

Sampling scheme identifier: **Flemish Cap Groundfish Survey - FCGS**

MS: PRT
Region: North-East Atlantic
Sampling scheme identifier: FCGS
Sampling scheme type: Research survey at sea
Observation type: SciObsAtSea
Time period of validity: 2025-2027
Short description (max 100 words): The objective of the Flemish Cap Groundfish Survey (FCGS) is to know the stock status of target species: their abundance, biomass and demographic structure and the hydrographical and environmental conditions on the Flemish Cap Bank (NAFO Division 3M).
Description of the population
Population targeted: Target species: Cod (<i>Gadus morhua</i>), Redfish (<i>Sebastes mentella</i> , <i>S. fasciatus</i> and <i>S. norvegicus</i>), American plaice (<i>Hippoglossoides platessoides</i>), Greenland halibut (<i>Reinhardtius hippoglossoides</i>), Roughhead grenadier (<i>Macrourus berglax</i>) and Northern shrimp (<i>Pandalus borealis</i>) Area: Flemish Cap Bank (NAFO Regulatory Area Division 3M). Flemish Cap is entirely outside any 200-mile EEZ, and the exploitation of its resources is regulated by the NAFO. Dates: The survey starts in the second half of June, and needs 35 days at sea. Population sampled: All fish, cephalopods, shrimp and non-commercial invertebrates. Flemish Cap is an isolated bank on the American continental shelf, with an approximated surface of 17 000 squared nautical miles within the 1460 m (800 fathoms) isobath and 10 555 within the 730 m (400 fathoms). Flemish Pass, an area deeper than 1000 m, separates it from the Newfoundland Grand Bank and gives it its isolated character by limiting the migration of many species, particularly those occurring in the shallowest zones. The trawling gear used is the Lofoten and the cod-end mesh size is 35 mm. An auxiliary net bag of 10 mm mesh size is used to retain the youngest individuals of shrimp escaping throw a small square of the cod-end. Stratification: Random stratified survey of the Flemish Cap area until 1460 m (800 fathoms) depth, making 181 bottom trawl hauls with a Lofoten fishing gear, at daytime: between 6:00' and 22:00', and 30 minutes effective fishing time. The adopted stratification of Flemish Cap considers 19 strata up to 730 m (400 fathoms) depth. Stratification was later extended to cover up to 1460 m (800 fathoms) depth, considering 39 strata. Two strata of this bank (numbers 26 and 27) have fishing grounds unsuitable for trawling due to the huge abundance of sponges, and the same goes for the five strata belonging to the Beothuk Knoll (numbers 35–39) due, presumably, to the massive presence of corals. All these strata have been removed from the survey, resulting in the current 32 strata surveyed. Each stratum is divided in rectangles of equal area. i.e. the number of rectangles is proportional to the stratum

area. A total of 478 rectangles are therefore considered in the current survey design. Each rectangle is in turn divided in 10 fishing units of equal area, leading to 4780 possible bottom trawl fishing hauls.

Sampling design and protocols

Sampling design description:

Type of survey: Bottom trawl fishing hauls that lasting for 30 minutes and are distributed using a stratified random sampling scheme. The trawling gear used is the Lofoten. Temperature and salinity profiles are taken with a CTD according to a predefined square grid. The survey starts in the second half of June, and needs 35 days at sea.

Trawl station methodology: 181 hauls will be selected at random, 120 of them in less than 730 m depth. The selection of the hauls is set with the following conditions:

- The number of hauls in each stratum is fixed, distributed proportionately to the number of units, and ensuring at least two hauls by stratum.
- Hauls (fishing units) are randomly chosen within each stratum with the following constraints: only one haul can be selected within a given rectangle, and two hauls cannot coincide in adjacent fishing units.
- Information from previous surveys and commercial fishing is used to eliminate hauls in unsuitable fishing grounds.
- The allocation of the hauls into each fishing unit could be made more accurate using the bathymetry of the area obtained by the NEREIDA project, reducing the risks of snagging in the bottom.

Is the sampling design compliant with the 4S principle?:

NA.

Regional coordination:

N. There is not signed agreement about task sharing.

The survey is carried out by Spain and Portugal and annually there is a joint coordination meeting ad hoc for this survey (FCCM). Spain contributes with vessel, staff and samples analysis in laboratory and Portugal contributes with staff and samples analysis in laboratory.

Link to sampling design documentation:

<https://archive.nafo.int/open/studies/s46/S46.pdf>

Design follows international recommendations:

Y.

The results of the survey are used by the NAFO Scientific Council to make an assessment on the state of the resources, which is the key tool for the NAFO Commission to take the appropriate management measures.

