DEEPFISHMAN

A FP7 Project: Management and Monitoring of Deep-sea Fisheries and Stocks

WP2 – Case Study 5 Report
Greenland halibut (*Reinhardtius hippoglossoides*) NAFO Subarea 2 and Divisions 3KLMNO

Contents

[1] For a definition of VMEs please see FAO TECHNICAL CONSULTATION ON INTERNATIONAL GUIDELINES FOR THE MANAGEMENT OF DEEP-SEA FISHERIES IN THE HIGH SEAS Rome, 4–8 February and 25–29 August 2008 ftp://ftp.fao.org/docrep/fao/011/i0605t/i0605t00.pdf

Executive Summary

Section 1: Biological parameters with up to date description of the current knowledge of life history pattern, stock structure and status.

Despite the big scientific research effort made in the study of the population structure of this species en the North Atlantic and more in particular in the NAFO Area, still is not clear what is the stock structure and the relationship of the different management units and how these uncertainties affect the assessment. It would be necessary to revise all the scientific work made in this field and try to clarify what is the stock structure and the relation between the different stocks present in NAFO waters.

It is not clear the Greenland halibut spawn and recruitment process. The reasons for this variability and complexity in reproduction and the implications for stock reproductive potential are unknown. To solve this problem and to understand and clarify the reproductive potential of the Greenland halibut a joint research project between Canada and Spain have started in 2009.

There are some aging problems in this species and the last studies show that there is an age underestimation and that this problem is bigger in the older ages. It is not know how these ageing problems affect the actual assessment. To solve the aging problems there are some on going initiatives as aging workshops and tagging programs.

Section 2: Historical development of the fisheries, including catches and fleets.

Before 1960 there was a small Canadian long-line fishery with low catch levels, less than 1000 tons. In 1960 started a new Canadian gillnet fishery persecuted Greenland halibut in Newfoundland bays. In 1966-1967 the Greenland halibut by catch in the international trawl redfish and grenadiers fisheries (mainly URSS, Poland and GDR fleets) started to increase significantly as consequence of the increase of the trawl depth in these fisheries and catches increased at the 35.000 tons level. In 1974 was established a quota for this resource by ICNAF to try to regulated this fishery. In 1989-1990 an intensive trawl fishery for Greenland halibut developed in deepwater's of Division 3L and 3M. The development of this new fishery quickly resulted in increased catches to about 47.000 tons in 1990. The major participants in this new fishery were EU Spain and Portugal. TACs prior to 1995 in this fishery were set autonomously by Canada since 1995 TACs have been established by Fisheries Commission for all Greenland halibut Subarea 2 and Divisions 3KLMNO stock. In 2004, as consequence of the declined of the biomass and catches NAFO established a Recovery Plan for this stock.

The most important fleet in the fishery is the trawl fleet. Around 60 frozen trawlers worked in the NRA in the last years. These trawlers have more than 800 GTR and use a gear with 130 mm minimum mesh size. The most important countries for trawlers are Spain, Portugal, Russia, Canada and Japan.

The other important fleet is the Canadian gillnet fleet. This fleet work in side the Canadian waters and is made by vessels less than 200 GTR using different mesh size gillnets (152-191 mm).

Section 3: Review of stock assessments carried out thus far

An analytical assessment using Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2007), and autumn (Div. 2J, 3K; 1996-2007) and the EU (Div. 3M; 1995-2007) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.2 for all ages. The exploitable biomass has been declining in recent years and the current estimates (2004-2007) are amongst the lowest in the series. Recent recruitment has been far below average, and fishing mortality, although decreasing, remains high.

The major problems with the assessment are the uncertainty in the results and the contradiction between these results and the commercials CPUEs. NAFO Scientific Council held an assessment methods working group to try to reduce the uncertainty in the results with other models. The conclusion was that more than a model problem it seems to be an input data quality. Models including the commercial CPUE information have more or less the same results and problems. New working groups will carry out during 2010 to try to solve these assessment problems and to implement the MSE to cover the uncertainty in the assessments results.

Section 4: Data inventory

In NAFO there are different types of fishery data: the official STATLANT 21 A and B data that is the data use by the Fisheries Commission for different things, STACFIS catch data that it is the catch data with the Scientific Council make the assessment, NAFO Observers data that have different official and scientific uses, the National Scientific Observers data with biological information and the VMS data that is the data for control and can be used by SC under certain restrictions. The STATLANT have not confidentially restrictions and can be split by countries. All the other data have some confidentially restrictions. One of the major problems is the quality of the fisheries data and the confidentiality problems with them.

Fisheries-independent survey data: A single survey series which covers the entire stock area is not available. A subset of standardized (depth and area) stratified random survey indices have been used to monitor trends in resource status.

Biological data for your stock: There are enough biological data available for this stock to carry out an analytical assessment. One of the problems is the inconsistency of the data available and the ageing problems to know the age composition of the catches. To solve these problems (age, maturity, etc) some working groups were carried out and it is planned to carry out in the future.

Data available in support of ecosystem based management: NAFO Scientific Council has established a Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) to implement the ecosystem based management. Most of the ecosystem information available is based on surveys but it is planned to expand this information to the fisheries.

Socio-economic data: In the Spanish and Portugues case, most of the socio economic data have been extracted from the National official statistic and are aggregated. It would be necessary to have a clear economy data base for each fishery or fleet to study the economics effects of the management measures in each fishery.

Section 5: Review of known and likely impact of the fisheries on deep-water biodiversity and VMEs.

Since 2007 the submarine mounts as VME are close to the trawl fisheries in the NRA. NAFO continues to take steps to protect vulnerable marine ecosystems by establishing coral and sponge protection zones since 2010 in addition to closures already made in previous years. As well, protocols have been devised to minimize catches of PET species. It is recognized that there are numerous international scientific research efforts underway to enhance the knowledge on benthic habitat, communities and species in the NAFO Regulatory Area, particularly the Spanish led an international survey in 2009-2010 (NEREIDA). The main objective of NEREIDA project is focused on the implementation of the Ecosystem Approach to the fisheries management in order to identify Vulnerable Marine Ecosystems (VMEs).

Section 6: Review of current and historical management and monitoring procedures.

NAFO Fisheries Commission is in charge of the Conservation and Enforcement Measures in NRA. All these conservation and enforcement measures are collected in the *Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures. NAFO/FC Doc. 09/1*. These measures are applied at different levels and are mandatory for all NAFO countries.

Current/short term (<5 yrs) most important management issues for this stock are: the recovery plan, the quality of the input data, the ageing and maturity problems and the Management Strategies Evaluation (MSE). All these concerns are now addressed by the NAFO Scientific Council.

Long-term (>5 yrs) most important management issues for this stock are: the Recovery Plan and the MSE. All these concerns are now addressed by the NAFO Scientific Council.

The most important issue in this moment to NAFO as Regional Fishery Organization is to implement the Management Ecosystem Approach. This is now addressed by the NAFO Scientific Council WGEAFM.

Section 1: Biological parameters with up to date description of the current knowledge of life history pattern, stock structure and status

1.1 General information

1.1.1 Name of stock:

Greenland halibut (*Reinhardtius hippoglossoides*) NAFO Subarea 2 and Divisions 3KLMNO.

1.1.2 Please include map of the spatial area inhabited by your stock (include depth contours and topographical features).

Figure 1.1 shows the NAFO Subarea 2 and 3 map with the most important topographical features.

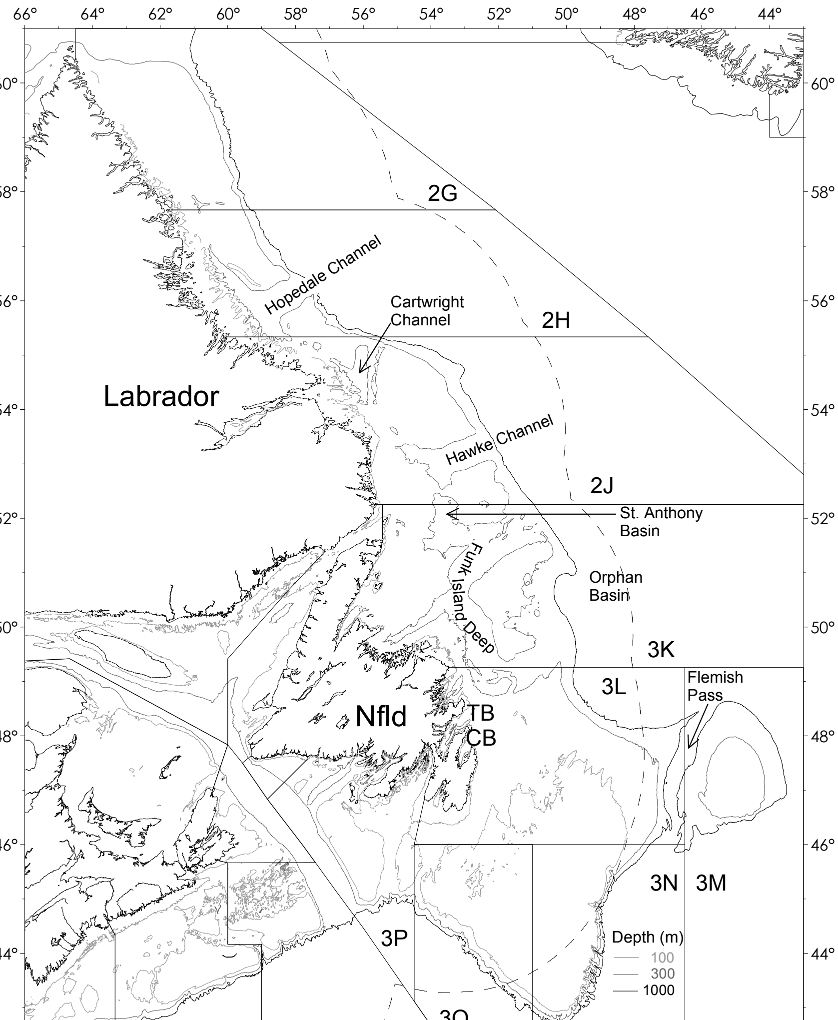

Figure 1.1 .- NAFO Subarea 2 and 3 map.

Figure 1.2 presents the distribution of the Greenland halibut stock biomass in the Canadian fall survey (Kulka, 2001).

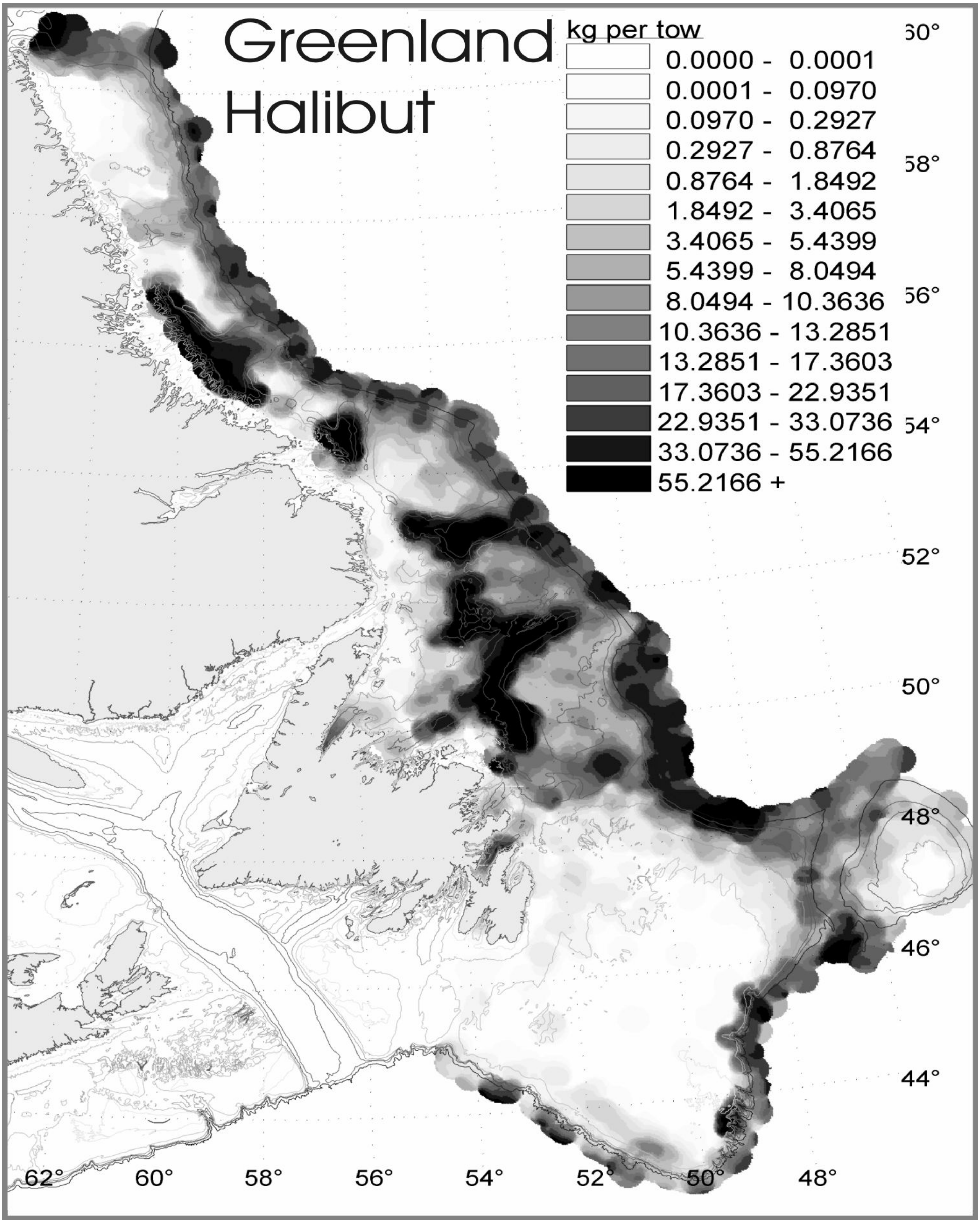

Figure 1.2.- Distribution of Greenland halibut based on fall surveys. Upper figure shows the entire surveyed area (Kulka, 2001).

1.1.3 What is the depth range inhabited by the adult stock?

It is a deepwater species with higher densities occurring in depths of about 500–1200 m along the edge of the continental slope and the channels running between the fishing banks of the continental shelf as well as the deep inshore bays of eastern Newfoundland and the fjords of Greenland and Baffin Island. In recent years, with advances in modern fishing technology, it has been found to be commercially abundant in some areas as deep as 1500–1800 m, particularly in the proximity of the Sackville Spur and Flemish Pass, immediately east of the Grand Banks (Bowering and Brodie 1995) and has been caught in long-line investigations as deep as 2200 m off West Greenland (Boje and Hareide 1993) and the Flemish Cap (de Cardenas et al. 1996). The species is also of commercial importance in the Gulf of St. Lawrence and exists in limited quantities along the south Newfoundland coast, Fortune Bay, and in the Laurentian Channel (Morgan *et al.,* 1997).

1.1.4 Name the scientific organisation and Working Group responsible for carrying out stock assessments and providing scientific advice.

Northwest Atlantic Fisheries Organization (NAFO) Scientific Council.

1.1.5 Name the Fisheries Management Organisation(s) responsible for managing the stock and supported fisheries.

NAFO

1.1.6. Is the management unit the same as the stock assessment unit? If not please explain why.

There are four main Greenland halibut populations in the north Atlantic. These are in the Gulf of St. Lawrence (NAFO Divisions 4RST), off eastern Canada and west Greenland (NAFO Subareas 0, 1, 2 and Divisions 3KLMNO), the east Greenland, Iceland and Faroe Islands population (ICES Subareas V and XIV) and the north east Arctic population (ICES Subareas I and II). Although considered to be a single population, the Greenland halibut off eastern Canada and west Greenland in the offshore are managed as two separate stocks: NAFO Subarea 0 and 1 and Subarea 2 + Divisions 3KLMNO (Morgan *et al.,* 2001).

1.2 Stock identity and status

1.2.1 Describe and review the scientific basis used to identify and delineate the stock.

There are many studies about the Greenland halibut population structure. In the Table below we can see the different methods used to study the population structure and their publication. Is difficult for us review this information because all participants in this case study are more related with the assessment.

Stock structure of Greenland halibut in the Northwest Atlantic has been studied using a variety of methods (e.g., protein electrophoresis (Fairbairn 1981), parasites (Khan et al. 1982; Arthur and Albert 1993), morphometrics (Bowering 1988), meristics (Misra and Bowering 1984; Riget et al. 1992), and tagging (Bowering 1984; Riget and Boje 1989). These data suggest that Greenland halibut comprise a single self-sustaining stock from Davis Strait to the Grand Bank and Flemish Cap (Bowering and Chumakov 1989). Greenland halibut in the Gulf of St. Lawrence are believed to be a separate, relatively small, self-sustaining stock, which receives migrants from the Labrador area through the Strait of Belle Isle between Quebec and the island of Newfoundland (Bowering 1982). The major spawning location of Greenland halibut in the western Atlantic is in the deep slope area of Davis Strait along the boundary between Canada and Greenland (Smidt 1969; Templeman 1973; Chumakov 1975; Bowering 1983). However, with research activity on Greenland halibut expanding to very deep water, complemented by commercial fishing operations, additional information on spawning locations is becoming available. Fish in spawning condition have recently been reported from the deep slope area off the coasts of Labrador and northeastern Newfoundland by domestic gillnetters (Morgan and Bowering 1997) to as far south as Flemish Pass (Junquera and Zamarro 1994; Morgan and Bowering 1997). It is not clear whether this is a change in behaviour or a typical behaviour that has not been previously observed, although major shifts in Greenland halibut distribution have been recorded in recent years. Apparent changes in behaviour have been reported also for other flatfish species in this area such as witch flounder and American plaice (*Hippoglossoides platessoides*). The extent of Greenland halibut spawning in the area of the continental slope off eastern Canada has been discussed in Morgan and Bowering (1997).

All the previous information support the biological stock complex (NAFO Subareas 0, 1, 2 and 3) but not the assessment stock (NAFO Subareas 2 and Div. 3KLMNO). Probably the reasons to split the biological stock in assessment stocks were more administrative than biological.

1.2.2 Is this robust? If not what studies are required to identify and delineate the stock more robustly?

Our opinion is that this is not robust and it would be necessary to review all the methods and data from all actual Northwest Greenland halibut stocks.

1.2.3 Describe and review any past or ongoing studies of stock identity.

There are many studies about the Greenland halibut population structure. In Table 1.1 we can see the different methods used to study the population structure and their publication. Is very difficult review for us these studies because we are not specialist in these matters. In the following paragraphs you can found a resume of these studies. The review of these studies was made in the 1.2.1 point of this report.

METHOD USED	REFERENCE
UNIVARIATE ANALYSIS OF MERISTICS	TEMPLEMAN (1970)
FECUNDITY VARIATIONS	BOWERING (1980)
PROTEIN ELECTROPHORESIS	FAIRBAIRN (1981)
BLOOD PROTOZOA AS BIOLOGICAL TAGS	KHAN ET AL. (1982)
SEXUAL MATURITY AND DISTRIBUTION PATTERNS	BOWERING (1983), BOWERING & CHUMAKOV (1989)
EXTERNAL TAGGING STUDIES	BOWERING (1984)
MULTIVARIATE ANALYSIS OF MERISTICS	MISRA & BOWERING (1984)
MULTIVARIATE ANALYSIS OF MORPHOMETRIC DATA	BOWERING (1988)
EXTERNAL TAGGING STUDIES	RIGET & BOJE (1989)
MERISTICS AND PROTEIN ELECTROPHORESIS	RIGET ET AL. (1992)
EXTERNAL TAGGING STUDIES	BOJE (1994)
PARASITIC INFESTATION RATES	ARTHUR & ALBERT (1993)
HELMINTH PARASITE INFESTATION RATES	BOJE ET AL. (1997)
MITOCHONDRIAL DNA	VIS ET AL. (1997)
MERISTICS	RASMUSSEN ET AL.

Table 1.1.- Methods used to study the Greenland halibut population structure and their references.

1.2.4 Are there any stocks of this species adjacent to the Case Study stock?

Greenland halibut in the Northwest Atlantic are managed according to a system of statistical Subareas and divisions established by the Northwest Atlantic Fisheries Organization (NAFO). According to this system the Northwest Atlantic is managed as four separate units: (1) Baffin Island-West Greenland (NAFO Subarea 0, Division 1A-offshore, and Divisions 1C-F); (2) West Greenland Inshore (NAFO Division 1A-inshore); (3) Labrador-eastern Newfoundland (NAFO Subarea 2 and Divisions 3KLMNO); and (4) Gulf of St. Lawrence (NAFO Divisions 4RST) (Bowering and Chumakov, 1989; Bowering and Brodie, 1995).

1.2.5 Is it suspected that immigration/emigration is occurring from/to areas outside the stock area? If so please describe.

It would be probably immigration in the Greenland halibut NAFO Subarea 2 and 3 from other areas because for certain ages in certain years appear more abundance than we can expected by the survey and catch information in precedent years. But this has not been demonstrated by biological studies.

Other sign of mixing individuals between North Atlantic populations is the genetic and tag information presented by Morgan *et al.*, 1997.

1.2.6 Have any tagging studies been carried out? If not please state why. If they have please summarise methods used and review results and conclusions. **See point 1.2.1**

Migratory patterns of Greenland halibut in the Northwest Atlantic were investigated by two tagging experiments in 1969 and 1971 using longlines to capture the fish and three experiments in 1979-80 using otter trawls (Bowering, 1984). Results of the White Bay experiment in 1969 showed some movement of Greenland halibut from tagging area to offshore deepwater areas of Labrador and Davis Strait, although many of the recaptures were in the general area of tagging. However, the Trinity Bay and Fortuna Bay experiments in 1971 and 1979 respectively indicated little movements from the tagging sites. The Funk Island Bank experiments in 1979 and 1980 indicated substantial movement to coastal waters of north-eastern Newfoundland in summer, but tags were also recovered both south and north of tagging areas, the most northerly of the latter from the northern edge of Hamilton Bank. From tagging experiments off Labrador in 1980, the few returns indicated eastward movement to the deepwater areas of the continental slope, with one recapture from deep water off the northern tip of Labrador.

Length frequencies at different places in the West Greenland were studied by Riget and Boje, 1989. In the study are, results seem to indicate that as they grow they migrate deeper, both to the fjords and the continental slope in the Davis Strait. Recaptures from tagging experiments in the inshore area have all been near the tagging site, except for two examples of long distance migrations. The recapture rates are show to be independent of the length of fish.

1.2.7 Are there any aspects of stock identity knowledge data that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

In case of existing migration this effect could have a big impact on the actual assessment. One of the major problem in the actual assessment is the lack of cohorts tracking in the input data. Probably this lack of track is related with the stock identity.

1.2.8 Based on the latest scientific advice for this stock (please append below), what is the current status of the stock?

Figure 1.3 presents the assessment results (2008) of the NAFO Subarea 2 and Div. 3KLMNO Greenland halibut stock for F_{bar} , 5+ biomass and recruitment. The exploitable biomass has been declining in recent years and the 2004-2008 estimates are amongst the lowest in the series. Recent recruitment has been far below average, and fishing mortality, although decreasing, remains high.

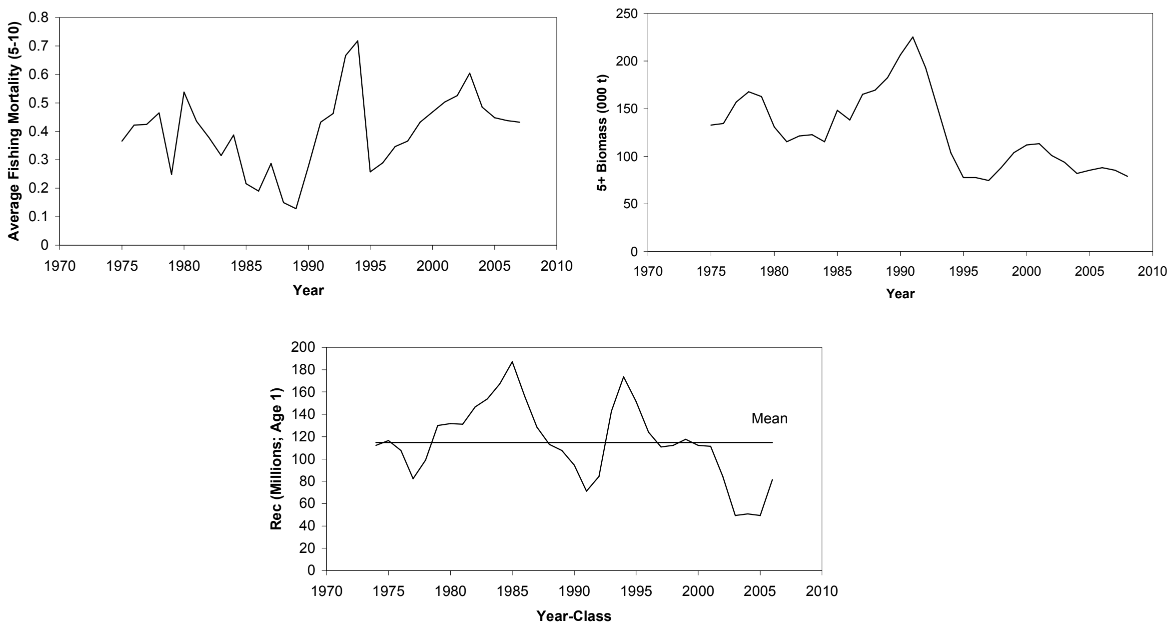

Figure 1.3.- NAFO Subarea 2 and Div. 3KLMNO Greenland halibut stock Fbar , 5+ biomass and recruitment based on the 2008 assessment (Healey and Mahe, 2008).

1.2.9 What is the recent historical trend in the stock (increasing, decreasing, stable).

Decreasing-stable at low level

1.3 Life history characteristics (LHCs)

1.3.1 Complete the following table citing (1) the most robust information available and (2) any other information available. Please cite the reasons for selecting the former. Cite information by sex & sexes combined, where appropriate. Please document any changes with time.

Table 1.2 presents the Greenland halibut life history characteristics.

LHC	Best estimate	Derived from?	Other estimates
Maximum observed length	120 cm	IEO Data base	
Maximum observed age	23	IEO Data base	
Length at 50% maturity	M (62 cm) F (78 cm)	Morgan and Rideout, 2007	F(64.5-69.5 Junquera *et al.*, 1999.
Age at 50% maturity	M(10 y.) F(12.7 y.)	Morgan and Rideout, 2007	
Length at recruitment	25-30 cm.	De Cardenas *et al.* 1997	

Age at recruitment to fishery	4-5 years old	Catch at age matrix	
Growth parameters: (von Bertalanffy parameters: B_0,T_0, L infinity, for example)	Males : L_{inf} = 249 ; t_0 = -1.89 ; K = 0.024 Females : L_{inf} = 278 ; t_0 = -1.52 ; K = 0.022	Bowering and Nedreaas, 2001	
Fecundity, egg size etc	15 000 and 158 000 eggs per female.	Junquera *et al.,* 1999	
Natural mortality	0.2	Assessment data	

Table 1.2.- Greenland halibut life history characteristics, their best estimations and references.

For maximum length and age data were derived from the IEO data base (1992-2008).

1.3.2 What are the main gaps in knowledge regarding LHCs?

Natural mortality and aging problems. The natural mortality value used in the assessment have not a clear biological sense. The Greenland halibut MSE have a operating model with natural mortality 0.1 to study the different between both assumptions.

1.3.3 Can these gaps be addressed by regular monitoring or are dedicated research initiatives required? Please describe programmes required.

To solve the aging problems there are some on going initiatives as methodology studies, aging workshops and tagging programs. To solve the uncertainty in the Natural mortality no initiatives are taking, only in the MSE different operating models.

1.3.4 Are there any aspects of LHC data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

The major impact of the wroth, aging and Natural mortality problems is the uncertainty in the assessment results.

1.4 Life history pattern and general species ecology

1.4.1 Reproductive type: is the species gonochoric or hermaphroditic? If hermaphroditic, please describe.

Gonochoric

1.4.2 Spawning type: is the species a determinate or batch spawner? Please give details.

Greenland halibut appear to have a peak and secondary spawning period with some fish in spawning condition being found in most months (Fedorov, 1971; Junquera, MS 1994; Junquera and Zamarro, 1994). It is not clear whether Greenland halibut spawn a single batch of eggs or multiple egg batches. Estimates of maturity at age and size in this population are highly variable and indicate that Greenland halibut in the SA 2 + Div. 3KLMNO area mature at a larger size than those in other populations throughout the north Atlantic (Fedorov, 1971; Morgan et al., 2003). The occurrence of immature fish at large size also appears to be common (Fedorov, 1971; Jorgensen and Boje, MS 1994; Morgan and Bowering, 1997).There is some evidence that this species may not spawn every year (Junquera et al., 2003). The reasons for this variability and complexity in reproduction and the implications for stock reproductive potential are unknown.

1.4.3 Spawning grounds: are the spawning grounds/areas known? If so please describe and include map.

Figure 1.4 shows the map with the Greenland halibut spawning and nursery areas. In the north-west Atlantic, Greenland halibut are thought to spawn mainly in the Davis Strait at about 67ºN at depths of 600 to 1000 m (Smidt, 1969), although fish in spawning condition have been observed elsewhere (Riget et al., 1992; Junquera and Zamarro, 1994). Historic data suggest a general increase in the proportion of mature fish in each length group from south to north, which is believed to result from mature fish migrating north to the main spawning area (Bowering, 1983).

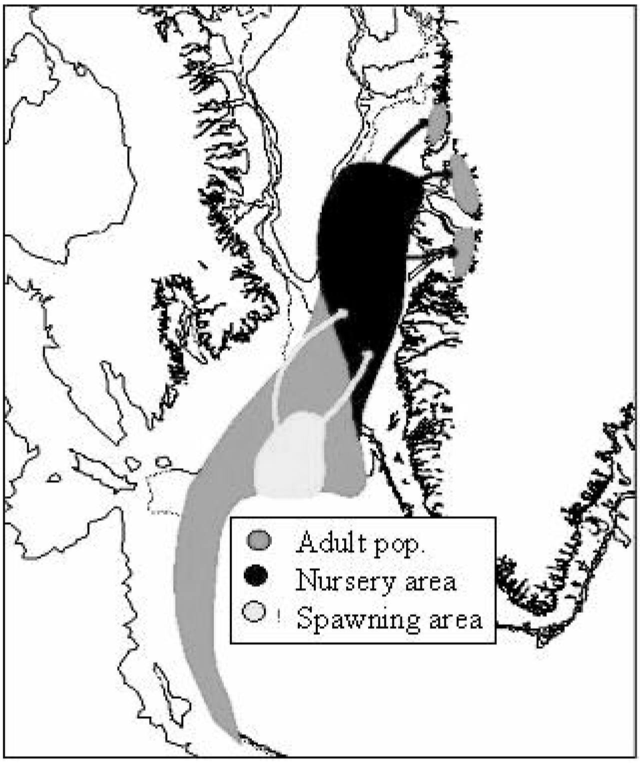

Figure 1.4.- Off eastern Canada and west Greenland (NAFO Subareas 0, 1, 2 and Divisions 3KLMNO) Greenland halibut population nursery and spawning areas. (Workshop on Greenland halibut biology and population dynamics, 2002)

1.4.4 Spawning time: when does spawning occur? Does this differ by spawning ground/area? If so please describe.

Up to now what was known about the Greenland halibut reproductive biology suggested the possibility that this species does not match the perception of a regular annual cycle of sexual maturity. Morgan and Bowering (1997) pointed out irregularities in the maturation process in the Northwest Atlantic Greenland halibut, possibly caused by variability in the distribution of adult fish, that hinders a precise estimation of maturity at age and size. Also, high variability in the main spawning seasons among areas and even within the same area is extensively documented. There is also evidence of some spawning outside of a single spawning season with fish often found in spawning condition throughout the year (Federov, 1971; Junquera and Zamarrro, 1994; Sigurdsson, MS 1977).

1.4.5 Early life history: are the early life stages well described and documented in the scientific literature? If so please describe.

The early life history was described by Stenberg, 2007. Davis Strait was the only major spawning area in West Greenland. Larvae distribution and growth of Greenland halibut and Sandeel (*Ammodytes sp.*) was studied across the West Greenland shelf. Results showed that in May small Greenland halibut larvae, some still with small remains of the yolk-sac, were primarily distributed offshore in Davis Strait. Their distribution coincided with their prey resources while some vagrant larvae were dispersed to areas with less food, which likely resulted in higher mortality rates. Consequently, the emergence of first feeding Greenland halibut larvae matched their prey in time and space which is believed to be crucial for survival success at this critical stage in their development. From June to July Greenland halibut larvae gradually shifted their distribution from the bank slopes to the deeper parts of the slope near the shelf break. The lack of clear and well-defined frontal zones made it difficult to evaluate the hydrographical processes that had significance for larval distribution patterns. Greenland halibut larvae did, however, show preference for stratified water masses. Growth analysis of Greenland halibut larvae was only possible for July and showed higher growth was observed at stations positioned in frontal zones suggesting that growth was significantly influenced by the level of frontal activity. The study also included distribution and growth comparisons with sandeel.

Results showed that egg and larvae can drift for long distances and that the exchange of individuals among the geographically-separated sub-populations could be important for metapopulation dynamics. Larvae from the spawning area in Davis Strait were primarily (>60%) transported to Canadian waters. Only larvae from the eastern part of the spawning area in Davis Strait remained in West Greenland. All larvae from the

East Greenland spawning area were transported south of Cape Farewell and to West Greenlandic (82%) or Canadian (18%) waters. From the West Icelandic spawning areas larvae either, depending on the spatial location on the emergence first feeding larvae, drifted to East Greenland (45-53%), West Greenland (19−34%) or Northern Iceland (21−28%) or remained (>98%) in Iceland waters. In Baffin Bay low water temperatures resulted in very slow development rates and eggs probably never hatched. The surveys showed that in West Greenland larvae settling started in August and continued in September but the settling peak period could not be determined. The study in the two areas of Hellefisk Bank showed that juveniles of age 1 and 2+ almost exclusively occurred in one area while the 0-group was equally distributed in both areas. In the area of high juvenile age 1 and 2+ abundance the condition and stomach fullness was significantly higher than in the low abundance areas. Nursery ground processes within the first year clearly restricted the successful nursery area to a more specific bottom habitat types. The concentrating of juveniles into specific nursery areas implies that juvenile densities may approach the carrying capacity of their habitats in years when settlement is high, which would dampen the annual variability in year class strength of Greenland halibut.

1.4.6 Life stages and habitats: whereabouts in the water column are the various life cycle stages found?

The vertical depth distribution of the yolk sac larvae was examined by Jensen (1935) and Stenberg (2007). Jensen concluded that yolk sac larvae are located between 600 and 1000 m of depth and hypothesised that yolk sac larvae are bathypelagic and gradually rise towards the surface as they utilize the yolk. Even though the same areas in Davis Strait, only a few specimens were found at the 400-800 depth strata with the highest concentrations being in the surface layers (<100 m). Jensen's hypothesis, however, cannot be rejected as larvae caught in the Stenberg (2007) study were actively feeding indicating that they was in a more progressed ontogenetic stage than the larvae Jensen reported and would therefore, in accordance with Jensens hypothesis, also be distributed in shallower depths. The pelagic larval phase ends when larvae metamorphose and settle. This occurs when larvae reach a size of approximately 65-70 mm (Stenberg, 2007).

1.4.7 Nursery areas: are there discrete nursery areas? Is so please describe and include map.

Figure 1.4 presents the Off eastern Canada and west Greenland (NAFO Subareas 0, 1, 2 and Divisions 3KLMNO) Greenland halibut population nursery and spawning areas. Recent years research has supported Adolf Jensen's pioneer work. Consequently, the prevailing theory on the reproductive cycle of the Greenland halibut stock complex in the Davis Strait is that spawning seems to take place in deeper waters (approximately 800-2000 meters depths) over an extended area from Davis Strait, south of 67ºN (Jensen 1935; Smidt 1969; Jørgensen 1997) to south of Flemish Pass off Newfoundland (Junquera and Zamarro 1994). Greenland halibut reach maturity after 6-11 years (males) and 8-12 years (females) (Smidt 1969; Bowering 198; Junquera and Zamarro 1994; Nielsen and Boje 1995). At the Canadian coast off Newfoundland and Labrador, Bowering (1983, 1984) suggested a prespawning migration of maturing Greenland halibut towards the deep part of the continental slopes in Davis Strait and off Labrador and Jørgensen (1997) showed a similar migration from the northern nursery areas southward to the deep part of the Davis Strait. For the West Nordic Stock, a prespawning migration of Greenland halibut from northwest, north and east Iceland towards the spawning area west of Iceland in late summer has also been described by Chumakov (1969) and Sigurdsson (1977). The egg and larval drift from the Davis Strait complex and from the West Nordic Stock can thus be summarised as follows. From the spawning grounds in the Davis Strait the eggs and larvae drift with the currents along the West Greenland and Canadian coasts and post larvae settle on the slopes of the banks off Greenland and Canada. (Templeman 1973). The West Nordic stock in the East Greenland/Iceland area probably spawns west of Iceland at depths around and below 1000 m (Magnusson 1977; Sigurdsson 1977). From there, eggs and larvae are carried either towards East Greenland by the Irminger Current/East Greenland Polar Current or northeastward along the coast of northern Iceland (Sigurdsson 1979). A part of the larvae carried towards Greenland drift south to Cape Farewell and further northwards by the West Greenland Current (Boje 1997; Jensen 1935; Smidt 1969). This is supported by tagging studies that showed migrations from southwest Greenland fjords to Iceland (Boje 1993).

1.4.8 Are juveniles and adults associated with particular topographical features and/or sea-bed substrates? If so please describe.

Older juveniles were considerably concentrated in more specific nursery areas where individuals had significantly better condition and higher stomach fullness (Stenberg, 2007). Increase in mean length by

depth, i.e. movement to greater depths as the grow, in the NAFO area has been extensively reported for Greenland halibut (Templeman, 1973; Bowering and Chumakov, 1989; Jorgensen, 1997; Bowering and Nedreaas, 2000).

1.4.9 Recruitment: what is the age and size of recruitment to the fishery? What is the age and size of smallest individuals in scientific cruises? What is known about recruitment variability and its causes?

The fisheries recruitment length is about 30 cm. and around 4 years all for the trawl fishery with a 130 mm. minimum mesh size. For surveys the normal recruitment for the survey gear is around 10 cm. and 1 year all. The minimum length catch in the Spanish surveys was 7 cm.

Larval growth rate was found to increase with increased hydrographical front activity suggesting a coupling between hydrographical processes and recruitment success. Settling occurs on different bottom habitats but within the first year juveniles are concentrated in more specific nursery areas. This observation implies that the densities of juveniles within these nursery habitats may approach its carrying capacity in years when settlement is high, which in turn would dampen the annual variability in year class strength (Stenberg, 2007).

1.4.10 Describe other salient aspects of the species life cycle not described above.

1.4.11 Feeding: list the main prey items of each life stage and rank in order of consumption rates/importance, where possible.

A variety of studies have been carried out in the NAFO area on Greenland halibut. Bowering and Lilly (1992) compared the diet of Greenland halibut in Divisions 2J and 3K over a 3-year period from 1982-84. The results are summarised. Off southern Labrador and eastern Newfoundland small (<20 cm) Greenland halibut feed mainly on pelagic crustaceans, mostly hyperiid amphipods and small *Gonatus* squids. Greenland halibut in the size range of 20-69 cm feed almost exclusively on capelin (*Mallotus villosus*) on the shelf area although Bowering et al. (1984) indicated that in the deep channels between the banks off Labrador northern shrimp could be the dominant prey. It was shown that even though many other prey types (e.g. crabs) are available to Greenland halibut in this size range throughout its distribution on the shelf they nevertheless fed intensively on capelin (see also Chumakov and Podrazhanskaya 1986). Large Greenland halibut (>69 cm), on the other hand, consumed larger fish as prey even though capelin were readily available. These included various species of demersal fish particularly *Sebastes* sp. and to a lesser degree Greenland halibut somewhat similar to that reported for large Greenland halibut in Davis Strait with the order reversed. No capelin are reported in the diet of Greenland halibut in the offshore areas of Davis Strait (Pedersen and Riget 1993; Smidt 1969) but are quite common in Greenland halibut stomachs from localised areas of the inshore regions of West Greenland (Pedersen and Riget 1993; Smidt 1969). Neither were they found in the stomachs of Greenland halibut in the deep waters of the Flemish Pass to the south (Rodriquez-Marin et al. 1995). There did not appear to be any diel effects in any of the data examined nor were there any annual variations observed in the 3 years investigated.

