



Ministero delle Politiche Agricole e Forestali

DIPARTIMENTO DELLE POLICHE DI MERCATO
DIREZIONE GENERALE PER LA PESCA E L'ACQUACOLTURA

**Council Regulation (EC) No 1543/2000 of 29 June 2000
establishing a Community framework for the collection
and management of the data needed to conduct the
common fisheries policy**

ITALIAN NATIONAL PROGRAMME

Year 2006

May 2005

Table of contents

1. INTRODUCTION.....	4
1.1 Management of the National Program	4
1.2 National Correspondent.....	5
1.3 Appreciation of the level of precision.....	5
2. MODULE OF EVALUATION OF INPUTS: FISHING CAPACITY AND FISHING EFFORT	5
2.1 C. Collection of data concerning fishing capacity.....	5
2.1.1. Minimum program	5
2.2 D. Collection of data related to fishing effort.....	6
2.2.1 Minimum program	6
2.2.2 Extended program	7
3. MODULE OF EVALUATION OF CATCHES AND LANDINGS	8
3.1 E. Commercial landings for all stock.....	8
3.1.1 Minimum program	8
3.1.2 Extended program	9
3.2 Italian discard sampling: E. estimation of average volumes for certain stocks and H. age & length composition.....	9
3.3 E. Recreational fishery (bluefin tuna).....	12
3.4 F. Collection of data concerning the catches per unit effort and/or effective effort of specific commercial fleets.	12
3.4.1 CPUE data series for swordfish long line (MP).....	13
3.4.2 CPUE data series for bluefin tuna purse-seiners (MP).....	13
3.4.3 CPUE data series for bluefin tuna traps (MP).....	13
3.4.4 CPUE data series for demersal trawl fishery (EP)	13
3.5 G. Eligibility of the scientific evaluation surveys of stocks	14
3.5.1 The MEDITS project (Minimum Program)	14
MEDITS PROJECT.....	14
3.5.2 The GRUND project (Extended Programme)	15
3.5.3 Organization of MEDIT and GRUND surveys.....	15
3.5.4 Joint European Tuna and Swordfish tagging project (Minimum Programme)	16
3. 6 H. Biological sampling of catches: composition by age and by length	21
3.7 I. Other biological sampling	28
4. MODULE OF EVALUATION OF THE ECONOMIC SITUATION OF THE SECTOR	28
4.1. J. Collection of economic data by groups of vessels.....	28
4.1.1 Minimum program	28
4.1.2 Extended program	29
4.2 K. Collection of data concerning the processing industry.....	30
5. DATABASE	31

6. NATIONAL AND INTERNATIONAL CO-ORDINATION	31
7. LIST OF ACRONYMS AND ABBREVIATIONS	31
8. ANNEXES	33
Annex I. Sample survey for the evaluation of specific fishing effort.....	33
Annex II. Sample survey for the evaluation of landings per species and of fishing effort by type of technique	40
Annex III Sample survey for the evaluation of economic data.....	46
Annex IV: Discard sampling survey: quantity estimation by species.....	50
Annex V: Biological sampling of catches.....	52

1. Introduction

The present document represents the Italian national programme for the collection of fishery data for the year 2006, according to the legal Community framework put in place in 2000 with the adoption of a Council Regulation¹ and a Council Decision², followed in 2001 by a Commission Regulation amended in 2004³ laying down the detailed rules of application.

In accordance with Article 3 of the implementing regulation, this national program includes the following components:

- (a) planned actions by article and with reference to the Community programme
- (b) expenditure analysis by article and by programme
- (c) for sampling, a detailed description of the strategies followed and the statistical estimates used, allowing assessment of precision levels and the cost-precision relationship.

As provided by Chapter I(A) of the Annex to Regulation (EC) No 1639/2001, the national programme is divided into the following three modules:

- (A) module of evaluation of inputs: fishing capacities and fishing effort;
- (B) module of evaluation and of sampling of catches and landings;
- (C) module of evaluation of the economic situation of the sector.

The present national programme covers the entire minimum programme.

Concerning the extended programme, it also includes:

- the GRUND scientific evaluation survey, which is deemed necessary for completeness of the fishery data collection programme in Italy and to guarantee the continuity with previous surveys carried out
- the CPUEs data series for catches and effort for demersal trawl fishery, as recommended by the STECF.
- Complementary parameters and more detailed disaggregation levels for the module of fishing effort
- Complementary parameters and more detailed disaggregation levels for the module of economic data

1.1 Management of the National Program

The Statistical Office of the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies is the authority responsible for implementing this national program.

The database is located centrally at the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies, which will also manages it.

¹ Council Regulation (EC) N° 1543/2000 of 29 June 2000 establishing a Community Framework for the collection and management of the data needed to conduct the common fisheries policy – OJ L 176,15.7.2000, p.1.

² Council Decision N° 439/2000 EC of 29 June 2000 on a financial contribution from the Community towards the expenditure incurred in Member States in collecting data, and for financing studies and pilot projects for carrying out the common fisheries policy – OJ L 176, 15.7.2000, p.42.

³ Commission Regulation (EC) N° 1581/2004 of 27 August 2004 Amending Regulation (EC) N°1639/2001 establishing the minimum and extended Community programmes for the collection of data in the fisheries sector and laying down detailed rules for the application of Council Regulation (EC) N° 1543/2000 – OJ L 289/6 27.8.2004, (subsequently called the “implementing regulation”).

The national fisheries data collection program is coordinated by a Scientific Committee whose aim is coordinating the data collection program, monitoring the process as a whole, suggesting improvements to the data collection methods and approving the pilot studies carried out for the purposes of this national program.

1.2 National Correspondent

The Italian national correspondent pursuant to Article 6(3) of the implementing regulation is:

Rossella Salvatori

Ufficio programmazione e statistiche

Direzione Generale Pesca e Acquacoltura

Ministero Politiche Agricole e Forestali

Viale dell'Arte

Rome

Tel +39 06 59084531

E mail: pesc5@politicheagricole.it

1.3 Appreciation of the level of precision

The precision level of the output values varies according to whether the data is gathered exhaustively (by census) or estimated by specific sample surveys.

Census data will be used where Community or national regulations stipulating the systematic collection of such figures already exist.

Sample-based estimates will be used for parameters for which there is no prior compulsory exhaustive collection requirement or which cannot be determined by census owing to the nature of the phenomenon. In the case of sample surveys, one of three different precision levels will be adopted according to the relevant parameter (confidence interval of estimates: 95%):

- Level 1: $\pm 25\%$
- Level 2: $\pm 10\%$
- Level 3: $\pm 5\%$

Methods and procedures to estimate the precision of the data are explained in the present program for each parameter.

2. Module of evaluation of inputs: fishing capacity and fishing effort

2.1 C. Collection of data concerning fishing capacity

2.1.1. Minimum program

To determine the fishing capacity of the Italian fleet, the following parameters will be evaluated:

- 1 Total number of vessels
- Average value of the following parameters for each segment:

- 2 Gross tonnage
- 3 Maximum continuous engine power of main engine in kW
- 4 Age of vessel, calculated on the basis of hull age

The data for all parameters will be referred to the fishing segments as described in Appendix III of the Regulation 1581/2004.

Data will be broken down by GFCM/FAO statistics divisions and will be updated annually.

Data will be gathered exhaustively for all parameters. The data source is the Fishing Licenses Archive (ALP) kept by the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies (MIPAF).

2.2 D. Collection of data related to fishing effort

2.2.1 Minimum program

Fuel consumption

Fuel consumption will be expressed by volume (litres) and cost (euro/litre). The values recorded will allow an estimate of average fuel consumption per vessel for each fishing segment.

The data will be collected by type of fishing techniques defined in Appendix III of the Regulation n. 1581/2004 and will be reported according to level 3 of geographical disaggregation defined in appendix I (GCFM/FAO statistics divisions).

Data on fuel consumption will be reported on an annual basis.

Data on fuel consumption will be collected according to sampling procedures making it possible to reach statistically significant sampling estimates with 10% maximum permissible error (95% confidence level).

The fuel-consumption parameter is one of the variables covered by the economic-data sample survey (Module C – Evaluation of the economic situation of the sector). The methodology is described in Section 4.1. Cost for the evaluation of fuel consumption is part of the overall cost of the economic survey.

Fishing effort by type of technique

The fishing effort by type of technique is measured by the weighted sum of the fishing days associated with an area and a specific period. Each day is weighted with a measuring unit representing the nominal fishing power of each vessel. The units vary according to the type of fishing gear; they are kW and GT for mobile gears, tonnage for fixed gears, and kW for polyvalent gears.

The data will be collected by type of fishing techniques defined in Appendix VIII. In addition effort by technique and by segment will be reported following appendix III.

Data on fishing effort by type of technique will be reported according to level 3 of geographical disaggregation defined in appendix I (GCFM/FAO statistics divisions) and on a quarterly basis.

Data related to fishing effort will be collected according to sampling procedures making it possible to reach statistically significant sampling estimates with 10% maximum permissible error (95% confidence level).

This parameter is one of the variables covered by the sample survey for estimation of landings (weight and value) by species (Module B – Evaluation and sampling of catches and landings).

The methodology is described in Annex II. Cost for the evaluation of fishing effort by type of technique is part of the overall cost of the landing survey.

Specific fishing effort

The specific fishing effort is defined as the effort associated with species of special interest. The species to be considered are listed in appendix VI of the Regulation 1581/2004.

The effort must be recorded by fishing technique, but account is to be taken only of days when catches of predefined stocks exceed specified thresholds (see annex I, Methodology, for the list of stocks and the relevant catch limits). Two types of catch limits will be used. They are defined as the proportion of total catches accounted for by catches of the relevant species. The first limit, or threshold value, is used to identify the target species, whereas the second indicates the catch limit of a species which, if exceeded, gives rise to a “by catch” consideration of that species. Essentially, there will be two specific fishing-effort parameters for each species, by virtue of the distinction between fishing days on which the species is deemed a target species and fishing days on which it is accounted for on a “by catch” basis.

The data will be collected by separating types of fishing techniques specified in appendix VIII of the implementing regulation and will be reported according to level 3 of geographical disaggregation defined in appendix I (GCFM/FAO statistics divisions) on a quarterly basis.

Data related to specific fishing effort will be collected according to sampling procedures making it possible to reach statistically significant sampling estimates with 25% maximum permissible error (95% confidence level). Description of sample survey is reported in Annex I.

Information collected by logbooks will be used only to cross check the estimates. In fact, the logbook is compulsory in the Mediterranean only for a minority of fleet (vessels of overall length exceeding 10 metres) and will contain production information only where vessels retain on board quantities exceeding 50 kg live-weight equivalent of the species included in a specific list (Annex VII of Regulation (EC) No 2737/1999).

In the case of the specific fishing effort moreover, the species required by Regulation EC n. 1639/01 are different from that provided by logbook framework.

Moreover, even for the common species, the logbook information is not sufficient for evaluation of the specific fishing effort. The threshold value on which the assignment of a fishing day to a specific species is based is determined by the catch proportion and not by a maximum catch quantity, so that if logbook recording is not compulsory it does not necessarily follow that analysis of the specific fishing effort is not required. The relevant survey must take account of all the fleet’s fishing days and be based on an examination of the make-up of total catches per day of activity.

Financial form related to fishing effort reports only cost for this survey.

2.2.2 Extended program

(a) Complementary parameters:

- fishing effort for longliners will be measured as number of hooks × time at sea;
- data on fishing effort of traps, pots and pond nets will be collected as number of gears at sea, multiplied by time (number of days of each gear at sea on an annual basis).

(b) Disaggregation levels:

- fuel consumption data will be gathered in a way which makes it possible to estimate the average fuel consumption per vessel within each segment defined in Appendix IV (but length classes < 10 m and 10<12 m will not be considered separately), on a quarterly basis;

- effort data by segment will be gathered with reference to the segments defined in Appendix IV (but length classes < 10 m and 10<12 m will not be considered separately);
- effort data will be gathered on a monthly basis, and referring to the level of geographical disaggregation 4 of Appendix I (GFCM/Geographical Sub Areas).

3. Module of evaluation of catches and landings

3.1 E. Commercial landings for all stock

3.1.1 Minimum program

Landings (quantity and value) of all stocks (including those listed in appendix XII of the implementing regulation) will be evaluated.

Conversion factors will not be applied to landing-weight-based quantities as all species are landed ungutted. Conversion factors could be necessary only for marginal share of landings. For these species, quantities will be converted to live weight by the FAO and Eurostat conversion factors⁴.

Landings by species (weight and value) will be disaggregated in accordance with the basic segmentation of vessels for capacities (appendix III of the Implementing Regulation).

Within the minimum programme estimate of overall annual commercial landings will be provided distinguishing the geographical origin of the catches according to level 2 of geographical disaggregation of Appendix I.

Commercial landings for all stocks will be reported on a quarterly basis.

