NOT TO BE CITED WITHOUT PRIOR
REFERENCE TO THE AUTHOR(S)

Northwest Atlantic Fisheries Organization

Serial No. N5021 **NAFO SCR Doc. 04/60**
(Revised)

SCIENTIFIC COUNCIL MEETING – SEPTEMBER 2004

Condition and Feeding of Greenland Halibut (*Reinhardtius hippoglossoides*) in Flemish Cap and Other Areas: 1992-2003

Esther Román (*), Concepción González and Xabier Paz
Centro Oceanográfico de Vigo (I. E. O.)
P. O. Box 1552. 36280 Vigo. Spain.
(*) esther.roman@vi.ieo.es

Abstract

The seasonal, annual and geographical changes in the Relative Condition Factor of a total of 65,113 individual biological data of Greenland halibut (*Reinhardtius hippoglossoides*) were analysed. These data were collected in three areas of the North Atlantic (NAFO Div. 3LNO and 3M, and ICES Div. IIb) in commercial fishing and scientific surveys from 1992 to 2003. The condition stage varied significantly among areas considering the season and sex, with a slightly increasing general trend in 3M and IIb, and descending in 3LNO in the studied period, but any clear pattern over time in any area. This index showed high differences among the three areas in the individuals ≥80 cm. This group showed a similar condition in Div. 3LNO and 3M but smaller in IIb, however the values were similar in inferior sizes for the three areas. There was a decrease of the condition in the intermediate sizes (30-60 cm) in the three areas in all the seasons. In general, the condition of males was slightly higher than in females, but both sexes presented annual oscillations. Relationship between the condition stage and the estimated biomass was not appreciated.

A total of 8 931 Greenland halibut stomachs were collected in summer 1993-2003 in Flemish Cap. Feeding intensity was higher on Flemish Cap (62.4%) than in other areas. The most important preys were *Pandalus borealis* (19.0%), *Sebastes* spp. (11.5%) and Hyperiidea (8.9%). Feeding habits by size range and the comparison among different Divisions were also analysed.

Introduction

Greenland halibut (*Reinhardtius hippoglossoides*) is an economically and ecologically important flatfish. It is distributed throughout the deep waters of the North Atlantic. The Greenland halibut stock in Div. 3LNO is considered to be part of a biological complex stock, which includes Subareas 0, 1, 2 and Div. 3KLMNO. The exploitable biomass was reduced to low levels in 1995-97. It increased during 1998-2000 due to reduced catches and the improvement of the recruitment, with a new decline in 2003-2004 to the lowest values in the series (Anon., 2004a). The stock in Flemish Cap maintained a continuous increase of the biomass, and it reached a maximum in 1998, but decreased since then (Casas, 2004). In the Arctic, the analysis of this stock indicated a level below the historical stocking. The Spanish bottom trawl showed an increase of Greenland halibut abundance and biomass in the Svalbard-Bear Island area in 2003 after three years with a declining trend. However, Arctic Greenland halibut is still considered outside of his safety biological limits (Anon, 2004b; Paz *et al*., 2004).

Simple condition indices provide a useful assessment of the physiological well-being of fishes and provide an indirect means of ecological relations and the effects of various management strategies (Murphy *et al*., 1991). Diverse studies have demonstrated to be a measure of the energy reserves of fishes and their relationship with the environmental, maturity, feeding or parasitic conditions.

The literature shows numerous studies on the condition stage in several species, and their relationship with the current situation of the biomass and reproductive potential of the population; some studied species were the cod *Gadus morhua* (Lambert and Dutil, 1997a; Lambert and Dutil, 1997b; Dutil and Lambert, 2000; Lambert and Dutil, 2000); American plaice, *Hippoglossoides platessoides* (Maddock and Burton, 1999; Morgan, 2003); red mullet, *Mullus surmuletus* (N´Da and Déneil, 1993).

Junquera *et al*. (1999) analysed the possible compensatory effect on the reproductive parameters (condition and fecundity) and growth related parameters because of the apparent decline in the adult stock of the Greenland halibut in Flemish Cap and other areas of Northwest Atlantic; this study indicated that the value of the condition factor in 3M has remained almost invariable throughout the period 1991-1997, in spite of being subjected to a strong exploitation.

Our study, focused in Flemish Cap, has tried to check if that stability is kept, and also compared the relative condition index values of several populations in the Northwest Atlantic. It was also examined the temporary condition variations (seasonal and annual) of Greenland halibut in three areas of North Atlantic (Div. 3M and Div. 3LNO), and Svalbard (ICES Div. IIb). Sex, length and maturity were also considered in the period 1992-2003, and the possible relationship in the current state of the population. On the other hand, it is also presented a study of the feeding habits of this species in the Div. 3M (Flemish Cap) in summer during the period 1993-2003, in order to analyse their incidence in the condition.

Material and Methods

We analyse 65 113 individual biological data of Greenland halibut (*Reinhardtius hippoglossoides*) of the Northwest Atlantic and Arctic from research and commercial surveys in the 1992-2003 period (Tables 1 and 2). The surveys were: the EU Survey in Flemish Cap Div. 3M (Casas, 2004), "Platuxa" Spanish Survey in NAFO Div. 3NO (González *et al.,* 2004), "3L-Fletán Negro" Spanish Survey (*per. comm.* X. Paz); and "Fletán Ártico" Spanish Survey in Svalbard ICES Div. IIb (Paz *et al*, 2004). The commercial surveys data correspond to those developed in NAFO (Spanish bottom trawl fishery target to Greenland halibut), ICES (Spanish pair trawl fishery target to cod, *Gadus morhua*, and Spanish bottom trawl fishery target to northern shrimp, *Pandalus borealis*) in the period 2001-2003. Data obtained in the Pilot Action of Experimental Fishing developed in the Sea of Barents-Svalbard (ICES, Div. I and IIb) targeted to American plaice, *Hippoglossoides platessoides*, in 1995 (Durán and Román, 2000) were also included.

The biological samplings were carried out on board. The data collected for each individual were: length (TL to the nearest lower cm), sex, maturity stage (immature, maturing, spawning and post-spawning), weight (gr) and stomach repletion degree (empty, partial fullness, fullness). The individuals were grouped in ranges of size of 10 cm (10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99 and ≥100 cm) to make their analysis easier. Some individuals smaller than 10 cm had not been kept into account because their weight presented a very high dispersion caused by mistake in the system of weight.

The annual cycle was not complete in all the years because there were not data corresponding to all the seasons. The spring includes the months between March and May; the summer includes from June to August; the autumn includes from September to November; and the winter includes the months between December and February. The inter-annual comparisons were only made when it was available, al least, two year series for the same season.

One only stock of Greenland halibut is considered in NAFO (3KLMNO) (Anon., 2004a); however the data collected in the Div. 3NO and 3L were gathered, and the data of Div. 3M were studied independently, in order to see if it presented any differences.

The condition index is calculated because it provides a useful assessment of the plumpness and physiological well-being of fishes. The traditional approach to these indices is the Fulton Condition Factor (*K*) (Anderson and Gutreuter, 1983).

$$K = W / (L)^3 * 100$$

where: W is the observed weight (gr) of the individual i

L is the total length (cm) of the individual i

To obtain the expected weight (W') the power function is calculated with the mathematical description of weight-length relationship for the individuals of each area, year, season and sex.

$$W' = a * (L)^b$$

where:	L	is the total length (cm) of the individual i
	a	is the intercept
	b	is the slope

To compare fish of the same species of different lengths, locations and years, the Relative Condition Factor (K_r) is calculated (Le Cren, 1951).

$$K_r = W/W'$$

where:	W	is the observed weight of the individual i
	W'	is the predicted weight based on weight-length equation for the individual i

The annual and seasonal study for each area was considered, as well as the comparisons among the areas by means of the mean Relative Condition Factor (*Kr*).

Statistics have been also used to measure the amount of variation in the observed values; the mean-centered coefficient of variation (COV) is the result of expressing the standard deviation as a percentage of the mean. The GLM (General Linear Model) Univariante procedure has been used to test the hypothesis that the means of the Relative Condition Factor of several groups are not significantly different.

Due to the different sampling conditions, the data from commercial and scientific surveys were analysed in order to study their degree of internal variability in each area before working with them as a whole The differences of the variation coefficient between both sources were low, and in the most of the cases, they did not show significant differences in the mean *Kr*, although some exceptions were found (Table 2).

Greenland halibut feeding habits were studied from the same research surveys data: 8 931 individuals in the 1993-03 period in 3M; 2 382 individuals in the 2002-03 period in Div. 3LNO; and 7 688 individuals in the years 1997, 2000, 2001 and 2002 in IIb (Table 3). In each haul, a maximum of 10 stomachs from each 10 cm length range were analysed. Fish whose stomachs were everted or contained preys ingested in the fishing gear were discarded. Specimens that presented total or partial regurgitation were taken into account to estimate the emptiness indice. The methodology was the same used in 1993 (Rodríguez-Marín *et al*., 1994).

From each predator, the data collected were: total length to the nearest lower cm, volume of the stomach content, quantified in c.c. using a trophometer (Olaso, 1990); the percentage of each prey in the total volume and digestion stage and number of each prey. Preys were identified by species when digestion stage permitted it, or to the lowest possible taxonomic level.

The Feeding Intensity Index (FI) is the percentage of individuals with stomach content and is calculated to analyse the feeding intensity for each predator: $FI = n_f / N_t * 100$, where n_f is the number of individuals with stomach content and N_f is the total number of individuals sampled.

The importance of each prey taxa in the stomach contents was evaluated using the percentage by volume: $V = v / V_t * 100$, where v is volume of a determined prey, and V_t is the total volume of preys. The volumetric method over values the importance of large organisms (Hyslop, 1980).

Results

The mean Fulton Condition Factor (K) remained stable in the studied period in the three areas. The higher K values were found in autumn and winter (except in males in IIb). This value increased with the size in all the areas. The individuals from 30 to 80 cm presented higher values in IIb than in the other areas. From this size, the value was similar in the three studied areas, and it was also similar in IIb and 3LNO in those individuals smaller than 30 cm, and a little bit lower to the value found in 3M (Tables 4, 5, 6 and Fig. 1).

The Mean Relative Condition Factor (*Kr*) in the three studied areas did not show clear trend throughout the considered period, the calculated values remained constant for both sexes (Fig. 2, 3 and 4). This value was higher in males than in females, except in Div. 3M. The males showed higher mean *Kr* in IIb (1.005) followed by Div. 3LNO, and this value was higher in females in Div. 3M (1.004) followed by IIb (Tables 4, 5 and 6). This index showed higher differences among the three areas in ≥80 cm individuals, with a similar condition in Div. 3LNO and 3M and lower in IIb; while the values were similar for the three areas in inferior sizes (Fig. 1). A slight fall of the condition appeared in the intermediate sizes, which was common to all the areas and in all the seasons (Fig. 5, 6, 7 and 8).

Comparing this index among the three areas, and keeping in mind the interaction of the sex and the season, significant differences have been found ($F(5,64957) = 0.77$, $p \leq 0.000$); these differences being significant however decreases when also considering the size range ($F(16,64957) = 1.758$, $p \leq 0.05$).

