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REPORT OF THE STUDY GROUP ON RECRUITMENT INDICES OF HAKE FROM THE SOUTHERN STOCK

Lisbon, 21 - 24 February 1989

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CONTENTS

Page

1. INTRODUCTION 1

   1.1 Terms of Reference 1
   1.2 Participants 1
   1.3 Study Stages 1

2. DESCRIPTION OF THE METHODOLOGY 1

   2.1 Spanish Surveys 1
   2.2 Portuguese Surveys 3

3. JUSTIFICATION OF CRITERIUM ADOPTED TO ESTIMATE RECRUITMENT INDICES 5

4. ANALYSIS AND DISCUSSION OF THE RESULTS 6

5. RECOMMENDATIONS 7

6. REFERENCES 7

Tables 1 - 10b 9

Figures 1 - 10 24

1. INTRODUCTION

1.1. Terms of Reference

At the ICES Statutary Meeting in 1988, and according to the recommendation of the 1988 W.G. on the Assessment of the Stocks of Hake, it was decided (C.Res. 1988/ 2:14) to establish a Study Group on Recruitment Indices of Hake from the Southern Stock, "to coordinate the methodology of the groundfish surveys and the analysis of the data for the estimation of recruitment indices".

The Study Group met at Lisbon (Instituto Nacional de Investigação das Pescas - INIP) from 21-24 February 1989.

1.2. Participants

F. Cardador	Portugal (chairwoman)
H. Dinis	Portugal
R. Goñi	Spain
F.J. Pereiro	Spain
F. Sánchez	Spain

1.3. Study Stages

The Group has considered necessary as a first step to the development of its task to describe in detail the methodology applied by the two countries involved in the recruitment surveys for Hake from the Southern Stock, Portugal and Spain.

Further an analysis of the available data and results is attempt in order to point out and to interpret the differences.

2. DESCRIPTION OF THE METHODOLOGY

2.1. Spanish Surveys

Survey area and season

Since 1980 the Instituto Español de Oceanografía (IEO) has been conducting fall groundfish surveys in the Spanish area of ICES divisions VIIIc and IXa, between the French and Portuguese borders. The main objective of the surveys is to estimate annual recruitment indices of hake from the Southern Stock. The ICES W.G. on the Assessment of the Stocks of Hake acknowledged that the continental shelf of Northwest Spain is one of the main nursery grounds for this stock (CIEM, 1977).

Survey sampling design

The area has been partitioned in strata based on depth and geographical criteria and a stratified random sampling scheme was applied.
The longest series, 1980-1986 and 1988, corresponds to surveys carried out off the Northwestern Spanish coast or Galician shelf. The continental shelf between Galicia and the French border, or Cantabrian shelf, has been also surveyed since 1980 but with interruptions in 1981, 1982 and 1987.

The Cantabrian shelf is stratified into 3 depth zones (30-100m, 100-200m, 200-500m) and 3 geographic sectors resulting a total of 9 sampling strata. This scheme has been employed in all the surveys of the series (Figure 1, Table 1).

During the period 1980-1983 the area of the Galician surveys was divided into 3 shallow strata (100-200 m) and 2 deep strata (200-500m) (Figure 2, Table 2). Since 1984 the shallow zone was divided into 7 strata so that evolution of abundance in recently set closed areas could be evaluate. The 7 new strata can be combined into the 3 original ones (Figure 3, Table 2).

Reseach Vessel

All surveys were carried out with the Spanish R/V "CORNIDE SAAVEDRA". This ship is a stern trawler that in 1984 was transformed from its original 56 m (LL) and 990 GRT to 66.7 m and 1133 GRT at present. The power of the engine was 1700 Kw untill 1983 and 2651 Kw afterwards.

Gear Type

Figure 4 contains the scheme of the bottom trawl gear (Spanish type BACA) employed in the surveys. Traditional otter doors of the trawl wheighting 750 Kg are used.
Till 1985 a cover cod end of 20mm mesh was used; since then an internal bag with the same mesh was adopted.

Characteristics of the Trawl Stations

Trawling is done during day light. Tows were 1 hour long in all the surveys before 1984 and 1/2 hour afterwards. Towing is done at a speed of about 3 Knots in direction to the next station to minimize cruising time.

Allocations of hauls

All strata were divided into 25 squared nautical miles units. The total number of tows was determined by the ship time assigned to each cruise. The number of hauls in each strata was proportional

to the area and their allocation random selected. A coverage of 33% and 50% of the units was always attempt in Cantabrian and Galician surveys, respectively (Table 1 and 2).

List of Surveys

During 1980-1988 the following surveys were carried out:

Year	Cantabrian Shelf	Galician Shelf
1980	21 Oct - 01 Nov	05 Oct - 20 Oct
1981	No Survey	19 Set - 01 Oct
1982	No Survey	13 Set - 25 Set
1983	16 Nov - 07 Dec	03 Set - 22 Set
1984	11 Set - 20 Set	27 Aug - 09 Set
1985	18 Set - 25 Set	01 Set - 15 Set
1986	26 Nov - 09 Dec	12 Set - 22 Set
1987	No Survey	No Survey
1988	09 Oct - 24 Oct	24 Set - 06 Oct

2.2.Portuguese Surveys

Survey area and season

Since the year 1981 and during Autumn the INIP (Instituto Nacional de Investigação das Pescas) carries out groundfish surveys along the Portuguese coast (div.IXa, ICES), to provide annual recruitment indices for hake and horse mackerel and their distributions.

These surveys covered the whole Portuguese coast with the exception of 1981 and 1983 surveys.
The area surveyed in 1981 and in 1983 corresponds to the main nursery grounds for hake adopted by ACFM in November 1980 (ICES, 1981) as closed areas for management purposes.

Survey sampling design

The Portuguese surveys follow a stratified random sampling scheme. The area is divided into 32 strata whose boundaries are based on depth and geographical areas (Figure 5). The depth intervals used are: 20-100 m (code 1), 100-200 m (code 2) and 200-500 m (code 3).
Each stratum is divided into units of approximately 25 squared nautical miles, sequentially numbered. Table 3 presents for each stratum the total number of sampling units (Nh).

Due to practical reasons and to compare results the stratification adopted on "recruitment surveys" corresponds to the same used on groundfish surveys conducted by the INIP to

estimate abundance indices of commercial species (Cardador, 1983).

Reseach Vessel

The Portuguese R/V "NORUEGA" is a stern trawler, built in Norway in 1978. The lenght over all is 47.5 meters, GRT of 495 tons and the power of the engine 2039 Kw.

Gear Type

The Figure 6 presents a provisional scheme of the bottom trawl gear used, named "Campel trawl net 1800/96", Norvegian type.

The vertical and horizontal (between wings) openings were calculated as 3 and 14.5 meters, respectively. In order to obtain a more accurate estimation these values will be tested at the sea with an adequate equipment .

The polyvalent trawl doors are rectangular (3x2 meters) (Norvegian type) and weighting 1100 Kg.
Since 1982 the cover of 20mm and the cod end of 40mm were replace by a single cod end of 20mm mesh size.

Characteristics of Trawl Stations

Trawl stations take place during day light, with a tow duration of 30 minutes and a mean trawl speed of 3 knots. In 1982 the speed was 4 knots to evaluate the effect in the catchability on the horse mackerel, but it was concluded that there was no need for that increase. The tow direction is to the next trawl station in order to optimize the survey time unless due to the type of bottom it is not considered adequate.

Allocation of hauls

According to ship time available the total number of random hauls was pre-estimated for each survey. Its partition per stratum was based on a compromise allocation which took on account the two target species, e.g., hake and horse mackerel. Therefore the allocation was estimated as an average of the optimum allocations for both species being proportional to the area and to the variance of the recruitment indices estimated in the previous year survey.
At sea, some changes occured due to several factors as the presence of commercial gears in the area, bad weather or survey gear dammage. Nevertheless attempts were made to get a minimum of two hauls per stratum, which was not always possible.