Commercial landings will be assessed on the basis of a sampling procedure, as logbook is compulsory in the Mediterranean only for a minority of fleet (vessels of overall length exceeding 10 metres) and will contain production information only where vessels retain on board quantities exceeding 50 kg live-weight equivalent of the species included in a specific list (Annex VII of Regulation (EC) No 2737/1999).

The methodology of the survey was approved by Eurostat during the meeting of the working group “fishery statistics” held in Luxembourg, 18-19 February 2002. The full methodology is reported in annex III⁵.

The estimates will be statistically significant with 10% maximum permissible error (confidence level 95%) for the stocks listed within appendix XII of the implementing regulation and level 1 (25%) for other species.

The sample survey will not cover the entire Italian fleet. Vessels fishing beyond the straits (or “ocean-fishing fleet”) will be excluded from the sample base. The same applies to vessels licensed for tuna fishing and associated in the “Associazione Produttori Tonnieri Salernitani. The landing data for such vessels will be recorded on a census basis and taken from the compulsory documentation.

⁴ FAO Fisheries Circular No 847 rev. 1.

⁵ The present survey integrates the ongoing sample survey Italy is carrying on in order to fulfil Regulation (EC) No 1382/91 as amended by Regulation (EC) No 2104/1993. However, the disaggregation level of results required by Regulation (EC) No 1543/2000 differs from that stipulated in Regulation (EC) No 1382/91. Therefore, results required by regulation EC no. 1543/00, as recommended by the Consultant and SGRN, imply an increase of the sample size.

Data related to tuna farming will be provided by a specific data collection implemented by the national administration in accordance with ICCAT procedures and, as such, will be excluded from the sample survey.

The NP does not take into account landings of foreign vessels because they are not present in Italy.

3.1.2 Extended program

Data concerning the stocks mentioned in Appendix XII of the implementing regulation will be collected on a quarterly basis, by separating the landings according to the types of techniques defined in Appendix IV (but length classes < 10 m and 10<12 m will not be considered separately), and by the geographical level 4 according to Appendix I.

3.2 Italian discard sampling: E. estimation of average volumes for certain stocks and H. age & length composition

The first objective of the discard sampling survey is to estimate annual discards (weight and number) for each species listed in appendix XII of the implementing regulation, of the bottom-trawl commercial fishing segment, by Geographical Sub Areas (GSA), at national level.

The second objective of the survey consists of the estimation of the length and age composition of the discarded species, listed in tab. 3.1.

Tab. 3.1

Giant red shrimp	<i>Aristaeomorpha foliacea</i>
Red shrimp	<i>Aristeus antennatus</i>
Horned octopus	<i>Eledone cirrhosa</i>
Musky octopus	<i>Eledone moschata</i>
Grey gurnard	<i>Eutrigla gurnardus</i>
Common squid	<i>Loligo vulgaris</i>
Blackbellied angler	<i>Lophius budegassa</i>
Anglerfish	<i>Lophius piscatorius</i>
European hake	<i>Merluccius merluccius</i>
Red mullet	<i>Mullus barbatus</i>
Striped mullet	<i>Mullus surmuletus</i>
Norway lobster	<i>Nephrops norvegicus</i>
Common pandora	<i>Pagellus erythrinus</i>
White shrimp	<i>Parapenaeus longirostris</i>
Common cuttlefish	<i>Sepia officinalis</i>
Common sole	<i>Solea vulgaris</i>
Mantis shrimp	<i>Squilla mantis</i>
Tub gurnard	<i>Trigla lucerna</i>

The species listed in tab. 3.1 are those representing more than 200 tonnes of the national landings (according to the Reg. CE n°1581/2004, chapter III, section H, item d3).

General characteristics of the sampling survey

The survey is species and fishing technique specific. It is an at-sea observer program, aboard commercial vessels and based on a voluntary participation of fishers (Borges et al., 2004).

Data on the quantities of the discarded species will be thus collected directly onboard and the length composition by species recorded (on the overall or on a sample, according to the amount of the discarded quantities), in order to derive the length frequency distribution (LFD) by species and fishing day.

For those species that can be directly aged by hard structures, the age will be also estimated using the otolith reading techniques, on a sample of the discarded species.

Target variables

The target variables to be recorded in the survey are the quantity (number and weight) of each discarded species, its length frequency distribution and age-length key (for those species that can be aged). Other associated variables will be recorded on board for providing additional information (e.g. lat-long positions).

Sampling frame

The sampling design will be a *two-stage stratified random scheme*, with strata represented by a combination of geographical sub-areas (GSA) and fishing segments. In each stratum the fishing days will be the primary sampling units and the commercial fishing vessels the secondary sampling units.

The survey will cover a one-year period, subdividing the whole time in quarters, in order to detect possible seasonal differences in the abundance and composition of the discards.

The sampling units will be extracted with equal probability and without replacement using the national commercial landings database for the selection process. A Total of 497 fishing days will be sampled by at-sea observers (see tab. 3.2)

The averages and variances of the investigated variables (discard quantity by species and GSA) and the related estimators will be assessed using the general formulations (Cochran, 1977) reported in the *Annex IV Discard sampling survey: quantity estimation by species*.

Average and variance of length frequency distributions will be estimated according to the method reported in Pennington et al., 2002 (see *Annex V Biological sampling of catches*).

The estimate of the individual fish age will be organised in age-length-keys (ALK) as outlined in the *Annex V Biological sampling of catches*.

References

Borges L., Zuur A.F., Rogan E., and Officer R. (2004) – Optimum sampling levels in discard sampling programs. *Can. J. Fish. Aquat. Sci.*, 61: 1918-1928.

Cochran W.G. (1977) - *Sampling Techniques*. John Wiley & Sons, Inc., New York.

Pennington M., Burmeister L-M., Hjellvik V. (2002) - Assessing the precision of frequency distributions estimated from trawl-survey samples. *Fish. Bull.*, 100: 74.80

Tab. 3.2

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD 1°quarter	SFD 2°quarter	SFD 3°quarter	SFD 4°quarter	SFD Tot.
9	LIGURIA	Bottom trawl	>12<18	2	3	3	2	10
9	LIGURIA	Bottom trawl	>18<24	1	1	1	1	4
9	TOSCANA	Bottom trawl	>12<18	3	3	3	3	12
9	TOSCANA	Bottom trawl	>18<24	2	2	2	2	8
9	LAZIO	Bottom trawl	>12<18	1	2	2	1	6
9	LAZIO	Bottom trawl	>18<24	5	4	5	4	18
9	LAZIO	Bottom trawl	>24<40	1	1	1	1	4
Total				15	16	17	14	62
10	CAMPANIA	Bottom trawl	>12<18	2	3	2	2	9
10	CAMPANIA	Bottom trawl	>18<24	1	2	2	2	7
10	CALABRIA TIRRENICA	Bottom trawl	>12<18	1	2	2	1	6
10	CALABRIA TIRRENICA	Bottom trawl	>18<24	0	1	1	1	3
10	SICILIA NORD	Bottom trawl	>12<18	3	3	3	2	11
10	SICILIA NORD	Bottom trawl	>18<24	1	2	2	1	6
Total				8	13	12	9	42
11	SARDEGNA	Bottom trawl	>12<18	2	4	3	3	12
11	SARDEGNA	Bottom trawl	>18<24	2	2	2	2	8
11	SARDEGNA	Bottom trawl	>24<40	2	2	2	2	8
Total				6	8	7	7	28
16	SICILIA SUD	Bottom trawl	>12<18	6	8	8	6	28
16	SICILIA SUD	Bottom trawl	>18<24	7	7	8	6	28
16	SICILIA SUD	Bottom trawl	>24<40	9	9	10	8	36
Total				22	24	26	20	92
17	F.VENEZIA GIULIA	Bottom trawl	>12<18	1	1	1	1	4
17	VENETO	Bottom trawl	< 12	2	2	2	2	8
17	VENETO	Bottom trawl	>12<18	6	7	7	6	26
17	VENETO	Bottom trawl	>18<24	2	3	3	2	10
17	E. ROMAGNA	Bottom trawl	< 12	1	1	1	1	4
17	E. ROMAGNA	Bottom trawl	>12<18	5	6	6	5	22
17	E. ROMAGNA	Bottom trawl	>18<24	2	2	2	2	8
17	MARCHE	Bottom trawl	>12<18	3	4	4	3	14
17	MARCHE	Bottom trawl	>18<24	4	5	5	4	18
17	MARCHE	Bottom trawl	>24<40	2	2	2	2	8
17	ABRUZZO	Bottom trawl	>12<18	2	2	2	2	8
17	ABRUZZO	Bottom trawl	>18<24	3	3	3	3	12
17	ABRUZZO	Bottom trawl	>24<40	2	2	2	1	7
Total				35	40	40	34	149
18	PUGLIA NORD	Bottom trawl	>12<18	12	14	14	11	51
18	PUGLIA NORD	Bottom trawl	>18<24	5	6	6	5	22
18	PUGLIA NORD	Bottom trawl	>24<40	2	2	3	2	9
Total				19	22	23	18	82
19	PUGLIA IONICA	Bottom trawl	>12<18	4	6	6	5	21
19	CALABRIA IONICA	Bottom trawl	>12<18	3	3	3	2	11
19	CALABRIA IONICA	Bottom trawl	>18<24	1	1	1	1	4
19	SICILIA EST	Bottom trawl	sd	1	2	2	1	6
Total				9	12	12	9	42
Overall total				114	135	137	111	497

3.3 E. Recreational fishery (bluefin tuna)

A specific pilot study was carried out in 2003 for overall evaluation of recreational bluefin tuna fishing.

Routine data collection started in 2004 and will continue in 2005 following the same methodology.

According to the pilot study, it appears quite clear that monitoring the tuna sport fishing activity is a difficult exercise, showing several problems.

The first issue is related to the high importance of the seasonal presence of the bluefin tuna and its dependence upon the meteorological and climatic condition. These facts are strongly conditioning the fishing activity and the distribution of the fishing fleet along the Italian coast.

The study carried out a long and difficult detailed census along the Italian coastline and the several islands to define the fleet, the number of sport fishermen concerned and the catch.

As far as the monitoring of this sector is concerned, the current official system based on the mandatory TR forms appears quite inefficient and absolutely unreliable (catches were declared only in one single harbour). Of course, as explained in the report, more efficient monitoring or landing control systems necessarily imply higher costs.

The study developed a cost/efficiency comparative analysis of the various approaches to study the sector.

According to the results of this cost/efficiency assessment, the best approach methods seems to be the log-books supported by controls or the continuous monitoring. Both methods are able to provide high quality data but with high costs.

Therefore, the routine data collection system will be based on a strong collaboration with sport fishermen and their organisation and Clubs (they will be asked to fill appropriate log books) integrated with controls from an ad hoc scientific staff.

Bluefin tuna catches from recreational fishery will be collected in weight and number by:

- annual
- geographical area as defined Appendix 1, level 2.
- distinguishing catch of fish below and above 10 kg.

3.4 F. Collection of data concerning the catches per unit effort and/or effective effort of specific commercial fleets.

Italian national programme for 2002 included a review of the utility of the CPUE time series and effort data which have been used during the years 1995 to 2000 by scientific assessments working groups. This review has been forwarded to the Commission, together with the Italian proposals on CPUE data series on the basis of the results gained from the study.

STECF analysed the results of the study and suggested that the Italian national programme should contain data series for catches and effort for the following fleet:

1. bluefin tuna traps (MP)
2. bluefin tuna purse-seiners (MP)
3. swordfish long line (MP)
4. demersal trawl fishery (EP)

3.4.1 CPUE data series for swordfish long line (MP)

Data series on CPUE for swordfish fished with surface long lines will be calculated.

Catch and effort for longliners targeting large pelagics will be provided in kg per 1000 hooks deployed .

A panel of vessels will be selected among vessels already monitored for economic and landings data. For this panel, data for the following parameters will be collected:

- number of days at sea,
- fishing areas,
- number of hooks per day,
- type and characteristics of hooks,
- catches

Collaboration with vessel's owners will be encouraged. Ad hoc questionnaires will be used to collect the above information.

Total cost for this programme consists in two parts:

- questionnaires on activity, landings and effort specification (gears, number of hooks, ecc.)
- elaboration of elementary data and calculation of CPUE figures.

3.4.2 CPUE data series for bluefin tuna purse-seiners (MP)

Landings of bluefin tuna will be derived from the landing's survey. Effort of pelagic seiners will be derived from the module on fishing effort.

Previous data will be elaborated to calculate CPUE figures.

3.4.3 CPUE data series for bluefin tuna traps (MP)

Different types of measurement of fishing effort exist that can be used to calculate CPUE data series for bluefin tuna traps.

In this project, the following measures will be used:

- number of days of lowering of the traps
- number of days of operations (mattanza)

All Italian tuna traps will be monitored.

The project can be divided into two components:

- questionnaires on activity and effort specification
- elaboration of elementary data and calculation of CPUE figures.