Relative Condition in Division 3M (Flemish Cap)

In the data corresponding to the summer samplings from 1992 to 2003, the mean *Kr* values of males and females showed an irregular oscillation whose general trend was slightly increasing in females and decreasing in males along the series, with a maximum in 2001 and a minimum in 1998. The oscillations of both sexes values followed the same trend in all the years, except in 1999 and 2000. A better condition of males is appreciated until 1998, and the condition of females was better in the following years (Fig. 2).

The total mean Relative Condition Factor (*Kr*) of males was 1.003 ± 0.09 with a 8.8% of coefficient of variation (COV); and this value in females was 1.004 ± 0.09 with a COV of 8.9% (Table 4). Males and females presented better condition (*Kr*) in spring and autumn respectively, and each sex lost condition in autumn and winter respectively. The biggest differences in the condition stage between sexes appeared in autumn (Fig. 5). A smaller condition appeared in the individuals of intermediate sizes (approximately 30 to 60 cm) throughout the years and in all the seasons (Fig. 6).

In the 1992-03 period, the biomass has passed from low levels to a gradual rise up to a maximum in 1998; then this value gradually decreased to the levels found in 1992 (Saborido and Vázquez, 2003; Casas, 2004), not showing correlation with the condition stage (Fig. 2).

The mean Relative Condition Factor was significantly different in the interaction of the year, season and size range ($F(17,20150) = 2.851$, $p \leq 0.000$), as well as it was also different in the sex and year interactions ($F(11,20150) = 2.554$, $p \leq 0.005$), sex and season ($F(3,20150) = 5.901$, $p \leq 0.001$), and sex and size range ($F(6,20150) = 3.898$, $p \leq 0.001$).

Relative Condition in Division 3LNO

In the data corresponding to the spring samplings from 1995 to 2003, the mean *Kr* values of males and females began to show an inter-annual oscillation from 1997, whose trend was slightly decreasing for both sexes, with a maximum in 2000 and a minimum in 2003. The oscillations of both sexes values followed the same trend, except in 1998; a better condition in males has been found from 2001, and it was similar for both sexes in the previous years (except in 1998) (Fig. 3).

The total mean *Kr* of males was 1.005 ± 0.10 with a 10.3% of COV and this value in females was 0.999 ± 0.10 with a COV of 10.4% (Table 5). The *Kr* values in males and females were higher in winter and spring respectively, and each sex lost condition in summer-autumn and winter respectively. The seasonal mean values for each sex were quite similar, except in winter, where a considerable difference appeared (Fig. 5). A smaller condition in the individuals of intermediate sizes (approximately from 30 to 70 cm) also appeared throughout the years and in all the seasons in this area (Fig. 7).

Biomass estimated data in Div. 3NO in the period 1995-03 (González *et al.*, 2004) compared with the results of annual relative condition in Div. 3LNO for the same period did not show the same trend (Fig. 3).

The mean Relative Condition Factor was significantly different in the interaction of the year, season, size range and sex effects ($F(14,26338) = 2.474$, $p \leq 0.005$).

Relative Condition in Division IIb

In the data corresponding to the autumn samplings from 1997 to 2003, the mean *Kr* value of males and females also showed an inter-annual oscillation which was more regular than in the other areas. The general trend of this value was slightly increasing for females and decreasing for males. The oscillations of the both sexes values followed an opposite trend since the year 2000 and they equalled in 2003 (Fig. 4).

The total mean *Kr* value of males was 1.005 ± 0.09 with a 8.8% of COV and in females it was 1.001 ± 0.10 with a COV of 9.7% (Table 6). In general, the condition of males was higher than the condition of females. Both sexes presented better condition (*Kr*) in winter; however, the condition is high in the three seasons sampled and similar for both sexes (Fig. 5). In this area, in all the seasons and throughout the years, the condition appeared low in the individuals of intermediate sizes, approximately between 40 and 70 cm (Fig. 8).

The data of estimated biomass for the 1997-03 period (Paz *et al*., 2004) compared to the obtained results of relative condition for the same period did not show any correspondence (Fig. 4).

The mean Relative Condition Factor was significantly different in the interaction of the year, size range and sex effects ($F(29,18028) = 1.903$, $p \leq 0.005$), as well as in the season and size range interaction ($F(10,) = 2.124$, $p \leq 0.05$).

Relative Condition in Relation with the Maturity and Feeding Intensity

Analysing the females with sizes ≥60 cm, where the most of the individuals that have past the first maturation are set (Junquera and Saborido-Rey, MS 1995), it is found that the condition was high in Div. 3LNO and 3M, mainly in summer-autumn, and it was much lower in IIb with few seasonal differences. The feeding intensity of these same individuals showed an increment in the seasons in which the condition decreased; this fact was shared by the three areas (Fig. 9).

Feeding Habit Study

Data of feeding habits showed a high feeding intensity in Div. 3M (62.8%) and low in IIb (20.4%) (Table 3 and Fig. 10). In Div. 3M, the composition of the main prey groups in the diet has not practically suffered variations in the 1993-03 period. Pisces (66.4%) and Crustacea (27.7%) were the main prey groups (Fig. 11). *Sebastes* sp (14.1%) and northern shrimp, *Pandalus borealis* (21.8%) were, respectively, the preys more abundant in these groups. Crustacea, mostly hyperiids, predominated in the stomach contents of individuals <20 cm and Pisces (mainly *Sebastes* sp and *Serrivomer beani*) were the principal prey in individuals ≥40 cm. Individuals of the size range 20-39 cm were an intermediate step between both diets, increasing the predation on northern shrimp and fish, and decreasing on the hyperiids (Table 7 and Fig. 12).

In Div. 3LNO, Pisces have appeared in more volume in the diet composition than in the other areas, being the main component (76.7%), mainly *Mallotus villosus* (46.8%). Crustaceans presented low importance in this area, but they were more important than fish in the individuals <20 cm; and it was remarkable the importance of the molluscs in intermediate sizes (Table 8 and Fig. 12).

In Div. IIb, the diet composition followed a similar general pattern than in the other areas. Fish (66.2%) and Crustacea (12.4%) were the main prey groups. Crustacea was the only prey group in individuals <20 cm; this prey was important in all the sizes ≤50 cm and fish in individuals ≥50 cm. Molluscs presented high importance in the intermediate size ranges, and it was also observed in 3LNO (Table 9 and Fig. 12).

The important of Echinodermata was minimum in Div. 3M and IIb, while there was not presence in Div. 3LNO. Offal was a prey very important in IIb (13.8%) and it was less important in Div. 3LNO (3.6%) being found in bigger size individuals. Cannibalism was observed in IIb 18 (%) and 3M.

Females and males showed similar prey group pattern in relation to size range in Div. 3M. Females in Div. 3LNO presented more variety of preys than males in sizes >30 cm. And in IIb, differences in the diet composition between sexes were more important; males preyed more on crustaceans than females, and females fed more on molluscs (Fig. 13).

Discussion

Several studies have studied the relationship between the condition stage and other biological parameters and their implication in the situation of the stocks. N´Da and Déneil (1993) observed that the red mullet (*Mullus surmuletus*) showed a minimum condition in the spawning season. In American plaice (*H. platessoides*), the condition factor decreases in the spawning season, when the feeding activity also decreases (Maddock and Burton, 1999); this fact can be caused by the mobilization of the reserves of somatic energy to carry out the reproduction. Morgan (2003) observed spatial, sexual and temporal changes in condition of American plaice, being the condition higher in the autumn.

Compared studies of Greenland halibut populations of diverse areas have been carried out, concluding that there were not differences among populations. Results of Bowering and Nedreaass (2001) in age validation and growth of the Northwest and the Northeast Atlantic populations suggested that the growth patterns between the two regions may be converging to a similar pattern in recent years. Genetic studies carried out in individuals of different areas of the North Atlantic did not reveal any significant inter-area differences (Vis *et al.,* 1997; Igland and Naevdal, 2001). This fact is possibly related with their highly migratory nature over extreme distances, deduced from migratory experiments (Boje, 2001).

Junquera *et al*. (1999) analysed the condition factor of this species in the Northwest Atlantic, from 1991 to 1997, in relation to the age and the year, and they did not found any differences. However, annual differences, without a clear pattern, were observed in our study in each area. Differences in the relative condition factor among the three compared areas have also been observed, taking into account the sex and the season. The period of better condition in each area has been found different. Females presented a higher condition index in Div. 3M and males in IIb, in general, being better the condition in males. On the other hand, the results of the relative condition of each area in this study did not showed any correlation with the estimated biomass values for these areas.

The maturity schedule for Greenland halibut is very complex (Bowering and Nedreaas, 2001). Spawning does not seem to take place all the year round in Barents Sea (Federov, 1971a; Federov, 1971b), this can affect to the seasonality in the condition. The spawning of this species does not have a clear seasonality in the Northwest Atlantic (Junquera and Zamarro, 1994; Junquera and Saborido-Rey, MS 1995; Morgan and Bowering, 1997) and the peak spawning time varies quite a lot from year to year. This lack of seasonality spawning was also reported in Barents Sea (Albert *et al*., MS 1998).

These complex characteristics of the maturation could agree with a seasonality absence in the feeding intensity following the annual reproductive cycle. Some studies about feeding habits of the Greenland halibut in Flemish Pass (Junquera, 1995; Rodríguez-Marín *et al*., 1995) and west of Greenland (Pedersen and Riget, 1993) did not showed a clear seasonal feeding, mainly in individuals <50 cm. However, Rodríguez-Marín *et al*. (1997) found a significant correlation between the feeding intensity and the females with size higher than that of first maturation. Other studies indicated that the maximum feeding intensity took place during the spring, as it was observed on the deep slope of the northeast Newfoundland continental shelf (Dawe *et al*., 1998), and in the west of Greenland waters (Pedersen and Riget, 1993). A low feeding intensity in autumn and winter was also in Flemiss Pass (Rodríguez-Marín *et al.,* 1993). However, our study showed in females ≥60cm an increase of the feeding intensity when the condition decreasing.

The individuals of the intermediate ranges presented a low condition throughout the years, common fact in the three studied areas and in all the seasons. The individuals ≥60 cm also showed a similar condition in Div. 3M and 3LNO, and it was higher to that of the Arctic; females of these size ranges presented a significant correlation with the feeding intensity, fact already indicated for Rodríguez-Marín *et al*. (1997) in the Northwest Atlantic. The biggest individuals (≥70 cm) showed a higher condition in comparison with the previous ones, which could be related with the proportion of individuals of these sizes with atresia.

In our study, a strong similarity among years in the feeding intensity in the three studied areas has been found, with a more intensity in Div. 3M and 3LNO than IIb, influenced by the area and sampling season (spring-summer *vs*. winter). The pattern of diet composition was similar in the studied areas, but the predation on prey item changed with the geographic area and the available preys. Greenland halibut <20 cm fed almost exclusively on crustaceans, while the importance of this prey decreased as the size of the predator increased, at the same time that fish acquired higher importance in the diet. Offal are an extra provision on food introduced by fishing activity, mainly in higher sizes fish as it was observed in other studies (Rodríguez-Marín *et al*., 1997).The occasional incidence of echinoderms and other bottom fauna is indicative of the bathypelagic way of live of the Greenland halibut (Chumakov and Podrazhanskaya, 1986).

