Protocols of the EU bottom trawl survey of Flemish Cap
You are free to copy and distribute the work and to make derivative works under the following conditions:

**Attribution.** You must attribute the work in the manner specified by the author or licensor.

**Noncommercial.** You may not use this work for commercial purposes.

Any of these conditions can be waived if you get permission from the copyright holder. Your fair dealing and other rights are in no way affected by the above.

http://creativecommons.org/licenses/by/2.5/ca/legalcode.en

ISSN-0250-6432
Protocols of the EU bottom trawl survey of Flemish Cap

Antonio Vázquez¹, José Miguel Casas² and Ricardo Alpoim³

¹Instituto de Investigaciones Marinas, Muelle de Bouzas, Vigo, Spain, Email: avazquez@iim.csic.es
²Instituto Español de Oceanografía, Apdo. 1552, 36200 Vigo, Spain, Email: mikel.casas@vi.ieo.es
³Instituto Português do Mar e da Atmosfera. Av. Brasília, 1400 Lisboa, Portugal, Email: ralpoim@ipma.pt

Vázquez, A., J. Miguel Casas, R. Alpoim. 2014. Protocols of the EU bottom trawl survey of Flemish Cap. Scientific Council Studies, 46: 1–42. doi:10.2960/S.v46.m1

Abstract

Methods and procedures used in the EU bottom trawl survey of Flemish Cap (NAFO Division 3M) are described in detail. The objectives of publicizing these protocols are to achieve a better understanding of its results, and to contribute to the routines being unaltered.

Keywords: bottom trawl, survey, Flemish Cap

Introduction

The following protocols have been routinely followed since the beginning of the survey series in 1988. They describe the working routines used in the past as well the procedures proposed to be followed in the future. However, there were some changes along the years, which include:

- Hauls schedule was of 24 hours during the first survey in 1988, and only then; it was from 6:00 to 22:00 local time in the remaining surveys.
- The former RV Cornide de Saavedra was substituted by RV Vizconde de Eza in 2003.
- Coverage area also changed in 2003, increasing its limits from 730 m isobaths to 1100 m in 2003 and 1460 m since 2004.
- Non-commercial invertebrates, sponges and corals among them, are recorded since 2007.
- Division 3M is divided into 39 sampling strata up to 1460 m depth, but only 32 of them are considered. Strata 35–39 in the Beothuk bank and strata 26 and 27 located in the SE Flemish Cap were not visited since 2007 as it was almost impossible to carry out standard hauls. Results from 2004 onwards refer to the area of those 32 strata.
- Sampling of target species, including cod, is done independently by sex, even it isn’t required by the NAFO criterion.
## Contents

1. **Introduction** ......................................................................................................... 1  
   - Objective ........................................................................................................... 3  
   - Flemish Cap .................................................................................................... 3  
   - Former research ......................................................................................... 3  
   - Fisheries ........................................................................................................ 4  
   - Work already done .................................................................................... 4  
   - Importance of the survey ........................................................................... 5  

2. **Survey design** ................................................................................................... 6  
   - Trawl station methodology .......................................................................... 6  
   - Criteria for rejecting a haul: ...................................................................... 6  
   - Vessels .......................................................................................................... 7  
   - Personnel ..................................................................................................... 7  
   - Standardization ........................................................................................... 7  
   - Survey gear .................................................................................................. 7  
   - Dates ............................................................................................................. 8  

3. **Data collection** ................................................................................................ 8  
   - Catch record .................................................................................................. 8  
   - Length sampling .......................................................................................... 8  
   - Biological sampling ................................................................................... 9  
   - Redfish (*Sebastes* spp.) sampling ............................................................. 10  
   - Shrimp (*Pandalus borealis*) sampling ......................................................... 10  
   - Taxonomy ...................................................................................................... 11  
   - Physical oceanography .............................................................................. 11  
   - Sampling benthonic invertebrates ............................................................... 11  
   - Conservation of specimens .................................................................... 11  
   - Recording data ........................................................................................... 12  
   - Feeding sampling ....................................................................................... 12  

4. **Data analysis** .................................................................................................. 13  
   - Results .......................................................................................................... 13  
   - Calculations .................................................................................................. 13  
   - Missing data ............................................................................................... 13  

5. **Validation of Survey Results** ......................................................................... 14  

6. **References** ...................................................................................................... 14  

7. **ANNEXES** ...................................................................................................... 21  
   - Data forms .................................................................................................... 22  
   - Species working codes .............................................................................. 27  
   - Shrimp sampling (*Pandalus borealis*) ..................................................... 33  
   - Publications 2002–2012 .......................................................................... 42

---

1 The covered items follow the scheme proposed by NAFO (1975a) and used in the Manual of Groundfish Surveys in the Northwest Atlantic (Doubleday 1981).
Objective

The objective of the survey is to know the stock status of target species: their abundance, biomass and demographic structure, and the oceanographic conditions on the bank. This objective implies the following actions:

- A 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.
- Recording catches of fish species and invertebrates.
- Detailed biological sampling in each haul, including length, sex, weight, otolith and gonad’s sampling for each one of the target species. Only length and length-weight sampling will be done for all the other species.
- Feeding analysis of most abundant species, to be done every two years.
- Sampling of invertebrates, with special attention to corals and sponges, to allow identification of potentially vulnerable marine ecosystems.
- Collecting environmental data through a reticule of CTD stations separated 15 nautical miles both in latitude and longitude.

Target species:

- cod (*Gadus morhua*)
- redfish (*Sebastes marinus, S. mentella* and *S. fasciatus*)
- American plaice (*Hippoglossoides platessoides*)
- Greenland halibut (*Reinhardtius hippoglossoides*)
- roughhead grenadier (*Macrourus berglax*)
- shrimp (*Pandalus borealis*)

Flemish Cap

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) one (Fig. 1). 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 position of the bank was first determined by the Marquis de Chabert in 1750, who indicated that the bank already appeared in Dutch charts, but in a wrong position (Chabert 1753).

The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a jet that flows eastward north of the Cap and then southward east of the Cap. To the South, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing, the circulation over the central Flemish Cap is dominated by a topographically induced anti-cyclonic (clockwise) gyre (Akenhead 1986, Stein 1996).

Templeman (1976) made the first full description of the Flemish Cap Bank and he made reference to the smaller cod caught in that bank by American fishermen in the late nineteenth century compared with the sizes of cod fished in the Grand Banks.

Former research

Regular fluctuations on the magnitude of the cod and redfish year-classes have been recorded in Flemish Cap. This was the reason to develop an international research project on the factors affecting the production of good or bad year-classes (Lilly 1986). On these studies was concluded that the predominance of the anticyclonic flow around Flemish Cap was the main factor for the larval survival.

Lilly (1986) made a review of the objectives and achievements of this project developed between 1978 and 1982. The Flemish Cap Bank was chosen to study the real processes and mechanisms included in fish production for the following reasons:

- Fluctuations in year-class strength of both cod and redfish were regularly observed in this area.
- The stocks of cod are discrete and confirmed as separate from those of the Grand Bank.
- The circulation patterns are likely quite amenable to study.
- The area is reasonably restricted in size.
- The area is one which, because of its major oceanographic features, has been of interest to physical oceanographers for many years and

---

2 The cited 181 hauls is not a proper quantitative objective, but it corresponds to the most appropriate number to reach the main objective of the survey, which is an adequate sampling of the whole bank. The survey is planned based on this Fig. and, because of that, it is seldom achieved and never exceeded.
there exist a useful historical data base of fish production and physical environmental data.

Thus, there were three important issues to consider for the prediction of the survival in the different year-classes:

- The effect of water circulation patterns and the abundance and size composition of the planktonic food supply on the retention and the survival of fish larvae on Flemish Cap.
- The effect of intraspecific and interspecific predation on the survival of juvenile fish.
- Improved assessment of the size of the spawning stocks.

The survey season was chosen in accordance to the initial objectives, and cod was the most important. Since cod spawning occurs mainly in March, sampling for larval survival studies had been proposed to be held between February and June, for survival of juveniles in March and September and for estimating the abundance of spawning stock population in March. For studying the way in which the eggs and larvae are swept by the currents, the period from March to May had been also proposed.

Cod annual recruitments were very weak along the years when the project was developed, hindering to complete the planned studies. One of the most important conclusions was that the 1981 strong year-class was originated from a very small spawning stock. This conclusion reinforced the general knowledge that the oceanographic conditions and circulation patterns on the bank at the time of spawning were the determining factors in the concentration or dispersion of the larvae to regions outside the bank causing the fluctuations in the size of cod year-classes.

One of the most important concerns about the fishing resources in Flemish Cap, not yet fully resolved, was the isolation of the cod in the Flemish Cap bank. According to de Cardenas (1994), results of two tagging surveys conducted by the European Union in 1991 and 1992 do not allow to reject the hypothesis that there is some interconnection with neighbouring populations. According to this author, these tagging results are similar to those obtained in the Canadian surveys of 1962 and 1964, and they suggest that there is some rate of emigration of individuals who have reached maturity (probably aged five or six). The occurrence of such migration, when it is not taken into account in the assessment, could produce significant errors in the estimation of the parameters and consequent mistakes in the advice of management measures (mesh sizes, reference fishing mortalities, etc...).

**Fisheries**

Flemish Cap is entirely outside any 200-mile EEZ, and the exploitation of its resources is regulated by the NAFO.

Inaccuracy in catch statistics was a constant problem in the history of fishing in Flemish Cap. It occurred as a result of, first, the overfishing of national quotas by NAFO member countries and the subsequent unreported catches and, second, the presence of uncontrolled fleet belonging to non-member countries, whose declaration of catches, when they were made, did not offer guarantees. In this scenario, the results of the research surveys in Flemish Cap were the most reliable information source on the state of stocks. Russia also conducted annual surveys during the period 1977–1993, but there was a great disparity between the results of these surveys when both coincided in the same year. A Canadian survey covered the period 1977–1985.

**Work already done**

This survey series was initiated by the EU in 1988, and the following surveys were done until 2012:

---

3The same issues, as well as the interest of the Spanish and Portuguese fishing fleet in those fisheries, were the reasons to initiate the EU survey series.
From 1988 to 2002, the survey was carried out on board RV *Cornide de Saavedra*, covering the 19 strata defined up to 730 m (400 fathoms) depth (Fig. 2); its primary objective was to assess the populations of cod and American plaice. In 2003, taking advantage of new fishing capacities of RV *Vizconde de Eza*, the surveyed area was increased to prospect 31 strata up to 1100 m (600 fathoms) depth, to cover the wider area of the Greenland halibut distribution, which was the commercial species of greatest interest to the EU fleet at that time. In 2004, the range of depths was extended up to 1460 m (800 fathoms) with 34 strata and it was reduced to 32 from 2008 onwards.

The results of the Surveys are presented systematically in the NAFO Scientific Council and they are published as research papers in the SCR Doc. series (Scientific Council Research Documents) (Vázquez 1989, Casas y González 2011, Vázquez 2012).

Calibration of RV *Cornide de Saavedra* versus RV *Vizconde de Eza* catch rates was made from 111 parallel hauls of the two vessels in the 2003 and 2004 surveys (González-Troncoso and Casas 2005); it allowed transforming the *Cornide de Saavedra* catch data in their equivalence in *Vizconde de Eza* scale, to produce homogeneous abundance indices series.

**Importance of the survey**

The main interest of the fisheries research in Flemish Cap is to know adequately the evolution of fishing grounds where cod, redfish and American plaice have...
traditionally been fished and, more recently, Greenland halibut, grenadiers and shrimp. Spain and Portugal are the EU countries most directly concerned in those fisheries. Survey results provide independent information about the stock status of commercial fisheries, which is in some cases the only available information. The results are provided regularly to the NAFO Scientific Council, and they are also the base for many later studies.

These results 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 Fisheries Commission to take the appropriate management measures. Results are used in the following stocks:

- cod (Div. 3M) – results are the only available fishery independent reference
- American plaice (Div. 3M) – “ “
- redfish (Div. 3M) – “ “
- Northern shrimp (Div. 3M) – “ “
- Greenland halibut (SA2 and Div. 3KLMNO) – together with two Canadian surveys
- roughhead grenadier (SA2+3) – together with two Canadian surveys

Furthermore, results have contributed to the preliminary identification of vulnerable marine ecosystems.

The Annex contains a list of publications supported by the survey series since 2002, when it was co-funded by the EU Data Collection Framework. The annex also lists several PhD theses where the information obtained from the survey series since its inception in 1988 was essential.

Survey design

The survey has a stratified random design, covering the area with 181 bottom trawl fishing stations, following the methodological specifications of NAFO (Doubleday 1981).

The adopted stratification of Flemish Cap is that described by Doubleday (1981), which considers 19 strata up to 730 m (400 fathoms) depth. Stratification was later extended by the Department of Fisheries and Oceans (DFO) of Canada (Bishop 1994) to cover up to 1460 m (800 fathoms) depth, considering 39 strata (Fig. 2). 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 (Table 1). Each stratum is divided in rectangles of equal area. i.e. the number of rectangles is proportional to the stratum area (Fig. 2b). A total of 478 rectangles are therefore considered in the current survey design (Table 1). Each rectangle is in turn divided in 10 fishing units of equal area, leading to 4780 possible bottom trawl fishing hauls (Fig. 2b).

Trawl station methodology

The selection of the hauls is set with the following conditions:

- The number of hauls in each stratum (Table 2) 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 constrains: 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.

In accordance with Table 2, 181 hauls will be selected at random, 120 of them in less than 730 m depth.

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.

**Vessels**

The survey is carried out on board RV *Vizconde de Eza*, 1400 GRT, 1800 kW.

Former RV *Cornide de Saavedra* was 1200 GRT and 1680 kW.

**Fishing gears**

The trawling gear used is the Lofoten (NAFO 1990) (Fig. 3), built and rigged as specified in Table 3. This gear is similar to that used by the commercial fleet engaged in American plaice fishing on Flemish Cap in the years when the survey started. It is characterized by being well adapted to the frequent hard bottoms of the bank, and it showed good performances throughout the years.

The cod-end mesh size is 35 mm, which is adequate for fishing juveniles of most important commercial species, particularly for cod at age one.

The cod-end mesh size (35 mm) is inefficient to retain juvenile shrimps (ages 1 and 2), and delays in one or two years the estimation of each new year-class entering the fishery. After several attempts in different surveys, an auxiliary net bag of 10 mm mesh size is used since 2000 to retain the youngest individuals of shrimp escaping throw an small square of the cod-end. The base of the bag is a diamond of 36 cm in each side, and it is attached to the cod-end in a central-dorsal position, 26 cm from the seam end, just in a position where it is believed that the escape is maximum (Aschan and Sunnanå 1997).

**Personnel**

- Catch sampling (2 teams of 5 persons each) 10
- Taxonomy 1
- Identification of redfish species 1
- CTD and data processing 1
- Survey leader 1

**TOTAL** 14 scientists

Every two years two persons will carry out feeding studies with exclusive dedication. In those years, the identification of redfish species and taxonomy tasks will be carried out by the teams in charge of catch sampling.

**Standardization**

**Daily fishing period:** 6.00 to 22.00

The target trawling speed is 3.5 knots. It is not possible to maintain the speed when trawling at deeper grounds due to insufficient weight of the trawl doors used. While this problem is not solved, deeper sets are made at the highest speed possible, which is always around 3.00 knots.

The 30 minutes trawling time is counted from the moment the gear, after its first contact with the bottom, acquires its characteristic mouth opening, until the beginning of the haul in. Its control is done, whenever possible, by using net sounders (ITI or SCANMAR), which enables accurate measures of those times. The start of the haul in is kept as the haul’s end to be consistent with previous criterion used (with the exception of 2005).

In the surveys previous to 2003, when net sounder was not available, the 30 minutes were counted according to the expression:

\[
t\, (\text{min}) = 32 + \frac{\text{depth} \, (\text{m})}{100}
\]

where \( t \) was the time between the end of the cable veering and the start of haul in. This criterion was established in the 1992 survey, in which it was made a systematic control of the gear behaviour with the SCANMAR sounder. The interpretation that was then made for counting the trawling time per haul was “as long as the art is in contact with the bottom before the start of the haul in” (Vázquez 1993).

Whenever possible during the haul in, the time when the gear loses its characteristic shape and it moves off the bottom is also recorded, which reveals the effective trawling time and, in his day, apply corrections to previous surveys.

As will be indicated (VI-Results, Estimates), the catch data are transformed to catch per trawled mile for processing, provided that fishing has lasted at least 20 and no more than 40 minutes.

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 haul in (when cable starts to be recovered).
The length of the wire released is determined by the following relationship (meters) and the results are in Table 4.

\[ \text{Cable length} = 2 \times \text{depth} + 200 \]

The dimensions of each gear in use are verified using the data forms in Fig. 3, by reporting in each cell the observed value versus the specified one. Groundrope and bobbins dimensions are detailed in Fig. 4.

**Dates**

The survey starts in the second half of June, and needs 30 fishing days.

**Data collection**

A haul’s data form (see annex) 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.

The personnel in charge of analysing the catch is divided into two shifts of five people each, with the following schedule:

| Hour | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|------|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Team A |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Team B |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

The teams exchange shifts in the middle of the survey (90 hauls).

The designated Team Leader is responsible for distributing the work for the rest of the team and for verifying that all data forms are covered adequately by reviewing them at the end of the haul analysis. It is also responsible for report to the other Team Leader of the work that remains when the haul analysis is not completed during the shift.

**Catch record**

One member of each team, and always the same, is responsible for logging the catches in the haul's data form (see annex). All fish species, as well the commercial cephalopods and crustacean are recorded. Non-commercial invertebrates, sponges and corals among them, are recorded since 2007 in a specific data form (see below). All species should be identified. Species already found are listed in the Annex, as well their working codes.

