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Structures and Changes of the Demersal Fish Assemblage off Greenland and Trends in Near Bottom Temperature, 1982-96

by

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Abstract

The analysed demersal fish community was mainly composed of very few boreal species and the great majority of the fish species was rare. Structures in the quantitative species composition were found to be determined by geographical as well as depth effects but no clear indications of persistent deliminations or boundaries in the demersal fish assemblage were determined. The species diversity ranged among similar magnitudes as observed for the subantarctic fish fauna. During the period 1982-96, survey results indicated fundamental shifts in species composition in coherence with dramatic changes in stock abundance, biomass and size structure for ecologically and economically important species. Compared with the mean stock sizes during the decade of the 80s, the decreases of cod, golden redfish (≥17 cm) and starry skates varied between 70 and almost 100 %. During the same period, American plaice displayed a less pronounced decrease and the stocks of Atlantic and spotted wolffish decreased in biomass but increased in abundance. The enormous increase of deep sea redfish (≥17 cm) and unspecified juvenile redfish (<17 cm) during the most recent years was due to recruitment. The geograhical differences between trends in fish abundance, biomass and individual size off West and East Greenland were pronounced. In comparison with the 80s, the aggregated fish biomass for all species off East Greenland almost doubled but decreased off West Greenland by 96 %. The aggregated fish abundance indices increased off East Greenland by a factor of 9 but decreased off West Greenland by 18 %. Positive effects in fish abundance, biomass and size observed recently were almost exclusively restricted to East Greenland and the negative effects were more pronounced off West Greenland where only 5 % of the fish were distributed. The increased effort of the shrimp fishery on traditional fishing grounds off West Greenland might have caused these differences because the applied gear is suspected to select efficiently small sized fish and there was no fishing effort recently directed towards groundfish. The disadvantageous development and poor status of various fish stocks off West Greenland is consistent with the effort distribution of the Greenlandic shrimp fleet.

A multiple linear model of the near bottom temperature based on year, month, depth, latitude and longitude effects explained 31 % of the variation in temperature. The average or warmer near bottom temperatures during the 90s did not indicate any unfavorable environmental conditions for fish growth or reproduction.

Introduction

The demersal fish assemblage in Greenlandic waters has been significantly affected by fishing during the past 70 years. For cod the history of exploitation is fragmentary documented since the recolonization of Greenland in 1721 (Hansen, 1949). Starting from 1917, cod catches increased to 100,000 tons annually in the 1930s taken

primarily by a hook and line fishery. After the war, the pertubations due to an intensive fishery came up to a high level of 400,000 tons. Since the early 70s, the productivity of the ecosystem decreased and became extremely irregular because of a collapse of the cod and redfish spawning stocks (Rätz, 1996 a). In 1991, the former profitable cod and redfish fishery was given up due to extremely low catch rates. Recently, a shrimp fleet is operating on traditional fishing grounds landing around 70,000 tons annually. Apart from cod, redfish and shrimp, the other finfish species were taken as by-catches.

The exploitation of fish stocks is generally based on catches comprising a variety of species. Multispecies models were developed to consider this fact but require the knowledge of the community structures in the entire ecosystem. On this account, several studies were published using catch data both from commercial fisheries or scientific surveys in order to identify persistent spatial boundaries of demersal marine fish assemblages in the Nothwest Atlantic and to underline their management implications (Muraski et al., 1983; Gabriel, 1992; Gomes et al. 1992). Since 1982, the demersal fish assemblage off Greenland has been monitored annually by German groundfish surveys representing the only fishery independent source of information about groundfish stocks inhabiting the shelf and continental slope off West Greenland in NAFO Divisions 1B-1F and off East Greenland in ICES Subarea XIVb outside the 3 mile zone down to 400 m depth. For the period 1982-96, this paper represents the spatial distribution patterns and trends in aggregated fish abundance, biomass and individual size as well as structures in quantitative species composition and diversity. The most recent status and trends in stock abundance, biomass and length composition for ecologically and economically important species as derived from survey catches were determined. The near bottom temperature regime was also evaluated and described.