A more recent study by Dawe *et al.* (1998) was carried out along the deep slope of the continental shelf in Division 3K. A summary of the results is presented. The percentage of empty stomachs (13.7%) was low in comparison with that found by Bowering and Lilly (1992) from the shelf and slope to the Northwest of this study area (42-48%), Rodriguez-Marin et al. (1995) from the nearby deep Flemish Pass (62-84%) and Orr and Bowering (1997) for Davis Strait (51%). Apparently high feeding intensity in this study was related to heavy predation on squid. *Gonatus spp.* occurred in 75% of stomachs and contributed 84% and 68% of the prey by numbers and weight, respectively. Three specimens of another squid (*Chiroteuthis sp.*) were found in two stomachs. Fish, usually the predominant prey type, was of secondary importance. Most were demersal species and no one species dominated. Some deep-water species, including black swallower (*Chiasmodon niger*), paperfish (*Scopelosaurus sp.*), and snipe eel (Nemichthyidae) were present although these have not been reported previously as prey of Greenland halibut (Bowering and Lilly 1992, Rodriguez-Marin et al. 1995, Orr and Bowering (1997)).

1.4.12 Predators: list the main predators of each life stage and rank in order of consumption rates/importance, where possible.

Casualty rates are high among Greenland halibut. The most significant predator of adults is the Greenland shark, found in great numbers in the same waters and at the same depths as halibut. Fishermen frequently find, on retrieving hooked lines, that their catch has been multilated by the sharks, particularly in the area of west Greenland.

Other important predators of adult fish are seals and two species of Arctic whales—the white whale and the narwhal. As early as 1852, scientists working in the Greenland area noted that the periodic disappearance of the fish usually coincided with increased sightings of white whales. Periodic invasions by whales into the fjords is now known to be usually followed by a collapse of the halibut fishery.
The larvae of Greenland halibut are eaten by cod and salmon, whereas the young, bottom-dwelling fish and medium-sized adolescents are eaten by cod and by larger Greenland halibut.
http://www.proainternacional.es/rodabae.htm

1.4.13 What are the main gaps in knowledge regarding life history patterns and general species ecology?
The main gap is the recruitment process for the different stocks or management units in the west Atlantic because still now we only know one area with recruits but we do not know how is the migration of these recruits to the different stocks or management units.

1.4.14 Further data collection/research requirements: can these gaps be addressed by regular monitoring or are dedicated research initiatives required? Please describe programmes required.
To address this gap it would be necessary a research project to study the migration between the recruitment area and the fishing grounds.

1.4.15 Are there any aspects of life history pattern and general ecological information and data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.
It would be necessary to understand better the relationship of the different populations and the recruitment process for each stock. This information could have a very important impact in the assessment.

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Section 2: Historical development of the fisheries, including catches and fleets.

2.1 Background information

2.1.1 Please provide the following information on the fleets that are prosecuting/have prosecuted your stock:-
If possible please use table below or a separate spreadsheet/data table/database if too large. For EU fleets, please match DCF and/or ICES/InterCatch metiers, using additional sub-categories if necessary.
Table 2.1 shows the normal information for the last years fishery (2003-2007).

Nationality	Gear type	Fleet ID for use in tables below and throughout questionnaire[2]	Fishery type:- target/mixed fishery/bycatch	If mixed or bycatch what are other or target spp?	Number of vessels	Large scale or artisanal	Time period
Spain	Trawl	SPt	Target		Around 30,	L. scale	1990-2008
Portugal	Trawl	PTt	Target		13-15	L. scale	1988-2008
Canada	Trawl Gillnets Longliners	CAt CAg CAl	Target Target Target		*	L. scale Both Both	1960-2008 1966-2008 1966-2008
Russia (USSR)	Trawl	RUt	Target		*	L. scale	1963-2008
Japan	Trawl	JAt	Target		*	L. scale	1984-2008
Estonia	Trawl	ESt	Target		*	L. scale	2000-2008
		**					

Table 2.1.- Greenland halibut fishery information by fleet and country.

Table 2.2 present a more complete information based in the STATLANT 21 data since 1960, the first considered year of the Greenland halibut target fishery.

STATLANT 21 B Catches

Ton Clase	(All)	(green)	Target Fisheries
Effort	(All)	(yellow)	By Catch other fisheries
Division	(Multiple)	(cyan)	Mix Fisheries
MainSpecies	(All)		

Suma de Total		Year				
Gear	Country	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007
Bottom otter trawl	Spain	0	9	144	159440	66747
	Union Soviet Socialist Republics	26297	72801	16044	3545	0
	Portugal	0	897	9501	64777	26996
	Poland	19133	64084	12223	0	43
	Canada	1734	12940	42243	12500	16533
	German Democratic Republic	16805	21147	20184	4	0
	Japan	0	3	7314	22592	16005
	Russia	0	0	0	5429	17563
	Federal Republic of Germany	926	5166	948	80	0
	Estonia	0	0	0	0	5475
	Faroe Islands	0	0	3	2598	2122
	Others	43	4749	51	5113	726
Midwater trawl	Union Soviet Socialist Republics	0	960	195	506	0
	German Democratic Republic	90	1071	20	8	0
	Canada	0	591	38	99	0

	Russia	0	0	0	0	625
	Others	0	13	15	43	33
Otter shrimp twin trawl	Iceland	0	0	0	0	542
	Faroe Islands	0	0	0	203	0
	Others	0	0	0	22	139
Gillnets	Canada	12748	156821	158140	47552	42891
	Portugal	0	101	12624	1062	0
	Faroe Islands	0	0	1104	0	0
Long-Lines	Canada	1762	1144	748	357	2026
	Norway	38	2112	43	127	40
	Faroe Islands	0	618	212	435	0
	Others	0	0	0	861	2

Table 2.2.- NAFO STATLANT 21 Greenland halibut caches (ton) by gear, country and decade. Yellow are by-catches of other fisheries, green are direct catches and blue are catches form mix fisheries.

The target species for the different gears and countries is very difficult to know, depends on the country and on the period. In the eighties most of the "Bottom otter trawl" effort was directed to cod and Flatfish (American place) and probably most of the catches of Greenland halibut were by-catches of these fisheries, except for Canada where exist a small fishery target Greenland halibut. For the Portuguese fleet, during the late 80th and early 90th, cod and red fish were the most important target species for the trawl fleet operating in NAFO, especially on the platform of the Grand Bank in Div 3L and the Flemish Cap, however this does not prevented that attractive concentrations of Greenland halibut were first detected in the NAFO Regulatory Area by trawlers in the late 80th. These concentrations were located in the northwestern edges of the "Sackville Spur", a fishing ground in the north of Flemish Pass, with depths between 700 and 900m. The component of the trawl fleet that first reached these concentrations were originally fishing redfish in the area, but quickly changed his effort for halibut due to the high yields found at greater depths. In 1989 started the Greenland halibut fishery in the NRA and most of the Greenland halibut catches came from this target fishery, but with some by-catches in the flatfish fishery. Since 1995 till now most of the Greenland halibut catches come from the target fishery with "Bottom otter trawl" gear in the NRA and with "Bottom otter trawl" and "Gillnets" inside of the Canadian waters. There are small by-catches in the fisheries targeting redfish, skates and shrimp.

The number of vessels is very difficult to know for all countries in the whole period. In the NAFO official STATLANT 21 b Data are information about the effort in days or/and hours but is not completed and have many gaps. This official effort is for all Fisheries and it is very difficult split it by target species or fisheries.

2.1.2 Please describe the historical development and the current activity of each fleet in more detail.

The Workshop on Greenland halibut biology and population dynamics – State of the art and identification of research needs described the history of the fishery as follow:

The target fishery for Greenland halibut in this management area began in the early 1960s, using synthetic gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined here, the effort moved progressively northward in the other bays along the east and Northeast coast of Newfoundland. Subsequently, vessels moved further offshore to the deep channels running between the shallow fishing banks. Catches increased from fairly low levels in the early 1960s to over 36,000 tons by 1969 and ranged from 24,000 tons to 39,000 tons over the next 15 years. With the exception of 1987, catches in the late 1980's were around 18,000 to 20,000 tons.

In 1990, an intense fishery for Greenland halibut developed in the NAFO Regulatory Area (NRA) of Div 3L and 3M, in the deepwater areas known as Sackville Spur and Flemish Pass. The development of this fishery resulted in a rapid escalation of catches to about 47,000 tons in 1990. Catches in the NRA in 1991 to 1993 were estimated to be around 55,000 tons in each year although some estimates were nearer 75,000 tons in at least one of these years. Overall, catches from the stock during 1991 to 1993 were estimated to be between 62,000 and 65,000 tons annually. Best estimates of catch suggested a decline to about 51,000 tons in 1994, although some estimates ranged as high as 56,000 tons. As a result of management measures introduced by the NAFO Fisheries Commission in 1995 (extensive quota restrictions and 100% observer coverage in the NRA), catches were greatly reduced. In 1995, the catch was estimated to be about 15,000 tons, increasing to almost 19,000 in 1996, and to about 20,000 tons in 1997-98. Catches from the stock in 1995-98 represent a

reduction of about two-thirds compared to the average annual catch of the previous 5 years. The catch increased to about 24,000 tons in 1999.

Description for the Spanish Greenland halibut Fishery:
The Spanish fishery for Greenland halibut has developed since 1990. This took place originally on the boundaries of NAFO Divisions 3L and 3M (Flemish Pass) and later extended in 1992 to the North of Division 3N (Junquera 1992; Hopper 1994).

1990-1994
From the commencement of this fishery until 1994, the technology and the skills of the fishermen steadily improve and the fishing methods for the deeper water are now designed to operate as deep as 2000 m. The Spanish fleet was mainly composed of bottom trawlers, and the mean fishing depth for Greenland halibut was around 900 m. In this period (90-94) the number of the Spanish vessels was increased from 9 to 35 vessels. Around the 42% of the Spanish vessels had less than 600 GRT, 30% had around 600-1000 GRT and 28% had more than 1000 GRT. Normally each vessel made only one trip of a duration of 5 to 6 month by year. The small group of the Spanish trawlers carried out other fisheries, mainly American plaice in Division 3NO beside the Greenland halibut fishery. The Greenland halibut catches increased from 2.000 tons till 40.000 tons in this period and the most important species in the by catch were the grenadiers (Roughhead and Roundnose). The catches mean length decreased from 55-60 cm to 40-45 cm.

1995-1999
In 1995 was the turbot war and in 1994, management of G. halibut in Subarea 2 and Div. 3KLMNO became the responsibility of the NAFO Fisheries Commission, which imposed a TAC of 27,000 tons for 1995. This level was maintained for 1996 to 1998 inclusive, and was proportioned throughout the management area in an attempt to reduce high concentrations of effort in localised areas. For both 1999 and 2000, Scientific Council advised that an increase in catch to about 30,000 tons should not impede stock recovery. This meant a big effort reduction for the Spanish fleet. More of the trawl effort in the period was directed to Greenland halibut fishery.

2000-2003
In this period different fisheries were developed by the Spanish trawl vessels (Skate, Shrimp, Redfish) and effort increased substantially, part due to these new fisheries and part due to the increase in the Greenland halibut TAC.

2004-2008
In 2003 Fisheries Commission established a fifteen year rebuilding plan for this stock (Report of the Fisheries Commission, 2003), with the intent to: "take effective measures to arrest the decline in the exploitable biomass and to ensure the rebuilding of this biomass to reach a level that allows a stable yield of the Greenland halibut fishery over the long term". The plan states that "the objective of this programme shall be to attain a level of exploitable biomass 5+ of 140,000 tonnes on average", and in an attempt to improve the rebuilding prospects for this stock, TACs were set at 20, 19, 18.5, 16 ('000 tons), respectively, for the years 2004-07. Subsequent TAC levels "may be adjusted by the Scientific Council advice" but "shall not be set at levels beyond 15% less or greater than the TAC of the preceding year". This recovery plan meant a great reduction in this period in the Greenland halibut fishery but not in the other fisheries (Skate, Shrimp, Redfish). In this period, the Spanish fleet has, at least, four different fisheries in NAFO Subarea 3 characterized by different mesh size, target species, depth and fishing area. The Spanish fleet effort in NAFO area is mainly directed to Greenland halibut (mostly in Div. 3LM) with 135 mm mesh size, alternating with the skate fishery in the second half of the year (Div. 3NO) with 280 mm mesh size, shrimp fishery (Div. 3LM) with 40 mm mesh size, and in less degree redfish (Div. 3O and Div. 3M) with 135 mm. mesh size.

Description for the Canadian Greenland halibut Fishery:
As reported in several previous documents (e.g. Brodie *et.al.* 2009), the Canadian fishery for Greenland halibut in Subareas 2 and 3 began in the early 1960s, using gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined here, the effort moved progressively northward in the other bays along the east and northeast coast of Newfoundland. In later years, vessels moved further offshore to the deep channels, such as the area in the central part of Div. 3K known as Funk Island Deep, and eventually to the continental slope. Canadian catches increased from fairly low levels in the early 1960s to almost 32,000 tons in 1980 then declined steadily to between 2900 and 6300 tons in each year from 1993-99. This declining trend was mainly a result of low catch rates and reduced effort, as fishers pursued other species such as snow crab which were more profitable. In 2000, the Canadian catch in NAFO Subarea 2 and

Divisions 3KLMNO increased to about 10,600 tons, more than two and a half times the catches in 1998 and 1999. However, catches have declined since then, to a level between 4,900 and 7,000 since 2002. Reasons for fluctuations in catch and effort include a switch of some effort by fishers in Divs. 3KL between snow crab and G.halibut due to changes in quotas and product prices, combined with variable catch rates for Greenland halibut in some of the traditional fishing areas (Brodie *et al.* 2007).

Canadian catches have been taken mainly by gillnet, and most of these gillnet catches are from Div. 3K. This fishery has been conducted mainly by small vessels (<20 m) fishing in the deepwater channels near the Newfoundland and Labrador coast as well as in the deepwater bays, using an average mesh size of about 150 mm. However, Canadian gillnet catches taken during recent years also include those from a substantial fishery along the deep edge of the continental slope. In an attempt to reduce the catch of young Greenland halibut in this deepwater fishery, gillnet mesh size for Greenland halibut in the Canadian zone in depths > 731 m (400 fm) was regulated to be no less than 191 mm, with the exception of Div. 2J. Other restrictions on numbers of nets also exist, as indicated in the tables below, which show the 2007 and conservation harvesting plans (CHP) regulations in the Canadian gillnet fishery for Greenland halibut. In 2005-2008, fishers in Div. 3K were permitted to use some 152 mm mesh gillnets in waters deeper than 732 m, but these fishers were then not permitted to fish for G. halibut in depths less than 732 m. The number of nets allowed in depths > 732 m in Div. 2GHJ + 3K was reduced from 500 to 400 in 2007, and further to 250 in 2008.

Gillnet catches during the 1990's ranged from 2400 to 6700 tons, averaging about 4200 tons. Catches in 2000 from this sector then increased to 9300 tons, similar to the levels seen in the late 1980's, but since then have declined to between 2400 and 3900 tons. Since early-2002, an area in the Funk Island Deep region of Div. 3K was closed to gillnetting in order to reduce by-catch of snow crab, and was partly responsible for the decline in gillnet catch. An area of Hawke Channel in Division 2J has also been closed to fishing for some years, due to crab – shrimp fishing interactions. The extent of these areas has undergone modifications over time.

Canadian otter trawl (OT) catches peaked at about 8,000 tons in 1982, but from 1993 to 1999, catches by this fleet were less than 1050 tons annually. OT catches increased sharply from less than 90 tons in 1998 and 1999, to around 1800 tons in 2001-02 and 2004, but were double this level at just over 3700 tons in 2003. Annual OT catch since then has been in the range of 1800 to 2400 tons. Much of the otter trawl catch after 2002 was in the slope area around the boundary between Divs. 3K and 3L, although almost all otter trawl catch in 2007-08 occurred in Div. 2J. This fishery is conducted mainly by large vessels (>30 m in length), and minimum cod-end mesh size has been regulated to be 145 mm for several years, in all areas.

Catches from Subarea 2 were very low prior to the mid 1970's, then increased to a peak around 9000 tons in 1982. From 1991 to 2001, catches from Subarea 2 were in the range of 1000 to 2500 tons per year. The catch in SA 2 increased to almost 3000 tons in 2003, due to higher catches in Div. 2GH, and was around this value in 2007-08. Most of the catch from Subarea 2 has come from Div. 2J, although catches in 1993-96 and 2003-04 were higher in Div. 2GH combined compared to Div. 2J. In some cases, fishing in Subarea 2 has been opportunistic, as vessels transit to or from Subarea 0. In most years, Div. 3K has produced the largest Canadian catches, peaking around 18,000 tons in 1979-80. Catches in recent years from Div. 3K have fluctuated between 750 tons (1995) and 5800 tons (2000), with the 2007-08 values being around 1500 tons. Peak catches of around 13,000 tons in Div 3L occurred in 1966-67 and 1980, and averaged about 1300 tons in 2005 to 2007. Catches in Div. 3M , 3N, and 3O combined have generally been in the range of 100 tons or less in recent years, mainly from Div. 3O.

Portuguese Greenland halibut Fishery:
Although the records of STATLANT begin in 1960, only since 1973 exist records of catches of Greenland halibut by Portugal in the NAFO area. From 1973 to 1981 there are only incidental catch records in all divisions. In 1982 started a Portuguese directed fishery to Greenland halibut in the Div.2J with gillnets vessels registered in the STATLANT as chartered vessels. This fishery lasts until 1986, when Portugal joins the European Community and loses the rights to fish within the Canadian EEZ. From 1987 onwards the Portuguese Greenland halibut fishery is composed mainly by trawlers.

During the late 80th and early 90th, cod and red fish were the most important target species for the trawl fleet operating in NAFO, especially on the platform of the Grand Bank in Div 3L and the Flemish Cap, however this does not prevented that attractive concentrations of Greenland halibut were first detected in the NAFO Regulatory Area by trawlers in the late 80th. These concentrations were located in the northwestern edges of the "Sackville Spur", a fishing ground in the north of Flemish Pass, with depths between 700 and

900m. The component of the trawl fleet that first reached these concentrations were originally fishing redfish in the area, but quickly changed his effort for halibut due to the high yields found at greater depths.

In 1990, just when this deep-sea fishery expand to the waters of the Flemish Pass, made by great Spanish freezer coming from Namibia, the Portuguese trawlers were more interested in high concentrations of cod in Division 3L. Partial and temporary overlapping concentrations of both cod and Greenland halibut in the Flemish Pass led to a widespread interest in the Greenland halibut by stern trawlers Portuguese.

In the following year, the impact of the sudden concentration of a high level of fishing effort in a restricted area had its consequences. In Division 3L observed a 43% reduction in fishing effort for the Greenland halibut, corresponding to a decrease in the estimated catch of 77%. In 1991 the deep-sea fisheries trawl began to explore the edges of the West Flemish Pass already in Division 3N, nevertheless the poor catch rates comparing with the North. It marks the beginning of deep-sea fisheries in the southern Grand Banks. In 1992, with the reduction of the total effort in the NAFO area and small quotas for cod and American plaice on the Grand Banks, rapidly over-fished, the effort for the Greenland halibut has increased, focusing on South Division 3N in 1992, and due to the rapid decline in the catch rates in Division 3L.

The fishery was supported mainly in the south, within two years, but with a low level, with about 10% of the total effort. The rest of both trawl and gillnets fleets have focused increasingly over the years in the Flemish Cap exploring the cod recruitment of strong year classes of 1990 and 1991 (trawl) and the survivors of year classes in the second half of the eighties (gillnets). It is only in 1995 with the collapse of cod in Div. 3M, with the maintenance of moratoria on fishing of cod and plaice on the Grand Banks, the Greenland halibut, again concentrated on the land's original Flemish Pass, continued to show great interest for trawlers .

From April 1995, enters into an obligation to carry an observer on board vessels to monitor the implementation of several restrictive measures (actual size, with the percentage of catch, etc.), and the establishment of a TAC the halibut of Subarea 2 and Divisions 3KLMNO Fisheries Commission of NAFO. Due to these measures, the Greenland halibut fishery, along with the red fish fishery has become the mainstay of long-distance fleet to operate in NAFO. The effort led to this species increased to greater than 64% between 1996 and 1998 (with a maximum of 80% in 1997) and from 1999 to 2001 stabilized at around 56% due to increased interest in other species in southern Grand Banks.

In the recent years the Greenland halibut catches remains stable in all divisions, except in the Div. 3M, where the catches increased. In Div. 3L, due to the continuously decrease in the catches of roughhead grenadier over recent years, the bulk of the catch is now represented by Greenland halibut and redfish (around 90%, the same level of the bulk Greenland halibut/roughhead grenadier in years before). In Div. 3N the relative weight of these two species has been declining from 76% in 1998 to 35% in 2004-2005, 11% in 2006 and fall to 4% in 2007-2008. In this division, the skates continue to be the most important fishery, with 60-70% of total catch in the last three years (37% in 2005). However, the catches of American plaice and yellowtail flounder show an important increase in the last years, reaching a average of 20% of total catch in Div. 3N (2007-2008).

2.1.3 What are the main gaps in knowledge regarding the fleets fishing your stock? Please prioritise.

One of the problems with the fleets is the accuracy of the data available, most of the available data about effort and fleets are in official STATLANT 21 and the quality of this data is not very much for the years prior to 2000. For me this data could be used for qualitative things but not for quantitative things. From 2000, we have more data (VMS, NAFO Observers, etc) than the STATLANT and the quality of these new data is much better.

Other problem is the difficult to identify the effort in a determine fishery, is possible to know the total effort but is difficult to split by fisheries.

2.1.4 Can these gaps be addressed by regular monitoring? If so, how?

The problem has been solved since 2000 with the NAFO Observers data and with the VMS data, the problem is that these data are not available completed for scientific purposes.

2.1.5 Please complete the table below on the extent of time-series data of landings and discards data:-

Table 2.3 shows for the more important countries in the Greenland halibut fishery the time series of landing and discards by fleet. Catches time series are present in point 2.1.1 of this report. Catch table was based on the STATLANT 21 b data. Data include landings or catches depending on the countries, Canada data is landings and for UE countries more of the data are total catches. This is because most of the countries take the data with observers on board and these observers collected and sample the total catch data more than the retained and discard data. Only Canada collected the data in port and this data is the landings data. The discards level for Greenland halibut based on the Scientific Observers data is very low, less than 0.5%. The landings figures would be very close to the catches figures.

Fleet ID	**Time-series of landings data**	**Time-series of discard data**
SPt	1990-2008	1990-2008
PTt	1988-2008	1988-2008
CAt	1960-2008	
CAg	1966-2008	
CAl	1966-2008	
Rut (URSS)	1963-2008	
JAt	1984-2008	
ESt	2000-2008	

Table 2.3.- Time series of Greenland halibut landings and discards by fleet, for the more countries and fleets in the NAFO Greenland halibut fishery.

In some years the Official STATLANT 21 b data are very different from the STACTFIS data. STACTFIS data are the best available data for NAFO Scientific Council and all the assessment were made with these data. STACTFIS data can not be split by country, is only available by stock.

In NAFO there are not official discards data, data available for discards is based on NAFO Observers and in the National Scientific Observers data.

The data of the NAFO Observers in the Portuguese fleet are not in the recent years available to the Institute, some information on discards estimations are available from the National Scientific Observers, this data are included in the catch estimations and in catch rate calculations but are not presented in a regular manner.

2.1.6 Does the earliest data available correspond to the start of exploitation of the stock. If not please describe. If earlier data exist please list where these can be found.

The target fishery for Greenland halibut in this management area began in the early 1960s, using synthetic gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. There was small by-catches of Greenland halibut in other fisheries (cod, flatfish) before 1960.

The first record of Greenland halibut catches was 900 kg in 1857. The quantity of Greenland halibut exploited remained very low until 1916 when nearly 600 tons was exported. The landings from 1916 until the early 1960's fluctuated between 250-1000 ton annually (Hopper, 1994).

2.1.7 If discard data are not available please indicate by fleet ID if, in your opinion, discards are likely to be significant.

As we said before, the NAFO official data (STATLANT) have not information about discards. The discards information are based on NAFO Observers and on the National Scientific Observers data and are not available for all nations.

If we understand as discards the Greenland halibut discarded we can say that discards are insignificant in most of the fleets and fisheries, but if we understand discards as other species not landed probably some by-catch species in the Greenland halibut fishery as grenadiers could be a problem for some fleets.

Table 2.4 presents the percentage of discards based on the Scientific Observers Data for the Spanish fleet in 2008. Results are in weight and came from a sample of 21% of the total Spanish effort. All discards are the 2.8% of the Total catch made by Spanish fleet. If we only see the Greenland halibut fishery the discards for

all species are the same percentage. The Greenland halibut species discards suppose the 0.3 % of the Greenland halibut catches.

	All Fisheries	GHL Fishery	GHL Catches
Retained %	97.2%	97.2%	99.7%
Discard %	2.8%	2.8%	0.3%

Table 2.4.- Percentage of retained catches and discards of the Spanish 2008 catches for all NAFO fisheries, for the Greenland halibut fishery and for the Greenland halibut species.

In the Portuguese fleet, from data available on discards from the National Scientific Observers from a couple years ago we concluded that discards are insignificant (around 3%).

Table 2.5 shows the significance of the discards for the most important fleets in the Greenland halibut fishery. The discards are not very significant for the mayor fleets in this fishery.

Fleet ID	Significant discards?
SPt	No (3%)
PTt	No (3%)
CAt	No
CAg	No
CAl	No
Rut (URSS)	No
JAt	No
ESt	No

Table 2.5.- Significance of the discards for the most important fleets in the Greenland halibut fishery.

2.1.8 If mis-reporting or under-reporting is/has been a problem please indicate years in table below:

Probably most of the fleets have had miss and under reporting catches but is very difficult know the period and if it is miss or under reporting. The miss and under reporting depends on several factors as the regulated fisheries, TAC levels, etc. and is very difficult to model this problem. Next paragraph try to give some guide lines of this problem.

Pre 1973: There were considerable catches of GHL from the mid-1960's to early 1970's. However, many of the flatfish catches during this period were not reported by species. In 1974, ICNAF provided species breakdowns of these catches, which included GHL, based on correspondance with scientists from several of the fishing nations involved. While there is likely to be considerable uncertainty over the species breakdowns, it has never been suggested that there is a bias. Accepted (reported) catches over much of this period averaged about 30,000 tons/year.

Mid 1970's to late 1980's: Catches during this period are generally thought to be reliable, as introduction of the Canadian 200-mile limit in 1977 reduced non-Canadian effort throughout much of the area. Catches from the stock peaked in the late 1970's near 40,000 tons.

Late 1980's to 1994: Generally considered to be the most problematic era for accuracy of reported catches in this stock. In the late 1980's, effort from EU (mainly Spanish and Portuguese) vessels rose sharply on this stock, as shallow-water species such as flounders and cod declined on the Grand Banks, and a deepwater fishery was developed around Flemish Cap and Flemish Pass. A number of large Spanish vessels, excluded from the Namibian hake fishery, caused the catches in the early 1990's to increase sharply. There were also many re-flagged and non-NAFO-member vessels involved in the fishery in these years as well. However, the magnitude of the increased catch was disputed. Various estimates of catch, often differing from the reported catches, were used by SC to assess the resource. For the 1991 catch, SC was unable to do better than estimate total catch in a range of 55 to 75 thousand tons, and has used the midpoint in subsequent assessments. Considerable doubt existed about other catches as well, notably 1993. By 1995, following a serious dispute between Canada and EU/Spain over this stock, NAFO had assumed management of the entire stock, including setting a TAC, and catches dropped sharply.

It is quite possible that catches in the early 1990s were 10 to 15 thousand tons higher or lower that the values used. While there is a tendency to believe that the higher values were more likely, there were also theories that some fleets over-reported catches in this period, trying to establish a higher catch share in advance of the inevitable TAC/quota system introduced in 1995 (Table 2.6). Whatever the level of uncertainty, there is little doubt that the early 1990's represents the period of highest catches ever seen from this stock.
Mid 1990s' to 2003: With the introduction of TAC and new management controls in the mid 1990's, there was likely a period where some catches were under-reported, particularly as effort declined from the very high levels of the early 1990's. However, there is no reason to believe catches were much higher than those estimated/used by SC in this period.

2004 to present: In 2003, FC introduced a Rebuilding Plan for this stock, and slashed the 2004 TAC from 42,000t to 20,000t. TAC's since then have declined to 16,000t, but estimated catches have remained in the 23,000 t range. From 2004 to 2006, it was generally accepted that these catch estimates were reasonable, although officially reported catches were much lower. However, for 2007, the SC estimate of 22,747 t was disputed by some contracting parties, who thought/insisted that the actual catch was closer to 17,500 tons.

In summary, there would be no reason to assume anything other than random variation in the catches pre-1989. After that however, there are many years where catches used by SC are likely to be anywhere in a range of available estimates, often at the middle or high end. Officially reported catch statistics differ widely (always lower in total) from the SC-accepted value of total catch in many of these years.

Fleet ID	**Mis-reporting? State years**	**Under-reporting? State years**
SPt	1990-1995	2003-2008
PTt	1990-1995	2003-2008
CAt		
CAg		
CAl		
Rut (URSS)		
JAt		
ESt		

Table 2.6.- Periods of uncertainty in the Greenland halibut catches for the most important fleets in the Greenland halibut fishery.

2.1.9 Please document available information on gear selectivity by fleet ID.

The minimum cod end mesh size authorized in NAFO for ground fish fisheries (Greenland halibut, Yellowtail flounder, etc) is 130 m. Most of the Spanish fleet use mesh size around 135 mm. The minimum fish landing length is 30 cm.

Based on the Spanish Observer data the normal catch length range start in 25-30 cm. The minimum observed length in the period 1991-2008 was 13 cm and the maximum 120 cm.

The Portuguese fleet use the same mesh size than the Spanish fleet, the bulk of the Greenland halibut catches are between 32 – 56 cm.

In February 1995 the European Union carried out a selectivity survey on board a Spanish commercial trawler, using the codend-cover method (Cardenas *et al.* 1997). The objective was to study the selectivity of 130 mm mesh size for the deep sea trawl fisheries in the NAFO Regulatory Area. One hour and four hour hauls were carried out and results obtained for Greenland halibut (*Reinhardtius hippoglossoides*), American plaice (*Hippoglossoides platessoides*), roughhead grenadier (*Macrourus berglax*) and threebeard rockling (*Gaidropsarus ensis*) (Table 2.7). For the two flatfish species, the proportion of retention increased with the duration of the haul. This increase reflected in a decrease of the corresponding selection factor. It also varied with the size of fish. The selection factor was greater in smaller individuals, and this induced an asymmetry in the selectivity curve. For the groundfish species, data were enough only to fit the four hour selectivity curves, which appeared more symmetrical than the flatfish ones.

	a	b	m	L_{25}	L_{50}	L_{75}	S.F.
			1 hour				
Greenland halibut	19.631	-0.466	0.389	34.53	38.69	41.93	2.99
American plaice	57.943	-1.582	0.102	28.05	32.34	34.89	2.50
			4 hour				
Greenland halibut	24.226	-0.540	0.178	30.46	37.68	42.26	2.91
American plaice	47.779	-1.375	0.101	24.75	29.75	32.72	2.30
Roughhead grenadier	9.636	-0.599	0.310	8.65	12.55	15.39	0.97
Threebeard rockling	13.538	-0.294	0.447	35.67	41.59	46.40	3.21

Table 2.7.- Parameters of the generalized logistic curves a, b and m, the length s at 25, 50 and 75 % retention and selection factors (SF) for each species and trawl duration.

2.1.10 Are there any aspects of data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?
It would be good that all participating countries in the fishery check the official catches accuracy. Most of the counties only present the official data (STATLANT), only Spain and Portugal present all the catch data available (STATLANT, NAFO Observers, National Scientific Observers). If all counties would do the same we can measure the quality of the official data, but if we only have the official data is impossible compare the quality of the data.

Discards data are not available. Discards are not significant for the most important fleets.

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Workshop on Greenland halibut biology and population dynamics – State of the art and identification of research needs.
http://www.norden.org/sv/publikationer/publikationer/2002-414/at_download/publicationfile

Section 3: Review of stock assessments carried out thus far

3.1. General overview

3.1.1 Please complete table below regarding previous assessments:-

The stock of Greenland halibut in SA2 and Divs 3KLMNO has for some time been a subject of concern. Scientific advice on the management of the stock has for some years continued to be based on an Extended Survivor Analysis (XSA) model of the stock dynamics and the assessment of the stock has been carried out in a consistent manner since a reformulation was introduced in 2003 (Darby et al., 2003) (Table 3.1). The 2003 assessment prompted the NAFO Fisheries Commission to put in place a fifteen-year rebuilding plan with the objective of attaining a 140-Kt exploitable biomass by 2019. Two alternative assessments to the XSA, based on ADAPT and ASPIC, were presented in 2004 (Darby et al., 2004). Estimates of population size and fishing mortality from these models were found to be reasonably consistent with the XSA results and they were therefore interpreted as supporting the XSA-based advice.

In 2009 a working group analysed five different models (XSA; SCAA; ADAPT, ASPIC and SURVA) with the Greenland halibut data (Kingsley, 2009) (Table 3.1), and the main conclusion were the following: There are clearly anomalies in the data and consistently with that, different assessment models applied to the data for this stock gave different results. The data appear to be unable to determine the biomass scale with great precision. It seems likely that the use of shrinkage causes much of the difference between XSA and other VPA models observed in these results. Where there are assessment uncertainties, instead of opting for a single assessment procedure or attempting to bridge gaps between several, it may be appropriate to proceed using a Management Procedure approach where TACs are adjusted adaptively and in a manner that takes due account of uncertainties. The working group did not conclude that the XSA should definitely be regarded as not robust. The differences between the various models are large and need to be reconciled.

Year	Assessment type[3]	Assessment method(s) used	Assessment package/ program used	Are input data on DEEPFISHMAN website?	Assessment used for latest scientific advice?	If not, what was latest scientific advice based on?	Reference
2008	Update-Exploratory	VPA	XSA Lowestoft suite	Yes	Yes		NAFO SCR Doc. 08/48
2009	Exploratory	Production Model	ASPIC	Yes	No	XSA	NAFO SCR Doc. 09/48
2009	Exploratory	VPA	ADAPT	Yes	No	XSA	NAFO SCR Doc. 09/44
2009	Exploratory	SCAA		Yes	No	XSA	SCR Doc. 09/43
2009	Exploratory	SURBA	FLR	Yes	No	XSA	NAFO SCR Doc. 09/47

Table 3.1.-Assessment models applied to the Greenland halibut NAFO Subarea 2 Div. 3KLMNO data.

3.1.2 How is the frequency of assessments linked to the advisory and management cycle?
Yearly for XSA.

3.2 Input data

3.2.1 For all exploratory assessments or the latest benchmark or update assessment, please list the input data citing length of time-series (where appropriate) and source.
The 2008 Scientific Council approved assessment (Healey and Mahe, 2008) was the following:

[3] Exploratory, Benchmark (to identify best practise), Update (repeat of previous years' assessment using same method and settings but with the addition of data for another year).

Table 5a. XSA Settings.
Lowestoft VPA Version 3.1
9/06/2008 13:00
Extended Survivors Analysis
G. halibut SA2+3KLMNO Index file: (Combined sexes with plus group).
CPUE data from file GhalTUN2008.txt
Catch data for 33 years. 1975 to 2007. Ages 1 to 14.
Tuning data

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU Survey	1995	2007	1	12	0.5	0.6
CAN 2J3K	1996	2007	1	13	0.8	1
CAN 3LNO	1996	2007	1	8	0.3	0.45

Time series weights:
Tapered time weighting not applied
Catchability analysis:
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 11
Terminal population estimation:
Terminal year survivor estimates shrunk towards the mean F of the final 5 years.
S.E. of the mean to which the estimates are shrunk = .500
Oldest age survivor estimates for the years 1975 to 2007
shrunk towards1.000 * the mean F of ages 10 - 12
S.E. of the mean to which the estimates are shrunk = .500
Minimum standard error for population estimates from each cohort age = .500
Individual fleet weighting not applied
Tuning converged after 45 iterations

There are more survey information about all the data and the assessment in NAFO 2008 Scientific Council Report (pag 200-222).

These data was the same for all the models described in 3.1.1

3.2.2 Are there any aspects of data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?
Some problems in aging.
Some problems to have good catch estimations in some periods.
None of the tuning surveys available cover the entire distribution of the stock. But cover the most important fishing ground of this stock.

3.3 Assessment method(s) used

3.3.1 Justification of the method: for exploratory assessments please describe reasons for selecting the method(s) used. Was any guidance available as to the type of method to use? If so please describe.

The stock of Greenland halibut in SA2 and Divs 3KLMNO has for some time been a subject of concern. Scientific advice on the management of the stock has for some years continued to be based on an Extended Survivor Analysis (XSA) model of the stock dynamics and the assessment of the stock has been carried out in a consistent manner since a reformulation was introduced in 2003 (Darby et al., 2003). The 2003 assessment prompted the NAFO Fisheries Commission to put in place a fifteen-year rebuilding plan with the objective of attaining a 140-Kt exploitable biomass by 2019. Two alternative assessments to the XSA, based on ADAPT and ASPIC, were presented in 2004 (Darby et al., 2004). Estimates of population size and fishing mortality from these models were found to be reasonably consistent with the XSA results and they were therefore interpreted as supporting the XSA-based advice.

In 2009 a working group analysed five different models (XSA; SCAA; ADAPT, ASPIC and SURVA) with the Greenland halibut data (Kingsley, 2009), and the main conclusion were the following: There are clearly

anomalies in the data and consistently with that, different assessment models applied to the data for this stock gave different results. The data appear to be unable to determine the biomass scale with great precision. It seems likely that the use of shrinkage causes much of the difference between XSA and other VPA models observed in these results. Where there are assessment uncertainties, instead of opting for a single assessment procedure or attempting to bridge gaps between several, it may be appropriate to proceed using a Management Procedure approach where TACs are adjusted adaptively and in a manner that takes due account of uncertainties. The working group did not conclude that the XSA should definitely be regarded as not robust. The differences between the various models are large and need to be reconciled.

Scientific Council in 2009 has found this evaluation of different models a useful exercise; however, the uncertainties with the present assessment may stem primarily from the structure of the input data and the underlying dynamics of the stock. Scientific Council noted that all of the models applied could broadly reproduce the trends when run with similar or the same data sets, and continued use of the XSA model is not considered to be invalidated by this exercise. The major divergences between the XSA with 'shrinkage' and other models occur in the most recent years and this warrants continuing investigation.

3.3.2 Benchmark: for benchmark assessments please describe agreed best practise and rationale for selection.

In NAFO the process is different and there are not benchmark assessments. But as the Greenland halibut assessment always have many problems in 2004 the XSA results was compared with other models (ADAPT and ASPIC) (Darby *et al.* 2004). In the 2009 June Working Group (see point 3.3.1) the XSA model was compared with other models (Kingsley, 2009): ADAPT VPA model, ASPIC stock production model, SURBA and Statistical Catch at Age (SCAA) and the conclusion were that most of the models have problems with the Greenland halibut input data and that is very difficult to compare models (Different assumptions and structure and weighing series) to chose what was the best model to carry out the assessment.