Their occurrence in past surveys is listed by Vázquez et al. (2013).

Species that are not possible classify immediately are labelled with the number of the station and with a letter by alphabetical order (e.g. #xx species A, #xx species B, ...), weighed and recorded in the summary report with the sequence described. Unidentified species are then set aside and sent to the dry laboratory for proper identification. The identification is made by a scientist appointed at the beginning of the survey (and always the same scientist) and regardless whether it is able to identify the samples, the specimens are frozen and stored in the freezer.

Sometimes redfish catch is excessive to sort all individuals (the Survey Leader or in his place the Team Leader determines when a catch is excessive). In these hauls, all species other than the redfish are separated and processed as usual. A number of boxes (number defined by the Team Leader) of redfish are separated for sampling, these boxes are chosen randomly without separating the three species and juveniles (see redfish sampling section below). The rest of the redfish catch is not weighed, but put in boxes; these boxes are counted and thrown overboard. The person in charge of recording catches places near the discard strip, counts and records the number of discarded boxes.

He is also responsible for controlling that only redfish is discarded and the rest of the species are separated and transported to the sorting zone.

Later, total catches of redfish species are calculated by extrapolation. In this case it is necessary to state, on the reverse of the haul summary report, the number of discarded boxes and the number of boxes with redfish that were sorted.

**Length sampling**

The length sampling follows the sampling NAFO recommendations on length ranges and sex discrimination (NAFO 1999)* (Table 5). Therefore, the length measurements of fish are made on the total length and to the centimetre below, except the redfish (Sebastes spp.) which is measured to the fork length and also to the centimetre below. The standard for the Grenadiers (pre-anal fin length5 to the half centimetre below) extends to: Macrourus spp., Coryphaenoides spp., Nezumia spp. and

---

*This recommendation was approved by the NAFO Scientific Council in 1974 (NAFO 1974, NAFO 1975b). The standard for the grenadiers was afterwards amended (NAFO 1980, p. 94, NAFO 1984, p. 75).

5Pre-anal fin length is considered the distance between the end of the snout and the first ray of the anal fin.
Trachyrhynchus spp. Mantle length to the half centimetre below is measured for cephalopods, and carapace length (distance from the posterior edge of the optic pit to the postero-dorsal edge of the carapace) to the half millimetre below for shrimp.

Following the same recommendations, length sampling is performed independently by sex in all flatfish, redfish, cod and grenadier (Macrourus berglax). In these species, the selected sample is classified by sex before measuring lengths in order to reduce the causes of error.

Table 5 shows how the sample data is submitted for consideration by the NAFO Scientific Council. This does not exclude the possibility of the data being gathered in greater detail; therefore, for example, fish whose frequencies are grouped into 2 or 3 centimetres are always measured to the centimetre below for convenience. Likewise, although the NAFO Scientific Council considers that the separation of the sexes in cod sampling is not required, this species is sampled independently by sex since 2010.

As a rule, all individuals in the catch are measured. Exception is made when the capture of some species is very abundant and then a subsample containing, as reference at least 200 individuals, is measured. This is a situation that occurs frequently with redfish; in these cases the number of boxes to be measured is determined by the person in charge of this species and the details of the capture and the selection of the sample are clearly reflected in the back of the haul’s data form.

When the capture of a species is very large and there is a large number of small fish and few large fish, it is not sometimes reasonable to measure all of them; in these cases the sampling is done independently for each size groups and details are noted on the reverse of the haul summary report. This procedure must be exceptional

The sample weight is always recorded in the haul summary report, whether or not equal to the capture.

The lengths shall be recorded in the appropriate data form for this purpose (see Annex). 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. Measurements of species which are measured in half-centimetre below are recorded in a specific data form.

The length frequency of each species is recorded in separated data forms. Only in the case of the species in which the numbers of individuals is very low, the length frequency of several species are recorded in the same form, always clearly stating to what species refers each measurement. Length measurements are made by at least two persons, so that always a person measure and other records.

**Biological sampling**

In each haul a full biological sampling is done for all or at least two species of the following ones: cod, American plaice, Sebastes marinus, S. mentella, S. fasciatus, juvenile Sebastes, Greenland halibut and roughhead grenadier. This biological sampling includes:

- length
- round weight
- sex
- gonad collection (if applicable)
- gutted weight (gonad free)
- otolith collection

The target sample size within each haul and for each species is 50 fish, except for juvenile Sebastes which is only 20. In the species where the size sampling is done by sex, the sample is separated by sex before measurement; the sample goal is measuring 25 fish of each sex. The purpose of this sampling is to get at least 10 fish of each cm or ½ cm length (Table 5) and sex (male and female, or indeterminate) at the end of the survey.

Only female gonads (ovaries) are collected. The number of ovaries collected by species and size range is as follow:

| Species                | Minimum length (cm) | Gonads per cm |
|------------------------|---------------------|---------------|
| Cod                    | 25                  | 6             |
| American plaice        | 25                  | 10            |
| Greenland halibut      | 40                  | 10            |
| Roughhead grenadier    | 20                  | 6 (1/2 cm)    |
| Redfish - marinus      | 20                  | 10            |
| Redfish - mentella     | 18                  | 10            |
| Redfish - fasciatus    | 15                  | 10            |

The total number of gonads collected is always smaller than otoliths, therefore in the biological sampling form it is requested to annotate in the column “G” when a gonad is collected. This allows for precise control of the fish sampled by length and the number of ovaries collected. Control sheets for each species are available at the beginning of each day based on data collected from previous hauls. It is requested that all fish which ovaries are collected also the otolith are taken.
Gonads are stored in perforated (to allow formalin to penetrate) plastic bags with the corresponding label where it is written the name of the species, number of the haul, the number of the observation and the fish size. Redfish is labelled with its scientific name (Sebastes marinus, Sebastes mentella, Sebastes fasciatus). When sampling work of a haul is finished, and not later, bags are closed and stored in their corresponding container. The fixative is phosphate based neutral buffered 4% formaldehyde (10% formalin), normally produced in 20 one batches: 18 one of water, 2 one of 35-40% high grade formaldehyde, 163.8 g of sodium phosphate dibasic dihydrate and 81.4 g of sodium phosphate monobasic monohydrate.

Biological sampling is stratified by fish length and sex, and continues till having completed the required number in each length class.

A simpler sampling is done to other species which include measuring only length and weight, to calculate their relationship, which is routinely used to estimate the sampling weight based on length composition and confirm the correctness of the catch records.

The requirement of sampling shrimp (measuring lengths of several stages of maturity) makes its sampling sometimes very time consuming to be done on each haul. If this happens, a random sample of approximately 1–2 kg is frozen to be worked out later. Two people from each team are responsible for working the samples (fresh or frozen). It is intended that the samples of shrimp caught are measured and recorded in the ARGO program before the end of the survey. Once on land, it is necessary to make a length and weight sample, so in addition to samples for length measurements, specific samples are frozen for the study of the length-weight relationship in the laboratory.

Likewise, the shrimp caught in the small net bag with 10 mm mesh, placed in the dorsal-central part of the cod-end, is collected, the catch recorded independently (Pandalus bag, Sebastes bag) and individuals measured by maturity stage. If the whole catch is not measured, the sample weight is recorded as in the rest of the species.

**Redfish (Sebastes spp.) sampling**

As pointed earlier, three species of redfish occur in Flemish Cap: Sebastes mentella, Sebastes marinus and Sebastes fasciatus. The morphological resemblance between Sebastes mentella and Sebastes fasciatus is high, making difficult their identification in a quick and routinely way, and both are commonly designated as beaked redfish. In 1988 and 1989 these species were not classified and hence two redfish entities were considered: S. marinus and beaked redfish, the latest included the unclassified fish (roughly those smaller than 15 cm) of the three species. Since 1990 the unclassified small fish, i.e. those where S. marinus was not possible to be distinguished from beaked redfish, was considered as a different category, named juvenile redfish. It is important to stress that many of the specimens classified into species are sexually immature, i.e. juveniles too. Therefore the category “juvenile redfish” does not refer to all sexually immature redfish but only those not able to be classified into species.

In 1990 and 1991, a subsample of beaked redfish catch (50 specimens) from each haul was classified into species (Sebastes mentella and Sebastes fasciatus) using the gasbladder musculature (Ni, 1981; Power and Ni, 1982) which is a more precise attribute than external characteristics. The fish dissection and musculature inspection was done but a designated expert in charge of this task solely. In 1990 these specimens were used exclusively for individual biological sampling, i.e. length, weight and age, as they were not taken randomly. In 1991, the subsample (maximum of 150 Kg) was taken randomly and then used also to estimate the haul catch species composition.

In 1991, during the process of redfish identification, it was developed sufficient skills to distinguish Sebastes mentella and Sebastes fasciatus by their external appearance. As a consequence, since 1992 the three redfish species are routinely separated in the whole catch, except the smallest ones still considered as juvenile redfish. A number of specimens were still dissected for inspecting the gasbladder musculature; these included those fish still difficult to classify by their external morphology, but also a selection of fish at different sizes for checking the correctness of the classification. The number of dissected fish reduced in each survey as experience was gained. The same person classified redfish species from 1992 to 2002, and since then different trained persons are in charge of this task. In the current procedure still a number of specimens are still dissected for inspecting the gasbladder musculature.

To optimize the identification process, difficult individuals are often retained for a later and more detailed identification; those individuals are generally the ones with smallest size. A violation of the random sampling criterion could occur if those selected fish, once they are classified, are not reintegrated to their corresponding sampling group/box, i.e. if all of them are put in the same box, and length sampling does not requires all boxes, a skew sampling will occur. Special care is taken to avoid this situation when a subsample for length measurements is taken.
The target of biological sampling is to get 20 otoliths by cm and sex from the whole bank. A data form is used to facilitate two individuals for each sex, cm and stratum are collected. It may allow getting larger sizes, which are scarce or only occurring in few strata. The person responsible for redfish classification does the biological sampling control.

**Shrimp (Pandalus borealis) sampling**

Shrimp is a protandrous hermaphrodite species. Every individual is born and mature as male, and after a transition period, becomes female. In some cases the external male characters are hardly visible. Sex can be identified attending to the external structure of the endopod of the first pair of pleopods.

Shrimp sampling requires some specific consideration: the absence of hard parts for ageing makes it necessary to obtain good length distributions to identify year-classes through modal analysis. Each length frequency sample usually contains around 300 individuals. Sex and maturity are recorded according to the following categories: “male”, “transition”, “primiparous female”, “multiparous female” and “ovigerous female”. Oblique carapace length (CL) is measured with a gauge from the optic pit’s back edge on the postero-dorsal edge of the lower half millimetre carapace.

Additional samples are taken for study in laboratory to calculate the length-weight relationship. These samples are frozen on board. Each individual is measured in the laboratory to the hundredth of millimetre and hundredth of gram accuracy. Samples are taken from all strata.

**Benthonic invertebrates**

Non-commercial invertebrates are sorted after fish and commercial invertebrates, and after taken a picture of the whole invertebrate catch. Additional photos of rare or first recorded species are taken. Catch records are written down in a specific data form (see Annex), where weight and number of each best identified group is noted, as well as any observation, e.g. on photos taken. A sample should be taken when catch is too large.

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.

Corals and sponges are of primary interest in studying vulnerable marine habitats, so special attention is paid in recording catches and retaining samples.

- Corals: all corals not included in the identification cards are preserved. A piece of each colony of Gorgonians and Antipatarians marked with an * in the invertebrates form is also retained, and the remaining frozen after a photo is taken.
- Sponges’ large catches: a photo is taken and samples of main species retained. In large specimens only a piece, like a cheese slice, containing most important elements is taken and preserved.

**Sampling fixatives are:**

- 70% alcohol for cnidarians (actinides excluded), crustaceans, molluscs and Equinodermata.
- 4% formalin for Polychaeta, sponges, actinides and all others.

**Taxonomy**

All species should be identified. List of species already found are listed by Vázquez et al. (2013). Their working codes are presented in the Annex. When species are not easily recognized, the item is reserved for late identification, putting a note on the haul’s data form. Those items are identified on board to the most precise taxonomic level using the appropriate references.

If species are not identified, individuals are labelled, frozen and stored for their study in the lab. When the species is a prime cite for Flemish Cap, the item is photographed and adequately stored.

It is necessary to complete the photographic record of species in the area.

**Physical oceanography**

Temperature and salinity profiles are taken with a CTD according to a predefined square grid (Fig. 5). It contains
80 stations with 15 nautical miles mean distance among them. Stations are done when time is available, trying to disturb the hurls program as little as possible, and anyway before the first haul of the day. A person is in charge of the whole issue.

Data are incorporated to tie IEO data base, and copy are sent to the Integrated Science Data Management (ISDM, former MEDS), the Canadian data base for that zone.

**Feeding sampling**

Feeding sampling is done every two years as a minimum, and it is under the exclusive task of two persons. To impede that the same specimens be required for different samplings, feeding sampling is normally done after catch sampling is finished and closely coordinated with the standard biological sampling work in such a way that the same fish measured in biological sampling are also analysed for their stomach contents. If there are sufficient individuals in the catch feeding analysis can be done on fish where biological sampling was not performed.

**Studied species are:**

| Studied species               | Studied species               |
|------------------------------|------------------------------|
| **Sebastes fasciatus**       | **Macrourus berglax**        |
| juvenile redfish             | **Nezumia bairdi**           |
| **Sebastes marinus**         | **Phycis chesteri**          |
| **Sebastes mentella**        | **Urophycis tenuis**         |
| **Gadus morhua**             | **Amblyraja radiata**        |
| **Hippoglossoides platessoides** | **Amblyraja hyperborea** |
| **Reinhardtius hippoglossoides** | **Bathyraja spinicauda** |
| **Glyptocephalus cynoglossus** | **Malacoraja sesta** |
| **Anarhichas denticulatus**  | **Rajella fyllae**           |
| **Anarhichas lupus**         | **Lycodes reticulatus**      |
| **Anarhichas minor**         | **Centroscyllium fabricii**  |

The target sample size is considered by fish length of 10 cm (0–9, 10–19, 20–29 cm, etc.) total length (LT) to the lower cm for most of the species, except for grenadiers, where 5 cm range (0–4.5, 5–9.5, 10–14.5 cm, etc.) pre-anal fin length (LPA) to the lower half cm is used. Length to the notch of the dorsal fin (LEAD) to the lower half cm is used for wolffish.

Data taken to each fish are: length, sex, sexual maturity, round weight and total stomach repletion in volume measured with a *trophometre* (Olaso 1990). Stomach content analysis is done on board, identifying all components to the lowest possible taxonomic level, and noting for each prey: number, digestion level (fresh, half-digested and full-digested), percentage of total volume, length in mm, and size and number of hard pieces.

Fish with everted stomach, which is common in roughhead grenadier (*M. berglax*) and redfish (*Sebastes* spp.), or containing preys taken in the cod-end, which is common if dogfish (*Anarhichas* spp.), are discarded. Fish with total or partially regurgitated food, which is common in rays, cod and roundnose grenadier (*C. rupestris*) are only considered for calculating feeding intensity indices. Size and colour of the bladder is observed and recorded to distinguish an empty stomach or containing scarce food from a total or partially regurgitated.

**Storing data in electronic media**

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* 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.
**Data analysis**

**Results**

Initial data analysis, done on-board after the end of the survey, provides the following preliminary results, without prejudice to a later and detailed analysis:

- Biomass and abundance estimates for all species and comparison with some previous surveys Figs.
- Shrimp stock structure.

Later work in laboratory includes:

- Concluding otoliths ageing for fish target species, and estimating their abundance at age.
- Concluding shrimp length distribution analysis, using program MIX to identify their normal distributed components.
- Performing the histological analysis of gonads to determine maturity ogives of fish target species.
- Processing and analysing CTD data.
- Reviewing benthonic invertebrates’ records based on photos taken in each haul to validate identification done on board.
- Updating benthonic invertebrates notes: list of species, and their distribution and abundance.
- Updating the photographic collection of species.

**Calculations**

Biomass and abundance estimates are calculated by the swept area method, which produces quite useful approximations of stock sizes, even if they admittedly sub-estimate real values, so they should be interpreted as indices and not as absolute Figs. Total biomass is calculated with the expression:

\[
B = \sum_e (C_{pm_e} \times \text{area}_e / 0.0075)
\]

- **B** – total biomass
- **e** – stratum
- **C_{pm_e}** – mean catch per mile of hauls in stratum **e**
- **\text{area}_e** – area of stratum **e** in square miles
- **0.0075** – accepted width of the fishing gear in miles.

And its standard error:

\[
s_B = \sqrt{\sum_e V(C_{pm_e}) \times (\text{area}_e / 0.0075)^2}
\]

\[
V(C_{pm_e}) = \sum_e \left[ (C_{p/m_p} - C_{pm_e})^2 / (n_e - 1) / n_e \right]
\]

\[
\begin{align*}
p & \quad \text{– any haul in stratum } e \\
C & \quad \text{catch in haul } p \\
m_p & \quad \text{miles towed in haul } p \\
n_e & \quad \text{number of hauls in stratum } e
\end{align*}
\]

Length frequencies that correspond to the previous total biomass estimates are also calculated based on data per mile in each haul:

\[
F(t) = \sum_e (f_{pm(t)_e} \times \text{area}_e / 0.0075)
\]

- **F(t)** – frequency at length **t**
- **e** – stratum
- **f_{pm(t)_e}** – mean frequency per mile for length **t** of hauls in stratum **e**.
- **\text{area}_e** – stratum **e** area in square miles.
- **0.0075** – accepted width of the fishing gear in miles.

When only female biomass is the issue, like in the case of shrimp, calculations are the same but they are based on the female catch at each haul. Total catch is the only recorded at each haul, so this amount is divided between male and female in the same proportions as their respective SOP\(^6\).