The clear lack of seasonality in the variations of the Relative Condition Factor is coherent with the commented reproductive characteristics. It seems that the reproductive behaviour of the population is not seasonally synchronized; a portion of the individuals would reproduce the same year, but not the other individuals, therefore the feeding habits would not show seasonality and, consequently, neither the condition value. Other studies are necessary to calculate the proportion of atresic individuals for age group to confirm these terms. And other eviscered weight analyses could give more information on the seasonal condition of the individuals.

Acknowledgements

This work was possible with the support of the Instituto Español de Oceanografía (IEO) and the support of the Agreement between the Secretaría General de Pesca Marítima (SGPM) and the Instituto Español de Oceanografía. The authors would like to thank the scientific observers on board of commercial fishing vessels and participant staff in the survey.

References

Albert, O. T.; E. M. Nilssen; A. Stene; A. C. Gundersen; and K. H. Nedreaas. MS 1998. Spawning of the Barents Sea/Norwegian Sea Greenland halibut (*Reinhardtius hippoglosssoides*). *ICES C.M. Doc*., 0: 22: 19p.

Andersen, R. O.; and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. L. A. Nielsen and D. L. Johnson, eds. Fisheries Techniques. *American Fisheries Society*, Bethesda, MD, pags 283-300.

Anon. 2004a. Report of Scientific Council Meeting (3-17 June 2004). *SCS Doc*. 04/16, Serial N5010.

Anon. 2004b. Report of the Arctic Fisheries Working Group. *ICES CM* 2004/ACFM:28.

Boje, J. 2001. Intermingling and seasonal migrations of Greenland halibut (*Reinhardtius hippoglossoides*) populations determined from tagging studies. *Fish. Bull*. **100**: 414-422.

Bowering, W. R.; and K. H. Nedreaas. 2001. Age validation and growth of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)): A comparison of populations in the Northwest and Northeast Atlantic. *Sarsia* **86**: 53-68.

Casas, J. M. 2004. Results from bottom trawl survey on Flemish Cap of July 2003. *NAFO Sci. Counc. Res. Doc*. No. 04/21 Serial No. N4969.

Chumakov, A. K.; and S. G. Podrazhanskaya. 1986. Feeding of Greenland halibut *(Reinhardtius hippoglossoides*) in the Northwest Atlantic. *NAFO Sci. Coun. Studies*, **10**: 47-52.

Dawe, E. G.; W. R. Bowering; and J. B. Joy. 1998. Predominance of squid (*Gonatus* spp.) in the diet of Greenland halibut (*Reinhardtius hippoglossoides*) on the deep slope of the Northeast Newfoundland continental shelf. *Fisheries Research* **36**: 267-273.

Durán, P.; and E. Román. 2000. Spanish experimental fishings: a cooperative research initiative between scientifics and the local fishing industry. *ICES CM* 2000/W:03.

Dutil, J. - D.; and Y. Lambert. 2000. Natural mortality from poor condition in Atlantic cod (*Gadus morhua*). *Can. J. Fish. Aquat. Sci*. **57**(4): 815-825.

Federov, K. 1971a. The state of the gonads of the Barents Sea Greenland halibut (*Reinhardtius hippoglossoides* (Walb.)) in conection with the failure to spawn. *Journal of Ichthyology 11*:673-682.

Federov, K. 1971b. Zoogeographic characteristics of the Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum). *Journal of Ichthyology 11*:971-976.

González, D.; E. Román and X. Paz. 2004. Results for Greenland halibut from the surveys conducted by Spain in the NAFO Regulatory Area of Div. 3NO, 1996-2003. *NAFO Sci. Counc. Res. Doc*. No. 04/11 Serial No. N4956.

Hyslop, E. J.. 1980. Stomach contents analysis a review of methods and their application. *J. Fish. Biol*. **17**: 411-429

Igland, O. T.; and G. Naevdal. 2001. Allozyme studies of Greenland halibut, *Reinhardtius hippoglossoides* Walbaum 1792, from the North Atlantic. *Sarsia* **86**: 237-240.

Junquera, S.; and J. Zamarro. 1994. Sexual maturity and spawning of Greenland halibut (*Reinhardtius hippoglossoides*) from Flemish Pass Area. *NAFO Sci. Coun. Studies*, **20**: 47-52.

Junquera, S. 1995. Effect of the feeding activity on the match rates in the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in Flemish Pass Area (1991-92). *NAFO Sci. Coun. Studies*, **23** 55-64.

Junquera, S.; and F. Saborido-Rey. MS 1995. Histological assessment of sexual maturity in Greenland halibut in Div. 3LM and 3N. *NAFO SCR Doc.,* No. 28, Serial No. N2537, 9p.

Junquera, S.; E. Román; X. Paz; and G. Ramilo. 1999. Changes in Greenland halibut growth, condition and fecundity in the Northwest Atlantic (Flemish Pass, Flemish Cap and Southern Grand Bank). *J. Northw. Atl. Sci.,* Vol. **25**: 17-28.

Lambert, Y.; and J.- D. Dutil. 1997a. Condition and energy reserves of Atlantic cod (*Gadus morhua*) during the collapse of the Northern Gulf of St. Lawrence stock. *Can. J. Fish. Aquat. Sci.* **54**(10): 2388-2400.

Lambert, Y.; and J.- D. Dutil. 1997b. Can simple condition indices be used to monitor and quantify seasonal changes in the energy reserves of Atlantic cod (*Gadus morhua*)?. *Can. J. Fish. Aquat. Sci.* **54** (Suppl. 1): 104-112.

Lambert, Y.; and J.- D. Dutil. 2000. Energetic consequences of reprodution in Atlantic cod (*Gadus morhua*) in relation to spawning level of somatic energy reserves. *Can. J. Fish. Aquat. Sci.* **57**(4): 815-825.

Levins, R. 1968. Evolution in Changes Environments. University Press. Princeton.

Le Cren, E. D. 1951. The length-weight realtionship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol.* **20**: 201-219.

Maddock, D. M.; and M. P. M. Burton. 1999. Gross and histological observations of ovarian development and related condition changes in American plaice. *J. of Fish Biology*, **53**: 928-944.

Morgan, M. J.; and W. R. Bowering. 1997. Temporal and geographic variation in maturity at length and age of Greenland halibut (*Reinhardtius hippoglossoides*) from the Canadian Northwest Atlantic with implications for fisheries management. *ICES J. Mar. Sci*., **54**: 875-885.

Morgan, M. J. 2003. A preliminary examination of variability in condition of American plaice in NAFO Divisions 3LNO. *NAFO SCR Doc*. 03/11 Serial No. N4817.

Murphy, B. R.; D. W. Willis; and T. A. Springer. 1991. The Relative Weight Index in Fisheries management: status and needs. *Fisheries*, Vol. **16**, No. 2: 30-38.

N´Da, K.; and C. Déneil. 1993. Sexual cycle and seasonal changes in the ovary of the red mullet, *Mullus surmuletus*, from the southern coast of Brittany. *J. of Fish Biology*, **43**: 229-244.

Olaso, I. 1990. Distribución y abundancia del megabentos invertebrado en fondos de la plataforma cantábrica. *Bol. Inst. Esp. Oceanogr*. Publ. Esp., No 5. 128 p.

Paz X.; C. González; and E. Román. 2004. Spanish bottom trawl survey “Fletán Ártico 2003” in the slope of Svalbard Area, ICES Division IIb. *ICES, Arctic Fisheries Working Group*, 2004, Working document 22.

Pedersen, S. A.; and F. Riget. 1993. Feeding habits of redfish (*Sebastes* spp.) and Greenland halibut (*Reinhardtius hippoglossoides*) in West Greenland waters. *ICES. J. Mar. Sci*., **50**: 445-459.

Rodríguez-Marín, E.; A. Punzón; and J. Paz. 1993. Greenland halibut (*Reinhardtius hippoglossoides*) feeding in Flemish Pass – NAFO Divisions 3LM. *NAFO SCR Doc*. 93/18, Serial No. N2195.

Rodriguez-Marín, E., A. Punzón, J. Paz and I. Olaso. 1994. Feeding of the most abundant fish species in Flemish Cap in summer 1993. *NAFO SCR Doc*. 94/35, Serial No. N2403. 33 p.

Rodríguez-Marín, E.; E. De Cárdenas; and J. Paz. 1997. Feeding of Greenland halibut (*Reinhardtius hippoglossoides*) in 3LMNO NAFO Regulatory Area Divisions (Northwest Atlantic), 1991-94. *NAFO SCR Doc*. 97/37, Serial No. N2869.

Saborido-Rey, F.; and A.Vázquez. 2003. Results from bottom trawl survey on Flemish Cap of July 2002. *NAFO SCR Doc*. 03/42, Serial No N4860.

Vis, M. L., S. M. Carr; W. R. Bowering, and W. S. Davidson. 1997. Greenland halibut (*Reinhardtius hippoglossoides*) in the North Atlantic are genetically homogeneous. *Can. J. Fish. Aquat. Sci.* **54**: 1813-1821.

Table 1.- Number of individuals of *R. hippoglossoides* sampled by area (NAFO Divs. 3LNO and 3M; ICES Div. IIb), year (1992-2003) and size range (cm).

Area	**Size range (cm)**	**Year**												***Total***
		1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	
3M	10-19		12	31	56	80	123	106	25	171	113	119	127	*963*
	20-29	53	134	109	101	135	227	176	85	53	129	138	108	*1448*
	30-39	59	159	306	146	168	341	669	278	278	464	475	208	*3551*
	40-49	429	379	475	250	308	357	679	295	432	1977	1866	673	*8120*
	50-59	252	222	184	112	143	175	258	129	199	1403	1379	591	*5047*
	60-69	33	17	24	26	12	22	16	12	13	284	373	97	*929*
	70-79	4	1		1	2	2	1	1	80		98	41	*231*
	80-89						1				35	24	12	*72*
	90-99										12	2	4	*18*
	Total	*830*	*924*	*1129*	*692*	*848*	*1248*	*1905*	*825*	*1226*	*4417*	*4474*	*1861*	*20379*
3 LNO	0-9											3	1	*4*
	10-19				3	16	101	35	78	49	133	167	329	*911*
	20-29				47	187	782	344	172	99	238	249	425	*2543*
	30-39				26	164	697	254	110	155	1847	1306	957	*5516*
	40-49				2	152	452	148	87	226	3796	3081	1119	*9063*
	50-59					88	249	159	70	149	1889	2208	800	*5612*
	60-69					39	135	123	61	136	519	775	147	*1935*
	70-79					10	51	69	39	80	183	184	52	*668*
	80-89					8	11	28	17	31	97	46	11	*249*
	90-99						3	4	1	4	35	4	3	*54*
	>= 100								1		3	1		*5*
	Total				*78*	*664*	*2481*	*1164*	*636*	*929*	*8740*	*8024*	*3844*	*26560*
IIb	10-19									1	33	3		*37*
	20-29				2		10	28	19	17	39	44	35	*194*
	30-39				92		496	159	421	197	419	419	351	*2554*
	40-49				2103		830	278	736	233	541	571	405	*5697*
	50-59				1185		689	273	709	230	531	608	408	*4633*
	60-69				540		381	159	358	150	379	510	336	*2813*
	70-79				202		248	118	126	106	186	237	201	*1424*
	80-89				16		76	45	39	94	114	130	166	*680*
	90-99				2		13	10	4	21	19	30	33	*132*
	>= 100						1	1			3	2	3	*10*
	Total				*4142*	*0*	*2744*	*1071*	*2412*	*1049*	*2264*	*2554*	*1938*	*18174*
	Total	*830*	*924*	*1129*	*4912*	*1512*	*6473*	*4140*	*3873*	*3204*	*15421*	*15052*	*7643*	*65113*

Table 2.- Number of individuals and Coefficient of Variation (COV %) of *Kr* in *R. hippoglossoides* sampled by area (NAFO Divs. 3LNO and 3M; ICES Div. IIb), year (1992-2003), survey and season.

