

**MANUAL FOR THE INTERNATIONAL BOTTOM TRAWL
SURVEYS IN THE WESTERN AND SOUTHERN AREAS**

REVISION II

**Agreed during the meeting of the International Bottom Trawl Survey Working Group
8-12 April 2002, Dublin**

1 INTRODUCTION

The International Bottom Trawl Survey Working Group, has the responsibility of coordinating various research vessel surveys conducted within certain ICES areas. The first survey to be coordinated was the International Young Fish Survey (IYFS) that was conducted in the North Sea and Skagerrak/Kattegat. A procedural manual was produced for the use of scientists involved in this survey.

In 1995 the manual was revised for a fifth time in order to clarify certain aspects of the surveys in the North Sea and Skagerrak/Kattegat (ICES CM 1999/D:2). At the same time the opportunity was taken to review the manual to establish whether the same procedures could be applied to Sub-Areas VI, VII and VIII and Division IXa. It was decided that some aspects of the manual applied equally to all areas but some procedures required dedicated text. These unique procedures were provided in Appendix XI as a draft.

In the 1999 IBTS Working Group meeting in Lisbon, due to the considerable difficulties in merging the protocols used in the North Sea with those used in the western and southern divisions, it was decided that two manuals should be the standard: one relating to the North Sea and the other to the western and southern areas. It was also decided that the latter should be based on the manual produced in the SESITS project (Evaluation of demersal resources of Southwestern Europe from standardized groundfish surveys - Study contract 96-029), which this documents refers as a 1° draft.

2 LIST OF SURVEYS

Scottish Surveys

- Quarter 1, Groundfish survey in ICES Division VIa (SGF6a)
- Quarter 3, Rockall Survey (SGF6b) (every second year)
- Quarter 4, Scottish Mackerel Recruit Survey (SMR)

Northern Ireland surveys

- Quarter 1, Northern Ireland Groundfish Survey in the Irish Sea (Division VIIa) (NIGFSq1)
- Quarter 4, Northern Ireland Groundfish Survey in the Irish Sea (Division VIIa) (NIGFSq4)

Irish surveys

- Quarter 4, West coast Groundfish Survey (WCGS)
- Quarter 4, Irish Sea-Celtic Sea Groundfish Surveys (ISCS)

English Survey

- Quarter 1, Celtic Sea and Western Approaches Groundfish Survey (CSGF)

French surveys

- Quarter 4, French Groundfish Survey in the Eastern Channel (Division VIId) (CGF)
- Quarter 4, French Groundfish Survey in the Celtic Sea and Bay of Biscay (Divisions VIIIf,g,h,j; VIIIf, b) (EVHOF)

Spanish surveys

- Quarter 3, Spanish Groundfish Survey in the Porcupine bank (Divisions VIIIf,k) (SPGFk)
- Quarter 4, Spanish Groundfish Survey in the Cantabrian Sea and Off Galicia (Divisions VIIIf and Northern part of IXa) (SPGFN)
- Quarter 2 and 4, Spanish survey in the Gulf of Cadiz (Southern part of division IXa) (SPGFs)

Portuguese surveys

- Quarter 3 and 4, Portuguese Bottom trawl Survey (Portuguese shelf - Division IXa) (PGF)

3 OBJECTIVES

The main objectives of the demersal surveys listed above are:

- to determine the distribution and relative abundance of all species of fish within the surveys area, particularly those of commercial importance,
- to estimate the distribution and abundance of recruits of the main commercial species to derive recruitment indices,

- to monitor changes in stocks of commercially important fish species independent of commercial fisheries data and to monitor changes in species currently not of commercial importance,
- to describe the spatial distribution pattern of all species,
- to collect data for the determination of biological factors including feeding, growth, maturity evolution, sex-ratio, weight,
- to analyse the effect of the environmental conditions in the species abundance distributions.

The commercial species are: cod, haddock, saithe, herring, hake, blue whiting, megrims, monkfishes, horse mackerel, mackerel, Spanish mackerel, rose and red shrimps and Norway lobster.

4 SURVEYED AREA AND SEASON

The total area surveyed extends from Scotland to the Gibraltar strait (59°40' N to 36° N), in depths between 20 to 750 m. This surveyed area covers the ICES Divisions VIa, VIIa,b,e,f,j,g,h, VIIIa,b,c and IXa (Figure 1).

The Quarter 1 Scottish Groundfish survey covers Division VIa and extends into the northern part of the Irish Sea and NW of Ireland. The depth range covered has been 20 to 500m since 2000. The survey is usually carried out in March of each year. The target species are cod, haddock, whiting, saithe and herring and age frequencies are constructed for these species. All other fish species encountered are also sampled for at least length frequencies. Indices of abundance at age are calculated for all the target species and these data are used at the Northern Shelf Assessment Working Group and also made available for the Herring Assessment Working Group.

The Quarter 3 Rockall survey is carried out in September every second year – currently falling on the odd years. The survey covers the whole of the Rockall Bank down to 250m depth.

The Mackerel recruit Quarter 4 survey covers the same general survey area as the first quarter groundfish survey began in 1985 and also has a depth range of 20 – 500m. The survey is carried out in November every year. The target species have now been extended to include cod, haddock, whiting, saithe and herring as well as the original target of mackerel. The demersal time series is still too short to be of use to the Northern Shelf Assessment Working Group.

The Northern Ireland surveys have been carried out in March and October since 1992. From March 1992 to March 2001, the survey extended from 54° 43' N to 53° 22' N. From October 2001 the survey is extended into the St George's Channel to 52° 18' N. Depth range is from 20 to 120m.

The Irish west coast groundfish survey is carried out in two parts: Part A covers ICES Division VIa (south) and VIIb (north); Part B covers ICES Division VIIb and VIIj. The survey is conducted from 15 to 300 m depths during the fourth quarter (October - November).

The Irish survey in the Irish Sea and Celtic Sea covers ICES Division VIIa and VIIg. The survey is conducted from 10 to 150 m depths during the fourth quarter (November-December).

The Spanish survey in the Porcupine bank covered ICES Division VIIb,k corresponding to the Porcupine Bank and adjacent area in western Irish waters from longitude 12° W to 15° W and from latitude 51° N to 54° N, covering depths between 180 and 800 m during the third quarter (August- September).

The English survey in the western approaches covers the area 47° 30'N to 52° 30'N and 3° W to 12° W, covering depths 40 to 600m in March/April each year.

The French demersal groundfish survey covered the ICES Divisions VIIf,g,h and VIIIa,b corresponding to Celtic Sea and Bay of Biscay. The area surveyed extends from the latitude 46°10' N to 51°40' N, and from 20 m to 600 m (400 m before 1999) during the fourth quarter of the year (October – November).

The northern Spanish groundfish survey covered ICES Division VIIIc and the northern part of IXa corresponding to the Cantabrian Sea and off Galicia waters. The surveys are conducted from 35 to 700 m depths during the third and the fourth quarter (September – October).

The southern Spanish groundfish survey is conducted in the southern part of ICES Division IXa, the Gulf of Cádiz. The covered area extends from 15 m to 700 m depth, during late Winter and Autumn.

The Portuguese groundfish surveys have been conducted since 1979 twice a year (in Summer and Autumn), covering Division IXa in Portuguese waters. The area surveyed extends from latitude 41°20' N to 36°30' N, and from 20 to 750 meters depth.

The historical evolution of the surveys is described in section 10.

5 SAMPLING DESIGN

The total covered area has been stratified according to depth and geographical criteria and a stratified random sampling scheme has been adopted for France and Spain. In Portuguese surveys a fixed sampling scheme is used. The bathymetric and the geographic strata used for all the demersal surveys are presented in figures 1 and 2. The total area covered corresponds to 286403 Km² (Table I).

Table I. Surface of the geographic sectors considered during the SESITS project.

Zone	Geographic Sector	
	Name	Km ²
Celtic sea	CN	35115
	CC	54535
	CS	69971
Bay of Biscay	GN	56820
	GS	14470
Cantabrian sea	AB	2460
	PA	4614
	EP	5352
Galicia	FE	7774
	MF	4139
Portugal	PN	11245
	PW	5837
	PS	7296
Gulf of Cádiz	CA	6774
Whole area		286403

The **Scottish West Coast Surveys** use a similar ICES rectangle based sampling strategy to that used in the North Sea. Trawl stations are selected at one tow per rectangle based on a library of clear tows. There is no explicit return to the same trawling position every year, although this is generally the case. Since 1999 the potential for using a depth rather than rectangle based stratification has been under investigation. To this end, and where possible, those rectangles which display substantial internal depth variation have been sampled twice at different depths. The recent inclusion of samples collected between 200 and 500m would suggest that depth stratification should be initiated as soon as possible.

Scottish Rockall Survey is a survey of a relatively small area, in the order of eight ICES rectangles. Trawl stations are on known clear tows and vary between 2 and 8 per rectangle depending on the proportion of the area inside 250m.

In the Northern Ireland surveys, the sampling design is stratified with fixed-position stations. Stratification is by depth and seabed type (Fig. 3). Haul duration is 3 nautical miles at 3 knots over the seabed. Stations in the St George's Channel are 1 nautical mile at 3 knots and have only been surveyed since October 2001. Number of stations is 45 in northern Irish Sea and 12 in St George's Channel. Tows are day time only.

The Irish surveys use an ICES rectangle based sampling strategy. The sampling design attempts to allocate at least two stations per rectangle (where the sea area is appropriate). Stations are selected randomly within each rectangle from known clear tow positions. On the WCGS and ISCGS *circa* 70 fishing stations are planned on each survey every year. This number of hauls is adjusted according to the ship time available at sea.

