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GROUND FISH SURVEYS IN THE ATLANTIC IBERIAN WATERS (ICES DIVISIONS VIIIc AND IXa): HISTORY AND PERSPECTIVES

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ABSTRACT

Spanish Oceanographic Institute (IEO) and Portuguese Research Institute (IPIMAR, ex-INIP) using their research vessels "Cornide de Saavedra" and "Noruega" have conducted groundfish surveys in Spanish and Portuguese waters. The results of these surveys have been reported to the relevant ICES Working Groups, communicated to ICES Annual Conferences and/or published in journals of biology and fisheries. Data collected from groundfish surveys were also the basis to carry out assemblage studies and to several advices to the Spanish, Portuguese and European fishery administrations concerning the implementation of technical measures for fish stock management. This communication intends to give information about the past, the present and the future of these surveys, concerning objectives, methodology and publications. Critical aspects and solutions to improve some aspects are presented.

INTRODUCTION

The Iberian area corresponding to ICES Divisions VIIIc and IXa have been intensively investigated during the last two decades using information provided by groundfish surveys.

The Oceanographic Institute (IEO), Spain and Research Institute (IPIMAR, ex-INIP), Portugal using the Spanish research vessel *Cornide de Saavedra* and the Portuguese research vessel *Noruega* initiated groundfish surveys research in Atlantic Iberian waters in 1974 and in 1979, respectively, covering the waters under the corresponding national jurisdiction.

The estimation of the abundance and the study of distribution of the most important commercial species in the area are common objectives. The results provided by these groundfish surveys have been extremely useful to assess and monitor the state of the stocks under routine assessment in

ICES and other commercial important fish stocks in the area. This communication intends to give information about the use of these surveys, in the past, the present and concerning objectives, methodology and derived publications. Critical aspects and solutions to improve methodologies and further use of these survey series are discussed.

I. GROUND FISH SURVEYS CURRENT OBJECTIVES

Area Covered

Each national Institute investigated the areas under national jurisdiction. Figure 1 indicates the areas surveyed and the corresponding ICES Divisions VIIIc and IXa.

1. Division VIIIc (Cantabrian Sea) and Division IXa (Galician waters and Spanish waters of the Gulf of Cadiz)

Spanish surveys

The main objectives of the Spanish surveys are:

- to estimate the relative abundance of the main fish, crustacean and cephalopod populations;
- to describe the spatial distribution pattern of the species;
- to estimate the year class strength of selected species (mainly hake);
- to gather data for the determination of biological parameters, including feeding and growth.

The target species in the Northern Spanish surveys are: hake (*Merluccius merluccius*), blue whiting (*Micromesistius poutassou*), megrims (*Lepidorhombus boscii* and *L. whiffiagonis*), monkfish (*Lophius budegassa* and *L. piscatorius*), horse mackerel (*Trachurus trachurus*) and Norway lobster (*Nephrops norvegicus*). The target species in the Gulf of Cadiz surveys are: hake, wedge sole (*Dicologlossa cuneata*), horse mackerel, Spanish mackerel (*Scomber japonicus*), Seabreams, prawn (*Penaeus kerathurus*), shrimp (*Parapenaeus longirostris*), octopus (*Octopus vulgaris* and *Eledone moschata*) and Cuttle fish (*Sepia officinalis*).

2. Divisions IXa (Portuguese waters)

Portuguese surveys

The target species of these surveys are hake, horse mackerel, mackerel, blue whiting, megrims, monkfish and Norway lobster.

The main objectives of the Portuguese groundfish surveys are:

- to estimate indices of abundance and indices of biomass of the most important fish species off the Portuguese continental waters;
- to study the distribution pattern and estimate indices of abundance for recruits;
- to estimate biological parameters, maturity evolution, sex-ratio, weight, food habits;
- to build length and/or age compositions for the target species.

Furthermore, complete species list is provided and information on the length distribution of other commercial species is available.

The indices of abundance together with its age structure allow to assess the state of the stocks when integrating this information in analytical assessments. They are also used for monitoring the state of the stocks with incomplete information to perform a full analytical assessment.

II. GROUND FISH SURVEYS HISTORY

1. Spanish surveys

The Spanish Oceanographic Institute (IEO) has been carrying out bottom trawl surveys since 1974. In the beginning, the area, time of the year, the objectives and consequently the sampling design of the surveys was different to the present one. Thus, during 1974-1979, bottom trawl surveys were accomplished in waters of Galicia (IXa Divisions North and West VIIIc) in different months of the year (May -September), being the main objective the distribution of the commercial interest resources as well as the associated fauna. Fishing stations were allocated at radials perpendicular to the coast and at different depths.

From 1980 on wards, based on the available information of the previous surveys, it was decided to carry out a random stratified sampling in Autumn. The main criterion for the stratification was the distribution of recruits of hake in the area, which was the primary objective of these surveys. In 1983 the sampling coverage was enlarged including the whole VIIIc Division (Cantabrian sea) and, simultaneously the sampling design, the characteristics of the gear and the duration of the haul were established for the Autumn surveys. Between 1984 and 1988 a series of Spring surveys were made in the same area and following the same methodology in order to complement the information on the annual cycle of the species. The Spring series finished in 1988 but the Autumn series have been maintained up to the present.