**Missing data**

Some strata were no visited in 1993, and only one haul was done in some stratum in 2011. Missing biomass and length frequencies estimates follows different procedure in each case.

If no haul is done in a stratum, biomass is estimated by comparison among data of that survey and those of previous five years surveys, adjusting values to a multiplicative model with two factors: year and stratum (Vázquez and Larrañeta 1980):

\[
B_{e,a} = E_e \times A_a
\]

being:

- **B_{e,a}** – biomass of stratum **e** in year **a**
- **E_e** – stratum **e** factor
- **A_a** – year **a** factor

Factors are calculated by iteration until convergence of the equations:

\[
E_e = \sum_a \left( B_{e,a} / A_a \times w_{e,a} \right) / \sum_a w_{e,a}
\]

\[
A_a = \sum_e \left( B_{e,a} / E_e \times w_{e,a}' \right) / \sum_e w_{e,a}'
\]

being:

\[
w_{e,a} = A_a^2 / V(B_{e,a})
\]

\[
w_{e,a}' = E_e^2 / V(B_{e,a})
\]

\[
V(B_{e,a}) = B_{e,a} \text{ variance} = B_{e,a}^{1.8}
\]

\(^6\) Sum Of Products: sum of length frequencies times mean weight at length.
This assumed variance is preferable to the one calculated in each stratum and year to prevent very low results due to a reduced numbers of hauls.

Length frequencies of no visited strata were calculated by extrapolation of results in the whole visited strata, using the same proportion as biomass estimates.

When only one haul was done in a stratum, biomass is calculated as the mean between the one estimated with the former described method for no visited strata ($B_{0}$) and the result obtained by the former described method for no visited strata. If length sampling was also available for that single haul, length frequencies of the stratum will be, like in the case of biomass, the mean between haul frequencies extrapolated to biomass $B_{1}$ and frequencies of total sampled biomass extrapolated to $B_{0}$. If no such sampling was available, length frequencies will be calculated by extrapolating frequencies of total sampled biomass to $(B_{1} + B_{0})/2$.

For age-length keys, when a length lacked assigned ages, frequencies at age for that length are assumed to be equal to an age-length key done with data of the previous five surveys.

Validation of Survey Results

All collected data are recorded in paper, in the forms available for each class of data, and later stored in a PC. Verification of the stored information follows these steps:

1 – Once all data of a haul have been typed, sample catch must be compared with SOP (based on length frequencies of the sample): if an important difference between them exists both original and recording are revised. Consistency between length distribution and biological sampling is also checked.

2 – All the data of each haul is printed to check that all typed information is equal to the one in the forms. Printing uses similar formats to those of the original forms for an easy reading and comparison.

3 – Once the survey is finished, length-weight relationships for each species are updated and discrepancies again checked. When discrepancies are important (greater than 15%) and the source of them detectable, corrections are done. All corrections are made also in the original forms but never erasing the original annotation but using a red ink pen to write down the change. This allows in the future an easy traceability of the modifications made during or after the survey.

Survey results are regularly presented to the NAFO Scientific Council (Casas y González-Troncoso 2011, Vázquez 2012).

Acknowledgements

This study was supported by the European Union Data Collection Framework (framework for the collection, management and use of data in the fisheries sector), IPMA (Portugal) and IEO and CSIC (Spain).

References

AKENHEAD, S.A. 1986. Water retention over Flemish Cap. p. 283–293 en S. Skreslet (ed.). The role of freshwater outflow in coastal marine ecosystems. NATO ASI Series Vol G7.

ASCHAN, M and K. SUNNANA – 1997. Evaluation of the Norwegian shrimp surveys conducted in the Barents Sea and the Svalbard area 1980–1997. ICES CM 1997/Y:07.

BEST, M., E. KENCHINGTON, K. MACISAAC, V.E. WAREHAM, S. FULLER, and A.B. THOMPSON. 2010. Sponge Identification Guide NAFO Area. Sci. Council Studies 43: 1–50

BISHOP, C.A. 1994. Revision and additions to stratification schemes used during research vessel surveys in NAFO Subareas 2 and 3. NAFO SCR Doc. 94/43

CASAS, M. and D. GONZÁLEZ-TRONCOSO. 2011. Results from Bottom Trawl Survey on Flemish Cap of June-July 2010. NAFO SCR Doc. 11/21.

CHABERT, M. 1753. Voyage fait par ordre du roi en 1750 et 1751, dans l’Amerique septentrionale, pour rectifier les cartes des côtes de l’Acadie, de l’ isle Royale & de l’isle de Terre-Neuve; et pour en fixer les principaux points par des observations astronomiques. L’imprimerie Royale, Paris, 288 pp

DE CARDENAS, E. 1994. Dinámica de la población del bacalao de Flemish Cap. Consideraciones sobre su aislamiento y gestión. Tesis Doctoral, Universidad Complutense de Madrid.

DOUBLEDAY, W.G. 1981. Manual of Groundfish Surveys in the Northwest Atlantic. NAFO Sci. Counc. Studies 2.

GONZÁLEZ-TRONCOSO, D. and M. Casas. 2005. Calculations of the calibration factors from the comparative experience between the RV Corin de Sauvedra and the RV Vizconde de Eza in Flemish Cap in 2003 and 2004. NAFO SCR Doc. 05/29.

KENCHINGTON, E., M. BEST, A. COGSWELL, K. MACISAAC, F.J. MURILLO-PEREZ, B. MACDONALD, V. WAREHAM, S. D. FULLER, H.I.O. JORGENSEN-BYE, V. SKLYAR and A.B. THOMPSON – 2009. Coral Identification Guide NAFO Area. Sci. Council Studies 42: 1–35.

LILLY, G. R. 1986. A synopsis of research related to recruitment of cod and redfish on Flemish Cap. NAFO SCR Doc. 86/101.

NAFO. 1974. Redbook 1974. NAFO.

NAFO. 1975a. Redbook 1975. NAFO.

NAFO. 1975b. Sampling yearbook (18) for the year 1974. NAFO.

NAFO. 1980. Scientific Council Report 1979–1980. NAFO.

NAFO. 1984. Scientific Council Report 1984. NAFO.
NAFO. 1990. Final report of the STACREC Working Group on Survey Design and Procedures. *NAFO SCS Doc.* 90/20.
NAFO. 1999. Inventory of Sampling Data 1990–1994. *NAFO.*
OLASO, I. 1990. Distribución y abundancia del megabentos invertebrado en fondos de la plataforma cantábrica. *Bol. Inst. Esp. Oceanogr.*, Publ. Esp. nº 5, 128 p.
STEIN, M. 1996. Flemish Cap – A review on research activities with focus on oceanographic conditions. *Sci. Coun. Studies* **25**: 1–24.
TEMPLEMAN, W. 1976. Biological and oceanographic background of Flemish Cap as an area for research on the reasons for year-class success and failure in cod and redfish. *ICNAF Res. Bull.*, **12**: 91–117.
VÁZQUEZ, A. 1989. Results from bottom-trawl survey of Flemish Cap in July 1988. *NAFO SCR Doc.*, 88/60.
VÁZQUEZ, A. 1991. Flemish Cap cod stock analysis. *NAFO SCR Doc.*, 91/95.
VÁZQUEZ, A. 1993. Results from bottom trawl survey of Flemish Cap in July 1992. *NAFO SCR Doc.*, 93/19.
VÁZQUEZ, A. 2012. Results from Bottom Trawl Survey on Flemish Cap of July 2011. *NAFO SCR Doc.*, 12/026.
VÁZQUEZ, A., J. M. CASAS, W. B. BRODIE, F. J. MURILLO, M. MANDADO, A. GAGO, R. ALPOIM, R. BAÑÓN and A. ARMESTO. 2013. List of Species as recorded by Canadian and EU Bottom Trawl Surveys in Flemish Cap. *NAFO SCR Doc.* 13/005.

Table 1. Specification and characteristics of the survey area, and number of selected hauls.

| Strata Depth interval (m) | Area sq. miles | Fishing units | Selected hauls |
|---------------------------|----------------|---------------|----------------|
| depth < 730 m             | 10 555         | 309           | 3 090          | 120 |
| depth: 730–1 460 m        | 5 515          | 13            | 169            | 1 690 | 61 |
| Total                     | 16 070         | 32            | 478            | 4 780 | 181 |

Table 2. Stratification of Flemish Cap and hauls plan.

| Stratum | Depth interval (fathoms) | Area (sq. miles) | Fishing units | Selected hauls |
|---------|--------------------------|------------------|---------------|----------------|
| 1       | 70–80                    | 342              | 100           | 4              |
| 2       | 81–100                   | 838              | 250           | 10             |
| 3       | 101–140                  | 628              | 180           | 7              |
| 4       | “                        | 348              | 100           | 4              |
| 5       | “                        | 703              | 200           | 8              |
| 6       | “                        | 496              | 150           | 6              |
| 7       | 141–200                  | 822              | 240           | 9              |
| 8       | “                        | 646              | 190           | 7              |
| 9       | “                        | 314              | 90            | 3              |
| 10      | “                        | 951              | 280           | 11             |
| 11      | “                        | 806              | 240           | 9              |
| 12      | 201–300                  | 670              | 200           | 8              |
| 13      | “                        | 249              | 70            | 3              |
| 14      | “                        | 602              | 170           | 7              |
| 15      | “                        | 666              | 200           | 8              |
| 16      | 301–400                  | 634              | 190           | 7              |
| 17      | “                        | 216              | 60            | 2              |
| 18      | “                        | 210              | 60            | 2              |
| 19      | “                        | 414              | 120           | 5              |
| 20      | 401–500                  | 525              | 160           | 6              |
| 21      | “                        | 253              | 80            | 3              |
| 22      | “                        | 530              | 160           | 6              |
| 23      | “                        | 98               | 30            | 2              |
| 24      | 501–600                  | 517              | 160           | 6              |
| 25      | “                        | 226              | 70            | 3              |
| 26      | “                        | 488              | 150           | 6              |
| 27      | “                        | 238              | 70            | 2              |
| 28      | “                        | 486              | 150           | 5              |
| 29      | “                        | 601–700          | 533           | 160           | 6 |
| 30      | “                        | 1134             | 350           | 11             |
| 31      | “                        | 203              | 60            | 2              |

Total (strata 1–34) | 16 070 | 4 780 | 181 |
Table 3. Technical data of the survey. Characteristics and deployment of the fishing tackle.

| procedure                                      | specification                                                                                                                                 |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Survey type                                    | sampling                                                                                                                                   |
| Haul selection method                          | Random                                                                                                                                     |
| Criterion to change position of a selected haul| Bottom unsuitable for trawling according to commercial fishing or former surveys.                                                            |
| Criterion to reject a haul                     | - snag in the bottom                                                                                                                     |
|                                                | - severe damages in the net or in the cod-end                                                                                              |
|                                                | - trawling time inferior to 20 minutes                                                                                                     |
| Daily fishing period                           | - gear malfunction                                                                                                                        |
| Species to be sampled                          | 6:00 to 22:00 local time                                                                                                                  |
| Species for aging                              | All fishes, cephalopods, shrimp and non-commercial invertebrates. cod, American plaice, redfish, Greenland halibut and roughhead grenadier. |
| Vessel                                         | RV *Vizconde de Eza*                                                                                                                       |
| TRB                                            | 1400 GT                                                                                                                                   |
| Power                                          | 1800 kW                                                                                                                                    |
| Maximum trawling depth                         | 1460 m                                                                                                                                    |
| Area to be surveyed                            | Div. 3M (depth < 1460 m)                                                                                                                  |
| Time to survey                                 | 30 days                                                                                                                                    |
| Fishing gear                                   | Lofoten                                                                                                                                   |
| Groundrope / headrope                          | 17.70 m /31.20 m                                                                                                                           |
| Groundrope                                     | 27 steel bobbins Ø 35 cm                                                                                                                  |
| Floats                                         | Ø 20 cm (2 × 16) + Ø 24 cm × 20                                                                                                           |
| Bridles                                        | 8 m Ø 16 mm                                                                                                                                |
| Vertical opening                               | 3.5 m                                                                                                                                      |
| Horizontal opening                             | 14 m = 0.0075 miles                                                                                                                        |
| Rigging warps                                  | 100 m, 45 mm, 200 kg/100m                                                                                                                 |
| Trawl doors                                    | Oval polyvalent, 850 kg                                                                                                                   |
| Wire                                           | Ø 20 mm                                                                                                                                     |
| Wire length                                    | 2 × Depth + 200 m                                                                                                                          |
| Cod-end mesh size                              | 35 mm                                                                                                                                      |
| Towing speed                                   | 3.5 knots                                                                                                                                  |
| Trawling time                                  | 30 minutes of effective fishing time determined by net sounder or “32 + depth (m)/100” minutes from the time the winches are locked.        |
Table 4. Trawling wire length as a function of depth, both in metres.

| depth | length | depth | length | depth | length |
|-------|--------|-------|--------|-------|--------|
| 100   | 400    | 600   | 1 400  | 1 100 | 2 400  |
| 150   | 500    | 650   | 1 500  | 1 150 | 2 500  |
| 200   | 600    | 700   | 1 600  | 1 200 | 2 600  |
| 250   | 700    | 750   | 1 700  | 1 250 | 2 700  |
| 300   | 800    | 800   | 1 800  | 1 300 | 2 800  |
| 350   | 900    | 850   | 1 900  | 1 350 | 2 900  |
| 400   | 1 000  | 900   | 2 000  | 1 400 | 3 000  |
| 450   | 1 100  | 950   | 2 100  | 1 450 | 3 100  |
| 500   | 1 200  | 1 000 | 2 200  |       |        |
| 550   | 1 300  | 1 050 | 2 300  |       |        |

Table 5. Length intervals and sexing criteria for sampling data transmission to NAFO (NAFO 1999, page 10)

| Species                      | Length Interval | Sexing |
|------------------------------|-----------------|--------|
| Atlantic cod (Gadus morhua)  |                 |        |
| Pollock (Pollachius virens)  |                 |        |
| Cusk (Brosme brosme)         |                 |        |
| White hake (Urophycis tenuis) |                 |        |
| Wolffishes (Anarhichas sp.)  |                 |        |
| Striped wolffish (Anarhichas lupus) |           |        |
| Spotted wolffish (Anarhichas minor) |           |        |
| Haddock (Melanogrammus aeglefinus) |           | 3      |
| Red hake (Urophycis chuss)   |                 | 2      |
| American plaice (Hippoglossoides platessoides) | (by sex) | 2 |
| Witch flounder (Glyptocephalus cynoglossus) | (by sex) | 2 |
| Yellowtail flounder (SA 3-4) (Limanda ferruginea) | (by sex) | 2 |
| Greenland halibut (Reinhardtius hippoglossoides) | (by sex) | 2 |
| Atlantic halibut (Hippoglossus hippoglossus) | (by sex) | 2 |
| Summer flounder (Paralichthys dentatus) |           | 2      |
| Greenland cod (Gadus ogac)   |                 | 2      |
| Redfishes (Sebastes sp.)     | (by sex)        | 1      |
| Golden redfish (Sebastes marinus) | (by sex) | 1 |
| Beaked redfish (Sebastes mentella) | (by sex) | 1 |
| Silver hake (Merluccius bilinearis) | (by sex) | 1 |
| Yellowtail flounder (SA 5-6) (Limanda ferruginea) | (by sex) | 1 |
| Winter flounder (Pseudeuleuneectes americanus) |          | 1 |
| Windowpane flounder (Scophthalmus aquosus) |          | 1 |
| Polar cod (Boreogadus saida)  |                 | 1      |
| Scup (Stenotomus chrysops)   |                 | 1      |
| Spotted hake (Urophycis regia) |              | 1      |
| Atlantic herring (Clupea harengus) |          | 1 |
| Atlantic mackerel (Scomber scombrus) |            | 1 |
| Atlantic butterfish (Peprilus triacanthus) |            | 1 |
| Atlantic menhaden (Brevoortia tyrannus) |          | 1 |
| Alewife (Alosa pseudoharengus) |                 | 1      |
| Argentines (Argentina sp.) (by sex) |        | 1 |
| Black seabass (Centropristis striata) |          | 1 |
| Blueback herring (Alosa aestivalis) |            | 1     |
Roundnose grenadier (*Coryphaenoides rupestris*) (by sex) 1/2 cm or 5 mm
Roughhead grenadier (*Macrourus berglax*) (by sex) 1/2 cm or 5 mm
Capelin (*Mallotus villosus*) (by sex) 1/2 cm or 5 mm
Squid (*Illex* sp. and *Loligo* sp.) (by sex) 1/2 cm or 5 mm
Sea scallop (*Placopecten magellanicus*) 1/2 cm or 5 mm
Northern prawn (*Pandalus borealis*) 1/2 cm or 5 mm

Note: Any other species not listed above should initially be reported in 1-cm groups.

Table 6. Sampling objectives for otoliths and gonads

| Species            | Otoliths  | Gonads       | Length range for gonads |
|--------------------|-----------|--------------|-------------------------|
| Cod                | 10 by cm and sex | 4 by cm | >= 25 cm               |
| A. plaice          | 30 by cm and sex | 5 by cm | >= 25 cm               |
| S. marinus         | 20 by cm and sex | 10 by cm | >= 10 cm              |
| S. mentella        | 20 by cm and sex | 10 by cm | >= 10 cm              |
| S. fasciatus       | 20 by cm and sex | 10 by cm | >= 10 cm              |
| Juvenile *Sebastes*| 20 by cm   | —           | —                      |
| G. halibut         | 10 by cm and sex | 2 by cm | >= 30 cm              |
| *M. berglax*       | 10 by ½ cm and sex | 4 for each ½ cm | >= 20 cm |

Fig. 1. Situation of Flemish Cap: depth contours and dashed line indicating the 200 miles Canadian EEZ.
Fig. 2 Flemish Cap stratification: left) Distribution of the 39 strata, right) fishing units in the whole bank and rectangles of the first 19 strata (inlet).