Area	Season	CV or RV	Year																								*Total*	
			1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003			
			No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV	No.	COV
3M	Spring	CV																			696	7,0	629	8,7	938	9,2	*2263*	*8,5*
	Summer	CV																			398	7,1	1885	8,9	85	7,2	*2368*	*8,6*
		RV	830	8,1	924	8,7	1129	8,3	692	8,5	848	9,2	1248	8,3	1905	8,4	825	7,6	1146	9,4	816	11,3	858	9,1	838	9,2	*12059*	*8,8*
	Autumn	CV																			1442	9,9	561	7,5			*2003*	*9,3*
	Winter	CV																			1145	9,1	541	9,0			*1686*	*9,1*
	Total		*830*	*8,1*	*924*	*8,7*	*1129*	*8,3*	*692*	*8,5*	*848*	*9,2*	*1248*	*8,3*	*1905*	*8,4*	*825*	*7,6*	*1146*	*9,41*	*4497*	*9,4*	*4474*	*8,8*	*1861*	*9,1*	*20379*	*8,8*
3LNO	Spring	CV																			1664	11,9	592	9,3	736	9,8	*2992*	*10,9*
		RV							78	8,7	664	8,9	2481	9,9	1164	10,1	636	12,3	929	11,7	40	13,5	752	12,6	1071	14,2	*7815*	*11,2*
	Summer	CV																			1691	7,3	1605	8,9	1509	9,8	*4805*	*8,7*
		RV																							528	13,8	*528*	*13,8*
	Autumn	CV																			2707	9,5	2471	8,9			*5178*	*9,2*
	Winter	CV																			2638	11,0	2604	10,0			*5242*	*10,5*
	Total								*78*	*8,7*	*664*	*8,9*	*2481*	*9,9*	*1164*	*10,1*	*636*	*12,3*	*929*	*11,7*	*8740*	*10,1*	*8024*	*9,7*	*3844*	*11,9*	*26560*	*10,3*
IIb	Summer	CV							4142	8,5													6	5,8			*4148*	*8,5*
	Autumn	CV																			489	10,4	353	8,9	465	9,2	*1307*	*9,7*
		RV											2744	9,5	1071	9,8	2412	9,3	1049	9,6	1775	10,5	2003	8,7	1296	9,0	*12350*	*9,5*
	Winter	CV																					192	10,5	177	8,9	*369*	*10,0*
	Total								*4142*	*8,5*			*2744*	*9,5*	*1071*	*9,8*	*2412*	*9,3*	*1049*	*9,6*	*2264*	*10,5*	*2554*	*8,9*	*1938*	*9,2*	*18174*	*9,3*
	Total		*830*	*8,1*	*924*	*8,7*	*1129*	*8,3*	*4912*	*8,5*	*1512*	*9,1*	*6473*	*9,5*	*4140*	*9,3*	*3873*	*9,5*	*3124*	*10,2*	*15501*	*10,0*	*15052*	*9,3*	*7643*	*10,6*	*65113*	*9,6*

Table 3.- Characteristics of individuals sampled of *R. hippoglossoides* in the feeding study by area (NAFO Divs. 3LNO and 3M; ICES Div. IIb) by year (1993-03) . Nº empty = Number of empty stomachs; % FI = Feeding intensity; Nº Reg. = Number of regurgitated stomachs; % Food:

Survey	Division	Year	Nº Empty	Nº Full	Nº Reg.	Total	% FI	Size range (cm)	Depth range (m)	Nº hauls	No. Prey Items
"Flemish Cap"	3M	1993	138	392	4	534	74.2	11 - 79	221-730	50	43
"Flemish Cap"	3M	1996	401	633	0	1034	61.2	12-82	231-670	54	53
"Flemish Cap"	3M	1997	442	649	3	1094	59.6	13-81	219-679	51	59
"Flemish Cap"	3M	1998	360	619	23	1002	64.1	14-79	203-709	56	59
"Flemish Cap"	3M	1999	486	746	1	1233	60.6	9-70	223-709	58	56
"Flemish Cap"	3M	2000	258	509	15	782	67.0	14-63	194-555	45	43
"Flemish Cap"	3M	2001	557	720	0	1277	56.4	13-66	166-708	66	57
"Flemish Cap"	3M	2002	305	669	2	976	68.8	12-66	160-730	58	52
"Flemish Cap"	3M	2003	410	589	0	999	59.0	12-68	83-688	88	48
"Platuxa"	3NO	2002	488	367	0	855	42.9	9-89	68-1377	72	30
"Platuxa"	3NO	2003	535	459	0	994	46.2	8-95	43-1449	75	26
"3L - Fletan negro"	3L	2003	314	219	0	533	41.1	10-88	132-1087	31	22
"Fletán Ártico"	II b	1997	1644	531	0	2175	24.4	25-102	543-1312	99	32
"Fletán Ártico"	II b	2000	1414	321	0	1735	18.5	15-97	484-1171	71	30
"Fletán Ártico"	II b	2001	1686	294	0	1980	14.8	21-101	1123 - 563	26	25
"Fletán Ártico"	II b	2002	1376	422	0	1798	23.5	17-103	581-1158	62	39
TOTAL	***Div 3M***	***1993-2003***	***3357***	***5526***	***48***	***8931***	***62.4***	***5-60***	***130-639***	***526***	***70***
	Divs. 3LNO	***2002-03***	***1337***	***1045***	***0***	***2382***	***43.9***	***5-72***	***39-1460***	***178***	***50***
	Div. II b	***2002***	***6120***	***1568***	***0***	***7688***	***20.4***	***15-103***	***484-1312***	***258***	***57***

Table 4.- No. individuals of *R. hippoglossoides* sampled, Mean Fulton Condition Factor, and Relative Condition Factor ± Std. Deviation (SD) with Coefficient of Variation (COV %) by sex in Flemish Cap (NAFO Div. 3M) from 1992 to 2003.

Season	Year	No. indiv. sampled		Mean Fulton Condition Factor		Relative Condition Factor ± Std. Deviation				COV (%)	
		Male	Female	Male	Female	Male	SD	Female	SD	Male	Female
Spring	2001	326	370	0,811	0,831	1,012	0,06	0,999	0,08	6,3	7,6
	2002	245	384	0,789	0,835	1,015	0,09	1,008	0,09	8,4	8,9
	2003	318	620	0,799	0,851	1,012	0,09	1,004	0,09	9,0	9,3
	Total spring	*889*	*1374*	*0,801*	*0,841*	*1,013*	*0,08*	*1,004*	*0,09*	*7,9*	*8,8*
Summer	1992	311	519	0,819	0,864	1,006	0,08	1,011	0,08	7,8	8,3
	1993	418	506	0,826	0,872	1,001	0,08	0,998	0,09	8,5	8,9
	1994	490	639	0,837	0,876	1,009	0,08	1,006	0,08	8,2	8,4
	1995	291	401	0,823	0,845	0,996	0,08	0,997	0,08	8,5	8,5
	1996	350	498	0,815	0,846	1,009	0,10	0,999	0,09	9,2	8,7
	1997	557	691	0,796	0,827	1,012	0,09	1,011	0,08	8,5	8,2
	1998	865	1040	0,787	0,811	0,996	0,09	0,994	0,08	8,8	7,9
	1999	352	473	0,800	0,820	0,994	0,07	1,012	0,08	7,2	7,8
	2000	520	626	0,772	0,794	1,000	0,10	1,009	0,09	9,7	9,2
	2001	570	644	0,810	0,856	1,009	0,10	1,019	0,10	10,0	10,1
	2002	1051	1692	0,803	0,848	0,996	0,09	0,998	0,09	8,6	9,2
	2003	415	508	0,788	0,817	1,003	0,09	1,007	0,09	9,0	9,1
	Total summer	*6190*	*8237*	*0,804*	*0,839*	*1,002*	*0,09*	*1,004*	*0,09*	*8,8*	*8,8*
Autumn	2001	555	887	0,836	0,863	0,998	0,10	1,012	0,10	10,0	9,8
	2002	202	359	0,796	0,837	0,999	0,07	1,017	0,08	7,3	7,6
	Total autumn	*757*	*1246*	*0,825*	*0,855*	*0,998*	*0,09*	*1,014*	*0,09*	*9,3*	*9,3*
Winter	2001	476	669	0,805	0,847	1,005	0,09	0,993	0,09	9,2	8,9
	2002	232	309	0,844	0,865	1,002	0,09	1,007	0,09	9,2	8,9
	Total winter	*708*	*978*	*0,818*	*0,853*	*1,004*	*0,09*	*0,997*	*0,09*	*9,2*	*8,9*
Total (Flemish Cap, 3M)		*8544*	*11835*	*0,806*	*0,842*	*1,003*	*0,09*	*1,004*	*0,09*	*8,8*	*8,9*

Table 5.- No. individuals of *R. hippoglossoides* sampled, Mean Fulton Condition Factor, and Relative Condition Factor ± Std. Deviation (SD) with Coefficient of Variation (COV %) by sex in NAFO Div. 3LNO from 1995 to 2003.