3.4.4 CPUE data series for demersal trawl fishery (EP)

Landings for demersal trawl fishery will derive from the landing's survey and they will be integrated with information from the triennial evaluation of discards to obtain catches per species. Fishing effort (average days at sea per gross tonnage) will derive from the effort module.

CPUE indexes will be calculated for the following species:

Norway lobster *Nephrops norvegicus*

Hake	<i>Merluccius merluccius</i>
Octopus	<i>Eledone cirrhosa</i>
Octopus	<i>Eledone moschata</i>
White shrimp	<i>Parapenaeus longirostris</i>
Red mullet	<i>Mullus barbatus</i>

Landings for demersal trawl fishery will derive from the landing's survey and they will be integrated with information from the triennial evaluation of discards to obtain catches per species.

Regarding specific fishing effort, it is available only for sole and Norway Lobster (see appendix VI of the implementing regulation). Therefore, further work is necessary to estimate specific fishing effort of the remaining species listed above. This work justifies the personnel cost inputted in the financial form.

3.5 G. Eligibility of the scientific evaluation surveys of stocks

3.5.1 The MEDITS project (Minimum Program)

In accordance with the requirements of Chapter III(G) of the Annex of the implementing regulation, the Italian data collection programme provides for continuation of the project, principally with a view to obtaining information comparable as between the various Italian areas and with other Mediterranean countries.

No changes are foreseen for MEDIT survey in 2006, compared with 2005.

Table 3.3 shows the breakdown of MEDITS hauls between countries and, as regards Italy, between the seven Geographical sub-areas in which the Italian fleet predominantly operates.

Table 3.3

MEDITS PROJECT				
<i>Geographical area</i>	Area		<i>No. of hauls</i>	
	<i>km²</i>	<i>%</i>	<i>No</i>	<i>%</i>
Spain	45 259	9	(94)	(8.4)
France	18 422	4	(95)	(8.5)
Italy: GSA9 – Ligurian/Upper Tyrrh.	40 000	8	120	11
Italy: GSA10 – Lower Tyrrh.	17 000	4	70	6
Italy: GSA11 – Sardinia	27 000	6	100	9
Italy: GSA16 – Sicilian Channel	50 000 5 000	11	120	11
Italy: GSA17 – Upper and Mid-Adriatic	59 000 33 000	18	180	16
Italy: GSA18 – Lower Adriatic	16 000 9 000	5	90	8
Italy: GSA19 – W. Ionian	14 000	3	70	6
Greece	172 497	34	(179)	(16)
TOTAL	506 178	100	1 118	100

There is also a willingness to work together with researchers from other countries with a view to distributing the hauls more homogeneously among the countries concerned.

3.5.2 The GRUND project (Extended Programme)

The 2006 Italian data collection programme retains the GRUND project with no modifications with respect to 2005 survey.

The total number of hauls is the same of those in the MEDITS project for Italian seas (750).

The number of operational units is seven (like the FAO/GFCM Geographical sub-areas), with a single motor vessel for each area using nets and mesh sizes similar to those employed for commercial fishing in the area; this means that full data comparability will be achieved within each large FAO/GFCM Geographical sub-areas and the data will also be comparable with that of commercial trawling in the same area.

The total number of hauls (750) will be distributed among the seven FAO/GFCM Geographical sub-areas in accordance with the basic principle of the data-collection regulation, in proportion to commercial trawl catches from the same geographical area and to the surface area of each geographical area.

GRUND PROJECT						
<i>FAO/GFCM Geographical sub-areas</i>	<i>Trawl-fishing production</i>		<i>Estimated area</i>		<i>Number of hauls</i>	
	<i>tonnes</i>	<i>%</i>	<i>km²</i>	<i>%</i>	<i>No</i>	<i>%</i>
9 – Ligurian/Upper Tyrrhenian	10 639	9	40 000	18	115	15
10 – Lower Tyrrhenian	7 217	6	17 000	8	70	9
11 – Sardinia	3 020	3	27 000	12	70	9
16 – Sicilian Channel	28 000	24	50 000	22	170	23
17 – Upper and Mid-Adriatic	40 618	34	59 000	26	170	23
18 – Lower Adriatic	18 000	15	16 000	7	85	11
19 – W. Ionian	10 996	9	14 000	7	70	9
TOTAL	118 490	100	223 000	100	750	100

The form in which the results are submitted to the relevant Italian Administration will be amended within a time scale and in a way to be agreed with the Administration, so that the requirements of Regulation (EC) No 1543/2000 can be observed.

3.5.3 Organization of MEDIT and GRUND surveys

The two surveys will be carried out in much the same way as at present, MEDITS in spring and GRUND in autumn.

To preserve the unitary international approach, the MEDITS project will, as at present, have a coordinator chosen at international level from the national coordinators of the participating countries, as well as a national coordinator and individual officers responsible for each of the seven zones. Working together with his counterparts in the other countries, the national coordinator will preserve the unitary project framework. The national coordinator and zone

officers will retain their links with the relevant Italian Administration to ensure that the results are supplied within the time scale and in the form stipulated.

An overall project coordinator for GRUND will be appointed by the Italian Administration, as well as officers in charge of areas or Geographical sub-areas, each officer being responsible for the data from his own area.

Costs to carry out MEDIT survey are equal to those of GRUND survey. This happens because the two surveys consider the same number of hauls. However, the two surveys are carried out in different seasons and with different nets (an experimental net for MEDIT and a commercial net for GRUND).

3.5.4 Joint European Tuna and Swordfish tagging project (Minimum Programme)

The Italian National Program for 2006 will adopt the joint European tuna tagging program proposed in the working group on tuna tagging held in Bari (April 2005).

No changes are foreseen for this project in 2006, compared with 2005.

The project is reported in the following pages.

Introduction

Bluefin tuna, swordfish and bigeye are highly migratory and their distribution range is very extensive. This makes it difficult to conduct direct assessment surveys such as acoustic or aerial surveys. Instead, these stocks are only assessed using a VPA framework calibrated with different CPUE series. Apart from the necessity of improving catch-effort data, ICCAT working groups have identified several uncertainties related with the assessment of bluefin tuna and swordfish stocks.

These uncertainties include:

for bluefin tuna

- Usefulness of CPUE series used as they may not necessarily reflect stock abundance due to spatio-temporal changes in the resource availability.
- Spatio-temporal variability in growth patterns.
- Estimates of mortality parameters, both natural and fishing.
- Rate of mixing among east and western Atlantic stocks.

for swordfish

- Spatio-temporal variabilities in growth patterns.
- Estimates of mortality parameters, both natural and fishing.
- Distribution pattern of juveniles which are particularly important in facilitating recent discussions on spatio-temporal fishery closures in the Mediterranean aiming to reduce catches of undersized fish.
- Rate of mixing among: (a) Atlantic stocks and (b) North Atlantic and Mediterranean stocks.

The objective of the joint European tagging program for 2006 and onwards (with Italy, Ireland, Spain, Portugal, Malta, Cyprus and Greece) is to clarify the above mentioned uncertainties. Details on the approach that will be followed for each species are given below.

Under the current tagging program there are no Bigeye tagging operations foreseen. This is because the results from the recent ICCAT BETYP program are being further analysed under

the framework of ICCAT. It is expected that tagging of bigeye will be reactivated on completion of this work.

Bluefin tuna

Three CPUE series are used for calibrating the eastern Atlantic bluefin tuna stock assessment:

- Spanish traps (ages 6+)
- Spanish baitboat (ages 2-3)
- Japanese longline (ages 8+)

Each of these fleets operates in a given time period and at a given depth range. For this reason, it has been argued whether they offer accurate reflections of stock abundance or not. In fact, Spanish baitboats operate in the surface water layer of the Gulf of Biscay, Spanish traps are located in the strait of Gibraltar area and Japanese longlines operate at a given depth range. Bearing this in mind, it is clear that CPUEs may not reflect the real stock abundance, as CPUEs are affected by inter-annual variability of the stock availability to the different gears. For instance, if abundance remains constant but the stock is distributed in shallower water in a given year than in the following one, the CPUE of surface fleets will drop down not because of the stock is less abundant but because there has been a change in availability. In essence, this implies that we are currently tuning the VPA with biased CPUE indices, leading to increased bias in stock abundance estimates.

Tagging can provide information on both the horizontal and vertical distribution of the stock that could be used to correct the annual CPUE values. The goal is to conduct a joint electronic tagging program that will track the variations in annual availability of bluefin to the different gears. In accordance with this goal the list of the CPUE series to be calibrated by means of the joint bluefin tuna tagging programme during 2006 will be extended to Purse seine CPUE series already being collected by each EU Member State within their mandatory Minimum DCR Programmes.

Tagging plans

Adult fish will be tagged using pop-up tags. The list of countries involved, areas of tagging, number of fish tagged, and method of tagging are presented in table 3.4.

In the case of juveniles, pop-up tags cannot be used, and the usefulness of internal archival tags is being tested. Implementation of this technique for Bay of Biscay juveniles is envisaged for 2006. In the meantime, during 2005 sonic tracking will be used to estimate the vertical availability of the stock to baitboat fisheries. As horizontal availability of the resource can not be addressed with sonic tracking, it is necessary to conduct conventional spaghetti tagging experiments to assure that juveniles present in the Bay of Biscay are representative of the whole stock. For that purpose, conventional tagging cruises will be conducted within the western Mediterranean recruitment area and in the Bay of Biscay. This will allow an estimate of the proportion of fish born in the Mediterranean that could be caught as juveniles northeast Atlantic fisheries to be produced. Details of conventional tagging plans are given in table 3.5.

Data analysis

Results on the vertical and horizontal distribution from electronic tagging will be integrated in a Habitat-Based-Model approach for CPUE standardization (Bigelow et al., 2002). The product will be an unbiased CPUE series that represents a more robust abundance index. The output of this tagging programme will also allow corrections to be made to other available CPUE series, such as purse seine series from national fleets currently not considered for VPA calibration.

The output of conventional tagging experiments will be analysed using existing statistical models to estimate the parameters of interest.

References

Bigelow, K. A., Hampton, J. and Miyabe, N. (2002). Application of a habitat-based model to estimate effective longline fishing effort and relative abundance of Pacific bigeye tuna (*Thunnus obesus*). Fish. Oceanogr. 11(3): 143-155.

Table 3.4 – BFT tagging program (pop-up satellite and sonic tags)

Objectives	Type of tags	Fishing area	Fishing period	Country	Tagging place	Gear	Tagging period	Programmed time	Expected date	pop-up	Number/size of fish
Refine CPUE from Bait boat	sonic	Bay of Biscay	Jun-Sep	Spain	Bay of Biscay	Bait boat	Jul-Aug	-	-	-	n=10 ; 10 kg
Refine CPUE from Tuna trap, Purse seine and Japanese longline	pop-up satellite	East Atlantic	Aug-Nov	Ireland	Irish waters	Sport fishing	Sept	240 days	May 2006	-	n=5 ; 200 kg
		East Atlantic	Apr-Sep	Portugal	Algarve	Tuna trap	Aug	270 days	May 2006	-	n=5 ; 150 kg
		East Atlantic	Apr-Aug	Spain	Barbate/Mazarron	Tuna trap/Tuna pens	Aug	270 days	May 2006	-	n=20 ; 150 kg
		East Med	May-Jun	Italy	East Med	Purse seine/Tuna pens	Aug	270/300 days	May/June 2006	-	n=40 ; 150 kg
		Central Med	Jun-Jul	Malta	Malta waters	Tuna pens	Aug	270/300 days	May/June 2006	-	n=10 ; 150 kg
		East Med	Jun-Jul	Cyprus	East Med	Tuna pens	Aug	270/300 days	May/June 2006	-	n=10 ; 150 kg

Table 3.5 – BFT tagging programme (conventional tags)

Fishing area	Tagging period	Country	Tagging place	Gear	Expected number/size of fish
West Med	Oct	Spain	Balearics	Bait boat	n= 2000 ; <6.4 kg
East Atlantic	Jun-Sept	Portugal	Algarve	Tuna Trap	Opportunistic*/ <6.4 kg
	Jul-Aug	Spain	Bay of Biscay	Bait boat	n= 2000 ; >7 kg

*No budget is requested for opportunistic tagging

Swordfish

Conventional (spaghetti-type) tagging on juvenile animals (0-2 yrs old) in the Mediterranean (eastern, central and western) and opportunistic tagging in the Atlantic are planned in order to help clarify uncertainties surrounding horizontal availability of the resource and migration. As the age estimates necessary for stock assessments are obtained through deterministic models, the information from tagging will allow the size variability by age to be taken into account. Natural mortality is considered to be age independent in the assessments, although tagging experiments in other large pelagic species (e.g. southern bluefin tuna, big eye and yellowfin) have demonstrated significant variations with age. It is expected therefore that tagging data will provide information on age dependent mortality. In addition, tagging of juveniles will allow the hypotheses regarding the low mobility of juvenile fish to be examined. This would support regional and temporal fishery closures in the Mediterranean with direct scientific evidence. This is at the request of ICCAT working groups.