3.3.3 Uncertainty: how is uncertainty addressed in all types of assessments?

All the assessment models: VPA (XSA and ADAPT), ASPIC, SURBA and (SCAA) run in the 2009 June Working Group give the results with a uncertainty measure. Models use different methods (Normal classic, bootstrap or both) to calculate the confident limits. The results show that all methods have a high degree of uncertainty in the estimation of the parameters.

The SC approved assessment (XSA) (Healey and Mahe, 2008) calculate the uncertainty but has a not statistical measure of the uncertainty. Normally all the projections (stochastic) have in account the uncertainty to present the scientific advice.

Last years also was presented a Greenland halibut Management Strategies Evaluation (Shelton and Miller, 2009) that it has account the uncertainty in the results and in models assumptions. But this exercise was not approved by the Fisheries Commission.

3.3.4 Multispecies: is your stock included in any multi-species assessments? If so please describe. If not should it? If yes, please describe a suitable way to go forward.

In this moments all the assessment carried out in NAFO are mono-specific (stock by stock). But one of the principles of the new NAFO Convention approved in 2008 is the Ecosystem Approach to Fisheries Management. To answer this request the NAFO Scientific Council has establish a Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) and it is in this group where will discuss how implemented the Ecosystem Approach and the ways to implement it.

3.3.5 Retrospective analyses: do assessments include retrospective analyses?

Yes, every year the Scientific Council run the retrospective analysis. The last results of the approved XSA retrospective analysis are presented in Figure 3.1 (Healey and Mahe, 2008):

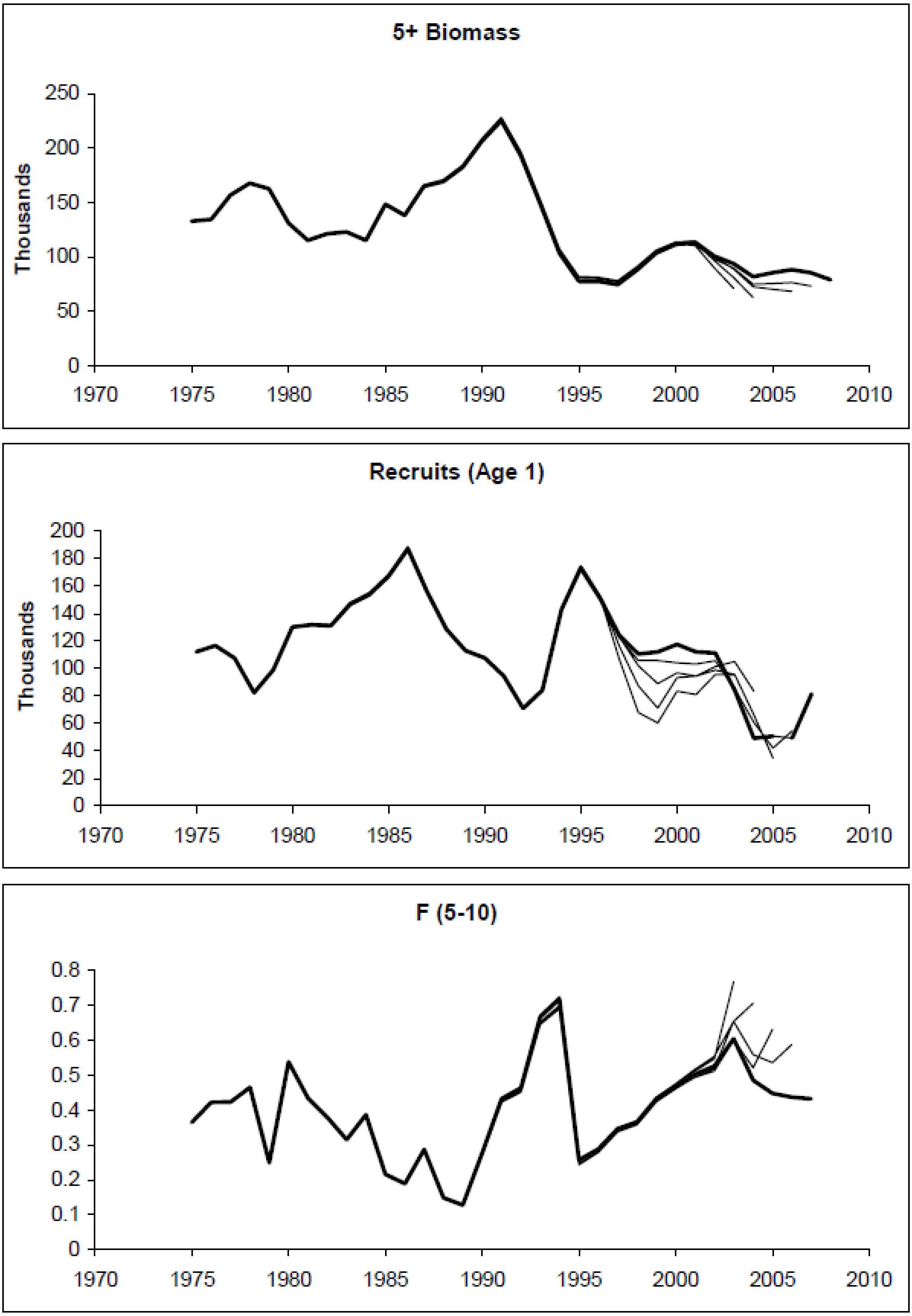

Figure 3.1.- Retrospective Analysis for 5+ biomass (t), Age 1 recruitment (000s) and average fishing mortality (ages 5-10). Bold lines highlight the 2008 assessment.

3.4 Biological reference points (BRPs): do you have BRPs for your stock? If so what is the basis? In the table below please detail type and value e.g. MSY 400 t, $F_{0.1}$, MEY etc.

NAFO SC approved the Precautionary Approach frame work (PA) for all stocks (NAFO, 2004*)*. But in the case of the Subarea 2+3KLMNO Greenland halibut stock we have not still approved the PA references points. This stock has a recovery plan that will be finish in 2018 with an objective of 140.000 tons of exploitable biomass. In the last years SC advice a $F_{0.1}$ fishing mortality level as the best way to reach in 2018 the objective of the NAFO Recovery plan. The last values are presented in table 3.2, and were calculated in 2008 for the following levels of fishing mortality were: F_{max}=0.34 **$F_{0.1}$**=0.18 and **F_{2007}**=0.49

Type	Limit	Target	Precautionary	Comments
Biology:	F_{Max}=0.34 ??		$F_{0.1}$=0.18	Are not approved as real PA Referents points.
Economic:				
Social:				
Ecosystem:				
Other (e.g interaction limits with PETs)				

Table 3.2.- Reference points for Greenland halibut NAFO Subarea 2 Div. 3KLMNO based on the 2008 assessment.

3.5 Projections: Do you perform projections of future stock status?

Each year a short term deterministic projections (five years) and medium term stochastic projections (five years) are performed under different scenarios and presented for Greenland halibut in the Scientific Council (Scientific Council, 2008). Results of the deterministic projections are presented in Figure 3.2:

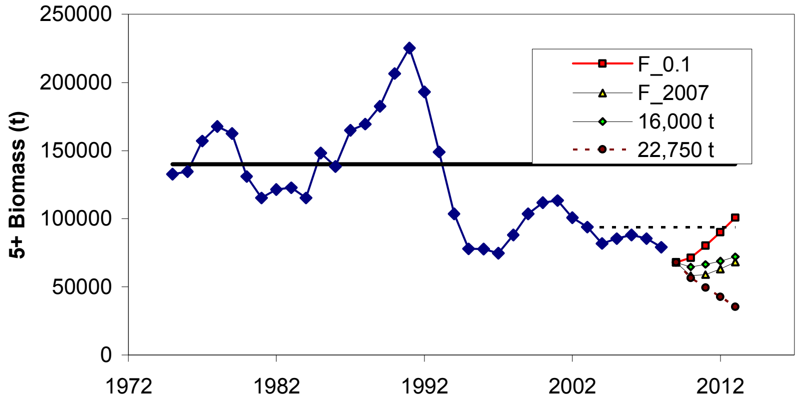

Figure 3.2.- Deterministic projections (5 years) for 5+ biomass (t) under for different scenarios ($F_{0.1}$, F_{2007}, 16.000 t catch and 25.750 t catch).

And for the Stochastic projections are presented in Figure 3.3:

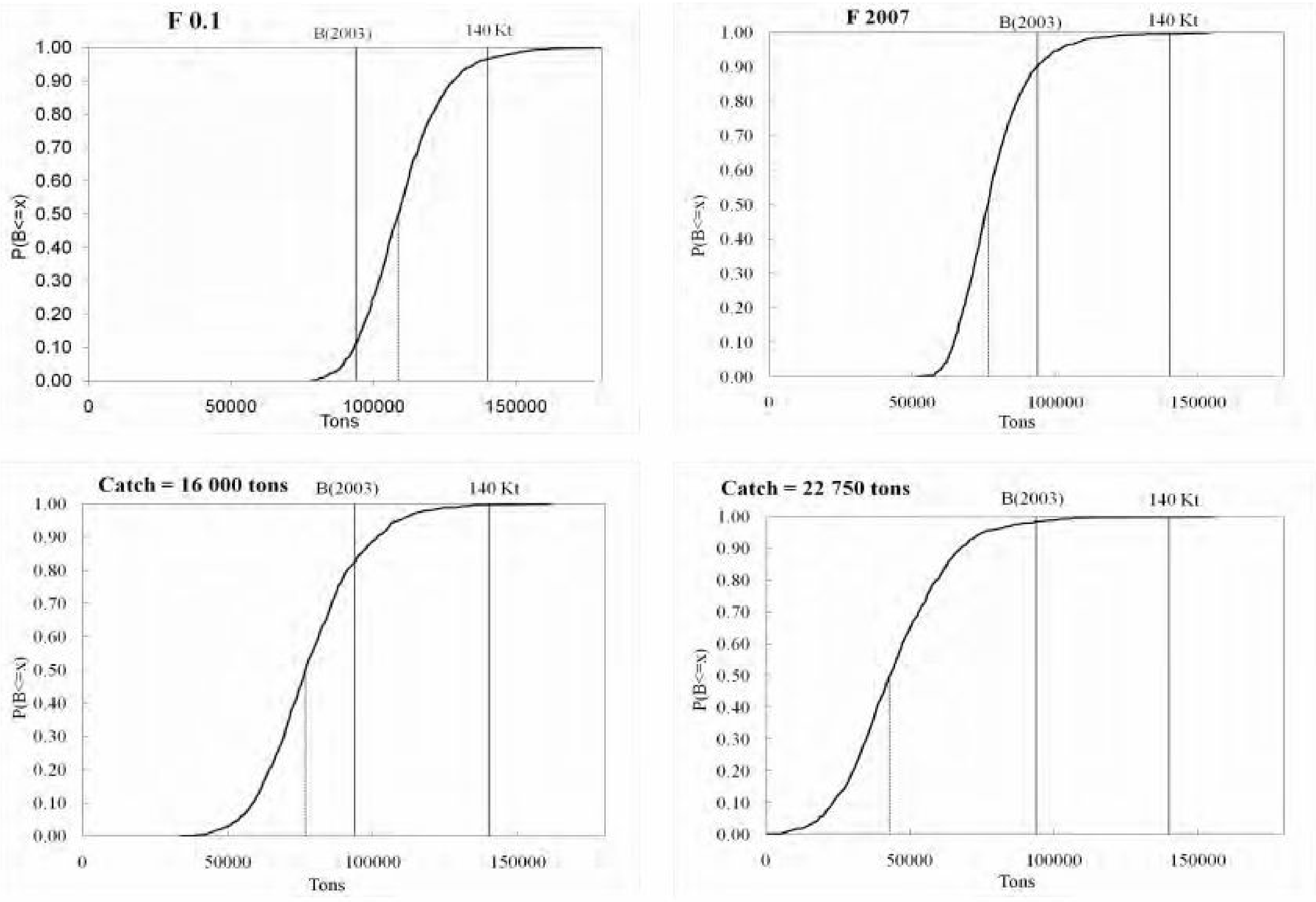

Figure 3.3.- Greenland halibut in Subarea 2 and Div. 3KLMNO: Probability profile of exploitable biomass in 2013 for each of the four projection scenarios. Solid vertical lines demarcate the biomass level in 2003 (93.800 t) and the rebuilding plan target (140.000 t). The dashed vertical line indicates the median projected biomass level in 2013.

3.5.1 Do you perform short, medium and/or long-term projections? If so, how is the length of the projection(s) defined and what is/are the length(s)?

In order to evaluate the population trends in the medium term, five-year deterministic and stochastic projections to 2013 were conducted assuming average exploitation pattern and weights-at-age from 2005 to 2007, and with natural mortality fixed at 0.2 (Scientific Council, 2008).

3.5.2 Are projections deterministic or stochastic?

Five-year deterministic and stochastic projections.

3.5.3 How is recruitment simulated in the projection/ (historical geometric mean, using S/R model etc).

Geometric mean (2000-2005) in the deterministic projections and Bootstrap in the same period in the stochastic projections. The reason for doing 5 years projections is to avoid uncertainties in the recruitment.

3.5.4 How is stock growth simulated (e.g. exponential survival equation)?

Exponential survival equation.

3.5.5 How are biological parameters projected (stochastically, mean of last 3 years etc).

Means of the 3 last years in the deterministic and means with theirs *CVs* in the stochastic projections.

3.5.6 What reference points are used in the projections?

For projected catch in years 2009 – 2012, four scenarios with either constant fishing mortality or catch were evaluated:

i) constant fishing mortality at $F_{0.1}$ (0.180)
ii) constant fishing mortality at F_{2007} (0.432)
iii) constant landings at 16,000 tons, and
iv) constant landings at 22,750 tons.

3.5.7 Harvest control rules (HCRs) and management strategy evaluation (MSE): does the stock have a pre-defined HCR? If so, please specify.

This stock has a recovery plan that will be finish in 2018 with a objective of 140.000 tons of exploitable biomass and the unique HCRs approved by the NAFO Fisheries Commission is that the change in the TAC between years can not be more than 15% (Conservation and Enforcement Measures, 2009).

3.5.8 Has this rule been agreed with all stakeholders?

The rules have been discussed in the Fisheries Commission with the stakeholders but not agreed.

3.5.9 Has the rule been simulation tested using MSE? If so please describe methods and outcomes.

Yes was simulated for different management strategies (Shelton and Miller, 2009) but the MSE process is still not approved by NAFO Fisheries Commission. Shelton and Miller (2009) evaluated alternative management strategies against a range of operating models reflecting alternative possible realities. A number of performance criteria were developed in order to quantify management objectives. Some of these are based on industry considerations with regard to catch and catch stability and others relate to the rebuilding, stock conservation and sustainability. Performance statistics were divided into two types - those that are imperative and require "satisficing", and those that are not imperative, but are useful in evaluating the trade offs. Robust feedback harvest control rules, either based on survey data directly or on the XSA, show the most promise. Two successful management strategies incorporating feedback harvest control rules are proposed for further consideration in the management of this stock.

3.5.10 Is the rule robust to uncertainties within the fishery system?

Shelton and Miller (2009) results show that although a number of the management strategies examined have the potential to rebuild the stock, we found that only two strategies had 100% success rates in meeting all satisficing performance statistics across short, medium and long term for all operating models – modFree and rbPlan. These two strategies react to relative changes in perceived stock size and are therefore robust to uncertainty about absolute stock size.

3.5.11 Do you have an estimate of virgin biomass, if so what is it, how was it derived and how reliable is it?

The approved assessment start in 1975 and the fishery started in 1960, there is not a approved virgin biomass for this stock. However there is some estimation of virgin biomass made under other not approved models as SCAA model. The problem of these estimations is that were vary variable depending on the models assumptions.

3.6 Assessment packages/programs used (e.g. FLR, CEDA, ASPIC, Lowestoft XSA etc)

The approved assessment was carried out with Lowestoft XSA Suite and with the FLR FLEDA to analyse the quality of the input data.

3.6.1 Were any technical problems encountered, were these resolved and if so how?

None

3.6.2 Were the packages/programs used suitable for use by scientists with little or no experience of them?

None, you need certain train to used the package because you need to chose the best options for you stock and input data and to do that, you need certain train and assessment experience.

3.6.3 If not, how could they be improved?

The best way to improve is with practical assessment training courses to learn the technical skills and attending assessment working groups to learn the practical skills.

3.6.4 Were the assessment diagnostics fit for purpose? If not how could they be improved?

The assessment diagnostics were not the best. There are some problems with the catchability trends in time and the variability of catchability is high for most of the ages and tuning surveys. To solve, some of trend and variability problems, in the 2003 assessment we cut the tuning series used in the assessment trying to achieve more stability in the catchability of the surveys as well as incorporating the shrinkage to reach less variability in the retrospective patter.

3.6.5 Did you receive any training in the use of the assessment packages/programs?

Yes we receive many assessment training and we have experience in assessment working groups.

3.7 Quality control/peer review

3.7.1 Were the assessments subjected to quality appraisal and/or peer review and if so how and by whom?

In the NAFO procedure, there is a Designated Expert in charge of the stock assessment and after is the SC STACFIS plenary who revise the assessment and make the suggestions to improve it.

3.7.2 What were the outcomes for the latest benchmark/update assessment and for all exploratory assessments?

Using Extended Survivors Analysis (XSA), estimates of stock status of Greenland Halibut in Subarea 2 and Divisions 3KLMNO are updated with an additional year of catch and survey information. Results are presented in table 3.3 and indicate that the recent estimates of exploitable (ages 5+) biomass are amongst the lowest in the time series, and fishing mortality remains relatively high despite reductions under the Fisheries Commission Rebuilding Plan. Further, none of the year-classes since the 1996 cohort have been above average (Healey and Mahé, 2008).

Terminal Fs derived using XSA with final year & oldest age shrinka

	RE Age 1	TOTALE	TOTSPE	LANDIN	YIELD/S	FBAR 5-
1975	112289	132745	21901	28814	1.3157	0.3652
1976	116668	134515	17670	24611	1.3928	0.422
1977	107522	156967	14817	32048	2.1629	0.4237
1978	82385	167779	15905	39070	2.4565	0.4651
1979	99031	162567	15619	34104	2.1835	0.2489
1980	130137	130949	12403	32867	2.65	0.5381
1981	131878	115319	14026	30754	2.1927	0.435
1982	131159	121359	19874	26278	1.3222	0.3785
1983	146631	122816	24154	27861	1.1535	0.3154
1984	153784	115307	24279	26711	1.1002	0.3863
1985	167248	148263	29003	20347	0.7015	0.2162
1986	187148	138252	33558	17976	0.5357	0.1895
1987	156283	164862	42319	32442	0.7666	0.2869
1988	128757	169413	44314	19215	0.4336	0.1489
1989	112950	182583	43867	20034	0.4567	0.1282
1990	107712	206522	55914	47454	0.8487	0.2776
1991	94449	225176	63402	65008	1.0253	0.4321
1992	71040	193014	49008	63193	1.2894	0.4627
1993	84255	148926	37916	62455	1.6472	0.6659
1994	143006	103612	28899	51029	1.7657	0.7176
1995	173619	77875	25695	15272	0.5944	0.2567
1996	151487	77778	19899	18840	0.9468	0.2883
1997	124090	74714	18439	19858	1.077	0.3463
1998	110643	88131	17210	19946	1.1589	0.3655
1999	112062	103716	17119	24226	1.4151	0.4324
2000	117558	111918	13791	34177	2.4782	0.4684
2001	112024	113461	12424	38232	3.0773	0.5028
2002	111402	100779	10872	34062	3.1329	0.5259
2003	84400	93844	9191	35151	3.8244	0.6044
2004	49258	81929	9342	25486	2.728	0.4851
2005	50750	85460	8558	23225	2.7138	0.4477
2006	49376	88165	7938	23531	2.9643	0.4374
2007	81438	85516	9885	22747	2.3012	0.4318
Arith. Mean	114922	128007	23915	31425	1.6913	0.3969
0 Units	(Thousar	(Tonnes	(Tonnes	(Tonnes)		

Table 3.3.- Extended Survivors Analysis (XSA) estimates of Age 1 recruitment (000s), 5+ biomass (t), SSB biomass (t), landings and average fishing mortality (ages 5-10) for Greenland Halibut in Subarea 2 and Divisions 3KLMNO

3.7.3 How could assessments be improved in terms of the data used and the methods used?

There is not a survey covering all the stock area and many of the assessment problems are related with the quality input data. Probably one way to improve the assessment it would be to have a indices covering all the area and in view of the data and models problems made the assessment base on the survey information (model free option). Some efforts were made to coordinate and calibrate the actual surveys in the area between UE and Canada but the results are not definitive yet.

The quality of the catch data series. There are some problems with the catch data in the pass and now is difficult to know the real level of the catches in some pass periods.

3.7.4 What additional data and information would be required?

Information about stock structure and a good tuning survey cover the entire stock area and depth.

References Section 3

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Scientific Council Meeting –Report of NAFO Scientific Council Meeting June 2009 SCS Doc. 09/23.

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Section 4: Data inventory

The data described below are to be collated by the Case Study Leader and made available to and stored on the DEEPFISHMAN data archive held by Ifremer for use during the project. Ifremer will shortly be circulating a data-exchange format. Data not subject to confidentiality restrictions will be stored at the end of the project on a web-based library similar to PANGEA.

In NAFO there are different types of data: the official STATLANT 21A and B data that is the data use by the Fisheries Commission for different things, STACFIS catch data that it is the catch data use by the Scientific Council to make the assessment, NAFO Observers data that have different official and scientific uses, the National Scientific Observers data with biological information and the VMS data that is the data for control and can be used by SC under certain restrictions. The STATLANT have not confidentially restrictions and can be split by countries. All the other data have some confidentially restrictions. Table 4.1 present the main characterises of the different data and their use by the Scientific Council in the assessment process.

	STATLANT 21 A and B	NAFO Observers	Scientific Observers	VMS	STACFIS
Organization	NAFO FC	Secretariat	Countries	Secretariat	STACFIS
Countries	All	NRA	Some	NRA	ALL
Availability	Country/Month	Country/Month	Country	Fisheries	Stock
Period	1960-2008	1996-2008	1992-2008	2003-2008	1960-2008
Fleet	+		+		
Landings	+	+	+		+
Discards		+	+		
Catches	+	+	+		+
Effort	+	+	+	+	
Length Dist.			+		
ALK			+		
Maturity			+		

Table 4.1.- NAFO Greenland Halibut in Subarea 2 and Divisions 3KLMNO data available and their main characteristics.

4.1 Fisheries data

4.1.1 Fleet composition

Are time-series data on the length, age, tonnage (GRT/GT) and power (KW) composition for each fleet ID listed at 2.1.1 above available? If so please append.
For all fleets we only have data base on the STATLANT 21 B, this data have only information about gear and tonnage class and are presented in fishing days (Table 4.2):

Suma de Total			Decade					
Gear	Country	TonClase	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total
Bottom otter trawl	Canada	0-49.9	150	570	796	8096	33695	43307
		50-149.9	353	511	1081	9891	37161	48997
		150-499.9	38985	12474	8043	2376	2330	64208
		500-999.9	16020	72981	97876	33170	9775	229822
		1000-1999.9			2465	8646	4451	15562
		2000 & over			479	4563	5789	10831
		Not known			18	3141		3159
	Canada Total		55508	86536	110758	69883	93201	415886

	Portugal	500-999.9	10			2	178	190
		1000-1999.9	37752	32292	26494	23924	13166	133628
		2000 & over	2772	10150	692	531	51	14196
	Portugal Total		40534	42442	27186	24457	13395	148014
	Spain	150-499.9		96	16603	15469	8419	40587
		500-999.9		134		14664	17374	32172
		1000-1999.9	42060	7891	58	4598	6013	60620
	Spain Total		42060	8121	16661	34731	31806	133379
	Russia	0-49.9				86		86
		150-499.9				1109		1109
		500-999.9				2923	1109	4032
		1000-1999.9				786	5304	6090
		2000 & over				1120	2265	3385
	Russia Total					6024	8678	14702
	Japan	0-49.9			62			62
		150-499.9	462		430	3311	1832	6035
		500-999.9		170	252		22	444
		1000-1999.9	195	109	1757	29	999	3089
		2000 & over	212	306	1123	886	73	2600
	Japan Total		869	585	3624	4226	2926	12230
	Lithuania	150-499.9					185	185
		1000-1999.9					564	564
	Lithuania Total						749	749
Bottom otter trawl Total			138971	137684	158229	139321	150755	724960
Bottom pair trawl (2	Spain	150-499.9	46415	39510	19987	3224		109136
		500-999.9		15655	7016	3047		25718
		1000-1999.9		898	294	1500	29	2721
		Not known			2735			2735
	Spain Total		46415	56063	30032	7771	29	140310
	Canada	150-499.9		86				86
	Canada Total			86				86
Bottom pair trawl (2 Total			46415	56149	30032	7771	29	140396
Gillnets	Canada	0-49.9	256	44658	32670	13562	15717	106863
		50-149.9		4890	5047	10874	5371	26182
		150-499.9		414	1613	2902	1094	6023
		500-999.9			900	509		1409
		Not known			10511	8494		19005
	Canada Total		256	49962	50741	36341	22182	159482
	Portugal	500-999.9		2819	3692	2804		9315
		1000-1999.9		3553	1595	98		5246
		2000 & over		56				56
		Not known				318		318
	Portugal Total			6428	5287	3220		14935
Gillnets Total			256	56390	56028	39561	22182	174417
Longlines	Canada	0-49.9	7752	2278	2482	1046	1106	14664
		50-149.9	684	2216	2450	1467	572	7389
		150-499.9	2017	1058	2895	4086	736	10792
		500-999.9			36	21		57
		Not known			783	873		1656
	Canada Total		10453	5552	8646	7493	2414	34558
	Portugal	150-499.9	1498			1141		2639
		500-999.9	5348	2381				7729
		1000-1999.9	3615	986				4601
	Portugal Total		10461	3367		1141		14969
	Russia	500-999.9				207		207
	Russia Total					207		207
	Japan	150-499.9			46		29	75
	Japan Total				46		29	75

Longlines Total			20914	8919	8692	8841	2443	49809
Gears not known	Canada	0-49.9	16	1290	32		7	1345
		50-149.9		166	46			212
		150-499.9			97	51		148
		500-999.9				669	72	741
		Not known			301	703		1004
	Canada Total		16	1456	476	1423	79	3450
	Russia	1000-1999.9					64	64
	Russia Total						64	64
Gears not known Total			16	1456	476	1423	143	3514
Total Xeral			206572	260598	253457	196917	175552	1093096

Table 4.2.- STATLANT 21 B effort data (fishing days) from 1960 till 2008 by gear, country and tonnage class.

Only for the Spanish fleet we present information based on the National Scientific Observers data (Table 4.3). Till 1995 this data is a census and since then till now is a sample of the total effort. The sample represents around 10-15% of the total effort. Same years was more and others less.

Spanish Trawlers (1992-2008)

Mean Horse Power	**1567**
Mean GRT	**762**
Mean Built Year	**1983**
Mean Length	**59**
Mean Carry Capacity	**1111**
Mean Frozen capacity	**29**
Mean Crew	**24**

Table 4.3.- Main characteristics of the NAFO Spanish trawl fleet.

4.1.2 Effort data

Please complete the tables below for each fleet ID and append all available time-series data disaggregated by fleet if possible. Please label with (1) an asterisk if data exist but are not available (but state where they exist), (2) leave blank if no data exist at all and (3) label N/K if the existence of data is not known.

Data was provided by year, nation and gear based on the official NAFO data STATLANTS 21 B and probably is not completed for all countries that have participated in the fisheries. To point it out that the effort measure (fishing days) is for all fisheries (Cod, flatfish, Greenland Halibut, etc) carried out in NAFO area. It is not possible split the effort by the different fisheries carried out in NAFO in the period.

Some countries have available effort data by year a by fishery based on NAFO Observers data. Table 4.4 shows the Spanish trawl effort in percentage split by Division and fishery for 2008:

Div.	Fishery	Total
3L	**Shrimp**	6%
	Greenland halibut	94%
	Skate	
3M	**Shrimp**	15%
	Greenland halibut	85%
	Skate	
3N	**Shrimp**	
	Greenland halibut	18%
	Skate	82%
3O	**Shrimp**	
	Greenland halibut	87%
	Skate	13%

Table 4.4.- Percentage of the 2008 Spanish fleet effort by Division and fishery.

For demersal and pelagic trawlers (Table 4.5):-
Most, but not all, of the Bottom trawl effort since 1990 is directed to the Greenland halibut and the legal minimum mesh size for this fishery is 130 mm. since 1994.
Data Base in the STATLANT 21 information and can be provided by month and year.

Effort	DAYS FISHED

Suma de Total			Decade					
Gear	Country	TonClase	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total Xeral
Bottom otter trawl	Canada	0-49.9	150	570	796	8096	33695	43307
		50-149.9	353	511	1081	9891	37161	48997
		150-499.9	38985	12474	8043	2376	2330	64208
		500-999.9	16020	72981	97876	33170	9775	229822
		1000-1999.9			2465	8646	4451	15562
		2000 & over			479	4563	5789	10831
		Not known			18	3141		3159
	Canada Total		55508	86536	110758	69883	93201	415886
	Portugal	500-999.9	10			2	178	190
		1000-1999.9	37752	32292	26494	23924	13166	133628
		2000 & over	2772	10150	692	531	51	14196
	Portugal Total		40534	42442	27186	24457	13395	148014
	Spain	150-499.9		96	16603	15469	8419	40587
		500-999.9		134		14664	17374	32172
		1000-1999.9	42060	7891	58	4598	6013	60620
	Spain Total		42060	8121	16661	34731	31806	133379
	Russia	0-49.9				86		86
		150-499.9				1109		1109
		500-999.9				2923	1109	4032
		1000-1999.9				786	5304	6090
		2000 & over				1120	2265	3385
	Russia Total					6024	8678	14702
	Japan	0-49.9			62			62
		150-499.9	462		430	3311	1832	6035
		500-999.9		170	252		22	444
		1000-1999.9	195	109	1757	29	999	3089
		2000 & over	212	306	1123	886	73	2600
	Japan Total		869	585	3624	4226	2926	12230
	Lithuania	150-499.9					185	185
		1000-1999.9					564	564
	Lithuania Total						749	749
Bottom otter trawl Total			138971	137684	158229	139321	150755	724960
Bottom pair trawl	Spain	150-499.9	46415	39510	19987	3224		109136
		500-999.9		15655	7016	3047		25718
		1000-1999.9		898	294	1500	29	2721
		Not known			2735			2735
	Spain Total		46415	56063	30032	7771	29	140310
	Canada	150-499.9		86				86
	Canada Total			86				86
Bottom pair trawl Total			46415	56149	30032	7771	29	140396

Fleet ID	Trawl type (single, double etc)	Min cod-end mesh size	Effort (days at sea)	Effort (days fishing)	Effort (hrs fishing)	GRT/GT of individual vessels	KW of individual vessels
SPt	Single	130 mm.		1990-2008	2001-2008	1990-2008	
PTt	Single and double	130 mm.		1989-2008	1989-2008	1990-2008	
CAt	Single	130 mm.	1960-2008	1960-2008	??	??	??
Rut (URSS)	Single	130 mm.	??	1960-2008	??	??	??
JAt	Single	130 mm.	??	1960-2008	??	??	??
ESt	Single	130 mm.	??	??	??	??	??
FRt	Single	130 mm.	??	??	??	??	??

Table 4.5.- STATLANT 21 B effort data (fishing days) from 1960 till 2008 by country and tonnage class for the trawl fleet and their characteristics.

Please cite the minimum level at which anonymised data in each field can be provided (haul/day/trip/month/year) and detail any additional relevant information here (e.g. data source – official logbooks or skippers tallybooks or both)

For longliners (Table 4.6):
Data Base in the STATLANT 21 information and can be provided by month and year.

Effort	DAYS FISHED

Suma de Total			Decade					
Gear	Country	TonClase	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total
Longlines	Canada	0-49.9	7752	2278	2482	1046	1106	14664
		50-149.9	684	2216	2450	1467	572	7389
		150-499.9	2017	1058	2895	4086	736	10792
		500-999.9			36	21		57
		Not known			783	873		1656
	Canada Total		10453	5552	8646	7493	2414	34558
	Portugal	150-499.9	1498			1141		2639
		500-999.9	5348	2381				7729
		1000-1999.9	3615	986				4601
	Portugal Total		10461	3367		1141		14969
	Russia	500-999.9				207		207
	Russia Total					207		207
	Japan	150-499.9			46		29	75
	Japan Total				46		29	75
Longlines Total			20914	8919	8692	8841	2443	49809

Fleet ID	L/L type (vert, horiz etc)	Number of longlines	Hook type and size	Effort (days at sea)	Effort (days fishing)	Effort (soaktime)	GRT/GT of individual vessels
CAl					1960-2008		

Table 4.6.- STATLANT 21 B effort data (fishing days) from 1960 till 2008 by country and tonnage class for the long-lines fleet and their characteristics.

Please cite minimum level at which anonymised data in each field can be provided (haul/day/trip/month/year) and add any additional relevant information here (e.g. data source – official logbooks or skippers tallybooks or both).

For netters (Table 4.7):

Canadian catches have been taken mainly by gillnet, and most of these gillnet catches are from Div. 3K. This fishery has been conducted mainly by small vessels (<20 m) fishing in the deepwater channels near the Newfoundland and Labrador coast as well as in the deepwater bays, using an average mesh size of about 150 mm. However, Canadian gillnet catches taken during recent years also include those from a substantial fishery along the deep edge of the continental slope. In an attempt to reduce the catch of young Greenland halibut in this deepwater fishery, gillnet mesh size for Greenland halibut in the Canadian zone in depths > 731 m (400 fm) was regulated to be no less than 191 mm, with the exception of Div. 2J. Other restrictions on numbers of nets also exist, as indicated in the table below, which show the 2006 conservation harvesting plan (CHP) regulations in the Canadian gillnet fishery for Greenland halibut. In 2005 and 2006, fishers in Div. 3K were permitted to use some 152 mm mesh gear in waters deeper than 732 m, but these fishers were then not permitted to fish in depths less than 732 m (Brodie *et al.*, 2007).

Area	Depth	# of Nets	Min. Mesh
2GH + 3L	293 – 549 m	125	152 mm
2GH + 3KL	549 – 732 m	200	152 mm
2GH + 3KL	> 732 m	500	191 mm
2J	> 732 m	500	152 mm
3NO	> 732 m	500	191 mm

Data Base in the STATLANT 21 information and can be provided by month and year.

Effort	DAYS FISHED

Suma de Total			Decade					
Gear	Country	TonClase	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total Xeral
Bottom pair trawl Total			46415	56149	30032	7771	29	140396
Gillnets	Canada	0-49.9	256	44658	32670	13562	15717	106863
		50-149.9		4890	5047	10874	5371	26182
		150-499.9		414	1613	2902	1094	6023
		500-999.9			900	509		1409
		Not known			10511	8494		19005
	Canada Total		256	49962	50741	36341	22182	159482
	Portugal	500-999.9		2819	3692	2804		9315
		1000-1999.9		3553	1595	98		5246
		2000 & over		56				56
		Not known				318		318
	Portugal Total			6428	5287	3220		14935
Gillnets Total			256	56390	56028	39561	22182	174417

Fleet ID	**Net type (gill, trammel etc)**	**Number of fleets**	**Length of fleets**	**Mesh size**	**Effort (days at sea)**	**Effort (days fishing)**	**Effort (soaktime)**	**GRT/GT of individual vessels**
CAg				Yes		1960-2008		

Table 4.7.- STATLANT 21 B effort data (fishing days) from 1960 till 2008 by country and tonnage class for the gillnets fleet and their characteristics.

Please cite minimum level at which anonymised data in each field can be provided (haul/day/trip/month/year) and add any additional relevant information here (e.g. data source – official logbooks or skippers tallybooks or both).

4.1.2.1 How could the content, availability and quality of fishing effort data be improved for the fleets fishing your stock?

The fleets operating in NAFO carry out different fisheries and for some countries it is difficult split the effort by fisheries, but one way to split the effort by fisheries it would be give the effort by depth, because the different fisheries carry out at different depths.

In short term it would be available for the Scientific Council a new measure of the effort based on the Vessel Monitoring System (VMS) data. One of the problems with this data are that it would be difficult to know the effort by country and depth but the Scientific Council is working to solve these problems. Other problem for VMS data is that only is mandatory for the NRA and not for the EEZ of the different countries.

4.1.3 Landings and discards data

4.1.3.1 Please append all available time-series of landings and discard data, disaggregated by fleet ID where possible.

These data was presented and explained in the point 2.1.1 and 2.5.1 of this report. Table 4.8 presents the Greenland halibut catches (tons) by country, gear, a decade. As was explained before, for some country are landing and for others are catches. There is not available official discards data.

STATLANT 21 B Catches

Ton Clase	(Todas)	(green)	Target Fisheries
Effort	(Todas)	(yellow)	By Catch other fisheries
Division	(Múltiples elementos)	(cyan)	Mix Fisheries
MainSpecies	(Todas)		

Suma de Total		Year					
Gear	Country	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total Xeral
Bottom otter trawl	Spain	0	9	144	159440	66747	226340
	Union Soviet Socialist Republics	26297	72801	16044	3545	0	118687
	Portugal	0	897	9501	64777	26996	102171
	Poland	19133	64084	12223	0	43	95483
	Canada	1734	12940	42243	12500	16533	85950
	German Democratic Republic	16805	21147	20184	4	0	58140
	Japan	0	3	7314	22592	16005	45914
	Russia	0	0	0	5429	17563	22992
	Federal Republic of Germany	926	5166	948	80	0	7120
	Estonia	0	0	0	0	5475	5475
	Faroe Islands	0	0	3	2598	2122	4723
	Others	43	4749	51	5113	726	10682
Midwater trawl	Union Soviet Socialist Republics	0	960	195	506	0	1661
	German Democratic Republic	90	1071	20	8	0	1189
	Canada	0	591	38	99	0	728
	Russia	0	0	0	0	625	625
	Others	0	13	15	43	33	104
Otter shrimp twin trawl	Iceland	0	0	0	0	542	542
	Faroe Islands	0	0	0	203	0	203
	Others	0	0	0	22	139	161
Gillnets	Canada	12748	156821	158140	47552	42891	418152
	Portugal	0	101	12624	1062	0	13787
	Faroe Islands	0	0	1104	0	0	1104
Long-Lines	Canada	1762	1144	748	357	2026	6037
	Norway	38	2112	43	127	40	2360
	Faroe Islands	0	618	212	435	0	1265
	Others	0	0	0	861	2	863

Table 4.8.- NAFO STATLANT 21 Greenland halibut caches (ton) by gear, country and decade. Yellow are by-catches of other fisheries, green are direct catches and blue are catches form mix fisheries.

4.1.3 VMS data

4.1.3.1 Please complete the table below and append all available time-series of data or VMS plots, disaggregated by fleet ID where possible:

VMS data is only available since 2003, is not possible split by countries or fisheries. NAFO VMS data correspond to trawl fleet working in the NAFO NRA and till now is not possible split by nations because data has confidentially problems. This data is collected and analyse by the NAFO Secretariat and presented to the NAFO Scientific Council as effort maps (Table 4.9).

Fleet ID	**Is VMS monitoring mandatory?**	**Do VMS data exist? State years**	**Are VMS data available for scientific analysis?**	**If an EU fleet, has funding for VMS been claimed under the DCF?**	**Have VMS data been linked with logbook or observer data?**	**Have they been post-processed to identify fishing gear?**	**Is a VMS footprint available for each fleet?**
Data available for all fleets in the NAFO Regulatory Area	Yes since 2003	2003-2007	Yes	Not	Not	Not fishing gear, but to identify fishing effort.	Not for each fleet (countries), it is for total trawl effort

Table 4.9.- Vessel Monitoring System (VMS) data available in NAFO and their main characteritcs.