In the Spanish survey in the Porcupine bank the whole area has been separated in two geographical strata and three depth strata (less than 200 m, 200-400, 400-800 m), resulting in 5 strata, given that there are no grounds shallower than 200 m in Outer geographical strata (Figures 2 and 4). The sampling design is random stratified with proportional allocation and a minimum of two stations per stratum with a total of 80 fishing stations.

English survey fishes fixed station positions allocated by area (division lines at 48° 45'N and 50° 15'N) and depth strata (40-89, 90-114, 115-139, 140-179, 180-299 and 300-600m).

In the French surveys the whole area has been separated in 5 geographical strata or sectors: southern Bay of Biscay (GS) and northern Bay of Biscay (GN), southern Celtic Sea (CS), center Celtic sea (CC) and northern Celtic sea (CN). In each sector a stratification scheme considering depth ranges has been adopted. 7 depth ranges has been considered: 0 - 30m, 31 - 80 m, 81-120 m, 121 - 160 m, 161 - 200 m, 201 - 400 m and 401 – 600m (Figures 2 and 5).

The sampling design is a stratified random allocation. The number of hauls per stratum is optimised by a Neyman allocation taking into account the most important commercial species in the area (hake, monkfishes and megrims). Minimum of two stations per stratum is performed and 140 fishing stations are planned every year. This number of hauls is adjusted according to the ship time available at sea.

In the Spanish surveys the area has been stratified according to depth and geographical criteria and a stratified random sampling scheme has been adopted. In the northern surveys (Cantabrian Sea and Galician waters) three depth strata have been used (80-120, 121-200, 201-500 m) and 5 geographic sectors (Figures 2 and 6). Supplementary hauls in deeper bottoms (500 - 700 m) and shallows waters (30 – 80 m) may be conducted depending of the ship time available at sea. In the southern surveys five depth strata have been used (15-30, 31-100, 101-200, 201-500 and 501-700 m) (Figures 2 and 6).

The number of hauls per strata is proportional to the trawlable surface adjusted with the ship time available at sea. A coverage of 5.4 hauls for every 1000 Km² (120 hauls per survey) is approximately conducted in the northern area.

In the Portuguese surveys the sampling design follows 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 (Figure 2), with a total of 48 strata (Figure 7). The positions of the 97 fixed stations were selected based on common stations made during 1981-1989 surveys and taking into account that at least 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.

6 VESSELS AND GEARS

The specifications of the vessels and gears used by each country in the groundfish surveys are presented in Table II.

The gear deployed on **all the Scottish surveys** is the 36/47 GOV trawl fitted with heavy ground gear 'C' and a 20 mm internal liner. The vessel undertaking this survey changed to *Scotia III* in March 1999 from the previous *Scotia*. The gear includes a full suite of Scanmar sensors; headline height, wing and door spread and speed through the water.

The **Northern Ireland surveys** are carried out on the R.V. *Lough Foyle*, a 43.5m stern trawler of 880 kw and GRT 547 tonnes. The fishing gear is a rock-hopper otter trawl with a 17m footrope fitted with 250 mm non-rotating rubber discs. The gear has a mean vertical opening of 3 m. The door spread varies from around 25m at 20 m depth to 40m at 80m depth. A 20mm (inside mesh) codend is fitted.

The **Irish west coast groundfish survey** is carried out on chartered commercial fishing vessels. Whilst the same vessel (MFV *Marliona*, 224 gross tonnage and 30 m LOA) has normally been used each year for Part A and Sionann for Part B, in 2001 Part B was conducted from the MFV *Regina Ponti* (34.5 m LOA). Both vessels use a Rockhopper net with 12 inch idscs and 11 inch Thyboron doors. The nets are fitted with a 20-mm codend liner. Gear performance throughout the survey is monitored using Furuno Ch24 (Headline Monitor).

The **Irish Sea and Celtic Sea groundfish survey** is conducted from the RV *Celtic Voyager*. This vessel is 32 m in length with gross tonnage of 340 t. The fishing gear used is a GOV 28.9/37.1 Trawl with Morgere Kite (0.85 by 0.85m). Mean vertical opening is 6 m and door spread 48 m. Morgere Polyvalent doors (Type AA4.5) are used and gear performance is monitored throughout the survey using the SCANMAR (RX400) net monitoring system (Headline height, Door spread).

The **Spanish survey in the Porcupine bank** is carried on the R/V *Vizconde de Eza*. This vessel is a stern trawler of 53 m length and 13.5 m wide with gross tonnage of 1400 t. Fishing gear used is a Porcupine baca 60/72 with 59.46 m footrope and a 71.96 headline (Figure 9). Doors are oval with 800 kg and 4.5 m² surface. Diameter of warp used is 20 mm, of sweeps is 55 mm and the groundrope 98 mm with a double synthetic coat. Mean vertical opening is 3.5 m and door spread 120 m. Codend mesh size is 20 mm.

The **English survey** in the western approaches is carried out on the RV *Cirolana*, a stern trawler 74m in length with a gross tonnage of 1731 t. The fishing gear used is a modified Portuguese High-Headline trawl (PHHT) with 350mm rubber bobbins, a bunt tickler chain and a 20mm codend liner.

Since 1997, the **French survey** has been carried out on the R/V *Thalassa*, a stern trawler of 73.7 m length by 14.9 m wide, gross tonnage of 3022 t. The fishing gear used is a GOV 36/47 without exocet Kite which is replaced by 6 additional floats (Figure 8). In average, the gear has a horizontal opening of 20 m and a vertical opening of 4 m. The doors are plane-oval with 1350 Kg.

All Spanish surveys in Spanish waters were carried on with R/V *Cornide de Saavedra*. This stern trawler was transformed in 1984 from its original 56 m (LL) and 990 GRT to 67 m and 1133 GRT at present. The gear used is a Baka trawl 44/60 with a 43.6 m footrope and a 60.1 headline (Figure 10). The traditional trawl doors used are rectangular, weighting 650 Kg and 3.6 m² of surface (2.67*1.34 m). The diameter of warp used is 22 mm (1.9 Kg/m). The mean vertical opening is 1.8 m and the horizontal opening is 21 m. Up to 1985, a codend cover of 20 mm mesh was used, and since then, a 20 mm mesh codend liner has been adopted.

The **Portuguese surveys** are carried with the R/V *Noruega*, which is a stern trawler of 47.5 m length, 1500 horse power and 495 G.T.R. The fishing gear used is a bottom trawl (type Norwegian Campell Trawl 1800/96 NCT) with a 20 mm codend mesh size (Figure 11). The main characteristic of this gear is the groundrope with bobbins. The mean vertical opening is 4.6 m and the mean horizontal opening between wings and doors is 15.1 m and 45.7 m, respectively. 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.

Table II. Sampling materials used in the groundfish surveys.

Country/Institute	Ireland	UK/ Scotland	UK/North Ireland	UK/ England	France	Spain	Spain /Porcupine	Portugal
Sampling Material	MIFRC	MLA	DARD	CEFAS	IFREMER	IEO	IEO	IPIMAR
Research vessel	<i>Celtic Voyager</i>	<i>Scotia</i>	<i>Lough Foyle</i>	<i>Cirolana</i>	<i>Thalassa</i>	<i>Cornide de Saavedra</i>	<i>Vizconde de Eza</i>	<i>Noruega</i>
Type	Stern Trawler							
GRT	340	N/A	547	1731	3022	1133	1400	496
KW	N/A	N/A	880	N/A	2200	1650	1800	1100
Overall length (m)	32	68.6	43.5	74	72.7	67	53	47.5
6.1.1.1 Gear Type	GOV 28.9/37.1	GOV 36/47	Rock Hopper	PHHT	GOV 36/47	BACA 44/60	BACA 60/72	NCT
Depth range (m)	15-200	20-200	20-120	40-600	30-400	30-700	150-800	30-750
Trawling speed (knots)	3.5	4	3	4	4	3	3.5	3.5
Doors weight (kg)	500	1100	N/A	1440	1350	650	800	650
Doors surface (m ²)	3.99	4.5	N/A	4.5	4.5	3.58	4.5	3.75
Sweep length (m)	60	60	12.5	18.28	50 100	200	250	No
Diameter of Lower Bridle (mm)	20	20	18	20	22	No	18	16
Diameter of Upper Bridle (mm)	12	14	20	16	12	No	18	14
Diameter of Middle Bridle (mm)	12	14	No	No	12	No	No	14
Exocet Kite	Yes	Yes	No	No	No	No	No	No
Floats in Headline	18	20	No	20	18	25	12	80
Floats in Winglines	32	20 + 20	No	32 + 32	24 + 24	15 + 15	32	80
Mean vertical opening (m)	6	4.6	3	4.4	4 4.1	2.0	3.5	4.8
Mean doors spread (m)	48	82	37	81.7	76.9 112.7	107.1	120.4	44.3
Mean horizontal opening (m)	N/A	19.6	N/A	N/A	18.7 20.5	18.9	20	15.6
Groundrope	Rubber disks	Bobbins	Rubber disks	Rubber bobbins + Rubber disks + Chain	Rubber disks and Chains Rubber and metal disks	Synthetic wrapped wire core	Synthetic wrapped wire core double coat	Bobbins

7 TECHNICAL DESCRIPTION OF THE HAULS

Start time of the haul is defined as the moment when the vertical net-opening and doorspread are stable. Stop time is defined as the start of pull back.

Net monitoring should be used in all fishing operations in order to ensure the proper gear deployment. Vertical net opening and doorspread should be monitored at 30 seconds intervals and mean valid values should be reported. It is recommended that wing spread be also measured.