List of Surveys

During 1981 - 1988 seven Portuguese recruitment surveys took place.
Table 3 presents the list of the surveys as well as the number of trawl stations per stratum and for the whole area sampled.

The dates of the surveys were the following ones:

1981 - 19 October - 14 November
1982 - 06 October - 18 November
1983 - 27 October - 22 November
1984 - No survey
1985 - 22 October - 19 November
1986 - 04 October - 31 October
1987 - 03 October - 25 October
1988 - 12/20 October and 15/21 November (engine dammage)

3.JUSTIFICATION OF CRITERIUM ADOPTED TO ESTIMATE RECRUITMENT INDICES

Since 1982, the Hake W.G. (ICES, 1982) had adopted 17 cm total lenght as the upper limit for the Ø group concerning the Southern Stock.
This criterium had been choosen by Pereiro et al (1980) according to the growth parameters adopted by the Hake W.G. in 1980 (k= 0.12, t_o= -0.48 and L_∞ = 98 cm) and due to the lack of age readings.

The Study Group decided to analyse if that criterium is at present suitable.

An analysis of the lenght compositions of the catches from the recruitment surveys conducted in all the areas (Cantabrian, Galician and Portuguese waters) was carried out. Stratified mean number per hour and per lenght group was estimated for each survey and area. The strata on the depth range 100-200m was choosen since in general terms the abundance of the smallest hake in that depth range is higher than in the others.

Lenght compositions of the hake catches from Galician surveys during 1980-1988 are presented in Table 4. The Figure 7 shows the corresponding histograms (5 - 30 cm lenght range). It can be observed one isolated component corresponding to a modal lenght which varies between 10 and 13 cm, followed by a sharp decrease before 16 cm. This lenght distribution is in agreement with the criterium so far adopted as the upper lenght limit for Ø age group. The Cantabrian surveys (Table 5, Figure 8) hake distributions show a similar pattern which indicate that the selected lenght upper limit of 17cm is adequate.

The lenght distributions of hake from Portuguese surveys show

high variability (Table 6, Figure 9). It can be observed, however, that the higher the catches of young individuals - 1981 and 1988 - the more the distributions ressamble to those of the Spanish surveys. In the surveys with low catches the Ø age group appears to be particullary under-represented. For this reason the Group decided to take on account only those surveys where the Ø group seems to be better represented, e.g., 1981, 1988, 1986 and 1985 (in decreasing importance). From the analysis of the corresponding histograms (Figure 9) it became apparent that the 17cm lenght limit is also appropriate for the Portuguese recruitment indices.

4. ANALYSIS AND DISCUSSION OF THE RESULTS

Tables 7, 8 and 9 indicate for each survey area and year the indices of recruitment (stratified mean number per hour of hake smaller than 17cm) and the corresponding sampling errors.

A summary of the recruitment indices available for hake from the Southern Stock is presented in Table 10.

Figure 10 shows the evolution overtime of the recruitment indices corresponding to part of the area in the 100-200 m depth range, which represents about 35% of the total area. For Galician and Portuguese waters those indices reflect the abundance in the traditional nursery grounds. The selection of this area was made on the basis of the longest series available for the three areas as well as its importance in terms of relative abundance of recruits.

It can be observed (Fig. 10) that recruitment indices for Galician and Cantabrian shelfs follow very similar trends since the begining of the series in 1983. In Galicia waters the highest values of the index corresponds to 1984 (2134 ind./ hour) and in Cantabrian area to 1988 (526 ind./hour). After a minimum in 1985 in both areas the abundance of recruits appears to be increasing in 1988 up to levels close to those achieved in 1984.

It is difficult to draw conclusions from the comparison of the Spanish and Portuguese indices, because when the first one shows a sharp increase (1984) and the second one decreases (1987) the series do not overlap. The main inconsistency is found in 1982 when Spanish index (Galicia) is at a level above average and the Portuguese value decreases sharply.

The apparent decline in the number of recruits in Portuguese surveys since 1981 could be explained by a failure in the recruitment or an inadequate survey season in Portuguese waters. The later hypothesis was analysed (Cardador, 1988, W.doc.) from the evolution of the lenght distributions of the Portuguese trawl landings by month (1985-1987). This analyses has indicated that the smallest hake is mainly caught in Autumn which is consistent with the recruitment survey season.
However the Study Group considered that other factors may have

influenced the low levels of recruitment in the Portuguese surveys since 1981: the efficiency of the gear (replacement of cover+cod end by a single cod end since 1981) and the reduction of the number of hauls in the nursery grounds due to a compromise allocation with horse mackerel.

When comparing the values of the recruitment indices for the three areas, it is clear that the highest levels of recruitment occur in the Galicia shelf.

An attempt was carried out to estimate a single abundance indice of recruitment for the whole area (Div. VIIIc + IXa). Concerning this estimation it should be pointed out that the vessel, gear type and survey season are different for Spanish and Portuguese surveys. Therefore the results only can reflect the trends on the levels of abundance indices.

The time series of the indice estimated for the whole area concerns only 1985-1988 (except 1987). It indicates a low level of recruitment in 1985 (123 ind./hour) followed by a sharp increase in 1986 (287 ind./hour) and in 1988 (377 ind./hour).

5.RECOMENDATIONS

The Study Group taking into account the discussion carried out during the meeting had considered important to make the following recommendations to improve the future work:

a)The two countries involved in estimation of recruitment indices for hake from the Southern Stock should survey every year their corresponding total area simultaneously (Set/Oct);

b)Both countries should make efforts to coordinate and standardize methodology (gear type, cod end mesh size);

c)The group recognize the need of age length keys for each survey in order to provide a more accurate recruitment index. The countries should support growth studies to achieve this important goal.

6.REFERENCES

Cardador, F. 1983. Indices of abundance from groundfish surveys in the Portuguese continental coast (Div. IXa) during 1979/82. ICES Doc. C.M.1983/G:45, 30p.

Cardador, F. 1988. Estratégias de exploração do stock de pescada (Merluccius merluccius L.) das águas ibero-atlânticas. Efeitos em stocks associados. INIP, Lisboa. Dissertation.

CIEM. 1977. Rapport du Groupe de Travail sur le Merlu. Nantes 30 Novembre-3 Décembre, 1986. CIEM Doc. C.M. 1977/G:3, 40p.

ICES. 1981. Reports of the ICES Advisory Committee on Fishery Management 1980. Coop.Res.Report 102: 71-74, 229, 233-234.

ICES. 1982. Report of the Working Group on Assessment of Hake stocks. Copenhagen, 29 April - 6 May 1982. ICES Doc. C.M.1982/Assess:14, 63p.

Pereiro,F.J. et al. 1980. Relationship between age and deep and recruitment indexes of hake on Galicia and Portugal shelf. ICES Doc. C.M. 1980/G:32, 11p.