Taking into account the existing fisheries, the following tagging schemes are suggested:

<i>Area</i>	<i>Country</i>	<i>Tagging period</i>	<i>Expected number of tags to be released</i>
E. Mediterranean	Greece	Sept-Nov	150
C. Mediterranean	Italy	Sept-Nov	150
W. Mediterranean	Spain	Sept-Nov	150
N. Atlantic	Spain	Jan-Dec	Opportunistic*
N. Atlantic	Portugal	Jan-Dec	Opportunistic*

*No budget is requested for opportunistic tagging

3. 6 H. Biological sampling of catches: composition by age and by length

The general framework of the present task is aiming to provide:

- information on the exploitation pattern of the target species disaggregated by fishing segments;
- information on the demographic structure of the landings (size/age);
- information on the growth, sexual cycle and mortality.

To be consistent with the above objectives, the sampling scheme has been designed taking into account:

- the fishing capacity, techniques and effort of the Italian fleet;
- the spatial and temporal variability of the landings.

Target variables

The target variables are the length and age of those species that can be aged, in order to estimate the length frequency distribution and the age-length key.

The above estimations regard the species listed in the Appendix XV of the Reg. CE 1581/2004.

Sampling frame

The total number of samples, by species and GSA, to be collected in order to derive the length frequency distribution and the age-length key is reported in Tab 3.6. Such number of samples,

which is proportional to the landing obtained in the previous years, according to the implementing regulation, will be revised after the estimation of the precision level.

For the sake of getting a good level of accuracy, mainly as regards the seasonality of the landing by fishing techniques, the sampling design will be a *two-stage stratified random scheme*, with strata represented by a combination of geographical sub-areas (GSA) and fishing segments. Therefore, in each stratum, the sampling fishing days will be the primary sampling units and the commercial fishing vessels the secondary sampling units.

The survey will cover a one-year period, subdividing the whole time in quarters, in order to detect seasonal differences in the demographic structure and composition of the landings.

The sampling units will be extracted with equal probability and without replacement, using the national commercial landings database for the selection process. The total number of samples will be collected during, at least, 1391 sampling fishing days, as reported in the tabs. n° 3.7, 3.8, 3.9, 3.10, 3.11, 3.12.

Average and variance of length frequency distributions by species will be estimated according to the method reported in Pennington et al., 2002 (see *Annex V Biological sampling of catches*).

The estimate of the individual fish age will be organised in age-length-keys (ALK) as reported in Baird, J.W. 1983 (see *Annex V Biological sampling of catches*).

Tab. 3.6

Number of samples by size and age in each Geographical Sub Area (GSA)

Species	Total number of samples by size	Number of individuals for each size sample	Total number of samples by age	Number of individuals for each age sample	Total number of samples by size and age in each GSA													
					9	10		11	16		17		18		19			
acciuga (<i>Engraulis encrasicolus</i>)	347	50	141	25	31	14	9	4			20	8	195	78	80	32	12	5
sardina (<i>Sardina pilchardus</i>)	160	50	65	25	27	11	13	5			8	3	84	34	16	7	12	5
sgombro (<i>Scomber scombrus</i>)	9	25	9	25	1	1	2	2			1	1	1	1	2	2	2	2
Tot.	516		215		59	26	24	11			29	12	280	113	98	41	26	12
tonno rosso (<i>Thunnus thynnus</i>)	60	100			2		21		6		16		5		2		8	
pesce spada (<i>Xiphias gladius</i>)	50	100			6		16		2		9		3		2		12	
tonno alalunga (<i>Thunnus alalunga</i>)	10	100					3				2		1		1		3	
palamita (<i>Sarda sarda</i>)	8	25			1		2				1		1		1		2	
Tot.	128				9		42		8		28		10		6		25	
calamaro comune (<i>Loligo vulgaris</i>)	13	50			4		2		1		2		2		1		1	
seppia (<i>Sepia officinalis</i>)	24	50			2		2		1		2		10		3		4	
moscardino bianco (<i>Eledone cirrhosa</i>)	7	25			2		1		1		1		1		1		1	
moscardino muschiato (<i>Eledone moschata</i>)	10	25									3		6		1			
gambero bianco (<i>Parapenaeus longirostris</i>)	150	50			4		6				97		1		24		18	
gambero rosso (<i>Aristaeomorpha foliacea</i>)	37	50			1		4		2		25				5			
gambero viola (<i>Aristeus antennatus</i>)	9	50			2				3								4	
scampo (<i>Nephrops norvegicus</i>)	106	50			9		2		1		18		38		31		7	
budego (<i>Lophius budegassa</i>)	18	100	9	25	3	2	1				2	1	3	2	5	2	4	2
nasello (<i>Merluccius merluccius</i>)	192	50	96	25	28	14	14	7	12	7	26	13	34	16	58	29	20	10
triglia di fango (<i>Mullus barbatus</i>)	172	50	85	25	14	7	5	3	4	2	44	23	41	20	32	15	32	15
triglia di scoglio (<i>Mullus surmuletus</i>)	39	50	20	25	3	2	1	1	7	4	23	11					5	2
pagello o fragolino (<i>Pagellus erythrinus</i>)	9	50	5	25	2	1	1	1			5	3					1	
sogliola (<i>Solea vulgaris</i>)	4	50					1						3					
sugarello maggiore (<i>Trachurus mediterraneus</i>)	2	50	2	25	1	1	1	1										
sugarello comune (<i>Trachurus trachurus</i>)	13	50	13	25	1	1	3	2			3	3	3	3	2	3	1	1
Tot.	805		230		76	28	44	15	32	13	251	54	141	41	163	49	98	30

Tab. 3.7 Pelagic trawl and seiners

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD	SFD	SFD	SFD	SFD
				1°trim.	2°trim.	3°trim.	4°trim.	Tot.
9	LIGURIA	Pelagic trawl and seiners	sd	1	2	1	1	5
9	TOSCANA	Pelagic trawl and seiners	sd	0	2	1	1	4
9	LAZIO	Pelagic trawl and seiners	sd	0	0	0	0	0
		Total		1	4	2	2	9
10	CAMPANIA	Pelagic trawl and seiners	sd	1	4	2	2	9
10	CALABRIA TIRRENICA	Pelagic trawl and seiners	>12<18	1	1	1	1	4
10	SICILIA NORD	Pelagic trawl and seiners	sd	3	3	3	3	12
		Total		5	8	6	6	25
16	SICILIA SUD	Pelagic trawl and seiners	sd	1	4	2	2	9
		Total		1	4	2	2	9
17	F.VENEZIA GIULIA	Pelagic trawl and seiners	sd	1	2	2	2	7
17	VENETO	Pelagic trawl and seiners	sd	4	4	5	4	17
17	E. ROMAGNA	Pelagic trawl and seiners	sd	3	4	4	3	14
17	MARCHE	Pelagic trawl and seiners	>24<40	2	2	2	2	8
17	ABRUZZO	Pelagic trawl and seiners	>24<40	1	2	2	1	6
		Total		11	14	15	12	52
18	PUGLIA NORD	Pelagic trawl and seiners	sd	0	1	1	1	3
18	PUGLIA NORD	Pelagic trawl and seiners	>24<40	2	2	2	2	8
		Total		2	3	3	3	11
19	SICILIA EST	Pelagic trawl and seiners	sd	3	4	4	3	14
		Total		3	4	4	3	14
		Overall total		23	37	32	28	120

Tab. 3.8 Gear using hooks

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD	SFD	SFD	SFD	SFD
				1°trim.	2°trim.	3°trim.	4°trim.	Tot.
9	LIGURIA	Gear using hooks	>12<18	1	1	1	1	4
		Total		1	1	1	1	4
10	CALABRIA TIRRENICA	Gear using hooks	sd	3	3	3	2	11
10	SICILIA NORD	Gear using hooks	sd	1	3	2	2	8
		Total		4	6	5	4	19
16	SICILIA SUD	Gear using hooks	>12<18	2	3	3	2	10
16	SICILIA SUD	Gear using hooks	>18<24	3	5	4	3	15
		Total		5	8	7	5	25
17	MARCHE	Gear using hooks	>12<18	0	0	0	0	0
		Total		0	0	0	0	0
18	PUGLIA NORD	Gear using hooks	>12<18	0	1	1	0	2
		Total		0	1	1	0	2
19	PUGLIA IONICA	Gear using hooks	sd	3	6	5	4	18
19	CALABRIA IONICA	Gear using hooks	>12<18	2	2	2	2	8
19	SICILIA EST	Gear using hooks	>18<24	4	6	5	4	19
19	SICILIA EST	Gear using hooks	>12<18	4	7	6	5	22
		Total		13	21	18	15	67
		Overall total		23	37	32	25	117

Tab. 3.9

Small scale fishery

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD 1°trim.	SFD 2°trim.	SFD 3°trim.	SFD 4°trim.	SFD Tot.
9	LAZIO	Small scale fishery	< 12	6	7	7	6	26
9	LIGURIA	Small scale fishery	< 12	5	6	6	5	22
9	TOSCANA	Small scale fishery	< 12	4	6	6	5	21
		Total		15	19	19	16	69
10	CAMPANIA	Small scale fishery	< 12	7	18	14	11	50
10	CALABRIA TIRRENICA	Small scale fishery	< 12	3	5	5	4	17
10	SICILIA NORD	Small scale fishery	< 12	13	16	16	13	58
		Total		23	39	35	28	125
11	SARDEGNA	Small scale fishery	< 12	4	22	14	11	51
		Total		4	22	14	11	51
16	SICILIA SUD	Small scale fishery	< 12	11	14	14	11	50
		Total		11	14	14	11	50
17	F.VENEZIA GIULIA	Small scale fishery	< 12	3	5	5	4	17
17	VENETO	Small scale fishery	< 12	3	6	5	4	18
17	E. ROMAGNA	Small scale fishery	< 12	5	6	6	5	22
17	MARCHE	Small scale fishery	< 12	7	9	9	7	32
17	ABRUZZO	Small scale fishery	< 12	4	6	6	4	20
		Total		22	32	31	24	109
18	PUGLIA NORD	Small scale fishery	< 12	4	7	6	5	22
		Total		4	7	6	5	22
19	PUGLIA IONICA	Small scale fishery	< 12	5	8	7	6	26
19	CALABRIA IONICA	Small scale fishery	< 12	7	6	7	6	26
19	SICILIA EST	Small scale fishery	< 12	8	10	10	8	36
		Total		20	24	24	20	88
Overall total				99	157	143	115	514

Tab. 3.10

Demersal trawl

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD	SFD	SFD	SFD	SFD
				1°trim.	2°trim.	3°trim.	4°trim.	Tot.
9	LIGURIA	Demersal trawl	>12<18	2	3	3	2	10
9	LIGURIA	Demersal trawl	>18<24	1	1	1	1	4
9	TOSCANA	Demersal trawl	>12<18	3	3	3	3	12
9	TOSCANA	Demersal trawl	>18<24	2	2	2	2	8
9	LAZIO	Demersal trawl	>12<18	1	2	2	1	6
9	LAZIO	Demersal trawl	>18<24	5	4	5	4	18
9	LAZIO	Demersal trawl	>24<40	1	1	1	1	4
		Total		15	16	17	14	62
10	CAMPANIA	Demersal trawl	>12<18	2	3	2	2	9
10	CAMPANIA	Demersal trawl	>18<24	1	2	2	2	7
10	CALABRIA TIRRENICA	Demersal trawl	>12<18	1	2	2	1	6
10	CALABRIA TIRRENICA	Demersal trawl	>18<24	0	1	1	1	3
10	SICILIA NORD	Demersal trawl	>12<18	3	3	3	2	11
10	SICILIA NORD	Demersal trawl	>18<24	1	2	2	1	6
		Total		8	13	12	9	42
11	SARDEGNA	Demersal trawl	>12<18	2	4	3	3	12
11	SARDEGNA	Demersal trawl	>18<24	2	2	2	2	8
11	SARDEGNA	Demersal trawl	>24<40	2	2	2	2	8
		Total		6	8	7	7	28
16	SICILIA SUD	Demersal trawl	>12<18	6	8	8	6	28
16	SICILIA SUD	Demersal trawl	>18<24	7	7	8	6	28
16	SICILIA SUD	Demersal trawl	>24<40	9	9	10	8	36
		Total		22	24	26	20	92
17	F.VENEZIA GIULIA	Demersal trawl	>12<18	1	1	1	1	4
17	VENETO	Demersal trawl	< 12	2	2	2	2	8
17	VENETO	Demersal trawl	>12<18	6	7	7	6	26
17	VENETO	Demersal trawl	>18<24	2	3	3	2	10
17	E. ROMAGNA	Demersal trawl	< 12	1	1	1	1	4
17	E. ROMAGNA	Demersal trawl	>12<18	5	6	6	5	22
17	E. ROMAGNA	Demersal trawl	>18<24	2	2	2	2	8
17	MARCHE	Demersal trawl	>12<18	3	4	4	3	14
17	MARCHE	Demersal trawl	>18<24	4	5	5	4	18
17	MARCHE	Demersal trawl	>24<40	2	2	2	2	8
17	ABRUZZO	Demersal trawl	>12<18	2	2	2	2	8
17	ABRUZZO	Demersal trawl	>18<24	3	3	3	3	12
17	ABRUZZO	Demersal trawl	>24<40	2	2	2	1	7
		Total		35	40	40	34	149
18	PUGLIA NORD	Demersal trawl	>12<18	12	14	14	11	51
18	PUGLIA NORD	Demersal trawl	>18<24	5	6	6	5	22
18	PUGLIA NORD	Demersal trawl	>24<40	2	2	3	2	9
		Total		19	22	23	18	82
19	PUGLIA IONICA	Demersal trawl	>12<18	4	6	6	5	21
19	CALABRIA IONICA	Demersal trawl	>12<18	3	3	3	2	11
19	CALABRIA IONICA	Demersal trawl	>18<24	1	1	1	1	4
19	SICILIA EST	Demersal trawl	sd	1	2	2	1	6
		Total		9	12	12	9	42
Overall total				114	135	137	111	497