Season	Year	No. indiv. sampled		Mean Fulton Condition Factor		Relative Condition Factor ± Std. Deviation				COV (%)	
		Male	Female	Male	Female	Male	SD	Female	SD	Male	Female
Spring	1995	29	49	0,865	0,877	1,005	0,09	1,001	0,08	9,2	8,4
	1996	297	367	0,772	0,806	1,002	0,09	1,002	0,09	9,3	8,7
	1997	928	1553	0,750	0,782	1,007	0,10	1,008	0,10	9,7	9,9
	1998	454	710	0,798	0,842	1,009	0,10	0,997	0,10	9,4	10,5
	1999	253	383	0,787	0,840	1,009	0,11	1,007	0,13	10,7	13,2
	2000	305	624	0,811	0,886	1,017	0,13	1,019	0,12	12,5	11,3
	2001	675	1029	0,792	0,854	1,001	0,11	0,997	0,12	11,3	12,3
	2002	571	773	0,776	0,811	1,006	0,11	1,016	0,12	10,9	11,5
	2003	636	1171	0,774	0,816	1,002	0,14	1,000	0,12	13,7	12,0
	Total spring	*4148*	*6659*	*0,778*	*0,824*	1,006	0,11	1,005	0,11	*11,2*	*11,2*
Summer	2001	824	867	0,795	0,853	1,004	0,06	0,998	0,08	6,4	8,0
	2002	578	1027	0,798	0,841	1,001	0,08	1,005	0,09	8,4	9,2
	2003	865	1172	0,747	0,799	0,988	0,12	0,982	0,10	11,7	10,6
	Total summer	*2267*	*3066*	*0,777*	*0,828*	*0,997*	*0,09*	*0,994*	*0,09*	*9,2*	*9,5*
Autumn	2001	1040	1667	0,796	0,835	0,994	0,09	1,002	0,10	9,5	9,5
	2002	712	1759	0,794	0,843	1,003	0,09	0,992	0,09	8,7	8,9
	Total autumn	*1752*	*3426*	*0,795*	*0,839*	*0,998*	*0,09*	*0,997*	*0,09*	*9,2*	*9,2*
Winter	2001	981	1657	0,815	0,858	1,022	0,12	0,992	0,10	11,5	10,5
	2002	1068	1536	0,825	0,859	1,012	0,10	0,992	0,10	9,5	10,3
	Total winter	*2049*	*3193*	*0,820*	*0,859*	1,005	0,10	0,999	0,10	*10,5*	*10,4*
Total (3LNO)		*10216*	*16344*	*0,790*	*0,835*	*1,004*	*0,10*	*0,999*	*0,10*	*10,3*	*10,4*

Table 6.- No. individuals of *R. hippoglossoides* sampled, Mean Fulton Condition Factor, and Relative Condition Factor ± Std. Deviation (SD) with Coefficient of Variation (COV %) by sex in ICES Div. IIb from 1995 to 2003.

Season	Year	No. indiv. sampled		Mean Fulton Condition Factor		Relative Condition Factor ± Std. Deviation				COV (%)	
		Male	Female	Male	Female	Male	SD	Female	SD	Male	Female
Summer	1995	2215	1927	0,885	0,920	1,004	0,08	1,004	0,09	8,4	8,5
	2002		6		1,011			1,006	0,06		5,8
	Total summer	*2215*	*1933*	*0,885*	*0,920*	*1,004*	*0,08*	*1,004*	*0,09*	*8,4*	*8,5*
Autumn	1997	1933	4148	0,844	0,913	1,004	0,09	1,004	0,08	9,0	9,8
	1998	447	624	0,849	0,936	1,010	0,09	1,003	0,10	9,4	10,0
	1999	1044	1368	0,892	0,971	1,003	0,09	0,992	0,09	8,9	9,6
	2000	393	656	0,835	0,957	1,001	0,08	1,011	0,10	8,0	10,4
	2001	1018	1246	0,824	0,919	1,006	0,10	0,992	0,11	9,8	11,0
	2002	1115	1241	0,847	0,966	0,999	0,08	1,013	0,09	8,1	9,1
	2003	731	1030	0,824	0,955	1,012	0,09	1,012	0,10	8,5	9,7
	Total autumn	*5999*	*7658*	*0,847*	*0,944*	*1,005*	*0,09*	*1,000*	*0,10*	*8,9*	*10,0*
Winter	2002	69	123	0,813	1,048	1,007	0,10	1,036	0,11	10,0	10,7
	2003	68	109	0,826	1,022	1,005	0,08	0,979	0,09	7,9	9,4
	Total winter	*137*	*232*	*0,819*	*1,036*	*1,006*	*0,09*	*1,009*	*0,11*	*9,0*	*10,5*
Total (IIb)		*8351*	*9823*	*0,856*	*0,942*	*1,005*	*0,09*	*1,001*	*0,10*	*8,8*	*9,7*

Table 7.- Volume (%) of the main preys by size range (cm) for *R. hippoglossoides*. Flemish cap (Div. 3M) in 1993-2003 period.

Preys	**Size Range (cm)**								**Total**
	<20	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80-89**	
PISCES	*2,0*	*8,6*	*41,6*	*65,3*	*84,5*	*92,6*	*91,1*	*100*	*66,4*
Sebastes sp.		0,4	1,8	10,8	23,0	23,2	91,1	45,3	14,1
Serrivomer beani		1,6	5,4	12,2	14,0	30,3			11,6
Chauliodus sloani			3,1	2,6	1,4				2,0
Lycodes sp.			1,1	1,5	1,0				1,1
Nezumia bairdi		0,7	2,4	3,0	5,6	0,1			3,4
Anarhichas sp.		0,2	0,3	1,5	1,5	3,3		45,3	2,0
Anarhichas lupus		0,0	0,3	1,1	0,4	9,2			1,0
Lumpenus lumpretaeformis	1,1	0,8	3,1	1,0	0,3	0,2			1,1
Lampadena speculigera			2,8	6,1	10,3	2,4			6,2
Other Pisces	0,9	4,9	21,2	25,6	27,0	24,0		9,4	23,9
CRUSTACEA	*86,3*	*85,6*	*48,9*	*28,4*	*11,5*	*7,0*			*27,7*
Hyperiidea	62,3	38,9	8,2	1,3	0,2				3,8
Pandalus borealis	12,2	42,5	38,1	24,9	9,8	6,4			21,8
Other crustaceans	11,8	4,1	2,6	2,2	1,5	0,6			2,1
MOLLUSCA	*11,1*	*3,8*	*8,6*	*5,9*	*3,7*	*0,2*	*8,9*		*5,4*
Illex coindetii	1,3	0,6	2,6	1,2	0,0				1,0
Decapoda Cephalopoda	5,3	2,2	3,6	1,6	0,8				1,7
Other Mollusca	4,5	1,0	2,4	3,0	2,9	0,2	8,9		2,7
ECHINODERMATA		*0,0*	*0,1*	*0,0*	*0,1*				*0,0*
OTHER INVERTEBRATES	*0,6*	*2,0*	*0,5*	*0,2*	*0,1*	*0,1*			*0,3*
OTHER	*0,1*		*0,3*	*0,2*	*0,2*	*0,1*			*0,2*
No. indivs. with stomach contents	907	719	1430	1796	628	40	4	2	5526

Table 8.- Volume (%) of the main preys by size range (cm) for *R. hippoglossoides*. Div. 3LNO in 2002-03 period.

Preys	**Size range (cm)**									**Total**
	<20	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80-89**	**90-99**	
PISCES	*31,5*	*97,8*	*93,9*	*68,7*	*51,2*	*80,1*	*100*	*71,7*	*100*	*76,7*
Ammodytes dubbius		1,9	1,0	2,9	0,4					1,3
Antimora rostrata					6,8			11,7	100	4,2
Gaidropsarus ensis								45,0		4,9
Coryphaenoides rupestris				0,9	1,9	35,8				1,9
Macrourus berglax				1,7	7,6	27,1				2,9
Macrouridae			0,2		12,8					2,5
Mallotus villosus	13,1	83,2	88,8	56,9	3,5					46,8
Other Pisces	18,5	12,7	3,9	6,4	18,3	17,3	100	15,0		12,2
CRUSTACEA	*68,2*	*1,0*	*3,3*	*5,0*	*2,7*	*2,5*				*3,3*
Pasiphaea tarda			1,6	1,8	2,3					1,3
Other crustaceans	68,2	1,0	1,7	3,3	0,4	2,5				2,1
MOLLUSCA	*0,0*	*1,1*	*2,8*	*26,2*	*35,2*	*1,9*		*20,0*		*16,4*
Oegopsida			1,5	18,8	10,0					7,0
Cephalopoda	0,0	0,0	0,2	2,5	1,4			20,0		3,2
Decapoda Cephalopoda		1,1	0,9	4,9	20,3	1,9				5,5
Other Mollusca			0,0		3,5					0,7
ECHINODERMATA	-	-	-	-	-	-	-	-	-	-
OTHER INVERTEBRATES	*0,1*	*0,0*	*0,0*	*0,0*						*0,0*
OTHER	*0,1*	*0,0*	*0,0*	*0,0*	*10,9*	*15,5*		*8,3*		*3,6*
Offal					6,8					1,3
Greenland halibut offal						15,5		8,3		1,5
Other	0,1	0,0	0,0	0,0	4,1					0,8
No. indivs. with stomach contents	260	321	237	147	60	12	3	4	1	1045

Table 9.- Volume (%) of the main preys by size range (cm) for *R. hippoglossoides* in Div. IIb (ICES) in the years 1997, 2000-02.

Preys	**Size Range (cm)**									**Total**
	<20	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80-89**	**90-99**	
PISCES		*38,8*	*28,3*	*31,4*	*57,6*	*72,2*	*73,9*	*74,7*	*89,4*	*66,2*
Sebastes mentella					2,0	4,2	5,6	6,5		3,9
Sebastes sp.							1,7	10,1		1,8
Micromesistius poutassou			17,4	19,2	22,6	14,4	9,8	8,4		13,6
Hippoglossoides platessoides							1,3	4,2		1,0
Cottunculus microps						3,0		4,6		1,2
Reinhardtius hippoglossoides				0,0	1,9	2,0	33,2	24,3	82,5	18,0
Gaidropsarus argentatus					5,0	4,3				1,8
Clupea harengus				0,5		1,6	1,7	2,8		1,3
Lycodes sp.				0,8	6,0	8,1	7,2	1,4		5,4
Other Pisces		38,8	10,9	10,9	20,0	34,6	13,3	12,4	6,9	18,3
CRUSTACEA	*100*	*54,8*	*38,7*	*49,3*	*27,9*	*7,5*	*0,7*	*0,6*		*12,4*
Pasiphaea tarda		7,1	26,1	40,5	21,1	5,9	0,4	0,4		9,6
Other crustaceans	100	47,7	12,6	8,8	6,8	1,6	0,3	0,2		2,8
MOLLUSCA		*5,3*	*28,1*	*17,7*	*13,4*	*6,7*	*3,7*	*0,0*	*2,1*	*7,5*
Oegopsida			14,9	6,6	0,9	0,9	2,7			2,2
Unidentified Cephalopoda			6,7	7,2	7,1	1,8	0,7	0,0		2,7
Unidentified Octopoda			2,4	3,2	3,3	2,5	0,3			1,5
Other mollusca		5,3	4,1	0,8	2,1	1,6	0,1		2,1	1,0
ECHINODERMATA					*0,0*	*0,0*				*0,0*
OTHER INVERTEBRATES					*0,0*	*0,1*	*0,2*			*0,1*
OTHER		*1,1*	*4,9*	*1,6*	*1,1*	*13,5*	*21,5*	*24,7*	*8,5*	*13,8*
Greenland halibut offal					*0,9*	*12,5*	*21,2*	*23,4*	*8,5*	*13,0*
Other		*1,1*	*4,9*	*1,6*	*0,2*	*1,0*	*0,4*	*1,3*		*0,8*
No. indivs. with stomach contents	1	9	147	432	465	301	160	45	8	1568

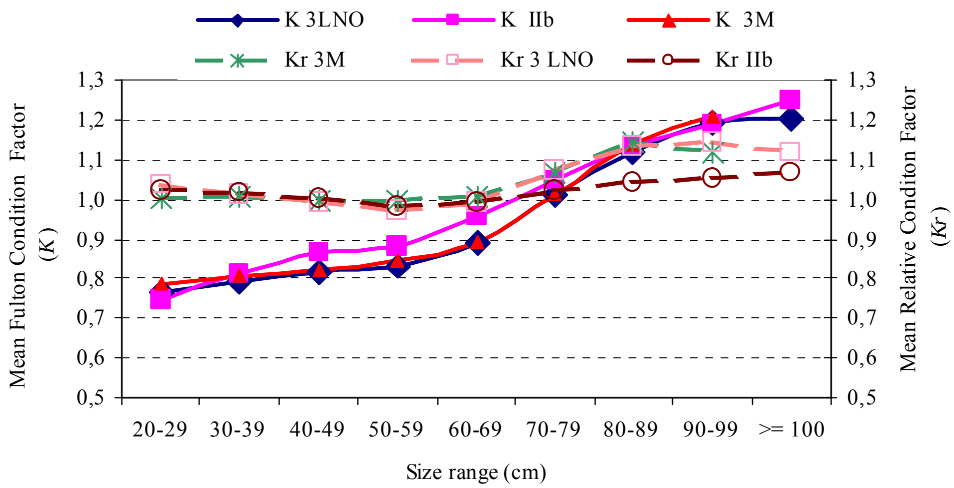

Fig. 1. Mean Fulton Condition Factor (left) and Mean Relative Condition Factor (right) of *R. hippodlossoides* by size range (cm) and area. The sampled periods were: 1992-2003 in Div. 3M, 1995-2003 in Div. 3LNO and IIb.