The hauls duration varies from 30 minutes (Porcupine, France and North of Spain) to 60 minutes (Portugal and South of Spain - Bay of Cádiz and England) and are carried out during daylight at a towing mean speed from 3.0 knots (Spain) to 3.5 knots (Porcupine and Portugal) and 4 knots (France and England).

8 BIOLOGICAL DATA

The catch is sorted by species, counted and weighted. In the case of a huge catch of one dominant species, only a fraction of the catch is sorted.

Length distributions are recorded for all fish and other commercial species caught. Length is measured:

- 1 mm below for commercial crustaceans (cephalothorax length)
- 1 mm below for commercial cephalopods (mantle length)
- 0.5 cm below for herring, sprat, anchovy and sardine (total length)
- 1 cm below for all other fish species (total length).

Biological parameters (length, weight, status of maturity among others) and hard structures (otoliths and *illicia*) are collected. The specification of the sampling level of otoliths and *illicia* is described in Table III.

In the April 2002 meeting of the IBTS WG, and following a study carried on sampling optimization presented at the 2001 ASC, it was recommended that for megrim ageing, sampling for age and length should be stratified by sex with a minimum sampling level of 5 otolith/cm/sex fixed allocation.

Table III - Specification of the sampling level of otoliths and *illicia* by country.

Species	Country	Otoliths, <i>illicia</i> or spines
<i>Gadus morhua</i>	FR,SC IR	All individuals Juveniles: 5/cm/ICES Div, Adults: 10/cm/ICES Div
<i>Lepidorhombus whiffiagonis</i>	FR,SC IR SP P	8/cm/sex/area Juveniles: 5/cm/ICES Div, Adults: 10/cm/ICES DIV 20/cm 3/cm/sex/area
<i>Lepidorhombus boscii</i>	FR,SC SP P	No 10/cm 3/cm/sex/area
<i>Lophius piscatorius</i>	All (IR from 2002) SC	All individuals (illicium) None
<i>Lophius budegassa</i>	FR,SP,P (IR from 2002)	All individuals (illicium & 2 nd fin ray) All individuals (Illicium only)
<i>Melanogrammus aeglefinus</i>	IR,SC	1/cm/ICES Rectangle
<i>Merlangius merlangus</i>	FR IR,SC	Proportional 1/10/cm/sex/area 1/cm/ICES DIV.
<i>Merluccius merluccius</i>	FR IR SP P	8/cm/sex/area 8/cm/undet./area Juveniles: 5/cm/ICES Div, Adults: 10/cm/ICES Div < 17 cm - 1 each 3 individuals > 17 cm - all individuals 3/cm/sex/area >40cm - all individuals 10/cm/undet./area
<i>Micromessistius poutassou</i>	SP P	10/haul (random) 10/cm/sex/area
<i>Microstomus kitt</i>	IR	5/cm/ICES Div
<i>Molva molva</i>	FR	All individuals
<i>Pleuronectes platessa</i>	IR	1/cm/ICES Rectangle
<i>Pollachius pollachius</i>	FR	All individuals
<i>Pollachius virens</i>	IR,SC	All individuals
<i>Scomber scombrus</i>	SP,SC P	10/cm/area 5/cm/sex/area
<i>Scomber japonicus</i>	P	5/cm/sex/area
<i>Solea vulgaris</i>	FR IR	All individuals Juveniles: 5/cm/ICES Div, Adults: 10/cm/ICES Div
<i>Squalus acanthias</i>	IR	Spines All individuals
<i>Trachurus trachurus</i>	SP P	15/cm 5/cm/sex/area 10/cm/undet./area

9 ENVIRONMENTAL DATA

9.1 Hydrographic data

The sampling design has to satisfy the requirements to resolve the following processes:

- Coastal Upwelling
- Ekman divergence near the capes
- Fluxes over the shelf, slope currents and circulation in the off-slope area
- Mesoscale features

CTD sampling station distribution satisfies the requirements of high resolution sampling along tracks to separate mesoscale features. The required separation between sampling points is of 10 - 15 km and the distance of the tracks off the break-shelf no major than 30-40 km. In order to detect the upwelling phenomenon, in regions where the shelf is narrow (less than 15 km), at least two sampling points are performed from the coast to the break-shelf. Homogeneous distribution of CTD stations at both sides of the most prominent capes is also conducted to evidence Ekman divergence processes. To evaluate the slope currents sample of at least three CTD casts in the following manner are done: one over the shelf, the second over the shelf-break (200 m depth) and the third off the shelf break. Equal separation distance among stations is convenient.

CTD stations outside the continental shelf are conducted during Spanish and Portuguese surveys in perpendicular profiles to the coast, with a minimum of two casts in the open ocean. In the Spanish surveys, whenever possible, information relative to the estimation of primary production is also collected. According to this, to exploit to the full the cruise, it is recommended the CTD system to have fluorometer and oxygen sensor, as well as the usage of at least a Niskin bottle (1.5 l) attached to the CTD cable at a depth of 40 m.

To avoid the aliasing effect and to improve the data analysis, CTD sampling stations are homogeneously distributed all over the study area, avoiding leaving large extensions uncovered. CTD casts sampled at stations over the shelf area cover the whole water column, from surface to bottom. When stations and CTD casts are over the slope area sample are conducted at least till 400 m depth.

Debris data

The main debris caught during the trawl operations are collected and counted by categories (plastic, wood, metal, glass, etc.).

10 DATABASE

Fish data from the **Scottish surveys** are collected on paper and entered into an in-house archival programme at sea. These are then transferred to a VAX native database on return to the laboratory. Age data are added to this database after age determination. Haul data are also recorded on paper and subsequently transferred to *chron* files for archival on the VAX system. Trawl surveillance data are recorded by PC using in-house software. Only summary data are routinely archived. FRS is currently (2002) in the process of developing a new SQL database system using NT servers. This will include all biological and haul data.

Northern Ireland surveys station and catch data are archived on board using an Oracle data base developed during 2001 and 2002. Biological data are entered on shore using a separate Oracle database.

The **Irish Marine Institute's** is currently developing a centralised client/server database application, STOCKMAN, operating under SQL Server 7. Recent developments relate to the implementation of a data analysis module to facilitate the extraction/exclusion of data, the editing and archiving of individual length frequencies and ALK's and the output of reports, including data precision statistics, in a number of formats. A routine to estimate sample CV's has been hard coded in to the data analysis module of STOCKMAN to provide the estimates of data precision required under the EU data collection regulation (1639/2001). Extracted data can be saved in a number of standard formats such as Excel, ASCII and CSV to facilitate further analysis and international data exchange.

Input of survey data is being facilitated through a single operation bulk upload from a temporary MS Access database. This Access database is created using electronic measuring boards, developed by CEFAS, and in use on the ISCGS groundfish surveys since November 2000.

At the moment, the **English survey** database is held on an INGRES database, designed inhouse by CEFAS. Forms containing station details, catch records, length data and biological information are created and stored on this system. The system runs on a VMS operating system and is in the process of being rewritten due to VMS not being supported from 2003. A description of the new database will be included when available.

Prior to 1997, all the **French data** were stored on a PC format database (MDBS Knowledgeman II). A new database was installed on board the RV THALASSA in 1998. This new database is in the MS Access format and is constituted with different types of files: (i) station information files containing all information about the haul (station reference number, position, depth, etc.); (ii) weight per haul file in the form of a table (lines: stations number, column: for each species the total weight per haul); (iii) number per haul file: the same structure than before but with total number per haul; (iv) length composition file (one file in the form of a table (lines: station number, species, sex; columns: total number per length class). This database is still under development and will eventually incorporate the data prior to 1997. The hydrographic data are in text format, as processed by the CTD software (*.avg). An application developed with Arcview processes those files to give charts of temperatures at different depth levels. All intermediate information (raw data, sample ratios, and scanmar data) are kept and stored on CD-ROM in asccii files and/or MS Access.

All the **Spanish survey** data are processed on board using a software package specifically created for it (files in *dBase III* format). This program was designed to be straightforward and logical, and solves the greater part of the processing of data collected in the bottom trawl surveys in which a stratified sampling methodology is used. It is possible to work with the program in small computers (8086 PC) on board commercial vessels. Two master files (species and gears) and seven incidence files per survey (survey design, hauls characteristics, gear performance, catch by specie (number and weight), length distribution, age/length key and hydrography) exist. This software has the possibility to generate the file formats for records types 1, 2 and 3 of IBTS data. Data concerning fishing stations, catch composition by species in weight, in number and by length (only for all fish species and Norway lobster) are recorded since 1980.

In 1990, a **Portuguese 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). In 1996 this database was transferred to a windows environment using Microsoft Access 2.0 and in 1999 it was converted to Microsoft Access 97. Six main tables are part of this database, two of which contain the log sheet (haul information, positions, etc.), two containing species sheet (catch data) and two containing sample length distribution. Maturity stages, individual weigh and otoliths are recorded in four independent tables, one for each species (megrim and monkfishes, hake, horse mackerel and blue whiting). Three accessory tables were also adopted containing scientific and common names and the three FAO letter codes for the species, fixed station information (position and depth) and information collected with the SCANMAR equipment.

11 GROUND FISH SURVEY HISTORIES

The Quarter 1 Scottish Groundfish survey started in 1981 and was originally targeted towards the fishing grounds on the continental shelf to the west of Scotland; in 1996 the survey area was extended to include the northern Irish Sea.

The target species are cod, haddock, whiting, saithe and herring and age frequencies are constructed for these species. All other fish species encountered are also sampled for at least length frequencies. Indices of abundance at age are calculated for all the target species and these data are used at the Northern Shelf Assessment Working Group and also made available for the Herring Assessment Working Group.