Table 1 - CANTABRIAN HAKE RECRUITMENT SURVEYS (Autumn)

Depth (m)	Sector	Nh	Number of hauls (nh) 1980	1983	1984	1985	1986	1989
30-100	1	8		3	2	2	2	3
	2	17	n.c.	2	2	4	3	4
	3	15		3	2	2	4	4
100-200	1	21	2	10	6	5	6	7
	2	34	9	15	9	12	11	11
	3	16	3	6	3	3	6	6
200-500	1	7	1	5	3	2	2	4
	2	15	4	14	8	7	5	5
	3	9	5	6	4	2	3	2
Total		142	24	64	39	39	42	46

Sector 1 : Eo - Peñas
Sector 2 : Peñas - Ajo
Sector 3 : Ajo - Bidasoa

Nh - Number of sampling units per stratum
n.c. - not covered

Table 2 - Galician Hake Recruitment Surveys (Autumn)

				Number of hauls (nh)							
Depth(m)	Sector	stratum	Nh	1980	1981	1982	1983	1984	1985	1986	1988
100-200	MF		29	10	11	14	12				
		MS	6					3	3	3	3
		SC	13					6	6	6	6
		CF	10					5	5	5	5
	FE		32	13	11	13	15				
		FV	6					3	3	3	3
		VP	22					12	11	10	11
		PE	4					2	2	2	2
	ER		16			7	9	8	8	2	8
200-500											
	MF		11		2		3	5	5	5	5
	FE		30		2		9	12	15	14	12
TOTAL			118	23	26	34	48	56	58	50	55

MF - Miño / Finisterre = MS + SC + CF
MS - Miño / Silleiro
SC - Silleiro / Corrubedo
CF - Corrubedo / Finisterre

FE - Finisterre / Estaca = FV + VP + PE
FV - Finisterre / Villano
VP - Villano / Prior
PE - Prior / Estaca

ER - Estaca / Ribadeo

Table 3 - Portuguese Recruitment Surveys (Autumn)

			Number of hauls (nh)						
SECTOR	STRATUM	Nh	1981	1982	1983	1985	1986	1987	1988
CAM	1	17	17	8	16	13	8	5	3
	2	10	11	5	9	5	8	3	2
	3	2	2	2	2	1	2	2	2
MAT	1	16	n.c.	15	n.c.	14	4	3	8
	2	12	n.c.	8	n.c.	2	2	2	3
	3	2	n.c.	2	n.c.	2	1	2	2
AVE	1	17	3	11	16	16	7	3	5
	2	15	8	4	10	10	2	2	2
	3	2	2	1	2	2	2	2	2
FIG	1	14	13	5	13	13	7	3	6
	2	21	16	9	15	5	5	4	2
	3	5	4	2	4	2	2	2	3
BER	1	9	n.c.	5	n.c.	2	2	2	1
	2	12	n.c.	9	n.c.	2	2	2	2
	3	2	n.c.	1	n.c.	n.c.	1	1	n.c.
LIS	1	16	n.c.	7	n.c.	6	4	2	6
	2	19	n.c.	14	n.c.	3	3	3	4
	3	12	n.c.	9	n.c.	2	2	2	2
SIN	1	7	n.c.	5	n.c.	4	2	1	4
	2	14	n.c.	13	n.c.	4	6	4	4
	3	8	n.c.	7	n.c.	2	2	2	2
MIL	1	3	2	1	2	2	2	2	1
	2	7	7	3	7	6	6	2	4
	3	8	11	4	8	3	2	2	2
ARR	1	8	3	1	3	3	3	2	3
	2	8	7	3	6	5	6	2	3
	3	8	6	2	5	3	4	2	2
SAG	1	4	n.c.	1	n.c.	1	1	2	2
	2	5	n.c.	4	n.c.	2	2	2	2
	3	4	n.c.	3	n.c.	2	2	2	2
POR	1	11	n.c.	9	n.c.	3	5	2	2
	2	5	n.c.	5	n.c.	2	3	2	2
	3	3	n.c.	3	n.c.	2	2	2	2
VSA	1	5	n.c.	5	n.c.	2	1	1	3
	2	2	n.c.	3	n.c.	2	2	2	2
	3	3	n.c.	2	n.c.	2	2	2	2
TOTAL		316	112	190	118	150	117	81	99

Table 4 - Spanish Galician shelf surveys
Hake : stratified mean number per hour

Strata: depth 100-200 m

Lenght group(cm)	Oct 80	Set 81	Set 82	Set 83	Set 84	Set 85	Set 86	Set 88
5	0	0	0	0	0	0	1	1
6	0	0	1	0	9	0	49	1
7	0	1	6	2	130	3	117	6
8	1	15	29	12	339	27	212	51
9	8	51	151	54	346	64	383	145
10	43	210	337	159	260	79	231	226
11	80	329	284	199	255	52	76	185
12	87	224	149	177	262	30	25	89
13	66	92	78	84	139	17	10	55
14	37	46	44	33	44	13	3	31
15	19	23	6	8	6	7	1	15
16	10	7	1	5	1	3	0	7
17	7	4	0	4	2	1	1	3
18	6	2	0	3	3	2	1	0
19	6	1	0	2	5	2	2	0
20	5	0	0	2	4	2	2	0
21	2	0	0	1	2	1	1	0
22	1	0	0	1	3	1	2	0
23	0	0	0	1	2	1	1	0
24	0	0	0	1	1	1	1	0
25	0	0	0	1	1	1	0	0
26	0	0	0	1	1	1	0	0
27	0	0	0	1	1	2	1	0
28	0	0	1	1	1	2	1	0
29	0	0	1	1	1	2	1	0
30	0	0	1	2	1	2	1	0
No hauls	23	22	34	36	39	38	31	38

Table 5 - Cantabrian shelf surveys
Hake : stratified mean number per hour

Strata: depth 100-200 m

Lenght group(cm)	Set 84	Set 85	Nov 86	Oct 88
5	0	0	0	0
6	1	0	1	0
7	4	0	2	10
8	18	5	20	85
9	67	11	54	163
10	93	22	58	123
11	137	27	39	66
12	55	21	19	38
13	8	14	8	18
14	5	8	7	9
15	1	5	5	4
16	2	5	1	1
17	2	4	2	1
18	2	3	1	1
19	3	3	0	1
20	2	1	0	2
21	2	1	1	2
22	2	1	0	1
23	1	1	1	1
24	1	1	0	1
25	1	1	0	1
26	1	1	1	1
27	0	1	1	0
28	1	1	1	1
29	0	1	0	2
30	0	1	1	2
No hauls	18	20	23	24

Table 6 - Portuguese surveys - Hake: stratified mean number per hour

Strata : depth 100-200 m

Lenght group(cm)	Oct 81	Oct 82	Oct 83	Oct 85	Oct 86	Oct 87	Oct 88
5	0	0	0	0	0	0	0
6	0	0	0	0	1	0	0
7	0	0	0	0	1	0	0
8	0	0	0	0	1	0	1
9	4	1	1	0	2	0	4
10	13	2	1	1	7	0	11
11	10	2	3	3	9	0	17
12	32	2	3	7	12	1	23
13	110	3	4	11	15	1	26
14	176	5	6	17	19	0	31
15	162	4	8	19	19	1	26
16	119	4	10	17	13	1	19
17	64	3	10	16	8	1	16
18	30	2	9	12	6	2	18
19	19	2	7	11	4	2	15
20	11	1	6	9	5	3	14
21	9	2	5	6	5	3	6
22	8	4	4	6	5	3	11
23	8	4	4	4	7	3	8
24	7	3	4	4	7	2	8
25	6	3	4	2	8	2	8
26	4	3	3	3	7	2	8
27	4	2	4	3	4	2	5
28	4	3	4	2	5	2	4
29	3	2	3	1	6	2	6
30	2	3	5	2	7	2	4
No hauls	49	79	47	48	47	30	32

Table 7 - Cantabrian shelf surveys
Indices of recruitment: number of Hake (< 17cm) per hour

		30-100 m		100-200 m		200-500 m	
Year	Sector	I	S	I	S	I	S
	1	167	103.7	503	188.9	2	1.3
	2	67	53.0	187	58.8	2	.9
1983	3	289	145.5	0	.0	29	29.3
	Total	170	62.6	238	62.6	10	8.5
	1	0	.0	855	548.0	7	7.4
	2	11	11.0	102	31.7	27	21.2
1984	3	527	526.9	414	246.3	1	.5
	Total	202	197.6	396	172.0	15	10.4
	1	36	13.0	48	15.4	30	3.0
	2	26	15.6	136	59.5	18	10.1
1985	3	728	80.0	194	24.9	8	7.0
	Total	292	30.8	124	29.4	16	5.3
	1	356	339.5	546	333.7	0	.0
	2	1546	1018.9	88	35.9	4	2.7
1986	3	174	99.9	2	.6	0	.0
	Total	794	439.9	204	100.2	2	1.3
	1	32	29.7	1366	883.7	24	22.2
	2	388	130.7	250	158.5	8	5.0
1988	3	778	434.5	12	7.7	0	.0
	Total	462	172.3	526	272.2	10	5.6