Fig. 3 Dimensions of the Lofoten trawl gear (31.20 m × 17.70 m)
**Fig. 4.** Groundrope rigging.

**Fig. 5.** Distribution grid of 80 CTD stations with a mean distance of 15 miles apart.
ANNEXES

Data forms
Species working codes
Shrimp (*Pandalus borealis*) sampling
Publications 2002–2012
Haul's data form (both sides)

| Pesca | CTD | Cable (m) | Altura de olas (m) | Apertura arc (m) |
|-------|-----|-----------|--------------------|-----------------|
| Estrato |    |           |                    |                 |
| Cuadrícula | |           |                    |                 |
| Día/mes | |           |                    |                 |
| Viento en nudos | |           |                    |                 |
| LARGADA | contacto | VIRADA | despegue | INCIDENCIAS |
| hora | | | | roturas menores |
| Latitud | | | | roturas severos en copo |
| Longitud | | | | mal funcionamiento arte |
| profundidad (m) | | | | enganchado |
| fondo | | | | arte que no tocó fondo |

| especie | CAPTURA | MUESTREO de tallas |
|---------|---------|-------------------|
|         | peso (g) | peso (g) | número |
| bacalao |         |         |        |
| plaquita americana |         |         |        |
| galineta marrón |         |         |        |
| * menella |         |         |        |
| * lucrarius |         |         |        |
| * jure喊les |         |         |        |
| flotón negro |         |         |        |
| mendo |         |         |        |
| camarón |         |         |        |
| Acunehphusa pelagica |         |         |        |
| Anarhichas lupus |         |         |        |
| * minor |         |         |        |
| * denticulatus |         |         |        |
| Antimora rostrata |         |         |        |
| Chauliodus sfoni |         |         |        |
| Micromesodes berglun |         |         |        |
| Nematolepis hattaki |         |         |        |
| Omogathus emins |         |         |        |
| Pote |         |         |        |
| Raja radiata |         |         |        |
| Snowshoe boa |         |         |        |
| Urnophyes chesteri |         |         |        |

Espacio reservado para notas y cálculos

Anotar con un asterisco las cajas de un

| S. menella | S. lucrarius | S. marinus |
|-----------|--------------|-----------|
|           |              |           |
|           |              |           |
|           |              |           |
| Total     | Total        | Total     |

En el caso de que se tengan cajas al mar, ¿cuántas se han tirado?

Otras especies / otros cálculos

Continuación de la tabla de capturas

| especie | CAPTURA | MUESTREO de tallas |
|---------|---------|-------------------|
|         | peso (g) | peso (g) | número |
|         |         |         |        |
|         |         |         |        |
|         |         |         |        |
|         |         |         |        |
|         |         |         |        |
|         |         |         |        |
|         |         |         |        |

Continúa al dorso
Length frequencies forms: 1 and $\frac{1}{2}$ cm

| talla (cm) | talla (cm) | talla (cm) |
|------------|------------|------------|
| 0          | 0          | 0          |
| 1          | 1          | 1          |
| 2          | 2          | 1.5        |
| 3          | 3          | 1          |
| 4          | 3          | 2.5        |
| 5          | 4          | 3          |
| 6          | 5          | 3.5        |
| 7          | 4          | 4          |
| 8          | 6          | 4.5        |
| 9          | 6.5        | 5          |
| 10         | 7          | 5.5        |
| 10         | 7.5        | 6          |
| 10         | 8          | 6.5        |
| 10         | 8.5        | 7          |
| 10         | 9          | 7.5        |
| 10         | 9.5        | 8          |
| 10         | 9          | 8          |
| 10         | 9.5        | 9          |
| 10         | 9          | 9          |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |

| talla (cm) |
|------------|
| 0          |
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |
| 7          |
| 8          |
| 9          |
| 10         |
| 10         |
| 10         |
| 10         |
### Length frequencies form for shrimp

| **Pandalus borealis** | **Campos de FLEWISH CAP 20** | **Copón Bolus** |
|-----------------------|-----------------------------|-----------------|
| **Peso** | **Peso muestra** | **Hembras Inmaduras** | **Hembras Maduras** | **H. Ovigras** |
| talla | Machos | Transición | | |
| 8 | | | | |
| 9 | | | | |
| 9,5 | | | | |
| 10 | | | | |
| 10,5 | | | | |
| 11 | | | | |
| 11,5 | | | | |
| 12 | | | | |
| 12,5 | | | | |
| 13 | | | | |
| 13,5 | | | | |
| 14 | | | | |
| 14,5 | | | | |
| 15 | | | | |
| 15,5 | | | | |
| 16 | | | | |
| 16,5 | | | | |
| 17 | | | | |
| 17,5 | | | | |
| 18 | | | | |
| 18,5 | | | | |
| 19 | | | | |
| 19,5 | | | | |
| 20 | | | | |
| 20,5 | | | | |
| 21 | | | | |
| 21,5 | | | | |
| 22 | | | | |
| 22,5 | | | | |
| 23 | | | | |
| 23,5 | | | | |
| 24 | | | | |
| 24,5 | | | | |
| 25 | | | | |
| 25,5 | | | | |
| 26 | | | | |
| 26,5 | | | | |
| 27 | | | | |
| 27,5 | | | | |
| 28 | | | | |
| 28,5 | | | | |
| 29 | | | | |
| 29,5 | | | | |
| 30 | | | | |
| 30,5 | | | | |
| 31 | | | | |
| 31,5 | | | | |
| 32 | | | | |
| 32,5 | | | | |
| 33 | | | | |
Biological sampling form: general and shrimp.

| Pesca | Días/mes | ESPECIE |
|-------|----------|---------|

| talla (cm) | sexo | peso (g) | peso eviscer. | G |
|-----------|------|----------|---------------|---|
| 1         |      |          |               |   |
| 2         |      |          |               |   |
| 3         |      |          |               |   |
| 4         |      |          |               |   |
| 5         |      |          |               |   |
| 6         |      |          |               |   |
| 7         |      |          |               |   |
| 8         |      |          |               |   |
| 9         |      |          |               |   |
| 10        |      |          |               |   |
| 11        |      |          |               |   |
| 12        |      |          |               |   |
| 13        |      |          |               |   |
| 14        |      |          |               |   |
| 15        |      |          |               |   |
| 16        |      |          |               |   |
| 17        |      |          |               |   |
| 18        |      |          |               |   |
| 19        |      |          |               |   |
| 20        |      |          |               |   |
| 21        |      |          |               |   |
| 22        |      |          |               |   |
| 23        |      |          |               |   |
| 24        |      |          |               |   |
| 25        |      |          |               |   |

| talla (cm) | sexo | peso (g) | peso eviscer. | G |
|-----------|------|----------|---------------|---|
| 26        |      |          |               |   |
| 27        |      |          |               |   |
| 28        |      |          |               |   |
| 29        |      |          |               |   |
| 30        |      |          |               |   |
| 31        |      |          |               |   |
| 32        |      |          |               |   |
| 33        |      |          |               |   |
| 34        |      |          |               |   |
| 35        |      |          |               |   |
| 36        |      |          |               |   |
| 37        |      |          |               |   |
| 38        |      |          |               |   |
| 39        |      |          |               |   |
| 40        |      |          |               |   |
| 41        |      |          |               |   |
| 42        |      |          |               |   |
| 43        |      |          |               |   |
| 44        |      |          |               |   |
| 45        |      |          |               |   |
| 46        |      |          |               |   |
| 47        |      |          |               |   |
| 48        |      |          |               |   |
| 49        |      |          |               |   |
| 50        |      |          |               |   |

| talla (mm) | sexo | peso (g) |
|-----------|------|----------|
| 26        |      |          |
| 27        |      |          |
| 28        |      |          |
| 29        |      |          |
| 30        |      |          |
| 31        |      |          |
| 32        |      |          |
| 33        |      |          |
| 34        |      |          |
| 35        |      |          |
| 36        |      |          |
| 37        |      |          |
| 38        |      |          |
| 39        |      |          |
| 40        |      |          |
| 41        |      |          |
| 42        |      |          |
| 43        |      |          |
| 44        |      |          |
| 45        |      |          |
| 46        |      |          |
| 47        |      |          |
| 48        |      |          |
| 49        |      |          |
| 50        |      |          |
Invertebrates’ data form.

### Campaña LIMUS CAP 2013

| Pesca | INVERTEBRADOS |
|-------|----------------|
|       |                |
|       |                |

| COED pesco, nº |  |
|---------------|---|
| CRUSTÁCEOS     |  |
| Acanthura pelagica | 285 |
| Acanthura puertorica | 286 |
| Acanthura spinosa | 54 |
| Amphiura     | 489 |
| Bibionidae   | 918 |
| Choneoceros sp | 789 |
| Clione sp | 854 |
| Euphausia flynni | 813 |
| Euphausia superba | 856 |
| Gymnocalycium sp | 888 |
| Gnorimosphaer gigan | 815 |
| Gnorimosphaerina sp | 905 |
| Gymnosomus sp | 901 |
| Icyactis | 872 |
| Lithodes maja | 650 |
| Melazoach | 928 |
| Nereidops sp | 951 |
| Nereis sedentaria | 651 |
| Nereis sp | 817 |
| Paguridae | 854 |
| Pandalus borealis | 802 |
| Pandalopsis sp | 631 |
| Pandalus major | 824 |
| Parathalassinus sp | 909 |
| Parathalassinus ruber | 825 |
| Pseudochiridae sp | 585 |
| Streptocephalus sp | 601 |
| Streptocephalus sp | 827 |
| Pseudocalanus sp | 640 |
| Salicornia sp | 982 |
| Salicornia sp | 829 |
| Engraulis acus | 635 |
| Serdaris sp | 835 |
| Spongilla variabilis | 990 |
| MARISCOS | 500 |
| Bathyophaus sp | 505 |
| Ceratopogon sp | 794 |
| Ceratopogon sp | 515 |
| Compsopogon sp | 11 |
| Compsopogon sp | 511 |
| Ctenophora sp | 506 |
| Ophiothrix sp | 931 |
| Sepiolidae sp | 964 |
| Tanaidaceae sp | 996 |
| Trachonothoides sp | 906 |
| Vampyromes sp | 798 |

| COED pesco, nº |  |
| CEPALÓPODOS     |  |
| Astacina sp | 893 |
| Opisthaster sp | 873 |
| Ophiura sp | 893 |
| Ophiura sp | 873 |
| Ophiura sp | 873 |
| Ophiura sp | 873 |

| COED pesco, nº |  |
| HOLOTURIAS    | 789 |
| CHIROSTOMATA  | 866 |
| CRINOIDEOS    | 853 |
| CTENOPHORA    | 866 |
| PEOLEONIDA    | 933 |
| Cnidarios     | 934 |
| ASCIDIAS      | 932 |
| PLEUROBRANCHIDAE | 946 |
| BRACHIOPODA   | 864 |
| ERIZOS       | 808 |
| HYDROZOA     | 844 |
| POLYCHAETA    | 955 |

Observaciones:
| Species working codes |  |
|-----------------------|--|
| **Phylum**            |  |
| Chordata              |  |
| Agnatha (Superclass)  |  |
| Petromyzontiformes    |  |
|         1             |  |
| Petromyzon marinus    | 157 |
| **Class**             |  |
| Pisces (Superclass)   |  |
| Carcharhiniformes     |  |
|         21            |  |
| Somniosus microcephalus | 704 |
| Etmopteridae          |  |
|         155           |  |
| Etmopterus princeps   | 124 |
| **Family**            |  |
| Squaliformes          |  |
|         914           |  |
| Apristurus sp.        | 153 |
| **Species**           |  |
| Saccopharyngiformes   |  |
| Sacropharyngidae      |  |
|         920           |  |
| Sacropharynx sp.      |  |
|         92           |  |
| Sacropharynx ampullaceus |  |
| Eurypharyngidae       |  |
|         35           |  |
| Eurypharynx plecanoides |  |
| **Notacanthiformes**  |  |
| Notacanthidae         |  |
|         165           |  |
| Notacanthus chemnitzii |  |
| **Osmeriformes**      |  |
| Osmeridae             |  |
|         479           |  |
| Mallotus villosus     |  |
| **Anguilliformes**    |  |
| Anguillidae           |  |
|         483           |  |
| Dipterus lineus       | 145 |
| Arhynchobatidae       |  |
|         484           |  |
| Argyrorhinchus sp.    | 185 |
| **Stomiiformes**      |  |
| Stomiidae             |  |
|         469           |  |
| Venefica proboscidea  | 127 |
| Synaphobranchidae     |  |
|         113           |  |
| Synaphobranchus kaupii |  |
| Anguillidae           |  |
|         998           |  |
| Simenchelys parasitica |  |
| Serriromeridae        |  |
|         123           |  |
| Serriromer beani      | 997 |
| Nemichthyidae         |  |
|         125           |  |
| Nemichthys scolopaceus | 48  |
| Page | Scientific Name                | Page |
|------|-------------------------------|------|
| 182  | Pachystomias microdon         | 701  |
| 468  | Malacosteus sp.               | 146  |
| 149  | Malacosteus niger             | 7    |
| 150  | Photostomias guernei          |      |
| 126  | Chauliodus sloani             |      |
| 260  | Stomias boa                   |      |
| 994  | Rhadinesthes decimus         | 139  |
| 380  | Melanostomias sp.             | 296  |
|      | **Aulopiformes**              |      |
| 703  | Bathyperois dubius            | 100  |
| 3    | Paralepididae                 | 101  |
| 161  | Arctozetus risso              | 56   |
| 262  | Paralepis speciosa            | 102  |
| 17   | Paralepis coregonoides        | 140  |
| 181  | Sudis hyalina                 |      |
| 160  | Magnisudis atlantica          | 110  |
| 32   | Alepisaurus ferox             | 105  |
| 371  | Alepisaurus brevirostris      | 107  |
|      | **Anotopteridae**             |      |
| 154  | Anotopterus pharao            | 222  |
| 930  | Scopelosaurus lepidus         | 128  |
| 715  | Bathysaurus ferox             | 910  |
|      | **Myctophiformes**            |      |
| 173  | Myctophidae                   | 104  |
| 367  | Ceratoscopelus maderensis     | 106  |
| 913  | Lampancytus sp.               |      |
| 370  | Notoptes Poupinii             | 232  |
| 366  | Benthosema glaciale           | 215  |
| 372  | Protomyctophum arcticum       | 426  |
| 368  | Lampadina speculigera         | 168  |
| 369  | Myctophum punctatum           | 924  |
| 981  | Taenioglanis exiguus          | 556  |
|      | **Cetomimiformes**            |      |
| 705  | Rondeletia loricata           | 134  |
| 223  | Cetostoma regani              | 170  |
| 249  | **Lophiiformes**              |      |
| 919  | Linophryniida                 | 211  |
| 183  | Haplophryne mollis            | 167  |
| 209  | Linophryne coronata           | 169  |
| 26   | Lophiidae                     |      |
| 143  | Lophius americanus            |      |
|      | **Ogcocephalidae**            |      |
| 301  | Dibranchus atlanticus         | 166  |
| 144  | Melanocetidae                 | 162  |
| 453  | Melanocetus johnsonii         | 164  |
| 706  | Chaenophryne longiceps        | 163  |
| 220  | Ophioagamias cornuta          | 130  |
| 269  | Dolophichthys allctor         | 382  |