The Quarter 3 Rockall began in 1985 and was carried out annually until 1997. However, in 1998 it was decided to make the survey a bi-annual event; in 1998 a new survey of deep water stocks was completed, in future the Rockall survey and a deep water survey will occur in alternate years. The Rockall surveys will generally be in September during odd numbered years.

The Mackerel recruit Quarter 4 survey covered the same general survey area as the first quarter groundfish survey began in 1985 and also has a depth range of 20 – 500m. The survey extended to the area west of the British Isles between 56B and 61B N and bounded by the 200m contour and the coast. It has generally not included the area of the Minch and the north channel of the Irish Sea. In 1998 the new research vessel *Scotia III* was used and the duration of the hauls was decreased from 60 minutes to 30 minutes. Up until 1995 the target species for this survey was mackerel but the Mackerel Assessment Working Group detected a discrepancy between the survey index and the VPA derived recruitment index. This led to a withdrawal of the survey index from the assessment. Given this situation the whole survey was re-designed to follow more closely the demersal quarter 1 survey. The mackerel survey now ends in the region of the northern part of Donegal Bay and also extends into the northern Irish Sea.

The **Irish West Coast Groundfish Survey** started in 1990 and for the first two years consisted of circa 25 stations concentrated around the Irish coast in ICES Areas VIa South and VIb. Adverse weather in 1992 limited station coverage to only 4 stations which effectively broke the time series. The survey was re-established in 1993 and has consisted of circa 70 stations, for Parts A and B combined, since then (see Figure 3). Spatial coverage was extended west out to the 200m contour, but remains as VIa South and VIb.

Due to the restrictions of the current and previous research vessel commercial trawlers have been contracted to carry out the survey work. Wherever possible continuity of vessel and gear has been maintained and standard IBTS methodology applied. However, due to the reduced staffing possible on commercial vessels it has rarely been possible to completely sort the catch. Until 2000 all cod were sorted from the catch and then a sub-sample of two baskets was taken and completely sorted. Last year, in response to an overall review of survey sampling undertaken during EU IPROSTS Project and also in anticipation of transferring this survey to our new research vessel in 2003, the catch is now completely sorted for all target species and a qualitative assessment made of the residual catch as a minimum.

The **Irish Sea Celtic Ground Survey** commenced in 1997 and evolved from an earlier Irish Sea Juvenile Fish Survey. As a consequence early survey stations concentrated largely around, though not exclusively, around a number of shallow spawning areas along the Irish east coast in VIIa. These positions were expanded in combination with clear tows provided by the industry and also CEFAS as well as some exploratory tows. Spatial coverage therefore extended into the western Irish Sea from 2001 into the area around the Isle of Man, Liverpool and Cardigan Bays and the Welsh coast. The survey is carried out on the Irish research vessel the R.V. Celtic Voyager which we received in 1997. The sampling procedure on board conforms to the IBTS standard protocols and as such all cod are sampled and aged, the entire catch is sorted and then sub-sampled as and where appropriate.

Trials on the new 65m research vessel, the R.V. Celtic Explorer, are due to commence in late 2002. Therefore, from 2003 onwards both the ISCGS and WCGS will be conducted on this new vessel, starting around mid October through to late November.

Porcupine survey began in 2001 and thus general description of the area and the methodology is applicable to this section.

During the late 1970's the Western mackerel stock fishery was expanding and concern for over-exploitation increasing. The **Celtic Sea and Western Approaches Groundfish Survey** was started, in 1981, with the aim of investigating the distribution, biology and pre-recruit abundance of this mackerel stock. These objectives were almost immediately extended to all species that could be adequately sampled with a bottom trawl. While mackerel was the primary target the survey covered all or part of the western continental shelf from the northern North Sea to the north coast of Spain. Later, as the objectives changed, the area shrunk in stages to its present boundaries: 47° 30' N to 52° 30' N and 3° W to 12° W. This has been the standard area since 1987. In the early years a March/April and December survey was carried out each year but since 1989 only the spring (quarter 1) survey has been conducted.

The **French demersal surveys** began in 1987. The survey area was limited to 48°30' N in the north and to the northern margin of Gouf de Cap Breton in the south (ICES divisions VIIh, VIIa,b,c and d). In 1990, the survey area was extended towards the north (up to 51°15' N) to cover the grounds of Celtic sea deeper than 100 meters (ICES divisions VIIe,f,g,h and j).

The survey was usually conducted in the fourth quarter (October-November) and some years in the second quarter (May-June) (Table IV). The old research vessel N/V Thalassa (a stern trawler of 66.7 m length and an engine power of 1323 kW) was used until 1995.

Table IV – French surveys: dates and number of hauls per area and year.

Year	Dates	Bay of Biscay	Celtic sea	Total
1987	30/09 - 30/10	131		131
1988	10/05 - 07/06	136		136
1988	07/10 - 04/11	134		134
1989	26/09 - 27/10	142		142
1990	25/09 - 10/11	137	56	193
1991	04/05 - 19/06	142	57	199
1992	18/09 - 30/10	107	52	159
1994	25/09 - 01/11	101		101
1995	07/11 - 11/12	114		114
1996	-	-	-	-
1997	4/10 - 21/11	77	53	130
1998	10/10 - 23/11	66	60	126
1999	10/11 - 24/12	52	59	111
2000	18/10 - 1/12	63	54	117
2001	18/10 - 1/12	69	82	151

Prior to 1997, the sampling designs were as follows:

a) In the Bay of Biscay (ICES divisions VIIh, VIIla,b,c and d) a stratified sampling scheme was originally used. The area was divided according to latitude into 3 blocks and the hauls were distributed in seven depth zones (15-30,31-80, 81-120, 121-160, 161-200, 201-400, 401-600 m). 100 hauls were made at fixed locations and 35 at changeable stations from year to year. Since 1989, all the hauls (mean number by survey 135) are made at the same locations.

b) In the Celtic Sea (ICES divisions VIIe,f,g,h and j) the sampling design was systematic, stations were located at the intersection points of a grid of lines 25 nautical miles apart both in latitude and in longitude. The mean number of sets was 56.

Catch weight and catch numbers were recorded for all species, only selected finfish and shellfish species were measured until 1990. Since 1991, all finfish and a selection of shellfish (mainly nephrops and squids) are measured.

Since 1992, gear geometry is monitored using Scanmar. On the other hand, salinity and temperature by depth are also recorded at the end of each fishing from this date.

Since 1974 the **IEO** has performed bottom trawl surveys in the Atlantic continental shelf waters of the Iberian Peninsula (Sánchez *et al.*, 1991; 1995). From 1980 the fishing resources of Divisions VIIlc and IXa of ICES were monitored through surveys, with the objective of following variations in the abundance of demersal and benthic species of commercial interest by means of indices independent of fishing activity. At the same time estimations were obtained of the strength of recruitment of diverse species (principally hake) during the autumn. The evaluations were made according to a stratified sampling protocol, maintaining other factors constant, such as time of year, ship, fishing gear, speed, trawl time, etc.

Two series of surveys have been conducted, one at Spring (April-May), starting in 1984, and the other in the Autumn (September-October) starting in 1980. The spring series ended in 1988 and the autumn one has been going on up to the present (Table V).

Table V. North of Spain surveys: dates and valid hauls per area by season and year.

Year	SPRING				AUTUMN			
	Dates	Galicia	Cantabrian Sea	Total	Dates	Galicia	Cantabrian Sea	Total
1980					05/10 - 20/10	23		23
1981					19/09 - 01/10	26		26
1982					13/09 - 25/09	34		34
1983					06/09 - 07/12	38	69	107
1984	31/05 -14/06		37	37	27/08 - 20/09	48	46	94
1985					01/09 - 26/09	50	47	97
1986	07/04 - 09/05	44	48	92	12/09 - 09/12	48	44	92
1987	11/03 - 14/05	50	56	106		0	0	0
1988	07/05 - 18/05		47	47	24/09 - 20/10	47	54	101
1989					12/09 - 17/10	40	51	91
1990					10/09 - 14/10	50	70	120
1991					12/09 - 11/10	51	56	107
1992					12/09 - 17/10	53	63	116
1993					09/09 - 06/10	48	61	109
1994					21/09 - 20/10	54	64	118
1995					27/09 - 25/10	53	63	116
1996					20/09 - 22/10	54	60	114
1997	08/04 - 18/04	15	12	27	19/09 - 23/10	56	63	119
1998					17/09 - 18/10	55	59	114
1999					28/09 - 28/10	57	59	116
2000					26/09 - 30/10	55	58	113
2001					25/09 - 27/10	54	59	113

Tows were of one hour duration in all surveys before 1984, and were reduced to 30 minutes thereafter. Since 1990, gear geometry is monitored using Scanmar equipment. Since 1993 hydrographic information has been collected using the methodology describe in section 8.

Some changes were made to the research vessels used over the period: the engine power increased in 1983 (from 1700 Kw to 2651 Kw), the length increased in 1985 (from 56 m to 67 m), a new bridge was used in 1990 (GPS, colour Echosounder, Plotter, Doppler log, etc.). In 1989, another research vessel (N/V F. de P. Navarro) was used to conduct the survey.

Since 1993 nine groundfish surveys have been conducted in the **Gulf of Cádiz** (Spanish waters) on board the R/V “Cornide de Saavedra” (Table VI).

Table VI. Gulf of Cádiz surveys: dates and number of valid hauls and year.