Since 1993 a new series of surveys was initiated in the South Atlantic region of the Iberian Peninsula (Gulf of Cadiz) using the same sampling methodology as the one used in Autumn groundfish surveys covering the North of Spain. This new series completes the coverage of the whole Iberian Atlantic waters, from the Cantabrian Sea to the Strait of Gibraltar (ICES Divisions VIIIc and IXa).

Following the recommendation of the ICES Study Group on Bottom Trawl Surveys in Sub-areas VI, VII and VIII and Division IXa (Anon 1991b), during the 1992 survey a calibration took place on board of *R/V Cornide de Saavedra* with the baka gear and the French *R/V Thalassa* with the standard gear system GOV 36/47. The catch efficiency and the conversion coefficients for the different species were obtained (Sánchez, Poulard and De la Gandara, 1994; Anon, 1994a).

2. Portuguese surveys

Portuguese groundfish surveys have been conducted along the Portuguese continental waters (Figure 2) since June 1979 on board of the *R/V Noruega*. Initially the main objectives of the surveys were to estimate the abundance and study the distribution of the most important commercial species in the Portuguese trawl fishery: hake, horse mackerel, blue whiting, seabreams and Norway lobster. Recruitment indices of abundance and distribution for hake and horse mackerel were also evaluated in the Autumn surveys. Additionally, trawl selectivity

experiments for hake and horse mackerel with 40 mm mesh size, were also conducted during 1981 surveys using the covered cod-end method.

A stratified random sampling design was adopted during 1979-1989. The number of strata changed during this period: from 1979 to 1980 the surveyed area was divided into 15 strata and since 1981 into 36 strata. Based in the statistical analysis of the previous surveys the design was revised in order to decrease the variance within stratum. The new strata are smaller than the previous ones and can be combined to get the older ones. The aim of increasing the number of strata was to increase the probability of spreading the random sampled units in order to decrease the total variance of the mean abundance indices by species.

The boundaries of each stratum are based on depth and geographical areas. The depth ranges during 1979-1988 were 20-100m, 101-200m and 201-500m. Each stratum was divided into units of approximately 25 nm², sequentially numbered. During 1979-1980 the number of random hauls per stratum was based on the previous information of the relative abundance of the target species in each geographical area and on the vessel time available. During 1981-1989, when the number of strata was 36, two random units were sampled by stratum whenever possible, to become possible to estimate the standard error of the stratified mean by stratum.

The tow duration was 60 minutes during 1979-1985 at a trawling speed of 3.5 Knots, changing to 30 minutes during 1986-1988, and changed again to 60 minutes since 1989, maintaining the same trawling speed. The decrease from 60 to 30 minutes was based on an analysis which has indicate that a 30 minutes tow was enough to get abundance indices for the target species (Cardador, 1983b). However in the 1989 Summer survey, experiments with the two durations at the trawling speed of 3.5 Knots have been performed indicating that 60 minutes tow was more adequate to sample all the structure of the horse mackerel population. The large adults of horse mackerel were not caught at a trawling speed of 3.5 knots with a duration of 30 minutes because the large pelagic fish can swim at at higher speeds in front of the trawl net. It is by mantaining the trawl pursuing the fish during a longer period than 30 minutes that the larger horse mackerel looses its *stamino* and enters into the traw net. The juveniles were well sampled with 30 minutes trawling at 3.5 knots.

Finally in Autumn 1989 a fixed stations plan was established as a result of an extensive discussion on the scope of ICES Methods Working Group (ICES, 1989, 1990) about the trade on biased estimations with low variance (fixed design) or unbiased estimations with large variance (stratified design). The fixed design is more appropriate for a time series obtained for the purpose of tuning the commercial catch-at-age time series. As a result it was considered that the fixed station design is more appropriate for VPA tuning than the random allocation design. Simultaneously the survey area was extended to the 750 m bathymetric in order to sample the adult hake, and the lower distribution bound of Norway lobster and monkfish (see details of the methodology on technical description below).

During the period 1979-1996 a total of 36 surveys were carried out. The season, total fishing days and valid hauls by survey are shown in the Table 1. In average 2 surveys per year were carried out, with 21 effective fishing days and 90 valid hauls per survey.

During 1990-1994 and under FAR project MA- 1-203¹ the second aim of the surveys was to estimate the abundance and distribution of eggs and larvae of the commercial species. A sampling scheme with a grid of 92 stations was applied. The stations were settled at 22 east-west sampling transects, 20 nautical miles apart, with depths varying from 20 to 1000 m. The sampling stations were placed 5' and 10' apart from each other in order to fit the bottom topography. Plankton samples were collected with a Bongo net (60 cm of mouth diameter and 335µm and 505µm mesh size), by oblique hauls from the surface to a maximum depth of 200 m or to the depth of seabed. These stations were conducted during the night. Using a CTD (Conductivity, Temperature and Depth recorder "Sea-Bird" (Model Seacat SBE 19) the temperature and salinity profiles were obtained at each plankton station. This is particularly important to monitor the presence of the thermocline for sampling strategy. At its presence the eggs of mackerel and horse mackerel are distributed above the thermocline.