Materials and Methods

Abundance, biomass estimates and length compositions were derived from annual groundfish surveys covering shelf areas and the continental slope off West and East Greenland. Surveys commenced in 1982 and were primarily designed for the assessment of cod. Because of favourable weather and ice conditions and to avoid spawning concentrations, autumn was chosen for the time of the surveys. These were carried out by the research vessel (R/V) WALTHER HERWIG (II) throughout most of the time period. In 1984 R/V ANTON DOHRN was used and she was replaced by the new R/V WALTHER HERWIG III since 1994, respectively.

The fishing gear used was a standardized 140-feet bottom trawl, its net frame rigged with heavy ground gear because of the rough nature of the fishing grounds. A small mesh liner (10mm) was used inside the cod end. The horizontal distance between wing-ends was 25 m at 300 m depth, the vertical net opening being 4 m. In 1994, smaller Polyvalent doors (4.5 m^2, 1,500 kg) were used for the first time to reduce net damages due to overspread caused by bigger doors (6 m^2, 1,700 kg), which have been used earlier. All calculations of abundance and biomass indices were based on the 'swept area' method using 22 m horizontal net opening as trawl parameter, i. e. the constructional width specified by the manufacturer. The towing time was normally 30 min. at a speed of 4.5 knots. Trawl parameters are listed in Table 1. Hauls which received net damage or became hangup after less than 15 minutes were rejected. Some hauls of the 1987 and 1988 surveys were also included although their towing time had been intentionally reduced to 10 minutes because of the expected large cod catches as observed from echo sounder traces.

The surveys were primarily designed for the assessment of cod. In order to reduce the error of abundance estimates, the subdivision of shelf areas and the continental slope into different geographic and depth strata was required due to a pronounced heterogeneity of cod distribution (Rätz, 1996 b, c). The survey area was thus split into seven geographic strata. Each stratum was itself subdivided into two depth strata covering the 0-200 m and 201-400 m zones. Figure 1 and Table 2 indicate the names of the 14 strata, their geographic boundaries, depth ranges and areas in nautical square miles (nm^2). All strata were limited at the 3 mile offshore line.

The applied strategy was to distribute the sampling effort according both to the stratum areas and to cod abundance. Consequently, fifty percent of the hauls were allocated proportionally to strata by stratum area while the other fifty percent were apportioned on the basis of a review of the historical mean cod abundance/nm^2, all hauls being randomly distributed within trawlable areas of the various strata. Non-trawlable areas were mainly located inshore. During 1982-96, 2,343 successful sets were carried out, the numbers of valid sets by year and stratum being listed in Table 3. Apart from stratum 7.2 (Dohrn Bank), East Greenland strata were not covered adequately in 1984, 1992 and 1994 due to technical problems. In 1995, the survey area off West Greenland was incompletely covered for the first time again due to technical problems. Only 50 % of the strata of West Greenland were covered, namely the southern strata 3.1, 3.2, 4.1, and 4.2. Stratum 7.1 has a very low area and therfore never been covered. In 1996, the entire survey area was covered. Figure 1 shows the positions of hauls conducted during the most recent survey.

Fish were identified to species or lowest taxonomic level and the catch in number and weight was recorded. Redfish (≥ 17 cm) were separated to *Sebastes marinus* L. or deep sea *Sebastes mentella* Travin, whereas juvenile redfish (<17 cm) were classified as *Sebastes spp.* due to time-consuming and difficult species indentification. Total fish lengths were measured to cm below. Stratified abundance estimates were calculated from catch-per-tow data using the stratum areas as weighting factor (Cochran, 1953; Saville, 1977). Strata with less than five valid sets were rejected from the calculation. The coefficient of catchability was set arbitrarily at 1.0, implying that estimates are merely indices of abundance and biomass. Respective confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

As a standard procedure, near bottom temperatures were measured directly before or after trawling in the vicinity of the swept area by a CTD-sonde with a precision of a hundredth °C. Table 23 lists the available numbers of temperature values by stratum and year. During the 14 year time series, a total of 1,207 measurements were conducted.