**Sci. Council Studies, No. 46, 2014**
Polyprionidae
534 Polyprion americanus
Howellidae
911 Ulcina olriki
Chiasmodontidae
727 Careproctus micropus
Anarhichadidae
724 Careproctus reinhardtii
Anarhichas sp.
725 Liparis fabricii
Anarhichas lupus
138 Paraliparis copei
Anarhichas minor
Anarhichas denticulatus
Stichaeidae
281 Lumpenus sp.
280 Lumpenus lampraeformis
212 Leptoclinus maculatus
Ammododytidae
129 Ammodytes sp.
191 Ammodytes dubius
Trichiuridae
180 Aphanopus carbo
Centrolophidae
941 Centrolophus niger
Caristiidae
142 Caristius fasciatus
Beloniformes
Scomberesocidae
117 Scomberesox saurus
Stephanodermiformes
Melampyidae
205 Porotritia sp.
Porotritia megalops
208 Scopelogadus beanii
Beryciformes
29 Diretmidae
201 Diretmus argenteus
Trachichthyidae
202 Hoplostethus atlanticus
Anoplogastrididae
248 Anoplogaster cornuta
Scopaseniformes
Sebastidae
52 Sebastes sp.
51 Sebastes norvegicus
53 Sebastes mentella
54 Sebastes fasciatus
50 Sebastes (juvenile)
49 Sebastes (bag)
558 Cyclopteridae
258 Triglops sp.
159 Triglops murrayi
Psychrolutidae
2 Cotycus sp.
115 Cotycus microps
116 Cotycus thomsonii
Agonidae
296 Aspidophoroides monopterygius
136 Leptagonus decagonus
911 Ulcina olriki
727 Careproctus micropus
724 Careproctus reinhardtii
726 Liparis liparis
725 Liparis fabricii
138 Paraliparis copei
114 Glyptocephalus cynoglossus
112 Hippoglossoides platessoides
118 Reinhartidiis hippoglossoides
120 Hippoglossus hippoglossus
932 Ascidiacea (Class)
853 Didemnidae
962 Thaliacea (Class)
Mollusca
Gastropoda
Caenogastropoda (Subclass)
Stromboidea (Superfamily)
Arrhoges occidentalis
Muricoidea (Superfamily)
Boreotrophon sp.
Buccinoidea (Superfamily)
Buccinum sp.
Turrisipho sp.
Beringius turtoni
Colus sp.
Neptunea despecta
Torellia delicata
Heterobranchia (Subclass)
Cephalaspidea
Scaphander punctostriatus
Nudibranchia
764 Scaphopoda
875 Polyplacophora
865 Bivalvia
Heterodonta(Subclass)
Astartidae
840 Astarte sp.
846 Nudibranchia
764 Scaphopoda
875 Polyplacophora
865 Bivalvia
Heterodonta(Subclass)
Astariidae
Cuspidariidae
Cuspidaria sp.
Pteriomorphia (Subclass)
Pectinidae
Chlamys islandica
Cephalopoda
Sepiolida
992 Chlamys islandica
500 Cephalopoda
964 Sepiolida
| Sci. Council Studies, No. 46, 2014 |
|----------------------------------|
| 30 | 503 | Semirossia sp. | 817 | Notostomus sp. |  |
| 929 | 980 | Teuthida | 880 | Notostomus elegans |  |
| 912 | 813 | Oegopsida | 302 | Ephyrina sp. |  |
| 11 | 302 | Gonatidae | | Oplophorus spinosus |  |
| 509 | 761 | Onychoteuthidae | | Nematocarinoidea (Superfamily) |  |
| 30 | 825 | Brachiotethiidae | | Pasiphaeidae (Superfamily) |  |
| 510 | 909 | Brachioteuthis sp. | | Pasiphaea multidentata |  |
| 12 | 824 | Histiotheuthidae | | Parapagisphaeae sulcatifrons |  |
| 516 | 921 | Todorodes sagittatus | | Alpheidea (Superfamily) |  |
| 810 | 999 | Illex sp. | | Pandalus (bag) |  |
| 504 | 620 | Illex illecebrosus | | Crangonoida (Superfamily) |  |
| 794 | 631 | Chiroteuthidae | | Argis dentata |  |
| 707 | 827 | Chiroteuthis verranii | | Sabinea sp. |  |
| 507 | 829 | Chiroteuthis picteti | | Sabinea saritii |  |
| 16 | 828 | Cranchiidae | | Sabinea kystrix |  |
| 768 | 747 | Taonius sp. | | Sabinea septemcarinata |  |
| 996 | 630 | Taonius pavo | | Pontophilus norvegicus |  |
| 512 | 640 | Teuthowenia megalops | | Palinura (Infraorder) |  |
| 942 | | Liguriella sp. | | Polychelidae |  |
| **Vampyromorpha** | | | | **Steroomastis sp.** |  |
| 798 | 475 | Vampyroteuthidae | | Stereomastis sculpa |  |
| 6 | 821 | Octopoda | | Stereomastis nana |  |
| 502 | 555 | Octopodidae | | Penthacherodes laevis |  |
| 762 | 954 | Bathypolytopus sp. | | Anomura (Infraorder) |  |
| 505 | 699 | Bathypolytopus bairdii | | Paguridae |  |
| 513 | 790 | Bathypolytopus arcticus | | Lithodidae |  |
| 508 | 820 | Graneledone sp. | | Lithodes maja |  |
| 515 | 650 | Cirroteuthidae | | Neolithodes grimaldii |  |
| 931 | 651 | Cirroteuthis muelleri | | Galatheidae |  |
| | | Opisthotheuthidae | | Munida sp. |  |
| **Arthropoda** | | | | Munidopsis curvostra |  |
| 600 | 790 | Crustacea (Subphylum) | | Brachyura (Infraorder) |  |
| **Decapoda** | | | | Oregoniidae |  |
| | | | | Hyas sp. |  |
| 635 | 788 | Dendrobranchiata (Suborder) | | Hyas araneus |  |
| 826 | 901 | Sergestoidea (Superfamily) | | Hya coarctatus |  |
| 636 | 789 | Penaeoidea (Superfamily) | | Chionoecetes opilio |  |
| 918 | 927 | Aristeaeopsis edwardsiana | | Geryonidae |  |
| 888 | | Benthesicymus barletti | | Chaceon quinqueceps |  |
| 977 | | Gennadas sp. | | Peracarida (Superorder) |  |
| | | Gennadas elegans | | Isopoda |  |
| | | Caridea (Infraorder) | | Gnathophausia |  |
| 14 | 872 | Oplophoroida (Superfamily) | | Gnathophausia |  |
| 612 | 816 | Acanthephyra sp. | | Gnathophausia |  |
| 285 | 903 | Acanthephyra eximia | | Gnathophausia zoea |  |
| 286 | 568 | Acanthephyra pelagica | | Gnathophausia gigas |  |
| | | Acanthephyra purpurea | | |
| Family          | Genus                        | Species Name     |
|-----------------|------------------------------|------------------|
| Eupopiidae      | Eucopia sculpticauda         | 983              |
| Myida           |                              | 928              |
| Amphipoda       |                              | 895              |
| Eucarida (Superorder) |                        | 700              |
| Euphausiacea    |                              | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     |                              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     |                              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     |                              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     |                              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     |                              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          |                              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      |                              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       |                              | 895              |
| Hyperiidea      |                              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      |                              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Eucopiidae      | Taenianthus sp.              | 983              |
| Mysida          | Taenianthus sp.              | 928              |
| Amphipoda       | Taenianthus sp.              | 895              |
| Hyperiidea      | Taenianthus sp.              | 700              |
| Eucarida (Superorder) |                      | 956              |
| Cirripedia      | Taenianthus sp.              | 854              |
| Chelicera (SubPhylum) |                      | 933              |
| Pycnogonida     | Taenianthus sp.              | 946              |
| Page | Text                                                                 |
|------|----------------------------------------------------------------------|
| 32   | **Sci. Council Studies, No. 46, 2014**                               |
| 809  | **Aphroditidae**                                                      |
| 882  | **Aphrodita** sp.                                                     |
|      | **Laetomonice** sp.                                                  |
|      | **Clitellata**                                                       |
| 890  | **Hirudinea (Subclass)**                                             |
| 836  | **Sipuncula**                                                        |
| 847  | **Bryozoa**                                                          |
| 864  | **Brachiopoda**                                                      |
| 975  | *Terebratulina septentrionalis*                                       |
| 807  | **Echinodermata**                                                    |
| 787  | **Asteroidea**                                                       |
| 855  | **Astropectinidae**                                                  |
| 871  | **Plutonaster agassizi**                                             |
| 796  | **Psilaster andromeda**                                              |
| 883  | **Brisingidae**                                                      |
| 870  | **Asterinidae**                                                      |
| 849  | **Ctenodiscidae**                                                    |
| 835  | **Benthopsectinidae**                                                |
| 830  | **Ceramaster granularis**                                            |
| 842  | **Hippasteria phrygiana**                                            |
| 795  | **Mediaster bairdi**                                                 |
| 961  | **Pseudarchasteridae**                                               |
| 904  | **Pseudarchaster sp.**                                               |
| 760  | **Pseudarchaster gracilis**                                          |
| 902  | **Solasteridae**                                                     |
| 949  | **Lophaster furcifer**                                               |
| 841  | **Pterasteridae**                                                    |
| 428  | **Poraniidae**                                                       |
| 874  | **Poraniomorpha hispida**                                            |
| 843  | **Echinasteridae**                                                   |
|      | **Zoroasteridae**                                                    |
|      | **Asteriidae**                                                       |
| 818  | **Zoroaster fulgens**                                                |
| 896  | **Stephanasterias albula**                                           |
| 805  | **Ophiuroidea**                                                      |
|      | **Asteronychidae**                                                   |
|      | **Asteroide**                                                        |
|      | **Gorgonocephalidae**                                                |
|      | **Ophiuridae**                                                       |
|      | **Ophiura sarsii**                                                   |
|      | **Ophioplithus sp.**                                                 |
|      | **Ophioplepididae**                                                  |
|      | **Ophiomusium lymani**                                               |
|      | **Ophiacanthidae**                                                   |
|      | **Ophiacantha sp.**                                                  |
|      | **Ophiactidae**                                                      |
| 831  | **Ophiopelis aculeata**                                              |
| 808  | **Echinoidea**                                                       |
| 822  | **Echinothuriidae**                                                  |
| 791  | **Phormosomatidae**                                                  |
|      | **Phormosoma placenta**                                              |
|      | **Schizasteridae**                                                   |
| 838  | **Brisaster fragilis**                                               |
| 866  | **Crinoidea**                                                        |
| 759  | **Holothuroidea**                                                    |
Shrimp sampling (**Pandalus borealis**)

The shrimp is a decapod crustacean Pandalidae. The distinctive characters of the species are the presence of prominent spines on the 3rd abdominal somite (in mid-dorsal position) and on the 4th abdominal somite (postero-dorsal margin); spines on the distal portion of the face (Fig. 1).

Berkeley (1930) first noted that *P. borealis* is a protandric hermaphrodite, i.e., each individual matures and functions first as a male, passes through a transitional or intersexual phase, and becomes a female. While this is the normal sequence of events, several authors have reported early maturing females in the southern portions of the distribution range.

The sex of *P. borealis* can be identified by changes in the external structure of the 1st pair of pleopods from the endopodite. However, a stricter classification should take into account also the observation of internal appendage and male appendage of the second pair of pleopods, allowing us to distinguish between male and female transition (Fig. 2). This appendix is difficult to see without the aid of a binocular microscope, making impractical the sampling aboard commercial vessels.

**Sampling**

Due to the biological characteristics of shrimp, the study of this species presents some particularities to be considered in sampling.

The absence of hard parts that can be used to identify the age of the individuals, makes necessary to obtain size distributions in adequate numbers to enable us to identify different year classes through modal analysis or identification of trends in the size distribution of the different states considered.

Furthermore, the great plasticity of this species in terms of growth, change of sex and sexual maturity, which is affected, both spatially and temporally, determine an adequate stratification in the sampling and detailed analysis (by sex and maturity state).

The carapace length (CL) is measured with a calliper from the posterior margin of the eyestalk to the posterior mid dorsal edge of the carapace (Fig. 3), to the lower half millimetre.

Approximately 200 or 300 individuals from the catch at each station will be randomly measured by sex and maturity stage (Figs. 4, 5, 6 and 7), according to the following categories:

- **Males (M)**, who include individuals both young and adult (M). They are distinguished by the shape of the endopodite apex from the 1st pair of pleopods (Fig. 4 and 5). Also, this sampling should be done by separating the males from the individuals in transition state (T), as these specimens in NAFO, at the survey time, are classified as immature females primiparous.

- **Immature primiparous females (IF)**. They differ mainly in the lanceolate shape of endopodite from the 1st pair of pleopods (Fig. 6), and the presence of sternal spines well defined on the abdomen (Fig. 7). In addition, as noted above, individuals in transition (T) will be considered as immature females. The presence of eggs in the head is not a decisive character, as may be present in individuals in transition or in females that have matured in the past (in this case the sternal spines are absent or much less marked).

- **Mature females (MF)**. They are females with sternal spines absent or barely marked. In this group are included the females in a new spawning process, without eggs in the abdomen but with eggs in the head and without sternal spines visible and the females at rest, without sternal spines and eggs in the abdomen or head.

- **Mature ovigerous females (HMOV)**, which present eggs in the abdomen.

In addition to the samples analysed on board will be collect samples for further study in the laboratory. These samples will be frozen at sea and subsequently analysed to establish the length-weight relationship. The sampling precision in the laboratory will be one hundredth of a millimetre and one hundredth of a gram. On the other hand berried females will be analysed for further study of fecundity (egg counts). Therefore samples should be collected properly so that egg loss as small as possible.

The frozen samples will be taken randomly from all strata considered in the survey.
Fig. 1. Dorsal and lateral view from *Pandalus borealis* (Butler, 1980); general aspects in its anatomy to determine the species and sex.
Fig. 2. Changes in form with increasing age of the endopodite of the first pleopod and the corresponding appendix internal and appendix masculine of the second pleopod of *Pandalus borealis*. Age in months is given in the ring in each endopodite and the carapace length (mm) above each Fig.. Male endopodite, black; transitional, cross-hatched; female, outline. Arrows indicate sequence (from Allen 1959)
Length measurement of shrimp

Fig. 3 Length measurement from the posterior margin of the eyestalk to the posterior mid dorsal edge of the carapace.

Fig. 4. **Males (M).** Carapace lengths from 6 to 22 mm approximately. Endopodite transformed as reproductive organ with the internal appendix clearly visible:

- Narrow and long in young males, the internal appendix exceeds the height of the apex of the endopodite (1).
- In adult males this organ is considerably wider compared with its length and rarely exceeds the apex of endopodite.

Fig. 5. **Transitional o intersex (T).** Lengths from 18 to 23 mm. The reproductive organ gradually reduces in size at each moult and does not reach the apex of the endopodite.

In this phase two states can be distinguished:

- No eggs in the head.
- With blue-green eggs in the head. Furthermore, as in males have well defined abdominal sternal spines. They will be considered immature females.

![Fig. 5] 5 = young female, 6 = older female female with setae on the pleopods.

Fig. 6. **Female.** Lengths from 18 to 30 mm. The male reproductive organ is disappeared. The endopodite shows a lanceolate shape (5 and 6). In females where there has been the release of eggs and larvae (hatching) the endopodite has long silks (7). Sternal spines have disappeared or are much less marked.

Females can present several maturity stages

**Immature females (IF).** They are hard to separate from the transition stage without observation of internal appendix in the 2nd pair of pleopods. In general they would be in this state those individuals with endopodite shape as females, and sternal spines well defined. Also, they will be considered as immature females those individuals at transition state with eggs in the carapace.

**Mature females, (MF).** They may have different stages that we will group into two: ovigerous females (HMOV) with eggs in the abdomen and non-ovigerous females (HM) no eggs in the abdomen and sternal spines barely marked or absents.
Fig. 7. Diagrammatic ventral view of the abdomen of a panda id shrimp showing sternal spines (from McCrary 1971). B and C. Spines well defined (present in males, transitional stage and immature females). D. Spines barely marked or absents in mature females which have previously spawned

References

ALLEN, J.A. 1959. On the biology of *Pandalus boreales* Kroyer, with reference to a population off the Northumberland coast. *J. Mar. Biol. Ass. U.K.*, 8: 189–220. http://dx.doi.org/10.1017/S002531540001568X

MC crary, J.A. 1971. Sternal spines as a characteristic for differentiating between females of some Pandalidae. *J. Fish. Res. Board Can.*, 28: 98–100. http://dx.doi.org/10.1139/f71-014

Publications 2002–2012 (which were partially or entirely based on survey results)

ALPOIM, R. 2003. A stock status update of American plaice (*Hippoglossoides platessoides*) in Division 3M. *NAFO SCR Doc.* 03/44.

2006. An assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. *NAFO SCR Doc.* 06/38.

ALPOIM, R., C. DARBY and A. ÁVILA DE MELO. 2002. An assessment of American plaice (*Hippoglossoides platessoides*) in Division 3M. *NAFO SCR Doc.* 02/62.

ALPOIM, R., A. ÁVILA DE MELO, R. BAñON, M. CASAS, S. CERVINO, S. JUNQUERA, I. MARTÍN, H. MURUA, X. PAZ, G. PÉREZ-GÁNDARAS, J.L. DEL RÍO, E. RODRIGUEZ-MARÍN, F. SABORIDO-REY, E.J. DOS SANTOS and A. VÁZQUEZ. 2002. Distribution and main characteristic of fish species on Flemish Cap based on the 1988–2002 EU-surveys in July. *NAFO SCR Doc.* 02/72.

ALPOIM, R., E. ROMAN, B. GREENE, R. BURRY and W.R. BOWERING. 2002. Results of the Greenland halibut (*Reinhardtius hippoglossoides*) otolith exchange between Spain, Canada and Portugal. *NAFO SCR Doc.* 02/141.

ALPOIM, R. and A. ÁVILA DE MELO. 2004. An assessment of American plaice (*Hippoglossoides platessoides*) in Division 3M. *NAFO SCR Doc.* 04/50.

2008. An assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. *NAFO SCR Doc.* 08/40.

ALPOIM, R., A.M. ÁVILA DE MELO and D. GONZÁLEZ-TRONCOSO. 2011. An Assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M. *NAFO SCR Doc.* 11/041.

ÁVILA DE MELO, R. ALPOIM and F. SABORIDO-REY. 2002. The Present Status of Beaked Redfish (*S. mentella* and *S. fasciatus*) in NAFO Division 3M and Medium Term Projections Under A Low Commercial Catch/ High Shrimp Fishery By-Catch Regime. *NAFO SCR Doc.* 02/54

2003. An assessment of beaked redfish (*S. mentella* and *S. fasciatus*) in NAFO Div. 3M. *NAFO SCR Doc.* 03/45.

2004. Interim Monitoring Report of Beaked Redfish (*Sebastes mentella* and *S. fasciatus*) in NAFO Division 3M. *NAFO SCR Doc.* 04/31.