III. TECHNICAL DESCRIPTION

1. Spanish surveys

Ship and gear characteristics

Spanish surveys cover the ICES Divisions VIIIc and part of Division IXa (Cantabrian sea, off Galicia and Gulf of Cadiz, Figure 2). All surveys were carried out with the Spanish R/V *Cornide de Saavedra*. This stern trawler was transformed in 1984 from its original 56 m (LL) and 990 GRT to 67 m (LL), 1133 GRT and 1650 KW.

The gear used is a Baka trawl (a commonly used gear in the Spanish trawl fleet) with a 43.6 m footrope and a 60.1 headline which had a cod-end of 20 mm mesh size. In the most recent survey headline height and wingend were measured using Scanmar, and values of 1.9 m and 22.0 m were obtained respectively. Up to 1985, a codend cover of 20 mm mesh was used and since then a 20 mm mesh codend liner has been adopted.

Sampling design in Spanish area

A stratified random sampling scheme has been adopted. The survey area has been stratified according to depth and geographical criteria and. In the North of Spain 5 geographical sectors and three depth zones have been used (30-100, 101-200, 201-500 m) (Figure 2). In the Gulf of Cadiz, the shelf and slope waters were divided into five depth strata (15-30, 31-100, 101-200, 201-500 and 501-700). All strata are divided into units of 25 square nautical miles (5x5). The total number of hauls is determined by the ship time assigned to each survey resulting in a coverage of one haul per 50 nm² (120 hauls per survey in the North surveys, approximately 20 hauls per ICES rectangle). The number of hauls per strata is proportional to the trawlable area and its allocations are random selected.

Trawling is carried out during daylight. In the North of Spain, tows had one hour duration in all

¹ "Estimation of the abundance and study of the distribution pattern of hake, horse mackerel, mackerel, monkfish and megrim in ICES Div. IXa (Portuguese waters)"

surveys before 1984, and were reduced to 30 minutes thereafter. In the Gulf of Cadiz the haul duration is one hour. In both surveys towing is carried out at a speed of 3 knots. Starting time of the haul is defined when winches stop and the ending time when the pull back of the net starts.

Information collected and database

The log sheet and the number and weight of all species caught are included in the surveys database, as well as the size distributions of all the fishes and of the invertebrates of commercial interest. All the survey data are processed on board using a software package specifically created for it (files in dBase III format) and with the possibility to generate the file formats for records types 1, 2 and 3 of IBTS data. Salinity and temperature by depth are recorded at the end of each fishing station using a CTD probe.

Results

The estimation of abundance indices and its statistical dispersion are obtained following a random stratified sampling protocol (Cochran, 1966). The minimum biomass by species is obtained applying the swept area method. Data are processed for the catches (in weight and in number) and by length class or/and by age group for each species. The age/length keys (ALK) are derived from otolith or other hard parts readings or by indirect methods from species length composition.

Abundance and distribution patterns of some target species have been investigated to detect factors that could cause its variability during the different surveys. Special attention have been given to studies on hake recruitment indices. Based on previous studies the geostatistic tools are used to investigate age group 0 aggregations of hake and its strategy of occupation of the nurseries.

Oceanographic stations are carried out using CTD SBE-25 equipment, in order to get an uniform and representative coverage on a spacial and temporal scale. Hydrographic stations are performed at the end of each fishing haul and CTD profiles from the shelf edge to the oceanic area are completed during the night. The areas which were not covered with the fishing stations CTD profile are covered with extra hydrographic stations. To analyse the dynamics of mesoscale and the vertical motion associated, the methodology of objective spatial analysis is applied, separating the macroscale and mesoscale contribution to the total field. To study the vertical motion the formulation of the Q vector in the equation omega (Hoskins *et al.* 1978) is used.

2. Portuguese surveys

Ship and gear characteristics

Portuguese surveys were carried out on board of the Portuguese R/V *Noruega*, a stern trawler with 47.5 m length overall, 495 tons GRT and 1500 HP, built in 1978 in Bergen, Norway.

The trawl gear used is denominated Norwegian Campell Trawl 1800/96 (NCT). The main characteristics of this gear are the ground rope with bobbins, 9 m sweep and three bridles, lower 40 m, and upper and middle 20 m long. During 1979-1980 a codend of 40 mm mesh size was used. Selectivity studies conducted during 1981 groundfish surveys were made with a cover of 20 mm and a codend of 40 mm mesh. Since 1982 a single codend of 20 mm mesh size is

adopted. The mean vertical opening is 4.6 m and the mean horizontal opening between wings and doors are 15.1 m and 45.7 m, respectively. These gear parameters were obtained with Scanmar Equipment. The polyvalent trawl doors used are rectangular (2.7 m x 1.58 m) with an area of 3.75 m² and weighting 650 Kg.