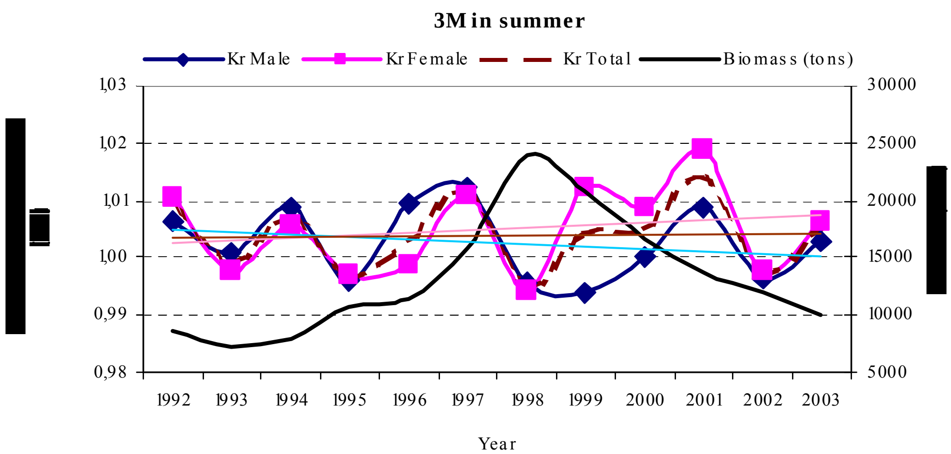

Fig. 2. Mean Relative Condition Factor and estimated biomass of *R. hippoglossoides* by year in Div. 3M in summer from 1992 to 2003.

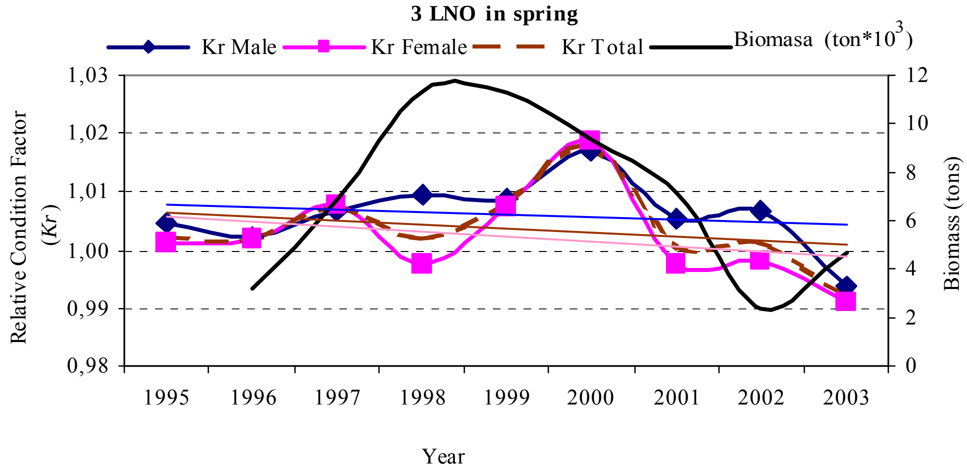

Fig. 3. Mean Relative Condition Factor and estimated biomass of *R. hippoglossoides* by year in Div. 3LNO in spring from 1995 to 2003. Biomass data correspond with "Platuxa" Spanish Survey in Div. 3NO.

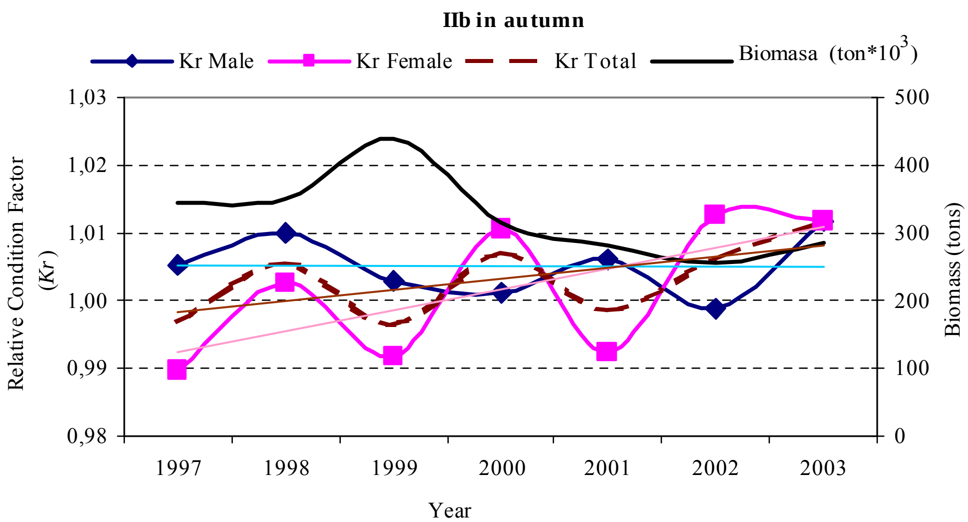

Fig. 4. Mean Relative Condition Factor and estimated biomass of *R. hippoglossoides* by year in Div. IIb in autumn from 1995 to 2003. Biomass data correspond with "Fletán Ártico" Spanish Survey in Div. IIb.

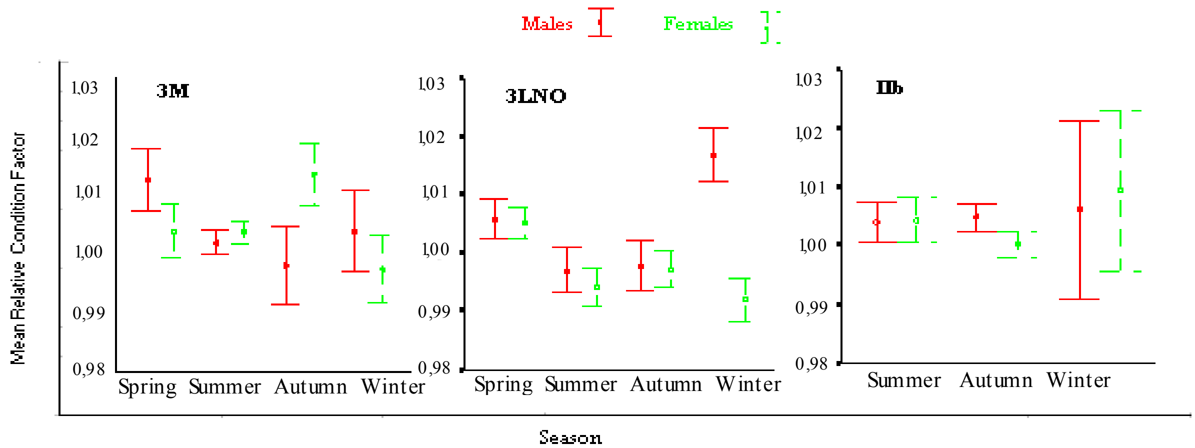

Fig. 5. Mean Relative Condition Factor (with 95% confidence interval) of *R. hippoglossoides* by sex and season in each area. The sampled periods were: 1992-2003 in Div. 3M, and 1995-2003 in Div. 3LNO and IIb.

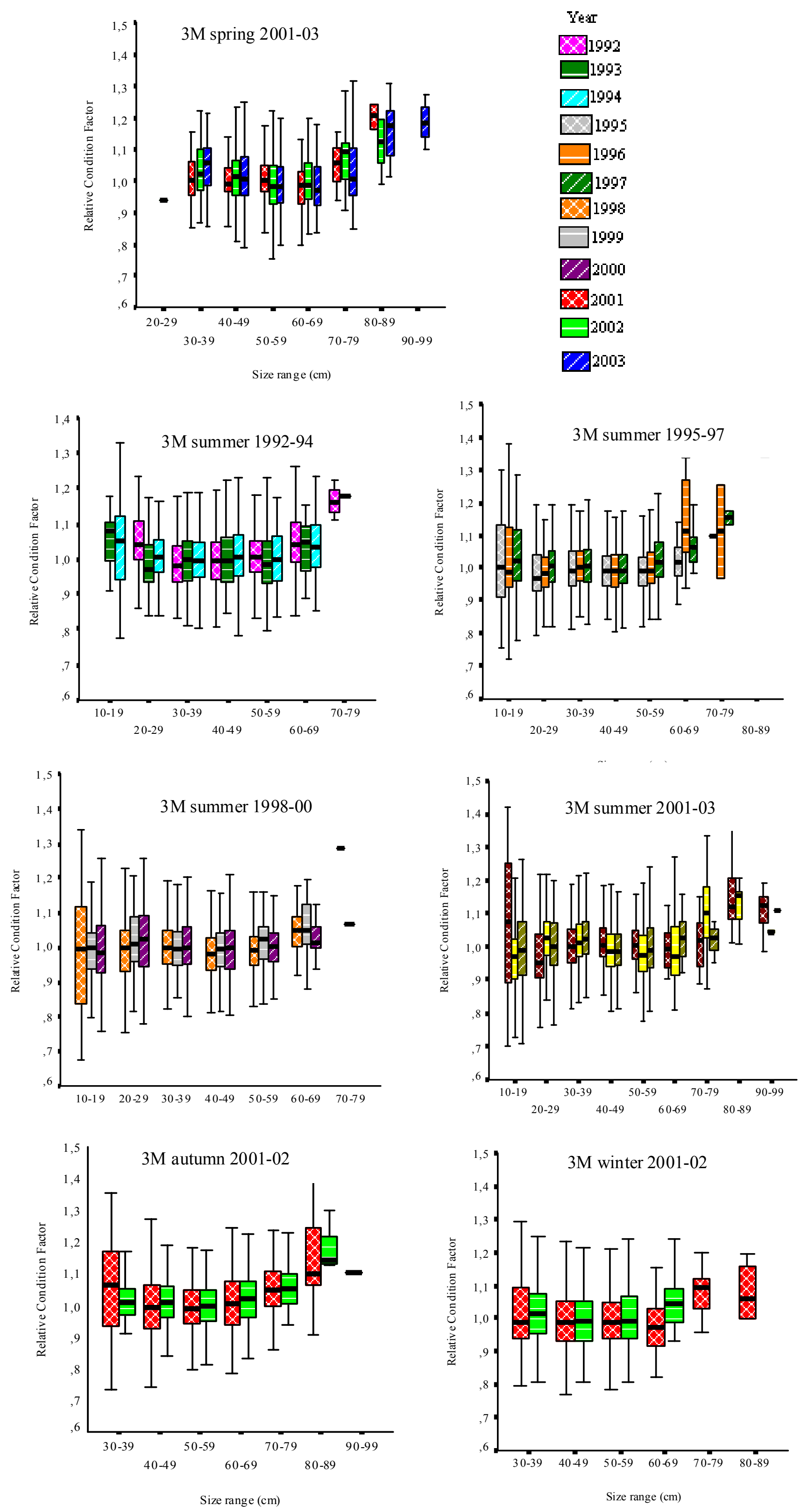

Fig. 6. Mean Relative Condition Factor of *R. hippoglossoides* by year and length (cm) in each season in Div. 3M from 1992 to 2003. Boxplots show the median and interquartile range.