Year	Dates	Valids hauls
1993	15/03 - 25/03	34
1993	17/10 - 25/10	29
1994	28/02 - 8/03	30
1995	13/03 - 19/03	30
1996	23/03 - 29/03	31
1997	19/02 - 26/02	30
1997	30/10 - 11/11	27+9
1998	26/02 - 09/03	31+31
1998	30/10 - 09/11	34
1999	03/11 –18/11	35
2000	01/11 – 16/11	36
2001	02/11 – 17/11	39

According to Cardador *et al.* (1997), the **Portuguese groundfish surveys** have been conducted along the Portuguese continental waters 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 used 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 ship 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, 1983). 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 higher speeds in front of the trawl net. It is by maintaining the trawl pursuing the fish during a longer period than 30 minutes that the larger horse mackerel loses its *stamino* and enters into the trawl net. The juveniles were well sampled with 30 minutes trawling at 3.5 knots.

Finally in Autumn 1989 a fixed station plan was established as a result of an extensive discussion on the scope of ICES Methods Working Group (ICES, 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.

Table VII. Portuguese surveys: dates and number of valid hauls by season and year.

Year	LATE WINTER / SPRING		SUMMER		AUTUMN	
	Dates	Hauls	Dates	Hauls	Dates	Hauls
1979			07/06-20/06	56	13/10-02/11	55
1980	06/03-15/03	36*			02/10-22/10	62
	23/05-10/06	63				
1981	07/03-30/03	67	09/06-29/06	69	20/10-13/11	111
1982	15/04-02/05	69	10/09-30/09	70	07/10-18/11	190
1983	10/03-01/04	69	17/06-06/07	68	28/10-22/11	117
1984						
1985			01/06-28/06	101	23/10-18/11	150
1986			09/06-30/06	118	05/10-29/10	117
1987					04/10-24/10	81
1988					13/10-19/11	98
1989			14/07-08/08	114	10/10-06/11	138
1990			06/07-30/07	98	27/10-06/12	123
1991			06/07-05/08	119	03/10-14/11	93
1992	14/02-20/03	88	07/07-30/07	81	15/10-5/11	59
1993	09/02-11/03	75	25/06-18/07	66	24/11-20/12	65
1994					16/10-22/11	89
1995			14/07-08/08	81	12/10-09/11	88
1996					11/10-08/11	71
1997			26/06-21/07	87	15/10-16/11	58
1998			05/07-29/07	87	09/10-10/11	96
1999			12/07-02/08	65	29/10-22/11	79
2000			19/07-14/08	88	07/10-05/11	78
2001			06/07-31/07	83	10/10-03/11	58

*Southwest and South

1996 and 1999 – R/V “Capricórnio”, trawl gear without bobbins

During 1990-1994 and under FAR project MA-1-203 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 particular 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 (Cardador *et al.*, 1995).

During the period 1979-1997 a total of 46 surveys were carried out. The season, total fishing days and valid hauls by survey are shown in the Table XIV. In average 2 surveys per year were carried out, with 21 effective fishing days and 90 valid hauls per survey (Table VII).

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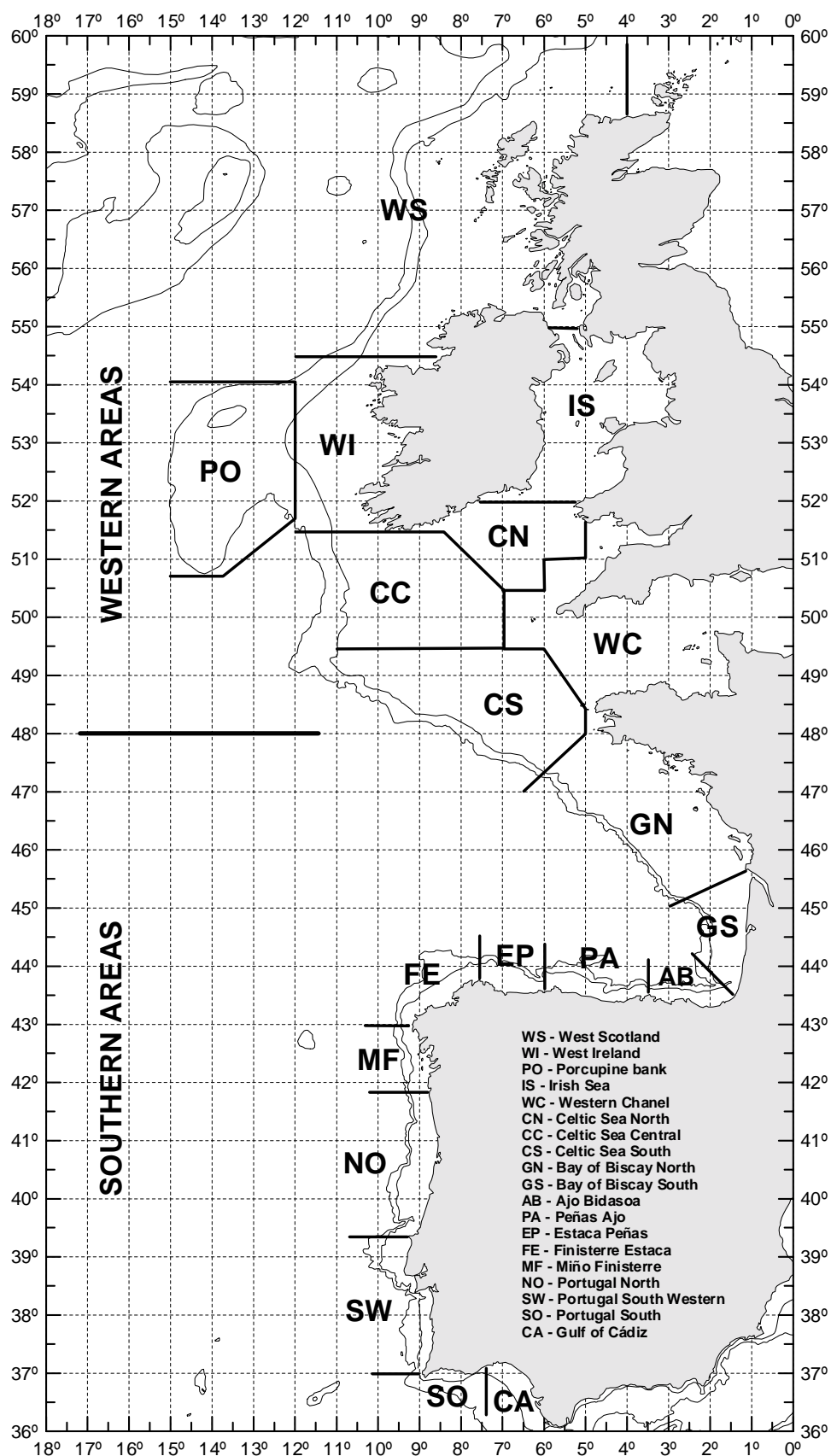


Figure 1. Coverage of the bottom trawl surveys included in the Western and Southern areas and general geographic stratification used.

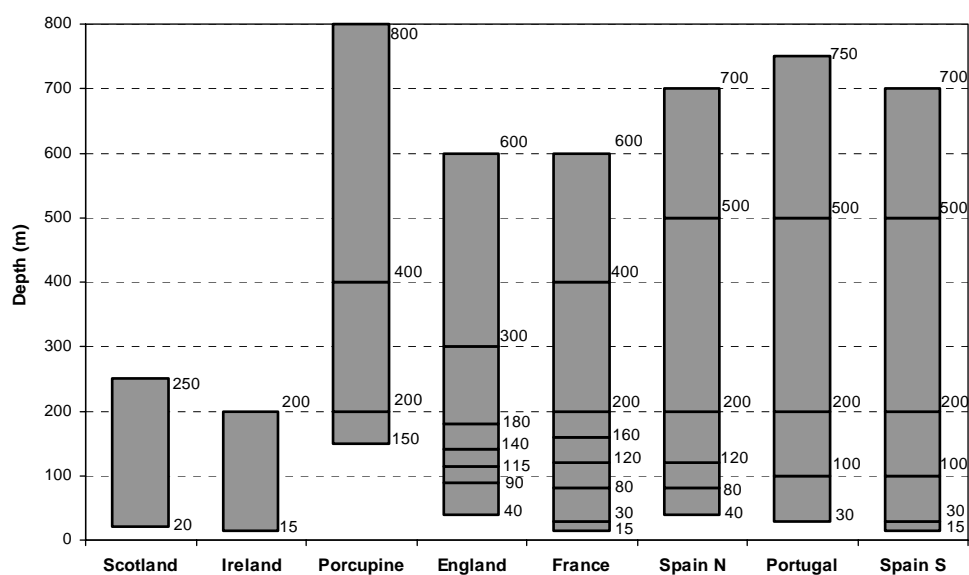
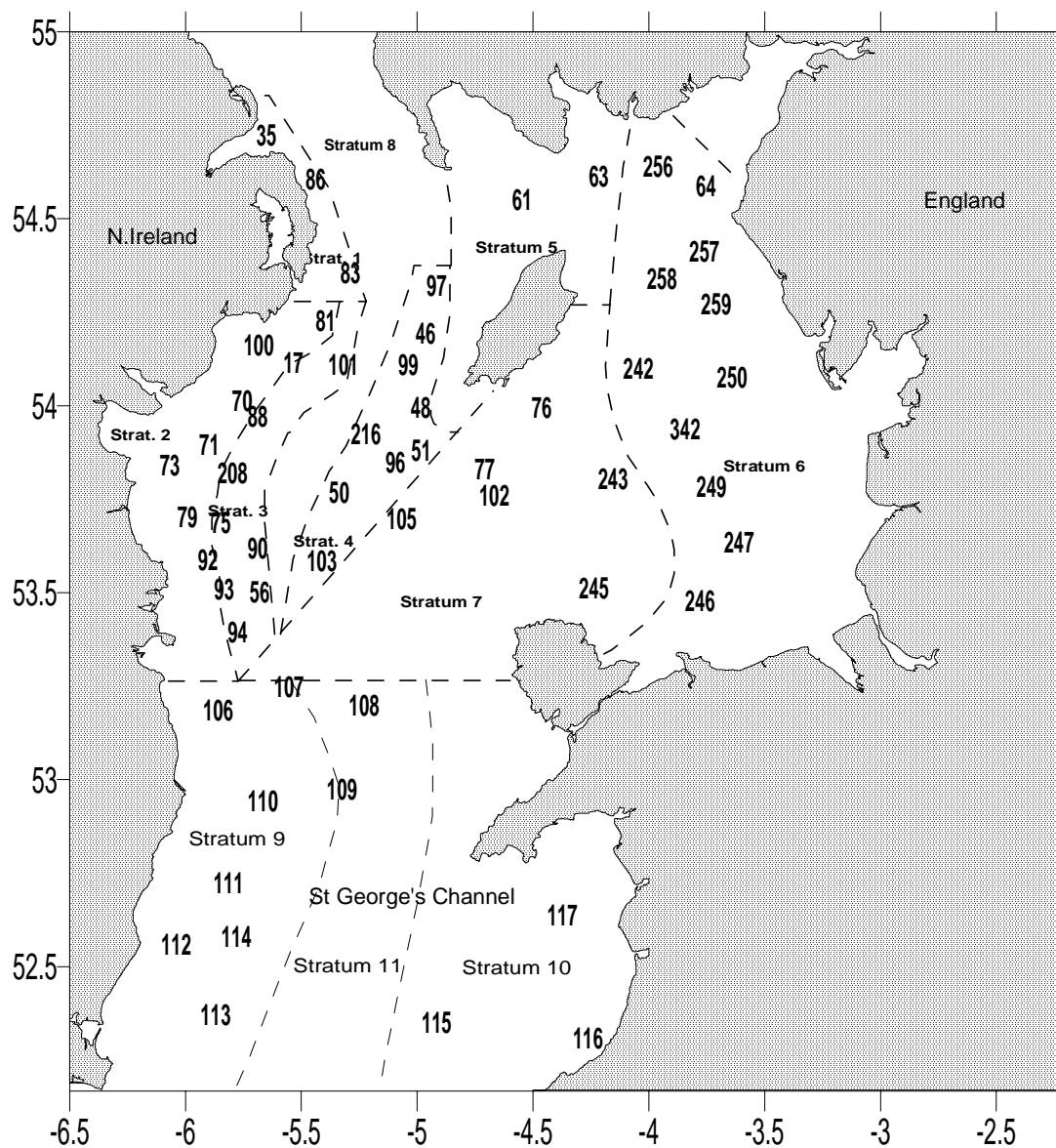