Sampling design

Surveys cover the Portuguese continental waters from 20 m to 750 m, following a fixed station sampling scheme. A total of 97 fixed stations are planned, spread over 12 sectors. Each sector is subdivided into 4 depth ranges: 20-100m, 101-200m, 201-500m and 501-750 m, with a total of 48 strata (Figure 3). The positions of the 97 fixed stations were selected based on common stations made during 1981-1989 surveys and taking into account that two stations should be made by stratum. A maximum of 30 supplementary stations are planned, fixed in each season, to be carried out if ship time is available or to replace positions that due to particular factors are not possible to accomplish.

Fishing stations take place during daylight, with an average duration tow of 60 minutes with a mean trawl speed of 3.5 knots.

Oceanographic stations take place at the final of each fishing station using a CTD equipment in order to get temperature and salinity data by depth to be used in biological studies.

Information collected and database

The catch from each haul is sorted and weighed by species. For the target species and for some other commercial species (fishes, cephalopods and crustaceans) length measurements, as well as other biological information, e.g., weight by length group, sex, maturity stages, collection of otoliths, stomach contents, are undertaken.

In 1990, a database was created at IPIMAR during the FAR project MA.1.203 using a SQL relational database in PC-DOS system (software Rbase 2.0 later upgraded to Rbase 4.0). Recently, this database was transferred to a windows environment using Microsoft Access 2.0. Three main tables, one containing the log sheet (haul information, positions, etc) other containing species sheet (catch data) and the third containing sample length distribution, are part of this database. Maturity stages, individual weigh, otoliths are stored in independent tables for each species. An accessory table containing scientific and common names and the three FAO letter codes for the species was also adopted.

Scientific effort

The human resources at sea involve 4 fishery biologist and 7 technicians per survey. The data are recorded in the database on board at the end of each fishing station.

IV. USE OF SURVEY INFORMATION

The Spanish and Portuguese groundfish surveys data have been the main source for several biological studies and stock parameters estimation. These studies include those related to the species distribution by area and depth, length-weight relationship, age determination, maturity, fecundity, food habits, recruitment estimation, abundance indices and cpue trend analysis.

Table 2 summarizes the referred studies by species. Most of the results of these studies are reported or published as is indicated in item 5. Data collected from groundfish surveys were also the basis to carry out assemblage studies on the Portuguese and Spanish shelf and to establish fishing closed areas as in the case of hake (STCF, 1990).

Ichthyoplankton studies were also performed during 1990 - 1994 under the Portuguese FAR project MA 1203, to estimate the abundance and distribution of eggs and larvae of the most commercial species.

Summer and Autumn Portuguese series as well as Autumn Spanish series have been used for stock assessment (VPA tuning) as it is shown in Table 3.

V. RESULTING PUBLICATIONS AND REPORTS

Most of the results provided by the groundfish surveys are reported to the relevant ICES Working Groups, communicated to ICES Annual Conferences and/or published in journals of biology and fisheries.

Data collected from groundfish surveys were also the basis to carry out assemblage studies and to several advices to the Spanish, Portuguese and European fishery administrations concerning the implementation of technical measures for fish stock management.

The main resulting publications and reports are listed below:

1. Spanish publications

Abaunza, P., 1995. The use of larval *Anisakis simplex* (Nematoda: Ascaridoidea) infection patterns can improve our biological knowledge of horse mackerel, *Trachurus trachurus*, from Cantabrian Sea and Galician waters (ICES Divisions VIIIc and IXa). *Working Document* to the 1995 ICES Working Group on the Assessment of Mackerel, Horse mackerel, Sardine and Anchovy.

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VI. CRITIQUE

Iberian groundfish survey series have been providing the basic information to perform the analytical assessments of several stocks of the Northeast Atlantic currently assessed within ICES Assessment Working Groups. These surveys have been also valuable to improve the biological parameters and to monitor the distribution of the species under assessment. They have also provided basic data for the study fish assemblages in Iberian shelf and slope and are the first stone for multispecies and ecosystem studies under development in EU projects like CORMA (FAIR) CT-95-0604.

Species like pouting (*Trisopterus luscus*), seabreams and rock fish (*Helicolenus dactylopterus*) not currently assessed within ICES have been evaluated to provide scientific advice to the Portuguese administration using data from the groundfish surveys. The recently ICES Study Group on the Assessment of Other Fish and Shellfish Species will consider these and other species in Division IXa to evaluate trends in the populations of these species and whenever possible to evaluate their state of exploitation. The information available on the abundance and distribution of other species not currently assessed within ICES are partly provided by the Portuguese and Spanish groundfish survey series.

In what concerns the sampling methodology used for the groundfish surveys this has been directed to the goal of obtaining abundance indices disaggregated by age to tune VPA in analytical assessments, specially for hake and horse mackerel. Attempts have been made to take profit of the same data series to other species stock assessments with success (blue whiting, mackerel, megrim and four-spot-megrim). Nevertheless the Portuguese gear used (Norwegian Campell Trawl) it is not efficient for monkfish capture and cannot appropriately sample these stocks which are currently assessed within ICES. For the study of the distribution of monkfish other gear than NCT has to be used in order to obtain a time series of abundance indices to tune the VPA. An European Study Project (SESITS- 029/96) is under development to standardize the groundfish gear methodology among areas and countries.