Tab. 3.11 Polyvalent

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD 1°trim.	SFD 2°trim.	SFD 3°trim.	SFD 4°trim.	SFD Tot.
9	LIGURIA	Polyvalent	< 12	1	1	1	1	4
9	TOSCANA	Polyvalent	< 12	1	2	2	1	6
9	LAZIO	Polyvalent	< 12	1	1	1	1	4
	Total			3	4	4	3	14
10	CAMPANIA	Polyvalent	< 12	1	4	3	2	10
10	CALABRIA TIRRENICA	Polyvalent	< 12	1	2	2	1	6
10	SICILIA NORD	Polyvalent	< 12	3	5	5	4	17
10	SICILIA NORD	Polyvalent	>12<18	1	2	2	1	6
	Total			6	13	12	8	39
16	SICILIA SUD	Polyvalent	< 12	1	2	1	1	5
	Total			1	2	1	1	5
17	F.VENEZIA GIULIA	Polyvalent	< 12	0	0	0	0	0
17	E. ROMAGNA	Polyvalent	< 12	1	1	1	1	4
17	MARCHE	Polyvalent	< 12	1	2	2	1	6
	Total			2	3	3	2	10
18	PUGLIA NORD	Polyvalent	< 12	1	1	1	1	4
	Total			1	1	1	1	4
19	PUGLIA IONICA	Polyvalent	>12<18	1	1	1	1	4
19	CALABRIA IONICA	Polyvalent	< 12	2	2	2	2	8
19	SICILIA EST	Polyvalent	< 12	1	1	1	1	4
	Total			4	4	4	4	16
	Overall total			17	27	25	19	88

Tab. 3.12 Passive polyvalent

GSA	DISTRICT	FISHING SEGMENT	LOA	SFD 1°trim.	SFD 2°trim.	SFD 3°trim.	SFD 4°trim.	SFD Tot.
9	TOSCANA	Passive polyvalent	>12<18	1	1	1	1	4
9	LAZIO	Passive polyvalent	>12<18	2	2	2	2	8
	Total			3	3	3	3	12
10	CALABRIA TIRRENICA	Passive polyvalent	>12<18	0	1	1	1	3
10	SICILIA NORD	Passive polyvalent	>12<18	1	2	2	1	6
	Total			1	3	3	2	9
11	SARDEGNA	Passive polyvalent	>12<18	1	5	3	3	12
	Total			1	5	3	3	12
16	SICILIA SUD	Passive polyvalent	>12<18	1	1	1	1	4
	Total			1	1	1	1	4
17	VENETO	Passive polyvalent	>12<18	2	2	2	2	8
	Total			2	2	2	2	8
19	PUGLIA IONICA	Passive polyvalent	>12<18	1	1	1	1	4
19	SICILIA EST	Passive polyvalent	>12<18	1	2	2	1	6
	Total			2	3	3	2	10
	Overall total			10	17	15	13	55

References

Pennington M., Burmeister L-M., Hjellvik V. (2002) - Assessing the precision of frequency distributions estimated from trawl-survey samples. *Fish. Bull.*, 100: 74.80

Baird, J.W. 1983. A method to select optimum numbers for aging in a stratified random approach. *In* Sampling commercial catches of marine fish and invertebrates. *Edited by* W.G. Doubleday and D. Rivard. Can. Spec. Publ. Fish. Aquat. Sci. **66**: 161–164.

3.7 I. Other biological sampling

Other biological samplings have to be carried out at three-year intervals for all species.

Since these samples were collected in 2002 and 2005, no activities is planned in the 2006 national program.

4. Module of evaluation of the economic situation of the sector

4.1. J. Collection of economic data by groups of vessels

4.1.1 Minimum program

The parameters to be evaluated for analysis of the economic situation of the sector are those reported in appendix XVII of the implementing regulation.

Definitions and specifications of these parameters will follow the recommendations of the expert working group on economic data collection, Paris May 2004 and of the SGECA meeting, October 2004.

Each parameter is estimated for each group of vessels as defined in appendix III of the Implementation Regulation.

Economic data will be provided by FAO statistics divisions (level 2 appendix I).

The reference period will be one year, except for production and average price by species, which will be estimated quarterly.

Economic parameters enumerated will be estimated by a specific sample survey. However, the value of fixed assets will be estimated processing data of the Vessel Register.

The sample survey results will be statistically significant with a maximum permissible error of 25% (confidence level 95%).

Methodology for the estimation of revenues, production costs, employment

The object of the sample survey is to estimate the aggregate economic account of the fishery sector by year type of fishing technique and FAO statistics divisions.

The survey is continuous in character and has a reference period of one year.

The target population of the survey comprises the Italian fishing fleet and the list is based on the Fishing License Archive kept at the Directorate-General of Fisheries and Acquaculture of the Ministry of Agricultural and Forestry Policies. It includes vessels < 12 meters.

The survey methodology and the questionnaire is reported in annex III.

Methodology: Total value of fixed assets and capital costs

The total value of fixed assets is defined as the monetary value of the capital invested in the fishing sector.

The replacement-value method will be used to estimate this parameter⁶.

The insurance value cannot be used because vessel insurance is neither compulsory nor customary in Italy. In the absence of an insurance market for fishing vessels, insurance tables broken down by fishing-vessel type and size do not exist as a reference basis.

The methodology for calculating replacement value is based on a number of information sources:

- The unit value of a vessel per unit GRT as published by RINA (the Italian Shipping Register). These values date from 1992 and are updated annually for inflation. The updated values are multiplied by the total GRT of each vessel. The RINA estimate is based on technical and engineering information. It also takes account of the hull material – wood, glass fibre or steel.
- The tables used to calculate fishing-vessel scrapping premiums (Regulation (EC) No 2792/1999).
- Market information obtained from field surveys to verify the estimated amounts.

Production and average price by species

Total production in tonnes and average price in euro/kg will be recorded for each species. The quarterly data will be disaggregated by type of fishing technique (appendix III of the Implementation Regulation) and referred to FAO statistics divisions.

The data will be obtained from the specific sample survey illustrated in Annex II - sample survey for the evaluation of landings per species and of fishing effort by type of technique.

Fleet data

The size parameters of the fleet will be updated annually, disaggregated by type of fishing technique (appendix III Implementing Regulation) and referred to FAO statistics divisions.

See Section 2.1 (fishing capacity) for methodology.

Effort data

The fishing effort will be evaluated on the basis of specific units of measurement that take account of technical and activity parameters.

Effort data will be updated quarterly, disaggregated by type of fishing technique (appendix III Implementing Regulation) and referred to FAO statistics divisions.

See Section 2.2 other details.

4.1.2 Extended program

(a) Complementary parameters

- Within the extended program, operational costs will be further subdivided in the following items (appendix XVIII implementing regulation):

⁶ The replacement-value method of estimating invested capital was chosen as standard for the concerted project “Economic performance of selected European fishing fleets” (FAIR PL97-3541).

- fuel and oil,
 - selling costs,
 - other variable costs,
 - total variable costs,
 - repair and maintenance,
 - other fixed costs,
 - total fixed costs,
 - Crew costs
- Landings per species (quantity and value) will be presented monthly (appendix XVIII implementing regulation).
- (b) Disaggregation levels:
- economic data will be disaggregated according to Appendix IV (but length classes < 10 m and 10<12 m will not be considered separately) and regarding the regional differentiation of level 3 of Appendix I of the implementing regulation.

4.2 K. Collection of data concerning the processing industry

A specific pilot study was carried out in 2003 for overall evaluation of Italian fish processing industry⁷.

On the basis of the results of this study a routine data recording system will start in 2006.

In particular, the pilot study suggested that the economic unit of observation more indicated to collect the information is the local unit, even if data related to the profit and loss account are available only at level of company. Therefore, the survey unit will be the company that will collect data on products from its local unit.

This implies that the archive of referring is ASIA⁸, that is based on the company.

The field of observation will be limited to the companies that belong to the sector of transformation of fishery products, that is those identified by the activities corresponding to the following ATECO codes:

15201 Preserving of fish, crustaceans and molluscs by freezing, salting, etc

15202 Production of fish products, crustaceans and molluscs

For the characteristics of the sector and the asked data to the enterprises, it's necessary to perform the survey yearly.

The survey will be carried out through postal technique. The enterprises will have the possibility to send the questionnaire by fax, by e-mail and also by electronic questionnaire (to be projected through ad hoc software).

⁷ The sector is composed by 493 companies and employees 7610 people (source: 2003 pilot study on Italian fish processing industry)

⁸ ASIA: statistical archives of active companies. ASIA has been realised by Istat on the basis of data provided by the company for administrative needs to some public or private organisations; these information are been integrated with other collected by Istat by means of some surveys

The parameters to be evaluated for analysis of the economic situation of the sector are those reported in appendix XIX of the implementing regulation.

Statistical methods to estimate target variables are those reported in the above mentioned pilot study.

5. Database

The centralized databank has been developed in 2004 and 2005.

The product assembled in previous years will be amended and improved in the light of the requirements identified on a case-by-case basis and requests for standardisation at Community level.

The cost of adaptation and feeding the databank is set out in the financial statement concerned.

6. National and international co-ordination

National co-ordination

An *ad hoc* scientific Committee manages the National program for the gathering of fishery data. This Committee is composed of the national correspondent and of other 9 members: 5 biologists, 2 statisticians, the Director General of DG Fishery and a manager from DG Fishery. The scientific Committee is entrusted with the task of co-ordinating the data collection program, of monitoring the entire process, of proposing adjustments aimed at improving the methodologies of data gathering and endorsing the pilot studies to be conducted within the present national program.

Composed of researchers in the fields of economic and fishery biology, a central co-ordination unit has been established with a view to managing and co-ordinating both the operational and technical aspects of the national data collection program.

An annual national meeting for co-ordination will be organised in 2006. Research institutes taking part to the implementation of the national program will participate to the meeting

International co-ordination

Closer cooperation between MS's is felt to be necessary to improve data collection and analysis. Therefore, several meetings are foreseen in 2005 to strengthen cooperation. Expenditure to take part of them are reported in the financial table.

Moreover, Italy will be pleased to host a workshop on age reading. The suggested title for this workshop is: "aging bony fish towards a standardized methodology for DCR".

7. List of acronyms and abbreviations

ALP	Archivio Licenza Pesca – Vessel Register
ASIA	statistical archives of active companies
ATECO code	Codification for sectors of economic activities
CPUE	Catch per Unit of Effort
DCR	Data Collection Regulation

GFCM	General Fishery Commission for the Mediterranean
GRT	Gross Registered Tonnage
GRUND	GRUpo Nazionale Demersali
GSA	Geographical Sub Areas
ICCAT	International Commission for the Conservation of Atlantic Tunas
ISTAT	National statistical institute
MEDITS	Mediterranean Trawl Survey Programme
MIPAF	Ministry of Agricultural and Forestry Policies
RINA	Registro Italiano Navale
SAC	Scientific Advisory Committee of GFCM

8. Annexes

Annex I. Sample survey for the evaluation of specific fishing effort

Purpose of survey

The object of the sample survey described in this section is to obtain a statistically significant estimate of the specific fishing effort as defined in the foregoing sections.

Survey period and reference period

The results of the sample survey will be furnished quarterly. The sampling design for the following year will be prepared annually in accordance with the methodology described below.

Determination of sample population and list

The object of the survey is to estimate the number of days of activity on which catches by species exceed two predetermined limits (limit 1: target-based catches; limit 2: “by catch” catches). Nine species are covered (see Table 8.1). The limits set for each species are as follows:

Table 8.1. Threshold values by species

<i>Species</i>	<i>1st threshold value</i>	<i>2nd threshold value</i>
Sole	30%	5%
Nephrops	30%	5%
Hake	30%	5%
Anchovy	30%	5%
Sardine	50%	5%
Swordfish	30%	5%
Bluefin tuna	30%	5%
Albacore	30%	5%
European eel	30%	

The sample basis comprises the list of days of activity per vessel over the survey reference year.