Figure 2. Bathymetric stratification used by each area.



- Key to strata:
1. Irish Coast (N), <100m, Mixed sediments
 2. Irish Coast, < 50m, sand and finer sediments
 3. Irish Coast, 50 - 100m, Muddy sediments
 4. W and SW Isle of Man, 50 - 100m, mud and muddy sand
 5. N Isle of Man, <50m, gravel sediments
 6. Eastern Irish Sea, <50m, sand and finer sediments
 7. S. Isle of Man, <100m, gravel sediments
 8. Deep western channel and North Channel >100m
 9. St George's Channel west; sandy/mixed sediments; <100m
 10. St George's Channel east; sandy/mixed sediments; <100m
 11. St George's Channel central; >100m; various hard and soft sediments.

Figure 3. Stratification used in Northern Ireland surveys

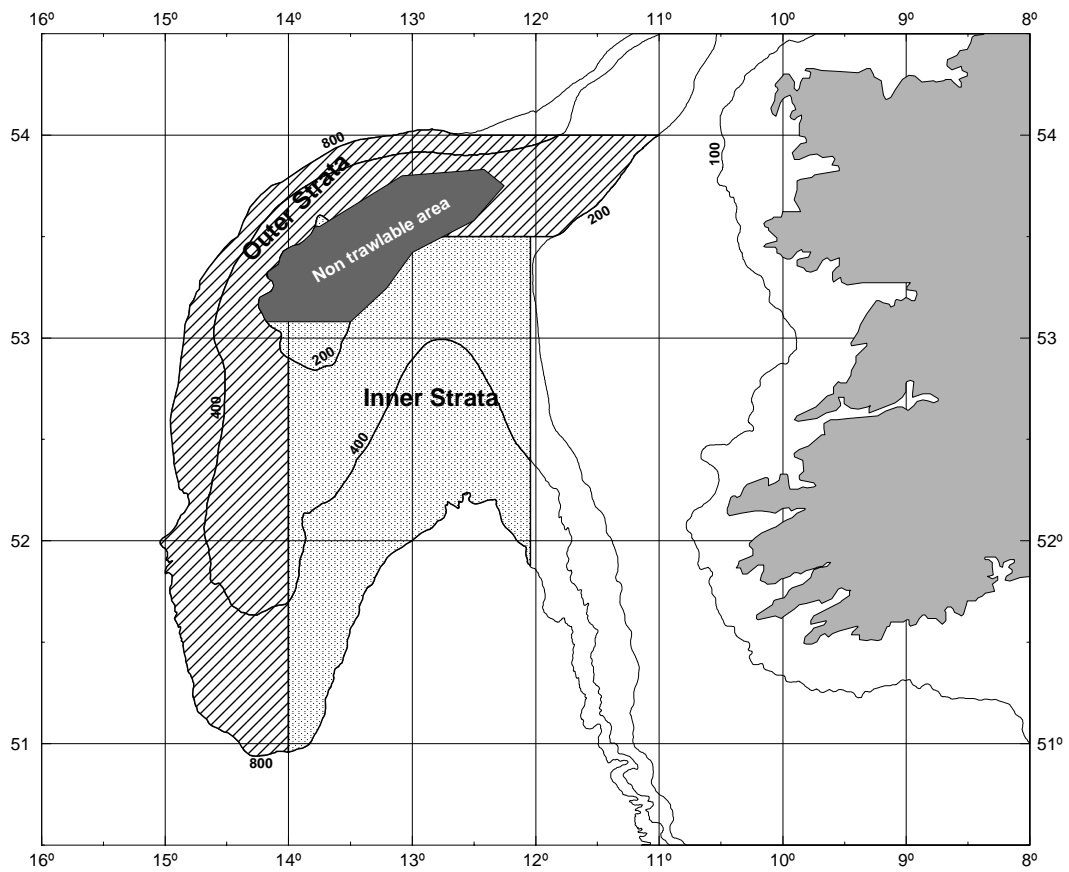


Figure 4. Stratification used in the Porcupine Spanish surveys. In each geographical strata bathymetric strata are: a) less than 200 m, b) 201-400 m and c) 401-800 m.

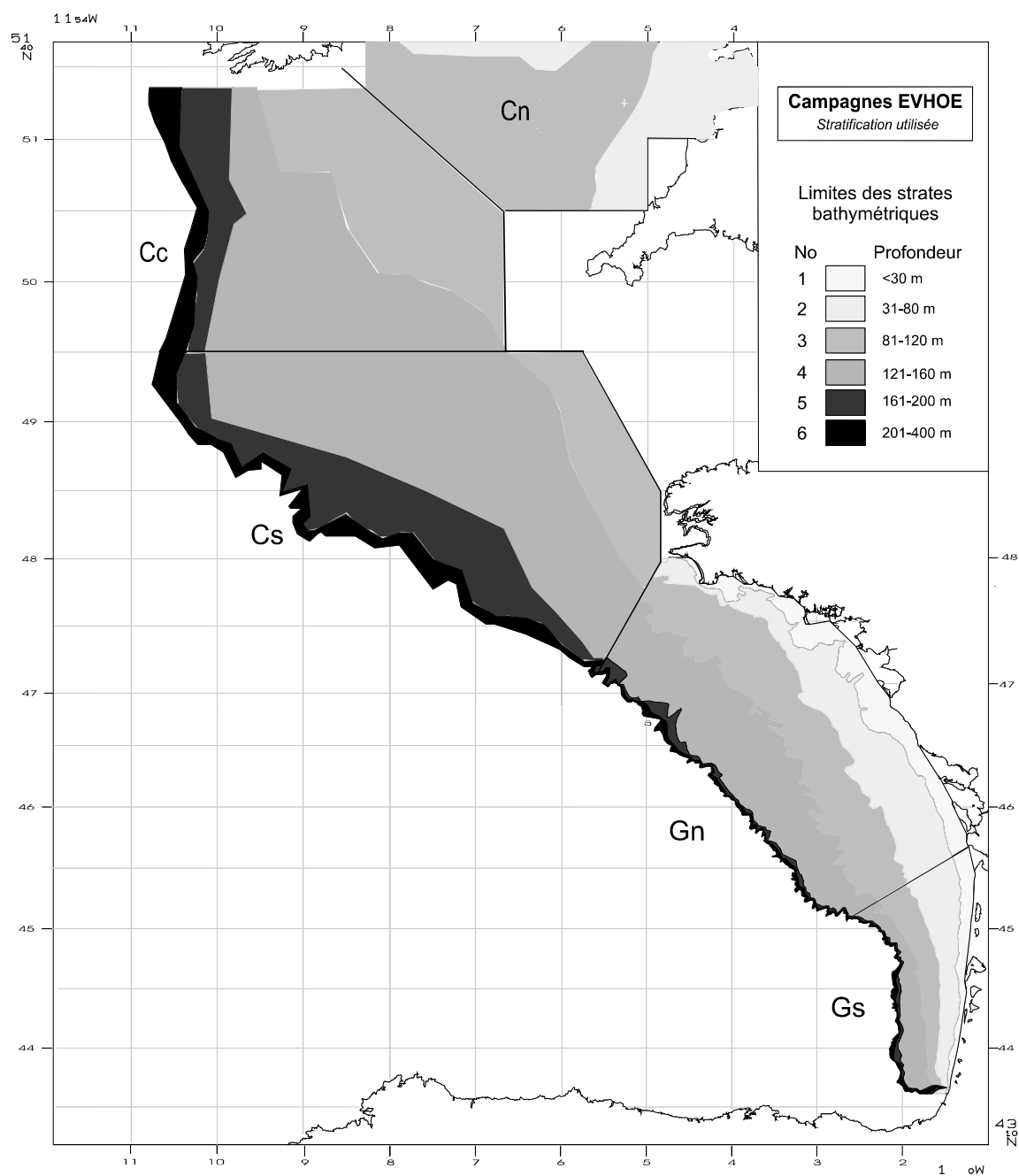


Figure 5. Stratification used in the Bay of Biscay and in the Celtic Sea for the French surveys.

