55'	6	PT	45	6	43º27'69	4º46'83	319.81	Sardina pilchardus	474.9	99
									Trachurus trachurus	4.13	0.86
08/03	16h02'	7	PT	102	6	43º27'64	4º41'45	170.50	Trachurus trachurus	213.13	100
08/03	22h15'	8	PT	138	6	43º34'86	4º49'91	-	-	-	-
09/03	0h34'	9	PT	54	16	43º29'76	4º55'40	380.96	sardina pilchardus	807.27	77.7
									Scomber scombrus	4.80	0.46
									Trachurus trachurus	0.55	0.05
									Mugil spp.	226.36	21.79
09/03	20h41'	10	PT	63	12	43º36'66	6º04'69	8.00	Sardina pilchardus	1.54	22.3
									Engraulis encrasicolus	0.91	13.15
									Scomber scombrus	0.53	[illegible].71
									Trachurus trachurus	0.44	6.35
									Other species	3.48	50.50
10/03	15h40'	11	PT	59	6	43º36'52	7º14'64	40.30	Sardina pilchardus	28.40	95.18
									Scomber scombrus	1.01	3.38
									Other species	0.43	1.44
10/03	19h30'	12	PT	83	53	43º36'13	6º45'00	68.9	Sardina pilchardus	55.89	89.32
									Scomber scombrus	0.11	.17
									Other species	6.58	10.51
10/03	21h28'	13	PT	101	6	43º39'8	16º40'8	5.7	Sardina pilchardus	3.28	71.43
									Scomber scombrus	0.05	1.06
									Engraulis encrasicolus	0.01	0.18
									Other species	1.26	27.34

Table 2.- Results of the pelagic fishing stations.

DATE	TIME	STATION Nº	GEAR	DEPTH (m)		POSITION (START)		CATCH TOTAL	DOMINANT SPECIES	WEIGHT (kg)	
				BOTTOM	GEAR	LAT.N	LONG.W			P/HOUR	%
11/03	00h18'	14	PT	254	2	43º54'85	6º33'46	96.6	Micromesistius poutassou	94.92	99.87
									Scomber scombrus	0.6	0.6
									Other species	0.7	0.7
11/03	13h16'	15	PT	33	6	43º43'12	7º35'63	19.58	Sardina pilchardus	16.03	95.75
									Engraulis encrasicolis	0.6	3.58
									Trachurus trachurus	0.1	0.05
14/03	14h57'	16	PT	153	10	43º28'29	8º50'84	1.7	Scomber scombrus	0.68	35.29
									Other species	1.13	62.43
14/03	20h50'	17	PT	77	34	43º24'55	8º26'37	138.52	Sardina pilchardus	110.63	97.17
									Scomber scombrus	2.67	2.35
14/03	22h38'	18	PT	60	16	43º25'8	8º22'3	63.18	Sardina pilchardus	47.5	90.22
									Engraulis encrasicolus	1.62	3.07
									Scomber scombrus	0.21	0.40
15/03	19h52'	19	PT	59	30	43º13'83	9º03'06	19.46	Sardina pilchardus	9.05	48.82
									Engraulis encrasicolus	8.71	47.02
									Scomber scombrus	0.27	1.44
									Other species	0.50	2.72
16/03	16h34'	20	PT	54	4	42º32'31	8º55'49	18.66	Sardina pilchardus	13.8	92.44
									Engraulis encrasicolus	0.57	3.80
									Other species		3.75
16/03	20h17'	21	PT	40	6	42º44'8	9º02'0	91.61	Sardina pilchardus	107.69	76.41
									Engraulis encrasicolus	30.77	21.83
									Scomber scombrus	0.43	0.31
18/03	21h53'	22	PT	44	6	42º21'57	8º51'16	26.9	Sardina pilchardus	16.30	81.63
									Engraulis encrasicolus	2.07	10.39
20/03	14h50'	23	PT	41	8	42º09'78	8º55'05	64.4	Sardina pilchardus	142.32	92.08
									Scomber scombrus	11.04	7.14
									Engraulis encrasicolus	0.48	0.31
20/03	22h21'	24	PT	43	6	42º22'15	8º53'08	35.8	Sardina pilchardus	29.7	83.0
									Engraulis encrasicolus	5.1	14.3
									Scomber scombrus	0.1	0.2
									Other species	0.9	2.5
21/03	13h35'	25	PT	39	4	42º22'08	8º54'41	81.7	Sardina pilchardus	80.0	97.9
									Engraulis encrasicolus	0.77	0.9
									Trachurus trachurus	0.11	0.2

Table 2.- Results of the pelagic fishing stations.