The complete list of vessels licensed for commercial fishing and the list of days of activity for the reference period are required for compilation of the sampling list.

The first list (vessels licensed for commercial fishing) is obtained from the Vessel Register (ALP) kept at the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies (MIPAF).

The second list (days of activity for the reference period) is of course not available in advance. However, on the basis of available data on fishing activity in the two years prior to the reference year, the total number of days of activity for the reference year can be predefined on the assumption of an expected variation of $\pm 5\%$ compared with the previous two-year period.

The list will be updated annually on the basis of the estimated number of days of activity for the two-year period preceding the reference year.

Selection of target variables

The purpose of the sample survey is to estimate the fishing effort directed towards species of special interest.

The fishing effort is obtained by multiplying the number of days of activity by size parameters (kW and GT for mobile gears, GT for passive gears and kW for polyvalent gears). The fleet's size parameters are census data obtained from evaluation of fishing capacity. Hence the target variable of the survey remains the number of days of activity at sea on which catches of a given species exceed specified threshold values.

Besides catches by species, the survey will be required to cover other, auxiliary variables for each fishing day. These variables, to be recorded for each individual day of activity, are as follows:

- total hours spent at sea
- fishing areas

The above variables will be recorded by an interviewer on landing.

Where vessels are at sea for more than one day at a time, the interviewer will be required to obtain as detailed information as possible with a view to distributing the total value over the actual number of days of the fishing trip.

Questionnaire and choice of interviewers

The questionnaire will be paper-based, at least in the initial phase of the survey. It will subsequently be computerised to assist accuracy and allow faster transmission of data by electronic means.

The order of questions will be “funnel-shaped” – that is, starting with general questions and then proceeding to the recording of the target information. The first part comprises general information such as vessel name, gears used and home marine district, while the second part includes the survey target information.

In view of the target phenomenon and the degree of knowledge available, the questions must be structured; in other words, there is no need to choose between open-answer questions and fixed or predefined-answer questions. In particular, a comprehensive list of the species for which the specific fishing effort must be recorded has been drawn up.

Interviewer selection and the conduct of interviews are two very important phases of the survey. Given the object of the survey, it is felt appropriate for the interviewers themselves to be engaged in fish production and fishery management.

The interviewers will undergo specific training courses. These will be conducted annually and will concern the information-gathering procedures to be used.

Sample design

Two-stage sampling with stratification at primary-unit level

The sampling design is complex, using a two-stage sample stratified at primary-unit level. The first-stage units are the fishing vessels and the second-stage units fishing days. Both the primary and the secondary units are selected without replacement and with equal probabilities. Two-stage sampling was chosen owing to the need for maximum possible precision coupled with containment of costs within a reasonable budget.

The primary units are stratified so as to take account of the level of disaggregation of the information required by the implementing regulation, and the stratification is therefore based on two variables. The first is the GFCM Geographical sub-areas. There are seven FAO Geographical sub-areas (GSA), which account almost exclusively for the fishing operations of the Italian fleet:

- 9: Ligurian Sea and Upper Tyrrhenian
- 10: Lower Tyrrhenian
- 11: Sardinia
- 16: Sicilian Channel
- 17: Upper and Mid-Adriatic
- 18: Lower Adriatic
- 19: Western Ionian

Even if GFCM Geographical sub-areas are chosen to stratify the universe, it will be possible to move to GFCM/FAO divisions, in order to comply with EU regulation n. 1639/01.

The second stratification variable is type of fishing technique. The relevant fishing techniques are set out in appendix VIII of the Implementing Regulation.

The final number of non-empty strata or domains from which the overall sample is to be extracted was 36 (see Table 8.2).

Sample size and allocation to strata

The sample size was determined after evaluation of the sampling error.

In particular, sample size was fixed on the basis of the requirement of a 25% maximum permissible error as laid down in the implementing regulation. Since corrected or approximately correct estimators will be used for the survey, the variances of the estimates had to be determined.

The required sample size to ensure an error not exceeding 25% with a probability $p = 95\%$ was calculated by the following formula:

$$n \geq \frac{N \sum_{h=1}^H N_h S_h^2}{\varepsilon^2 \hat{Y}^2 + \sum_{h=1}^H N_h S_h^2}$$

in which:

- n: sample size calculated on the basis of secondary units
- N: population size
- h: generic stratum $h = 1, \dots, H$
- S_h^2 : variance of target variable
- \hat{Y} : total target variable
- ε : maximum permissible error

The overall sample size will be distributed among the H strata by Neyman's criterion, according to which stratum allocation is based on minimisation of sample variance. This criterion is expressed by the formula:

$$n_h = n \frac{N_h S_h}{\sum_{h=1}^H N_h S_h}$$

The above formulae are applicable provided that the variance S_h^2 and the total Y of the target variable (the number of days of activity at sea on which catches of a given species exceed specified threshold values) in the population (the total number of fishing days of the Italian fleet) are known. A pilot survey was not necessary for estimating S_h^2 and Y , as estimates of previous surveys on the fishing-days variable were used.

The value of S_h^2 was calculated on the basis of average sample data from the surveys mentioned. The variance of the target variable is defined in each stratum by the following formula:

$$S_h^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_h} (y_{hi} - \bar{y}_h)^2$$

in which:

- h : stratum index ($h = 1, \dots, H$)
- i : primary-unit index
- n_h : number of secondary units observed in stratum h
- y_{hi} : value observed on the i th unit of the sample
- \bar{y}_h : simple arithmetic mean of the values observed on the n_h units of the sample

After determination of the number of secondary units for each stratum (n_h), the number of primary units (m_h) was taken proportionally to the variability within each stratum.

The sampling design was drawn up by applying the procedure described above and is set out in Table 8.2.

Table 8.2. Sampling design for the 2004 survey of specific fishing effort

<i>Geographical area</i>	<i>Type of fishing technique</i>	<i>Number of primary units</i>	<i>Number of secondary units</i>
10, Lower Tyrrhenian	Demersal trawl	5	82
10, Lower Tyrrhenian	Pelagic trawl and seiners	4	39
10, Lower Tyrrhenian	Gears using hooks	10	551
10, Lower Tyrrhenian	Polyvalent (passive gears)	8	26
10, Lower Tyrrhenian	Polyvalent (combining mobile and passive gears)	5	302
11, Sardinia	Demersal trawl	7	33
11, Sardinia	Gears using hooks	3	22
11, Sardinia	Polyvalent (passive gears)	7	44
16, Sicilian Channel	Demersal trawl	7	113
16, Sicilian Channel	Pelagic trawl and seiners	7	71
16, Sicilian Channel	Gears using hooks	2	10
16, Sicilian Channel	Polyvalent (passive gears)	12	40

17, Upper and Mid-Adriatic	Demersal trawl	10	572
17, Upper and Mid-Adriatic	Beam Trawl	4	9
17, Upper and Mid-Adriatic	Pelagic trawl and seiners	9	115
17, Upper and Mid-Adriatic	Gears using hooks	3	124
17, Upper and Mid-Adriatic	Polyvalent (passive gears)	9	225
17, Upper and Mid-Adriatic	Polyvalent (combining mobile and passive gears)	5	293
18, Lower Adriatic	Demersal trawl	7	181
18, Lower Adriatic	Pelagic trawl and seiners	9	44
18, Lower Adriatic	Gears using hooks	3	73
18, Lower Adriatic	Polyvalent (passive gears)	8	48
19, Western Ionian	Demersal trawl	5	17
19, Western Ionian	Pelagic trawl and seiners	4	37
19, Western Ionian	Gears using hooks	6	308
19, Western Ionian	Pots and traps		
19, Western Ionian	Polyvalent (passive gears)	9	227
19, Western Ionian	Polyvalent (combining mobile and passive gears)	6	196
9, Ligurian Sea and Upper Tyrrhenian	Demersal trawl	6	33
9, Ligurian Sea and Upper Tyrrhenian	Pelagic trawl and seiners	5	33
9, Ligurian Sea and Upper Tyrrhenian	Gears using hooks	3	65
9, Ligurian Sea and Upper Tyrrhenian	Polyvalent (passive gears)	9	126
9, Ligurian Sea and Upper Tyrrhenian	Polyvalent (combining mobile and passive gears)	4	78
		201	4137

After determination of the sampling design, the sampling units were selected on a random basis without replacement, by the simple random sampling method. The primary units were extracted from the panel used for the survey on landings and economic parameter. For each sampled vessel will be possible to compare data from different surveys, in order to check elementary data.

Estimator

A two-stage sampling design is used, stratified in the first stage, both the primary and the secondary units being selected by a probabilistic mechanism without replacement and with equal probabilities.

The object of the survey is to estimate the total value of the number-of-fishing-days variable by segment and by area. To estimate the total, it was decided to use a direct estimator, expressed by:

$$\hat{Y} = \sum_{h=1}^H \sum_{i=1}^{m_h} \sum_{j=1}^{n_{hi}} K_{hi} Y_{hij}$$

in which :

$$K_{hi} = \frac{M_h}{m_h} \frac{N_{hi}}{n_{hi}}$$

where :

Y_{hij} : value of variable y of secondary unit j of primary unit i of stratum h

M_h : number of primary units in stratum h

m_h : number of sample primary units in stratum h

N_{hi} : number of secondary units of primary unit i in stratum h

n_{hi} : number of sample secondary units of primary unit i in stratum h

In the case of two-stage sampling with stratification at primary-unit level, and assuming extraction of the sampling units with equal probability and without replacement, the expression for the sampling variance of the estimate \hat{Y} of the total Y is as follows:

$$V(\hat{Y}) = \sum_{h=1}^H M_h^2 \frac{M_h - m_h}{M_h} \frac{S_h^2}{m_h} + \sum_{h=1}^H \frac{M_h}{m_h} \sum_{i=1}^{M_h} N_{hi}^2 \frac{N_{hi} - n_{hi}}{N_{hi}} \frac{S_{hi}^2}{n_{hi}}$$

in which:

- h : stratum index ($h = 1, \dots, H$)
- i : primary-unit index
- j : secondary-unit index
- M_h : number of primary units in stratum h
- m_h : number of sample primary units in stratum h
- S_h^2 : variance of target variable between totals of primary units in stratum h
- N_{hi} : number of secondary units of primary unit i in stratum h
- n_{hi} : number of sample secondary units of primary unit i in stratum h
- S_{hi}^2 : variance of target variable within primary unit i of stratum h

Phases of sample survey

Task B1: Reception of records from interviewers

Daily records will be received by email and computerised daily with effect from the end of the first week of the reference quarter. The closing date for despatch is set at the

thirtieth day after the reference day. Specific software for checking incoming records will be used.

Task B2: Checking of sampling data

Sampling data will be checked with software designed specifically to identify and deal with non-sampling errors and to check the individual items of data.

Task B3: Expansion of data to entire population

The weightings mentioned in the previous section will be applied for scaling up to the population as a whole.

Task B4: Checking of expanded data

Specific software will be used to check the results and to analyze inconsistencies.

Task B5: Transmission of data to Central Statistical Office

The institute conducting the survey will forward the results to the Central Statistical Office in the agreed format within five months of the end of the reference month.

Annex II. Sample survey for the evaluation of landings per species and of fishing effort by type of technique

A specific sample survey will be conducted to estimate the Italian fleet's landings (quantity and value) and fishing effort by type of technique. The sampling data will be expanded to the entire population to yield the final overall estimates, which will be statistically significant because corrected estimators will be used.

The methodology of the survey was approved by Eurostat during the meeting of the working group "fishery statistics" held in Luxembourg, 18-19 February 2002.

The present survey integrates the ongoing sample survey Italy is carrying on in order to fulfil Regulation (EC) No 1382/91 as amended by Regulation (EC) No 2104/1993. However, the disaggregation level of results required by Regulation (EC) No 1543/2000 differs from that stipulated in Regulation (EC) No 1382/91. Therefore, results required by regulation EC no. 1543/00, as recommended by the Consultant and SGRN, imply an increase of the sample size.

Purpose of survey

The object of the relevant statistical survey is to estimate landings (by weight and value) of each species by the commercial fishing fleet, by quarter, type of technique and FAO statistics divisions.

Survey period and reference period

The object of the sample survey is to estimate landings by weight and value. These estimates will be referred to quarterly periods. Hence the sample survey concerned will be repeated quarterly.

Determination of sample population and list

The purpose of the survey is to estimate total catches and average prices for each individual species. The sampling base thus comprises the more than 800 landing points along the 8 000-kilometre Italian coastline. However, the list of landing points cannot on any account be deemed to constitute the list of elementary units.

These difficulties have been overcome by adopting an observed population that differs from the total sample population but includes units exhibiting the phenomenon to be analysed. The elementary analysis units essentially constitute landings from vessels included in the sampled fleet, so that the list from which the sampling units will be extracted comprises all the vessels making up the Italian fishing fleet.