2005. A revised assessment of beaked redfish (*S. mentella* and *S. fasciatus*) in NAFO Div. 3M using
the original EU survey indices converted to the new RV Vizconde de Eza units. NAFO SCR Doc. 05/47.
2007. An XSA based assessment of beaked redfish (S. mentella and S. fasciatus) in NAFO Division 3M. NAFO SCR Doc. 07/47.
ÁVILA DE MELO, A., F. SABORIDO-REY, D. GONZÁLEZ-TRONCOSO, I. SKRYABIN and R. ALPOIM. 2009. An Assessment of Beaked Redfish (S. mentella and S. fasciatus) in NAFO Division 3M Based on Revised 2005-2008 catches (Is a Retrospective Biased Assessment Necessarily Useless in Terms of Scientific Advice?). NAFO SCR Doc. 09/029.
ÁVILA DE MELO, A., R ALPOIM AND D. GONZÁLEZ-TRONCOSO. 2010. An ASPIC Based Assessment of Redfish (S. mentella and S. fasciatus) in NAFO Divisions 3LN (Is a retrospective Biased Assessment Necessarily Useless in terms of Scientific Advice?). NAFO SCR Doc. 10/28.
ÁVILA DE MELO, A., F. SABORIDO-REY, D. GONZÁLEZ-TRONCOSO, M. POCHTAR and R. ALPOIM. 2011. An Assessment of Beaked Redfish (S. mentella and S. fasciatus) in NAFO Division 3M (With an Approach to the Likely Impact of Recent 3M Cod Growth on Redfish Natural Mortality. NAFO SCR Doc. 11/026.
BOWERING, W.R. and A. VÁZQUEZ. 2002. Distribution and abundance of witch flounder on Flemish Cap and in Flemish Pass based on Canadian and EU research survey data. NAFO SCR Doc. 02/25.
CABANAS, J.M. 2002. Hydrographic Conditions on Flemish Cap in July 2001. NAFO SCR Doc. 02/25.
2003. Hydrographic Conditions on Flemish Cap in July 2002. NAFO SCR Doc. 03/32.
CADRIN S., M. BERNREUTHER, E. HJÖRLÉIFSSON, T.JOHANSEN, L. KERR, K. KRISTINSSON, S. MARIANI, C. PAMPOULIE, J. REINERT, F. SABORIDO-REY, T. SIGURDSSON and C. STRANSKY. 2009. Mechanisms and consequences of life cycle diversity of beaked redfish, Sebastes mentella. ICES CM 2009/H.01.
CADRIN, S.X., M. BERNREUTHER, A. K. DANÍELSDÓTTIR, E. HJÖRLÉIFSSON, T. JOHANSEN, L. KERR, K. KRISTINSSON, S. MARIANI, K. NEDREAS, C. PAMPOULIE, B. PLANQUE, J. REINERT, F. SABORIDO-REY, T. SIGURDSSON and C. STRANSKY. 2010. Population Structure of beaked redfish, Sebastes mentella: evidence of divergence associated with different habitats. ICES J. Mar. Sci. 67(8): 1617–1630. http://dx.doi.org/10.1093/icesjms/fsq046
CASAS, J.M. 2004. Results from Bottom Trawl Survey on Flemish Cap of June–July 2003. NAFO SCR Doc. 04/021.
2006. Northern shrimp (Pandalus borealis) on Flemish Cap surveys 2006. NAFO SCR Doc. 06/66.
2007. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2007. NAFO SCR Doc. 07/78.
2007. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2007. NAFO SCR Doc. 07/89.
2008. Division 3M Northern Shrimp (Pandalus borealis)-Interim Monitoring Update NAFO SCR Doc.08/55.
2008. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2008. NAFO SCR Doc. 08/67.
2008. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2008. NAFO SCR Doc. 08/68.
2009. Division 3M Northern shrimp (Pandalus borealis)-Interim Monitoring Update. NAFO SCR Doc. 09/50.
2009. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2009. 09/54.
2009. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2009. NAFO SCR Doc. 09/56.
2009. Comparison of Northern Shrimp Age composition calculated from Length distributions in the EU Survey and from Commercial Samples in 3M Division. NAFO SCR Doc. 09/57.
2010. Division 3M Northern shrimp (Pandalus borealis)-Interim Monitoring Update. NAFO SCR Doc. 10/47.
2010. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2010. NAFO SCR Doc. 10/64.
2010. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2010. NAFO SCR Doc.10/66.
2011. Division 3M Northern shrimp (Pandalus borealis)-Interim Monitoring Update. NAFO SCR Doc. 11/45.
2011. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2011. NAFO SCR Doc. 11/60.
2011. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2011. NAFO SCR Doc. 11/62.
2012. Assessment of the International Fishery for Shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993–2012. NAFO SCR Doc. 12/52.
2012. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys 2012. NAFO SCR Doc. 12/53.
CASAS, J.M., J.L. DEL RIO and D. GONZÁLEZ-TRONCOSO. 2004. Northern shrimp (Pandalus borealis) on Flemish Cap surveys 2003 and 2004. NAFO SCR Doc. 04/77.
CASAS, J.M. and D. GONZÁLEZ-TRONCOSO. 2005. Results from Bottom Trawl Survey on Flemish Cap of July 2004. NAFO SCR Doc. 05/35.
CASAS, J.M., J.L. DEL RIO, J. TERUEL and A. ALONSO. 2005. Northern Shrimp (Pandalus borealis) on Flemish Cap Surveys. NAFO SCR Doc. 05/78.
CASAS, J.M. and D. GONZÁLEZ-TRONCOSO. 2007. Results from Bottom Trawl Survey on Flemish Cap of June–July 2006. NAFO SCR Doc. 07/10.
2009. Results from Bottom Trawl Survey on Flemish Cap of June–July 2008. NAFO SCR Doc. 09/19.
2011. Results from Bottom Trawl Survey on Flemish Cap of June–July 2010. NAFO SCR Doc. 11/21.
CERVIÑO, S. 2002. Bootstrap estimate of catch-sampling variability for indices of abundance at age. NAFO SCR Doc. 02/76.
CERVIÑO, S. and A. VÁZQUEZ. 2003. Re-opening criteria for Flemish Cap cod: a survey-based method. NAFO SCR Doc. 03/38.
2004. A survey-based assessment of cod in Division 3M. NAFO SCR Doc. 04/53.
CERVIÑO, S., J. GIL and R. SANCHEZ. 2005. Changes in Flemish Cap cod distribution and its relationship with environmental changes. NAFO SCR Doc. 05/16.

CERVIÑO, S. and F. SABORIDO-REY. 2006. Using the bootstrap to investigate the effects of varying tow lengths and sampling schemes in fish survey. Fish. Res., 79: 294–302. http://dx.doi.org/10.1016/j.fishres.2006.03.021

DEL RÍO, J.L., E. ROMÁN and S. CERVIÑO. 2002. Abundance and distribution of elasmobranchs in NAFO regulatory area (Divs. 3MNO). NAFO SCR Doc. 02/106.

DEL RÍO, J.L., J.M. CASAS and T. PATROCINIO. 2002. Northern Shrimp (Pandalus borealis) on Flemish Cap in July 2002. NAFO SCR Doc. 02/150.

DEL RÍO, J.L., J.M. CASAS and D. GONZALEZ-TRONCOSO. 2003. Northern Shrimp (Pandalus borealis) on Flemish Cap in June 2003. NAFO SCR Doc. 03/80.

2004. Revision of the northern shrimp (Pandalus borealis) on Flemish Cap. In June 2003. NAFO/OSCRD 04/69.

DOMÍNGUEZ-PETIT, R. A. ALONSO-FERNÁNDEZ and F. SABORIDO-REY. 2011. Incidence and significance of cystic structures in the ovaries of gadoid fish. Scientia Marina 75(2): 359-368. http://dx.doi.org/10.3989/scimar.2011.75n2359

DOMINGUEZ-PETIT, R. R. RIDEOUT, D. GARABANA, Y. LAMBERT and J. MORGAN. 2011. Poster: Comparative estimates of fecundity for Greenland halibut from the NW Atlantic using the autodiametric method. FRESH final conference, Vigo, Spain. May 2011.

DURÁN-MUÑOZ, P., F.J. MURILLO, A. SERRANO, M. SAYAGO-GIL, S. PARRA, V. DÍAZ DEL RÍO, M. SACAU, T. PATROCINIO and J. CRISTOBO. 2008. A Case Study of available methodology for the identification of vulnerable Ecosystems/Habitats in bottom deep-sea fisheries: Possibilities to apply this method in the NAFO Regulatory Area in order to select Marine Protected Areas. NAFO SCR Doc. 08/006.

FERNÁNDEZ, C., S. CERVIÑO and A. VÁZQUEZ. 2007. A Survey-based Assessment of Cod in Division 3M. NAFO SCR Doc. 07/39

FERNÁNDEZ, C., S. CERVIÑO, F. SABORIDO-REY and A. VÁZQUEZ. 2008. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 08/26.

FULLER, S.D., F.J. MURILLO, V.WAREHAM and E. KENCHINGTON. 2008. Vulnerable Marine Ecosystems Dominated by Deep-Water Corals and Sponges in the NAFO Convention Area. NAFO SCR Doc. 08/22.

GIL, J., R. SÁNCHEZ, S. CERVIÑO and D. GARABANA. 2002. Geostrophic circulation and heat flux across the Flemish Cap. NAFO SCR Doc. 02/58.

2004. Geostrophic circulation and heat flux across the Flemish Cap. J. Northw. Atl. Fish. Sci., Vol. 34: 61–68.

GONZÁLEZ IGLESIAS, C. 2012. Atlantic cod predation on redfish in Flemish Cap. NAFO SCR Doc. 12/27.

GONZÁLEZ, C., E. ROMÁN AND X. PAZ. 2003. Food and Feeding Chronology of American Plaice (Hippoglossoides platessoides) in the North Atlantic. NAFO SCR Doc. 03/23.

GONZÁLEZ, C., E. ROMÁN and X. PAZ. 2004. Condition and feeding of American plaice (Hippoglossoides platessoides) in the North Atlantic with emphasis in Flemish Cap. NAFO SCR Doc. 04/59.

GONZÁLEZ, C., X. PAZ, E. ROMÁN and M. ALVÁREZ. 2006. Feeding habits of wolffishess (Anarhichas denticulatus, A. lupas, A. minor) in the North Atlantic. NAFO SCR Doc. 06/52.

GONZÁLEZ, C., E. ROMÁN, X. PAZ and E. CEBALLOS. 2006. Feeding habits and diet overlap of skates (Amblyraja radiata, A. hyperborea, Bathyraya spinicauda, Malacochara senta and Rajella fyllae) in the North Atlantic. NAFO SCR Doc. 06/53.

GONZÁLEZ, C., J. TERUEL, E. LÓPEZ and X. PAZ. 2007. Feeding Habits and Biological Features of Deep-Sea Species of the Northwest Atlantic: Large-eyed Rabbitfish (Hydrolagus mirabilis), Narrownose Chimaera (Harrtiota raleighana) and Black Dogfish (Centroscyllium fabricii). NAFO SCR Doc. 07/63.

GONZÁLEZ, C., X. PAZ and A. ARMESTO. 2008. Daily ration and energy content obtained from the diet of American plaice (Hippoglossoides platessoides) in the Grand Bank and Flemish Cap. NAFO SCR Doc. 08/52.

GONZÁLEZ IGLESIAS, C. and J.M. CASAS. 2012. Atlantic Cod Predation on Northern shrimp in Flemish Cap (NAFO Div. 3M). NAFO SCR Doc. 12/55.

GONZÁLEZ-COSTAS, F. 2009. Roughhead Grenadier Subarea 2 and 3 XSA model configuration. NAFO SCR Doc. 09/21.

GONZÁLEZ-COSTAS, F. 2010. An assessment of NAFO roughhead grenadier Subarea 2 and 3 stock. NAFO SCR Doc. 10/32.

GONZÁLEZ-COSTAS, F. and H. MURUA. 2005. Assessment of roughhead grenadier, Macrourus berglax, in NAFO Subareas 2 and 3. NAFO SCR Doc. 05/54.

GONZÁLEZ-COSTAS, F., D. GONZÁLEZ-TRONCOSO, J.M. CASAS and G. RAMILO. 2006. Spiny dogfish (Squalus acanthias) and black dogfish (Centroscyllium fabricii) Spanish data (surveys and fishery) in NAFO Divisions 3LMNO. NAFO SCR Doc. 06/30.

GONZÁLEZ-COSTAS F. and H. MURUA. 2007. An analytical assessment of NAFO roughhead grenadier Subareas 2 and 3 stock. NAFO SCR Doc. 07/34.

GÓNZALES-COSTAS, F. and H. MURUA – 2008. A review on roughhead grenadier (Macrourus berglax) biology and population structure on Flemish Cap (NAFO Division 3M) 1991-2007 based upon EU Flemish Cap bottom survey data. NAFO SCR Doc. 08/27.

GONZÁLEZ-COSTAS, F. and D. GONZÁLEZ-TRONCOSO. 2009. Spanish 2006–2008 Fisheries Footprint, scientific Observers and surveys coverage and update of the Standardized CPUE Indices for Greenland Halibut. NAFO SCR Doc. 09/22.

GONZÁLEZ-TRONCOSO, D. and M. CASAS. 2005. Calculations of the calibration factors from the comparative experience between the RV Cornide de Saavedra and the RV Vizconde de Eza in Flemish Cap in 2003 and 2004. NAFO SCR Doc. 05/29.

GONZÁLEZ-TRONCOSO, D., M. CASAS and F. SABORIDO-REY. 2006. Results from bottom trawl survey on Flemish Cap of July–August 2005. NAFO SCR Doc. 06/16.
GONZÁLEZ-TRONCOSO, D. and F. GONZÁLEZ-COSTAS. 2006. Quality of the surveys information in relation with the Greenland halibut assessment of Subarea 2 and Divisions 3KL. NAFO SCR Doc. 06/50.

GONZÁLEZ-TRONCOSO, D., M. SACAU and F. GONZÁLEZ-COSTAS. 2007. A study of Spanish Greenland halibut commercial effort and CPUE in 3LMNO using GIS with comparisons to the Spanish Div. 3NO survey and EU Flemish Cap survey catche. NAFO SCR Doc. 07/54.

GONZÁLEZ-TRONCOSO, D and X. PAZ. 2007. Some Ecological Indices in Flemish Cap derived from the surveys conducted by EU between 1988 and 2006. NAFO SCR Doc. 07/65.

GONZÁLEZ-TRONCOSO, D. and C. FERNÁNDEZ. 2009. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 09/34.

GONZÁLEZ-TRONCOSO, D. and A. VÁZQUEZ. 2010. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 10/41.

2011. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 11/38.

GONZÁLEZ-TRONCOSO, D. and F. GONZÁLEZ-COSTAS. 2011. New projections from the assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 11/47.

GONZÁLEZ-TRONCOSO, D. and XABIER PAZ. 2008. Growth features of American plaice (Hippoglossoides platessoides) in Northwest Atlantic. NAFO SCR Doc. 08/53.

GONZÁLEZ-TRONCOSO, D. and A. VÁZQUEZ. 2010. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 10/41.

HENDRICKSON, L. and A. VÁZQUEZ. 2005. Density-dependent Changes in the Spatial Distributions of Atlantic Cod (Gadus morhua), American Plaice (Hippoglossoides platessoides), and Greenland Halibut (Reinhardtius hippoglossoides) on the Flemish Cap During 1988-2002. J. Northw. Atl. Fish. Sci., Vol. 37: 53–72. http://dx.doi.org/10.2960/J.v37.m566

JUNQUERA, S. H. MURUA and K. PATTERSON. 2001. Monitoring update of the roughhead grenadier (Macrourus berglax) stock in NAFO Subareas 2 and 3. NAFO SCR Doc. 01/75.

KENCHINGTON et al. 2009. The Use of Density Analyses to Delineate Sponge Grounds and Other Benthic VMÉs from Trawl Survey Data. NAFO SCR Doc. 09/06.

KENCHINGTON, E., BEST, M., COGSWELL, A., MACISAAC, K., MURIILLO-PEREZ, F. J., MACDONALD, B., WAREHAM, V., FULLER, S. D., JÖRGENSENBY, H. I. Ø., SKLYAR, V., and THOMPSON, A. B. 2009. Coral Identification Guide NAFO Area. NAFO Sci. Council Studies 42: 1–35. doi:10.2960/S.v42.m1. http://dx.doi.org/10.2960/S.v42.m1

KENCHINGTON, E. FJ. MURILLO, A. COGSWELL and C. LIRETTE. 2011. Development of Encounter Protocols and Assessment of Significant Adverse Impact by Bottom Trawling for Sponge Grounds and Sea Pen Fields in the NAFO Regulatory Area. NAFO SCR Doc. 11/75.

LILLY, G. and A. VÁZQUEZ. 2005. Flemish Cap (NAFO Division 3M), pp 90-94 in K. Brander (ed.) Spawning and life history information for North Atlantic cod stocks. ICES Coop. Res. Report 274, 152 pp.

LILLY, G.R., K. WIELAND, B.J. ROTSCHILD, S. SUNDBY, K. DRINKWATER, K. BRANDER, G. OTTERSEN, J. CARSCADDEN, G. STENSON, G. CHOUINARD, D. SWAIN, N. DAAN, K. ENBERG, M. HAMMILL, A. ROSING-ASVID, H. SVEĐÅNG, and A. VÁZQUEZ. 2008. Decline and recovery of Atlantic cod (Gadus morhua) stocks throughout the North Atlantic. pp 39–66 In: Kruse, G.H., K. Drinkwater, J.N. Ianelli, J.S. Link, D.L. Stram, V. Wespestad, and D. Woodby (eds.). Resiliciency of gadoid stocks to fishing and climate change. Proceedings of the 24th Lowell Wakefield Fisheries Symposium, 364 pp.

MARSHALL, T., L. O’BRIEN, J. TOMKIEWICZ, G. MARTEINSDÖTTIR, M. J. MORGAN, F. SABORIDO-REY, F. KÖSTER, J. BLANCHARD, D. SECOR, G. KRAUS, P. WRIGHT and H. BJÖRNSSON. 2003. Developing alternative indices of reproductive potential for use in fisheries management: case studies for stocks spanning an information gradient. J. North. Atl. Fish. Sci. 33: 161–190. http://dx.doi.org/10.2960/J.v33.a8

MILLER, D.C.M., P. A. SHELTON, B.P. HEALEY, W.B. BRODIE, M.J. MORGAN, D. BUTTERWORTH, R. ALPOIM, D. GONZÁLEZ, F. GONZÁLEZ, C. FERNÁNDEZ, J. IANELLI, J-C. MAHÉ, I. MOSQUEIRA, R. SCOTT and A. VAZQUEZ. 2008. Management strategy evaluation for Greenland halibut (Reinhardtius hippoglossoides) in NAFO Subarea 2 and Divisions 3LMNO. NAFO SCR Doc. 08/025.