I - stratified mean number per hour
S - sampling error

Table 8a - Galician Shelf Surveys
Indices of recruitment: number of Hake (< 17cm) per hour

		100-200 m		200-500 m	
Year	Sector	I	S	I	S
1980	MF	257	50.0	n.c.	
	FE	668	149.5	n.c.	
	ER	n.c.			
	Total	i.c.		n.c.	
1981	MF	1177	252.7	463	463.2
	FE	1325	207.4	614	553.7
	ER	n.c.			
	Total	i.c.		573	423.7
1982	MF	902	121.0	n.c.	
	FE	1660	347.6	n.c.	
	ER	167	7.1		
	Total	1064	151.5	n.c.	
1983	MF	912	327.1	43	42.3
	FE	786	137.7	93	56.7
	ER	278	122.7		
	Total	728	138.2	80	42.9

I - stratified mean number per hour
S - sampling error
i.c. - incomplete coverage
n.c. - no covered

Table 8b - Galician Shelf Surveys
Indices of recruitment: number of Hake (< 17cm) per h

		100-200 m		200-500 m	
Year	Sector	I	S	I	S
1984	MF	2558	428.1	1077	733.9
	FE	1749	335.0	219	109.7
	ER	344	403.9		
	Total	1762	229.0	449	212.6
1985	MF	354	91.0	79	40.7
	FE	314	86.7	276	90.9
	ER	149	210.0		
	Total	295	66.2	223	67.4
1986	MF	892	427.1	593	443.2
	FE	1206	342.9	14	5.9
	ER	1543	768.2		
	Total	1158	267.7	169	119.0
1988	MF	986	227.0	80	76.5
	FE	2785	782.7	267	169.3
	ER	521	291.6		
	Total	1637	341.7	217	125.6

I - stratified mean number per hour
S - sampling error

Table 9a - Portuguese Surveys
Indices of recruitment: number of Hake (< 17cm) per hour

October 1981

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	1414	268.5	1333	277.5	59	5.0
MAT		n.c.		n.c.		n.c.
AVE	37	18.6	1243	319.7	1753	495.0
FIG	53	20.8	454	70.4	1799	948.2
BER		n.c.		n.c.		n.c.
LIS		n.c.		n.c.		n.c.
SIN		n.c.		n.c.		n.c.
MIL	0	.0	70	24.5	165	64.6
ARR	0	.0	23	9.2	157	119.0
SAG		n.c.		n.c.		n.c.
POR		n.c.		n.c.		n.c.
VSA		n.c.		n.c.		n.c.
Total	431	77.7	692	94.1	608	198.5

October 1982

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	296	166.0	35	34.2	0	.0
MAT	62	47.9	0	.0	0	.0
AVE	25	9.4	0	.0	0	.0
FIG	3	1.7	30	13.2	4	.0
BER	0	.4	4	2.4	0	.0
LIS	35	34.6	8	3.0	0	.2
SIN	16	10.5	12	5.5	0	.3
MIL	106	.0	47	27.1	35	33.7
ARR	0	.0	213	106.3	8	6.0
SAG	156	.0	5	2.2	0	.0
POR	7	4.4	0	.0	0	.0
VSA	1	.5	0	.0	0	.0
Total	64	23.5	26	7.5	6	4.6

I - stratified mean number per hour
S - sampling error
n.c. - not covered

Table 9b - Portuguese Surveys
Indices of recruitment: number of Hake (< 17cm) per hour

October 1983

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	55	18.1	24	12.9	0	.0
MAT		n.c.		n.c.		n.c.
AVE	3	2.4	21	8.0	73	27.0
FIG	26	13.1	47	9.6	21	9.5
BER		n.c.		n.c.		n.c.
LIS		n.c.		n.c.		n.c.
SIN		n.c.		n.c.		n.c.
MIL	0	.0	79	28.3	27	19.5
ARR	0	.0	87	32.5	94	82.4
SAG		n.c.		n.c.		n.c.
POR		n.c.		n.c.		n.c.
VSA		n.c.		n.c.		n.c.
Total	23	6.1	46	6.9	49	27.2

October 1985

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	58	20.4	262	63.2	0	.0
MAT	4	2.5	184	14.0	0	.0
AVE	3	2.0	50	11.0	45	17.0
FIG	3	1.4	50	17.3	4	2.0
BER	54	22.0	15	1.0		n.c.
LIS	17	17.3	35	23.7	6	4.0
SIN	257	254.5	33	24.1	37	3.0
MIL	17	17.0	165	51.6	57	13.5
ARR	3	1.8	240	84.9	133	51.5
SAG	14	.0	18	18.0	0	.0
POR	76	65.3	121	38.5	0	.0
VSA	18	14.0	0	.0	0	.0
Total	37	15.6	90	9.5	35	7.6

I - stratified mean number per hour
S - sampling error
n.c. - not covered

Table 9c - Portuguese Surveys
Indices of recruitment: number of Hake (< 17cm) per hour

October 1986

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	1	.8	2	1.0	0	.0
MAT	0	.0	8	4.5	0	.0
AVE	0	.0	3	3.0	24	24.0
FIG	8	5.8	20	8.2	50	22.0
BER	1	1.0	16	16.0	0	.0
LIS	456	455.5	172	61.6	21	21.0
SIN	0	.0	62	25.3	40	40.0
MIL	2	2.0	231	55.9	82	78.0
ARR	1	1.3	651	187.5	129	70.7
SAG	188	.0	55	55.0	0	.0
POR	28	11.9	8	.0	0	.0
VSA	2	.0	4	4.0	0	.0
Total	67	57.4	93	15.5	43	16.0

October 1987

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	2	2.4	1	.7	0	.0
MAT	0	.0	2	2.0	0	.0
AVE	0	.0	0	.0	15	15.0
FIG	0	.0	5	2.6	27	9.0
BER	0	.0	1	1.0	0	.0
LIS	2	2.0	5	2.9	0	.0
SIN	0	.0	3	2.4	0	.0
MIL	0	.0	20	20.0	3	3.0
ARR	2	2.0	20	10.0	6	2.0
SAG	0	.0	0	.0	0	.0
POR	0	.0	2	2.0	0	.0
VSA	0	.0	0	.0	0	.0
Total	1	.4	5	1.4	4	1.0

I - stratified mean number per hour
S - sampling error

Table 9d - Portuguese Surveys
Indices of recruitment: number of Hake (< 17cm) per hour

October 1988

	20-100 m		100-200 m		200-500 m	
Sector	I	S	I	S	I	S
CAM	12	6.9	5	3.0	0	.0
MAT	3	2.5	1	1.3	0	.0
AVE	4	4.0	13	9.0	197	157.0
FIG	2	1.6	102	66.0	23	8.2
BER	30	.0	53	19.0	n.c.	
LIS	1	.7	409	366.5	7	7.0
SIN	150	149.5	370	65.3	2	.0
MIL	2	.0	405	237.9	2	2.0
ARR	71	70.7	476	386.1	11	11.0
SAG	44	30.0	4	4.0	3	3.0
POR	0	.0	6	6.0	0	.0
VSA	0	.0	13	13.0	0	.0
Total	19	9.5	175	61.4	13	6.0