Possibilities of improvement

Assessment of the main demersal stocks exploited in the southwestern part off Europe (ICES Sub-Areas VII, VIII, and IX) are conducted by the ICES WG on the Southern Shelf Demersal Stocks using analytical models. When conducting these assessments VPA are tuned using abundance indices estimated from these bottom trawl survey series.

These surveys have been carried out by two decades covering Portugal in Division IXa, Spain in Divisions IXa and VIIIc and France in Divisions VIIIa,b and Divisions VIIg,h,j. The ICES SSDS Working Group pointed out some difficulties to use these indices in the case of stocks distributed on the whole area (hake for example), due to some discrepancies in the indices estimated from the distinct surveys. The IBTS (International Bottom Trawl Surveys) Working Group (Anon, 1996a) straight out the lack of coordination and standardization of these surveys, and it has recommended the establishment of an ICES database for the Western and Southern bottom surveys, and it pointed out the need for continuing surveys during the fourth quarter of the year which is the most consistent series in this area over time. To respond to these problems the new study project titled "Evaluation of demersal resources of Southwestern Europe from standardized groundfish " 029/96 (SESITS) is in progress.

The SESITS project is under progress during 1997 and would continue during 1998. The partners are IEO, IPIMAR and IFREMER with support funding from E.U (DG XIV). The coordination is of the responsibility of the fishery biologist Dr. Francisco Sánchez (IEO).

The main objectives of SESITS project are as follows :

- 1) to standardize the methodology of the bottom trawl surveys in the area.
- 2) to estimate abundance indices for the target species, analyse their spatio-temporal variability and for some cases the possible effects of the hydrographic parameters (hake, for example).
- 3) to maintain and standardize the surveys data base (Spain, France and Portugal).
- 4) to continue the series of the surveys in Autumn.

Special effort is being done in this project to the necessary standardization of the methodology of these surveys. As recommended by the IBTS WG, estimation of the catchabilities of the different sampling gears (NCT, Baka, GOV) are planned with overlapping of the different surveys (Portugal/Spain in the Division IXa, Spain/France in Divisions VIIIb and VIIIc). It is expected then combination of these data should be possible. During the study period some countries (France, Portugal) are going to change their research vessel or their sampling gear. Catchability conversion factors will be estimated. Likewise the creation of a data base in standardized files is also considered.

Revision of sampling design

Selection of an homogeneous criteria concerning sampling design (depth strata, station grid, haul monitoring, hydrographic stations scheme, etc.) is necessary. The precision of the species abundance indices is dependent of the degree of homogeneity of the strata. It is evident that in the whole of the ICES area there are different biological communities and target species, which implies that a design of strata suitable for one area is not necessarily so for another. The target species of the fleet working in the Gulf of Cadiz and the fish communities present there are very different to those found in the Celtic Sea. A first approximation has been made by analyzing the data of recent years from Spanish historical series in an attempt to determine whether the stratification used to date is suitable, or if other more homogeneous strata should be adopted which provide an improvement in the precision of indices. With multi-species surveys, a stratification suitable for one species is not necessarily so for others. This becomes even more complicated when the same species, in the different stages of its life, occupies different niches (juveniles usually live in more superficial waters than adults). One way of dealing with the problem is to apply multi-variant analyses to a matrix of data to determine the degree of similarity between sampling stations and to establish the main groupings or associations between species. Previous works of this type have been reported for the Spanish and Portuguese waters (Anon., 1997a, Cardador, 1997, Sánchez, 1997)

In general in this area the seasonal spatial distribution of the target species as well as their abundance variability by stratum is well understood. The work developed by the ICES Methods Working Group has been a forum of useful analysis and discussions on clarifying the appropriate use of this type of surveys for analytical assessments. They have been used in tuning methods of the Virtual Population Analysis, Laurec and Shepherd (1983) Extended Survival Analysis (Shepherd, 1992), Integrated Catch Analysis (Patterson and Melvin, 1996).

To improve the abundance indices estimation, based on the fixed sampling design in use in the Portuguese surveys application of generalized additive methods and generalized linear models and other statistical studies are expected to be further developed in the near future under a FAIR project proposed in 1997.