NAFO Secretariat is working to split this information by fisheries, the first step was for the Greenland halibut fishery and was presented by Campanis *et al.* 2008. This document analyse the Greenland halibut fishery effort 2003-2007 by quarter and present maps with the effort distributions for each year. Here we only present the 2007 map (Figure 4.1).

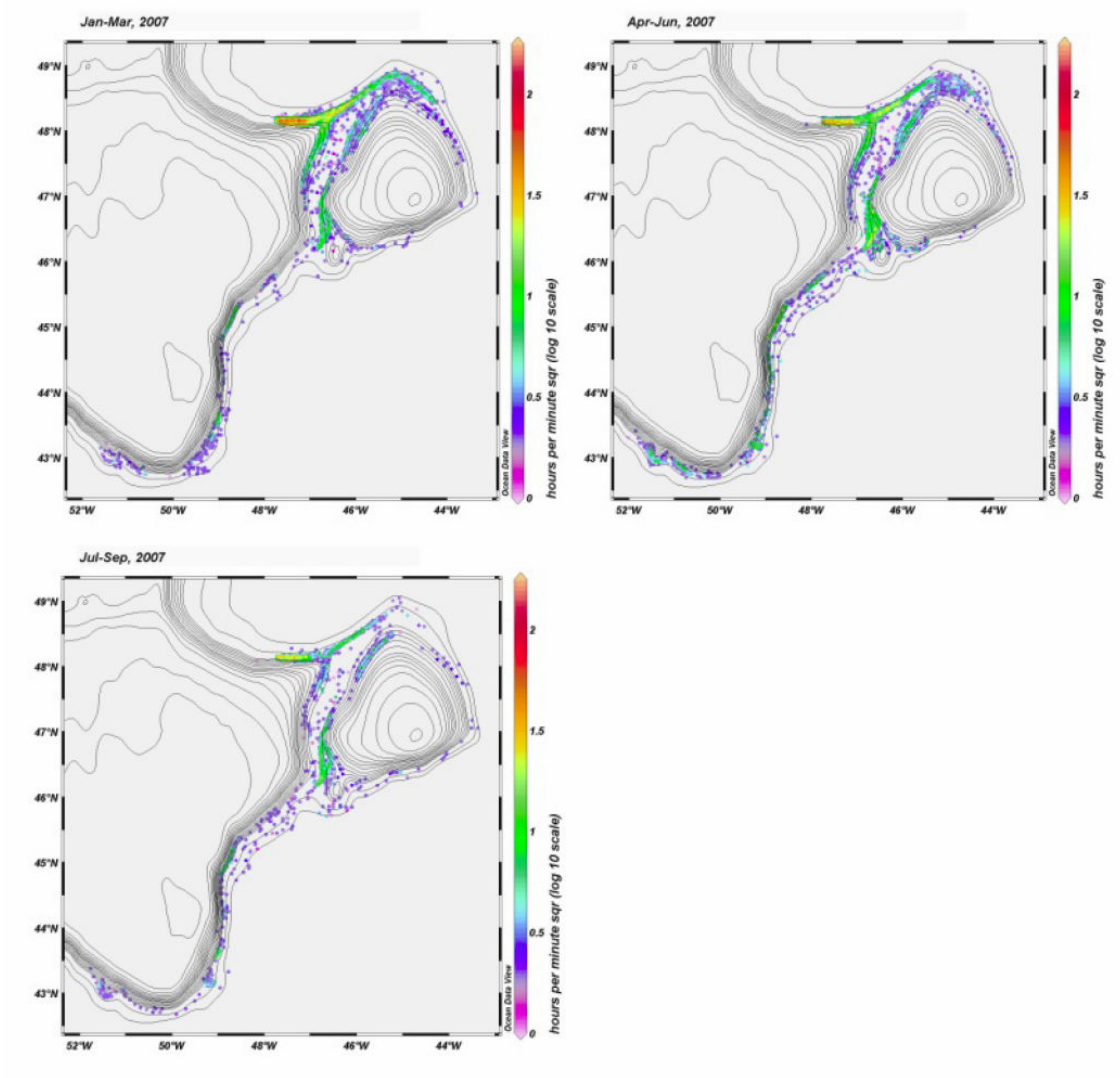
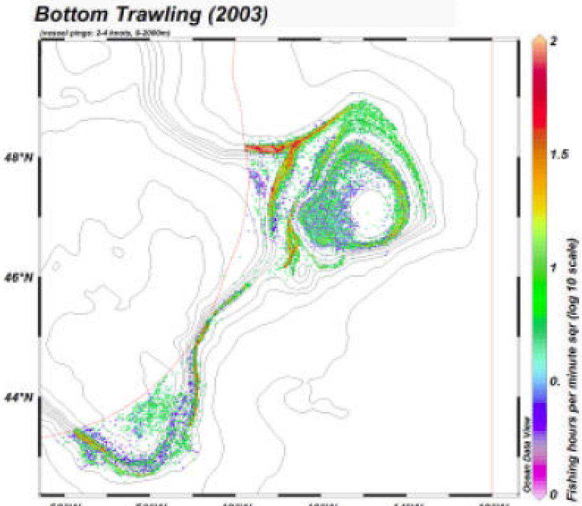
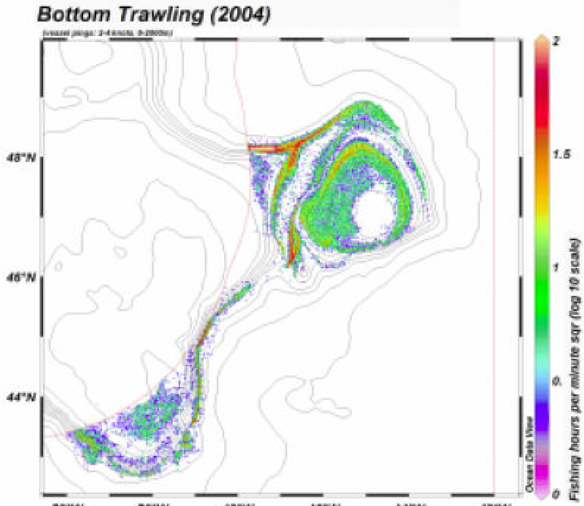
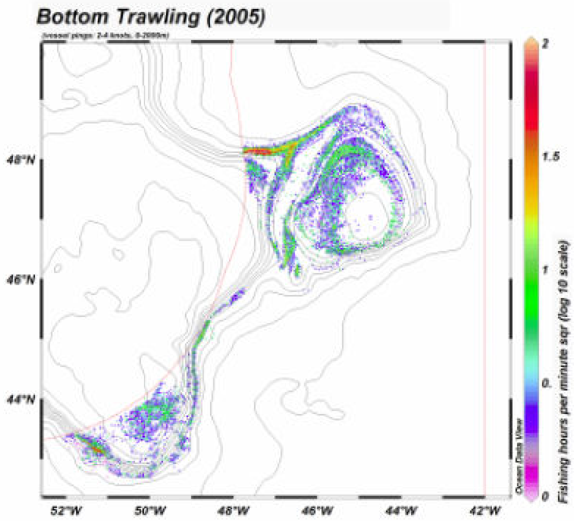


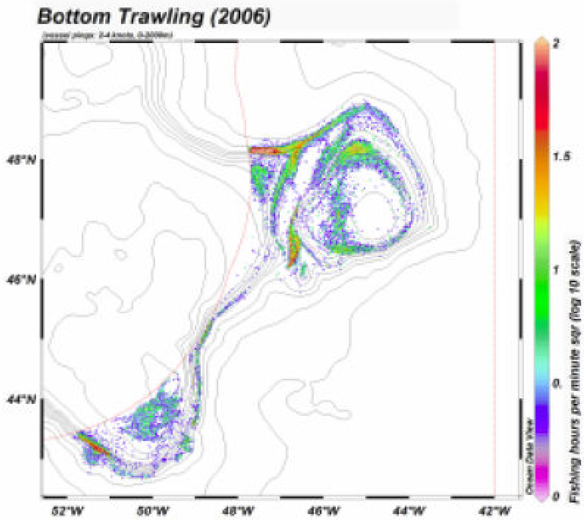
Figure 4.1.- NAFO Regulatory Area (NRA) effort distribution (more than 700 meters depth) by quarter for 2007.

There is a NAFO Working paper where the VMS data was analysed for all trawl effort and not only for Greenland halibut effort (NAFO Secretariat, 2008).









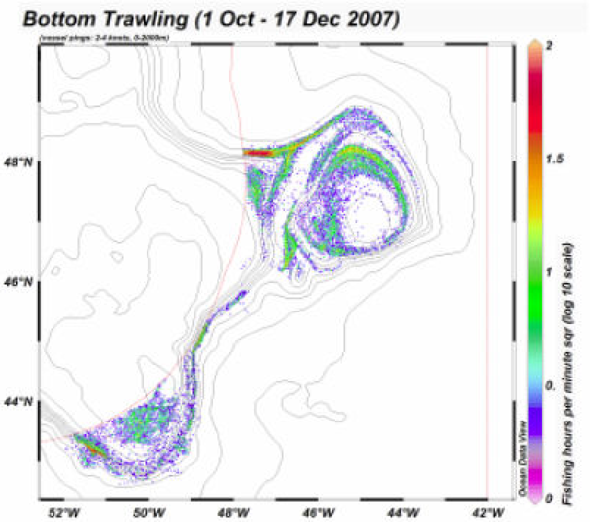


Figure 1. Mapping of annual fishing effort (hours/1minute square/3 months) for 2003-2007 estimated from VMS data and assuming that a vessel steaming at a speed of 2.00-3.99 knots is trawling. (Note that the label in the figures of 2-4 knots means more than 2.0 and less than 4.0 knots.)

Figure 2 (next 4 pages). Mapping of quarterly fishing effort (hours/1minute square/3 months) for 2003-2007 estimated from VMS data and assuming that a vessel steaming at a speed of 2.00-3.99 knots is trawling. (Note that the label in the figures of 2-4 knots means more than 2.0 and less than 4.0 knots.)

Figure 4.2.- NAFO Regulatory Area (NRA) trawl effort distribution by year since 2003 till 2007.

4.1.3.2 Please review any analyses of VMS data carried out for fleets fishing your stock

To calculate the effort through the VMS data, Thompson and Campanis, 2007 have assumed that the vessel is trawling when the speed is approximately 2–4 knots, is hauling at slower speeds and is steaming at higher speeds. This provides an estimate of the number of tows undertaken over a know number of days.

An analysis of the Greenland halibut fishery in the NAFO Regulatory Area (NRA) was undertaken using data provided through the Vessel Monitoring System (VMS) by Campanis *et al.* in 2008. The fishery occupies distinct regions on the slopes of the nose and tail of the Grand Bank, with little indication of consistent spatial changes in the pattern of fishing among quarters or years. There is evidence that the effort has been reducing fairly steadily from 2003 to 2007. This is in line with the observed reduction in TAC.

The VMS data for vessels fishing in the NAFO Regulator Area (NRA) is held by the NAFO Secretariat, Dartmouth, Nova Scotia, Canada. Recent advances have allowed the NAFO Scientific Council to access summary VMS data in order to answer questions that will assist in the management of the fishery.

This paper details the seasonal fishing patterns of commercial fishing vessels targeting Greenland halibut in the NRA. The basic data is derived from locations transmitted by fishing vessels as part of the monitoring and surveillance protocols that have been in place since 2003. Using certain assumptions, it is possible to quantify when and where vessels are fishing, and to observe seasonal patterns and annual changes.

4.1.3.3 How could the coverage, availability, quality and use of VMS data be improved?

NAFO Secretariat have been working very much in the last years to improve the quality and utility of the VMS data. In this moments we are trying to incorporate more information in the VMS data as depth, catches or cod end size to have the possibility the analyse the VMS data by fishery.

From 2010 onwards the period of emission of the VMS data will be 1 hour, since 2004 it was 2 hours.

It would be good that the VMS data was available for all NAFO area and not only for the NAFO NRA area.

4.1.4 Observer data

4.1.4.1 Please complete the table below on observer activity, where applicable:

In NAFO there are two types of Observers: NAFO Observers that only collect information, they do not sample, they are regulated by the NAFO Observer Program and their covertures is 100% in the NRA and the National Scientific Observers that they recollect information and made biological samplings. The covertures of the National Observers is not the same for all countries and years and for the EU countries are under the DCF. There are some UE countries that the same Observer carry out the NAFO and Scientific functions (Table 4.10).

Fleet ID	Observer type: enforcement or scientific or both?	If EU vessels – funded under DCF or compliance with EC Deep-water Licensing Reg?	% of vessel trips covered	Sampling Plan /SOP available?	Data made available to stock assessments?
SPt	Enforce		100%		Yes
	Scientific	DCF	15%	Yes	Yes
PTt	Enforce		100%		No
	Scientific	DCF	13%	Yes	Yes
CAt	Scientific		??		Yes
CAg	Scientific		??		Yes
CAl	Scientific		??		Yes
RUt	Scientific/Enforce		100%		Yes
JAt	Scientific/Enforce		100%		Yes
ESt	Scientific/Enforce	DCF	100%		Yes
FRt					

Table 4.10.- NAFO Observers data (Scientific and NAFA Observers) and their use in the assessment of the Greenland halibut stock.

4.1.4.2 Fisheries data recorded by observers: please complete yes/no and cite time-series in the cells in the table below. Please append all available time-series data disaggregated by fleet ID if possible.:

The NAFO Observers only are mandatory in the NRA and till now only recollect fishery information (catches, effort, etc) but not information about seabirds, marine mammals or turtles (Table 4.11). In this

moments NAFO is preparing a protocol for these observers to recollect information on VME. The NAFO Observers information is available for some countries (Spain) in aggregating format and present the results as SCR documents, NAFO Secretariat have the aggregated information of these observers for all countries but not in electronic format.

Spain
The Scientific Observers data is available since 1992 and besides recording catches, discards, and effort, these observers carried out biological sampling of the main species taken in the catch. Some of them record information for VME, seabirds, marine mammals and turtles but this information is not include in the DCF. The Scientific Observer data have some confidentially restrictions and is only give for the assessment groups aggregating and as SCR documents.

Fleet ID	**Species composition of retained catch?**	**Species composition of discarded catch?**	**Fishing effort details (see under 4.1.2)**	**VME spps e.g. corals and sponges etc**	**PET[5] spp**	**Seabirds**	**Marine mammals**	**Turtles**
SPt	Yes	Yes		Some		Some	Some	Some
PTt	Yes	Yes						
CAt	Yes??	Yes??						
CAg	Yes??	Yes??						
CAl	Yes??	Yes??						
RUt	Yes??	Yes??						
JAt	Yes??	Yes??						
ESt	Yes??	Yes??						
FRt								

Table 4.11.- Fisheries data recorded by observers by fleet.

4.1.4.3 Are all species in retained and discarded catches recorded? If not please describe by fleet ID.

Spain: both the Scientific and the NAFO Observers collect catch and discards information for all fishes species.

Portugal: Both the Scientific and the NAFO Observers collect catch information for all fish species, some Scientific Observers collect discards information.

4.1.4.4 Are species ID keys available and are they fit for purpose? .

All the Spanish NAFO and Scientific Observers receive a training course where we supply the observers with all the material and knowledge necessary to carry out their work.

In Portugal the NAFO Observers belong to a private company. The Scientific Observers receive a training course where we supply the observers with species ID keys for the most common fishes.

4.1.4.5 Are species recorded as presence/absence, by weight or by number? Please describe by fleet ID

Both NAFO and Scientific Observers record the species by weight (landing+discards). NAFO Observers only take data. The Scientific Observers take data and make biological samples of the catches main species.

4.1.4.6 Please list fishing effort details recorded by observers on vessels in each fleet.

Both, NAFO and Scientific observers collect the fishing effort as trawling time in a haul by haul basis.

4.1.4.7 Are corals and sponges recorded as presence/absence, by weight or by number? Please describe by fleet ID.

[5] PET – protected, endangered or threatened species.

Spain: The little observers information available about corals and sponges are take by weight. Not all Scientific observers recollect information about coral and sponges. The Observers who recollected information have been some identification problems and most of the information is in available as big taxonomic levels (corals or sponges). The best information about corals and sponges come from the surveys.

No information is recorded by the Portuguese Scientific Observers.

4.1.4.8 To what taxonomic level are corals and sponges identified? Please describe by fleet ID.

Spain: The observers information are identified as general taxonomic levels (corals or sponges) and depends on the observer formation. In the case of the survey information we try to identify to the small taxonomic levels possible.

No information is recorded by the Portuguese Scientific Observers.

4.1.4.9 Are coral and sponge ID keys available and are they fit for purpose? Please describe by fleet ID.

NAFO SC is preparing a Corals and Sponges guide (Kenchington *et al.*, 2009) for all fleets and observers. In 2009 have been presented the corals guide.

4.1.4.10 Please list any PET spp captured by fleet. What details are recorded?

For fish species we need a PET list to cross with the catches information. For this species we have the catch weight and the position.

For not fish species, this information in many cases are not available because are collected under observations charter and is not available to quantify because some observers collected and others not and is not available in electronic format.

4.1.4.11 Please list seabird spp captured by fleet. What details are recorded?

This information in many cases are not available in electronic format because are collected as personal comments. This information is impossible quantify because some observers collected and others not and is not in a electronic data base. We can put the more important species or groups. It would be expected that the turtle by catch level was very low because this is a deepwater fishery and the most important gear in the fishery is the trawl. The data collected were position, species, sex, total length and wings length.

4.1.4.12 Please list marine mammal spp captured by fleet. What details are recorded?

Spain: Based on 1993 and 1994 data, the most important marine mammals captured were the cetaceans and the pinnipeds. Seals were more frequently caught than cetaceans and the most important seals species were: harbour seals, harp seals, grey seals and ringed seals. Among the dolphins there were with side dolphins, striped dolphins, common dolphins and pilot whales (Lens, 1997). The data collected were position, species, sex and different length measures.

No information is recorded by the Portuguese Scientific Observers.

4.1.4.13 Please list turtle spp captured by fleet. What details are recorded?

This information in many cases are not available in electronic format because are collected as personal comments This information is impossible quantify because some observers collected and others not and is not in a electronic data base. We can put the more important species or groups. It would be expected that the turtle by catch level was very low because this is a deepwater fishery and the most important gear in the fishery is the trawl. The data collected were position, species, sex and different length measures.

4.1.4.14 How could observer coverage, availability and quality of observer data, and the use of data be improved?

The Scientific observer data have a good quality, it can be improved by increasing the covertures of total fishing effort observed and to have some new observers specialising in Ecosystem Indicators (Corals, sponges, etc).

4.1.5 Fishing footprint

4.1.5.1 Does a spatial and temporal fishing footprint of effort exist for each of the fleets fishing your stock?

Yes , there is a NAFO regulatory Area (NRA) footprint make with effort data between 1988-2007 (Table 4.12 and figure 4.3). This footprint is for all fisheries carried out in the NRA for all countries and gears (NAFO Secretariat, 2009).

4.1.5.2 If so please describe the data used (VMS, logbook data etc) and include the latest charts.

All data available (VMS, Logbooks, observers, etc.) was submitted by the different countries to NAFO Secretariat: Table 4.12 from NAFO Secretariat. 2009.

	Submission Information		Data Supplied				Filter
Flag State	Date	Data format	Years	Lat/Lon [1]	Date/time	Speed (knots)	Speed (knots)
Canada	18-Sep-08	point data	1987-2007	dec	year	-	-
Estonia	12-Sep-08	haul data	1996-2007	dec	year	-	-
Faroe Is.	16-Sep-08	haul data	2003-2007	dec	year	-	-
Germany	03-Mar-09	-	2001-2007	-	-	-	-
Greenland	10-Sep-08	haul data	1993-2008	deg	year	-	-
Iceland[2]	19 (23) Sep 08	point data	1993-2006	dec	-	-	-
Japan	24-Nov-08	point data	2001-2007	dec	date/time	0-6.9	1.0-4.0
Norway	30-Dec-08	point data	2000-2007	dec	year/month	1.0-5.0	1.0-4.0
Portugal	12-Sep-08	point data	1997-2007	deg	date/time	0-14.0[4]	1.0-4.0
Russia[3]	16-Apr-09	point data	1987-2007	dec	year/month/day	-	-
Spain[3]	24-Apr-09	point data	1987-2007	dec	year	-	-

[1] dec: decimal degrees as DD.dddd; deg: DDMMdd

[2] Iceland re-submitted their information after the September 2008 Annual meeting.

[3] Russia and Spain submitted their point data, respectively, during and soon after the FCWGFMS March 2009 meeting.

[4] Submission indicated maximum speed of 28.0 knots which is assumed to be an outlier.

- not submitted or no information.

Table 4.12.- Summary of flag State submission on bottom fishing activities in the NRA for the period 1987-2007

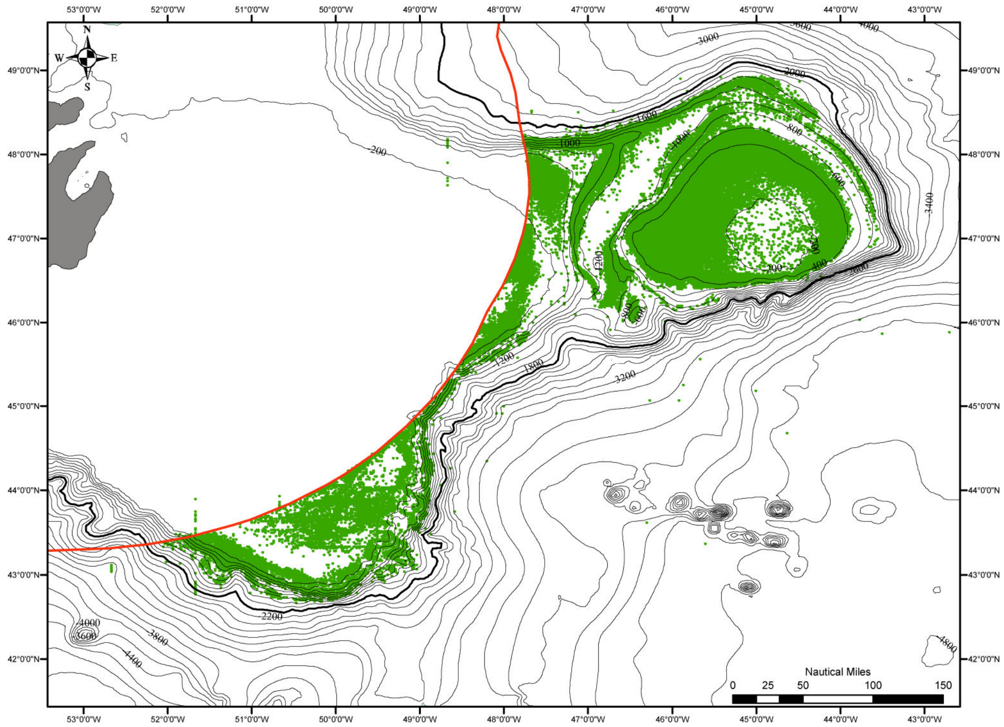


Figure 4.3. Composite plot of coordinates of bottom fishing activity data submitted by all flag States for 1987-2007 filtered by criteria of occurrence (at least in least two different years) and speed (1.0-4.0 knots) (NAFO Secretariat. 2009).

4.1.5.3 How has the fishing footprint changed over time for each fleet.

The footprint is for all fisheries and for the whole period. Footprint has changed over the time because the fisheries has changed, some fisheries were closed (cod, American place, etc) and other fisheries have started in this period (Greenland halibut, shrimp, etc.). But there is not very much information by year to study the footprint variability. Only since the introduction of the VMS data in 2003 NAFO SC have information year by year to make this study.

4.1.5.4 Is there any information on the distribution of fishing effort by depth strata? If so please describe trends with time.

Yes there is some information about the depth distribution of the effort. Figure 4.4 (NAFO Secretariat. 2009) shows the percentage of fishing activity, assumed to be trawling, by depth within the NRA for all fleets. The source data was the Secretariat's VMS data for 2003-2007. Not information about the trend with time because the VMS data started in 2003.

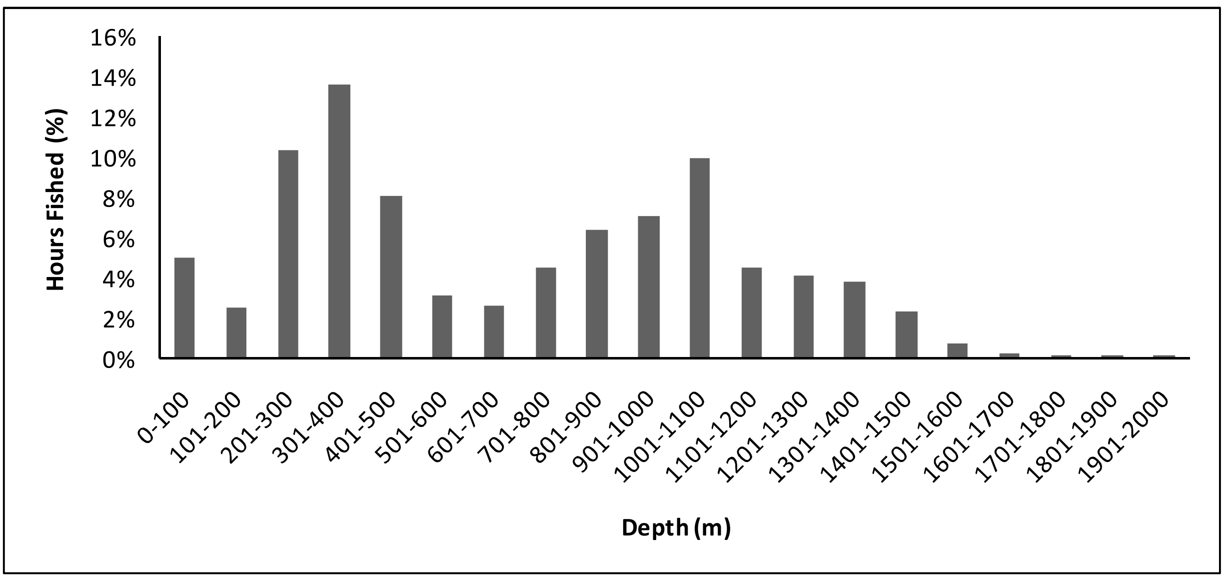


Figure 4.4.- Percentage of fishing activity, assumed to be trawling, by depth within the NRA for all fleets in the period 2003-2007.

There is some information by countries based on the Scientific Observer data, this data is a sample of the total effort. In Figure 4.5 we can observer the percentage of the Spanish effort since 1992 till 2008 by depth. It can be observed that since 2003, the effort more than 700 m. decrease and the effort less than 200 m increase. These trends are results of the decrease in the Greenland halibut fishery due to the Recovery plan. Since 1990 with the development of the Greenland halibut fishery, the effort in the depth between 700-1400 was increased a lot, before 1990 all the effort as carried out at less than 300 m.

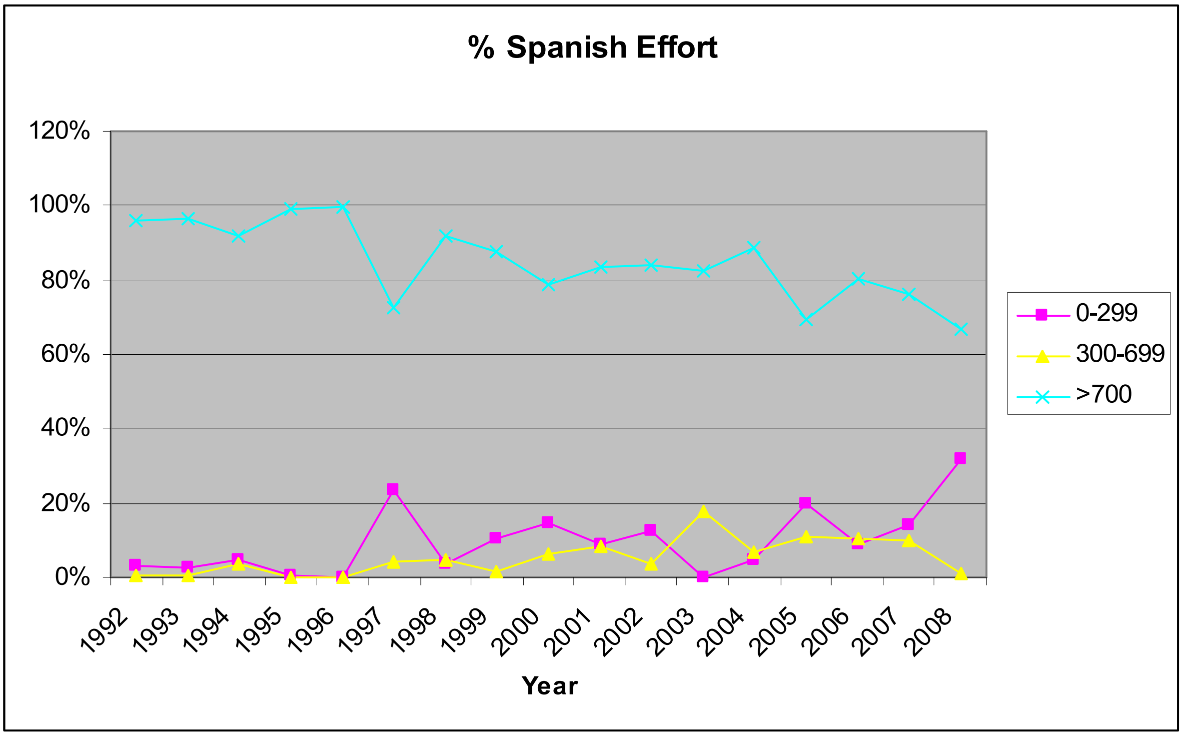


Figure 4.5 .- Percentage of the NAFO Spanish effort by year and depth strata.

For Portuguese fleet some information can be found in Alpoim *et al.* 2001.

4.1.5.5 Please describe highest level of resolution and lowest level of desegregation available for data of position of fishing recorded in logbooks.

In NAFO we don't have available the logbooks information but is more or less the same as the STATLAN. I think that the lowest level of desegregation in the logbook and STATLAN information is by day. With this level is not possible to know the hauls positions. To know the position of the hauls we use the NAFO and Scientific Observer data.

4.1.6 Abundance indices derived from commercial catch and effort data

4.1.6.1 Please list available abundance indices indicating which are and which are not used in assessments.

Standardized estimates of CPUE were available from fisheries conducted by Canada, EU- Spain and EU-Portugal. This information are used in the assessment but not in the model "STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in SA 2 + Div. 3KLMNO should not be used as indices of the trends in the stock. It is possible that by concentration of effort and/or concentration of Greenland halibut, commercial catch rates may remain stable or even increase as the stock declines." (Scientific Council Meeting, 2004).

4.1.6.2. Please include tables and figures of all available indices and append data at the lowest disaggregation level possible (ideally haul by haul).

The Scientific Council has not available the information haul by haul, only is available the final results of the different Standardised CPUE models as SCR documents (Tables, 4.13, 4.14 and 4.15).

Table 4.13 (Brodie *et al.* 2009). Standardized CPUE for Greenland halibut in NAFO 2HJ3KL based on a multiplicative model based utilizing HOURS FISHED as a measure of effort. Results are from the CANADIAN OTTERTRAWL fleet (2008 based on preliminary data).

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	S.E.	RETRANSFORMED MEAN	S.E.	CATCH	EFFORT	% OF CATCH IN THIS ANALYSIS
1976	-1.2081	0.0933	0.310	0.093	767	2475	9.5
1977	-0.9274	0.0442	0.421	0.088	2866	6813	20.9
1978	-0.3547	0.0327	0.750	0.135	3951	5267	30.0
1979	-0.3430	0.0697	0.745	0.194	5183	6957	35.4
1980	-0.1831	0.0253	0.894	0.141	3946	4414	42.9
1981	-0.3057	0.0238	0.791	0.122	6155	7778	59.2
1982	-0.2641	0.0225	0.825	0.123	8143	9865	73.4
1983	-0.2691	0.0172	0.824	0.108	7085	8603	87.4
1984	-0.1256	0.0195	0.950	0.132	6070	6393	90.4
1985	-0.5955	0.0196	0.594	0.083	4847	8166	91.2
1986	-0.8184	0.0289	0.473	0.080	1896	4011	74.6
1987	-0.3754	0.0422	0.731	0.149	2465	3371	85.6
1988	-1.1496	0.0535	0.335	0.077	629	1876	38.8
1989	-0.6703	0.0375	0.546	0.105	988	1810	21.2
1990	-0.7217	0.0226	0.522	0.078	2402	4599	75.9
1991	-1.0587	0.0218	0.373	0.055	3254	8722	70.0
1992	-1.1765	0.0188	0.332	0.045	2502	7534	50.2
1993	-1.0780	0.0276	0.365	0.060	1034	2834	87.7
1994	-0.9822	0.0531	0.396	0.090	575	1450	96.5
1995	-0.8311	0.0933	0.452	0.135	632	1398	56.2
1996	-0.9686	0.0307	0.406	0.071	1043	2566	81.0
1997	-0.6055	0.0346	0.583	0.108	1017	1744	94.7
1998	-0.7977	0.0953	0.467	0.141	46	99	63.0
1999	-0.8731	0.0982	0.432	0.132	81	187	81.5
2000	-0.7096	0.0299	0.527	0.091	1285	2439	99.3
2001	-0.5274	0.0221	0.635	0.094	1833	2889	99.2
2002	-0.9409	0.0263	0.419	0.068	1784	4260	98.7
2003	-1.0339	0.0134	0.384	0.044	3710	9661	89.9
2004	-1.0067	0.0166	0.394	0.051	1832	4650	98.5
2005	-1.0073	0.0253	0.392	0.062	2225	5675	97.8
2006	-0.5138	0.0373	0.638	0.122	2282	3575	97.9
2007	-0.1470	0.0457	0.917	0.194	1866	2034	99.7
2008	0.2422	0.0528	1.349	0.306	2429	1801	93.0