SECTOR	STRATUM (DEPTH-m)	AREA ($n.m.^2$)	$\bar{M}$	$\bar{L}$ (cm)	FISHING STA. No.	BIOMASS (Tons)
20	1	20.55	27	18.06	23	556.5
	2	54.35	9	"	"	490.6
	3	279.79	-	"	"	-
21	1	20.90	95	19.53	20,22	2 153.8
	2	76.30	31	"	"	2 565.8
	3	208.71	-	"	"	-
22	1	28.91	89	19.41	20,21	2 772.8
	2	95.47	2	"	"	205.8
	3	191.28	-	"	"	-
23	1	28.99	15	19.73	19	475.0
	2	49.47	3	"	"	162.6
	3	155.05	-	"	"	-
24	1	29.6	16	19.73	19	525.1
	2	74.21	11	"	"	894.2
	3	192.33	8	"	"	1 685.4
25	1	59.93	16	20,28	17,18	1 079.6
	2	105.57	34	"	"	4 041.4
	3	317.07	-	"	"	-
26	1	17.42	156	20,28	17,18	3 059.8
	2	79.79	59	"	"	5 313.8
	3	275.95	-	"		-
27	1	58.53	13	20,82	15	879.7
	2	57.49	77	"	"	5 117.9
	3	363.41	1	"	"	420.1
28	1	33.1	199	21.2	11	7 752.8
	2	55.05	90	"	"	5 831.5
	3	429.69	-	"	"	-
29	1	24.04	143	20.86	12,13	3 981.3
	2	64.80	506	"	"	37 973.3
	3	363.06	15	"		6 307.0
30	1	18.81	98	20.79	10,12,13	2 127.9
	2	94.77	30	"	"	3 281.9
	3	134.49	32	"		4 968.0
31	1	35.88	1	18.94	10	37.7
	2	29.09	8	"	"	244.8
	3	160.27	1	"	"	168.6
32	1	22.99	33	21.32	6,9	898.2
	2	79.44	131	"	"	12 320.0
	3	267.59	-	"	"	-
33	1	24.04	403	21.32	6,9	11 469.4
	2	66.55	5	"	"	393.9
	3	206.96	-	"	"	-
34	1	26.69	30	21.32	6.9	947.9
	2	43.55	15	"	"	773.4
	3	157.49	-	"	"	-
35	1	29.61	94	20.45	4,5	3 159.9
	2	50.52	50	"	"	2 867.8
	3	98.96	-	"	"	-
36	1	68.98	25	20.45	4,5	1 986.2
	2	65.5	8	"	"	594.9
	3	58.18	-	"	"	-
37	1	31.35	36	20.45	4.5	1 281.3
	2	116.72	9	"	"	1 192.6
	3	72.12	-	-	-	-
38	1	26.82	2	20.8	2,3	62.0
	2	65.50	54	"	"	4 085.8
	3	81.18	-	-	-	-
39	1	14.28	23	20.8	2,3	379.4
	2	131.01	29	"	"	4 388.8
	3	135.54	-	-	-	-
40	1	36.58	5	20.8	2,3	211.3
	2	102.09	1	"	"	117.9
	3	160.97	14	"	"	2 603.2

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

(1cm)	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-9	P-10	P-11	P-12	P-13	P-15	P-17	P-18	P-19	P-20	P-21	P-22	P-23	P-24	P-25
5																						
6																						
7																						
8																						
9																						
10																						
11									2													
12			1				17		-													
13			-		8		17		2										1			
14			1	2	25		-		3									1				
15			1	8	42		-		6				2					1	-	55	3	
16			2	3	34	19	68		6				8				1	-	-	77	6	3
17			-	5	17	-	51		1				-			7	15	12	3	286	24	9
18			-	-	-	-	392		-	1		1	-	94	11	17	79	38	11	571	136	55
19			6	13	110	168	1142	149	1	5	95	3	19	565	108	32	66	48	69	308	252	60
20	1	1	36	16	312	968	1192	938	8	29	279	11	77	780	365	57	62	42	52	99	140	23
21	5	2	40	37	431	1173	273	1384	3	59	354	22	101	646	223	28	36	29	30	33	24	8
22	8	3	28	17	212	819	17	1186	11	47	238	11	53	148	154	9	26	8	6	22	12	-
23	-	-	8	13	101	503	17	272	5	11	34	8	25	27	40		8	3	2		3	2
24	1	1	4	2	34	173		148	1	1		-	4	27	6		1					
25					8	93		50	2			1										
26						56																