MORGAN, M.J., J. BURNETT, , J. TOMKIEWICZ and F. SABORIDO-REY. 2003. The Availability of Data for Estimating Reproductive Potential for Selected Stocks in the North Atlantic. NAFO Sci. Council Studies 37: 1–378.

MORGAN, J., A. PÉREZ-RODRÍGUEZ and F. SABORIDO-REY. 2011. Does increased information about reproductive potential result in better prediction of recruitment? Can. J. Aqu. Fish. Sci. 68: 1361–1368. http://dx.doi.org/10.1139/f2011-049

MORGAN, M.J., D. GARABANA and F. SABORIDO-REY. 2012. Distribution of spawning and sex ratio in Greenland halibut. NAFO SCR Doc. 12/24.

MORGAN, M.J., D. GARABANA, R.M. RIDEOUT, E. ROMÁN, A. PÉREZ-RODRÍGUEZ and F. SABORIDO-REY. 2013. Changes in distribution of Greenland halibut in a varying environment. ICES.J. Mar. Sci. 70 (2): 352-361. http://dx.doi.org/10.1093/icesjms/fss179

MURILLO, F.J., P. DURÁN MUÑOZ, M. SACAU, D. GONZÁLEZ-TRONCOSO and A. SERRANO. 2008. Preliminary data on cold-water corals and large sponges by-catch from Spanish/EU bottom trawl groundfish surveys in NAFO Regulatory Area (Divs. 3LMNO) and Canadian EEZ (Div. 3L): 2005–2007 period. NAFO SCR Doc. 08/10.

MURILLO F.J., DURÁN MUÑOZ, P., ALTUNA PRADOS, A., AND SERRANO, A. 2009. Distribution of deep-water corals of the Flemish Cap, Flemish Pass and the Grand Banks of Newfoundland (Northwest Atlantic Ocean): interaction with fishing activities. ICES
Symposium, Issues Confronting the Deep Oceans: The Economic, Scientific, and Governance Challenges and Opportunities of Working in the Deep Sea). 27–30 April 2009. Horta. Azores, Portugal. Abstract E62.

MURILLO, F.J., E. KENCHINGTON, C. GONZÁLEZ and M. SACAU. 2010. The Use of Density Analyses to Delineate Significant Concentrations of Pennatulaceans for Trawl Survey Data. *NAFO SCR Doc.* 10/07, Serial Number N5753.

MURILLO, F.J., KENCHINGTON, E., SACAU, M., PIPER, D. J. W., WAREHAM, V., AND MUÑOZ, A. 2011. New VME indicator species (excluding corals and sponges) and some potential VME elements of the NAFO Regulatory Area. *NAFO SCR Doc.* 11/73.

MURILLO, F.J., P. DURÁN MUÑOZ, A. ALTUNA and A. SERRANO. 2011. Distribution of deep-water corals of the Flemish Cap, Flemish Pass and the Grand Banks of Newfoundland (Northwest Atlantic Ocean): interaction with fishing activities. *ICES J. Mar. Sci.* 68 (2), 319–332. http://dx.doi.org/10.1093/icesjms/fsq071

MURILLO, F.J., SALAS, C., GOFAS, S., VALDÉS, A., PATROCINIO, T, and SERRANO, A. 2011. Diversity and distribution of mollusk assemblages of the Grand Banks of Newfoundland and Flemish Cap (Northwest Atlantic Ocean). 6th Congress of the European Malacological Societies, 18–22 July 2011. Vitoria-Gasteiz, Spain.

MURUA, H. 2002. A Review on Roughhead Grenadier (*Macrourus berglax*) Biology and Population Structure on Flemish Cap (NAFO Division 3M), 1991–2001 Based on Flemish Cap Survey Data. *NAFO SCR Doc.* 02/18.

MURUA, H. 2003. Population structure, growth and reproduction of roughhead grenadier on the Flemish Cap and Flemish Pass. *J. Fish Biol.* 63: 356–373. http://dx.doi.org/10.1046/j.1095-8649.2003.00158.x

MURUA, H. 2003. A Review on Roughhead Grenadier (*Macrourus berglax*) Biology and Population Structure on Flemish Cap (NAFO Division 3M), 1991-2002 Based on EU Flemish Cap Bottom Survey Data. *NAFO SCR Doc.* 3/13.

MURUA, H. 2003. Assessment of Roughhead Grenadier, *Macrourus berglax*, in NAFO Subareas 2 and 3. *NAFO SCR Doc.* 03/43.

MURUA, H. and C. GONZÁLEZ. 2004. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Division 3M) 1991–2003 based upon EU Flemish Cap bottom survey data. *NAFO SCR Doc.* 04/14.

MURUA, H., C. GONZÁLEZ and J. M. CASAS. 2005. Areview on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Division 3M) 1991–2004 based upon EU Flemish Cap bottom survey data. *NAFO SCR Doc.* 05/36.

MURUA, H., F. GONZÁLEZ-COSTAS and D. POWER. 2005. A review of the Fishery and the Investigations of Roughhead grenadier (*Macrourus berglax*) in Flemish Cap and Flemish Pass. *J. Northw. Atl. Fish. Sci.* 37: 13–27. http://dx.doi.org/10.2960/j.v37.m567

MURUA, H. and C. GONZÁLEZ. 2006. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Division 3M) 1991-2005 based upon EU Flemish Cap bottom survey data. *NAFO SCR Doc.* 06/07.

MURUA, H., S. CERVIÑO and A. VÁZQUEZ. 2006. A survey-based assessment of cod in Division 3M. *NAFO SCR Doc.* 6/32.

MURUA H., F. GONZALEZ-COSTAS and D. POWER. 2006. A review of the biology and fishery of roughhead grenadier (*Macrourus berglax*) in the North West Atlantic. American Fishery Society - AFS Symposium. Lake Placid (USA).

MURUA, H. and C. GONZALEZ. 2007. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Division 3M) 1991-2006 based upon EU Flemish Cap bottom survey data. *NAFO SCR Doc.* 07/25.

MURUA H., M. ARANDA y L. MOTOS. 2007. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish 2007. Evaluación y gestión internacional del bacalao de Terranova. In: García-Orellán, R. and X. Santos Solla (eds.), Canadá y la Unión Europea. Visión multidisciplinar de la gestión pesquera. Univ. Santiago de Compostela, 254 pp.

PÉREZ-RODRÍGUEZ, A., J. MORGAN and F. SABORIDO-REY. 2009. Comparison of Demographic and Direct Methods to calculate Probabilistic Maturation Reaction Norms for Flemish Cap cod (*Gadus morhua*), *Evolutionary Applications* 2(3): 291–298. http://dx.doi.org/10.1111/j.1752-4571.2009.00084.x

PÉREZ-RODRÍGUEZ, A. and M. KOEN-ALONSO. 2010. Standardization of time series for the EU bottom trawl Flemish Cap survey: Estimation of conversion factors between RV Cornide de Saavedra and RV Vizconde de Eza. *NAFO SCR Doc.* 10/22.

PÉREZ-RODRÍGUEZ, A., M. J. MORGAN, R. M. RIDEOUT, R. DOMÍNGUEZ-PETIT and F. SABORIDO-REY. 2011. Study of the relationship between total egg production, female spawning stock biomass and recruitment in Flemish Cap cod (*Gadus morhua*). *Ciencias Marinas* 37(4B): 675–687.

PÉREZ-RODRÍGUEZ, A., M. KOEN-ALONSO and F. SABORIDO-REY. 2012. Changes and trends in the demersal fish community of the Flemish Cap, Northwest Atlantic, in the period 1988-2008. *ICES J. Mar. Sci.* 69(5): 902–912. http://dx.doi.org/10.1093/icesjms/fsr019

PÉREZ-RODRÍGUEZ, A. and F. SABORIDO-REY. 2012. Food consumption of Flemish Cap cod *Gadus morhua* and redfish *Sebastes* sp. using generic bioenergetic models. *NAFO SCR Doc.* 12/68.

PÉREZ-RODRÍGUEZ, A., J. MORGAN, M. KOEN-ALONSO and F. SABORIDO-REY. 2013. Disentangling genetic change from phenotypic response in reproductive parameters of Flemish Cap cod *Gadus morhua*. *Fish. Res.* 138: 62–70. http://dx.doi.org/10.1016/j.fishres.2012.09.004

ROMÁN, E., C. GONZÁLEZ and E. CEBALLOS. 2004. Food and feeding of most abundant fish species in Flemish Cap. *NAFO SCR Doc.* 04/58.

ROMÁN, E., C. GONZÁLEZ and X. PAZ. 2004. Condition and
feeding of Greenland halibut (Reinhardtius hippoglossoides) in Flemish Cap and other areas: 1992–2003. NAFO SCR Doc. 04/60.
SABORIDO-REY, F. and A. VÁZQUEZ. 2003. Results from Bottom Trawl Survey on Flemish Cap of July 2002. NAFO SCR Doc. 03/42.
SABORIDO-REY, F., G. GARABANA, D. and S. Cerviño. 2004. Age and growth of redfish (Sebastes marinus and S. fasciatus) in Flemish Cap (Northwest Atlantic). ICES J. Mar. Sci., 61: 231–242. http://dx.doi.org/10.1016/j.icesjms.2003.11.003
SABORIDO-REY, F., M.J. MORGAN and R. DOMÍNGUEZ. 2004. Estimation of Reproductive Potential for Flemish Cap Cod. NAFO SCR Doc. 04/61.
SABORIDO-REY, F., D. GARABANA, C. STRANSKY, S. MELNIKOV and V. SHIBANOV. 2004. Review of population structure and ecology of Sebastes mentella in the Irminger Sea and adjacent waters. Rev. Fish Biol. and Fish. 14: 455–479. http://dx.doi.org/10.1007/s11160-005-3585-9
STRANSKY, C., C. GUDMUNDSDÓTTIR, T. SIGURDSSON, S. LEMVIG, K. NEDREAAAS and F. SABORIDO-REY. 2003. Age Readings of Sebastes marinus and S. mentella Otoliths: Bias and Precision Between Readers. NAFO SCR Doc. 03/16.
STRANSKY, C., C. GUDMUNDSDÓTTIR, T. SIGURDSSON, S. LEMVIG, K. NEDREAAAS and F. SABORIDO-REY. 2005. Age determination and growth of Atlantic redfish (Sebastes marinus and S. mentella): bias and precision of age readers and otolith preparation methods. ICES J. Mar. Sci. 62: 655–670. http://dx.doi.org/10.1016/j.icesjms.2005.01.018
TOMKIEWICZ, J., J. BURNETT, M.J. MORGAN and F. SABORIDO-REY. 2003. Available information for estimating reproductive potential of Northwest Atlantic groundfish stocks. J. Northw. Atl. Fish. Sci. 33: 1–21. http://dx.doi.org/10.2960/J.v33.a1
VÁZQUEZ, A. 2002. Results from bottom trawl survey on Flemish Cap of July 2001. NAFO SCR Doc. 02/12.
VÁZQUEZ, A. 2002. Catchability comparison between Lofoten and Campelen gears. NAFO SCR Doc. 02/74.
VÁZQUEZ, A. 2007. Evolución de los recursos pesqueros en el área NAFO. p 53–75 In: Canadá y la Unión Europea. Visión multidisciplinar de la gestión pesquera. García-Orellán, R. and X. Santos Solla (eds.). Univ. Santiago de Compostela, 254 pp.
VÁZQUEZ, A. 2009. La pesca española del bacalao en Terranova. Foro Ac. Rec. Mar. Rias Gal. 11: 125–140.
VÁZQUEZ, A. 2010. Results from Bottom Trawl Survey on Flemish Cap of June–July 2009. NAFO SCR Doc. 10/23.
VÁZQUEZ, A. 2011. Validation of Flemish Cap cod ageing. NAFO SCR Doc. 11/28.
VÁZQUEZ, A. 2012. Results from Bottom Trawl Survey on Flemish Cap of July 2011. NAFO SCR Doc. 12/26.
VÁZQUEZ, A. 2012. On recruitment of the Flemish Cap cod stock. NAFO SCR Doc. 12/39.
VÁZQUEZ, A. and S. CERVIÑO. 2002. An assessment of the cod stock in NAFO Division 3M. NAFO SCR Doc. 02/58.
VÁZQUEZ, A. and S. CERVIÑO. 2005. A review of the status of the cod stock in NAFO Division 3M. NAFO SCR Doc. 05/38
VÁZQUEZ, A. and D. GONZÁLEZ TRONCOSO. 2008. Results from Bottom Trawl Survey on Flemish Cap of June–July 2007. NAFO SCR Doc. 08/34.
VÁZQUEZ, A. and R. PIñEIRO. 2008. Using a size indicator based on survey data to evaluate the state of the Flemish Cap ecosystem. NAFO SCR Doc. 08/51
VÁZQUEZ, A. and M. MANDADO. 2012. A stochastic VPA of the Flemish Cap cod stock. NAFO SCR Doc. 12/035.
VÁZQUEZ, A. J.M. CASAS, W.B. BRODIE, F.J. MURILLO, M. MANDADO, A. GAGO, R. ALPOIM, R. BAÑÓN and A. ARMESTO. 2013. List of Species as recorded by Canadian and EU Bottom Trawl Surveys in Flemish Cap. NAFO SCR Doc. 13/005.
WITTHAMES, P.R., A. THORSEN, L.N. GREENWOOD, F. SABORIDO-REY, ROSARIO DOMINGUEZ, H. MURUA, M. KORTA and O.S.KJESBU. 2009. Advances in methods for determining fecundity: application of the new methods to some marine fishes. Fish. Bull. 107(2): 148–164.

Ph Thesis or equivalent
JUAN FRANCISCO SABORIDO REY. 1994. El Género Sebastes Cuvier, 1829 (Pisces, Scorpaenidae) en el Atlántico Norte: identificación de especies y poblaciones mediante métodos morfométricos; crecimiento y reproducción de las poblaciones en Flemish Cap. Universidad Autónoma de Madrid.
SANTIAGO CERVIÑO LÓPEZ. 2004. Estudio de la Incertidumbre Asociada a los Métodos de Evaluación de las Poblaciones de Peces. Universidad de Vigo.
ANTÓNIO ÁVILA DE MELO. 2004. A comparative assessment of beaked redfish (S. mentella and S. fasciatus) in NAFO Division 3M and medium term projections under a low commercial catch/high shrimp fishery by-catch regime. Dissertação para acesso à categoria de Investigador Auxiliar. Instituto Nacional de Investigação Agrária e das Pescas.
DOLORES GARABANA BARRO. 2005. The genus Sebastes Cuvier, 1829 (Pisces, Scorpaenidae) in the North Atlantic: Species and stock discrimination using traditional and geometric morphometrics. Universidad de Vigo.
M CONCEPCIÓN GONZÁLEZ IGLESIAS. 2012. Ecología de la platóia americana (Hippoglossoides platessoides (Fabricius,1780)) en el Atlántico Norte. Universidad de Vigo.
ALFONSO PÉREZ RODRÍGUEZ. 2012. An integrative study to the functioning of the Flemish Cap demersal community. Universidade de Vigo.
NAFO Scientific Council Studies

No. 1. Miscellaneous Selected Papers (101 pages, published March 1981)
No. 2. Manual on Groundfish Surveys in the Northwest Atlantic. W. G. Doubleday, Editor (55 pages, published December 1981)
No. 3. Miscellaneous Selected Papers (82 pages, published April 1982)
No. 4. Special Session on Remote Sensing, September 1981 (98 pages, published September 1982)
No. 5. Symposium on Environmental Conditions in the Northwest Atlantic During 1970–79, September 1981 (113 pages, published December 1982)
No. 6. Miscellaneous Selected Papers (103 pages, published December 1983)
No. 7. Miscellaneous Selected Papers (97 pages, published August 1984)
No. 8. Miscellaneous Selected Papers (95 pages, published April 1985)
No. 9. Special Session on Squids, September 1984 (179 pages, published November 1985)
No. 10. Miscellaneous Selected Papers (112 pages, published August 1986)
No. 11. Miscellaneous Selected Papers (128 pages, published March 1987)
No. 12. Miscellaneous Selected Papers (90 pages, published March 1988)
No. 13. Miscellaneous Selected Papers (82 pages, published November 1989)
No. 14. Miscellaneous Selected Papers (82 pages, published November 1989)
No. 15. Miscellaneous Selected Papers (68 pages, published May 1991)
No. 16. Special Session on Management Under Uncertainties, September 1990 (189 pages, published November 1991)
No. 17. Workbook – Introduction to Sequential Population Analysis (98 pages, published February 1993)
No. 18. Symposium on Changes in Abundance and Biology of Cod Stocks and Their Possible Causes (110 pages, published July 1993)
No. 19. Miscellaneous Selected Papers (98 pages, published October 1993)
No. 20. Miscellaneous Selected Papers (113 pages, published February 1994)
No. 21. Collection of Papers Related to Northern Cod and Seals in NAFO Divisions 2J and 3KL, Papers from June 1993 (165 pages, published December 1994)
No. 22. Miscellaneous Selected Papers (95 pages, published May 1995)
No. 23. Miscellaneous Selected Papers (95 pages, published September 1995)
No. 24. Symposium on Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life (155 pages, published January 1996)
No. 25. Flemish Cap Selected Environmental and Other Papers (91 pages, published July 1996)
No. 26. Selected papers on Harp and Hooded Seals (129 pages, published December 1996)
No. 27. Miscellaneous Selected Papers (81 pages, published December 1996)
No. 28. Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results (105 pages, published December 1996)
No. 29. Selected Studies Related to Assessment of Cod in NAFO Divisions 2J+3KL (125 pages, published May 1997)
No. 30. Miscellaneous Selected Papers (117 pages, published December 1997)
No. 31. Miscellaneous Papers (165 pages, published December 1998)
No. 32. Miscellaneous Papers (133 pages, published April 1999)
No. 33. Miscellaneous Papers (135 pages, published May 2000)
No. 34. Miscellaneous Papers (91 pages, published October 2001)
No. 35 Workshop: The Canada-United States Yellowtail Flounder Age Reading (68 pages, published December 2002).
No. 36 Workshop on Assessment Methods (320 pages, published May, 2003)
No. 37 Working Group on Reproductive Potential (378 pages, published August, 2003)
No. 38 Yellowtail Flounder Ageing Manual (54 pages, published May, 2005)
No. 39 Workshop on Mapping and Geostatistical Methods for Fisheries Stock Assessment (50 pages, published May, 2005)
No. 40 Identification of Wolffish, Hake and rockling in the Northwest Atlantic (7 pages, published 2007)
No. 41 Report of the Greenland Halibut (*Reinhardtius hippoglossoides*) Age Determination Workshop (96 pages, published 2008)
No. 42 Coral Identification Guide NAFO Area (35 pages, published 2009)
No. 43 Sponge Identification Guide NAFO Area (52 pages, published 2010)
No. 44 Report of the Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species (75 pages, published 2012)
Scientific Publications of the
Northwest Atlantic Fisheries Organization

In efforts to reduce paper usage and ensure publications are accessible to all, many publications are available FREE electronically at www.nafo.int.