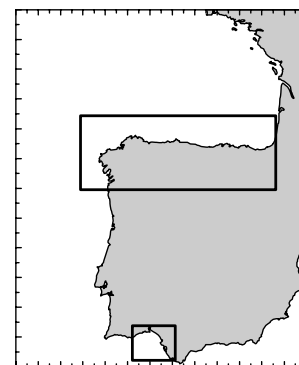
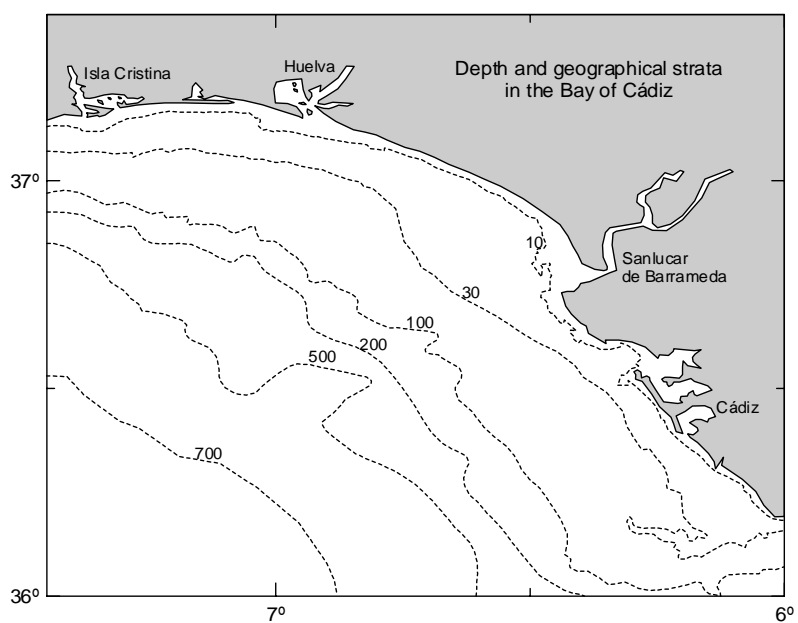
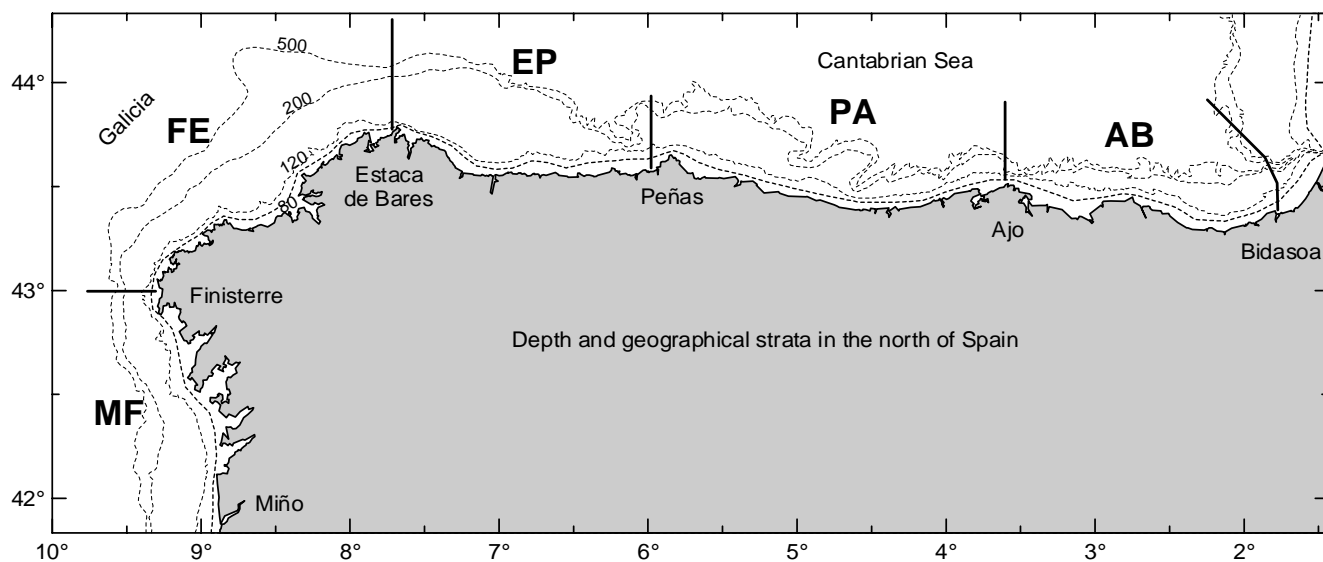


Figure 6. Stratification used in the Spanish surveys in the Iberian shelf.

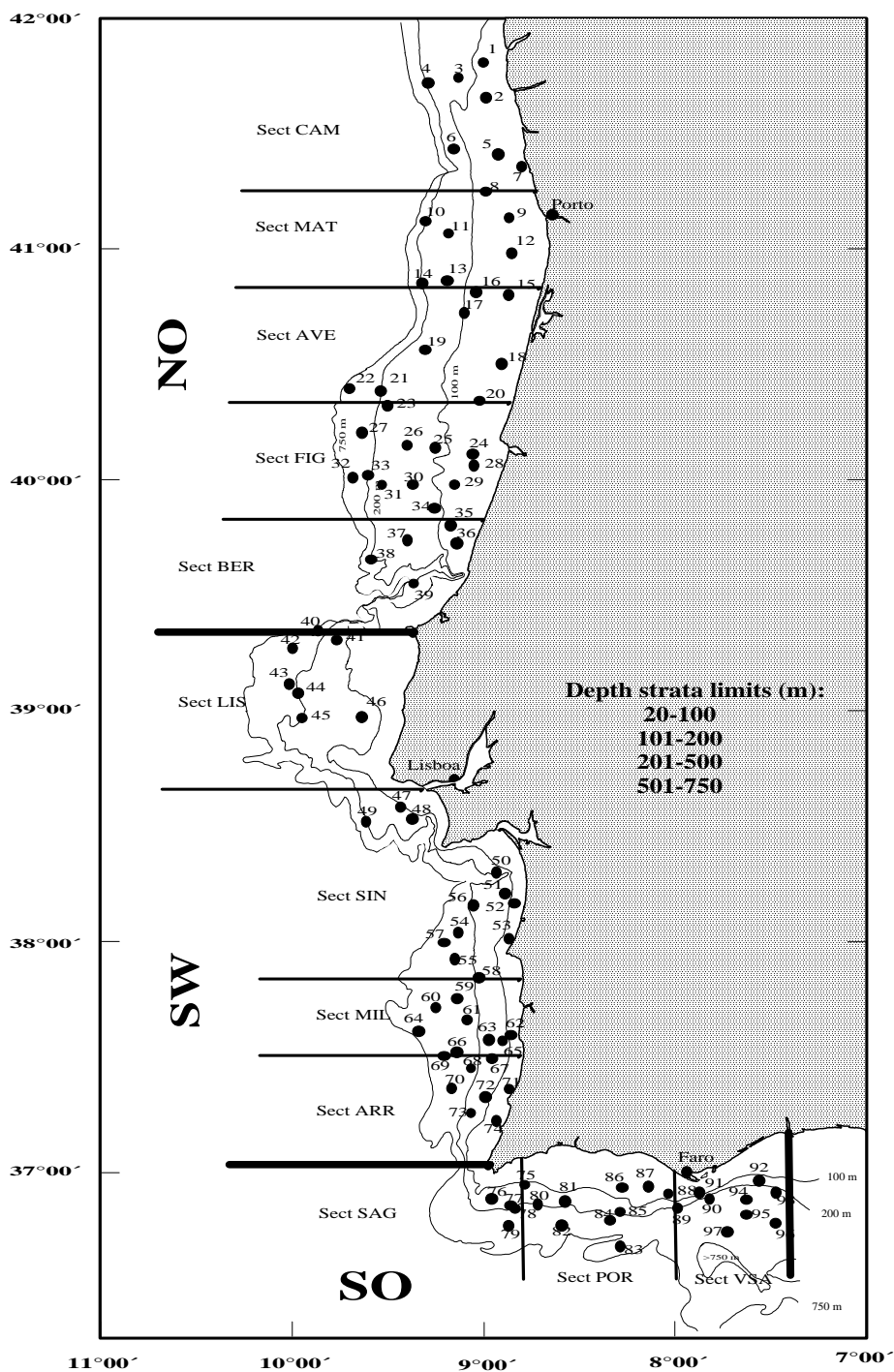


Figure 7. Stratification used in the Portuguese surveys.