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.188

Table 4.13.- Standardized CPUE for Greenland halibut in NAFO 2HJ3KL based on a multiplicative model based utilizing HOURS FISHED as a measure of effort, based on the CANADIAN OTTERTRAWL fleet.

```
Call:
lm(formula = lcpueplusmcpue ~ year + division + month + depth +
    vessel + division:month + division:depth)

Residuals:
      Min        1Q    Median        3Q       Max
-2.686704 -0.251569  0.008237  0.257554  2.241800

Coefficients: (2 not defined because of singularities)
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)          6.205e+00  6.131e-02 101.206  < 2e-16 ***
year1993            -1.868e-01  2.487e-02  -7.511 6.30e-14 ***
year1994            -2.556e-01  2.487e-02 -10.277  < 2e-16 ***
year1995            -1.783e-01  5.251e-02  -3.395 0.000689 ***
year1996             1.336e-02  2.702e-02   0.494 0.621047
year1997            -6.648e-02  2.875e-02  -2.313 0.020751 *
year1998            -2.614e-01  2.941e-02  -8.889  < 2e-16 ***
year1999            -3.610e-01  3.594e-02 -10.046  < 2e-16 ***
year2000            -7.985e-02  2.581e-02  -3.094 0.001979 **
```

```
year2001            -1.693e-01  2.836e-02  -5.969 2.46e-09 ***
year2002             1.060e-03  3.044e-02   0.035 0.972225
year2003            -2.297e-01  2.913e-02  -7.884 3.44e-15 ***
year2004            -4.842e-01  2.679e-02 -18.072  < 2e-16 ***
year2005            -3.073e-01  2.858e-02 -10.754  < 2e-16 ***
year2006            -2.563e-02  2.854e-02  -0.898 0.369148
year2007             6.525e-01  3.058e-02  21.338  < 2e-16 ***
year2008             4.978e-01  4.396e-02  11.325  < 2e-16 ***
division3M          -4.488e-01  5.414e-02  -8.291  < 2e-16 ***
division3N          -4.213e-01  6.915e-02  -6.092 1.15e-09 ***
division3O          -1.620e+00  4.470e-01  -3.624 0.000291 ***
monthFeb            -7.964e-02  2.738e-02  -2.909 0.003633 **
monthMar            -2.770e-01  3.072e-02  -9.017  < 2e-16 ***
monthApr            -1.373e-01  3.102e-02  -4.427 9.63e-06 ***
monthMay            -2.032e-01  2.942e-02  -6.909 5.14e-12 ***
monthJun            -2.166e-01  2.971e-02  -7.292 3.26e-13 ***
monthJul            -3.034e-01  2.943e-02 -10.307  < 2e-16 ***
monthAug            -4.788e-01  2.856e-02 -16.765  < 2e-16 ***
monthSep            -5.767e-01  3.070e-02 -18.789  < 2e-16 ***
monthOct            -6.641e-01  2.970e-02 -22.363  < 2e-16 ***
monthNov            -3.687e-01  2.768e-02 -13.319  < 2e-16 ***
monthDec            -1.315e-01  2.769e-02  -4.748 2.08e-06 ***
depth2              -1.666e-02  1.892e-02  -0.881 0.378538
depth3              -4.284e-02  1.922e-02  -2.228 0.025890 *
depth4              -4.536e-02  1.997e-02  -2.272 0.023128 *
depth5              -1.956e-02  2.120e-02  -0.922 0.356362
depth6               9.541e-04  2.175e-02   0.044 0.965007
depth7               8.029e-02  3.300e-02   2.433 0.014980 *
depth8               1.472e-01  4.506e-02   3.266 0.001094 **
depth9               9.750e-02  9.749e-02   1.000 0.317247
vessel   2          -3.776e-02  9.926e-02  -0.380 0.703621
vessel   3          -3.284e-01  8.871e-02  -3.702 0.000215 ***
vessel   4           2.505e-01  5.786e-02   4.329 1.51e-05 ***
vessel   5          -3.715e-01  7.192e-02  -5.166 2.43e-07 ***
vessel   6           2.598e-01  5.699e-02   4.558 5.21e-06 ***
vessel   7          -2.294e-01  5.594e-02  -4.101 4.15e-05 ***
vessel   8          -1.255e-01  9.299e-02  -1.350 0.177202
vessel   9          -1.256e-01  5.920e-02  -2.122 0.033873 *
vessel  10           1.859e-01  8.342e-02   2.229 0.025828 *
vessel  11          -5.144e-01  7.143e-02  -7.202 6.31e-13 ***
vessel  12          -4.806e-02  5.789e-02  -0.830 0.406446
vessel  13           3.709e-01  7.255e-02   5.112 3.24e-07 ***
vessel  14          -6.955e-01  5.521e-02 -12.597  < 2e-16 ***
vessel  15          -7.460e-01  5.817e-02 -12.825  < 2e-16 ***
vessel  16          -7.779e-01  6.054e-02 -12.849  < 2e-16 ***
vessel  17           2.697e-01  2.159e-01   1.249 0.211511
vessel  18          -1.711e-01  5.269e-02  -3.247 0.001168 **
vessel  19          -2.001e-01  5.609e-02  -3.567 0.000363 ***
vessel  20           1.601e-01  7.022e-02   2.280 0.022613 *
vessel  21          -5.546e-02  5.546e-02  -1.000 0.317318
vessel  22          -2.062e-01  7.089e-02  -2.908 0.003640 **
vessel  23           1.873e-02  5.467e-02   0.343 0.731870
vessel  24          -1.341e-01  1.115e-01  -1.203 0.229070
vessel  25          -8.200e-02  5.522e-02  -1.485 0.137598
vessel  26           6.893e-01  6.697e-02  10.293  < 2e-16 ***
vessel  27          -1.963e-01  6.183e-02  -3.175 0.001502 **
vessel  28          -5.431e-01  5.321e-02 -10.206  < 2e-16 ***
vessel  29           1.267e-01  7.628e-02   1.661 0.096738 .
vessel  30          -3.339e-01  7.615e-02  -4.384 1.17e-05 ***
vessel  31          -1.823e-01  1.286e-01  -1.418 0.156156
vessel  32          -5.984e-01  1.493e-01  -4.009 6.12e-05 ***
vessel  33           3.506e-01  1.397e-01   2.510 0.012079 *
vessel  34           1.778e-01  5.349e-02   3.325 0.000888 ***
vessel  35          -2.398e-01  6.215e-02  -3.859 0.000115 ***
vessel  36          -2.874e-01  9.683e-02  -2.968 0.003005 **
vessel  37          -9.146e-02  1.020e-01  -0.897 0.369756
vessel  38          -3.836e-01  6.324e-02  -6.066 1.35e-09 ***
```