The most comprehensive and efficient sampling base currently in existence, which is also official, is the Fishing Licence Archive (ALP) kept by the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies. This sampling base excludes ocean-fishery and tuna-fishing vessels.

Selection of target variables

The target (or descriptive) variables are the prices and quantities by species of the total production of the Italian fishing fleet.

Regulation (EC) No 1639/2001 enumerates some 45 species whose weight and value must be communicated⁹. The sample survey discussed here will cover all these species.

⁹ Appendix XII of the implementing regulation.

To sum up, the target variables to be recorded in this survey are:

- quantities of each species landed
- price per species

In addition to the descriptive variables, the survey will record other, associated variables that may be useful for providing additional information.

The connected variables covered by the survey break down into “annual structural data” and “other information on weekly activity and production”, as follows:

Table 8.3 Variables to be recorded in the sample survey

<u>Annual structural data</u>	<u>Other information on weekly activity and production</u>
Company type and year of foundation	Gear used
Communication equipment	Total fishing days
Navigation equipment	Sailing days
Fish location instrumentation	Rest or other days
Preservation equipment	Bad-weather days
Number of owners, vessel age and ownership shares	Number of trips
Contractual provisions for work remuneration	Total hours
	Sailing hours
	Actual hours
	Average crew numbers
	Distance of fishing area from coast
	Port of departure
	Port of sale
	Commercial channel (fish market, wholesaler, fish shops or travelling sellers, processing industry)

The “other information on weekly activity and production” is needed for estimation of fishing effort by type of technique, as required by Chapter II(D) of the Annex to the implementing regulation.

Questionnaire and choice of interviewers

The survey uses two questionnaires, namely an annual questionnaire for recording structural information and a weekly questionnaire for activity information.

The order of questions will be “funnel-shaped” – that is, starting with general questions and then proceeding to the recording of the target information. The first part of the weekly questionnaire includes general information such as vessel name, gears used, days of activity at sea, bad-weather days and rest days, total hours, number of trips and distance of fishing area from coast, while the second part covers information on species caught (quantities, average prices and marketing channel).

In view of the target phenomenon and the degree of knowledge available, the questions must be structured; in other words, there is no need to choose between open-answer questions and fixed or predefined-answer questions. In addition, an exhaustive list of the species for which quantities and prices must be recorded has been drawn up; it is the responsibility of the interviewer to specify the individual species caught.

Other important aspects of the questionnaire design, such as use of language, question formulation and correct recording of information, are dealt with directly by the interviewers, who thus constitute the filter between the interviewees and the data-processing centre. Note too that the information base by individual vessels is fully computerised; the software, written for the specific purposes of the survey, is structured consistently and includes check programs to avoid partial or inconsistent completion of questionnaires.

Interviewer selection and the conduct of interviews are also two very important phases of the survey. The interviewers themselves work in the fish production and management sector. It is considered essential to use interviewers who belong to the fish production sector in order to ensure that correct and prompt information is obtained. Again, their motivation will ensure that the information collected is objective and impartial.

Sampling design

Sampling in a single stratified stage

A complex-type sampling design using a single-stratified-stage sample with two variables is employed. The stratification is designed to maximise the homogeneity of the strata, using parameters of known form for each unit of population, linked to (correlated with) the target variables. The stratification uses two parameters, one geographical and one technical (fishing systems), in accordance with the disaggregation of the results.

Sample size and allocation to strata

The sample size was determined after evaluation of the sampling error.

In particular, the precision of the estimates had to be specified – that is, the value of the mean square error had to be fixed; furthermore, since corrected or approximately correct estimators are used, the variance values of the estimates needed to be determined.

On the basis of a single-stratified-stage sampling procedure and assuming extraction of the sampling units with equal probability and without replacement, the expression for the sampling variance of the estimate \hat{Y} of the total Y is as follows:

$$V(\hat{Y}) = \sum_{h=1}^H N_h^2 \frac{N_h - n_h}{N_h} \frac{S_h^2}{n_h}$$

in which:

- \hat{Y} represents a corrected estimate of Y, the total of the survey variable
- N_h : stratum size
- n_h : number of samples in stratum h
- S_h^2 : variance of generic stratum h

For a given population, the variance thus varies either in accordance with the total sample size n or, for an assigned value of n, in accordance with the numbers $n_1, \dots, n_h, \dots, n_H$, which are linked by the condition that their sum shall be equal to n.

Of the various ways of determining the sample sizes of the H strata, the proportional criterion was discarded in favour of Neyman's criterion, which involves taking a variable percentage of elements from each stratum in order to obtain the minimum value of $V(\hat{Y})$.

However, Neyman's method is applicable only in the case of a single target variable, as a different sample size would otherwise be obtained for each variable considered. Since our survey is multivariate – that is, there is more than one target variable in the survey – the sample size was calculated by Bethel's method, which is the application of Neyman's technique to the multivariate case. The approach here is to reduce the analysis to a linear-programming problem, whereby sample size and stratum allocation can be identified while at the same time minimising the variances of all the variables (cf. 1989, *Survey Methodology*, 15, 47-57).

The problem of optimum stratum allocation for multipurpose surveys was solved by Bethel using the Kuhn-Tucker theorem, the expressions for optimum allocation thus being derived in terms of LaGrange multipliers.

The application of this method calls for a preliminary estimate of the variances S_h^2 – that is, the variances of the estimates of total catches and of prices for each species – for each region and fishing system. The results of previous sample surveys were used for this purpose.

Bethel's method was therefore applied to the available data by a procedure implemented on STATISTICA vers. 6 StatSoft inc.

The sample size was defined in 1250 vessel units.

Extraction without replacement of sampling units

After determination of the sample size and stratification proportions, the sampling plane – i.e., the association of the corresponding extraction probability with each population unit – was constructed.

The following quantity was used as a measure of the standardised size:

$$P_i = \frac{LOA_i}{LOA_h}$$

in which:

- i: generic vessel
- h: generic stratum defined by region and fishing system
- LOA: length overall

The LOA was chosen as the standardised measure of size on the basis of a large number of correlation studies between various vessel size variables and catches per species.

Hanurav's algorithm (1967, *Journal of the American Statistical Association*, 77, 88-96) was used as the extraction method.

For completeness, the problem of sample dropouts must be considered. It turns out that one of the main problems arising with the ALP (Fishing Licence Archive) list is delayed updating, as a result of which the list includes non-existent units.

The required dimension is restored after extraction of non-samplable units by replacement of non-includable units on the basis of a list of substitute vessels. On the basis of experience from previous surveys, the sample dropout proportion is put at approximately 10%.

Estimators – expansion factors

The direct estimate of the total Y, obtained by single-stratified-stage sampling, is given by:

$$\hat{Y} = \sum_{h=1}^H \hat{Y}_h = \sum_{h=1}^H \sum_{i=1}^{n_h} K_h Y_{hi}$$

in which:

- h: generic stratum
- H: total number of strata
- \hat{Y}_h : direct estimate of total Y_h
- n_h : size of sample h
- Y_{hi} : value of generic variable y to be recorded, relative to unit i of stratum h
- K_h : basic weight to be assigned to each of the n_h units

Assuming that the units are extracted with variable probabilities (PPS), the inclusion probability is not equal for each unit but varies in accordance with the standardised size P_i , which, as stated, is given by LOA_i/LOA_h – that is, the LOA of the generic vessel divided by the LOA of stratum h.

In this case the average weight of the generic sampling unit i of stratum h is given by:

$$K_{hi} = \frac{1}{\pi_{hi}} = \frac{1}{n_h \frac{LOA_i}{LOA_h}} = \frac{LOA_h}{n_h LOA_i}$$

If some of the replies in the total are lacking, the initial weights k_{hi} are adjusted on the basis of data on the respondents (r_h) and non-respondents (s_h) in the extracted sample (n_h). The method involves multiplying the initial weight (k_{hi}) by a factor (d_h) defined as follows:

$$d_h = \frac{r_h + s_h}{r_h}$$

The resulting weights (v_{hi}) are called “base weights” because they are used to calibrate the sum of the weights applied to the population levels and to eliminate distortion due to differences in non-response rates between strata. In the present case, the base weights are therefore given by:

$$v_{hi} = \frac{r_h + s_h}{r_h} \frac{LOA_h}{n_h LOA_i}$$

This method assumes that the missing total replies have no effect on homogeneous groups of statistical units.

The estimator for response homogeneity groups (RHGs)

$$\hat{Y}_{(r)h,RHG} = \sum_{i=1}^{n_h} v_{hi} y_{(r)hi}$$

is correct.

Finally, in the case of a single-stratified-stage sample in which the units are assumed to be extracted without replacement and with equal probabilities in each stratum, the variance of the sampling distribution of the estimate of the total is as follows (Sen-Yates-Grundy formula):

$$\widehat{Var}(Y_{HT}) = \sum_{i=1}^n \sum_{j>1} \left(\frac{y_i}{\pi_i} - \frac{y_j}{\pi_j} \right)^2 \frac{\pi_i \pi_j - \pi_{ij}}{\pi_{ij}}$$

in which π_{ij} is the inclusion probability of second order.

Checking for non-sampling errors – results validation system

In the last phase of the survey, the basic data are checked to eliminate a proportion of non-sampling errors. The non-sampling error is checked with specific software written to correct wrong values and for statistical analyses. The programs essentially involve graphic visualisation of the basic data.

Sample survey phases

Task B1: Reception of records from interviewers

The weekly records will be received daily over the Internet from the end of the first week of the reference quarter. The closing date for sending in will be the thirtieth day of the quarter following the reference quarter.

Task B2: Checking of sample data

This will be carried out by software specifically designed for identifying and processing non-sampling errors and checking individual data items.

Task B3: Expansion of data to population as a whole

The relevant weightings will be applied for expansion to the entire population.

Task B4: Checking of expanded data

Specific software will be used to check the results and to analyse them for inconsistencies.

Task B8: Forwarding of data by the survey institute to the Central Statistical Office.

The survey institute will forward the survey results to the Central Statistical Office within six months.

Annex III Sample survey for the evaluation of economic data

The object of the sample survey is to estimate the aggregate economic account of the fishery sector by year type of fishing technique and FAO statistics divisions.

The survey is continuous in character and has a reference period of one year.

The target population of the survey comprises the Italian fishing fleet and the list is based on the Fishing Licence Archive kept at the Directorate-General of Fisheries and Aquaculture of the Ministry of Agricultural and Forestry Policies.

The survey is based on the same panel as the survey for evaluation of landings and fishing effort. The justification for the use of the same panel for both surveys is that the following items coincide in each:

- population and hence list
- level of disaggregation by type of technique
- geographical disaggregation level
- periodicity (annual or quarterly according to parameter)

Survey efficiency is increased by the use of the same sampling design because:

- the common panel mitigates problems of missing answers/lack of response (due to vessel non-traceability or failure to cooperate)
- the same recording network can be used
- the same basic software can be used by the interviewers for computerising the questionnaires
- a standardised procedure for managing the entire survey can be used (checking of incoming records, evaluation and checking of interviewers, recording of basic data, data processing, generation of end-results and calculation of sampling errors).

The sample size in the landings and effort survey was calculated so as to ensure observance of the precision levels required for the specific target variables of that survey (see annex II).

A posteriori analysis on the coefficient of variation for economic variables justified the use of the same panel as values obtained are satisfactory. The sample size obtained to estimate landings is sufficient to obtain economic data with a good level of reliability.

Finally, using the same vessels to collect data, it is possible to directly compare all information collected for each vessel, improving the possibility of checking data (for example, comparing fuel costs with landings, with fishing days and so on).

Statistical procedures used to elaborate economic data are the same defined in annex II:

- a) PPS without replacement method, based on LOA;
- b) the estimator for response homogeneity groups, to calculate gross saleable production, production costs, fixed costs and the number of persons employed in the sector;
- c) Sen-Yates-Grundy formula , to estimate the variance and the coefficient of variation of our estimates;
- d) graphic checking with specific software, to control non-sampling errors.

Questionnaire and interviewers

The economic-data survey will be conducted quarterly. This interval was chosen because of the nature of the variables to be monitored. Enterprises usually base their accounts on quarterly periods, partly for tax reasons. Again, the interviewers' task would be too onerous if a shorter period were chosen, while a longer period would entail higher costs.

The questionnaire is divided into the following main sections: fuel and oil, production costs, selling costs, maintenance costs, other fixed costs and labour costs.

The questionnaire is computerised and will be transmitted to the processing centre electronically.

The interviewers are provided with PCs to fill in the questionnaires and forward them via the Internet.