Table 4.- Length distribution of sardine by pelagic fishing stations

AGE	EAST CANTABRIC	WEST CANTABRIC	NORTH GALICIA	SOUTH GAL.	TOTAL
1	14 982	14.667	4 798	5 848	40 295
2	1 515	7 812	6 566	5 264	21 157
3	112 580	591 040	247 040	69 022	1 019 682
4	23 764	123 240	33 547	3 337	183 888
5	49 159	247 510	63 057	5 929	365 655
6	32 784	173 500	45 454	4 136	255 874
7	20 990	109 160	24 875	2 157	157 182
8	5 259	26 547	5 437	473	37 716
9	6 004	25 929	5 728	457	38 118
10	1 192	5 901	971	76	8 140
TOTAL	268 229	1 325 306	473 473	96 699	2 127 707
BIOMASS (tons)	16 984	91 920	37 238	8 800	154 942

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

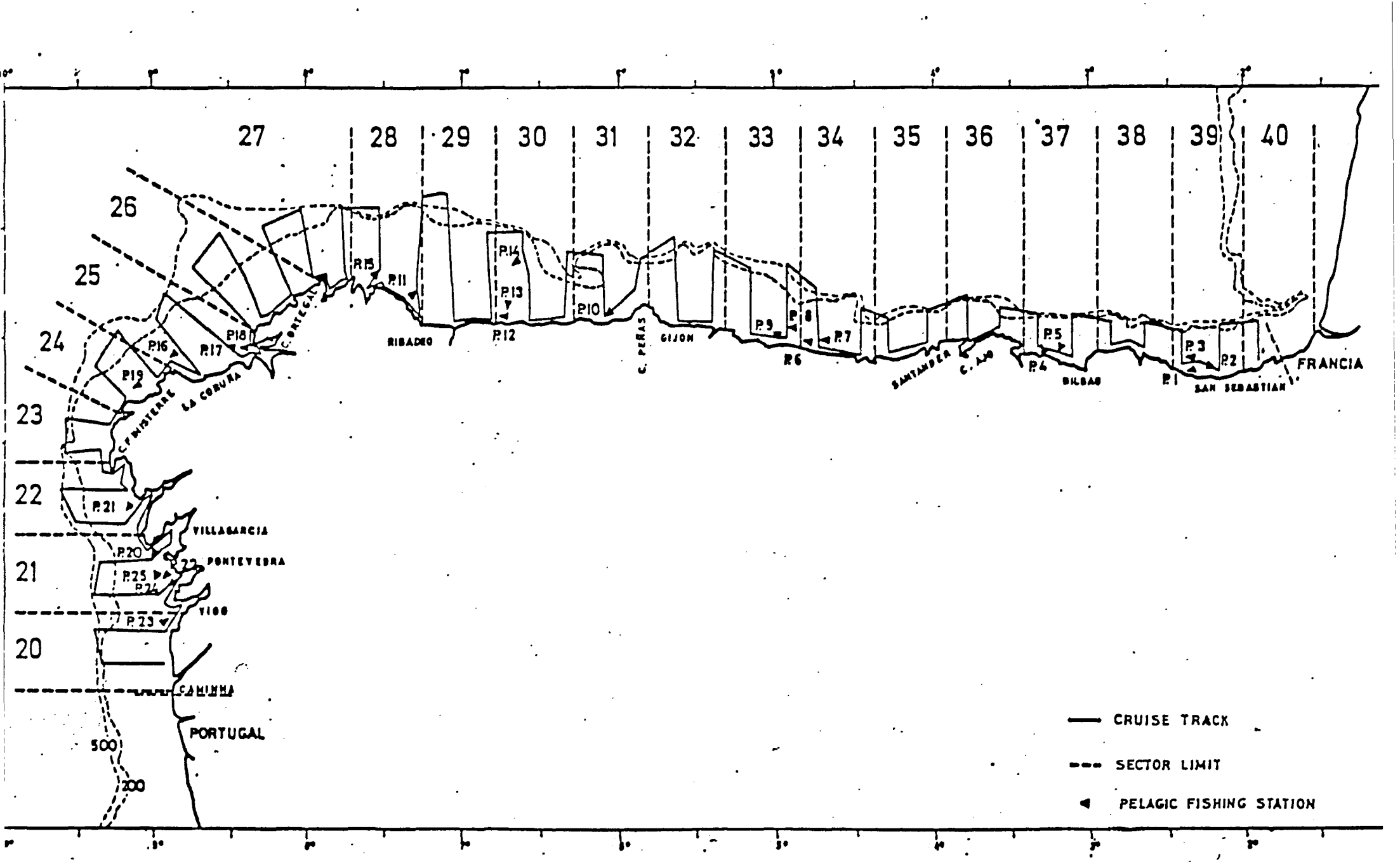

Figure 1.Area surveyed showing cruise track, geographical sectors, 200 and 500 m contour, and pelagic fishing stations.