vessel 39	-5.557e-01	6.067e-02	-9.160	< 2e-16	***
vessel 40	-3.787e-01	7.331e-02	-5.166	2.42e-07	***
vessel 41	-4.434e-01	8.412e-02	-5.271	1.38e-07	***
vessel 42	1.454e-01	5.816e-02	2.501	0.012406	*
vessel 43	-3.238e-01	9.472e-02	-3.419	0.000631	***
vessel 44	3.913e-01	8.626e-02	4.537	5.77e-06	***
vessel 45	-6.342e-01	7.404e-02	-8.566	< 2e-16	***
vessel 46	-3.764e-01	6.531e-02	-5.763	8.45e-09	***
vessel 47	-1.386e-01	5.957e-02	-2.326	0.020027	*
vessel 48	-3.736e-02	5.634e-02	-0.663	0.507315	
vessel 49	-3.110e-01	8.978e-02	-3.464	0.000534	***
vessel 50	3.577e-02	7.573e-02	0.472	0.636675	
vessel 51	-9.421e-02	5.681e-02	-1.658	0.097304	.
vessel 52	-9.964e-02	1.006e-01	-0.990	0.321961	
vessel 53	-2.785e-01	6.008e-02	-4.635	3.60e-06	***
vessel 54	3.930e-02	5.959e-02	0.660	0.509569	
vessel 55	7.556e-02	6.228e-02	1.213	0.225045	
vessel 56	-1.990e-01	5.629e-02	-3.535	0.000409	***
vessel 57	1.988e-01	5.396e-02	3.684	0.000231	***
vessel 58	-2.561e-01	6.576e-02	-3.894	9.89e-05	***
vessel 59	-3.464e-01	5.485e-02	-6.315	2.79e-10	***
division3M:monthFeb	1.432e-01	4.548e-02	3.150	0.001638	**
division3N:monthFeb	1.392e-01	7.475e-02	1.862	0.062559	.
division3O:monthFeb	-3.686e-01	3.939e-01	-0.936	0.349422	
division3M:monthMar	2.547e-01	4.515e-02	5.642	1.72e-08	***
division3N:monthMar	2.826e-01	8.007e-02	3.529	0.000418	***
division3O:monthMar	1.010e+00	4.284e-01	2.357	0.018415	*
division3M:monthApr	2.591e-01	4.709e-02	5.502	3.84e-08	***
division3N:monthApr	4.257e-01	7.532e-02	5.652	1.62e-08	***
division3O:monthApr	8.860e-01	3.549e-01	2.496	0.012556	*
division3M:monthMay	1.528e-01	4.867e-02	3.140	0.001696	**
division3N:monthMay	4.471e-01	7.272e-02	6.149	8.05e-10	***
division3O:monthMay	6.966e-01	3.336e-01	2.089	0.036770	*
division3M:monthJun	9.459e-02	5.247e-02	1.803	0.071445	.
division3N:monthJun	3.729e-01	7.012e-02	5.317	1.07e-07	***
division3O:monthJun	-1.397e-01	5.195e-01	-0.269	0.788015	
division3M:monthJul	1.915e-01	5.521e-02	3.469	0.000525	***
division3N:monthJul	4.210e-01	7.024e-02	5.994	2.11e-09	***
division3O:monthJul	3.390e-01	3.333e-01	1.017	0.309128	
division3M:monthAug	2.779e-01	5.094e-02	5.456	4.98e-08	***
division3N:monthAug	7.401e-01	6.657e-02	11.118	< 2e-16	***
division3O:monthAug	5.996e-01	3.426e-01	1.750	0.080166	.
division3M:monthSep	2.176e-01	6.620e-02	3.287	0.001014	**
division3N:monthSep	5.124e-01	6.744e-02	7.597	3.25e-14	***
division3O:monthSep	-5.410e-02	3.618e-01	-0.150	0.881138	
division3M:monthOct	4.012e-01	5.497e-02	7.299	3.09e-13	***
division3N:monthOct	6.098e-01	6.680e-02	9.129	< 2e-16	***
division3O:monthOct	7.566e-01	4.830e-01	1.566	0.117277	
division3M:monthNov	2.310e-01	5.147e-02	4.488	7.27e-06	***
division3N:monthNov	2.851e-01	7.029e-02	4.056	5.03e-05	***
division3O:monthNov	6.257e-01	3.299e-01	1.897	0.057876	.
division3M:monthDec	2.624e-01	5.943e-02	4.415	1.02e-05	***
division3N:monthDec	2.586e-01	7.075e-02	3.655	0.000258	***
division3O:monthDec	6.208e-01	3.368e-01	1.843	0.065370	.
division3M:depth2	1.742e-01	4.640e-02	3.754	0.000175	***
division3N:depth2	-5.969e-02	4.241e-02	-1.407	0.159343	
division3O:depth2	7.470e-01	3.877e-01	1.927	0.054015	.
division3M:depth3	1.724e-01	4.412e-02	3.907	9.38e-05	***
division3N:depth3	-4.822e-02	4.120e-02	-1.170	0.241861	
division3O:depth3	9.099e-01	3.301e-01	2.756	0.005853	**
division3M:depth4	1.686e-01	4.361e-02	3.866	0.000111	***
division3N:depth4	-1.641e-03	4.269e-02	-0.038	0.969332	
division3O:depth4	1.002e+00	3.386e-01	2.959	0.003095	**
division3M:depth5	7.021e-02	4.421e-02	1.588	0.112278	
division3N:depth5	8.907e-05	4.578e-02	0.002	0.998448	
division3O:depth5	8.579e-01	3.492e-01	2.457	0.014021	*
division3M:depth6	-5.249e-03	4.787e-02	-0.110	0.912685	

```
division3N:depth6    1.855e-02  5.078e-02   0.365 0.714964
division3O:depth6    5.502e-01  3.512e-01   1.567 0.117195
division3M:depth7   -1.575e-01  6.336e-02  -2.485 0.012960 *
division3N:depth7   -5.077e-02  6.855e-02  -0.741 0.458914
division3O:depth7    1.643e-01  4.628e-01   0.355 0.722601
division3M:depth8   -7.068e-01  7.931e-02  -8.911  < 2e-16 ***
division3N:depth8   -1.947e-01  1.509e-01  -1.290 0.196973
division3O:depth8           NA         NA      NA       NA
division3M:depth9   -7.347e-01  1.185e-01  -6.199 5.87e-10 ***
division3N:depth9    4.931e-02  1.808e-01   0.273 0.785054
division3O:depth9           NA         NA      NA       NA
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Residual standard error: 0.4166 on 11988 degrees of freedom
Multiple R-Squared: 0.5308, Adjusted R-squared: 0.5249
F-statistic: 89.81 on 151 and 11988 DF, p-value: < 2.2e-16

Table 4.14. Spanish Standardized CPUE Parameter estimates from final log-linear model (González-Costas F. and D. González-Troncoso. 2009.).

For Portuguese fleet: (Vargas *et al.* 2009)

TABLE IV - A: GREENLAND HALIBUT TRAWL CATCH RATES, 1988-2008: mean annual cpue's corrected for the month, division and vessel of each observation.

	3L			3M			3N			3LMN			
	CPUE	ST.ERROR	C.V.	CPUE	ST.ERROR	C.V.	CPUE	ST.ERROR	C.V.	CPUE	ST.ERROR	C.V.	
1988	0.433	0.088	40.5							0.402	0.093	46.1	1988
1989	0.411	0.073	53.6							0.384	0.073	56.7	1989
1990	0.380	0.037	33.9	0.158			0.158			0.323	0.036	41.8	1990
1991	0.226	0.044	43.8				0.120	0.030	43.8	0.174	0.033	53.2	1991
1992	0.158	0.028	55.2				0.256	0.031	42.5	0.224	0.029	61.5	1992
1993	0.116	0.037	45.2				0.171	0.019	37.5	0.192	0.020	39.1	1993
1994	0.112	0.003	3.8				0.112	0.014	30.4	0.136	0.021	44.2	1994
1995	0.130	0.024	51.8	0.159	0.013	18.7	0.135	0.022	42.5	0.141	0.015	47.8	1995
1996	0.190	0.020	38.1	0.181	0.015	25.3	0.164	0.019	30.9	0.173	0.009	29.3	1996
1997	0.198	0.019	31.1	0.243	0.030	34.6	0.115	0.009	10.4	0.189	0.018	42.5	1997
1998	0.269	0.014	19.2	0.237	0.020	29.7	0.209	0.016	25.4	0.245	0.009	24.4	1998
1999	0.287	0.024	26.4	0.339	0.037	32.5	0.259	0.021	23.8	0.291	0.018	33.6	1999
2000	0.269	0.019	19.0	0.280	0.029	23.2	0.294	0.042	28.7	0.276	0.021	30.1	2000
2001	0.211	0.028	35.4	0.207	0.009	11.6	0.198	0.013	15.1	0.205	0.013	28.4	2001
2002	0.230	0.022	31.3	0.216	0.025	37.8	0.262	0.034	25.6	0.227	0.016	36.1	2002
2003	0.218	0.026	38.4	0.208	0.033	45.3	0.206	0.024	28.3	0.215	0.019	42.5	2003
2004	0.119	0.011	28.0	0.101	0.021	61.0	0.134	0.009	19.8	0.131	0.012	49.7	2004
2005	0.293	0.018	8.7	0.272	0.060	31.1				0.274	0.024	17.3	2005
2006	0.442	0.039	21.6	0.243	0.034	24.6				0.353	0.041	34.6	2006
2007	0.639	0.080	30.6	0.385	0.069	35.6				0.521	0.067	40.7	2007
2008	0.427	0.034	19.3	0.420	0.023	11.2				0.406	0.020	15.8	2008

Table 4.15. Portuguese Standardized CPUE from final log-linear model (Vargas *et al.* 2009.).

Figure 4.6 presents the Greenland halibut in SA 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2008 average.) (SCIENTIFIC COUNCIL MEETING Report – 2009.)

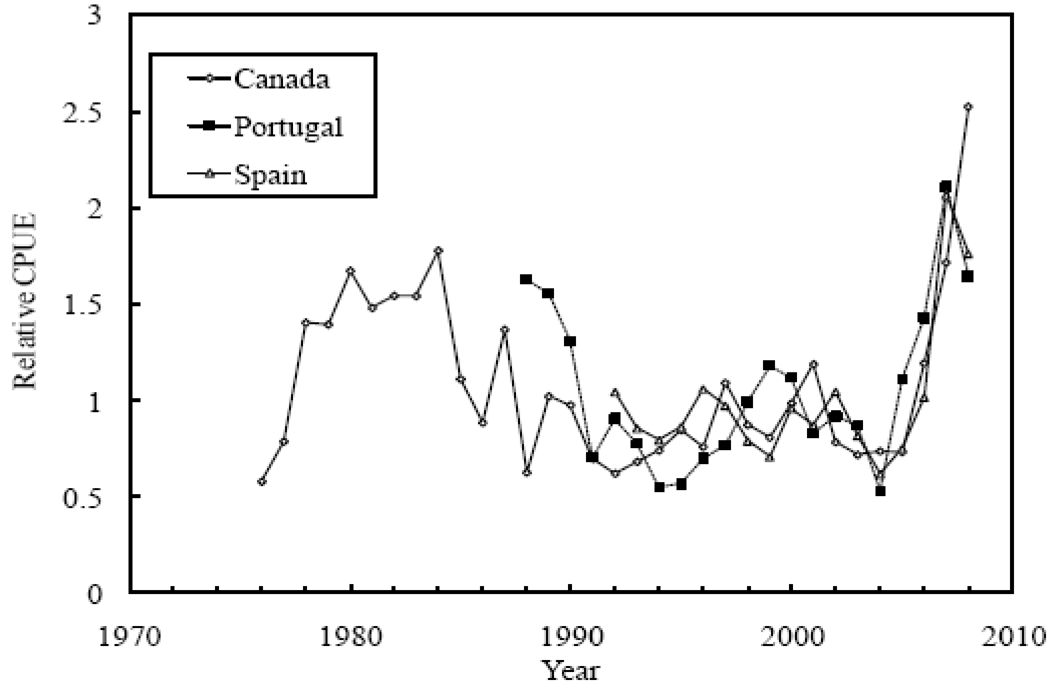


Figure 4.6.- Greenland halibut in SA 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2008 average.)

4.1.6.3. Please describe how the indices are calculated. Are they standardised and if so please describe method used.

The three available CPUEs are standardised and the method used are different by fleet. For the Spanish are described by González-Costas and González-Troncoso., for Portugal by Ávila de Melo and Alpoim, 1996. and for Canada by Brodie *et al.* 2009. See point 4.1.6.2 to know the models.

4.1.6.4 Please describe strengths and weaknesses of each index and if not used in assessments please explain why.

"STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in SA 2 + Div. 3KLMNO should not be used as indices of the trends in the stock (SCIENTIFIC COUNCIL MEETING. 2004). It is possible that by concentration of effort and/or concentration of Greenland halibut, commercial catch rates may remain stable or even increase as the stock declines." Different fleet applies different models to standardised the CPUE information.

4.1.6.5 How can these indices be improved and are there any potential new indices that can be used in assessments.

It would be good to develop only one model for all fleets.

One way to improve the standardisation is take in account the interactions between year and space. Some work was made in this way by Brandão *et al.* 2009. Updated CPUE data for the Canadian, Portugese and Spanish fleets are standardised using GLMs with an overdispersed Poisson error structure, and allowing for finer spatial stratification than the Division level to correct for possible redistribution of fishing towards higher density areas. Results for standardisations without year-interactions do show the recent increases evident in the nominal CPUE data; these results are independent of the extent of spatial stratification, and are broadly compatible with previous standardisation exercises, except for now showing a higher rate of recent increase in the Canadian case. However, the introduction of either Division or depth interaction terms with year in the standardisation does reduce the extent of the recent rate of increase.

4.1.7 Information and data made available by fishers, fisher organisations or other stakeholders

4.1.7.1 Please describe any existing data collection programmes in place.

The Vessel Monitoring System (VMS) is an application for remote monitoring of vessels. It provides real-time updates of vessel locations, handles catch and activity reports and provides easy access to information of each vessel. All vessels fishing in the NAFO Regulatory Area are required to be equipped with satellite tracking devices that transmit position reports every two hours. In addition, other hail reports, e.g., catch-on-entry, catch-on-exit, and transshipments, are transmitted to national Fisheries Monitoring Center (FMC) which in turn send the various messages, including position reports to the Secretariat. The VMS reports are

then automatically forwarded to those Contracting Parties with an inspection presence in the NAFO Regulatory area (Canada and EU). Through the VMS, the inspectors can easily locate any fishing vessel.

4.1.7.2 Please list the data and information for each fleet ID and describe if/how it has been used in monitoring and/or assessments. Please append the data at the lowest level of disaggregation possible.

The VMS and the NAFO Observer are Monitoring, Control and Surveillance data and these data is only supply aggregated for the NRA to the SC.

4.1.7.3 How could fishers play a stronger role in providing data and information for monitoring and assessments?

One way to improve the data collected, it would be that the vessel crew facilitated the Scientific Observers work on board to have a better data quality.

4.1.8 Fisheries data in general

4.1.8.1 Are there any aspects of fisheries data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.

The available data is enough to provide the assessment. Probably we need more efforts to improve the quality and the availability of the data.

4.2 Fisheries-independent survey data

4.2.1 Please complete the table below for any surveys that are currently carried out or have taken place in the last 10 years and append all available time-series abundance, length and age data at the lowest level of disaggregation possible (ideally haul by haul for catch and effort data):

The lowest level it would be the same as in the Scientific Council. For each survey there are indices of abundance by age and year for the objective species of the survey and are presented to the SC as SCR documents. Figure 4.16 (a and b) shows the characteristics of the different surveys carry out in NAFO with information about the Greenland halibut.

Country	Name of survey	Name of vessel (RV or commercial?	Gear used: trawl, acoustic etc	Time of year	Frequency & duration	Time-series available	Cover entire stock area?	If EU country, is DCF funded?
Canada	Spring	Teleost and Wilfred Templeman	Trawl (Campelen)	Apr-June	Yearly (300 sets)	1995-2007	No	
Canada	Autumn	Teleost and Wilfred Templeman	Trawl (Campelen)	Fall	Yearly (420 sets)	1978-2007 2J3K 1981-2007 3L	No	
EU SP-PT	Flemish Cap	Vizconde	Trawl (Lofoten)	Jul	Yearly (180 sets)	1988-2007	No	Yes
EU SP	3LNO	Vizconde	Trawl (Campelen)	Apr-May	Yearly (210 sets)	3NO1995-2007 3L 2003, 2004, 2006, 2007	No	Yes

Table 4.16 a .- Characteristics of the different surveys carry out in NAFO with Greenland halibut information (2008).

Stock name: Greenland halibut in Subareas 2+3KLMNO

Name of survey	Location (Div.)	Season months(s)	Years of survey from, to or since	Type of survey and gears	Target species	No. of Sets	24 hr fishing	Area of coverage in relation to stock distribu-tion (%)	Depth range	Research data related to stock size estimates: abun-dance	bio-mass	ALK	LF	Indiv-idual weights	Country	SCS/ SCR Doc. No.
Canadian groundfish spring	3LNO	Apr-June	1995-2007	Stratified-random Campelen trawl	Groundfish	295 in 2007	Y		46-731 m	Y	Y	Y	Y	Y	Canada	08/32
Canadian autumn groundfish	2J,3K, 3L	Fall	1978-2007 2J3K 1981-2007 3L	Stratified-random Engel trawl 1978-94 2J3K Yankee trawl 1981-82 3L Engel trawl 1984-94 3L Campelen Trawl all areas 1995-2007	Groundfish (Cod, flounders, G. halibut, Redfish & shellfish)	412 in 2007	Y	This column not appropriate for this species given differences in depth coverage and areas covered in the surveys.	2J3K in 2007 127-1494 m 3L in 2006 81-1424 m	Y	Y	Y	Y	Y	Canada	08/32
EU bottom trawl	3M	Jul	1988-2007	Stratified-random Bottom trawl	Groundfish & shrimp	174 in 2007	N		128-1460 m	Y	Y	Y	Y	Y	EU	08/34
EU-Spain bottom trawl	Reg. Area 3LNO	Apr-May	3NO1995 -2007 3L 2003, 2004, 2006, 2007	Stratified-random Bottom trawl	Groundfish	204 in 2007	N		56-1464 m in recent years	Y	Y	N	Y	Y	Spain	08/07 08/20
Canadian groundfish	2GH	Sep-Oct	occasion since 1978	Stratified-random Campelen in 1996-2006	Groundfish & shellfish	81 in 2H in 2006	Y		107-1437 m in 2006	Y	Y	Y	Y	Y	Canada	08/32
Canadian groundfish	3MNO	Sep-Dec	3NO 1990-2007 3M* 1996-2003, 2006-07	Stratified-random Campelen	Groundfish	26-3M 94-3N 99-3O in 2007	Y	3M * full coverage 1996; since 1997 only in deepwater Sackville Spur, Flem. Pass	768-1404 m 3M 48-1419 m 3N 64-1410 m 3O in 2007	Y	Y	Y	Y	Y	Canada	08/32
Russian	3M	May	1987-96	Stratified-random Bottom trawl	Groundfish	90	Y	Flemish Cap	914 m in 1996	Y	Y	Y	Y	N	Russia	98/13
	3LM Fl. Pass	Feb Apr-May	1995-96 2000	Stratified-random Bottom trawl	Groundfish	94	Y		732-1280 m	Y		Y	Y	N	Russia	01/10
	3M	May-June	2001-02	Stratified-random Bottom trawl	Groundfish		Y		127-1280	Y	Y	Y	Y	N	Russia	03/09

Table 4.16 b .- Characteristics of the different surveys carry out in NAFO with Greenland halibut information (all years).

4.2.2 For each survey please:-

- Describe main aims
- Describe the survey protocol and include map of survey grid
- Describe survey gear used in detail
- If survey does not cover entire area of stock – please explain why.
- Document gear selectivity where appropriate

This information about the surveys can be found in SCRs documents.

Brodie and Stansbury, 2007 describe the Spring and fall Canadian surveys. Stratified random multispecies trawl surveys have been conducted by the Department of Fisheries and Oceans in the Newfoundland and Labrador Region annually in spring since 1971, and in autumn since 1977. Spring surveys cover NAFO Divisons 3L, 3N, 3O, and 3P. Since 1990 the autumn surveys have covered the offshore areas of NAFO Divisions 2J, 3K, 3L, 3N, and 3O. During 1995, the Campelen 1800 shrimp trawl was adopted as the standard survey gear, and coverage was extended to include the inshore areas of Div. 3K and 3L, parts of Div. 3M, Div. 2GH, and areas deeper than 1 000 m.

Some changes, planned and unplanned, have occurred to both survey series since 1995. Many of these unplanned changes have occurred because vessel breakdowns have not allowed full or timely completion of the entire survey area. The main problems with the 2004-06 fall surveys were the complete absence of survey sets deeper than 731 m in Div. 3LMNO, the lack of coverage in several other strata in Div. 3L, the reduction in coverage in some strata in Div. 3K, and the extension of the timing into January in 2005 and 2006. The approximately 650 sets completed in 2004 and 2005 surveys were the lowest numbers since the 1995 survey, although the number of sets in 2006 improved to 704. Coverage in the spring survey series has generally been more consistent, although the 2006 survey had minimal coverage in Div. 3NO, and at a later time than usual.

There are at least three sources of uncertainty resulting from the problems encountered during the surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets); changes in timing (surve coverage extended later, coverage of some strata/Divisions often spread out over a much longer period than planned); and vessel effects (few direct comparisons of the 3 vessels used, using vessels in areas where they have little or no coverage in previous years). Careful attention to survey gear and fishing protocols, along with set-by-set monitoring with trawl sensors ensures minimal variability during tows. However, the problems with survey coverage and timing have introduced a further degree of uncertainty into the survey estimates, and therefore stock assessment advice, for many species.

Gonzalez-Troncoso and Casas (2005) presented the description of the EU Spain and Portugal Flemish Cap survey. The surveys on NAFO Regulatory Area of Div. 3M was initiated by EU in 1988. Until 2003, surveys were carried out in summer (July), on board the Spanish vessel R/V Cornide de Saavedra using bottom trawl net type Lofoten until a depth of 400 fathoms. Since that year, the survey is carried out by the R/V Vizconde de Eza using the same trawl net. R/V Vizconde de Eza replaced R/V Cornide de Saavedra in 2003 survey. The objective of this change is to improve the Greenland halibut indices of abundance and biomass. For this, it is necessary to reach bigger depths. Due to the impossibility of the R/V Cornide de Saavedra to fish in depths of more than 400 fathoms, it was necessary to change the vessel. In order to maintain the data series obtained since 1988, comparative fishing trials between the two vessels were conducted in summers 2003 and 2004 to develop factors between the two fishing vessels. A series of 130 paired hauls until 400 fathoms was carried out, 61 in 2003 and 69 in 2004; 111 of then were valid hauls in both vessels. Mean catch and biomass, with their respective standard deviations, and length distribution, were transformed from R/V Cornide de Saavedra series to R/V Vizconde de Eza series.

Gonzalez-Troncoso *et al.,* (2004) described the 3NO EU-Spanish in NAFO. Surveys on NAFO Regulatory Area of Div. 3NO was initiated by Spain in 1995. Until 2001, the surveys was carried out in spring (May), on board the Spanish vessel C/V Playa de Menduiña (338 GT and 800 HP) using bottom trawl net type Pedreira. Since that year, the R/V Vizconde de Eza replaced the C/V Playa de Menduíña as the research vessel for the survey, using bottom trawl net type Campelen. The main specifications and geometry of these gears, as the rigging profile and the net plan, and a sheet with the resume of the main technical data of the survey are described in previous paper (Walsh et. al., 2001). In the period 1998-2003, the surveyed depth strata was the same (extended to 1464 m). The survey area was stratified following the standard stratification schemes (Bishop, 1994). Sets was allocated to strata proportionally to their size, with a minimum of two planned hauls per stratum and the trawl positions were chosen at random (Doubleday, 1981). Biomass and abundance indices were calculated by the swept area method (Cochran, 1997), assuming catchability factor of 1. Length distribution estimated from catches is presented for the period 1996-2003. The year 1995 is not representative for this species, because in that year more deeper strata were not surveyed, so it is not included in the analysis. R/V Vizconde de Eza had replaced C/V Playa de Menduíña in 2001 survey, so, in order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop factors between the two fishing vessel and gear combinations. A series of 92 paired hauls was carried out, 90 of then were valid hauls. Mean catch, stratified mean catch, abundance, biomass and their respective standard deviations, and length distribution, were transformed from C/V Playa de Menduíña series to R/V Vizconde de Eza series.

Roman *et al.* (2008) described the EU-Spanish survey in NAFO Division 3L. The surveys on NAFO Regulatory Area of Div. 3L (Flemish Pass) were initiated by Spain in 2003. The Research vessel "Vizconde de Eza" carried out the surveys following the same procedures and using the same bottom trawl gear Campelen. In 2003, the survey was carried out in spring (June) and it did not cover all strata adequately (69% of the total area prospected in 2006-2007). In 2004, the survey was carried out in August, for a period of nine days, and it covered only the 96%. In 2005, it was not possible to perform the survey due to problems with the winch of the ship; and in 2006, for the first time, an adequate prospecting survey was conducted in Division 3L with over 100 valid hauls. The survey area was stratified following the standard stratification schemes (Bishop, 1994). All surveys had a stratified random design following NAFO specifications (Doubleday, 1981). Sets were allocated to strata proportionally to their size, with a minimum of two planned hauls per stratum and the trawl positions were chosen at random. Biomass and abundance indices were calculated by the swept area method (Cochran, 1997), assuming catchability factor of 1.

4.2.3 Are the survey data used in assessments? If so please describe how. If not please explain why.

The following data series were used to calibrate the XSA during the 2008 assessment:

a) EU 3M - a European Union summer survey in Division 3M from 1995–2007, ages 1 – 12

b) Can 2J3K autumn survey, true Campelen data from 1996 - 2007, ages 1 to 14
c) Can 3LNO spring survey, true Campelen data from 1996 - 2007, ages 1 to 8. This survey was not completed during 2006.

The reasons to exclude some period of the different surveys were the following: During the 2003 assessment, STACFIS agreed to exclude survey data from 1978-1994 from the calibration dataset to exclude time periods when changes in survey catchability were apparent. Retrospective patterns in biomass, fishing mortality and recruitment were less severe when the 1978-1994 data were excluded. Darby et al. (2003) also reported improved within survey correlations for the shortened time series. The 1995 data from the Canadian fall survey have also been excluded as the survey coverage in that year was incomplete; several of the deep water strata were not surveyed.

The reasons to exclude the EU-Spain 3NO survey was explained by Healey and Mahe (2005) and was the following: The Spanish survey covers just a small portion of the overall stock area. However, this index has generally been consistent with other survey series throughout the stock area. There are problems at the oldest ages. Further, most residuals are positive in the early years of this index, and conversely, most residuals are negative in the later years. The mean annual residual exhibits a declining trend. We note that the Spanish survey in Divs. 3NO has been converted to account for a 2001 vessel change, which may explain at least part of this trend. The trends in the assessment remain unaffected given the inclusion of the Spanish index. Addition of the Spanish 3NO series increases the estimates of recent recruitment, but estimates of the exploitable biomass, 10+ biomass, and average fishing mortality are quite similar. In both analyses, fishing mortality has increased substantially the past two years, and estimated biomass is estimated as the lowest in the time series. Notice that the XSA results with the Spanish data included indicate slightly higher estimates of recent fishing mortality. Note that with the addition of another tuning index, the impact of shrinkage is lessened. For the Spanish 3NO series, there are consistently large residuals at the oldest two ages; also the mean squared residual for this index is high for ages 2, 12, and 13. In addition, most of the residuals from 1997-1999 are positive, whereas the majority of residuals in the most recent period are negative.

4.2.4 Please identify strengths and weakness of each survey and identify if and how they could be improved.
A single survey series which covers the entire stock area is not available. A subset of standardized (depth and area) stratified random survey indices have been used to monitor trends in resource status.

Survey evaluation and consistency. Ideally, age-disaggregated survey indices should measure cohorts consistently at several ages. The consistency of standardized indices for all age-disaggregated survey series was evaluated. In addition, correlation coefficients as a measure of the age over age cohort-consistency in the survey series that are used to calibrate the virtual population analysis (VPA) were updated. The results are consistent with those noted in previous assessments: reasonably good up until ages 6 to 7; at ages 7 to 8, all of the survey series had poor correlations; and the correlations improved at the older ages. Potential explanations of the poor correlations could include: changing fishing mortality, immigration or emigration to/from the survey area, ageing problems, catchability issues or even a combination of these factors. Nonetheless, cohort analyses (such as VPA) of this stock are still considered appropriate.

4.2.5 If any surveys have been terminated within the last 10 years please explain why.
Was not the case.

4.2.6 Are any new surveys being considered? If so please describe.
Previous survey experiments have noted that the depth distribution of Greenland halibut extends beyond 1500m, the maximum depth of the survey information currently available to assess this stock. In addition, fisheries for Greenland halibut have at times fished at depths beyond 1500m. Therefore, STACFIS recommends that exploratory deep-water surveys for Greenland halibut in Subarea 2 and Divisions 3KLMNO be conducted using gears other than bottom trawls to compliment existing survey data.

4.2.7 Please append any survey abundance indices available for your stock (tables and figures) and comment on their strengths and weaknesses and how they could be improved
Table 4.17 presents the Canadian fall survey biomass (Healey, 2008).

Year	2G	2H	2J	3K	SA2+3K	3L	2J3KL	3M	3N	3O	3LMNO	TOTAL
1995	NO SURVEY		35.6	69.2	-	11.3	**116.1**	NO SURVEY			-	
1996	22.3	26.1	64.8	120.3	**233.5**	36.6	**221.7**	10.2	5.1	1.0	**52.9**	**286.4**
1997	15.5	38.6	82.1	130.5	**266.7**	48.6	**261.2**	7.0	6.4	2.1	**64.1**	**330.8**
1998	4.5	39.0	62.1	142.2	**247.8**	55.9	**260.2**	7.8	14.8	5.4	**83.9**	**331.7**
1999	10.5	30.7	87.1	175.6	**303.9**	34.0	**296.7**	2.4	2.7	1.9	**41.0**	**344.9**
2000	NO SURVEY		54.9	143.3	**198.2**	34.1	**232.3**	5.5	9.3	4.2	**53.1**	**251.3**
2001	NO SURVEY	37.7	65.8	128.7	**232.2**	29.9	**224.4**	5.3	7.2	4.5	**46.9**	**279.1**
2002	NO SURVEY		53.6	67.0	**120.6**	22.4	**143.0**	2.5	5.7	4.1	**34.7**	**155.3**
2003	NO SURVEY		59.8	71.5	**131.3**	26.1	**157.4**	4.3	1.1	2.6	**34.1**	**165.4**
2004	NO SURVEY	48.2	59.1	90.5	**197.8**	15.9 *	**213.7**	NO SURVEY	2.9	0.4	**19.2**	**217.0**
2005	NO SURVEY		61.1	112.6	**173.7**	30.1	**203.8**	NO SURVEY	3.3	2.3	**35.7**	**209.4**
2006	NO SURVEY	65.8	105.9	110.2	**281.9**	32.5	**314.4**	3.2	1.1	0.2	**37.0**	**318.9**
2007	NO SURVEY		57.7	179.1	**236.8**	27.6	**264.5**	3.4	5.3	3.6	**39.9**	**276.7**

*During 2004, Division 3L was not completely surveyed.

Table 4.17.- Greenland halibut biomass estimates (000 t), by Division, from Canadian fall surveys during 1995-2007.

Biomass estimated by swept area method (tons) of the Greenland halibut in the EU-Spain and Portugal Flemish Cap survey in past surveys (Vazquez and Gonzalez-Troncoso, 2008) is presented in table 4.18.

	year	Greenland halibut	roughhead grenadier
120-730 m	1988	6926	2009
	1989	4472	871
	1990	5799	852
	1991	8169	1335
	1992	8728	1577
	1993	6529	3021
	1994	8037	1975
	1995	10875	1558
	1996	11594	1362
	1997	16098	1197
	1998	24229	1691
	1999	21207	1250
	2000	16959	1047
	2001	13872	2079
	2002	12100	1211
	2003	6214	2348
	2004	12292	3597
	2005	11698	2387
	2006	11706	3933
	2007	13040	1367
120-1460 m	2004	28343	17184
	2005	21515	14253
	2006	24358	12109
	2007	31723	7807

Table 4.18.- Greenland halibut biomass estimates (t), by strata, from Flemish Cap survey during 1988-2007

Survey estimates (by the swept area method) of Greenland halibut biomass (t) and SD by year on NAFO Div. 3NO (Table 4.19). n.s. means stratum not surveyed. 1997-2000 data are transformed C/V Playa de Menduíña data. 2001-2007 data are original from R/V Vizconde de Eza. In 2001, there are data from the two vessels. The last two rows present the biomass corresponding to set of ages 5+ and 10+ (Gonzalez-Troncoso *et al.* 2008).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL	6859	11305	11246	9331	7721	2380	4701	3437	3071	2720	3286
S.D.	546	860	973	707	790	410	575	373	325	379	363
Biomass 5+	4303	6284	6367	8785	6700	2011	3386	2318	2585	2151	3057
Biomass 10+	406	504	660	1111	741	279	495	318	380	182	343

Table 4.19.- Survey estimates (by the swept area method) of Greenland halibut biomass (t) and SD by year on NAFO Div. 3NO

Stratified mean catches (Kg) and SD of Greenland halibut by year (2003-2007)for the UE Spanish 3L survey (table 4.20). n.s. means stratum not surveyed. In 2003, the data correspond to 69% of the total area prospected in 2006-2007 (Román *et al* 2008).

	Survey				
Stratum	2003	2004	2005	2006	2007
TOTAL	65511.53	76900.01	-	99349.19	107946.61
$(\overline{y})$	14.64	12.29	-	15.32	16.64
SD	1.09	0.59	-	0.95	1.33

Table 4.20.- Stratified mean catches (Kg) and SD of Greenland halibut by year (2003-2007)for the UE Spanish 3L survey.

More detail information about the Surveys can be found in Diana *et al.*,(2008) for EU-Spanish 3NO survey, Roman *et al.* (2008) for EU-Spanish 3L Survey, Healey (2008) for Canadian autumn and spring surveys and Vazquez and Gonzalez-Troncoso (2008) for EU-Spain and Portugal Flemish Cap Survey. Based on these information, the indices (mean numbers per town) used in the assessment was the following (Table 4.21):

EU Flemishh Cap Survey Mean Numbers per Town

Year/ages	1	2	3	4	5	6	7	8	9	10	11	12
1991	1.619	0.257	0.433	1.311	2.869	1.605	2.751	0.664	0.575	0.437	0.176	0.015
1992	2.085	1.566	0.556	1.272	2.303	2.797	2.421	1.311	0.581	0.339	0.171	0.083
1993	1.769	1.548	0.966	0.861	1.269	1.921	2.024	1.574	0.965	0.264	0.129	0.048
1994	1.777	1.238	1.697	1.785	1.921	2.966	2.659	1.467	0.785	0.273	0.112	0.059
1995	12.407	2.543	2.23	1.909	2.656	5.098	3.766	2.122	1.308	0.26	0.066	0.022
1996	5.843	7.969	2.415	3.036	4.203	5.82	2.488	1.616	0.424	0.086	0.026	0.038
1997	3.325	3.775	5.996	6.497	7.105	8.455	4.992	2.152	0.657	0.22	0.028	0.021
1998	2.735	2.134	7.685	10.996	12.334	11.297	7.84	2.621	0.746	0.195	0.034	0.007
1999	1.059	0.7	3.008	10.468	13.413	12.583	5.554	1.823	0.348	0.102	0.008	0.003
2000	3.748	0.292	0.595	2.165	7.092	14.096	5.404	2.32	0.449	0.114	0.054	0
2001	8.031	1.433	1.811	0.993	2.788	7.787	6.625	3.213	0.183	0.045	0.006	0
2002	4.081	2.939	2.795	1.668	3.786	5.593	5.732	1.275	0.129	0.06	0.019	0.007
2003	2.198	1	0.608	1.514	2.476	2.937	1.93	0.466	0.131	0.099	0.019	0.005
2004	2.192	3.288	4.373	1.971	6.965	7.797	2.537	0.644	0.29	0.134	0.079	0.047
2005	0.544	0.811	3.176	2.496	6.885	7.592	2.916	0.61	0.111	0.12	0.055	0.019
2006	0.68	0.4	0.65	1.17	5.98	7.46	3.31	0.77	0.22	0.18	0.13	0.06
2007	0.418	0.092	0.567	0.342	3.438	7.371	5.76	1.513	0.307	0.205	0.077	0.047

Canadian Fall Survey Mean Numbers per Town

Year/ages	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1996	98.68	47.82	32.01	9.539	6.283	2.466	0.836	0.191	0.179	0.039	0.024	0.012	0.017	0.006
1997	28.05	58.62	43.61	21.13	10.37	5.007	1.998	0.641	0.203	0.055	0.032	0.022	0.009	0.003
1998	23.35	25.07	31.19	21.87	10.86	4.452	2.066	0.565	0.132	0.059	0.028	0.021	0.013	0.002
1999	15.99	34.42	24.07	28.28	20.04	10.53	3.811	0.703	0.139	0.072	0.021	0.006	0.025	0.002
2000	38.57	21.94	16.43	13.2	13.76	7.207	2.161	0.502	0.063	0.03	0.015	0.004	-1	0.007
2001	43.9	22.72	17	14.07	9.765	7.591	3.403	0.692	0.112	0.023	0.014	0.004	0.011	0.001
2002	40.67	24.08	12.5	9.679	6.027	1.974	0.719	0.19	0.039	0.013	0.004	-1	0.003	-1
2003	45.7	26.67	11.69	9.49	6.389	2.271	0.893	0.268	0.04	0.017	0.01	0.006	0.002	-1
2004	32.49	32.93	13.89	12.31	9.209	2.684	1.198	0.358	0.083	0.032	0.006	0.004	0.008	-1
2005	16.06	16.15	8.557	13.84	10.98	6.848	3.96	0.662	0.116	0.034	0.027	0.009	0.007	0.002
2006	32.34	17.98	8.502	17.6	13.03	9.113	4.177	1.151	0.18	0.028	0.024	0.01	-1	0.002
2007	32.61	14.51	12.81	18.77	9.573	10.35	6.171	2.14	0.338	0.076	0.039	0.024	0.009	0.005

Canadian Spring Survey Mean Numbers per Town

Year/ages	1	2	3	4	5	6	7	8

1996	1.621	4.241	4.599	2.183	0.827	0.284	0.057	0.001
1997	1.162	3.924	5.16	3.227	1.461	0.507	0.099	0.013
1998	0.22	0.814	3.847	6.186	4.955	1.238	0.326	0.072
1999	0.292	0.552	1.149	1.982	3.388	1.09	0.242	0.05
2000	0.793	1.069	1.068	1.506	1.954	2.037	0.556	0.031
2001	0.565	0.714	0.739	0.676	0.796	0.716	0.279	0.023
2002	0.642	0.572	0.603	0.581	0.608	0.208	0.049	0.006
2003	0.926	2.137	1.663	1.569	1.055	0.206	0.051	0.008
2004	0.662	0.572	1.181	1.184	1.161	0.259	0.041	0.02
2005	0.353	0.306	1.09	0.946	1.372	0.823	0.206	0.025
2006								
2007	1.595	0.516	0.802	0.399	1.405	1.491	1.121	0.183

Table 4.21.- Mean numbers per town and age of the different surveys used in the XSA assessment of the NAFO Greenland halibut Subarea 2 and Div. 3KLMNO.

The Canadian Autumn Survey in the last years have been covertures problems and due to these problems the indices used in the assessment is only 2J3K information.

The Canadian Spring Survey only cover till 700 m. depth, and this is a problem for the Greenland Halibut stock because the most important depth distribution is between 700-1300 meters.

The UE Flemish Cap Survey cover since 2004 depth till 1400 meters. The assessment only use the information till 700 m. and probably this cause some problems in the assessment.

The Spanish 3NO and 3L Surveys have not participated in the assessment and it would be to study how these information can be used in futures assessments although these surveys have spatial cover problems for the Greenland Halibut Stock.

Figure 4.7 shows for Greenland halibut in SA 2 + Div. 3KLMNO: Relative biomass indices over 1996-2008 from Canadian fall surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and Spanish surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2007 average. (SCIENTIFIC COUNCIL MEETING, 2009).

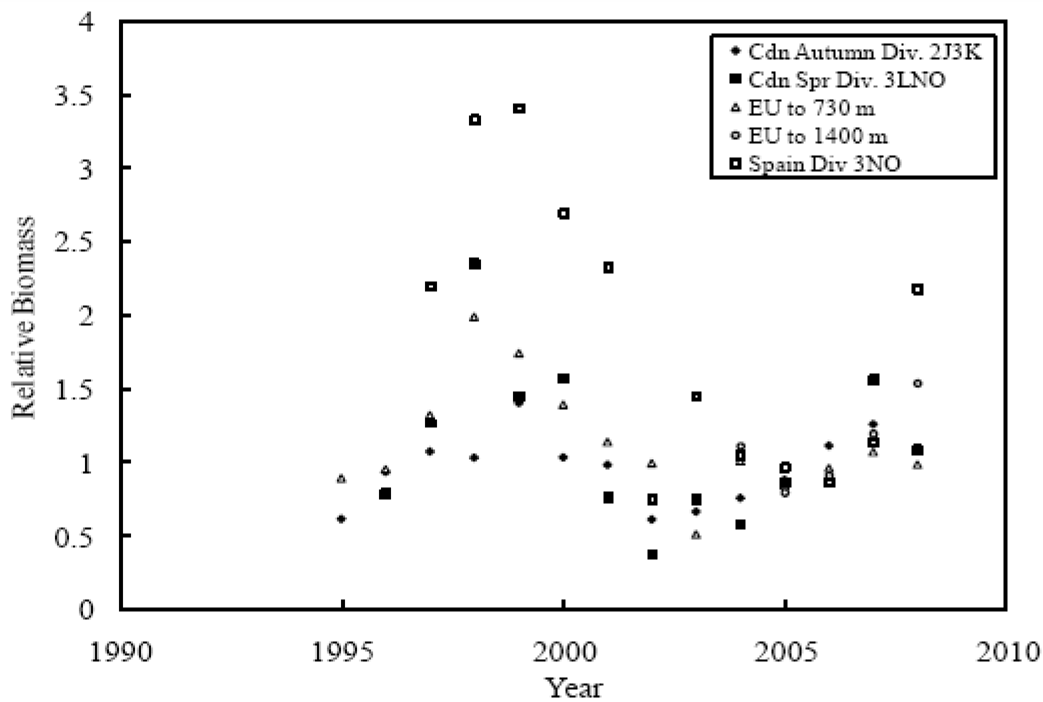


Figure 4.7.- **Relative biomass indices over 1996-2008 from Canadian fall surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and Spanish surveys of the NRA of Div. 3NO.**

4.2.8 Are there any aspects of fisheries-independent survey data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.

This was answered in the 4.2.7 point.

4.3 Biological data for your stock

4.3.1 Please complete the table below for each fleet/survey inserting in each cell the time series of data available, if quarterly (q) or annual (a), and if collected by observers (O), by market sampling (MS) or both (OMS). Please append all available time-series of quarterly and annual data.

For all countries, except Canada and France, the fisheries data are collected by Observers on board and is for the total catches (landing+discards). Canada has some samplings on board (total catch) and some market (landings). Normally this kind of information is available by year and country/survey and normally is presented as SCR documents. Table 4.22 presents the Surveys and fleets time series of data available.

	Retained or Survey					
Fleet ID/ Survey ID	**Length comp.**	**Age comp.**	**Sex comp.**	**Length & weight at age**	**Maturity comp.**	**Period**
Spring	+	+	+	+	+	1995-2007
Autumn	+	+	+	+	+	1978-2007
Flemish Cap	+	+	+	+		1988-2007
3LNO	+	+	+	+		1995-2007
SPt	+	+	+	+		1991-2007
PTt	+	+ (1994-1999)	+	+ (1994-1999)		1990-2007
CAt	+	+	+	+		1975-2007
CAg	+	+	+	+		1975-2007
CAl	+		+			??
RUt	+		+			??
ESt						
Lit						
Jat						
FRt						

Table 4.22.- Surveys and fleets time series of data available.

4.3.2 For the most recent assessment, how was total international catch data raised from fleets and what are the strengths and weakness of the current raising regime.

The historical catch-at-age construction matrix was explained by Bowering and Brodie (2000) and the availability of the length and age data to make the catch at age matrix was presented by Healey and Mahe (2008). Length sampling provided by EU-Portugal, EU-Spain, and Russia for 2007 otter trawl fisheries are quite similar, with modal catch length of about 43-46cm. Note, however, that the length sampling for 2007 generally indicates that larger fish were caught compared to 2005 and 2006. This is most strongly apparent from the Russian and Spanish sampling. Available age-length keys indicate a difference between Spanish and Canadian age interpretations. Until the differences can be resolved, the length samples from these nations are converted to catch-at-age using Canadian age length keys. Recent research suggests that in addition to these inconsistencies, the Canadian, EU and Russian age determination methods may be underestimating ages. Computation of Canadian catch-at-age is described by Brodie et al (2007). Samples from the Canadian fishery were used to derive catch-at-age independently for each gear.

No sampling data are available for the 2007 catches taken by EU-Lithuania, EU-Estonia, Japan, St. Pierre and Miquelon (EU-France) and the Faroe Islands (EU-Denmark) (1923 t combined catch), all operating in the NAFO Regulatory Area (NRA). Catch-at-age was developed for these fleets under the assumption that

the age-composition was similar to that of the combined Spanish, Portuguese and Russian fisheries operating within the NRA.

4.3.3 If age data are available please describe the age determination materials and methods used.

An age Determination Workshop was help in 2008 (Treble and Dwyer, 2008). Prior to the workshop there was an exchange of otoliths and scales collected during the 2005 EU survey in SA3. During the workshop each lab presented information on ageing methods using scales, otolith whole and otolith section: no two labs used the same method. Research related to methods and age validation was also presented. Observations have been made in recent years that suggest Greenland halibut are longer lived and slower growing than previously thought. The otolith cross-section methods presented during the workshop indicated older ages at a given length compared to surface ages. For the Alaskan stock it was suggested the methods deviate beginning at approx. 60 cm or age 7 yr. For the stock in NAFO SA0 deviations in the age bias plot of whole versus section age estimates began at about age 15 (approx. 50 cm). For the Northeast Atlantic stock off the Norwegian coast ages derived from a revised whole otolith method began to deviate beginning at ages 4–5 (approx. 40 cm). Dark "featureless" translucent margins on large otoliths indicate an accumulation of compacted small annual zones. It became clear during the workshop that bias between age readers could not be solved by simply agreeing to common interpretation practices.

4.3.4 How have ages been validated?

Two types of validation methods were applied, Oxytetracycline (OTC) and 14C radiocarbon assay of otolith cores from fish from locations within SA0, SA1 and SA2 born during the nuclear bomb testing in the 1960's. The growth of tag-re-captured fish was also examined as an indirect way of verifying age and growth rates The conclusions of the Workshop were the following (Treble and Dwyer, 2008):

Current production methods underage old fish but it is not known to what extent or at what size/age the under ageing begins.

Validation methods that have been applied; bomb radiocarbon dating and tagging and oxytetracycline marking for Greenland halibut, have been carried out for NAFO Div. 0B and 2G that indicate longevity of this species goes beyond that indicated by present techniques.

Biological methods that indicate longevity have been applied for the Barents Sea, analysis of otolith morphometry and length measures, and show much greater age expectancy and this affects the fishable portion of the stock.

Precision and bias are still problematic due to a lack of standard application of methods and criteria.

The current scale method under-estimated the current otolith methods at the oldest ages.

Systematic studies of new methods and comparisons there of are needed to determine a reliable method for production ageing.

4.3.5 Are the age data considered to be reliable?

See conclusions of the Workshop (Treble and Dwyer, 2008) in the point before (4.3.4).

4.3.6 Has there been any ageing workshops for your species? If please review outcomes.

Yes it has been and the conclusion of the Workshop (Treble and Dwyer, 2008) appear in the point 4.3.4.

4.3.7 Are there any aspects of data (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.

The impact of the aging problems on current stock assessment have never discussed but certainly these problems could have very import consequences in the assessment and advice. Some of the assessment inconsistencies could be explain by the aging problems.

4.4 Ecosystem, biodiversity and VME data (see footnote 1 on page 2 for definition of VME)

4.4.1 Background information

4.4.1.1 Please list the known ecosystem types in your stock area (include maps if available).

NAFO Scientific Council has established a Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) to study this information and one of the terms of reference is to identify the regional ecosystems in the NAFO Convention Area (NCA).There is not a list of ecosystem types in NAFO Convention Area yet, some work was made to identify different ecosystems en NAFO Subarea 5 and 6 and, WGEAFM will apply the methodologies developed in the Subareas 5 and 6 to all the NAFO Convention Area (NCA*). (Report of the NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM). 2008).

It can be referred as ecosystem the mayor habitat features: canyons, seamounts, abyssal plain, shelf slope, glacial erratic boulder fields etc. Also the coral and sponge grounds as known communities.

4.4.1.2 If these are not known, are there any research programmes currently underway to identify and delineate ecosystems in your area? If so please describe.

Yes, as we comment before, NAFO Scientific Council has established a Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) and one of the its objectives is identify and delineate ecosystems in NAFO Area.

There are initiatives at the national level currently on the go in Canada (DFO) and USA (NOAA).

There is also the international survey led by Spain "Nereida" which is creating a multibeam map of the NRA from 200-2000 m (2009-2010) and the associated survey by Canada which is collecting in situ data on sponges and corals over the same time period. Annual.

4.4.2 Data available in support of ecosystem based management.

4.4.2.1 Please complete the following table where data are available and append all available time-series data at the lowest level of disaggregation possible:

Marine Strategy descriptor	Data in support of ecosystem based management	Data source(s)	Are there any data issues?
(1) Biological diversity	Species assemblage composition	Survey Information	
	VME -spatial distribution	Survey and Fisheries Information	
	VME – species composition	Survey and Fisheries Information	
	Fishery interactions with VMEs	Survey and Fisheries Information	
	Presence of PET – spp	(WGEAFM Report 2008)	
	PET – population biology	N/A	
	PET – fishery interactions	N/A	
(2) Non-indigenous species	Invasive	N/A	
	Introduced	N/A	
(3) Populations of commercially exploited fish and shellfish	Addressed in Sections 1, 3, 4	Survey and Fisheries Information	
(4) Food webs	Data on prey, predators. Fishery impacts on prey/predators abundance, addressed in 4.4.4	Survey and Fisheries Information	
(5) Eutrophication		N/A	
(6) Sea-floor integrity	Addressed in 4.4.5 and 4.4.7 below		

(7) Hydrographical conditions		Survey Information	
(8) Contaminants in waters/ecosystem	Any data on levels of e.g. metals PCBs	N/A	
(9) Contaminants in fish and other seafood	Addressed in 4.6.6 below	N/A	
(10) Properties and quantities of marine litter		N/A	
(11) Introduction of energy, including underwater noise		N/A	

4.4.2.2 Where data are available please describe, review and append[4].

The NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) review all the data available and with the following results:

Oceanographic surveys are the main source of information for physical oceanography and primary production. Satellite imaging is suitable for mapping primary production and satellite-based data products are becoming more common.

Bottom-trawl fishing surveys, scientific observers and NAFO observers are main sources of information on fish stocks, catches and by-catches. A list of current surveys in the area is provided by the SC Report every year.

The primary objective of RV surveys has traditionally been to provide fisheries-independent indices of abundance and biomass of main commercial species for their use in stock-assessment. Associated with this, ageing and maturity studies are also carried out. However, most surveys have evolved over the years trying to enhance their ability for sampling non-commercial species and to provide a wider picture of the marine community. Among the biological studies already implemented, or in the process of being implemented, in these RV surveys are an improved recording of benthic organisms, production of length-frequency distributions for all species, and stomach content analyses and growth and condition studies, typically for selected species. Some examples of these changes include the special attention towards identifying invertebrate by-catch in the NRA (Divs. 3LMNO) by the Spanish/EU groundfish bottom trawl since 2005, or the enhanced sampling (non-commercial species, bottom grab sampling, stomach contents) to be implemented in the 2J3KLNO Canadian multispecies fall survey as part of the DFO "Ecosystem Research Initiative" in the Newfoundland and Labrador region.

In addition to annual surveys, some dedicated research surveys aim to identify and characterize coral communities have also take place in recent years.

Data available is largely confined to the fishing areas and seasons and to those taxa caught by groundfish gears. For coral and sponges, targeted benthic surveys are required to cover their depth range. This is important both for the determination of their distribution and abundance, which will allow for more effective conservation measures. Equally, as their distribution is spatially and temporally stable due to their attachment and longevity, fishing activity can be maximized by drawing boundaries which more closely approximate the coral locations.

4.4.2.3 In the area inhabited by your stock are there any research initiatives related to climate change? If so please review (Descriptor 7).

There are several national initiatives in Canada and the US trying to address different aspects of climate change, and to downscale global climate change scenarios into regional areas, and its potential effects on fish populations and ecosystems. Although these initiatives largely encompass the NCA, there is no focused project on the NRA itself nor being driven specifically by NAFO.

The major NAFO contribution to the climate change research is data recollecting. There are many data collection programs related with the clime change in NAFO Area and to collect and keep all these data

[4] Aspects to be reviewed for each marine strategy descriptor, may be further refined according to the outcome of on-going work from ICES/JRC task groups on these descriptors.

NAFO has created the Integrated Science Data Management (ISDM) (SCIENTIFIC COUNCIL MEETING Report – 2009). ISDM is the regional environmental data centre for NAFO and as such is required to provide an inventory of all environmental data collected annually by contracting countries of NAFO within the convention area. The following is the inventory of oceanographic data obtained by ISDM during 2008 and updates on other activities in the NAFO Convention area.

i) "Real-time" temperature and salinity profiles
"Real-time" temperature and salinity profiles from 252 863 stations were received, processed, archived and were made available in 2008. These stations consist of low resolution profile data that were transmitted on the Global Telecommunication System (GTS) within 30 days of collection.

ii) Delayed-mode profiles