Link to sampling protocol documentation:

<https://archive.nafo.int/open/studies/s46/S46.pdf>

Protocol follows international recommendations:

Y.

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Sampling implementation

Recording of refusal rate:

NA.

Monitoring of sampling progress within the sampling year:

The criterion used to change the position of a previously selected random haul has always been the information from the commercial fishing and from previous surveys about the suitability of the bottom trawling. This information is contrasted with the more detailed bathymetric charts of the bottom that have been developed in the project NEREIDA.

Criteria for rejecting a haul:

- Snag of the trawling gear in the bottom;
- Damages in the cod-end or severe damages in large sections of the wings or belly;
- Less than 20 minutes of effective trawling time;
- Gear malfunction, i.e., when it is considered that gear contact with bottom was not correct, or the geometry of the gear was not maintained properly through the whole trawl.

Rejected fishing hauls means that, because standard conditions were not achieved, such station cannot be used to quantify the biomass and abundance neither to determine the structure of the population. However, the specimens caught in any non-valid hauls can be used to make all kind of biological sampling.

The order of execution of selected stations is determined during the survey, setting each day the hauls to be held the next day, trying to minimize the routes between stations.

A detailed plan of the order of the stations is impractical because it is necessary to make changes due to unforeseen malfunction of the gear (e.g. obstruction, breakages...).

The distance travelled in each haul is the geographical distance between the GPS positions of the start of the haul (when the gear comes into contact with the bottom and it acquires its characteristic shape) and the start of the hauling (when cable starts to be recovered).

The development of the survey depends on the weather conditions and other factors (breakdowns, gear damages, etc.), so that the final fishing plan is decided on board day to day in order to optimize the use of the working day.

Every year, issues about logistic, sampling plan and protocols are discussed in the coordination meeting (FCCM) (Mar-Apr) previously to the survey (Jun-Jul).

Data capture**Means of data capture:**Trawl hauls

The trawling gear used is the Lofoten and the the cod-end mesh size is 35 mm. An auxiliary net bag of 10 mm mesh size is used to retain the youngest individuals of shrimp escaping throw a small square of the cod-end.

ScanMar and, ITI sensors are used to monitor the gear.

Fishing hauls and Catch Record. A haul's data form is filled in each set. It will contain information gathered in the bridge during and immediately after finishing the haul, as well as catch information by species. This form is available in the sampling area before sorting the catch starts. There are two forms, one for depth < 700 m. and another one for > 700 m. There is a space reserved for sums and calculations. Catch record. All fish species, as well the commercial cephalopods and crustacean are recorded.

Biological data

Length sampling. The length frequency of each species is recorded in separated data forms. Length measurements are made by at least two persons, so that always a person measure and other records. The lengths shall be recorded in the appropriate data form for this purpose After the measurement, it is clearly indicated the beginning and end of the size range and measures are counted and registered the total number of individuals measured by size. For species with sex discrimination, frequencies are recorded in separate columns with indication of the sex on headings.

Biological sampling. In each haul a full biological sampling is done for the most of target species by two observers and always a person measure and other writes down data in the form. Control sheets for each species are available at the beginning of each day based on data collected from previous hauls.

Length data is collected using a measuring board for fish and cephalopods species. For crustaceans, sampling is made using a digital caliper connected to a laptop that records length data automatically to an Excel file.

Weight data is collected using marine scales.

Stomach contents

Stomach sampling. This sampling is done every two years as a minimum, and it is under the exclusive task of two observers that always a person measure and other records data in a specific form. Sampling data is recorded in a specific software of the Trophic Relationships.

Benthos in the trawl

Benthonic invertebrates. Non-commercial invertebrates, sponges and corals among them, are recorded in a specific data form. Catch records are written down in a specific data form where weight and number of each best identified group is noted, as well as any observation. A photographic record is made of the whole invertebrate catch.

Litter items

Marine litter data is registered and written down in the hauls form for their classification according to the established code. In addition, a photographic record of it is made.

Hydrography-CTD

Temperature and salinity profile using a CTD. The files generated in each station *.hex must be checked and converted to ASCII files by means of the SBD data processing program.

All survey data are captured using specific recording specific paper forms.

All data recorded during the survey are entered in a computer as soon as possible, as data is validated and potential errors corrected in an easy way. The data collected each day is always inputted before the next day work starts, to allow updating control of samples already taken.

After stored, data from each fishing haul will be printed to verify that the stored information is equal to that in the forms. Printing formats should be similar to that of the forms in use.

Data are stored and initially managed in an ad hoc software called ARGO. The system provides a reliable way of data storage and elaboration of results, as well as the possibility of transferring data to any other programs.