Species diversity and eveness indices were computed using the formula of Shannon and Weaver (1963) and Pielou (1966), respectively. Statistical analyses such as multiple linear regression and multidimensional scaling were performed using the CSS Statistica software. This software provides descriptions and references of the applied analyses.

Results

During the period 1982-96, the total survey catch amounted to 3.3 million individuals and 1100 tons. Table 4 lists the 66 various fish taxa ranked according to their relative importance in numbers. The rank species importance illustrated that the ichthyofauna off Greenland was mainly composed of very few boreal species as only one arctic species (capelin, *Mallotus villosus*) contributed more than 4 % to the overall catch in numbers (Fig. 2). The dominant fish species were the three redfish components, juvenile redfish < 17cm, deep sea and golden redfish ≥ 17 cm (*Sebastes marinus* and *S. mentella*), Atlantic cod (*Gadus morhua*), and American plaice (*Hipplogossoides platessoides*). For these species, the trends in stock abundance and biomass, mean individual size and recent length compositions were presented. The same information was also compiled for Atlantic and spotted wolffish (*Anarhichas lupus* and *A. minor*) and starry skate (*Raja radiata*). These eight ecologically and economically important species contributed 92 % and 96 % to the overall catch in numbers and biomass, respectively.

The differences between strata based on log-transformed mean species composition over the past 15 years were shown in Figure 3. The strata were illustrated as points in a three dimensional space and obviously grouped into two clusters by the depth effect. All shallow strata (0-200 m) were positioned on the left hand side of the graph, whereas the deep strata were grouped in the right part. A geographical effect seemed also to contribute signifcantly to the position of the strata in the graph and to their illustrated distances based on the quantitative species composition. It is apperent, that all strata off West Greenland strata were clustered in the front, whereas the East Greenland strata were found in the rear.

Diversity and eveness indices of the individual strata were listed in Table 5 and illustrated in Figure 4. The eveness indices showed negligible differences and varied between 3.4 and 3.8. In contrast, the variations in species diversity among the strata were significant. Based on the mean species composition over the past 15 years, the strata off West Greenland were found to be generally more divers than the strata off East Greenland, the difference amounted to 46%.

Table 6 lists abundance, biomass indices and mean individual weights for all fish species aggregated off West, East Greenland and total. The trends of these values were illustrated in Figures 5, 6, and 7. Both abundance and biomass trends were very similar. Followed by a decrease from 1982 until 1984 the indices increased to intermediate maxima in 1987, but decreased again thereafter. Since 1993, the abundance indices exceeded the intermetiate maximum by a factor of 3 to 4. Most recently, the biomass also increased significantly by 48 % as compared with the mean of the decade of the 80s. These positive effects were restricted to the survey area off East Greenland only, where 94 % of the indivduals and 96 % of the biomass was concentrated. During the 80s, the fish were found to be more evenly distributed, the values amounted to 57 % and 55 %, respectively. The mean individual weight showed an overall dramatic decline by 78 % compared to the mean during the 80s. Especially during the 90s, the fish off West Greenland were significantly smaller and had a weight around 50 g only. Since 1994, the individual weight increased to 127 g off East Greenland while the fish of West Greenland did not show any growth indications and remained at the record low.