High depth resolution CTD, towed CTD, bathy thermographs, oxygen data were processed and archived in 2008 from 1082 stations. Additional data on nutrients, oxygen, plankton and other parameters were available from bottles. Delayed-mode profiles collected before 2007 from 7 371 stations were processed in 2008. These data were received from the responsible institutions.

iii) Surface thermosalinograph data
Surface temperature and salinity data were processed from 37 377 stations in 2008, collected from "ships of opportunity" i.e. cargo ship and other ships. The data were acquired on the Global Telecommunication System.

iv) Drifting buoy data
Data in 2008 comprised 283 721 data points from 367 buoys. A large proportion of buoys provide data for marine meteorology (air temperature, pressure, surface water temp) and a smaller proportion provide oceanographic data (surface currents and temperature).

v) Wave data
These data were available from 14 wave buoys in NAFO area and are available online.

vi) Tides and water levels
Data were collected from 52 tide gauges in 2008, some every minute and others every hour.

vii) Argo data
Argo is an international program to deploy profiling floats on a 3 by 3 degree grid in the world's oceans. The floats measure temperature, salinity and oxygen with depth down to 2000 m. Data were available in 2008 from 37 active and 39 inactive floats.

viii) Atlantic Zone Monitoring Program
Chemical, physical and biological oceanographic data were available from 7 fixed stations and from 13 standard sections. Information on water levels was also collected, as were data on SST and ocean colour (by remote sensing). Each year, data are analysed and synthesized into "State of the Ocean" report.

Data availability
All data are available either directly online (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/index-eng.html) or by request and is free of charge.

More detail information about these data can be found in Bradshaw *et al.* 2009.

4.4.2.4 Has there been any baseline studies on ecosystems in your stock area? If so please describe.

Not really, but there are long enough time series on some components (e.g. fish assemblages) that some analysis of trends and changes over time can be done. Work on this regard is currently on the go for both the NL shelf and The Flemish Cap ecosystem.

Significant concentration of corals and sponges mapping were done in NAFO NRA. (SCIENTIFIC COUNCIL MEETING Report – 2009).

4.4.2.5 Are you aware of any major changes e.g. regime shifts, in ecosystems in your stock area? If so please review.

There have been major changes in the fish communities in relation to the collapse on several groundfish stocks, the increase in some shellfish species (e.g. Northern Shrimp), and the recovery of seal populations. Some important drivers for these changes include overfishing, and ocean climate (e.g. cold periods), but still remains unclear if these changes truly represent a regime shift (i.e. the system is in a "new" pseudo-stationary configuration), or if they are simply a transient state of a highly perturbed system which is in the process of returning to some previous configuration.

4.4.2.6 How is the health of ecosystems in your stock area monitored? e.g. size spectra studies, biodiversity studies, diversity indices, presence/absence of indicator species, other indicators etc. Please describe and review (Descriptor 1).

Gonzalez-Troncoso and Paz (2007) calculated some ecological indices from the data obtained in the research surveys conducted by EU (Spain and Portugal) in Flemish Cap between the years 1988 and 2006. These indices were calculated for individual populations (intrinsic population rate of growth and mean length of catch) and for all the community (ABC curves, indices about faunal diversity, proportion of non-commercial species, mean length in community and size spectra). We use the data of twenty seven species captured in the survey year by year, included the *Pandalus borealis*. The indices present a general stable pattern. Despite the moratorium of the principal commercial species of the bank of Flemish Cap, it seems not to be recovery of the general community.

Results for the population indicators shows that: Growth rate estimates for eleven species indicated that there was no evidence to reject the null hypothesis of a zero growth rate, whereas twelve populations were significantly increasing and four species were significantly decreasing (*Gadus morhua*, *Hippoglossoidess platessoides*, *Lycodes vahlii* and *Notacanthus chemnitzi*). Note that, between the four species on decreasing, two of them have a high commercial interest and are under moratorium (*Gadus morhua* and *Hippoglossoidess platessoides*). The mean of the length remains significantly stable along the years for seventeen species of the seventy seven. For eight species, the mean decreases, and increases only for two species, the *Hippoglossoides platessodies* and the *Notacantus chemnitzi*.

And for community indicators: In all cases, the abundance curve lies above the biomass curve, so the W statistic is negative, but in general its absolute value is not too high. Generally, the diversity is higher for biomass and lower in abundance when we use all the species, but the trend is the same in all the cases, with a slight decrease in the indices along the years. The ratio of non commercial species in abundance and biomass decrease in the last years. It must be due to the increase in the biomass and abundance of the species of the genus *Sebastes.* The mean population length has decreased in the period studied. It could indicate that fishing shift the distribution to smaller lengths. All size spectra showed regular decreasing patterns generally indicative of high fish numbers in smaller sizes and viceversa in large sizes. They were rather curvilinear and well fitted by quadratic functions, with R2 varying between 0.91 and 0.98.

4.4.2.7 Is primary production monitored in your stock area? If so please review.

Yes, at least by SeaWifs satellite imagery and Sir Alister Hardy Foundation for Ocean Science (SAHFOS) Continuous Plankton Recorder (CPR) Survey. The CPR Survey's marine monitoring programme has been collecting data from the North Atlantic and the North Sea on the ecology and biogeography of plankton since 1931. The unique marine biological dataset provides a wide range of environmental and climatic indicators and is used by marine scientists and policy makers to address marine environmental management issues such as harmful algal blooms, pollution, climate change and fisheries. SAHFOS is based in Plymouth, UK, and cooperates with sister CPR surveys around the globe.

4.4.2.8 Are changes in the spatial and temporal distribution of plankton species monitored? If so please review.

Yes, by Sir Alister Hardy Foundation for Ocean Science (SAHFOS) Continuous Plankton Recorder (CPR) Survey.

4.4.2.9 Are there any aspects of ecosystem data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.

Fisheries Commission request a mono specific (Stock by Stock) assessment and advice to Scientific Council. The ecosystem data are not fundamental to provide this kind of assessments and advices but are useful. When NAFO implement the ecosystem approach these kind of data it will be more necessary.

4.4.2.10 Are there any other human activities that impact the ecosystem significantly? If so please describe.

Oil perforations looking for petroleum in the Newfoundland Grand Banks.

4.4.3 Protected, Endangered and Threatened (PET) species (part of Descriptor 1)

4.4.3.1 Please list any PET species in your area that interact or could interact with fisheries for your stock.

No very much information about the PET. Some general information can be founded in the WGEAFM Report .

4.4.3.2 Are there currently any research programmes active to identify the presence and extent of these interactions? If so, please review.

There is no specific program directed to interactions between PET species and fisheries.

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4.4.3.3 Please describe any mitigation methods applied to reduce the impact of fishing on PET species.

There is no specific method to reduce the impact of fishing on PET species.

4.4.3.4 Are there any aspects of PET data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers.

No.

4.4.4 Ecosystem modelling (Descriptors 4,5)

4.4.4.1 Is there any ecosystem modelling work carried out in your area? If so please specify the ecosystems studied and the modelling methods used (e.g. ecopath, ecosim etc).

There are a wide range of models for many of the ecosystems within NCA (Atlantic Canada Ecosystems and Eastern sea board of the US). However, modelling studies are more limited for the NRA and the stocks managed by NAFO. In this case, there are EwE models for the NL shelf system, and some bioenergetic-allometric models are currently in development for this ecosystem. There is also some preliminary work being done towards developing a multispecies model for the Flemish Cap ecosystem in the future.

4.4.4.2 Are predator/prey relationships well understood and if not what research is being undertaken?

Predator-prey relationships are not well understood. There is a significant amount of information on the diet of several fish species on the Flemish Cap and Grand Banks ecosystem (Gonzalez *et al,* 2006), but the implications of these feeding habits in terms of consumer-resource dynamics are still largely unknown. In Canada, some information exists on the diet of a handful of predators in the NL shelf over time (e.g. cod, turbot, harp seals), but diet information is scarce for most species. In addition to some early Ecosim work, there is some modelling work being done to specifically explore the impact of seal predation, fisheries and capelin availability in Northern cod in the NL shelf system.

4.4.4.3 Is there sampling of stomach contents? If so, how frequently, by whom, and how have the results been used?

In the NL shelf and the Flemish Cap ecosystems there is currently two main programs which collect stomach contents. In the Flemish Cap, the UE/Spain and Portugal surveys have collected stomach contents for nearly 20 species since the beginning of that survey. The Spanish 3NO survey has collected the some information for Division 3NO since 1995.

On the NL shelf a new DFO program (ERI-NEREUS) had started in 2008 to collect stomach contents for some key species in this system. In addition seal stomach contents have also been collected by DFO since the

1980s. Stomach contents of cod and turbot in the NL shelf were also collected by DFO in the past, but cod sampling stopped in the mid 1990s. Although protocols have changed over time, both Canadian and Spanish and EU surveys have taken the general approach of using sampling schemes intended to develop time-series of diets.

4.4.5 Fishery interactions (Descriptors 1,6)

We have not information about this point (N/A).

4.4.5.1 Please review any gear trials conducted to assess gear/habitat interactions.

N/A

4.4.5.2 Has there been any research into environmentally friendly gears? If so please review.

N/A

4.4.5.3 Do you have a reporting system for lost and abandoned fishing gear (particularly gillnets)? If so how effective is it and is it supported by interviews with fishers?

N/A

4.4.5.4 Are there any lost/abandoned fishing gear retrieval survey/mitigation exercises regularly carried out? If so please review.

N/A

4.4.5.5 If bait is used in any of your fisheries, is the bait sourced sustainably? Is its use monitored? If so, how?

N/A

4.4.5.6.Are there any aspects of data and knowledge relating to fishery interactions (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

N/A

4.4.6 Pollutants and contaminants (Descriptor 9):

We have not information about this point (N/A).

4.4.6.1 Are contaminant levels in your stock species monitored? If so how and by whom? Please review results.

N/A

4.4.6.2 Do you assess the ecosystem effects (negative and positive) of marine debris and examine options for its collection and disposal? (Descriptor 10) If so how?

N/A

4.4.6.3 Are there any aspects of data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

N/A

4.4.7 Vulnerable Marine Ecosystems (VMEs) (Descriptor 1)

4.4.7.1 FAO have recently circulated guidelines on VME identification and composition, how have you interpreted these in your stock area?

Yes, this was interpreted and review by WGEAFM in 2008.

4.4.7.2 Has any mapping of VMEs been carried out in your stock area? If so, please provide information on location, extent and mapping methods used (multi-beam sonar, ROV, etc). Please attach maps where available.

There is not a map to show the general ecosystems in NRA.

The first map shows (Figure 4.8) the areas of the different mounts submarine in the NRA. These areas (green areas in the map) were considered ecosystem based on the specials physical characterises.

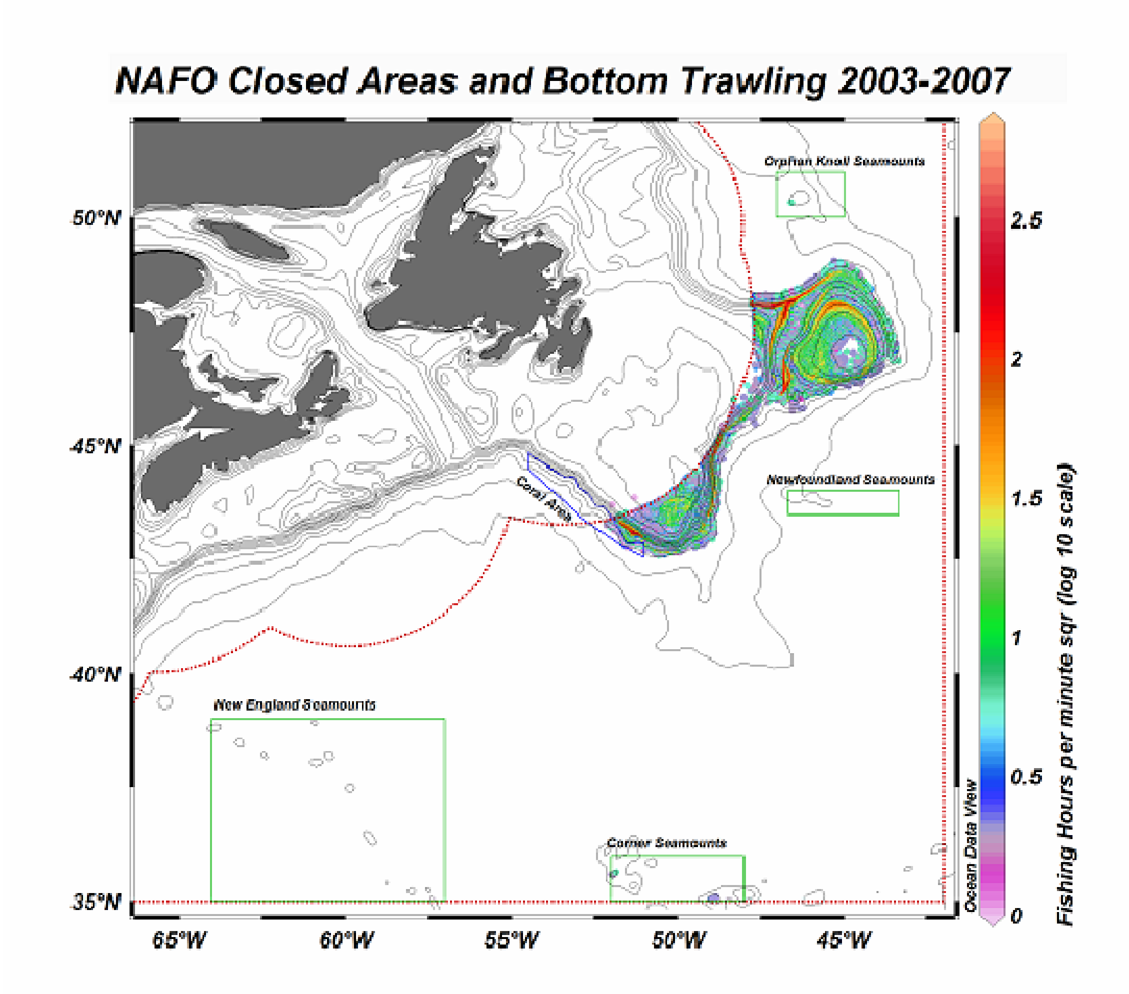

Figure 4.8.- Areas of the different mounts submarine in the NRA. These areas (green areas in the map) were considered ecosystem based on the specials physical characterises.

The next map (Figure 4.9) has been carried out using available information mainly from RV surveys and shows the high concentrations of corals and sponges in the NRA. This polygons will be protected as VME since 2010.

Currently there is a survey underway to begin a more detailed exploration and mapping of some of these areas using multibeam sonar and ROVs.

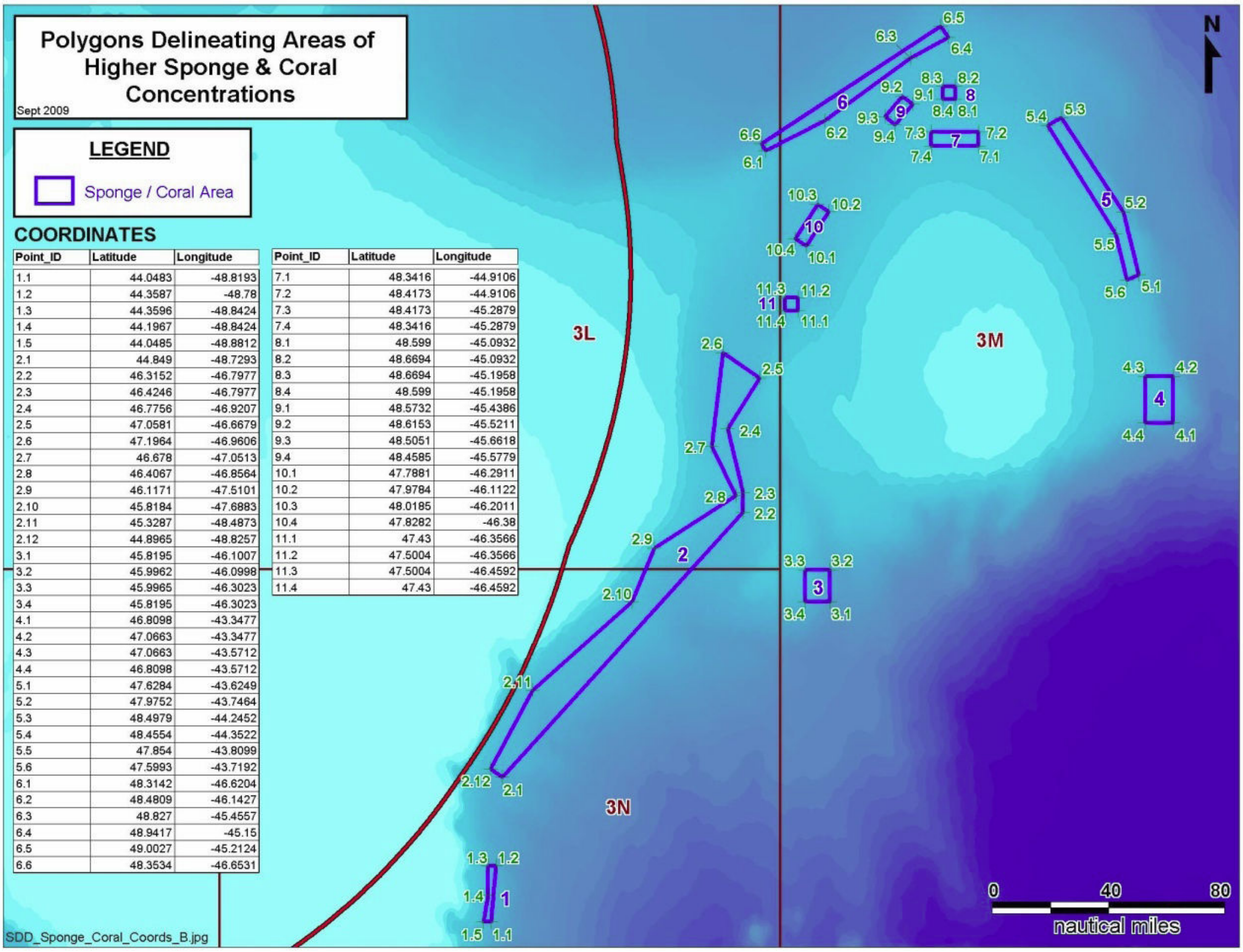

Figure 4.9.- Polygons delineating Areas of higher sponges and corals concentrations in NRA.

4.4.7.3 Please complete the following table for your stock area:

Corals and sponges will start to be monitored in 2009 by the NAFO Observers Program.

VME	Present	How Monitored?	Issues?
Seeps	NO		
Vents	NO		
Carbonate mounds	YES		
Corals	YES	Not monitored/Start in 2009	
Sponges	YES	Not monitored/Start in 2009	
Fish components	Yes (partial)	RV surveys, not specific to VMEs	
Seamounts	YES	Not monitored	
Others			

Table 4.23.- NAFO Vulnerable Marine Ecosystem (VME) data

4.4.7.4 If your stock area, or a substantial part of your area, has not been mapped, do you consider it likely that VMEs may exist? If so, have any precautionary measures (e.g. closed areas) been implemented (e.g. to protect seamounts that have not been specifically mapped)? If so please describe.

VME map only include the NAFO Regulatory Area but part of the stock area is inside of the Canadian EEZ and based in data analyzed by WGEAFM probably exist more VME inside the Canadian EEZ.

As we show before in the point 4.4.7.2 , since 2007 the submarine mounts are close to the trawl fisheries. And since 2010 the areas with high concentrations of corals and sponges will be close to the trawl fisheries.

4.4.7.5 Have you any plans to develop/extend mapping activities with regard to VMEs? If so please describe.

The main objective of NEREIDA project is focused on the implementation of the Ecosystem Approach to the fisheries management in order to identify Vulnerable Marine Ecosystems (VMEs) paying special attention to the cold water corals and sponges.

The study is centred in NAFO Regulated Area and tries to give an answer to the urgent request in order to define in a precise way those areas which are candidate to become VMEs. This demarcation is a necessary step in the decision making process for the protection of these areas.

Participation of various countries members of the NAFO contracting parties will provide to the NEREIDA project a multidisciplinary approach as well as the application of technologies and working protocols which will mean an active collaboration between institutions and organisms involved (Instituto Español de Oceanografía, Secretaría General del Mar, Consejo Superior de Investigaciones Científicas, Polar Research Institute of Marine Fisheries and Oceanography, Centre for Environment Fisheries & Aquaculture Science, Geological Survey of Canada, Canadian Hydrographic Service and Ecosystem Research Division-Fisheries and Oceans Canada (Bedford Institute of Oceanography).

In May 2009 it is scheduled the beginning of a historic series of oceanographic surveys on board the R/V Miguel Oliver, owned by the Secretaría General del Mar. Information derived from these surveys will be very useful to adopt solutions that guarantee the development and sustainable use of fisheries resources as well as the location and identification of sensible and vulnerable zones within the NAFO Regulated Area.

4.4.7.6 If management measures have been introduced to protect VMEs, how have these impacted on fishing?

Closure of seamounts to trawl vessels since 2007 have not very much impact in the fisheries because the trawl effort in these areas were very small.

NAFO continues to take steps to protect vulnerable marine ecosystems by establishing coral and sponge protection zones since 2010 in addition to closures already made in previous years. As well, protocols have been devised to minimize catches of these species. It is recognized that there are numerous international scientific research efforts underway to enhance the knowledge on benthic habitat, communities and species in the NAFO Regulatory Area, particularly the Spanish-led international survey in 2009-2010.

4.4.7.7 Are there any aspects of data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

There is very little fisheries information available on VMEs. Currently assessments are essentially based on catches in RV surveys using trawls. There is not fine scale no time series available for the potential VME areas. The available information essentially covers the shelf and shelf-break are in the NRA. Seamounts and Oceanic waters in the NRA remain unexplored for the most part. Sharing of data within the WG among members remains an issue that delays provision of advice and limits the ability to do a thorough exploration of the data and validation of results.

At the present time no formal ecosystem advice is regularly provided. NAFO is beginning to develop its approach to VMEs.

4.4 Socio-economic data

In the Spanish case, most of the socio economic data have been extracted from the National official statistic. The most important data bases are available in the web in the following address:

http://www.mapa.es/estadistica/pags/pesquera/Estadísticas_Pesqueras_2008-04.pdf
http://www.mapa.es/es/estadistica/pags/pesquera/introduccion.htm
http://www.ine.es/inebmenu/mnu_sintesis.htm

And from a stude made by Garza-Gil *et al.* in 2009. Table 4.24 shows the socio economic data available and their used in the management.

In the Portuguese case, the socio economic data are collected by "Ministério da Agricultura, do Desenvolvimento Rural e das Pescas. DGPA - Direcção Geral das Pescas e Aquicultura"and have been extracted from the National official statistic. The most important data bases are available in the web in the following address:
http://www.dgpa.min-agricultura.pt/portal/page?_pageid=33,1&_dad=portal&_schema=PORTAL
http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_main

Have socio-economic studies been conducted for the fleets fishing for your stock? Are socio-economic surveys need-specific or are they part of monitoring programmes? If so please complete the table below and answer the remainder of the questions in this section and append data where possible. Please label with (1) an asterisk if data exist but are not available (but state where they exist), (2) leave blank if no data exist at all and (3) label N/K if the existence of data is not known.

I don't understand the different between (2) leave blank if no data exist at all and (3) label N/K if the existence of data is not known.

Fisheries socio-economic data	Indicate which fleet IDs	How are the data currently used in MSE and stock/fisheries management?	Are the data available to you? If so please append as a separate document. If not please identify source. Are there any data issues?
Demographics	Spain (some data)	Not use	
Migration	Spain N/K		
Sexual equality	Spain (some data)	Not use	
Full-time vs part-time employment	Spain (some data)	Not use	
Sea based employment	Spain (some data)	Not use	
Land based employment	Spain (some data)	Not use	
Grey[5] market data	Spain N/K		
Dependency and distribution links	Spain (some data)	Not use	
Ethnicity data			
Fish consumption	Spain (some data)	Not use	
Export data	Spain (some data)	Not use	
Import data	Spain (some data)	Not use	
CITES			
Capital costs	Spain (some data)	Not use	
Repair costs	Spain (some data)	Not use	
Equipment/gear			
Global markets			
HACCP[6]	Spain N/K		
Catch values	Spain (some data)	Not use	
Fuel costs	Spain N/K		

Table 4.24 .- Case study 5 socio economic data available and their used in the management.

4.5.1 For each fleet ID please provide/detail/describe:

4.5.1.1 A map showing the geographic location of fishing grounds (by season/quarter if spatial pattern changes).

Data for the Portuguese fleet are not available, but the fleet operate in the same fishing grounds as the Spanish fleet.

Figure 4.10 presents in red the most important fishing grounds for Greenland halibut for the Spanish fleet in 2006.

[5] Grey market, that is where fish is distributed without sales records and is opaque to the competent authorities.
[6] HACCP -Hazard Analysis Critical Control Points – analytical process and EU requirement relating to global trade and food quality.

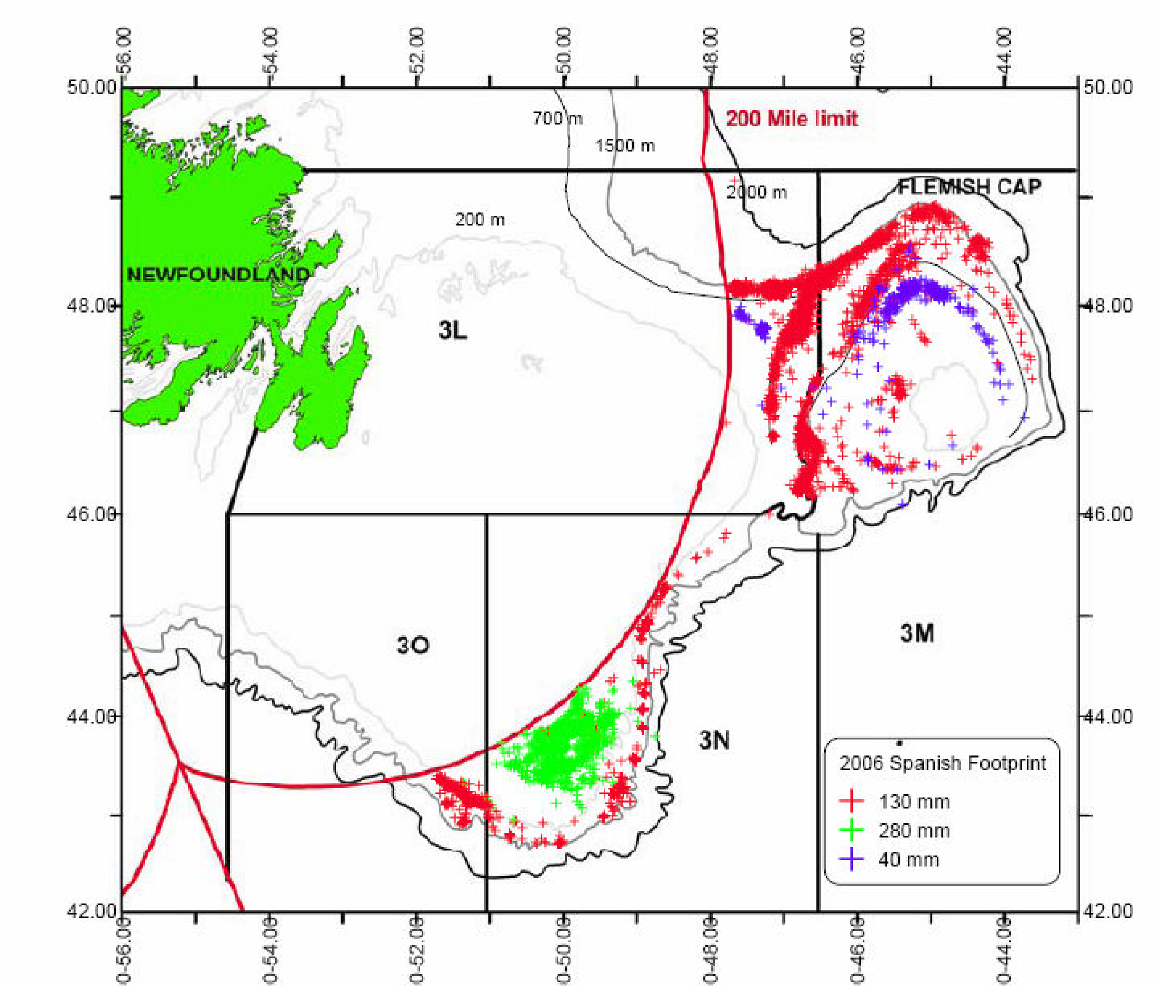

Figure 4.10.- Spanish fleet foot-print in NRA in 2006. Red is the Greenland halibut fishery, green is the skates fishery and blue is the shrimp fishery.

And Figure 4.11 shows the Canadian Greenland halibut catches for 2007 and 2008.

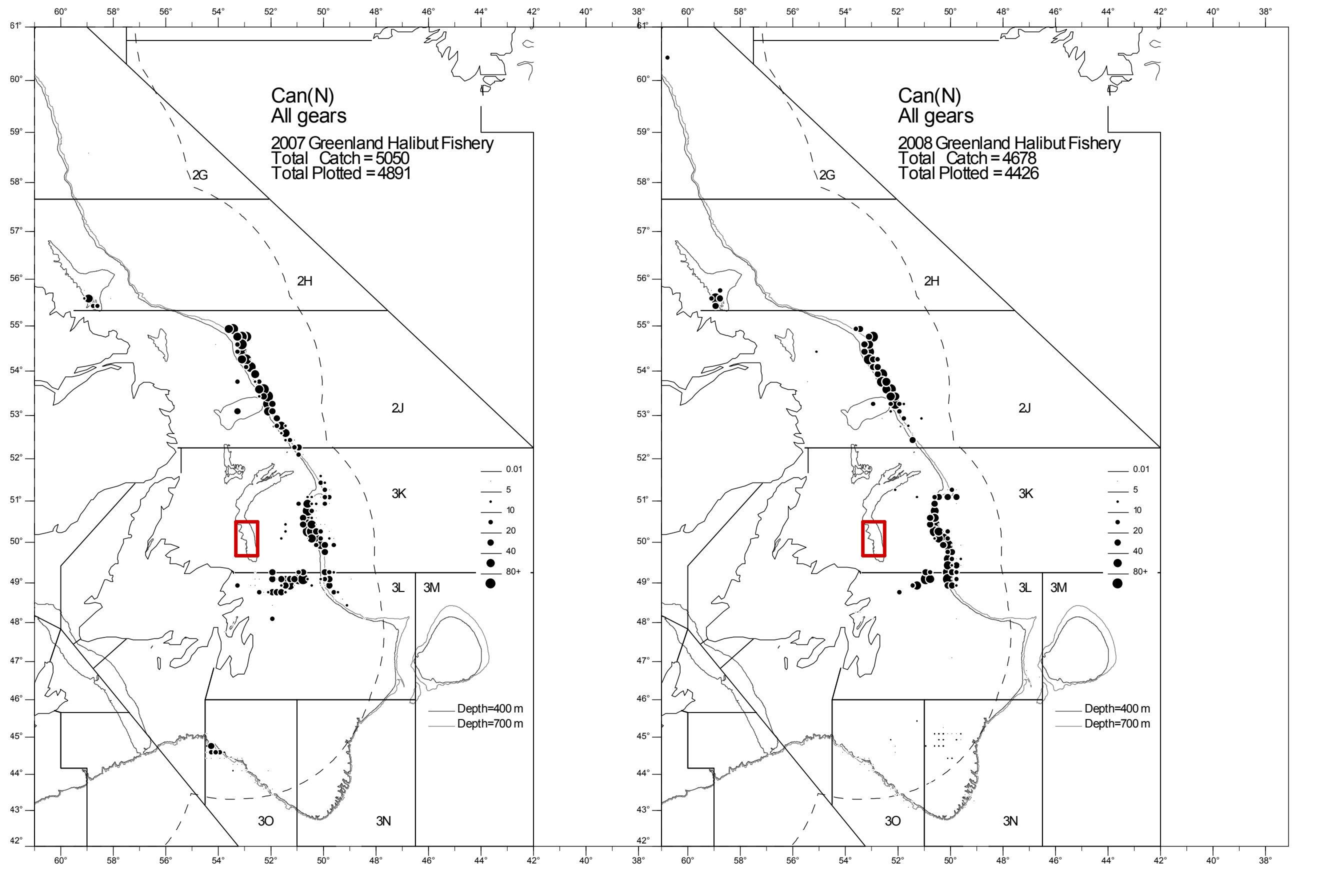

Figure 4.11.- Distribution of the Canadian Greenland halibut catches for 2007 and 2008 fishery.

4.5.1.2 An estimate of the mean distance from home port to main fishing grounds, by season/quarter if variable.

The most important home port for Spanish fleet is Vigo and the distance from Vigo to fishing grounds in Flemish pass (Division 3L-3M) is more or less about 1675 NM. The fishing grounds and the distance are more or less the same for the Portuguese fleet. The most important home port for the Portuguese fleet is Aveiro.

For the Canadian fleet is much less, the most important Canadian fishing grounds are in Division 2J-3K and the distance to the home ports in Newfoundland is less than 200 NM.

4.5.1.3 An estimate of the mean distance from main fishing grounds to landing ports (if different from homeport), by season/quarter if variable.

Landing ports and home ports are the same for the most important fleets.

4.5.1.4 Jurisdiction of fisheries i.e. within national EEZs (please list countries) or in international waters (please indicate RFMO responsible for management).

Canada in the Canadian EEZ for the Canadian fleets (CAt, Cal and CAL) and NAFO in the international waters of the NAFO Area (NRA) for all the others fleets.

4.5.1.5 Number of vessels, vessel size in terms of length or GRT (average, min, max and stdev), mean engine power : kW or BHP (average, min, max and stdev).

Spanish Fleet: Base on the mean value in the period 1992-2008, the characterises of the Spanish fleet are presented in table 4.25:

Spanish Trawlers (1992-2008)

Mean Horse Power	**1567**
Mean GRT (ton)	**762**
Mean Built Year	**1983**
Mean Length (m)	**59**
Mean Carry Capacity (ton)	**1111**
Mean Frozen capacity (Ton/day)	**29**
Mean Crew (persons)	**24**

Table 4.25.- Technical characteristics of the Spanish fleet in the period 1992-2008

The number of vessels increased from 4 in 1990 to 33 in 1994 and from this year till 2004 the number of vessels by year was around 33. From 2004 till now the numbers of vessels decreased till 14 in 2008.

Portuguese fleet: 13 vessels; mean length 76.5 m., mean GRT of 1649 GT and mean power of 2890 HP

4.5.1.6 Main type of fishing gear used (please supply as much information as possible).

Characterises of the normal trawl gear used by the trawlers in NRA was described by Duran and Roman (2001) and are the following: Trawl net Pedreira with 130 mm codend. Figure 3 shows a general diagram of this type of gear, including the trawl doors and groundropes normally used, depending on the preferences of each skipper. Groundrope may be fitted with iron bobbins or, alternatively, rubber disks (rockhopper). Long bridles are used and polyvalent oval or Viking type trawl doors. The weight of these trawl doors and the size of the gear depend on the characteristics of each particular ship. Approximately, vertical opening ranging from 2.5 to 4 metres, and horizontal opening from 20 to 40 metres.

The Canadian effort by gear, mesh-size and geographical zone in 2007 is presented in table 4.26.

Area	Gear	Min. Mesh	Effort	Vessels
Canadian EEZ	Gillnets	152 mm	725 nets	<20 meters
Canadian EEZ	Gillnets	191 mm	900 nets	<20 meters
Canadian EEZ	Otter Trawl	145 mm	2016 hour	>30 meters
NRA	Otter Trawl	130 mm	3290 days	>50 meters

Table 4.26.- Canadian effort by gear, mesh-size, geographical zone and vessel size in 2007

4.5.1.7 An estimate of the average length of trips and the average number of crew per vessel.

Spanish fleet: The normal length of Trips actually is between 3 and 4 months and the crew is about 24 persons.

Portuguese fleet: The normal length of trips actually is between 4 and 5 months and the mean crew is about 35 persons.

4.5.1.8 Total number of fishermen in the fleet, split into full-time/part-time if appropriate, and by gender.

The problem is that the Spanish and Portuguese trawl fleets carry out each year different fisheries in different areas as: multispecies in Hatton, Redfish in Reikjanes, Cod and Redfish in Norway and Norwegian Sea, Greenland halibut, skates and redfish in NAFO. The number of the fishermen is for the fleet and not for the fishery.

Apart from Greenland halibut, the Spanish fleet also catches other incidental species (mainly redfish, skate and roughhead grenadier) both in NAFO waters as well as in other fishing zones, such as Hatton Bank, Irminger, Svalbard, Reikgianes, Greenland, southwest Atlantic and the Falkland Islands. Specifically,

43.6% of this fleet's landings, which took place from 2001 to 2005, come from NAFO zones whereas the remaining 56.4% came from the other fishing grounds; and of this 43.6%, 32.8% corresponds to Greenland halibut landings (Garza-Gil and Varela-Lafuente, 2009).

The Spanish mean crew for vessel is 24 persons full time. All of them males.
The Portuguese mean crew for vessel is 35 persons full time. All of them males.

4.5.1.9 Main type of vessel ownership within the fleet e.g. fishing companies, skipper/owner, co-operative etc

Fishing Companies. The Spanish fleet is made up of 35 freezer vessels (data from 2005) from twenty fishing companies whose activities include the processing and preserving of fish products. Since 2005 the number of vessels has decreased very much (13 in 2008) due to the Greenland halibut recovery plan.

The Portuguese fleet is made up of 13 freezer vessels from 5 owners whose activities include the processing and preserving of fish products.

4.5.1.10 Total quantity and value of the case study species landed and all species landed in each of the last 3 years. **.**

From the last updated STATLANT the Portuguese landings of Greenland halibut were 2326t, 1873t and 1976t in a total catch of 12537t, 11180t and 12357t for 2006, 2007 and 2008 respectively. The price of the Greenland halibut (headoff and unguted) are around 3€ per kg. The real value and the value for others species are not available.

With relation to catches and based on a representative sample of eleven vessels (which represents 28% of the population, in average terms for the period 2001–2005), this fleet lands around 53,000 tonnes on average over the period under consideration, of which 43.6% corresponds to NAFO waters, the rest coming from other Atlantic zones (Garza-Gil and Varela-Lafuente, 2009).

Table below (Garza-Gil and Varela-Lafuente, 2009) presents the values of the catches, there is not information about the Greenland halibut value.

4.5.1.11 Total revenues, costs and profits in each of the last 3 years.

Based on Garza-Gil and Varela-Lafuente (2009) and for the period 2001-2005, the economic results for the Spanish fleet were presented in Table 4.27:

Economic results of the Spanish fleet in NAFO: 2001–2005

(in 1000 €$_{05}$)	2001	2002	2003	2004	2005
Total costs[a]	106,009.0	103,584.1	100,402.7	81,536.9	73,257.7
Energy consumption	17,041.8	16,254.9	16,482.2	18,225.8	16,786.9
Other current costs	19,012.1	20,346.4	18,888.9	16,942.1	16,525.6
Vessel costs	18,776.8	17,531.0	17,543.1	10,781.7	8088.4
Wages and salaries	51,178.3	49,451.9	47,488.6	35,587.4	31,856.8
Total income	161,820.2	143,678.9	144,083.5	108,978.4	97,164.3
NAFO income	85,322.7	72,179.2	76,948.1	53,399.4	46,123.9
Income other areas	76,497.6	71,499.8	67,135.4	55,579.0	51,040.4
Gross value added (GVA)	106,989.6	89,546.6	91,169.4	63,028.8	55,763.4
Gross cash flow (GCF)	55,811.2	40,094.7	43,680.9	27,441.4	23,906.6
Amortisations	18,871.4	20,512.6	16,865.0	14,218.4	12,332.7
Net profit (NP)[b]	36,939.8	19,582.1	26,815.9	13,223.0	11,573.9
Interests	1963.4	1845.6	2002.7	2259.6	2181.2
Net profit	34,976.4	17,736.5	24,813.2	10,963.4	9392.6

Source: Data estimated from sample.

[a] These costs do not include the financial burdens of the companies or the taxes paid.

[b] Net profit before taking away the interest.

Table 4.27.- Economic results of the Spanish fleet in NAFO in the period 2001-2005.

Not available for Portugal

4.5.1.12 Unionisation or other types of fishermen's association present.

Not Available N/A for the Spanish fleet, probably this information are available but we don't know where.

In Portugal at least two unions are present and participate in the work collective agreement:

CGTP/Federação dos Sindicatos do Sector da Pesca
Av. Elias Garcia, 123, 2º - 1050-098 Lisboa
Telefone: +351 21 780 22 50; Fax : +351 21 780 22 59
EMail :fpescas@mail.telepac.pt

UGT/PESCAS - Sindicato Nacional dos Trabalhadores do Sector das Pescas
João Carlos Ramos (SG)
Estrada da Lota – Apartado 940, 3800-210 Aveiro Codex
Telefone: +351 234 429 736; Fax: +351 234 421 832

4.5.1.13 Main wage structure (e.g. fixed wages or share wages etc)

In the Spanish and Portugal cases the normal way of payment is a small part fixed and the mayor part with share wages depending in the revenues of the trip.

4.5.1.14 Are landings of case study species (1) sold on local market(s) for direct consumption, (2) sold on local markets for processing (3) sold on non-local markets (please describe where) for direct consumption or processing, (4) exported fresh or (5) other (please describe).

Spain case 2 and 3. The frozen Greenland halibut products are for national market and for exportation. The principal non national market for Spanish Greenland halibut products are: Portugal, France and Japan.

Portugal exports the majority of the Greenland halibut landings to the Asian countries (Japan, China, Korea, etc.) and also to Europe. This sell is made through brokers.

4.5.1.15 What are the market characteristics (1) open auction, (2) contract, (3) single buyer, (4) other (please describe).

For Spain, open auction after processing.

In Portugal it could be (2) or (3), see point 4.5.1.14.

4.5.1.16 What were total landings and the average prices for each category above, in each of the last 3 years.

Greenland halibut Spanish landings was present before in this report. We have not information for the Greenland halibut products prices.

Portuguese Greenland halibut landings were present before in this report. The price of the Greenland halibut (headoff and unguted) are around 3€ per kg. The real value is not available.

4.5.1.17 How is the case study species processed (fresh, frozen, salted, cured, canned etc) and in what form? (fillets, wholefish, fishmeal etc).

The most important Greenland halibuts frozen products for the Spanish fleet are: Unheatfish with skin for the national market and without skin for Japanese market. Less usual fillets with and without skin.

In Portugal, the Greenland halibut is processed on board, the head and guts are removed and then the fish is frozen by size category. After the sale it is the buyers that further process according their needs.

4.5.1.18 What was the total quantity and value of the product produced in each of the last 3 years.

The most recent information available for the Spanish fleet is for the period 2001-2005. We have not information of the Greenland halibut products values we only have information of the total NAFO products values and were presented in 4.5.1.11 paragraph.

Not available for Portugal. See point 4.5.1.16.

4.5.1.19 Number and location of processing units and the total number and gender split of employees.

For Spain: we understand processing units as the ground processing plant in this point, because we could understand as processing unit the vessels. We only have information about Galicia in this point. Most of the Spanish fish processing plants are in Galicia (Table 4.28).

ESTRATO	Nº DE EMPRESAS	FACTURACIÓN	TAMAÑO MUESTRAL
Conserva 1	22	Menor a 4.808.096,84 €	4
Conserva 2	11	4.808.096,84-18.030.363,13 €	4
Conserva 3	13	Superior a 18.030.363,13 €	13
Nuevos transformados	20		
TOTAL	**66**		

Table 4.28.- Type of processing plants, number of companies in Galicia, turnover and sample size.

The employees of these plants are most of them women (table 4.29 from Doldán *et al.*, 2005).

	Mujeres	Hombres	Total
Pesca Extractiva (I)	325	25.367	25.692
Marisqueo (II)	6.988	1.298	8.286
• Miticultura	1.894	5.241	7.135
• Piscicultura marina	52	143	195
Acuicultura (III)	1.946	5.384	7.330
Total Pesca (I+II+III)	**9.269**	**32.049**	**41.308**
• Conserva	3.886	1.271	5.157
•Otros transformados	1.607	526	2.133
Total conserva y transformados.	**5.493**	**1.797**	**7.290**
Total pesca-conserva	**14.762**	**33.846**	**48.598**
Comercio			2.687
Servicios relacionados			2.010
TOTAL			**53.295**

Table 4.29.- Number of employments (Fishing and Processing plants) by sex in Galicia.

Not available for Portugal. Most Greenland halibut landings are sold to abroad.

4.5.1.20 Revenues, costs and profits of processing units in each of the last 3 years.

For Spain, not information about this point.

Not available for Portugal.

4.5.1.21 Please describe any subsidies currently in force.

There are subsidies to facilitate the implementation of fishing effort adjustment plans for companies and sailors under the (CE) No 1198/2006 Regulation and in the National level under Orden PRE/1645/2009 where are regulate the financial help to the decrease of the Spanish effort in the Greenland halibut fishery. http://www.boe.es/boe/dias/2009/06/20/pdfs/BOE-A-2009-10244.pdf

In Portugal there are also subsidies (till 31 December 2009) to facilitate the implementation of fishing effort adjustment under the Operational Program Fisheries 2007 -2013 (PROMAR) in the framework of the

European Fisheries Fund. The Portuguese "*Portarias*" 424-A/2008 and 1447/2008 regulate the temporary cessation of fishing activities.
http://www.dre.pt/pdf1sdip/2008/06/11301/0000200004.PDF
http://www.dre.pt/pdf1sdip/2008/12/24100/0878008785.PDF

4.5.1.22 Please supply data on any other issues listed in table at 4.5

In the Spanish case, most of the socio economic data have been extracted from the National official statistic. The most important data base are available in the web in the following address:
http://www.mapa.es/estadistica/pags/pesquera/Estadísticas_Pesqueras_2008-04.pdf
http://www.mapa.es/es/estadistica/pags/pesquera/introduccion.htm
http://www.ine.es/inebmenu/mnu_sintesis.htm

Many economic information about the Spanish fleet in NAFO was presented by Garza-Gil and Varela-Lafuente (2009).

In the Portuguese case, the socio economic data are collected by "Ministério da Agricultura, do Desenvolvimento Rural e das Pescas. DGPA - Direcção Geral das Pescas e Aquicultura" and have been extracted from the National official statistics. The most important data bases are available in the web in the following address:
http://www.dgpa.min-agricultura.pt/portal/page?_pageid=33,1&_dad=portal&_schema=PORTAL
http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_main

4.5.2 For the country of each fleet ID please provide/detail/describe:-

4.5.2.1 Proportion of total national employment in (1) catching, marketing, processing etc of all species and (2) catching, marketing, processing of the case study species.

Not available for Portugal. But in Portugal for one NAFO fishermen exist 4 employees in land involved in this fisheries.

For Spain is presented in Table 4.30 the mayor economic indices. Table 4.30 compare in different colours the Total National, the primary sector, the fishery sector in general and the direct fishing sector.

COMPARACIÓN DE PRINCIPALES MACROMAGNITUDES (TOTAL NACIONAL, TOTAL AGRARIO, TOTAL SECTOR PESQUERO Y TOTAL SECTOR PESCA MARÍTIMA)
Valores calculados a precios corrientes

	Año 2007
TOTAL NACIONAL	
VAB pb (millones de euros) (2) (A)	942.002,00
Ocupados Total (miles de personas) (3)	20.356,00
VAB por ocupado (euros) (4)	46.276,38
Remuneración asalariados (millones de euros) (2)	496.796,00
A. Agricultura, ganadería y pesca	
VAB pb (millones de euros) (2) (A)	27.087,00
Ocupados Total (miles de personas) (3)	925,50
VAB por ocupado (euros) (4)	29.267,42
Remuneración asalariados (millones de euros) (2)	5.774,00
A.1. Pesca**	
VAB pb (millones de euros) (2) (A)	1.722,00
Ocupados Total (miles de personas) (3)	52,20
VAB por ocupado (euros) (4)	32.988,51
Remuneración asalariados (millones de euros) (2)	872,00
A.1.1. Pesca Marítima	
VAB pb sector pesca marítima (millones de euros) (1)	779,08
Empleos equivalentes asalariados en el sector pesca marítima (miles personas) (1)	35,26
VAB sector pesca marítima por empleo equivalente (euros) (1)	22.096,67
Remuneración asalariados (millones de euros) (1)	534,48

VAB sector pesca marítima por ocupado s/ VAB por ocupado (%) (4)	47,75%
VAB sector pesca marítima s/ VAB (%) (4)	0,1%
Ocupados en el sector pesca marítima s/ Total ocupados (%) (4)	3,81%

FUENTES: (1) MARM-SGE- Encuesta Económica de Pesca Marítima
(2) INE- Contabilidad Nacional
(3) INE- EPA
(4) Elaboración propia con datos INE
** NOTA: Pesca incluye sector Pesquero Cultivador y Extractivo
pm: precios de mercado
pb: precios básicos
(A) Estimación avance

Table 4.30.- Spanish mayor economic indices for 2007. In different colours the Total National, the primary sector, the fishery sector in general and the direct fishing sector.

4.5.2.2 Proportion of total national gross domestic product (GDP) in (1) catching, marketing, processing etc of all species and (2) catching, marketing, processing of the case study species.

N/K

Not available for Portugal.

4.5.2.3 Percentage unemployment in (1) total population (2) fishermen in general

For Portugal (Instituto Nacional de Estatística, IP, 2010.) are presented in Table 4.31. The first part presents the Total population, the employment population and the unemployed population, by quarter and by sex. The second part presents the employ unemployed population by econimic sector and sex. http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpub_boui=84756142&PUBLICACOESmodo=2

3.4 - População total, activa, empregada e desempregada

Portugal	Valor Trimestral (10³) 4º Trim. 09	3º Trim. 09	2º Trim. 09	1º Trim. 09	4º Trim. 08	3º Trim. 08	2º Trim. 08	Variação Homóloga (%)
População Total								
Total (HM)	10 647,3	10 641,0	10 634,4	10 630,7	10 631,1	10 625,1	10 618,9	0,2
Homens	5 153,4	5 150,5	5 147,3	5 145,5	5 145,2	5 142,5	5 139,6	0,2
População Activa								
Total (HM)	5 586,8	5 565,3	5 583,9	5 594,8	5 613,9	5 629,5	5 638,0	-0,5
Homens	2 942,8	2 933,6	2 960,1	2 958,9	2 987,6	2 986,7	2 996,2	-1,5
População Empregada								
Total (HM)	5 023,5	5 017,5	5 076,2	5 099,1	5 176,3	5 195,8	5 228,1	-3,0
Homens	2 662,8	2 666,0	2 702,9	2 718,6	2 784,4	2 793,0	2 808,4	-4,4
População Desempregada								
Total (HM)	563,3	547,7	507,7	495,8	437,6	433,7	409,9	28,7
Homens	279,9	267,6	257,2	240,4	203,3	193,7	187,8	37,7
Taxa de Actividade (%)								
Total (HM)	52,5	52,3	52,5	52,6	52,8	53,0	53,1	-
Homens	57,1	57,0	57,5	57,5	58,1	58,1	58,3	-
Taxa de Actividade (15 e mais anos) (%)								
Total (HM)	61,8	61,7	61,9	62,1	62,3	62,5	62,7	-
Homens	68,0	67,9	68,5	68,6	69,3	69,3	69,6	-
Taxa de Desemprego (%)								
Total (HM)	10,1	9,8	9,1	8,9	7,8	7,7	7,3	-
Homens	9,5	9,1	8,7	8,1	6,8	6,5	6,3	-

Fonte: INE, Estatísticas do Emprego

3.5 - População empregada por situação na profissão e sector de actividade

Portugal	Valor Trimestral (10³) 4º Trim. 09	3º Trim. 09	2º Trim. 09	1º Trim. 09	4º Trim. 08	3º Trim. 08	2º Trim. 08	Variação Homóloga (%)
SITUAÇÃO NA PROFISSÃO								
Trabalhador por conta de outrem								
Total (HM)	3 827,1	3 837,8	3 873,6	3 884,5	3 953,1	3 942,0	3 978,3	-3,2
Homens	1 962,7	1 976,4	2 006,5	2 019,0	2 083,8	2 080,3	2 098,4	-5,8
Trabalhador por conta própria como isolado								
Total (HM)	877,6	867,0	889,5	887,7	902,0	917,3	911,0	-2,7
Homens	479,3	471,3	480,5	475,9	477,3	482,7	483,5	0,4
Trabalhador por conta própria como empregador								
Total (HM)	270,9	267,7	272,6	281,6	282,0	285,8	288,2	-3,9
Homens	201,8	198,8	200,2	207,1	205,7	208,2	206,0	-1,9
Trabalhador familiar não remunerado e outro								
Total (HM)	48,0	45,0	40,5	45,3	39,3	50,6	50,5	22,1
Homens	19,1	19,5	15,7	16,7	17,6	21,8	20,5	8,5
SECTOR DE ACTIVIDADE (a)								
Agricultura, produção animal, caça, floresta e pesca								
Total (HM)	581,7	567,2	551,3	558,9	572,2	589,4	587,4	1,7
Homens	311,5	297,8	280,5	284,9	293,6	301,3	298,9	6,1
Indust., Construção, Energia e Agua								
Total (HM)	1 389,5	1 413,6	1 444,6	1 455,0	1 498,0	1 520,1	1 539,6	-7,2
Homens	1 008,3	1 028,8	1 052,9	1 070,4	1 104,6	1 118,2	1 126,9	-8,7
Serviços								
Total (HM)	3 052,3	3 036,7	3 080,3	3 085,1	3 106,1	3 086,3	3 101,0	-1,7
Homens	1 343,0	1 339,4	1 369,4	1 363,3	1 386,2	1 373,4	1 382,5	-3,1

(a) As estimativas por sector de actividade têm por referência a CAE-Rev. 3

Fonte: INE, Estatísticas do Emprego

Table 4.31.- The first part, Portugues Total population, the employment population and the unemployed population, by quarter and by sex. The second part presents the employment population by economic sector and sex.

For Spain, Table 4.32 presents the unemployed number (000s) by sector and the unemployed percentage between economic sectors.

	2000	2001	2002	2003	2004	2005	2006	2007
Parados por sectores económicos								
TOTAL DE PARADOS (miles)	2.496,4	1.904,4	2.155,3	2.242,2	2.213,6	1.912,5	1.837,1	1.833,9
Agricultura, silvicultura, caza y pesca	188,6	145,6	154,6	159,6	159,4	107,5	90,7	96,9
Industria (sin construcción)	163,0	157,0	182,1	187,7	188,6	161,2	146,2	135,6
Construcción	158,5	147,1	176,2	172,9	173,6	151,9	161,7	183,4
Servicios	666,0	567,6	678,8	721,6	751,2	673,9	706,8	713,7
No clasificables	1.320,3	887,1	963,7	1.000,4	940,8	818,0	731,7	704,3
PORCENTAJE	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Agricultura, silvicultura, caza y pesca	7,55	7,65	7,17	7,12	7,20	5,62	4,94	5,28
Industria (sin construcción)	6,53	8,24	8,45	8,37	8,52	8,43	7,96	7,39
Construcción	6,35	7,72	8,18	7,71	7,84	7,94	8,80	10,00
Servicios	26,68	29,80	31,49	32,18	33,94	35,24	38,47	38,92
No clasificables	52,89	46,58	44,71	44,62	42,50	42,77	39,83	38,41

Table 4.32.- Spanish unemployed number (000s) by sector since 2000 till 2007 and the unemployed percentage between economic sectors.

4.5.2.4 Average annual earnings in (1) total population (2) fishermen in general

For Spain, Table 4.33 present for 2007 the rent level for each of the different fisheries where Spain has fleet. First part of table presents for National fisheries and the second part for the International fisheries.

RENTA DE LA PESCA por UTA (Unidad de Trabajo Anual). Año 2007. Pesca Marítima
(Valores en euros a precios corrientes)

ESTRATO	Renta de la Pesca	UTA (Unidad de Trabajo Anual)	RENTA de la PESCA por UTA
Canarias Golfo de Cádiz. Arrastre	5.400.594,04 €	561,00	9.626,73 €
Canarias Golfo de Cádiz. Artesanales	22.556.858,47 €	1.305,00	17.284,95 €
Canarias Golfo de Cádiz. Cerco	9.746.658,61 €	738,00	13.206,85 €
Mediterráneo. Arrastre	78.323.560,03 €	3.232,00	24.233,77 €
Mediterráneo. Artesanales	43.533.036,43 €	749,00	58.121,54 €
Mediterráneo. Cerco	43.528.500,64 €	1.638,00	26.574,18 €
Mediterráneo. Palangre	13.035.491,33 €	568,00	22.949,81 €
Cantábrico Noroeste. Arrastre	13.054.760,30 €	1.066,00	12.246,49 €
Cantábrico Noroeste. Artesanales	59.277.169,08 €	2.457,00	24.125,83 €
Cantábrico Noroeste. Cerco	40.383.421,95 €	2.047,00	19.728,10 €
Cantábrico Noroeste. Palangre	7.800.393,27 €	517,00	15.087,80 €
Cantábrico Noroeste. Redes de Enmalle	8.948.454,95 €	400,00	22.371,14 €
Caladero Nacional sin determ. Palangre	3.825.678,32 €	804,00	4.758,31 €
Aguas NACIONALES	349.414.577,42 €	16.082,00	21.727,06 €
Aguas Comunitarias. Palangre	37.762.003,28 €	1.995,00	18.928,32 €
Aguas Comunitarias. Arrastre	34.272.191,31 €	1.383,00	24.781,05 €
Sahariano. Artesanales	1.903.479,95 €	480,00	3.965,58 €
Sahariano. Cañeros Atuneros	3.865.674,83 €	433,00	8.927,66 €
Sahariano. Palangre	3.611.363,32 €	600,00	6.018,94 €
Sahariano. Arrastre	16.766.974,75 €	1.826,00	9.182,35 €
NAFO - Svalbard. Arrastre	21.982.529,30 €	620,00	35.455,69 €
Atlántico SW, Brasil, Índico, Subsahariano. Arrastre	32.946.446,99 €	1.292,00	25.500,35 €
Atlántico, Índico, Pacífico, Subsahariano. Palangre	16.621.792,91 €	1.843,00	9.018,88 €
Atlántico, Índico, Pacífico, Sahariano. Cerco Atún	81.769.139,93 €	6.261,00	13.060,08 €
SWO otros. Palangre	20.496.123,51 €	2.443,00	8.389,74 €
Aguas NO NACIONALES	271.997.720,08 €	19.176,00	14.184,28 €
TOTAL SECTOR	621.412.297,50 €	35.258,00	17.624,72 €

FUENTES: MARM-SGE- Encuesta Económica de Pesca Marítima

** NOTA: UTA: Empleos Equivalentes a Jornada Completa (considerando una jornada media anual de 1.800 horas)

Table 4.33.- Spanish fisherman rent level for 2007. First part National fisheries and the second part for the International fisheries.

4.5.2.5 Please describe any immigration/emigration issues impacting on your case study stock **.**

In Spain, an increase in the emigration people from Africa and Latin America working in fisheries was noted in last years but we have not available information on this.

In Portugal, the main crew are Portuguese, there are some emigrants from such as Africa, East Europe or even from Indonesia but there are below the 10-15% of the fishermen. The exact level of emigration is not available.

4.5.3 General:

4.5.3.1 How are economic and social factors considered in scientific analyses and advice to fisheries management?

In the Scientific advice is not considered, I don't know how the Fisheries Commission in charge of the management use the social and economic factors and information to deal with the management of the stock.

4.5.3.2 How are socio-economic studies coordinated, and how may they be improved?

In Spain, the socio-economic studies available was made by the Vigo University and paid by the sector. The mayor problem is the availability of the economic data. This data is very difficult to compile and is not available in detail.

4.5.3.3 What are the priorities for future monitoring, data collection and analysis?

The European Commission is in charge of these matters. COMMISSION Decision of 6 November 2008 (2008/949/EC) establish the priorities about the social and economics data in CHAPTER III "MODULE OF EVALUATION OF THE FISHING SECTOR":

A. Collection of economic variables

1. Variables to be collected are listed in Appendix VI. All economic variables are to be collected on an annual basis with the exception of those identified as transversal variables as defined in Appendix VIII and those identified in order to measure the effects of the fishery on the marine ecosystem as defined in Appendix XIII which are to be collected at more disaggregated levels The population is all vessels in the Community Fishing Fleet Register on 1 January. All economic variables have to be collected for active vessels. For each vessel for which economic variables defined in Appendix VI are collected, the corresponding transversal variables defined in Appendix VIII have also to be collected.

2. For inactive vessels only capital value (Appendix VI), fleet (Appendix VI) and capacity (Appendix VIII) shall be collected.

3. National currencies shall be transformed into euros using the average annual exchange rates available from the European Central Bank (ECB).

4.5.3.4 For EU fleets, are socio-economic data provided under the DCF? Please list.

COMMISSION DECISION of 6 November 2008 (2008/949/EC).

4.5.3.5 Are there any aspects of data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

The NAFO Scientific Council is in charge of the resource assessment and not in the socio economics problems of the management measures. Fisheries Commission is the NAFO body in to assess this information.