Some examples of computer displays relating to the software used by interviewers to collect and transfer information to head office are given below:

Figure 1: for each vessel, quarterly information on fixed costs

Foglio costi [trimestre 1] dal 01/01/2004 al 31/03/2004

TUTTI GLI IMPORTI VANNO DIGITATI IN EURO

Fissi | Produzione | Vendita | Lavoro

Descrizione	Unitario (Euro)	Valore (Euro)	% Armat.	% Oper.	Note
▶ Retribuzioni lorde		0,00	100	0	
▶ Oneri sociali e contributivi		0,00	100	0	
▶ IRPEF - equipaggio		0,00	100	0	
▶ Ipsema malattie		0,00	100	0	
▶ Ipsema infortuni		0,00	100	0	
▶ Contabilità e tenuta libri paga		0,00	100	0	
▶ Spese legali e notarili		0,00	100	0	
▶ Assicurazione sul natante		0,00	100	0	
▶ Costi di gestione c/c bancari		0,00	100	0	
▶ Interessi passivi su c/c bancari e mutui		0,00	100	0	
▶ Spese servizi e quota associativa sinda		0,00	100	0	

TOTALI **OPERATIVI 0,00** **ARMATORIALI 0,00** Chiudi

TOT. GEN. **OPERATIVI 0,00** + **ARMATORIALI 0,00** = **0,00**

Browse **000015411** **SCHEDA NON TRASMESSA**

Foglio costi [trimestre 1] dal 01/01/2004 al 31/03/2004

TUTTI GLI IMPORTI VANNO DIGITATI IN EURO

Fissi | **Produzione** | Vendita | Lavoro

Descrizione	Unitario (Euro)	Valore (Euro)	% Armat.	% Oper.
▶ Acquisto attrezzi di pesca		0,00	100	0
Acquisto reti		0,00	100	0
Acquisto cavi		0,00	100	0
Spedizioniere pratiche doganali		0,00	100	0
Retail - riparazione reti		0,00	100	0
Spese gasolio		0,00	100	0
Spese lubrificanti		0,00	100	0
Spese panatica di bordo		0,00	100	0
Indumenti lavoro equipaggio		0,00	100	0
Acquisto esca		0,00	100	0
Spese telefonia di bordo (cellulare e CB)		0,00	100	0
Spese TV di bordo		0,00	100	0

TOTALI **OPERATIVI 0,00** **ARMATORIALI 0,00** Chiudi

TOT. GEN. **OPERATIVI 0,00** + **ARMATORIALI 0,00** = **0,00**

Browse **000015411** **SCHEDA NON TRASMESSA**

Figure 2: for each vessel, quarterly information on production costs

Foglio costi [trimestre 1] dal 01/01/2004 al 31/03/2004

TUTTI GLI IMPORTI VANNO DIGITATI IN EURO

Fissi | **Produzione** | Vendita | Lavoro

Descrizione	%	Unitario (Euro)	Valore (Euro)	% Armat.	% Oper.
▶ Diritti mercato ittico			0,00	100	0
Provvigioni grossista			0,00	100	0
Provvigioni astatore			0,00	100	0
Facchinaggio prodotti ittici			0,00	100	0
Spese per automezzi trasporto pesce			0,00	100	0
Spese per ghiaccio			0,00	100	0
Cassette, goffe e imballaggi			0,00	100	0
			0,00	100	0
			0,00	100	0
		0,00	0,00	100	0

TOTALI **OPERATIVI 0,00** **ARMATORIALI 0,00** Chiudi

TOT. GEN. **OPERATIVI 0,00** + **ARMATORIALI 0,00** = **0,00**

Browse **000015411** **SCHEDA NON TRASMESSA**

Figure 3: for each vessel, quarterly information on commercialisation costs

Foglio costi [trimestre 1] dal 01/01/2004 al 31/03/2004

TUTTI GLI IMPORTI VANNO DIGITATI IN EURO

Fissi | Produzione | **Vendita** | Lavoro

Descrizione	Costo unitario carburante
Diritti mercato ittico	Digitare il costo unitario (Eur/litro) del carburante.
Provvigioni grossista	In mancanza la scheda non potrà essere chiusa.
Provvigioni astatore	
Facchinaggio prodotti ittici	
Spese per automezzi trasporto	
Spese per ghiaccio	
Cassette, goffe e imballaggi	

TOTALI **OPERATIVI 0,00** **ARMATORIALI 0,00** Chiudi

TOT. GEN. **OPERATIVI 0,00** + **ARMATORIALI 0,00** = **0,00**

Browse **000015411** **SCHEDA NON TRASMESSA**

Figure 4: for each vessel, quarterly information on fuel costs

Phases of sample survey

Task B1: Receive records from interviewers

The quarterly records will be received over the Internet with effect from the end of the first week of the reference quarter. The final date for forwarding will be two months after the reference quarter.

Task B2: Checking of sample data

This will be carried out by software specifically designed for identifying and processing non-sampling errors and verifying individual data items.

Task B3: Expansion of data to population as a whole

The relevant weightings will be applied for expansion to the entire population.

Task B4: Checking of expanded data

Specific software will be used to check the results and analyse them for inconsistencies.

Task B8: Forwarding of data from the survey institute to the Central Statistical Office.

The survey institute will forward the survey results to the Central Statistical Office within nine months of the end of the year to which they refer.

Annex IV: Discard sampling survey: quantity estimation by species

The *average discard* per boat j in the i th fishing day of the h th stratum:

$$\bar{X}_{hi} = \sum_{j=1}^{n_{hi}} X_{hij} / n_{hi}$$

where n_{hi} is the number of sampled boats in the i th fishing day.

The *average discard* per boat considering all the sampled fishing days of the h th stratum:

$$\bar{X}_h = \sum_{i=1}^{m_h} \sum_{j=1}^{n_{hi}} X_{hij} / n_{hi} m_h$$

where m_h is the number of sampled fishing days.

The *average discard* per boat in the *geographical district*:

$$\bar{X} = \sum_{h=1}^H \sum_{i=1}^{m_h} \sum_{j=1}^{n_{hi}} X_{hij} / n_{hi} m_h H$$

The *total discard* in the i th fishing day of the h th stratum:

$$\hat{X}_{hi} = (N_{hi} / n_{hi}) \sum_{j=1}^{n_{hi}} X_{hij}$$

The *total discard* considering all the fishing days sampled of the h th stratum,:

$$\hat{X}_h = (M_h / m_h) \sum_{i=1}^{m_h} (N_{hi} / n_{hi}) \sum_{j=1}^{n_{hi}} X_{hij}$$

The *total discard* in the in the *geographical district*:

$$\hat{X} = \sum_{h=1}^H (M_h / m_h) \sum_{i=1}^{m_h} (N_{hi} / n_{hi}) \sum_{j=1}^{n_{hi}} X_{hij}$$

The *variance estimate, standard deviation and coefficient of variation* of the discard **within** the i th fishing day of the h th stratum:

$$s_{hi}^2 = \sum_{j=1}^{n_{hi}} (X_{hij} - \bar{X}_{hi})^2 / (n_{hi} - 1); \quad \text{std}_{hi} = s_{hi}; \quad CV_{hi} = s_{hi} / \bar{X}_{hi}$$

The *variance estimate and standard deviation* of the discard **within** all the sampled fishing days of the h th stratum:

$$s_{2h}^2 = \sum_{i=1}^{m_h} n_{hi} s_{hi}^2 / n_h; \quad \text{std}_{2h} = s_{2h}$$

The *variance estimate and standard deviation* of the discard **between** the sampled fishing days of the h th stratum:

$$s_{1h}^2 = \sum_{i=1}^{m_h} (\bar{X}_{hi} - \bar{X}_h)^2 / (m_h - 1); \quad std_{1h} = s_{1h}$$

Variance, standard deviation and relative error of average and total estimators

Estimator: \bar{X}_{hi}

$$var[\bar{X}_{hi}] = s_{hi}^2/n_{hi}; \quad std[\bar{X}_{hi}] = (var[\bar{X}_{hi}])^{1/2}; \quad rel - error[\bar{X}_{hi}] = std[\bar{X}_{hi}] / \bar{X}_{hi}$$

Estimator: \bar{X}_h

$$var[\bar{X}_h] = ((1 - f_{1h})/m_h) s_{1h}^2 + [(1 - f_{2h})f_{1h}/(\bar{n}_h m_h)] s_{2h}^2;$$

$$std[\bar{X}_h] = (var[\bar{X}_h])^{1/2}; \quad rel - error[\bar{X}_h] = std[\bar{X}_h] / \bar{X}_h$$

Estimator: \bar{X}

$$var[\bar{X}] = \sum_{h=1}^H w_h^2 \{var[\bar{X}_h]\}; \quad std[\bar{X}] = (var[\bar{X}])^{1/2};$$

$$rel - error[\bar{X}] = std[\bar{X}] / \bar{X}$$

Estimator: \hat{X}_{hi}

$$var[\hat{X}_{hi}] = N_{hi}^2 s_{hi}^2 / n_{hi}; \quad std[\hat{X}_{hi}] = (var[\hat{X}_{hi}])^{1/2};$$

$$rel - error[\hat{X}_{hi}] = std[\hat{X}_{hi}] / \hat{X}_{hi}$$

Estimator: \hat{X}_h

$$var[\hat{X}_h] = M_h^2 ((1 - f_{1h})/m_h) s_{1h}^2 + N_h^2 [(1 - f_{2h})f_{1h}/(\bar{n}_h m_h)] s_{2h}^2$$

$$std[\hat{X}_h] = (var[\hat{X}_h])^{1/2}; \quad rel - error[\hat{X}_h] = std[\hat{X}_h] / \hat{X}_h$$

Estimator: \hat{X}

$$var[\hat{X}] = \sum_{h=1}^H w_h^2 \{var[\hat{X}_h]\}; \quad std[\hat{X}] = (var[\hat{X}])^{1/2}; \quad rel - error[\hat{X}] = std[\hat{X}] / \hat{X}$$

If seasonal variations of discards will occur in the survey period a post-stratification over time could be applied.

Annex V: Biological sampling of catches

Estimate of length frequency distribution by species

Average and variance of length frequency distributions will be estimated according to the method reported in Pennington et al., 2002.

The mean fish length and its variance estimate are based on the clusters of fish caught at n sampling fishing days. This is because the sample of fish measured during a survey is not a random sample of individual fish from the entire population, but a sample of n clusters, one cluster from each fishing day. Because fish caught together are usually more similar than those in the general population, a total of M fish collected in n clusters will contain less information, about the population length distribution, than M fish sampled randomly.

Since both the lengths and the number of fish in a sampling fishing day are random variables, a ratio estimator is appropriate (Cochran, 1977). The ratio estimator, R , of the mean length is given by:

$$\hat{R} = \frac{\sum_{i=1}^n M_i \hat{\mu}_i}{\sum_{i=1}^n M_i}$$

where M_i = the number of fish caught in the sampling fishing day i ;

and $\hat{\mu}_i$ = an estimate of the average length of fish in the sampling fishing day i .

The estimated variance of \hat{R} is approximately given by:

$$\text{var}(\hat{R}) = \sum_{i=1}^n \frac{(M_i / \bar{M})^2 (\hat{\mu}_i - \hat{R})^2}{n(n-1)} \quad \text{where: } \bar{M} = \sum_{i=1}^n M_i / n$$

Then the variance σ_x^2 of the population length distribution is estimated. If m_i are measured in each sampling fishing day, then the calculated variance:

$$\hat{\sigma}_x^2 = \frac{\sum_{i=1}^n \sum_{j=1}^{m_i} (M_i / m_i)^2 (x_{i,j} - \hat{R})^2}{M - 1}$$

is an estimator of variance σ_x^2 ; where

$M = \sum_{i=1}^n M_i$ is the total number of the fish caught during the survey and

$x_{i,j}$ = the length of the j^{th} fish in the sampling fishing day i .

Age length-key by species

The total number of fish for each age group will be obtained by the sum of the individuals in each length class (Baird, 1983).

$$N = \sum_i N_i p_i$$

where N_i = n° of individuals for each length class;

p_i = proportion of the individuals in an age group for length class;

$N_i p_i$ = number of individuals for length class and belonging to an age group.

$n_i p_i$ = number of aged individuals for length class and belonging to an age group.

Variance of landing for each length class ($Var N_i p_i$) is calculated using the Gulland's formula (1955) as follows:

$$Var(N_i p_i) = N_i^2 Var(p_i) + P_i^2 Var(N_i)$$

The first term of the equation represents the variability due to the ageing and the second one the variability due to the length measures. The latter is negligible compared to the former (Brander, 1974, Pope e Knights, 1975; Levi e Mortera, 1982) and thus the formula is reduced as follows:

$$Var(N_i p_i) = N_i^2 Var(p_i)$$

Assuming that the age groups are distributed in the length classes according to a binomial distribution the variance will be estimated as follows:

$$Var(p_i) = \frac{p_i * (1 - p_i)}{n_i}$$

where n_i = number of individuals aged for the length class (all the age groups of that length class).

If all the individuals of a length class belong to a single age group then the variance is zero.

The variance of the total number of individuals for an age group is computed by the sum of the variance of each length class containing the age group of interest according to the following formula:

$$Var(N) = \sum_{i=1}^L N_i^2 Var(p_i)$$

where L are the length classes.

The coefficient of variation CV for each age group is calculated as follows:

$$CV = \frac{Var(N)}{\sum_{i=1}^L N_i p_i}$$

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