I - stratified mean number per hour
S - sampling error
n.c. - not covered

Table 10a - Summary of recruitment indices of Hake from the Southern Stock

Area	Strata depth (m)	Nh	1980 Index	1980 S	1981 Index	1981 S	1982 Index	1982 S	1983 Index	1983 S	1984 Index	1984 S
Cantabrico	30-100	40							170	62.6	202	197.6
	100-200	71	no		no		no		238	62.6	396	172.0
	200-500	31	data		survey		survey		10	8.5	15	10.4
	Total	142							169	36.0	258	102.5
Galicia	100-200‡	61	473	81.9	1255	162.1	1300	191.2	846	171.4	2134	268.9
	100-200	77					1064	151.5	728	138.2	1762	229.0
	200-500	41	n.c.		573	423.7	n.c.		80	42.9	449	212.6
	Total	118	i.c.		i.c.		i.c.		503	91.4	1306	166.7
Portugal	20-100‡‡	59			431	77.7	99	47.9	23	6.1		
	20-100	127					64	23.5				
	100-200‡‡	61			692	94.1	49	16.0	46	6.9		
	100-200	130	no survey				26	7.5			no survey	
	200-500‡‡	25			608	198.5	15	11.0	49	27.2		
	200-500	59					6	4.6				
	Total‡‡	145			571	61.1	63	20.7	37	6.1		
	Total	316					38	10.0				
Total Area (VIIIc+IXa)	Spain	260	inc. cov.		inc. cov.		inc. cov.		321	45.9	734	94.1
	Portugal	316	no survey		inc. cov.		38	10.0	inc. cov.		no survey	
	All area	576	inc. cov.		inc. cov.		inc. cov.		inc. cov.		inc. cov.	

‡ part of the area as reported in ICES Hake WG (revised)
‡‡ traditional nursery grounds as reported in ICES Hake WG (revised)
Index - stratified mean number per hour (hake < 17cm)
S - sampling error

Table 10b - Summary of recruitment indices of Hake from the Southern Stock

Area	Strata depth (m)	Nh	1985 Index	1985 S	1986 Index	1986 S	1987 Index	1987 S	1988 Index	1988 S
Cantabrico	30-100	40	292	30.8	794	439.9			462	172.3
	100-200	71	124	29.4	204	100.2			526	272.2
	200-500	31	16	5.3	2	1.3	no		10	5.6
	Total	142	148	17.1	326	133.7	survey		395	144.5
Galicia	100-200‡	61	333	63.0	1057	271.3			1930	424.5
	100-200	77	295	66.2	1158	267.7	no		1637	341.7
	200-500	41	223	67.4	169	119.0	survey		217	125.6
	Total	118	270	49.1	814	179.5			1144	227.2
Portugal	20-100‡‡	59	20	6.0	2	1.4	1	.7	15	9.9
	20-100	127	37	15.6	67	57.4	1	.4	19	9.5
	100-200‡‡	61	123	17.6	120	25.6	7	2.8	148	61.9
	100-200	130	90	9.5	93	15.5	5	1.4	175	61.4
	200-500‡‡	25	65	17.1	79	34.0	10	2.5	25	13.2
	200-500	59	35	7.6	43	16.0	4	1.0	13	6.0
	Total‡‡	145	71	8.3	65	12.3	5	1.3	73	26.4
	Total	316	58	7.5	73	24.1	3	.6	82	25.6
Total Area (VIIIc+IXa)	Spain	260	203	24.2	547	109.4	no survey		735	129.8
	Portugal	316	58	7.5	73	24.1	3	.6	82	25.6
	All area	576	123	11.7	287	51.1	inc. cov.		377	60.3

‡ part of the area as reported in ICES Hake WG (revised)
‡‡ traditional nursery grounds as reported in ICES Hake WG (revised)
Index - stratified mean number per hour (hake < 17cm)
S - sampling error

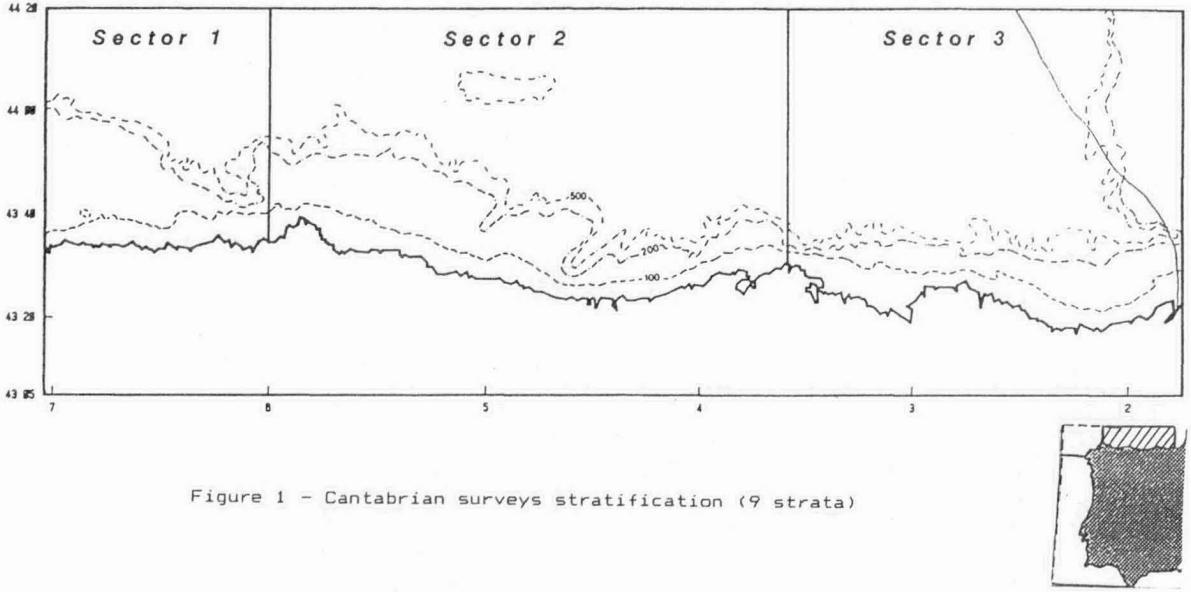


Figure 1 - Cantabrian surveys stratification (9 strata)

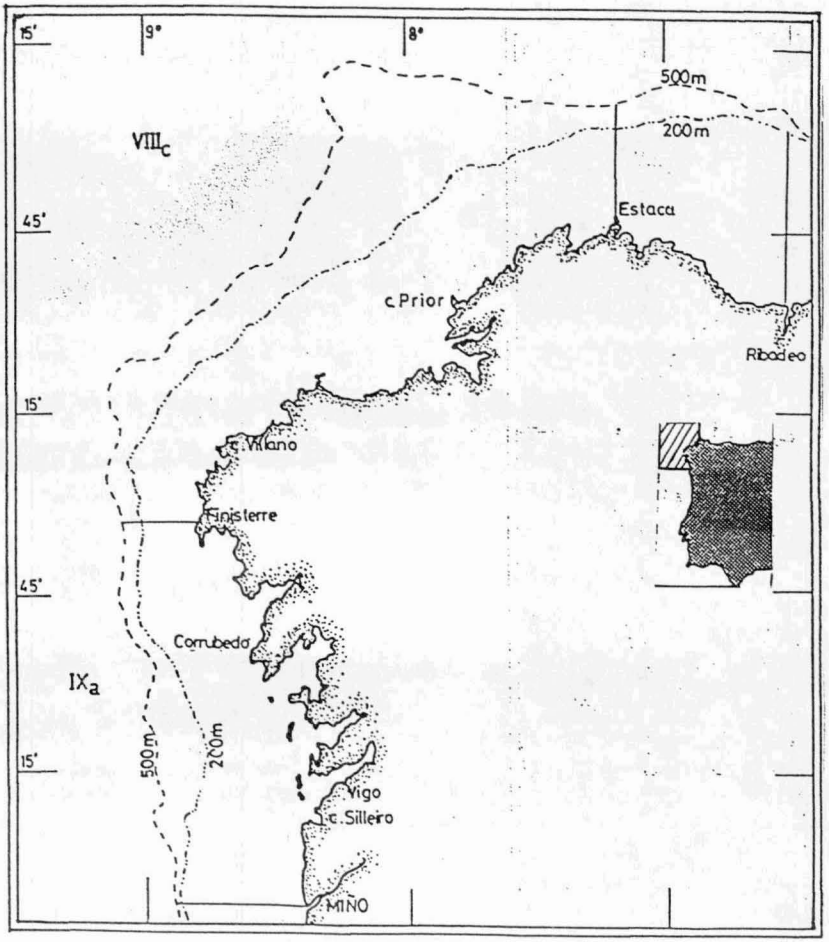


Figure 2 - Galician surveys stratification during 1980-1983 (5 strata)