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TABLE 1 - PORTUGUESE SURVEYS: List of surveys, fishing days and valid hauls by survey

LIST OF SURVEYS DURING 1979-1996

YEAR	LATE WINTER /		
	SPRING	SUMMER	AUTUMN
1979		X	X
1980	2 X (1)		X
1981	X	X	X
1982	X	X	X
1983	X	X	X
1984			
1985		X	X
1986		X	X
1987			X
1988			X
1989		X	X
1990		X	X
1991		X	X
1992	X	X	X
1993	X	X	X
1994			X
1995		X	X
1996			X
TOTAL	7	12	17

TOTAL FISHING DAYS BY SURVEY

YEAR	LATE WINTER /		
	SPRING	SUMMER	AUTUMN
1979		12	14
1980	16 + 9		19
1981	19	18	18
1982	14	17	33
1983	18	17	22
1984			
1985		22	24
1986		17	21
1987			14
1988			17
1989		25	23
1990		23	35
1991		30	32
1992	27	22	16
1993	23	21	20
1994			27
1995		21	24
1996			22
TOTAL	126	245	381

TOTAL VALID HAULS BY SURVEY

YEAR	LATE WINTER /		
	SPRING	SUMMER	AUTUMN
1979		55	55
1980	63 + 36		62
1981	67	69	111
1982	69	70	189
1983	69	68	117
1984			
1985		101	150
1986		118	117
1987			98
1988			81
1989		114	138
1990		98	123
1991		119	99
1992	88	81	59
1993	76	66	65
1994			94
1995		81	88
1996			71
TOTAL	468	1040	1717

(1) - SouthWest and South

1996 - R/V "Capricórnio", trawl net without rollers

Table 2 - Type of biological studies carried out by species using information collected from the Portuguese and Spanish groundfish surveys series.

Biological studies	Species
Distribution	hake, horse-mackerel, mackerel, Spanish mackerel, blue whiting, four-spot-megrim, megrim, black and white monkfish, John dory (<i>Zeus faber</i>), rock fish (<i>Helicolenus dactylopterus</i>), Pouting (<i>Trisopterus luscus</i>) European squid (<i>Loligo vulgaris</i>) and Veined squid (<i>Loligo forbesi</i>)
Length-weight relationship	hake, horse-mackerel, mackerel, Spanish mackerel, blue whiting, European squid and Veined squid.
Age determination	hake, horse-mackerel, mackerel, Spanish mackerel, blue whiting, four-spot-megrim, European squid and Veined squid
Maturity	hake, horse-mackerel, mackerel, Spanish mackerel, blue whiting, four-spot-megrim, black monkfish, European squid and Veined squid
Fecundity	horse-mackerel
Food habits	hake, horse-mackerel, mackerel, blue whiting, black monkfish, John dory , European squid and Veined squid
Recruitment	hake, horse-mackerel, mackerel, blue whiting, megrim, four-spot-megrim
Genetic	hake
Parasitism	horse mackerel, hake, mackerel
Communities, diversity	demersal fish and invertebrates
Trawl selectivity	hake, horse mackerel

Table 3 - Groundfish surveys series used in ICES stock assessment Working Groups (in VPA tuning), by species.

Species	Survey series			Source
	Portuguese Summer	Portuguese Autumn	Spanish Autumn	
Hake	since 1989	since 1989	since 1983	ICES, 1997a
Horse-mackerel	since 1989	since 1985	since 1985	ICES, 1997b
Mackerel		since 1986	since 1984	ICES, 1997b
Four-spot-megrim	since 1989	since 1990	since 1988	ICES, 1997a
Megrim	since 1989 (*)		since 1988	ICES, 1997a
Blue whiting		since 1985	since 1985	ICES, 1996
Norway lobster		since 1990 (*)		ICES, 1997c