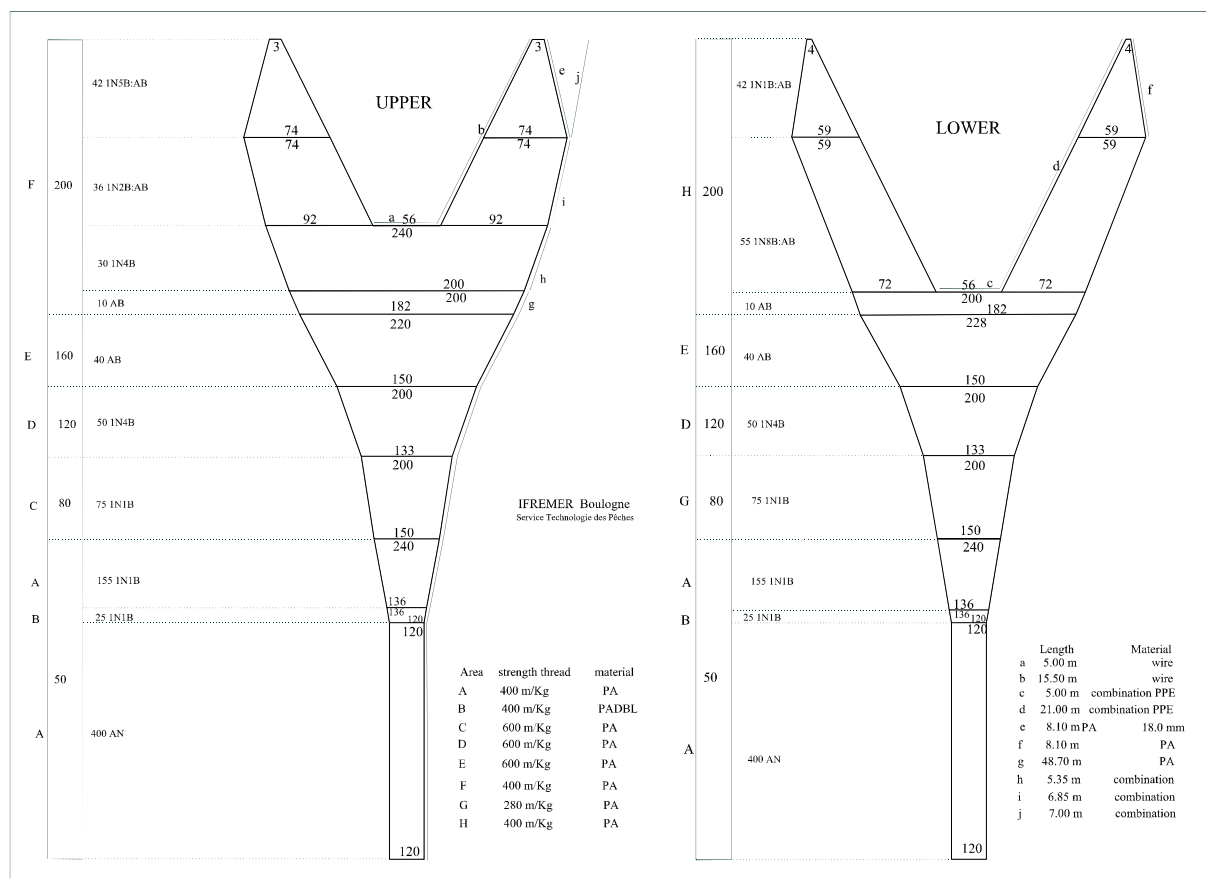
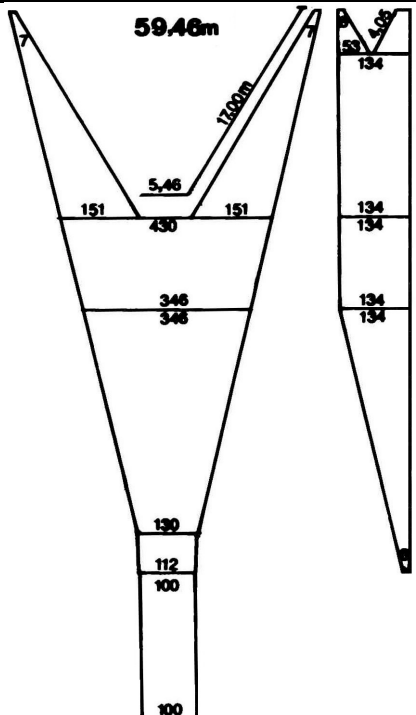
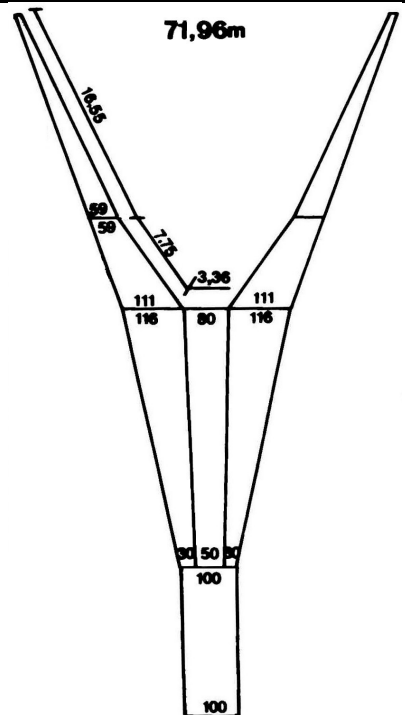


Figure 8. Scheme of the GOV 36/47 trawl gear used in the French surveys.

Mesh mm kc/ik	Twine Rtex/mat (bpa)	Stretched length (m)	Knots selvedge per side	Upper & Lateral	Stretched length (m)	Knots selvedge per side	Lower
90	2.5 PE	17.32	2/1		17.35	6/1	
90	2.5 PE	7.60	2/1		8.05	6/1	
90	2.5 PE	22.81	2/1		23.17	2/1	
90	2.5 PE	13.5	1/1		13.5	1/1	



Floats: 11 (280 mm) on the headline every 50 cm. 34 (200 mm) on the wings every 50 cm. 16 (200 mm) on the wings every 100 cm.

Sweeps: 250 m, 55 mm Ø.

Groundrope: 26 mm Ø, with double nylon coat. 50 kg of chains.

Winglines: Upper 10 m 14 mm Ø; Lower 10 m 18 mm Ø.

Figure 9. Scheme of the Porcupine baca 60/72 trawl gear used in the Porcupine survey.

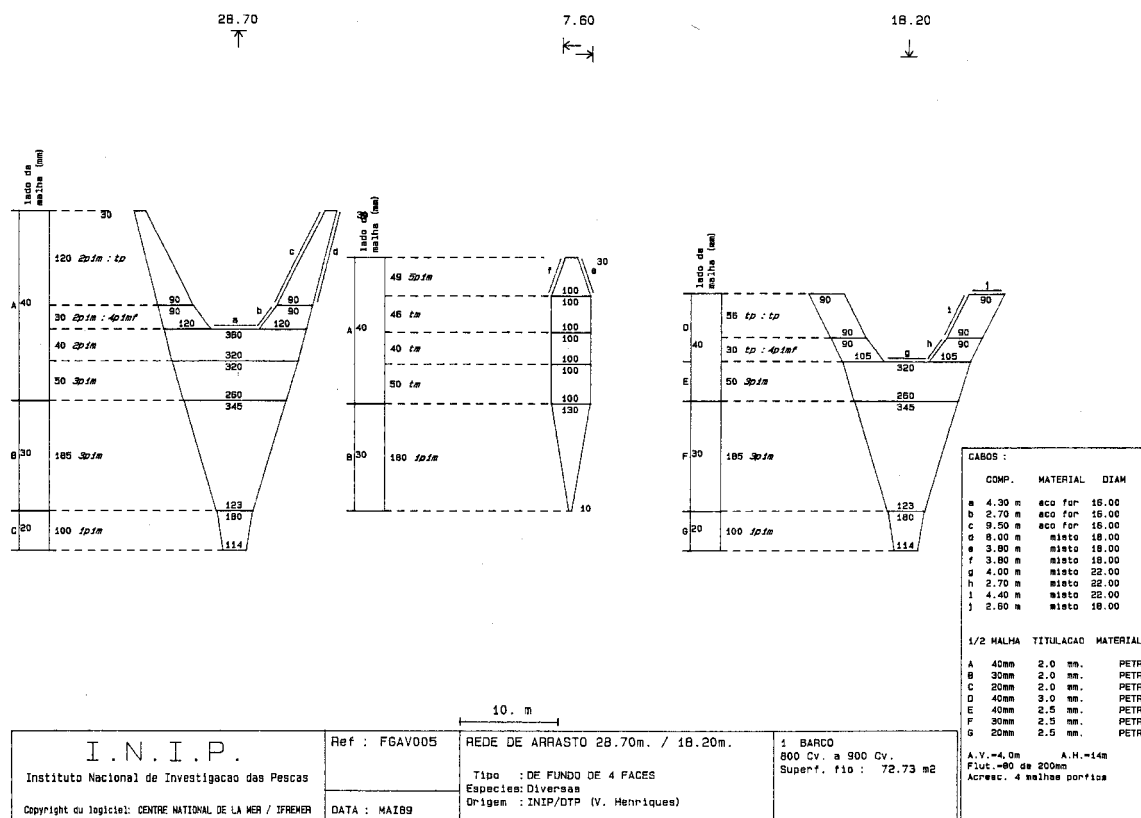


Figure 11. Scheme of the NCT trawl gear.