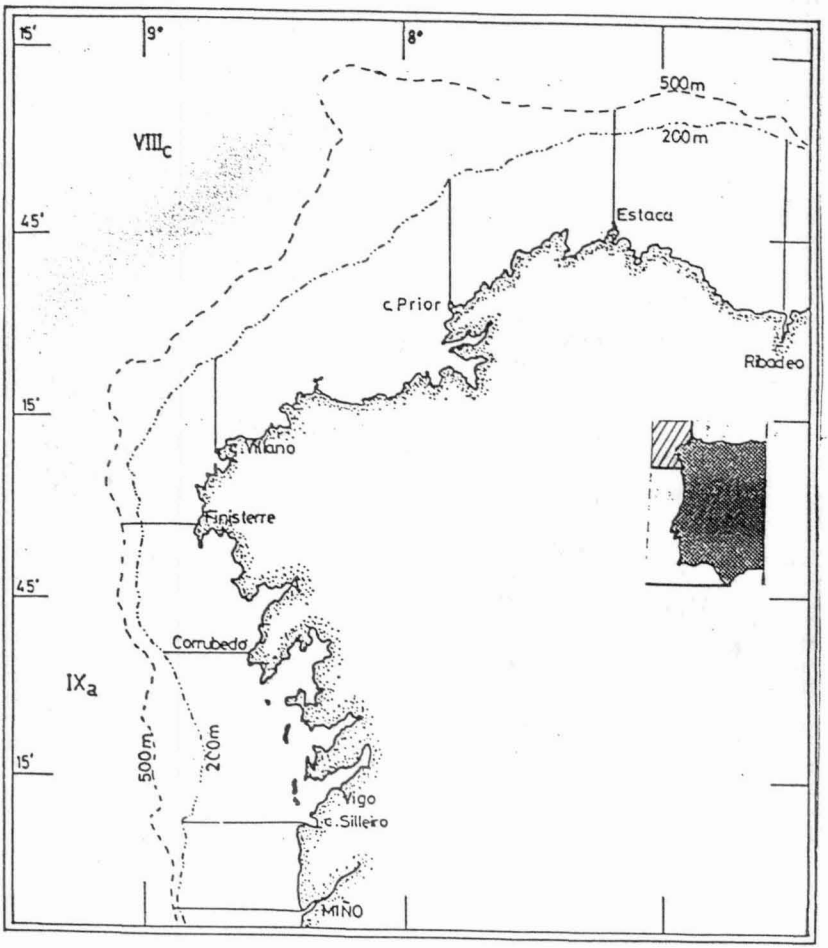


Figure 3 - Galician surveys stratification since 1984 (9 strata)

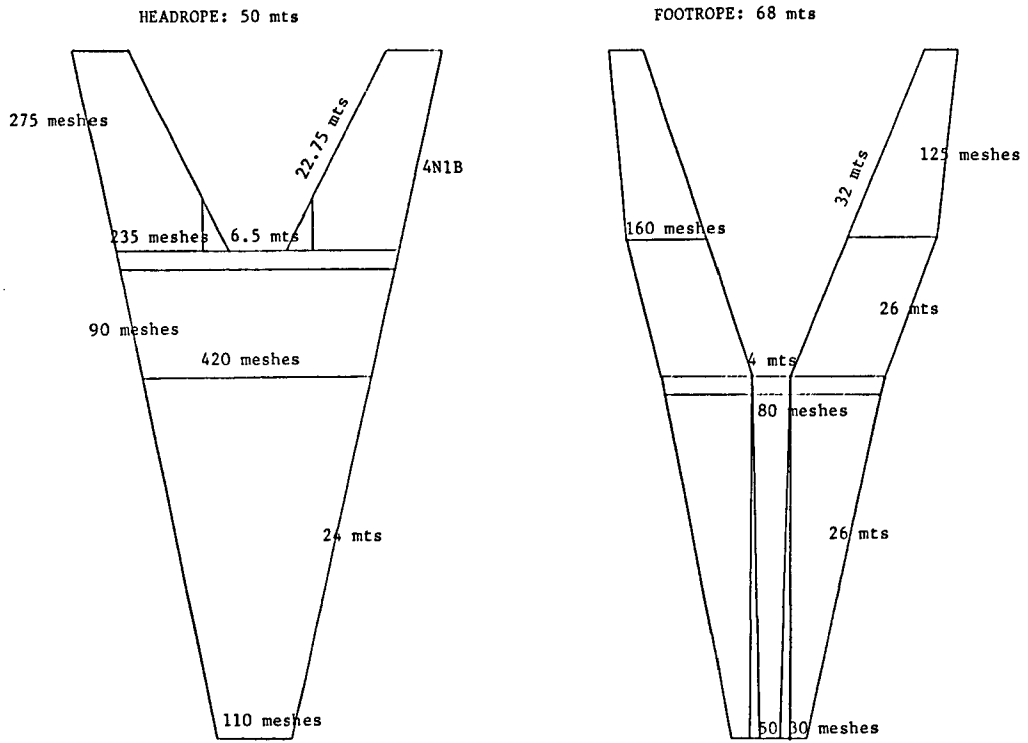


Figure 4 - Spanish bottom trawl net used in the surveys

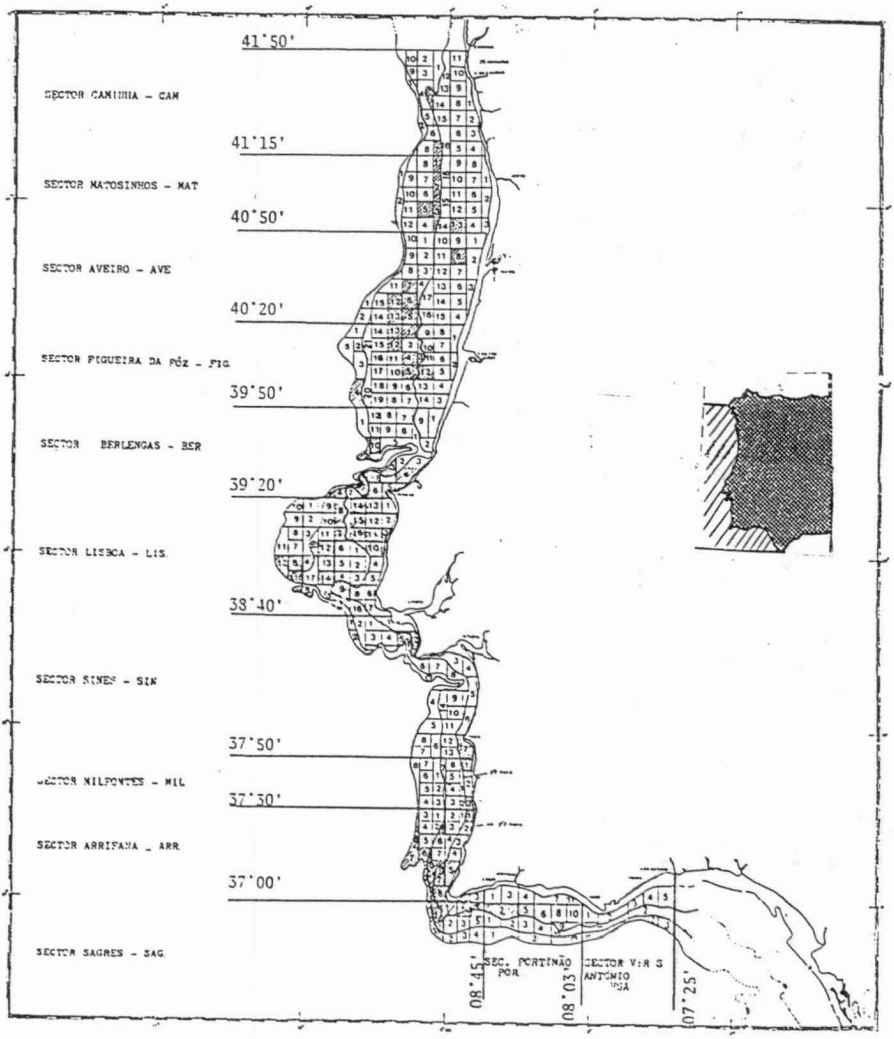


Figure 5 - Portuguese surveys stratification (32 strata)