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Section 5: Review of known and likely impact of the fisheries on deep-water biodiversity and VMEs.

5.1 Please list below all previous and current studies of biodiversity in the area inhabited by your stock and append time-series data used.

There are some studies made about the biodiversity in Flemish Cap (Gonzalez-Troncoso *et al.* 2006; Gonzalez-Troncoso and Paz, 2007) based on EU Flemish Cap Survey data. Koen-Alonso *et al.* (2006) studied the changes in the fish community of the Newfoundland Shelf based on the Canadian multi-species bottom trawl surveys. The data of these studies are not available as time series, is only available as results and presented in the previous studies.

5.2 Please review each study identifying the aims, methods and data used, outcomes and recommendations made.

The aim of this study is to test the variability of the assemblages defined in the Flemish Cap area. Data from 951 bottom hauls were analysed, covering depths between 126 and 740 m in the years 1995–2002. The fish fauna in Flemish Cap appears distributed in a persistent structural zonation defined in three assemblages. The first three factors of a Principal Component Analysis explained the 78.4% of the variance in distribution species, and they are consistent with the results of a cluster analysis. The three characteristic assemblages show a temporal persistence, but some changes appear in this period, for instance: displacements of the assemblages limits towards shallower waters, and some changes in relative position of the dominant species in each assemblage. These changes can be related with the constant decrease of the biomass of the main demersal fish species like Atlantic cod and American plaice. The species of Genus Sebastes appear as dominant fish species in the area (Gonzalez-Troncoso *et al.* 2006).

Gonzalez-Troncoso and Paz (2007) calculated some ecological indices from the data obtained in the research surveys conducted by EU (Spain and Portugal) in Flemish Cap between the years 1988 and 2006. These indices were calculated for individual populations (intrinsic population rate of growth and mean length of catch) and for all the community (ABC curves, indices about faunal diversity, proportion of non-commercial species, mean length in community and size spectra).

Koen-Alonso et al. (2006) analyses were carried out discriminating two major geographical areas:
NAFO Divisions 2J3K (Fall Survey)
NAFO Divisions 3LNO (Spring Survey)
In each region, only core strata were considered.
Each region was analysed considering two time series:

Engels	**1981-1994 (2J3K) and 1985-1995 (3LNO)**
Campelen	**1995-2004 (2J3K) and 1996-2004 (3LNO)**

The basic survey indices were:
Total Biomass
Total Abundance
Biomass / Abundance ratio
These indices were calculated by operational species and by functional groups.
The biomass and abundance indices were used to produce:
Diversity indices
k-dominance and ABC plots

5.3 Have any of these studies related biodiversity trends to fishings impacts? If so please review.

Not fishing impact analysis.

5.4 If biodiversity studies have not been carried out are there any existing data that can be used? Please append.

Survey and fisheries information. These information is only available as results and present as SCR documents.

5.5 What in you opinion would be the best way forward to investigate the impacts of fishing on biodiversity in your stock area?

There are many studies that trying to explicate the effect of fishing in individual populations or, more and more, in communities, trying to contribute to the development if an ecosystem approach in the evaluation of fisheries. But it must be noted that the majority of the ecosystem indicators are sensitive but not specific to fishing impacts (Shin et al., 2005). It has been shown that the relationships between diversity, stability and stress are far very complex and difficult to explain.

The most Vulnerable Marine Ecosystems (VMEs) are ones that are both easily disturbed and are very slow to recover, or those that may never recover. Vulnerable ecosystem features may be physically or functionally fragile. According to this definition, cold-water coral ecosystems are considered VMEs.

Bottom trawling has deleterious impacts on complex habitats (Watling and Norse, 1998; Auster and Langton, 1999). The structural characteristics and long-lived nature of some deep water corals make them especially vulnerable to damage by the mechanical impacts of bottom fishing activities (Probert et al., 1997; Phillipart, 1998; Freiwald et al., 2004).

In the last years, the studies of fishery impacts to the benthos and the ecosystem in NAFO area are increasing (Messieh et al., 1991; Collie et al., 1997; Prena et al., 1999; Kenchington et al., 2001; Hermsen et al., 2003; Gilkinson et al., 2005; Henry et al., 2006; Kenchington et al., 2006; Kenchington et al., 2007) and are very useful to understand the fishery effects on the ecosystem, though most of them are in small areas and shallow waters and the effects in deep waters could be very different.

5.6 Please list below all previous and current studies of the condition of VMEs in the area inhabited by your stock.
This revision was made by the WGEAFM and can be extract from his 2008 Report.

5.7 Please review each study identifying the aims, methods and data used, outcomes and recommendations made.
The review was made and compile in the 2008 Report of the NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM).

5.8 Have any of these studies investigated the impacts of fishing on VMEs? If so please describe.
No, we are in the phase of identify the VME, but some work about this point was made in the NAFO SC. The sponges and coral areas were compared with the NAFO Footprint.

The Scientific Council response to significant concentrations of corals was provided at the Scientific Council Meeting in October of 2008. The response is available in the NAFO/ICES Pandalus Assessment Group Meeting (2008). And for concentrations of sponges the NAFO SC answer was made in the 2009 NAFO SC report.

5.9 If VME/fishing interaction studies have not been carried out are, what in you opinion would be the best way forward to investigate the impacts of fishing on VMEs in your stock area ?
Considering that advancing the general ecosystem approach will require multiple meetings, Scientific Council (2009) reorganized the Terms of Reference (ToR) for WGEAFM. The new ToRs are intended to provide a general envelope and reference grid for WGEAFM work with minimal modification of ToRs between meetings, or at least to provide some degree of ToR stability over the next few years. The re-organized ToRs are grouped within themes as follows:

Theme 1: Take stock of past and planned WGEAFM related work
ToR 1: Update on identification and mapping of sensitive species and habitats in the NAFO area. This ToR is intended to provide a place to summarize the work done by correspondence between meetings, as well as to discuss advancements made to address identified gaps. In the 2009 Annual Meeting this ToR will be focused on the VME work and later developments (e.g. the multinational effort, led by Spain, to map NAFO VMEs).

Theme 2: Status and functioning of NAFO marine ecosystems (empirical evidence)
ToR 2: Synthesis of current understanding of the dynamics of Large Marine Ecosystems (LMEs) in the NAFO area. This ToR is intended to summarize our understanding on the dynamics of these ecosystems, but focused on the possibility of regime shifts and its potential mechanisms if indeed such shifts have occurred. Here

ecosystem regime shifts are loosely defined when ecosystem change is large, abrupt and difficult to reverse. Do we understand the cause(s) for such shifts and, more importantly, what are the drivers (tipping points) for such shifts?

ToR 3: Scope of Marine Protected Areas and VMEs in the context of habitat and spatial functioning. This ToR is intended to examine examples of what does and what does not work, e.g. links between scale, biodiversity and sustainability of ecosystem goods and services – what is the evidence to propose a workable and pragmatic solution.

Theme 3: Practical application (synthesizing the evidence and theory)

ToR 4: Systems level modelling and assessment approaches. This ToR is intended to discuss alternative modelling and assessment approaches which can provide the outputs for overall objective fisheries based risk assessments. Can we set out a framework for the integration of modelling and assessment approaches to be developed/adopted?

ToR 5: Ecosystem indicators and how they can be used in management advice. This ToR is aimed to discuss, given the present understanding of LME dynamics (including the impacts of fishing), what are the most promising types of indicators, either now or in the future, and how they could be used for informing management decisions?

ToR 6: Methods for the long-term monitoring of VME status and functioning. This ToR is aimed to begin the discussion on how to incorporate the monitoring and management of VMEs within a larger ecosystem-based management framework.

Additional ToR for WGEAFM from this Scientific Council meeting Scientific Council noted that no biomass index is available for coral or sponges aggregations within the NAFO Regulatory Area. Therefore, the detection of trends over time and the monitoring schemes to assess impact/recovery that are required by the FAO Deep Sea Fisheries guidelines is problematic. Further, it is not possible to analyse the relationship between the occurrence of coral or sponge aggregations and commercial bottom trawl fishing effort.

Scientific Council requests that WGEAFM investigate cost and time effective methods to monitor the health of the VME areas. Further, and subject to the above and data availability, Scientific Council further requests that the relationship between historical commercial bottom trawl fishing effort and the occurrence of VME indicator species be investigated.

5.10 Are there any aspects of data and knowledge (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

Till the implementation of the Ecosystem Approach in NAFO and the data requirements to implement it, this point is not know.

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Section 6: Review of current and historical management and monitoring procedures

6.1 Management procedures

6.1.1 Please tick which mechanisms are in **currently** place to manage your stock, fisheries, ecosystems, VMEs and PET species?

Management mechanism	Stock	Fisheries	Ecosystems	VMEs	PETs
Free access (totally unregulated)					
TAC	X				
ITQ (individual transferable quotas)					
IQ (individual non-transferable quotas)	Spain (national level)				
TURF (territorial use of right fishing)[7]	X				
Effort limitation (gear, days at sea etc)	X				
Licensing	X	X			
Capacity limits					
Technical Measures	X	X			
Spatial closures			X	X	
Temporal Closures					
VME Encounter protocols				Developing	
PET Encounter protocols					
Others					X

Table 6.1.- NAFO management measures in place at different levels.

6.1.2 What are the possibilities of entry i.e. how and how easily newcomers can enter the fishery? Are there legal, economic or social barriers to entry?

Spain and Portugal: In the Spanish and Portuguese cases there are vessel lists that can operate in NAFO Area. To entry new vessels in the fishery is very difficult, you need to retire old units to put a new one. In NAFO the Contracting party is the EU and not the European Countries.

In this moments the EU stimulate the elimination of the old vessels more than open the possibilities of the new ones and is responsible for that all EU countries compliance with the NAFO Conservation and Enforcement Measures :

The NAFO Conservation and Enforcement Measures (2009) regulate the fishery and for these points establish that Each Contracting Party shall:
1. authorize the use of fishing vessels flying its flag for fishing activities under Article 1 only where it is able to exercise effectively its responsibilities in respect of such vessels;
2. ensure that only authorized fishing vessels flying its flag conduct fishing activities under Article 1;
3. ensure that fishing vessels flying its flag comply with applicable measures adopted under the NAFO Convention.
4. undertake to manage the number of authorized fishing vessels and their fishing effort commensurate to the fishing opportunities available to that Contracting Party in the Regulatory Area.
5. through its competent authorities, every two years, check each of their vessels, notified in accordance with Article 20, to certify the correctness of the vessel's plans for fish rooms and other fish storage places. The master shall ensure that a copy of such certification remains on board to be shown to a NAFO inspector if requested.

6.1.3 Who controls the fishing area, sets the management polices and carries out surveillance (i.e. monitoring and enforcement of fisheries management)? Please describe the monitoring and surveillance methods used.

[7] Rights-based mechanism where right to fish is associated with a specific area where the management authority is at the local (TURF) level.

NAFO Fisheries Commission is in charge of the Conservation and Enforcement Measures about the following aspects of the Fisheries:

Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures:
CHAPTER I – CONSERVATION AND MANAGEMENT MEASURES
CHAPTER Ibis – BOTTOM FISHERIES IN THE NAFO REGULATORY AREA
CHAPTER II – CONTROL MEASURES
CHAPTER III – MONITORING OF FISHERIES
CHAPTER IV – JOINT INSPECTION AND SURVEILLANCE SCHEME
CHAPTER V – PORT STATE CONTROL
CHAPTER VI – SCHEME TO PROMOTE COMPLIANCE BY NON-CONTRACTING PARTY VESSELS WITH RECOMMENDATIONS ESTABLISHED BY NAFO
CHAPTER VII – ELECTRONIC REPORTING, SATELLITE TRACKING AND OBSERVERS

Chapter IV pag. 25-31 (JOINT INSPECTION AND SURVEILLANCE SCHEME) deal with these questions.

6.1.4 Is IUU (Illegal, unregulated and unreported) fishing a problem for your stock? If so please describe.
In this moment the IUU is not a problem in the Greenland halibut Subarea 2 and Div. 3KLMNO stock even is not a problem in the NAFO Area. All the NAFO protocols and measures to avoid this problem are very effectives. Chapter VI of the Conservation and Enforcement Measures recompile all the measures to avoid this problem.

6.1.5 How do you interact with other agencies and fisheries management bodies to combat IUU fishing?
All the measures are collected in the SCHEME TO PROMOTE COMPLIANCE BY NON-CONTRACTING PARTY VESSELS WITH RECOMMENDATIONS ESTABLISHED BY NAFO. NAFO Conservation and Enforcement Measures (Charter VI).

6.1.6 Are measures in place to track the products of harvested species? If so, please describe and review.
Chapter II Article 23 of the Conservation and Enforcement Measures. Product Labelling Requirements: When processed, all fish harvested in the Regulatory Area shall be labelled in such a way that each species and product category and, in the case of shrimps, the date of capture, is identifiable using respectively the 3-Alpha Code in Annex II and the product form code in Annex XX(c). It shall also be clearly marked as having been caught in the Regulatory Area.

Furthermore, all shrimps harvested in Divisions 3L and 3M and all Greenland halibut harvested in Subarea 2 and Divisions 3KLMNO shall be marked in accordance with the stock area.

6.1.7 At each level (stock, fisheries etc), please describe any management procedures that have been tried in the past and have not been successful. Please describe why they did not work?
If we consider the TAC regulations as a management procedure. If this is the case, in the last eighties, in some NAFO fisheries (cod, flatfish), the TAC regulation didn't work very well (stocks collapsed). Problems were not only the TAC regulation probably were more as the assessment and environmental changes.

For the Greenland halibut in Subarea 2 and Divisions 3KLMNO stock Scientific Council estimated that the TAC have been overshoot in the last years. The catches in 2004-2008 have exceeded the rebuilding plan TACs by 30% on average, despite reductions in fishing effort

6.1.8 Please prepare for your stock a figure similar to the example shown below:-
Before 1960 there was a small longline fishery with low catch levels, in 1960 started a new gillnet fishery persecuted Greenland halibut in Newfoundland bays and effort and catches increased substantially. In 1966-1967 the Greenland halibut by catch in the international trawl redfish and grenadiers fisheries started to increased significantly as consequence the increase of the trawl depth in these fisheries (Figure 6.1).

In 1974 was established a quota for this resource by ICNAF to try to regulated this fishery. In 1989-1990 an intensive trawl fishery for Greenland halibut developed in deepwater's of Division 3L and 3M. The

development of this new fishery quickly resulted in increased catches to about 47.000 tons in 1990.The major participants in this new fishery were EU Spain and Portugal. TACs prior to 1995 in this fishery were set autonomously by Canada since 1995 TACs have been established by Fisheries Commission for all Greenland halibut Subarea 2 and Divisions 3KLMNO stock. In 2004, as consequence of the declined of the biomass and catches NAFO established a Recovery Plan for this stock (Figure 6.1).**

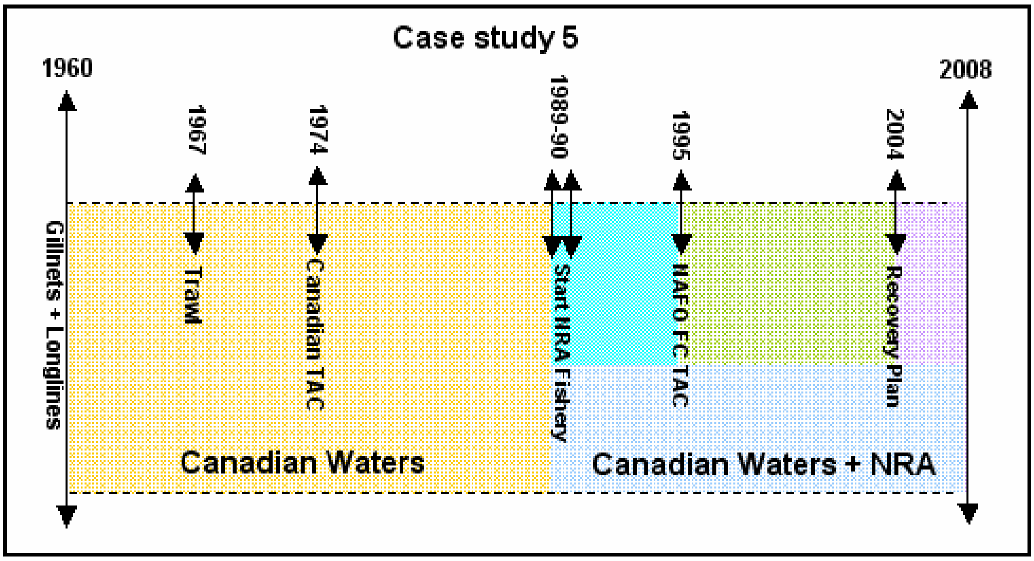

Figure 6.1.- NAFO Greenland halibut fishery history. Main milestones of the fishery.

6.2 Management procedures at the stock level

6.2.1 Please describe the management procedures currently in place.

NAFO Conservation and Enforcement Measures (2009) in its Article 7 compile the Greenland halibut Recovery Plan in place:

1. Contracting Parties shall implement a fifteen-year rebuilding programme for the Greenland halibut stock in Subarea 2 and Divisions 3KLMNO.

2. The objective of this programme shall be to attain a level of exploitable biomass 5+ of 140,000 tonnes on average, allowing a stable yield over the long term in the Greenland halibut fishery.

3. For this purpose, a total allowable catch for the following years is established as follows:
2004: 20,000 tonnes
2005: 19,000 tonnes
2006: 18,500 tonnes
2007: 16,000 tonnes
The total allowable catch for subsequent years shall be established taking into account the progress made in the rebuilding of the stock. Fisheries Commission established a TAC for 2008 and 2009 of 16.000 tonnes.

4. The Scientific Council shall monitor and review the progress of the programme and submit each year an assessment thereon to the Fisheries Commission.

5. The total allowable catch from 2008 onwards may be adjusted by the Scientific Council advice. However, the total allowable catch shall not be set at levels beyond 15% less or greater than the total allowable catch of the preceding year.

The TAC approved for 2008 and 2009 for this stock was 16.000 tons.

Table 6.2 presents the NAFO legal minimum landing size for different species and products.

Minimum Fish Size*

Species	Gilled and gutted fish whether or not skinned; fresh or chilled, frozen, or salted.			
	Whole	*Head Off*	Head and Tail Off	Head Off and Split
Atlantic Cod	41 cm	27 cm	22 cm	27/25 cm**
Greenland halibut	30 cm	N/A	N/A	N/A
American plaice	25 cm	19 cm	15 cm	N/A
Yellowtail flounder	25 cm	19 cm	15 cm	N/A

Table 6.2.- NAFO legal minimum landing size for different species and fish products.

6.2.2 What has been the strengths and weakness of these procedures?

One of the problems of the NAFO Greenland halibut Recovery Plan was that this Plan was developed by the Fisheries Commission without supervision or evaluation of the Scientific Council. Probably the objectives and the measures of this Plan are not the best of the biological point of view.

Normally there are problems to estimate the real catch levels in this stock. As was said before, Scientific Council estimated that the TAC have been overshoot in the last years.

6.2.3 How could they be improved?

In the last years the Scientific Council is working in the Management Strategies Evaluation (MSE) to try to improve the Greenland halibut management strategies.

STACTFIS try to estimate the best catch figures to use in the assessment.

6.2.4 Should other types of management procedures be considered? Is so please describe and identify expected benefits.

Fishing sector would prefer a effort control more than TAC control. In our opinion effort control would be more easy and cheaper to implement because now all the vessels in the NAFO NRA are equipped with VMS control and it would be possible save money in the control measures. TAC control have many problems to know the real catches and is very expensive all the vessels have to have a observer on board.

6.3 Management procedures at the fisheries level

6.3.1 Please describe the management procedures currently in place.

NAFO Conservation and Enforcement Measures in its Article 7 compile the management procedures in place for the Greenland halibut in Subarea 2 and Divisions 3KLMNO:
6. The following specific measures shall be applicable with regard to the Greenland halibut fishery in Subarea 2 and Divisions 3KLMNO in respect of vessels 24 meters in length or greater:

a) Contracting Parties shall issue specific authorizations to vessels fishing for Greenland halibut (hereafter referred to a 'authorized vessels') and shall transmit the list of such vessels to the NAFO Secretariat.

b) Each Contracting Party shall allocate its quota for Greenland halibut among its authorized vessels.

c) Authorized vessels may only land Greenland halibut catches in designated ports.

To this end each Contracting Party shall designate ports of that Contracting Party in which landings of Greenland halibut are authorized and communicate a list of these ports to the Executive Secretary by 1 January 2006. Each Contracting Party shall transmit to the Executive Secretary any subsequent changes in the list at least 15 days before they enter into force. On the basis of this information the Executive Secretary shall establish a list of designated ports and transmit it as well as any subsequent changes to all Contracting

Parties. Prior to entry into any designated port authorized vessels or their representatives shall provide the competent port authority at least 48 hours before the estimated time of arrival with the following:

i) Estimated time of arrival;
ii) Estimate of quantities of Greenland halibut retained onboard;
iii) Information on the zone or zones where the catches were taken.

Minimum authorized mesh sizes shall be as follows:

a) 40 mm for shrimps and prawns;
b) 60 mm for short finned squid (*Illex*);
c) 280 mm in the codend and 220 mm in all other parts of the trawl for skate;
d) 130 mm for groundfish;
e) 100 mm for pelagic *Sebastes mentella* (oceanic redfish) in Subarea 2 and Divisions 1F and 3K; and
f) 90 mm for redfish in the fishery using mid-water trawls in Division 3O.

6.3.2 What has been the strengths and weakness of these procedures?

The NAFO monitoring and control measures are one of the most complete of the fisheries. The problem could be the accuracy of the catch data recollected by the Inspectors and Observers.

6.3.3 How could they be improved?

One way to improve the data accuracy could be that the Observers and Inspectors would be independents of the Contracting Parties and only depend of the NAFO Secretariat.

6.3.4 Should other types of management procedures be considered? Is so please describe and identify expected benefits.

It could be good the temporary closure of the Fishery in some months of the year when the quota are not enable to maintain all vessels around the year.

6.4 Management procedures at the ecosystem level

6.4.1 Please describe the management procedures currently in place.

NAFO Conservation and Enforcement Measures in its Article 15 compile the Area and Time Restrictions at the ecosystem level:

5. As of January 1, 2007, and until December 31, 2010, the following areas shall be closed to all bottom fishing activities. The closed areas are defined by connecting the following coordinates (in numerical order and back to coordinate 1). Fogo Seamounts, Orphan Knoll, Corner Seamounts, Newfoundland Seamounts, New England Seamounts.

6. At the 2007 Annual Meeting, the Fisheries Commission shall consider providing access to a small scale and restricted exploratory fishery, effective January 1, 2008, not to exceed 20% of the fishable area of each seamount. These representative areas that may be fished on each seamount will be recommended by the Scientific Council based on existing survey and commercial data from these seamount areas. Scientific Council is requested to provide the Fisheries Commission, at the 2007 Annual Meeting, recommendations on: 1) areas that could be fished on each seamount and, 2) a protocol for the collection of the data required to assess these seamounts, with a view to future recommendations on management measures for these areas.

7. Contracting Parties shall provide the Executive Secretary, in advance of the June 2007 Scientific Council meeting, with all existing data from survey and commercial fisheries that have taken place in these seamount areas. The Executive Secretary will forward this information to the Scientific Council for its review in making the above noted recommendations to the Fisheries Commission.

8. Vessels may only fish in the defined areas in accordance with the protocol established by the Scientific Council and adopted by the Fisheries Commission. In addition to the protocol, vessels fishing in the areas defined in paragraph 5, shall have a scientific observer onboard.

9. If vessels fishing in the areas defined in paragraph 5 encounter hard corals, notification of the location of the coral area is to be provided to the Executive Secretary which will implement an immediate temporary closure of that area to all Contracting Parties pending a Fisheries Commission decision at the next Annual Meeting.

10. The measures referred to in paragraphs 5-9 shall be reviewed in 2010 by the Fisheries Commission, based on the advice from the Scientific Council, and a decision shall be taken on future management measures which may include extending the application of these measures for an additional period or making the closure(s) permanent.

6.4.2 What has been the strengths and weakness of these procedures?

One of the problems was the definition of the bottom fishing activities and exploratory fisheries, no all Contracting Parties understand the same with bottom fishing activities and exploratory fisheries. In other hand was the first step in NAFO to protected areas and ecosystems.

6.4.3 How could they be improved?

Clarify better the definition of the bottom fishing activities and exploratory fisheries.

6.4.4 Should other types of management procedures be considered? Is so please describe and identify expected benefits**.**

More or the measures in place are related with closured areas and we think that it would be good study other measures as fishing gears, data collection, etc to protected the ecosystems.

6.5 Management procedures relating to VMEs

6.5.1 Please describe the management procedures currently in place.

NAFO Conservation and Enforcement Measures in its Article 16 compile the procedures relating to VME and in particular to Coral Protection Zone:

1. As of January 1, 2008, and until December 31, 2012, the following area in Division 3O shall be closed to all bottom fishing activities. The closed area is defined by connecting the following coordinates (in numerical order and back to coordinate 1).

2. Contracting Parties shall provide the Executive Secretary, in advance of the June 2009 Scientific Council meeting, all existing data from surveys and commercial fisheries that have taken place in this area. The Executive Secretary will forward this information to the Scientific Council for its review in determination of a data gathering program for corals.

3. The measures referred to in this Article shall be reviewed in 2012 by the Fisheries Commission, based on the advice from the Scientific Council and a decision shall be taken on future management measures.

4. Contracting Parties shall establish/incorporate a coral monitoring program into government and/or industry research programs.

Most of the work made in this field since 2008 was based in the work made by WGEAFM. In the 2009 NAFO General Council meeting was presented the VME areas with significant concentrations of corals and sponges for their protection. See point 4.4.7.2 of this report.

6.5.2 What has been the strengths and weakness of these procedures?

We started the studies in these fields two years ago and the progress have been quite good. In this moment there is a special survey to identify all the VME in the NRA.

6.5.3 How could they be improved?

We need more time and persons to analyse all VME data.

6.5.4 Should other types of management procedures be considered? Is so please describe and identify expected benefits?

More or the measures in place are related with closured areas and we think that it would be good study other measures to protected VME as fishing gears, data collection, etc. In NAFO there is a Working Group to study and implemented the ecosystem approach and probably it would be good transform the Working Group in a Scientific Council Committee because the matters of the Working Group increase year after year..

6.6 Management procedures relating to PET species

6.6.1 Please describe the management procedures currently in place.

NAFO Conservation and Enforcement Measures in its Article 17 compile the procedures relating to PET and in particular to Conservation and Management of Sharks:

1. Contracting Parties shall report data for all catches of sharks, in accordance with the data reporting procedures laid down in Chapter III, including available historical data.

2. Contracting Parties shall ensure that fishing vessels fully utilize their entire catches of sharks. Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts and skins, to the point of first landing.

3. Contracting Parties shall require their vessels not to have onboard shark fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. Contracting Parties that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures.

4. The ratio of fin-to-body weight of sharks described in paragraph 3 shall be reviewed by the Scientific Council and reported back to the Commission in 2006 for revision, if necessary.

5. Fishing vessels are prohibited from retaining on board, transhipping or landing any fins harvested in contravention of these provisions.

6. In fisheries that are not directed at sharks, Contracting Parties shall encourage the release of live sharks, especially juveniles, to the extent possible, that are caught as by-catches and are not used for food and/or subsistence.

7. Contracting Parties shall, where possible, undertake research to identify ways to make fishing gears more selective.

8. Contracting Parties shall when possible conduct research to identify shark nursery areas.

6.6.2 What has been the strengths and weakness of these procedures?

Measures have been working quite good to protected sharks.

6.6.3 How could they be improved?

It is necessary to extend these measures to other PET species in NAFO Area.

6.6.4 Should other types of management procedures be considered? Is so please describe and identify expected benefits.

Probably it is necessary to understand and know better the biology of the PET species to try to protected better. To carry out these studies it will be necessary more people and money.

6.7 Comparison of management measures introduced against scientific advice

6.7.1 Please complete the following table for your stock and related fisheries. In your opinion has the scientific advice been followed by Management Bodies? Please score 0 (not at all) to 10 (fully adhered to) in column on right.
NAFO Greenland halibut Sebarea 2 and Div. 3KLMNO stock scientific advises and Fisheries Commission TAC are presented in Table 6.3.

Year	Scientific advice	Agreed management measures	Adherence (score 0 to 10)
2000	30.000 ton	35.000 ton	6
2001	40.000 ton	40.000 ton	8
2002	40.000 ton	44.000 ton	7
2003	36.000 ton	42.000 ton	6
2004	16.000 ton	20.000 ton	6
2005	NR *	19.000 ton	
2006	NR *	18.500 ton	
2007	NR *	16.000 ton	
2008	$F_{0.1}$ (10.000 ton)	16.000 ton	6
2009	$F_{0.1}$ (10.000 ton)	16.000 ton	6

Table 6.3.- NAFO Greenland halibut Sebarea 2 and Div. 3KLMNO stock scientific advises and Fisheries Commission TAC (2000-2009).

NR * Not scientific recommendation because Fisheries Commission approved a recovery plan.
1. Contracting Parties shall implement a fifteen-year rebuilding programme for the Greenland halibut stock in Subarea 2 and Divisions 3KLMNO.
2. The objective of this programme shall be to attain a level of exploitable biomass 5+ of 140,000 tonnes on average, allowing a stable yield over the long term in the Greenland halibut fishery.
3. For this purpose, a total allowable catch for the following years is established as follows:
2004: 20,000 tonnes
2005: 19,000 tonnes
2006: 18,500 tonnes
2007: 16,000 tonnes
The total allowable catch for subsequent years shall be established taking into account the progress made in the rebuilding of the stock.

6.8 Data-poor stocks and the Precautionary Approach

6.8.1 In your opinion, is your stock/fishery data-poor? Please score on a scale 1 (extremely data-poor) to 10 (extremely data-rich). Please justify your scoring.
Our score will be 7-8 because there are enough information for this stock (biological, survey, fishery) to do a more or less good assessment. The mayor problem is the inconsistence of the input data with the assumptions of the different models (stock structure, migration, aging, etc).

6.8.2 In your opinion have Management Bodies made adequate use of the Precautionary Approach. If they have, please cite examples. If they have not, please cite examples.
NAFO have implemented the PA approach for all stocks but few stock have calculated the PA reference points. One stock that is under an adequate use of the PA is the Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO.

6.9 Ecosystem and socio-economic considerations.

6.9.1 Describe and review how existing managing procedures take into account ecosystem considerations.
NAFO is starting to develop a ecosystem managing procedures and this way was captured in the new NAFO Convention approved in 2007 in its Article II:
"The objective of this Convention is to ensure the long term conservation and sustainable use of the fishery resources in the Convention Area and, in so doing, to safeguard the marine ecosystems in which these resources are found."

6.9.2 How can this be improved?

With more data and time, experts and money.

6.10 Stocks under moratorium/collapsed fisheries

6.10.1 Is your stock under moratorium or have fisheries recently collapsed?

No, but there is a recovery plan in place.

6.10.2 If yes, is a Recovery Plan in place? If yes, please describe.

NAFO Conservation and Enforcement Measures (2009) in its Article 7 compile the Greenland halibut Recovery Plan in place:

1. Contracting Parties shall implement a fifteen-year rebuilding programme for the Greenland halibut stock in Subarea 2 and Divisions 3KLMNO.

2. The objective of this programme shall be to attain a level of exploitable biomass 5+ of 140,000 tonnes on average, allowing a stable yield over the long term in the Greenland halibut fishery.

3. For this purpose, a total allowable catch for the following years is established as follows:
2004: 20,000 tonnes
2005: 19,000 tonnes
2006: 18,500 tonnes
2007: 16,000 tonnes
The total allowable catch for subsequent years shall be established taking into account the progress made in the rebuilding of the stock.

4. The Scientific Council shall monitor and review the progress of the programme and submit each year an assessment thereon to the Fisheries Commission.

5. The total allowable catch from 2008 onwards may be adjusted by the Scientific Council advice. However, the total allowable catch shall not be set at levels beyond 15% less or greater than the total allowable catch of the preceding year.

6.10.3 Please review the strengths and weaknesses of the plan and, if appropriate, please identify how it could be improved.

One of the problems of the NAFO Greenland halibut Recovery Plan was that this Plan was developed by the Fisheries Commission without supervision or evaluation of the Scientific Council. Probably the objectives and the measures of this Plan are not the best of the biological point of view.

In the last years the Scientific Council is working in the Management Strategies Evaluation (MSE) to try to improve the Greenland halibut management strategies. Scientific Council has applied management strategy evaluation (MSE) to evaluate the likely outcomes of various alternative management strategies (Miller *et al.* 2007; Miller *et al.* 2008; Shelton and Miller, 2009) :

This has to date been applied to the NAFO SA 2 + Div. 3KLMNO Greenland halibut fishery, during the NAFO Study Group on Rebuilding Strategies for Greenland halibut in Vigo in 2008 and subsequent work. MSE involves the evaluation of alternative management strategies encompassing clearly defined harvest control rules against a range of simulated realizations of the true fishery and fish stock dynamics (the operating models). The aim is to find those management strategies that are robust to the uncertainties while achieving the performance statistics required by the managers.

Development of alternative operating models and management strategies and deciding on performance statistics requires input from various stakeholders, such as scientists, managers and the fishing industry. Results of this process provide an insight in to those management strategies that are likely to be successful, and those that will likely fail. Management strategies are evaluated over the short, medium and long-term and so are useful when considering medium-term rebuilding plans, of the type that currently exist within NAFO for cod in Div. 3NO and halibut in SA 2 + Div. 3KLMNO. In this sense, the MSE approach follows

the same process that currently happens with discussions between scientists, managers and industry. It provides a basis for formalising these discussions within sets of equations and allows for a more complete analysis of the consequences of various actions.

6.10.4 If a recovery plan is not in place please explain why and express what, in your opinion, is required .

It is not the case.

6.11 Stocks managed under a management strategy framework

6.11.1 Is a management strategy framework in place for your stock? If yes please describe.

Is not in place (not approved by the Fisheries Commission) but was developed by the Scientific Council and Fisheries Commission is studying it to approve.

6.11.2 Please review the outcomes from the most recent Management Strategy Evaluation and describe what effects the outcomes have had on management.

Management Strategy Evaluation is applied to the Subarea 2+Divs. 3KLMNO Greenland halibut stock as an aid to decision-making by NAFO Fisheries Commission. Alternative management strategies are evaluated against a range of operating models reflecting alternative possible realities. A number of performance criteria were developed in order to quantify management objectives. Some of these are based on industry considerations with regard to catch and catch stability and others relate to the rebuilding, stock conservation and sustainability. Performance statistics were divided into two types - those that are imperative and require "satisfying", and those that are not imperative, but are useful in evaluating the trade offs. Robust feedback harvest control rules, either based on survey data directly or on the XSA, show the most promise. Two successful management strategies incorporating feedback harvest control rules are proposed for further consideration in the management of this stock (Shelton and Miller, 2009).

6.12 International Plan of Action (IPOA)

6.12.1 Where applicable do the fisheries for your stock follow IPOA guidelines[8]? If so please describe

Our opinion is that the NAFO Greenland halibut fishery follow IPOA guidelines (Sea Birds, Sharks, Capacity and IUU) and the measures related with these guidelines are compile in the NAFO Conservation and Enforcement Measures.

6.13 Current/short term (<5 yrs) management issues

6.13.1 What are the main management issues currently facing your stock/fisheries Please prioritise.

Priority	**Description of issue**	**Is issue being addressed? Yes /no**
1	Recovery	Yes
2	Uncertainty input	Not
3	Ageing	Yes
4	Uncertainty results	Partially
5	MSE	Partially

6.13.2 If the issue is currently being addressed, please describe how, below.

How these problems have been addressed is explained by Shelton and Miller (2009). As example you can see Recovery Plan and MSE developing process.

[8] FAO website: http://www/fao.org/fishery

6.13.3 If the issue is only partially or not being addressed please describe what further/additional procedures/measures are required.

We need that the NAFO Fisheries Commission approve the MSE and scientific projects to study the assessment problems. Workshop have been carried out to solve the Greenland halibut ageing problems and the next one will be in 2011.

6.14 Long-term (>5 yrs) management issues

6.14.1 What are the main management issues currently facing your stock/fisheries? Please prioritise.

Priority	Description of issue
1	Recovery Plan
2	MSE

6.14.2 Express in your opinion how these issues could be addressed.

Recovery Plan, this plan will finish in 2018 and it will need a SC monitoring.

The development by NAFO SC of the MSE is still ongoing, now we need that Fisheries Commission implement it.

6.15 Monitoring procedures

6.15.1 What are the main monitoring issues currently facing your stock/fisheries? Please prioritise.

Priority	Description of issue
1	Assessment problems
2	Recovery Plan
3	MSE

6.15.2 Express in your opinion how these issues could be addressed.

Most of them are now addressed and are important points of the NAFO Scientific Council work and are being studied in different NAFO Working Groups.

6.16 Monitoring at sea

For each fleet identified in 2.1.1 with vessels carrying observers:-

6.16.1 Please list and prioritise the problems observers encounter at sea.

Problems to collect the real data and work space problems because in some vessels there are more than one observer on board (NAFO and Scientific observers).

6.16.2 How can these problems be addressed?

With a good, professional and independent observers team and the help of the vessels crews to carry out the Observers tasks.

6.16.3 Is there any coordination of observer sampling plans and observer activity across and between fleets from different Member States and other non-EU countries? If so please review.

Yes, for EU countries in the RCM meetings and with non EU countries there are some scientific coordination under the NAFO Scientific Council.

6.16.4 Please describe and review any other sea-going monitoring programmes in place.

See DCR and RCM reports.

6.16.5 Please identify the strengths and weaknesses of existing monitoring programmes at sea.

More coordination between countries to based the information on fleet and fisheries levels instead of countries levels. More data collection to implemented the ecosystem approach.

6.16.6 How could they be improved?

One way to improve at European level is in the Regional Coordination meetings, but it would be good to do it also at NAFO Scientific Council Level.

6.17 Port-based monitoring

This point is not applicable for the foreign fleets, maybe for the Canadian fleet, but this is an Canadian internal matter not accessible for us. All other fleets work in the NRA and monitoring their fisheries at sea.

For each fleet identified in 2.1.1:

6.17.1 Please review any port-based sampling schemes, citing % landings/discards coverage, essential data collected and other non-essential data collected?

6.17.2 Please list and prioritise the problems encountered sampling landings/discards from your stock.

6.17.3 How can these problems be addressed?

6.17.4 Is there any coordination of port sampling plans across and between Member States and non-EU countries? If so please review.

6.17.5 Please describe and review any other shore-based monitoring programmes in place

6.17.6 Please identify the strengths and weaknesses of existing shore-based monitoring programmes.

6.17.7 How could they be improved?

6.18 EU Data Collection Framework (DCF)

6.18.1 For each fleet identified in 2.1.1, please list data and information currently collected under the DCF.

The data collected since 2009 appear in the COMMISSION DECISION of 6 November 2008 (2008/949/EC) CHAPTER II. For 2008 the data collected by Spain is presented in Table 6.4.

Species or Fleet segment	Area / Stock	Types of data transmitted															
		Effort	Species specific effort	Quantities landed	Quantities discarded	CPUE data	Survey data	Length comp landings	Age comp landings	Length comp discards	Age comp discards	Growth	Sexual maturity	Fecundity	Sex ratios	Economic data fleets	Fish processing industry
*Gadus morhua**	Div. 3M	X		X			X	X									
*Gadus morhua**	Div. 3NO	X		X			X	X									
*Glyptocephalus cynoglossus**	Div. 3NO	X		X			X	X							X		
*Hippoglossoides platessoides**	Div. 3LNO	X		X			X	X							X		
*Hippoglossoides platessoides**	Div. 3M	X		X			X	X							X		
*Limanda ferruginea**	Div. 3LNO	X		X			X	X							X		
*Macrourus berglax**	SA 2+3	X		X			X	X	X			X	X		X		
Raja spp.*	Div. 3LNO	X		X			X	X							X		
*Reinhardtius hippoglossoides**	SA 2+3	X		X		X	X	X	X			X			X		
Sebastes spp.*	Div. 3LN	X		X			X	X							X		
Sebastes spp.*	Div. 3M	X		X			X	X							X		
Sebastes spp.*	Div. 3O	X		X			X	X							X		
*Urophycis tenuis**	Div: 3LMNO	X		X			X	X							X		

* los datos de estas especies son de CAPTURA TOTAL y no de desembarques

** Datos de 2004, 2005 y 2006

Table 6.4.- Spanish data collected under the DCF in 2008 for the NAFO stocks.

6.18.2 Please identify the strengths and weaknesses of the EU DCF?

The normal level of the DCF is country and it would be European fleet or fishery.

6.18.3 How could it be improved for your stock?

Working more at EU level more than EU countries levels because in the NAFO case is European Union who signed the NAFO Convention.

6.19 Gap analysis of past and present scientific projects and data collection programmes

6.19.1 What are the main gaps in scientific knowledge and in data collection programmes. Please prioritise.

Category	Issue
Scientific	1. Stock Structure 2. Biology (growth, fecundity, recruitment) 3. Ecosystem Approach 4. 5.
Data collection	1. Commercial data quality (Catch, effort) 2. Ecosystem data 3. 4. 5.

6.20 Fisheries monitoring in general

NAFO monitoring system is expensive (NAFO Observer in each vessel) and with this money the quality of the data compile it would be better.

6.20.1 Are there any aspects of monitoring data and information (quality, temporal and spatial extent, time series, availability, accessibility, flow) that [a] impact on assessments and/or [b] affect your ability to provide timely fisheries advice to managers?

Quality of the commercial data (effort, catches) has big a impact in the quality of the assessment results. Other important problem that has a big impact in the quality of work of the NAFO Scientific Council is that in the last years the tasks of the SC have increase very much (ecosystem approach, MSE, etc) but the SC people is the same and the work load have increase very much and the quality are not the same.

References Section 6

COMMISSION DECISION of 6 November 2008 (2008/949/EC).

Miller D. C. M., Peter A. Shelton, Brian P. Healey, M. Joanne Morgan and William B. Brodie. 2007. Management strategy evaluation for Greenland halibut (Reinhardtius hippoglossoides) in NAFO Subarea and Divisions 3LKMNO. NAFO SCR Doc. 07/58.

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Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures. NAFO/FC Doc. 09/1.

Report of NAFO Scientific Council Study Group on Rebuilding Strategies for Greenland halibut. 2008. NAFO SCS Doc. 08/13.

Scientific Council Meeting –Report of NAFO Scientific Council Meeting. 2009. SCS Doc. 09/23.

Shelton P. A. and David C.M. Miller. 2009. Robust management strategies for rebuilding and sustaining the NAFO Subarea 2 and Divs. 3KLMNO Greenland halibut fishery. NAFO SCR Doc. 09/037.

Section 7: Please review the key uncertainties about the biology, data and management for your stock and any other issues relevant to DEEPFISHMAN.

See the Executive Summary.