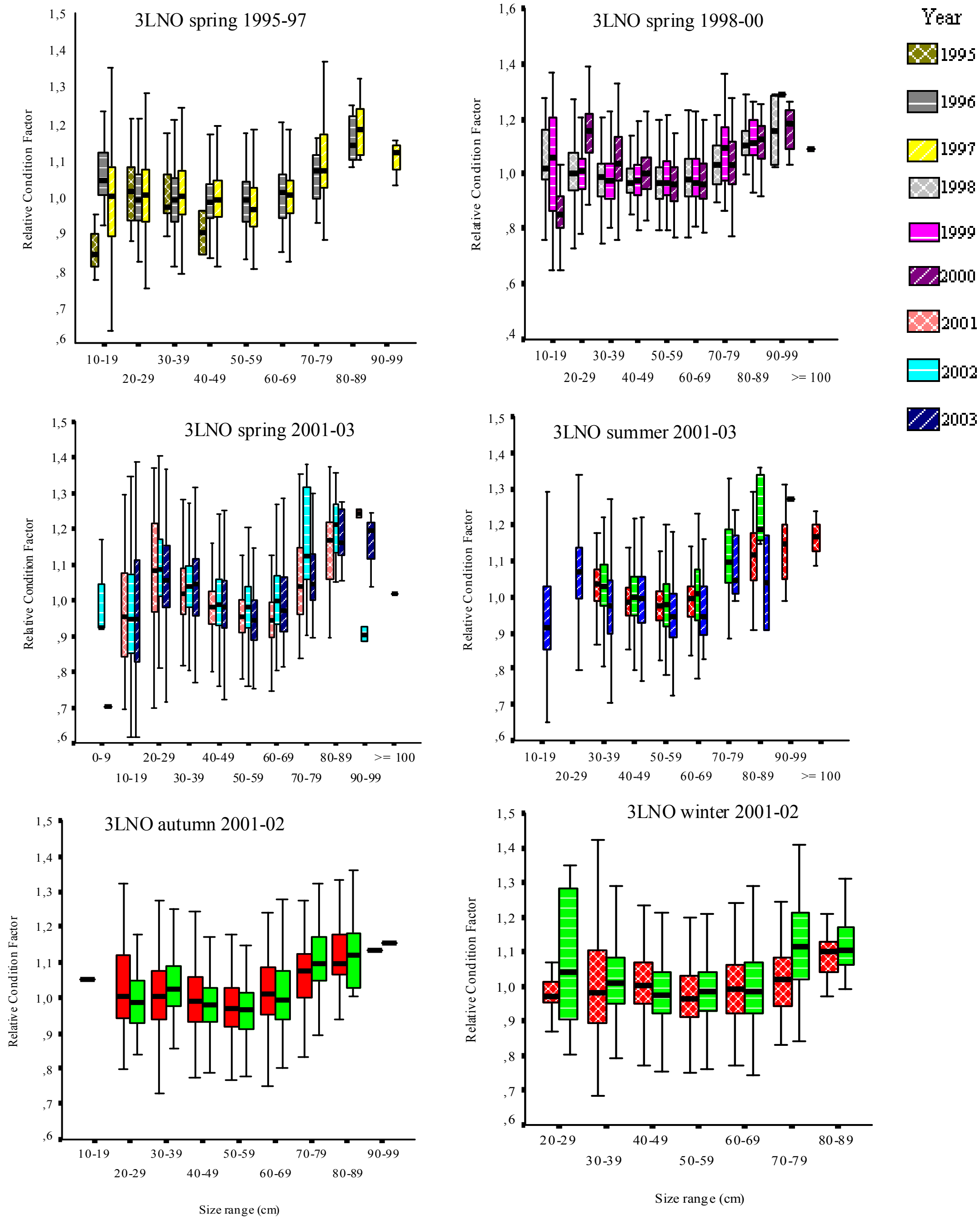

Fig. 7. Mean Relative Condition Factor of *R. hippoglossoides* by year and length (cm) in each season in Div. 3LNO from 1995 to 2003. Boxplots show the median and interquartile range.

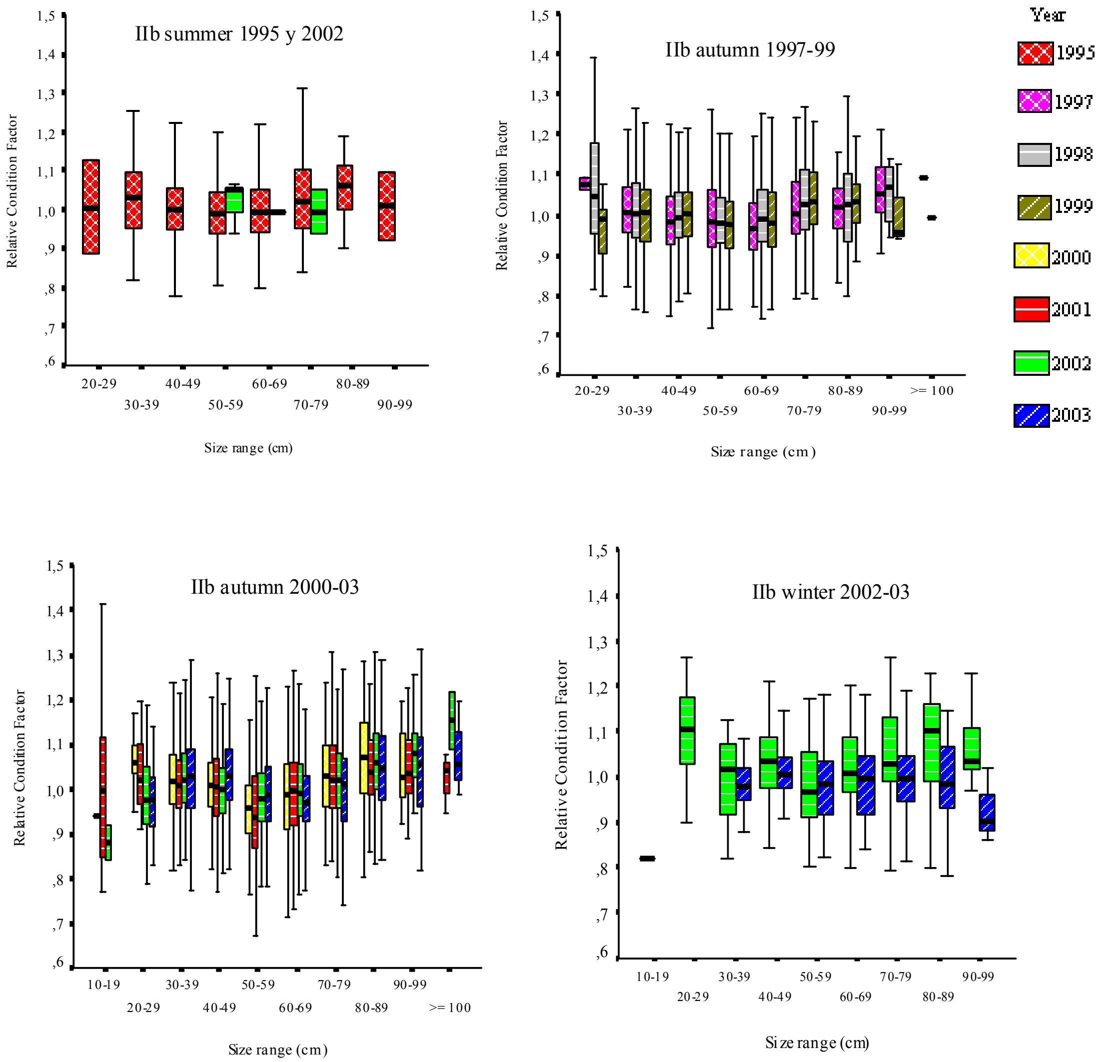

Fig. 8. Mean Relative Condition Factor of *R. hippoglossoides* by year and length (cm) in each season in Div. IIb from 1995 to 2003. Boxplots show the median and interquartile range.

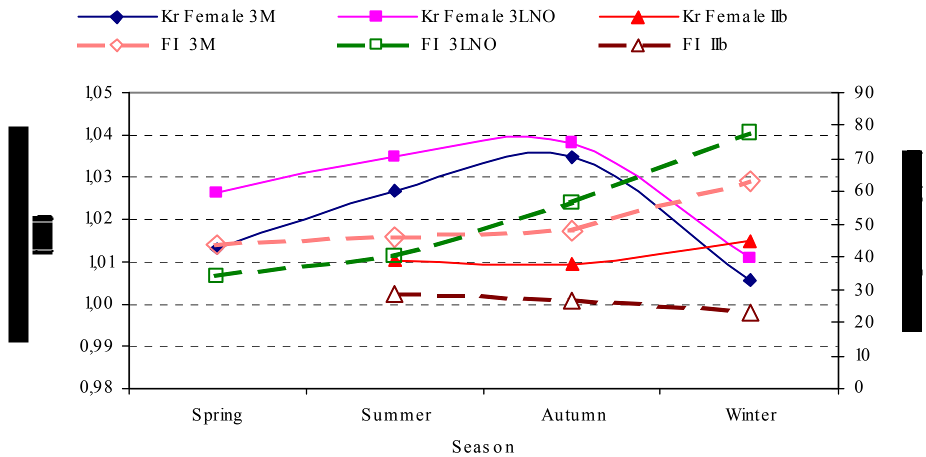

Fig. 9. Mean Relative Condition Factor (*Kr*) and Feeding Intensity (FI%) in females >=60 cm of *R. hipploglossoides* by area. The sampled periods were: 1992-2003 in Div. 3M, 1995-2003 in Div. 3LNO and IIb.