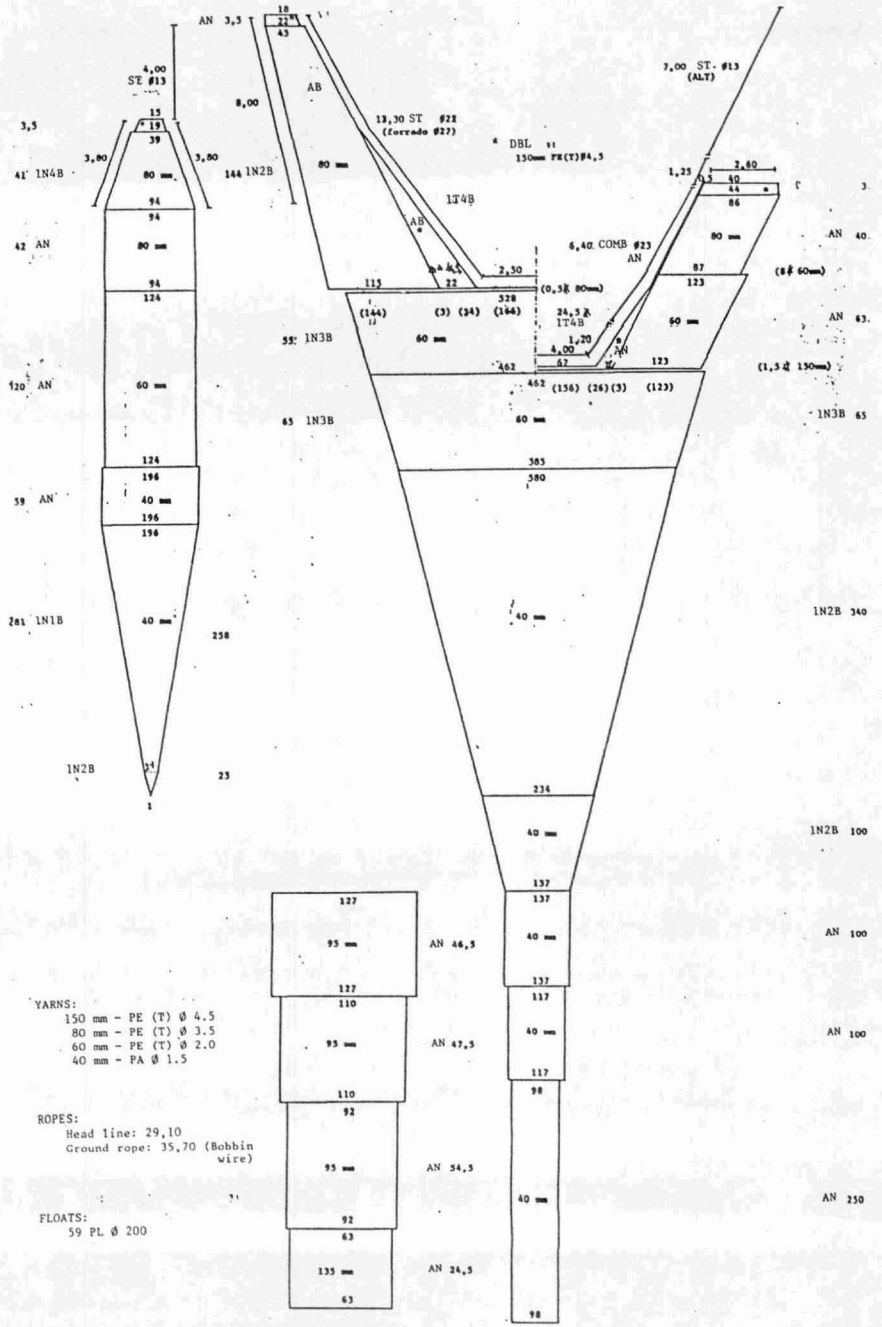
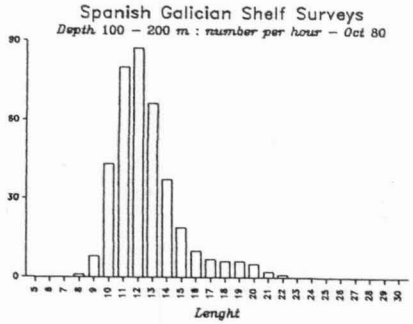
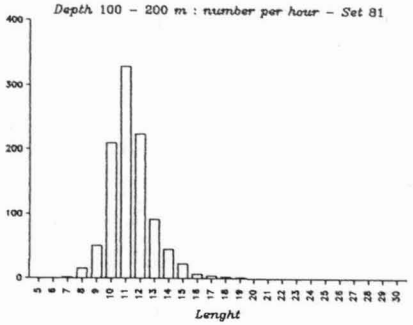


Figure 6 - Portuguese bottom trawl net used in the surveys





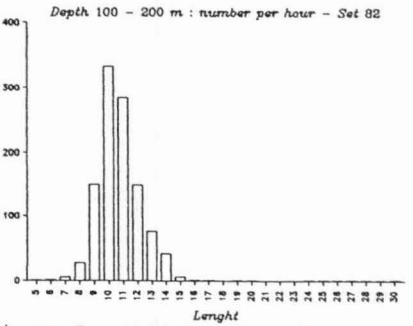


Figure 7a Galician recruitment surveys: hake length distributions.

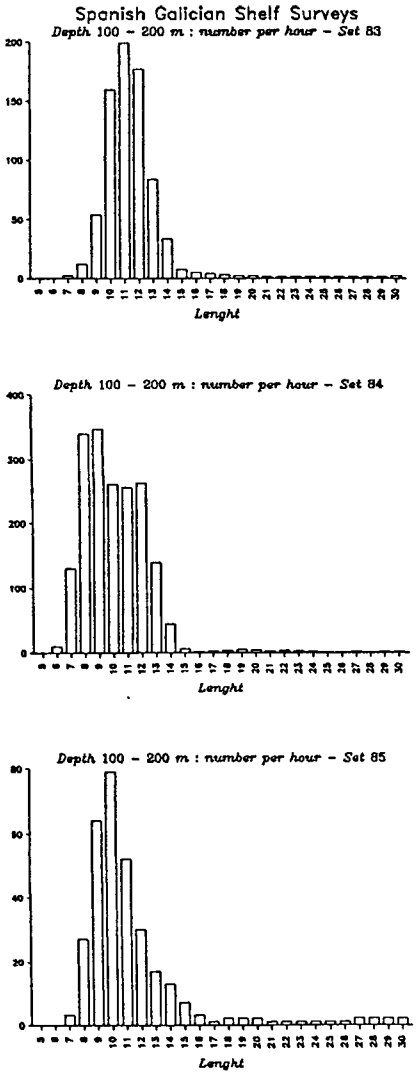


Figure 7b Galician recruitment surveys: hake length distributions.