(*) used only for cpue trend analysis

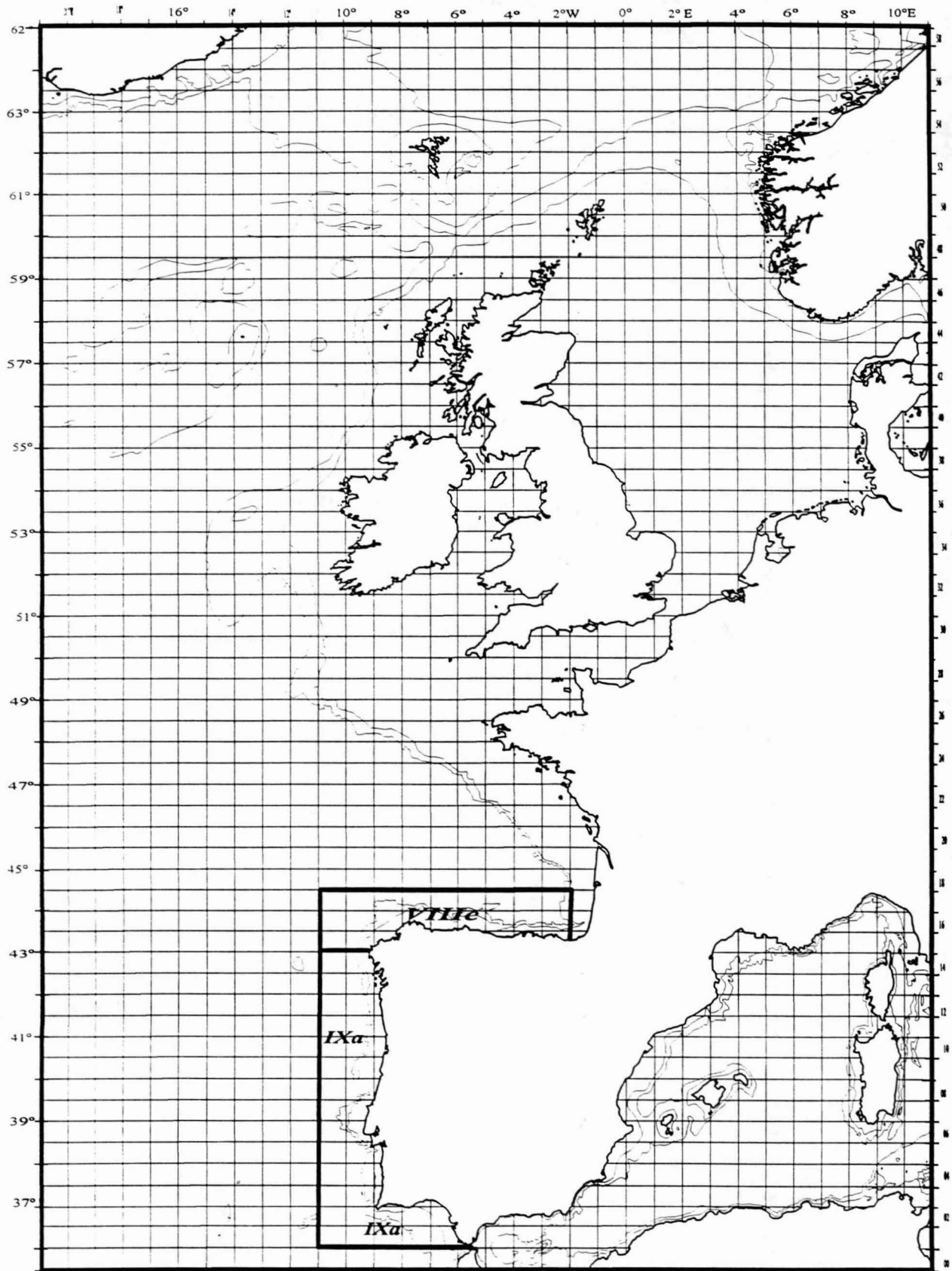


FIGURE 1 - ICES DIVISIONS VIIIc and IXa - Area covered by Spanish and Portuguese Groundfish Surveys

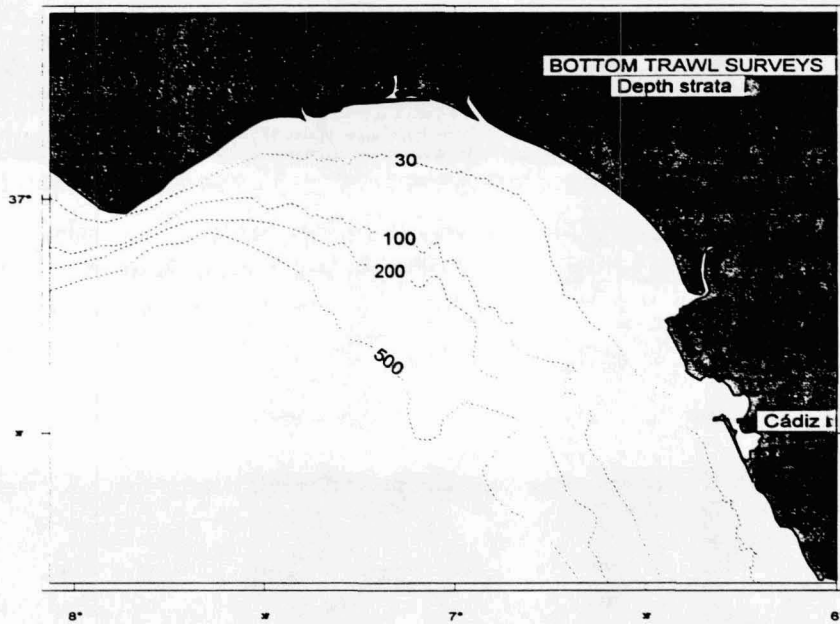
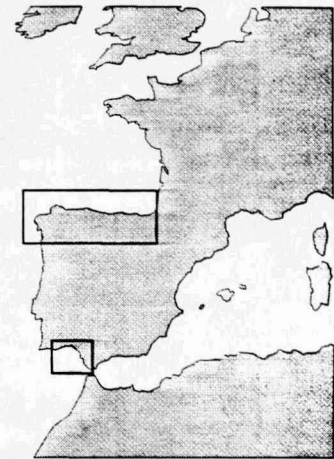
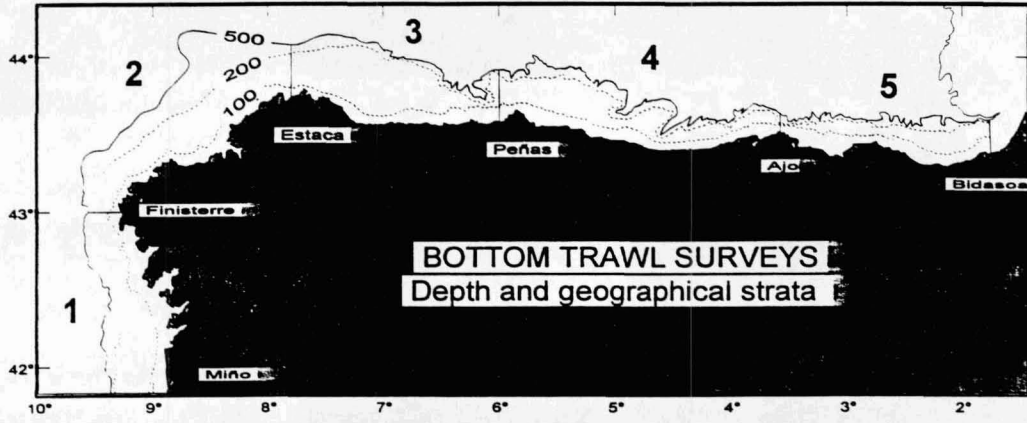