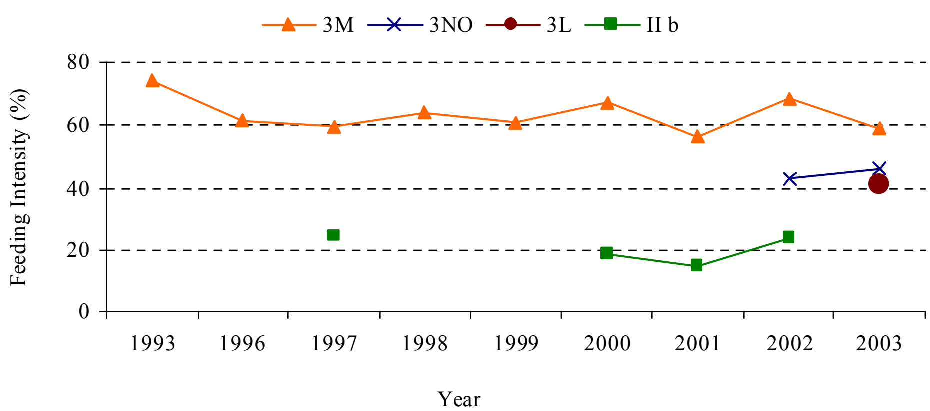

Fig. 10. Feeding Intensity (%) in feeding habit data of *R. hipploglossoides* in North Atlantic. NAFO (Div. 3M, 1993-2003; Div. 3LNO, 2002-2003) and ICES (Div. IIb, 1997, 2000-2002).

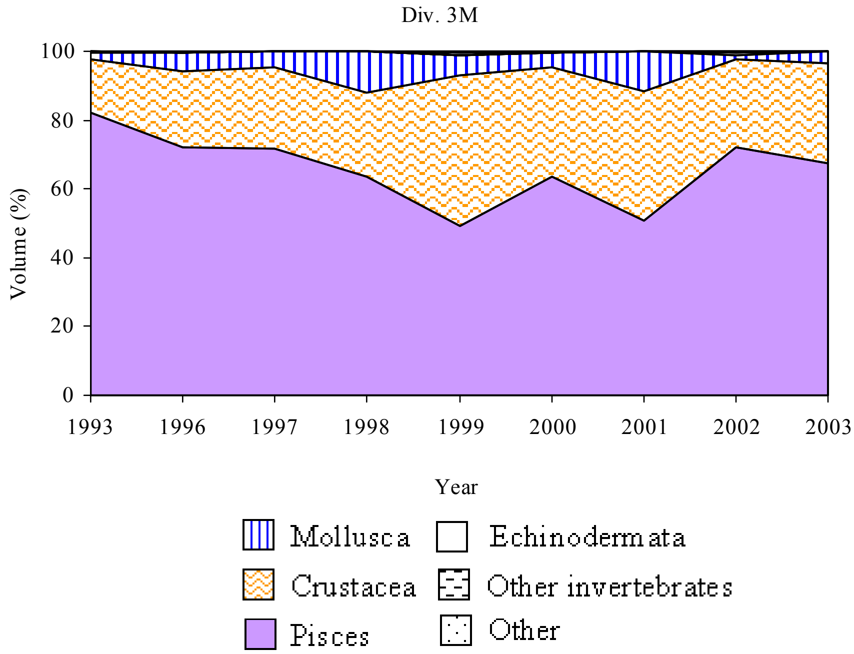

Fig. 11. Volume (%) of the main prey groups for *R. hippoglossoides* in Flemish Cap (Div. 3M), 1993-2003 period.

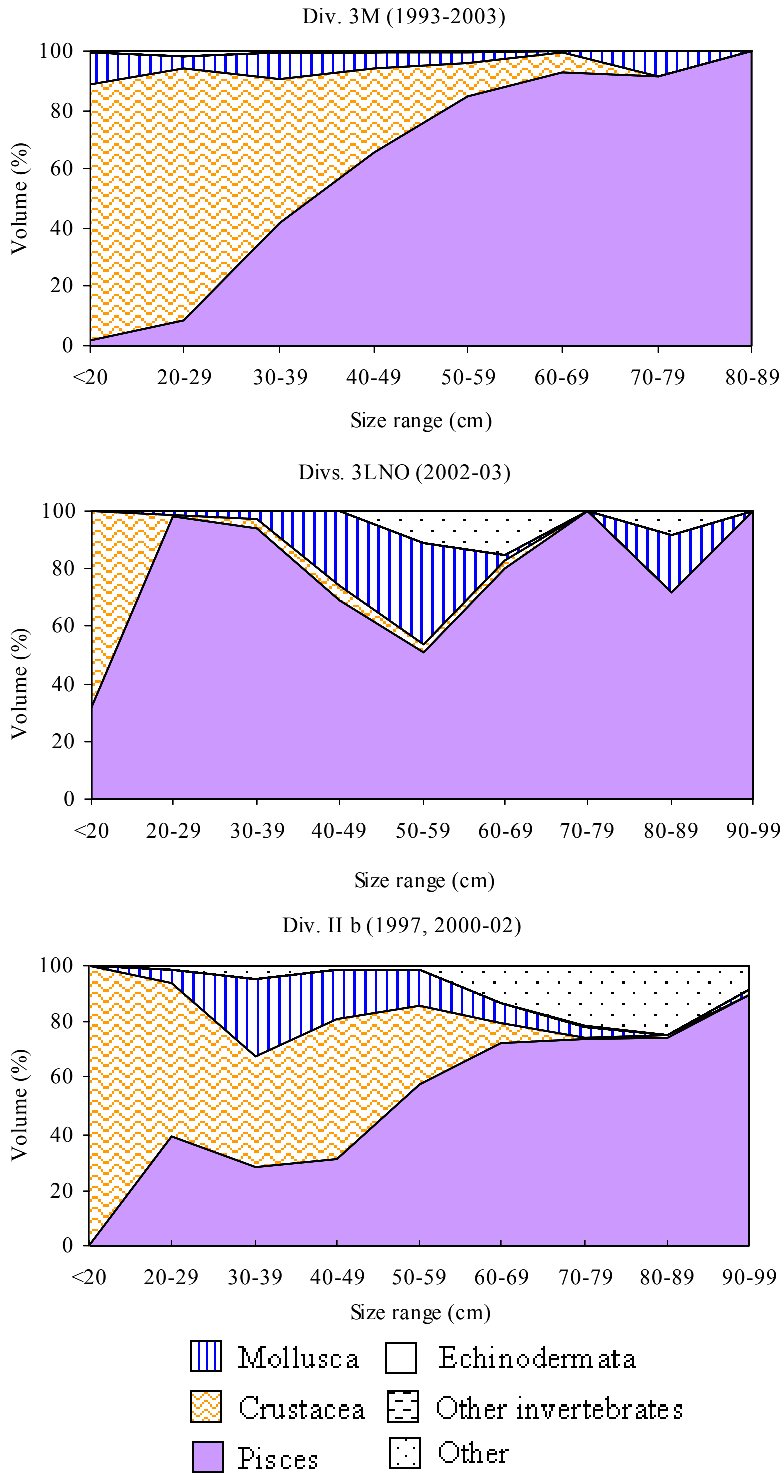

Fig. 12. Volume (%) of the most prey groups by size range (cm) for *R. hippoglossoides* in NAFO (Div. 3LNO and 3M) and ICES (Div. IIb).

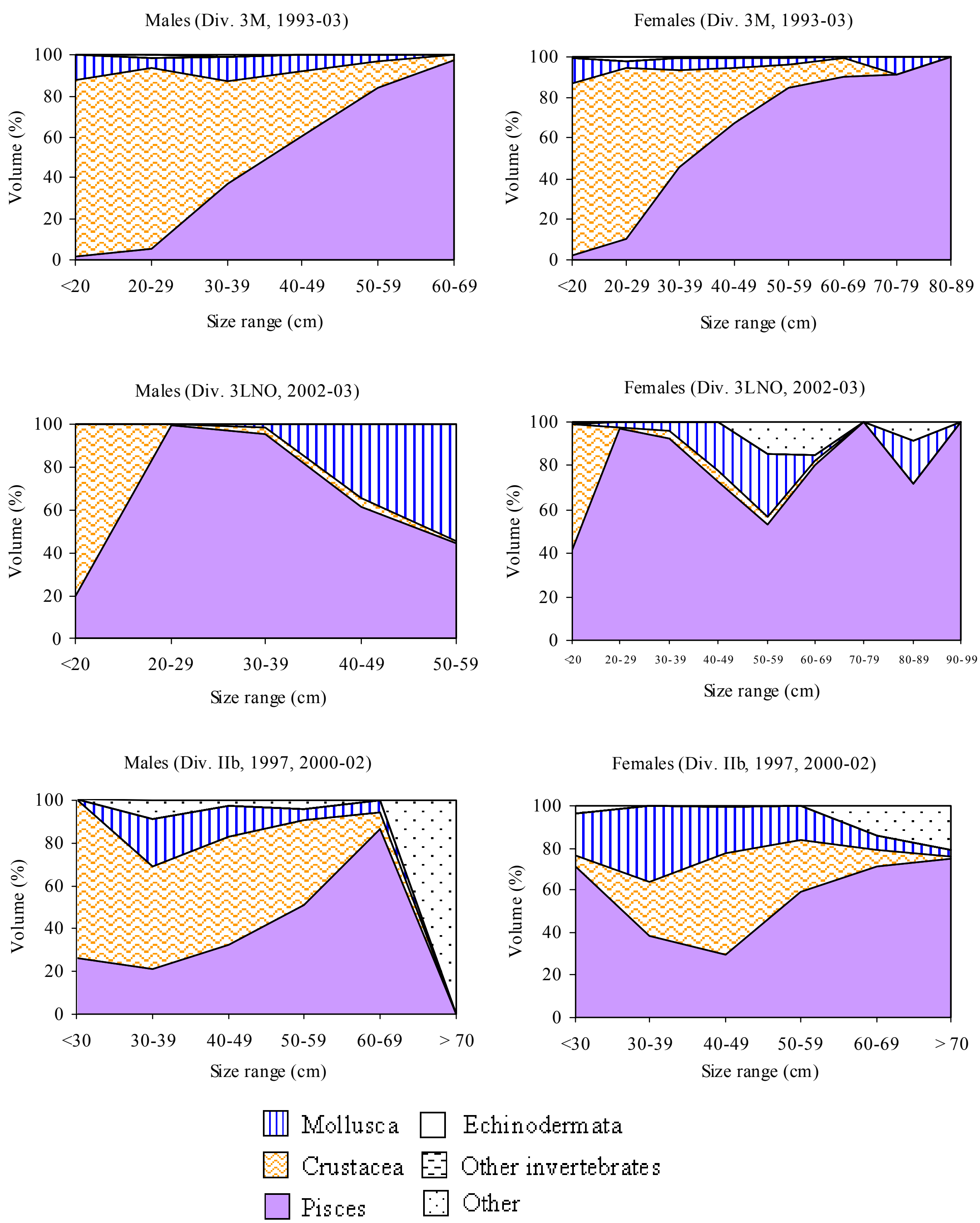

Fig. 13. Volume (%) of the most prey groups by size range (cm) for *R. hippoglossoides* in NAFO (Div. 3M and 3LNO) and ICES (Div. IIb).