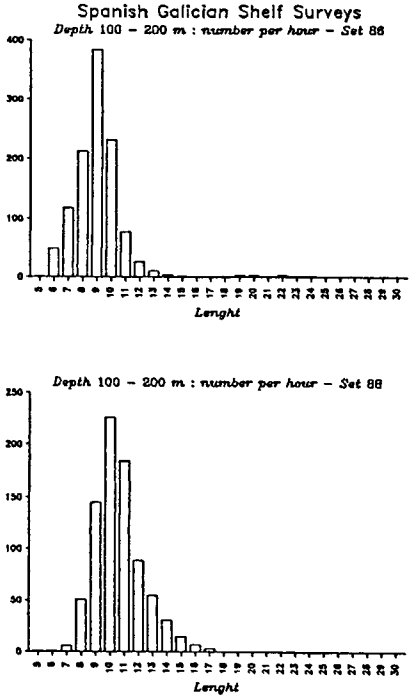
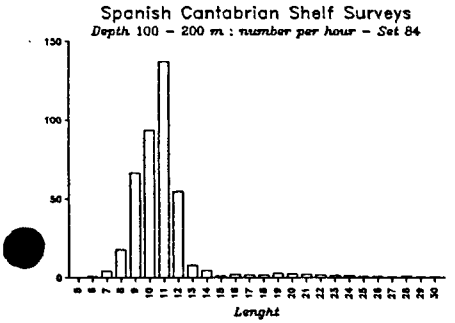
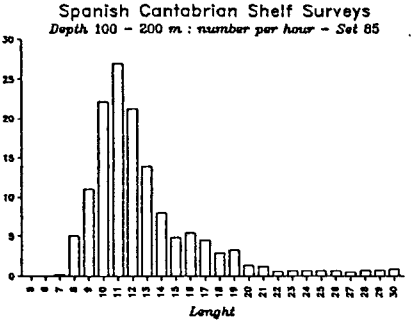
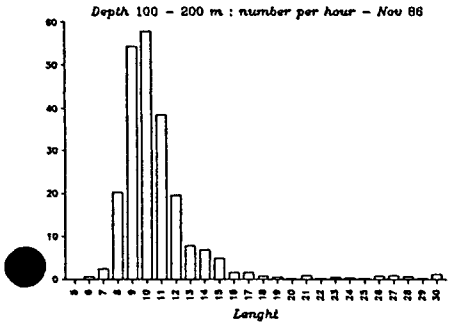


Figure 7c - Galician recruitment surveys : hake lenght distributions







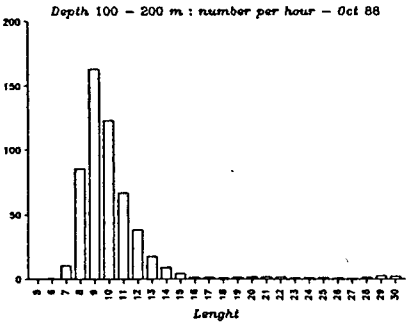


Figure 8 - Hake lenght distributions

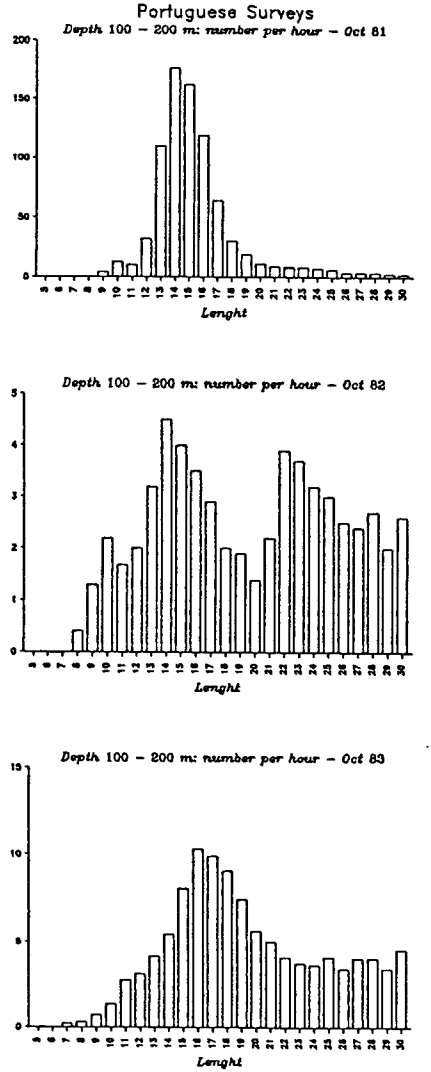


Figure 9a - Hake lenght distributions

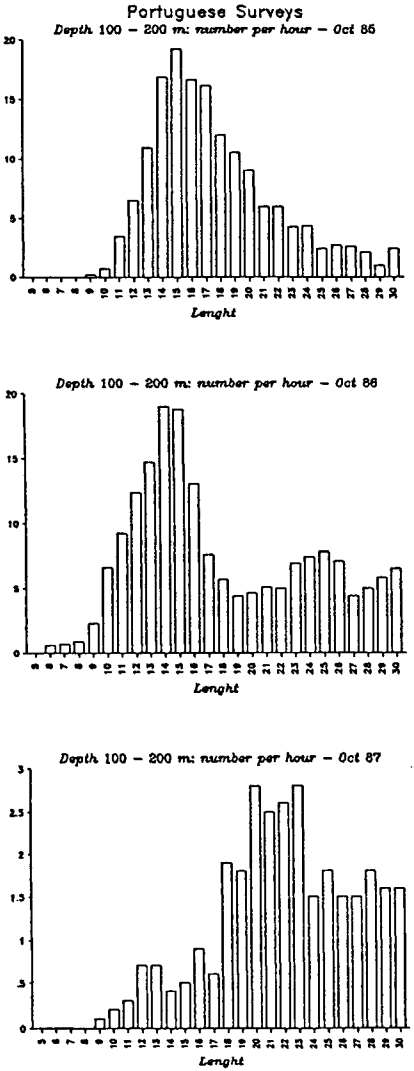


Figure 9b - Hake lenght distributions

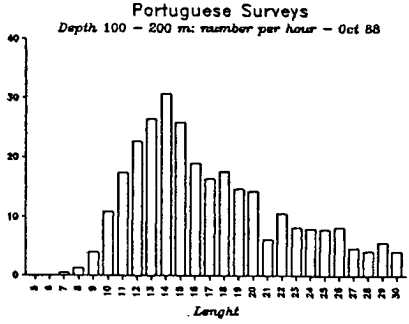


Figure 9c - Hake lenght distributions

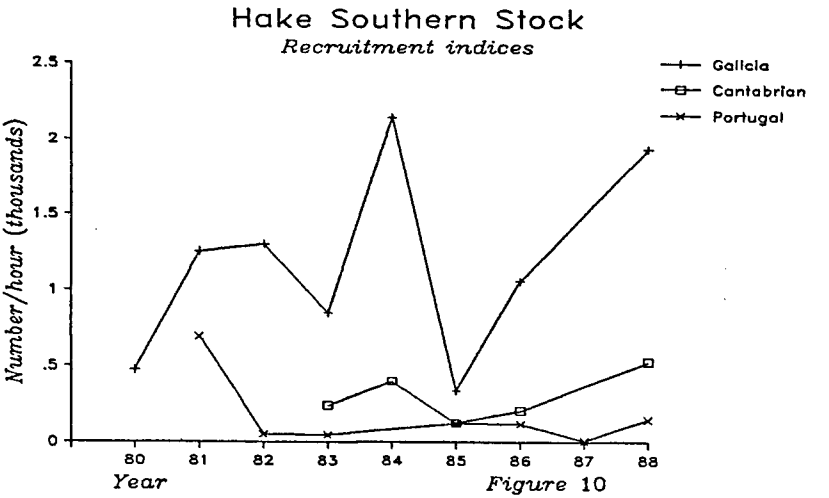

Hake Southern Stock
Recruitment indices
Galicia
Cantabrian
Portugal
Number/hour (thousands)
2.5
2
1.5
1
.5
0
80
81
82
83
84
85
86
87
88
Year

Figure 10