Tables 4 and 5 list abundance and biomass estimates for Atlantic cod. The values were shown in Figures 8 and 9 appended by the trend in mean individual weight and recent length frequencies in Figures 10 and 11, respectively. During the survey period, Atlantic cod was found to be the most dominant fish species in weight (46 %). Until 1990, the trends in stock abundance and biomass controlled the aggretated values of the entire demersal fish assemblage. The increase in stock abundance and biomass during 1984-87 to 830 million individuals and 690,000 tons was due to the recruiting process of the year classes 1984 and 1985. Thereafter, the stock abundance and biomass collapsed by nearly 100% to indices amounting to 2 million and 4,000 tons in 1996. The most recent length structure was dominated by recruits ranging at 16 cm and 34-43 cm, representing both poor year classes 1995 and 1993 at age 1 and 3, respectively (Fig. 11). The losses in individuals and weight were less pronounced off East Greenland (94 %) than off West Greenland (100%) as compared with the mean abundance and biomass during the 80s. The same geographical effect was found for the size reductions. During the 90s, the mean individual weight of Atlantic cod off East Greenland exceeded the weight of the fish off West Greenland by a factor of 5. Since 1992, the individuals were extremly small and did not exceed 500 g. Until 1989, only 9 % of the fish were distributed off East Greenland while during the following seven years this portion increased to 52 %.

In comparison with the 80s, the most recent abundance and biomass estimates of golden redfish (≥17 cm) displayed a significant decrease by 92 % and 94 %, respectively (Tab. 9 and 10, Fig. 12 and 13). The great majority of golden redfish was always found to be distributed off East Greenland. However, the loss in abundance and biomass was again more pronouced off West Greenland than off East Greenland (95 and 92 %; 96 and 93 %, respectively). Until the end of the decade of the 80s, the abundance of golden redfish (≥17 cm) off West Greenland had decreased to non-recognizable values and not shown any signs of recovery since then. Figure 14 illustrates that the calculated size reductions were more significant off West Greenland (22 %) than off East Greenland (19 %) The length compositions in 1995 and 1996 were dominated by immature fish of 20-22 cm and 25-27 cm indicating an annual growth increment of about 5 cm (Fig. 15).

As observed for the golden redfish (≥17 cm) the stock of deep sea redfish (≥17 cm) was found to be distributed almost exclusively off East Greenland (Tab. 11 and 12, Fig. 16 and 17). During the 80s, abundance and biomass estimates for deep sea redfish (≥17 cm) varied without any distinct trend. Since 1991, both estimates indicate enormous increases by a factor of 27 and 15 for abundance and biomass due to good recruitment, respectively. Campared with the mean observed during the 80s, the size reduction off West Greenland amouted to 68 % in body weight while the fish off East Greenland showed a lesser reduction by 48 %. During 1995-96, individual sizes increased off East Greenland from 150 to 195 g whereas the fish off West Greenland dereased in body weight from 110 to 88 g (Fig. 18). In 1995, the length frequency was dominated by juvenile small fish around 20-22 cm and (Fig. 19). One year later, the majority of the fish varied in total length from 23 to 26 cm after an annual growth rate of about 3 cm.

Juvenile and unspecified redfish (<17 cm) dominated the abundance of finfish by far (35 %). Since 1993, this category was very abundant and concentrated off East Greenland (Tab. 13 and 14, Fig. 20 and 21). Driven by the recruitment, the mean individual weight varied between 7 and 64 g. In 1993 and 1994, the length distributions peaked at 6, 9, 12 and 15 cm (Fig. 4). Juvenile redfish (<17 cm) off East Greenland were generally bigger as compared with fish off West Greenland (Fig. 22). Annual growth increments of 4 cm were indicated by pronounced peaks in the length compostions (Fig. 23).

The abundance and biomass indices of American plaice off West and East Greenland showed contrary trends. In comparison with the mean indices of the decade of the 80s, the most recent estimates of abundance and biomass decreased off West Greenland by 83 and 92 % while this stock became more abundant off East Greenland by factors of 2.7 and 1.3, respectively (Tab. 15 and 16, Fig. 24 and 25). A similar reversal was observed for the geographical distribution pattern of the stock. During the 80s, only 15 % of the stock abundance and 20 % of the biomass was distributed off East Greenland. During the 90s, both estimates increased to 57 % and 71 %, respectively. The fish off West Greenland were generally smaller as compared to East Greenland (Fig. 26). Based on the mean of the 80s, the aggregated individual weight for both surey areas off West and East Greenland decreased by 19 %. The loss of individual weight was also more pronouced off West (51 %) than off East Greenland (35%). During 1995-96, the length composition remained relatively unchanged with the bulk of fish at the sizes of 15 to 30 cm.