Once they are corrected, they are transferred to the shared database SIRENO, which is managed by the IEO.

Data capture documentation:

<https://archive.nafo.int/open/studies/s46/S46.pdf>

Survey Plan FCGS 2021 (Spanish)

http://www.ieo.es/es_ES/web/ieo/investigacion

Quality checks documentation:

<https://archive.nafo.int/open/studies/s46/S46.pdf>

(See: Validation of Survey Results, pag. 14)

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Data storage National database: Spanish Database: SIRENO (IEO) Survey Database: ARGO (IIM-CSIC) Stomach contents: DataBase Trophic Relationships (IEO) International database: VME Indicators: ICES VME database (http://vme.ices.dk) Hydrography-CTD: IODE/SeaDataNet Quality checks and data validation documentation: https://archive.nafo.int/open/studies/s46/S46.pdf (See: Validation of Survey Results, pag. 14) All data recorded during the survey are entered in a computer as soon as possible, data is validated and potential errors corrected in an easy way. The data collected each day is always inputted before the next day work starts, to allow updating control of samples already taken. After stored, data from each fishing haul will be printed to verify that the stored information is equal to that in the forms. Printing formats should be similar to that of the forms in use. Data are stored and initially managed in an ad hoc program, ARGO. The system provides a reliable way of data storage and elaboration of results, as well as the possibility of transferring data to any other programs. Once they are corrected, they are transferred to the shared database SIRENO, which is managed by the IEO.
Sample storage Storage description: <u>Age</u> Otoliths collected on board are kept duly labelled waxed paper envelopes and later in the laboratory they are classified and stored in boxes for each species before reading. <u>Maturity</u> Gonads collected on board are kept in micro-perforated duly labelled plastic bags that are fixed in formaldehyde solution using a special mask during sample handling. Gonads on board are kept in containers by species. At the lab, ovary samples are stored in 70° alcohol, in outdoor storage rooms located at labs. Due to lack of space, only a sample of the gonads that may be of interest for further studies are kept. On the other hand, all of the histological sections and slides are stored. The samples of otoliths and gonads are stored in the three Institutes of MS participants: IEO and IIM-CSIC (Vigo, Spain) and IPMA (Lisbon, Portugal) in according of the task sharing by species. Shrimp (<i>Pandalus borealis</i>) samples Additional samples are taken for study in laboratory to calculate the length-weight relationship. These samples are frozen on board. Samples are taken from all strata. After the survey samples are stored in freezers at the lab (IEO: C.O. Vigo) until they are sampled. <u>Benthonic invertebrates</u> All specimens of less frequent species are retained, particularly those from species not included in the invertebrates' identification cards or those with uncertain or incomplete classification. Samples are stored in plastic bags, labelled with survey, haul and species, and they are preserved in the appropriate conservation media (alcohol and formalin). <u>Taxonomy</u>

If some species are not identified on board, individuals are labelled, frozen and stored in boxes for their study in the lab. After the survey samples are stored in freezers at the lab (IEO: C.O. Vigo) until they are identified by experts.

Sample analysis:

To improve the quality of the maturity data, a workshop is held prior to the surveys in NAFO waters to review the different maturity stages of the main bony fish species, and of sharks and rays both oviparous and ovoviviparous.

Maturity manuals for each of the species are available onboard to scientific staff for each species. Each maturity stage characteristics are explained and illustrated with photographs taken of individuals of different sizes sampled in the study area. The gonad is shown inside the fish as seen in biological sampling, and also outside the fish and in detail. Those stages for which photographs of individuals captured in the study area are not available are illustrated with photographs of the reports of the ICES maturity workshops that were carried out for the correspondent species.

<https://archive.nafo.int/open/studies/s46/S46.pdf>

Manual ESP_IEO_P5_AtSea_Maturity (Spanish)

http://www.ieo.es/es_ES/web/ieo/investigacion

Survey Plan FCGS 2021 (Spanish)

http://www.ieo.es/es_ES/web/ieo/investigacion

Data processing

Evaluation of data accuracy (bias and precision):

Y.

<https://archive.nafo.int/open/studies/s46/S46.pdf> (See: Data analysis, pag 13)

Editing and imputation methods:

Y.

<https://archive.nafo.int/open/studies/s46/S46.pdf> (See: Data analysis, pag 13)

Quality document associated to a dataset:

N.

Validation of the final dataset:

Final datasets are validated taking into account the guidelines and formats of SC- NAFO.
<https://archive.nafo.int/open/studies/s46/S46.pdf> (See: Validation of Survey Results, pag 14).