The NAFO publications listed below are available through the NAFO Secretariat. Prices include postage and handling.

Please note: Pricing for volumes shipped overseas is higher due to increased postage costs.

| Price North America (CAD $) | Price Overseas (CAD $) |
|-----------------------------|------------------------|

Journal of Northwest Atlantic Fishery Science - Available FREE online at www.journal.nafo.int

This publication provides an international forum for the primary publication of original research papers on fisheries science in the Northwest Atlantic, with emphasis on environmental, biological, ecological and fishery aspects of the living marine resources and ecosystems.

Please note: Scientific publications during ICNAF times (1949–1979) are available at the Secretariat in print format and are now available online at www.nafo.int

Vol. 43, 2010-2011 (Regular Issue) ................................................................. 40.00 45.00
Vol. 42, 2009-2010 (The Role of Marine Mammals in the Ecosystem in the 21st Century) ................................................................. 40.00 45.00
Vol. 41, 2008-2009 (Reproductive and Recruitment Processes of Exploited Marine Fish Stocks) ................................................................. 40.00 45.00
Vol. 40, 2008 (Regular issue) ................................................................................................................................. 40.00 45.00
Vol. 39, 2007-2008 (Environmental and Ecosystem Histories in the Northwest Atlantic – What Influences Living Marine Resources?) ................................................................................................................................. 40.00 45.00
Vol. 38, 2007 (Regular issue) ................................................................................................................................. 40.00 45.00
Vol. 37, 2005-2007 (Flemish Cap Symposium) ................................................................................................................................. 40.00 45.00
Vol. 36, 2005-2006 (Regular issue) ................................................................................................................................. 36.00 41.00
Vol. 35, 2005 (Symposium on Elasmobranch Fisheries: Managing for Sustainable Use and Biodiversity Conservation) ............. 46.00 51.00
Vol. 34, 2004 (Mini-symposium on Hydrographic Variability in NAFO Waters for the Decade 1991–2000 in Relation to Past Decades) ................................................................................................................................. 31.00 36.00
Vol. 33, 2003 (Reproductive Potential of Fish Populations of the North Atlantic) ................................................................................................................................. 31.00 36.00
Vol. 32, 2003 (Regular issue) ................................................................................................................................. 31.00 36.00
Vol. 31, 2003 (Joint NAFO/ICES/CSIRO Symposium entitled "Deep-Sea Fisheries") ................................................................................................................................. 41.00 46.00
Vol. 30, 2002 (Regular issue) ................................................................................................................................. 31.00 36.00
Vol. 29, 2001 (Regular issue) ................................................................................................................................. 31.00 36.00
Vol. 28, 2000 (Special Issue on A Review of the Cod Fisheries at Greenland, 1910-1995) ................................................................................................................................. 31.00 36.00
Vol. 27, 2000 (NAFO/ICES/ICES Symposium on Pandalid Shrimp Fisheries – Science and Management at the Millennium) ................................................................................................................................. 41.00 46.00
Vol. 26, 2000 (Regular issue) ................................................................................................................................. 41.00 46.00
Vol. 25, 1999 (Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish) .......... Out of Print
Vol. 24, 1998 (Regular issue) ................................................................................................................................. 26.00 31.00
Vol. 23, 1998 (What Future for Capture Fisheries) ................................................................................................................................. 36.00 41.00
Vol. 22, 1997 (NAFO/ICES Symposium On The Role of Marine Mammals in the Ecosystem) ................................................................................................................................. 31.00 36.00
Vol. 21, 1997 (Regular issue) ................................................................................................................................. 26.00 31.00
Vol. 20, 1996 (Special Issue on North Atlantic Fishery Management Systems: A Comparison of Management Methods and Resource Trends) ................................................................................................................................. 26.00 31.00
Vol. 19, 1996 (Gear Selectivity/Technical Interactions in Mixed Species Fisheries Symposium) ................................................................. 26.00 31.00
Vol. 18, 1996 (Regular issue) ................................................................................................................................. 23.00 28.00
Vol. 17, 1994 (Special Issue on Report of the Canada-USSR Capelin Symposium) ................................................................................................................................. 21.00 26.00
Vol. 16, 1994 (Regular issue) ................................................................................................................................. 21.00 26.00
Vol. 15, 1993 (Special Issue on Decapod Crustacean Larvae from Ungava Bay) ................................................................................................................................. 21.00 26.00
Vol. 14, 1992 (Special Session on Changes in Biomass, Production and Species Composition)................................. 21.00  26.00
Vol. 13, 1992 (Regular issue) ......................................................................................................................... 16.00  21.00
Vol. 12, 1992 (Regular issue) ......................................................................................................................... 16.00  21.00
Vol. 11, 1991 (Regular issue) ......................................................................................................................... 16.00  21.00
Vol. 10, 1990 (Special issue on The Delimitation of Fishing Areas in the Northwest Atlantic) ................................................. 16.00  21.00
Vol. 9, No. 2, 1989 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 9, No. 1, 1989 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 8, 1988 (Regular issue) ......................................................................................................................... 16.00  21.00
Vol. 7, No. 2, 1987 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 7, No. 1, 1986 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 6, No. 2, 1985 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 6, No. 1, 1985 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 5, No. 2, 1984 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 5, No. 1, 1984 (Regular issue) ................................................................................................................ 16.00  21.00
Vol. 4, 1983 (Guide to the Early Stages of Marine Fishes in the Western North Atlantic Ocean, Cape Hatteras to the Southern Scotian Shelf) ............................................................. 26.00  31.00
Vol. 3, No. 2, 1982 (Regular issue) ................................................................................................................ 14.00  19.00
Vol. 3, No. 1, 1982 (Regular issue) ................................................................................................................ 14.00  19.00
Vol. 2, 1981 (Regular issue) ......................................................................................................................... 14.00  19.00
Vol. 1, 1980 (Regular issue) ......................................................................................................................... 14.00  19.00

NAFO Scientific Council Studies - Available FREE online at www.nafo.int

This publication includes papers of topical interest and importance to the current and future activities of Scientific Council.

No. 44, 2011 (Report of the Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species) .................................................. Online only
No. 43, 2010 (Sponge Identification Guide - NAFO Area) .................................................................................. Online only
No. 42, 2009 (Coral Identification Guide - NAFO Area) .................................................................................. Online only
No. 41, 2008 (Report of the Greenland Halibut (Reinhardtius hippoglossoides) Age Determination Workshop) Online only
No. 40, 2007 (Identification of Wolffish, Hake and Rockling in the Northwest Atlantic) ..................................... Online only
No. 39, 2005 (Workshop on Mapping and Geostatistical Methods for Fisheries Stock Assessment) .................... 31.00  36.00
No. 38, 2005 (Yellowtail Flounder Ageing Manual) ............................................................................................ 36.00  41.00
No. 37, 2003 (Working Group on Reproductive Potential) .................................................................................. 41.00  46.00
No. 36, 2003 (Workshop on Assessment Methods) ............................................................................................. 41.00  46.00
No. 35, 2002 (Workshop: The Canada-United States Yellowtail Flounder Age Reading) ........................................ 31.00  36.00
No. 34, 2001 (Regular issue) ......................................................................................................................... 31.00  36.00
No. 33, 2000 (Regular issue) ......................................................................................................................... 31.00  36.00
No. 32, 1999 (Regular issue) ......................................................................................................................... 31.00  36.00
No. 31, 1998 (Regular issue) ......................................................................................................................... 31.00  36.00
No. 30, 1997 (Miscellaneous Selected Papers) ................................................................................................. 26.00  31.00
No. 29, 1997 (Selected Studies Related to Assessment of Cod in NAFO Divisions 2J+3KL) ................................. 26.00  31.00
No. 28, 1996 (Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results) ................................. 26.00  31.00
No. 27, 1996 (Miscellaneous Selected Papers) ................................................................................................. 26.00  31.00
No. 26, 1996 (Selected Papers on Harp and Hooded Seals) ............................................................................... 26.00  31.00
No. 25, 1996 (Flemish Cap Selected Environmental and Other Papers) .............................................................. 26.00  31.00
No. 24, 1996 (Symposium on Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life) .................................................. 26.00  31.00
No. 23, 1995 (Miscellaneous Selected Papers) ................................................................................................. 26.00  31.00
No. 22, 1995 (Miscellaneous Selected Papers) ................................................................................................. 26.00  31.00
No. 21, 1994 (Collection of Papers Related to Northern Cod and Seals in NAFO Divisions 2J and 3KL) ............ 26.00  31.00
No. 20, 1994 (Miscellaneous Selected Papers) ................................................................................................. 26.00  31.00
No. 19, 1993 (Miscellaneous Selected Papers) ................................................................................................. 21.00  26.00
No. 18, 1993 (Symposium on Changes in Abundance and Biology of Cod Stocks and Their Possible Causes) .... 21.00  26.00
No. 17, 1993 (Workbook: Introduction to Sequential Population Analysis) ......................................................... 18.00  23.00
No. 16, 1991 (Special Session on Management Under Uncertainties, 5–7 September 1990) ............................... 21.00  26.00
No. 15, 1991 (Miscellaneous Selected Papers) ................................................................................................. 18.00  23.00
No. 14, 1990 (Miscellaneous Selected Papers) ................................................................................................. 18.00  23.00
### NAFO Scientific Council Reports - Available FREE online at www.nafo.int

This publication contains reports of Scientific Council Meetings held through each year since NAFO replaced ICNAF. (The comparable publication during ICNAF was entitled the *Redbook*).

| Year       | Date of Issue       | Price 1 | Price 2 |
|------------|---------------------|---------|---------|
| 2011       | April 2012          | $36.00  | 41.00   |
| 2010       | April 2011          | $36.00  | 41.00   |
| 2009       | May 2010            | $36.00  | 41.00   |
| 2008       | May 2009            | $36.00  | 41.00   |
| 2007       | May 2008            | $36.00  | 41.00   |
| 2006       | May 2007            | $36.00  | 41.00   |
| 2005       | May 2006            | $36.00  | 41.00   |
| 2004       | January 2005        | $36.00  | 41.00   |
| 2002/2003  | August 2003         | $31.00  | 36.00   |
| 2001       | January 2002        | $31.00  | 36.00   |
| 2000       | January 2001        | $29.00  | 34.00   |
| 1999       | January 2000        | $29.00  | 34.00   |
| 1998       | January 1999        | $26.00  | 31.00   |
| 1997       | January 1998        | $23.00  | 28.00   |
| 1996       | January 1997        | $23.00  | 28.00   |
| 1995       | January 1996        | $23.00  | 28.00   |
| 1994       | January 1995        | $21.00  | 26.00   |
| 1993       | January 1994        | $21.00  | 26.00   |
| 1992       | December 1992       | $18.00  | 23.00   |
| 1991       | December 1991       | $16.00  | 21.00   |
| 1990       | December 1990       | $14.00  | 19.00   |
| 1989       | December 1989       | $14.00  | 19.00   |
| 1988       | December 1988       | $12.00  | 17.00   |
| 1987       | December 1987       | $12.00  | 17.00   |
| 1986       | December 1986       | $12.00  | 17.00   |
| 1985       | December 1985       | $12.00  | 17.00   |
| 1984       | December 1984       | $12.00  | 17.00   |
| 1983       | December 1983       | $12.00  | 17.00   |
| 1982       | December 1982       | $12.00  | 17.00   |
| 1981       | December 1981       | $12.00  | 17.00   |
| 1979–80     | December 1980       | $12.00  | 17.00   |
Early Stages of Fishes in the Western North Atlantic Ocean (Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras)

This comprehensive scientific publication is the only up-to-date textbook providing detailed descriptions and accurate drawings of the early life-history stages of the fishes from the Northwest Atlantic Ocean north of 35°N and west of 40°W. The region covers the world’s most famous fishing grounds and includes the Davis Strait, southern Greenland, Flemish Cap, Georges Bank, northern Sargasso Sea and Middle Atlantic Bight to Cape Hatteras.

Hardcover 2-Volume Edition by Michael. P. Fahay.......................................................... 120.00 135.00

Identification of Wolffish, Hake and Rockling in the Northwest Atlantic

1-page Identification Guide produced in full-colour on laminated stock ......................................................... 10.00 15.00

Sponge Identification Guide NAFO Area

Coral Identification Guide NAFO Area (full-colour on waterproof stock) .................................................. 30.00 35.00

Coral Identification Guide NAFO Area

Coral Identification Guide NAFO Area (full-colour on waterproof stock) .................................................. 25.00 30.00
Information for Preparing Manuscripts for NAFO Scientific Publications

Journal of Northwest Atlantic Fishery Science

The Journal is for the primary publication of original practical and theoretical research that is unpublished and is not being submitted for publication elsewhere. While it is intended to be regional in scope, papers of general applicability and methodology may be considered. Space is also provided for notes, letters to the editor and notices. Each paper is assigned to an Associate Editor of the Journal’s Editorial Board, and is normally reviewed by two referees regarding suitability as a primary publication.

NAFO Scientific Council Studies

The Studies publishes papers which are of topical interest and importance to the current and future activities of the Scientific Council, but which do not meet the high standards or general applicability required by the Journal. Such papers have usually been presented as research documents at Scientific Council meetings and nominated for publication by the Standing Committee on Publications. Studies papers are not peer reviewed.

Content of Paper

The paper should be in English. The sequence should be: Title, Abstract, Text, References, Tables and Figures.

Title

The paper should start with the title, followed by the name(s), address(es) and emails of the author(s) including professional affiliation, and any related footnotes.

Abstract

An informative concise abstract should be provided along with key words listed alphabetically.

Text

In general, the text should be organized into Introduction, Materials and Methods, Results, Discussion, and Acknowledgements. Authors should be guided by the organization of papers that have been published in the NAFO Journal or Studies.

Introduction should be limited to the purpose and rationale of the study.

Materials and Methods should describe in sufficient detail the materials and methods used, so as to enable other scientists to evaluate or replicate the work.

Results should answer the questions evolving from the purpose of the study in a comprehensive manner and in an orderly and coherent sequence, with supporting tables and figures.

Discussion should explain the main contributions from the study, with appropriate interpretation of the results focusing on the problem or hypothesis. Comparisons with other studies should be included here.

Acknowledgements should be limited to the names of individuals who provided significant scientific and technical support, including reviewers, during the preparation of the paper, and the names of agencies which provided financial support.

References

The references cited in the text should be listed alphabetically. References should be mainly restricted to significant published literature. Unpublished documents and data, papers in preparation, and papers awaiting acceptance to other journals, may be cited with full contact addresses as unpublished or personal communications.

Examples:

KING, M. 1995. Fisheries biology, assessment and management. Fishing News Books, UK, 341 p.

CROWDER, L. B., and S. A. MURAWSKI. 1998. Fisheries by-catch: implications for management. Fisheries, 23: 8–16. doi:10.1577/1548-8446(1998)023<0008:FBIFM>2.0.CO;2

ÁVILA DE MELO, A. M., D. POWER, and R. ALPOIM. MS 2005. An assessment of the status of the redfish in NAFO Division 3LN, NAFO SCR Doc., No. 52, Serial No. 5138, 19 p.

Text citations of the above would be (King, 1995; Crowder and Murawski, 1998; Ávila de Melo et al., MS 2005). The surnames of two authors may be used in a citation, but et al. should be used for more than two authors. The citation of mimeographed reports and meeting documents should contain the abbreviation “MS”. Abbreviations of periodicals can be found ftp://ftp.fao.org/fi/asfa/Monitoring_List/MASTER.txt. The Digital Object Identifier (doi) should be included if available. http://www.crossref.org/freeTextquery/ can be used to checked this.

Tables and Figures

All Tables and Figures must be cited in the text. Tables and Figures must be numbered consecutively and correspond with the order of presentation in the text. Figure captions should be included as a separate page. Each table and figure should have a complete concise descriptive caption. Figures should always be submitted in black and white. Colour plots and photographs are acceptable only if colour is essential to the content. Preferably, all figures should be submitted as separate files in .eps or .ps format. Photographs, maps and contour plots can also be submitted in high quality .jpg format.

If using excel, open the files in R and save the graphs by right clicking and saving as metafiles or postscript files. If using SlideWrite copy the files as Metafiles (WMF). Do not save them as bitmap files. They are not editable.

Paper Submission

Papers should be submitted by email to Dr. Neil Campbell, General Editor, at journal@nafo.int or ncampbell@nafo.int