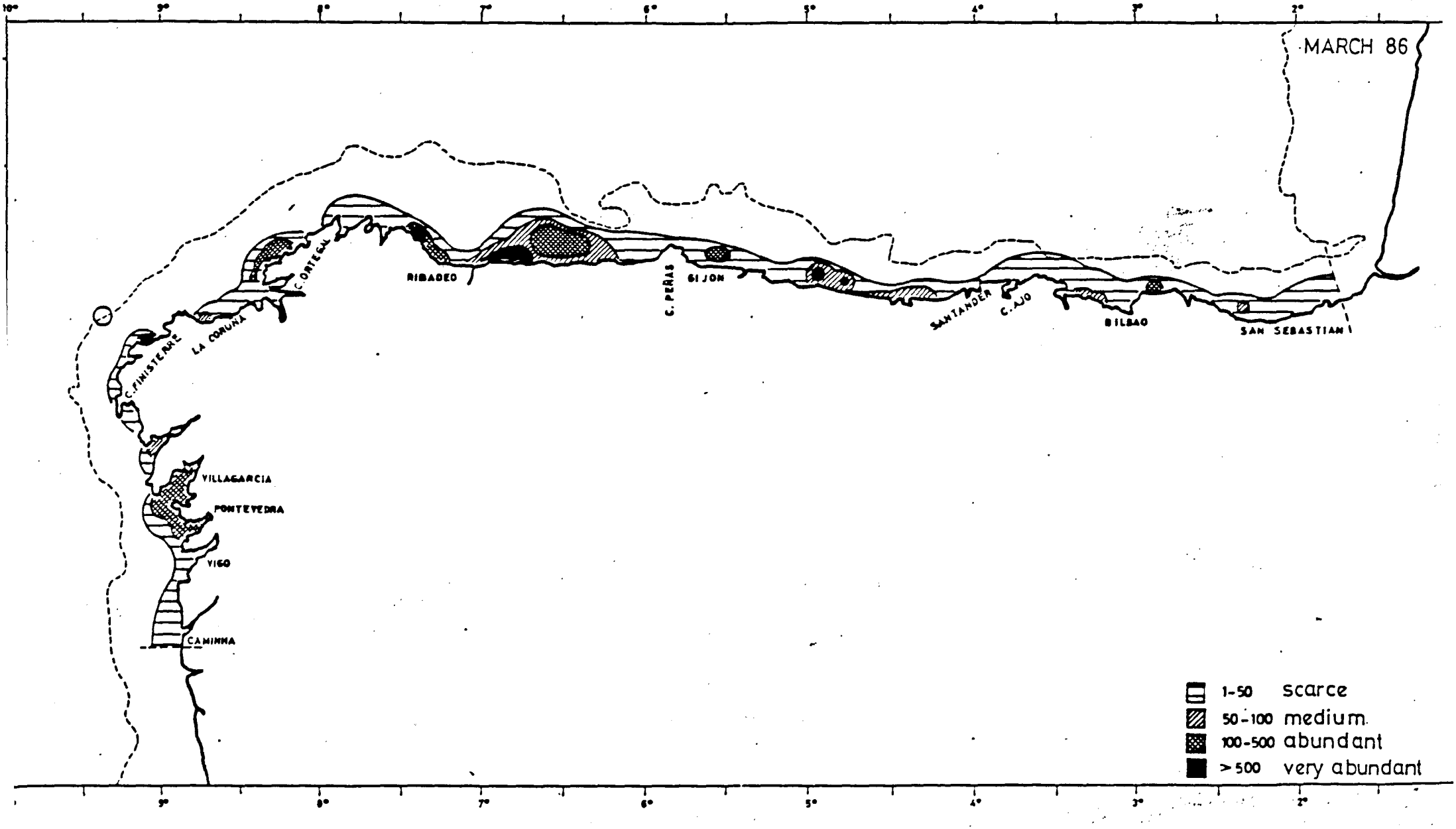

Figure 2.- Relative abundance distribution of sardine.

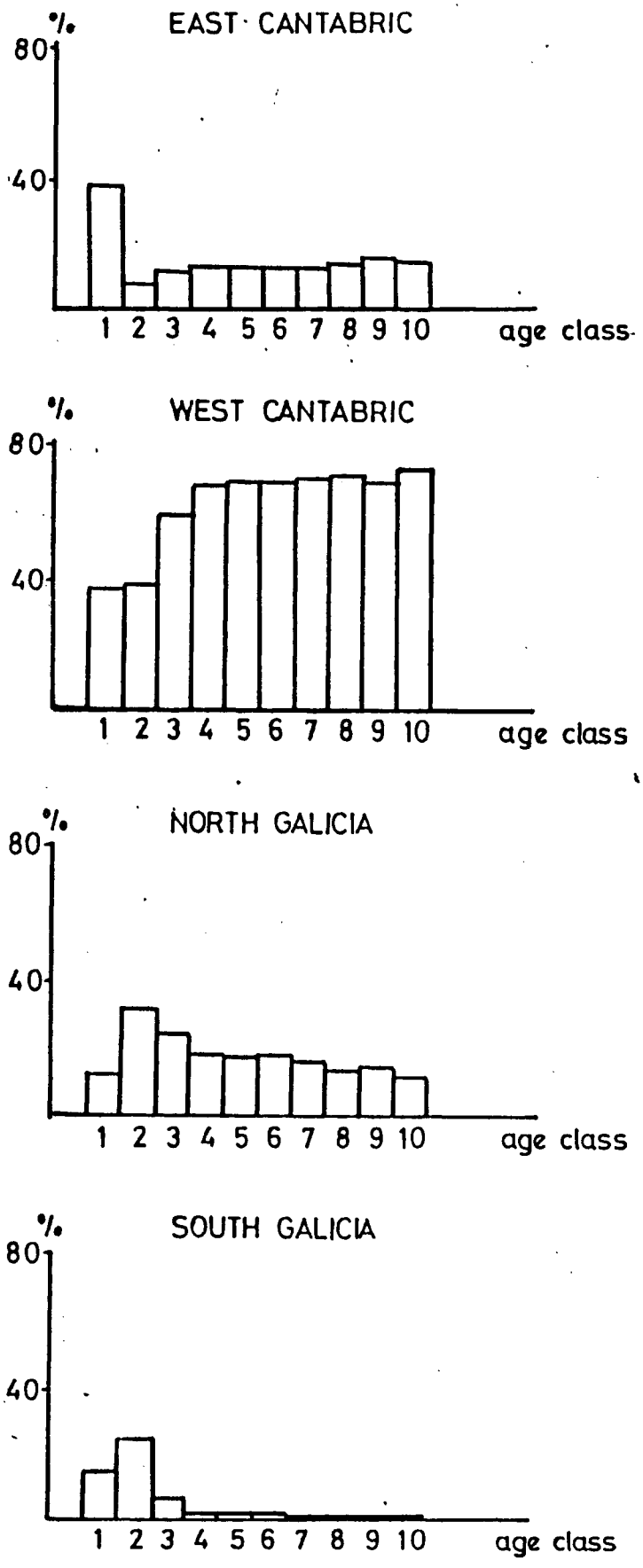

Figure 3.- Demographic estructure of the population in the different subareas in relation to the whole surveyed area.