The comparison of the proportions of the Atlantic wolffish stock distributed off West and East Greenland resulted in significant shifts. During the decade of the 80s, 43 % of the stock abundance and 33 % of the biomass were found off East Greenland (Tab. 17 and 18, Fig. 28 and 29). Since 1990, the East Greenland proportions increased to 60 % and 70 %, respectively. These geographical shifts in stock distribution were due to abundance and biomass increases off East Greenland by a factor of 2.3 and 1.1 in comparison with the

average indices observed during the 80s. For West Greenland, a decrease for both abundance and biomass off West Grennland by 44 % and 84 % was evident, the stronger decrease in biomass pointing to a pronounced reduction in fish size. The Atlantic wolffish off West Greenland lost 69 % in body weight while the fish off East Greenland lost only 38 % (Fig. 30). During the 90s, the Atlantic wolffish off West Greenland had a mean weight of 210 g only and were exceeded by the individuals off East Greenland by 140 g. The analysis of the length distributions in 1994, 1995, and 1996 revealed the dominance of small fish <30 cm (Fig. 31).

Spotted wolffish were caught rarely during the whole survey period, but abundance and biomass estimates decreased significantly off West Greenland by 80 % and 94 % when compared with the mean during the 80s (Tab. 19 and 20, Fig. 32 and 33). In contrast, the estimates of stock size increased off East Greenland by factors of 1.7 and 0.55 when comparing the most recent observation in 1996 with the means during the 80s, respectively. During the 90s, the majority of the fish were distributed off East Greenland, 67 % of stock abundance and 76 % of stock biomass. During the previous decade, the stock was found to be inversely partitioned with only 34 % of abundance and biomass off East Greenland. The mean individual weight decreased more pronounced off West Greenland (68 %). The fish off East Greenland lost only 46 % in body weight (Fig. 34). The length compositions in 1994, 1995 and 1996 were scattered due to small catches (Fig. 35).

During the decade of the 80s, the majority of starry skates were distributed off West Greenland, only 2 % of abundance and 8 % of biomass were found off East Greenland (Tab. 21 and 22, Fig. 36 and 37). During the 90s, the East Greenland proportions in abundance and biomass increased to 8 % and 36 % due to a pronounced decrease in stock size off West Greenland by 74 % and 91 % and an increase off East Greenland by factors of 1.9 and 0.4, respectively. Compared with the mean of the 80s, starry skates off West Greenland lost 67 % in body weight while the individuals off East Greenland were significantly bigger throughout the survey time and showed a 46 % reduction in individual weight (Fig. 38). The Figure 39 displays the scattered length compositions in the three most recent years with the bulk of the specimens being smaller than 30 cm (Fig. 39).

Table 24 lists mean near bottom temperatures by stratum and weighted means by stratum area, 1982-96. Respective values were illustrated in Figure 40. All years were characterized by high differences in mean temperatures ranging around 3 °C between strata. Most of the shallow strata (0-200 m) on the left hand panel in Figure 40 showed lower temperatures as compared with the mean and similar trends during the survey period, the weighted mean temperature being illustrated as bold lines. A very cold event around 2 °C was identifiable for the period 1982-84 followed by a warming of 2 °C to an overall mean of 4 °C. During 1987-89, a less pronounced cooling was observed. Subsequently, there was an increasing trend exceeding 3.5 °C in the most recent years. The estimated near bottom temperaure for 1996 indicated the warmest conditions of the entire survey period. In contrast to this trend, the temperature regime of the deep strata (201-400 m) appeared more constant and generally warmer than the mean, the only exception being stratum 7.2. A multiple linear correlation and regression model was formulated based on year, month, depth, latitude and longitude effects. All these variables were found to contribute significantly to the model and to explain 31 % of the variation in near bottom temperature. The highest regression weight was determined for the positive depth effect (deeper-warmer) followed by the negative effect of the longitude (western areas colder than eastern). The month and latitude effects were determined to be also negative (later in the year-colder; northern areas were colder than southern). In contrast, the year effect was positive pointing to a slightly increasing trend in the near bottom temperature troughout the past 15 years. The relevance of the temperature model is illustrated in Figure 41 showing the scattered plot of observed versus predicted values.