FIGURE 2 - Spanish surveys: depth and geographical strata

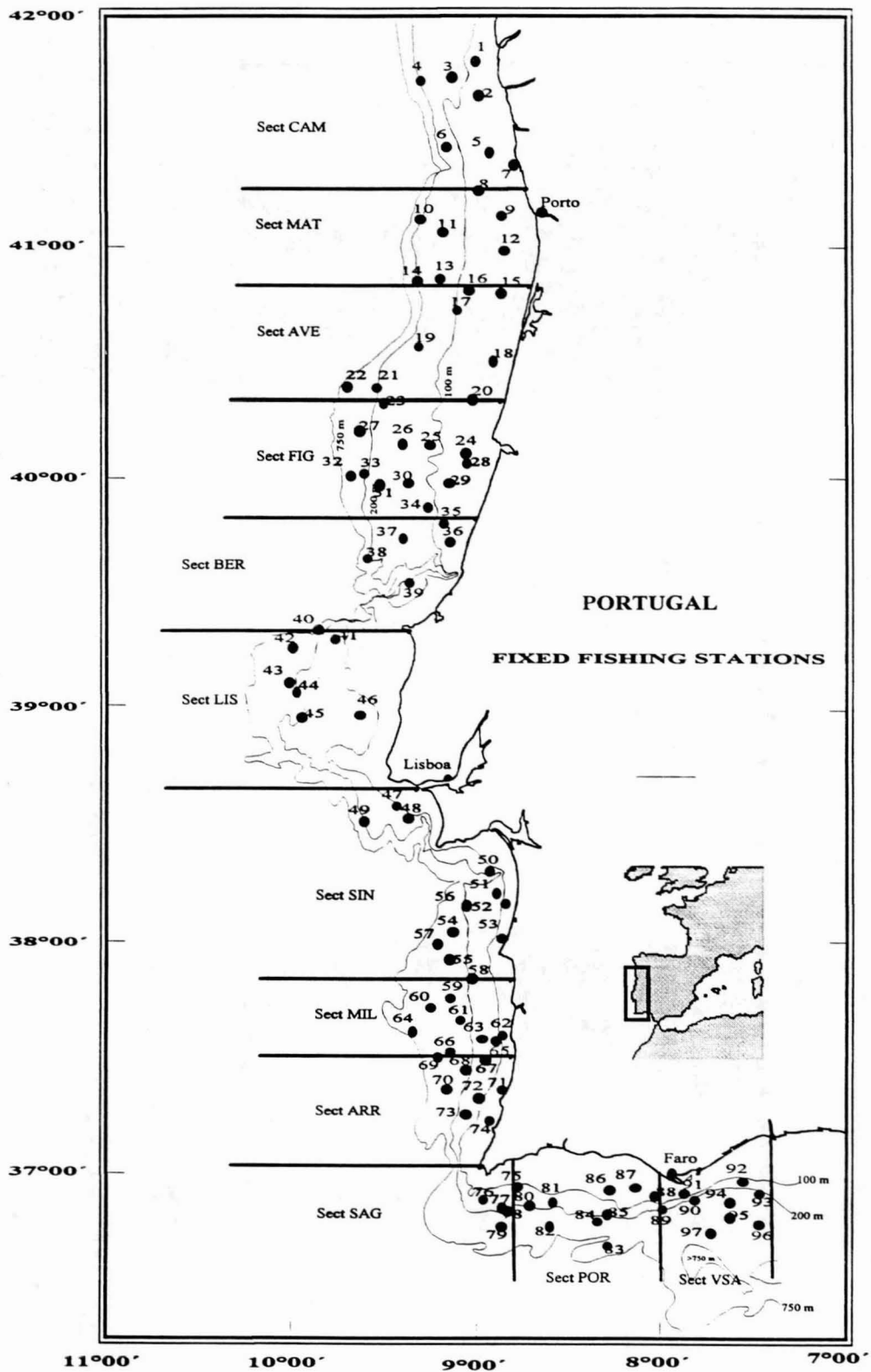


FIGURE 3 - Portuguese surveys: depth and geographical strata