Discussion

Recent dramatic collapses of demersal fish stocks in the Northwest Atlantic and changes of harvesting strategies in terms of effort and target species require the implementation of ecological aspects into stock assessments. Such ecological aspects should cover biotic interactions, expoitation as well as environmental effects. Therefore, the present paper deals not only with one single fish stock but comprises trends in abundance, biomass and size composition of the eight most common fish species contributing more than 90 % of the overall fish ocurrence off West Greenland and East Greenland offshore down to 400 m in depth since 1982. Detailed comparisons between structures and changes in the demersal fish assemblage off West Greenland (NAFO Divisions 1B-1F) and East Greenland (ICES Sub-area XIV) were given together with temporal and geographical properties of the near bottom temperature regime.

The great majority of the fish species was rare and the fish community was mainly composed of very few boreal species. The differences between strata off Greenland based on their quantitative species compositions were found to be determined by geographical as well as depth effects. Deep strata appeared to have more similar species compositions and to be distinguished gradually from shallow strata. Furthermore, the West and East Greenland strata were also found to be identifyable. Inspite of these significant geographical and depth patterns

in the quantitative species composition of the individual strata, no clear indications of persistent delimitations or boundaries in the demersal fish assemblage off Greenland were determined. Geograhical and depth effects were also decisive for the species composition of the fish fauna inhabiting the shelf areas and continental slopes in the Antartic Weddell Sea (Hubold 1992). Measurements of species diversity and eveness indices in marine communities are highly dependent on the sample gear, sample size, and sample effort as well as taxonomic expertise and, therefore hardly comparable with results of different studies. However, the determined species diversity was found to range among similar magnitudes as observed for the subantarctic fish fauna around Elephant Island (Tiedtke and Kock, 1989) whereas the communities in the high Antarctic Weddell and Ross Sea and the Prydz Bay were substantially more divers (Schwarzbach, 1988; Hubold, 1992).

During the period 1982-96, survey results indicated fundamental shifts in species composition of the demersal fish assemblage inhabiting the shelf and continental slope off West and East Greenland down to 400 m in depth. These observations happened in coherence with dramatic changes in stock abundance, biomass and size structure for ecologically and economically important species. Compared with the mean stock sizes during the decade of the 80s, the decreases of cod, golden redfish (≥17 cm) and starry skates varied between 70 and almost 100 %. During the same period, American plaice displayed a less pronounced decrease and the stocks of Atlantic and spotted wolffish decreased in biomass but increased in abundance. The enormous increase of deep sea redfish (≥17 cm) and unspecified juvenile redfish (<17 cm) during the most recent years due to recruitment resulted in an compensatory increase in aggregated fish abundance and biomass by a factor of 5 and 0.5, respectively. Compared with the mean of the 80s, all stocks considered separately lost significantly in individual weight, the aggregated loss amounting to 78 %. Presently, these stocks were almost exclusively composed of small juveniles. Similar stock collapses and individual size reductions but without any clear indication for biomass compensation within the demersal fish community have been described for Divisions 2J3KL (Atkinson, 1994).

The geograhical differences between trends in fish abundance, biomass and individual size off West and East Greenland were pronounced. In comparison with the 80s, the aggregated fish biomass for all species off East Greenland almost doubled but decreased off West Greenland by 96 %. The aggregated fish abundance indices increased off East Greenland by a factor of 9 but decreased off West Greenland by 18 %. For the same period, a decrease in overall individual weight by 95 % was estimated for West Greenland while the fish off East Greenland showed a lower reduction by 77 %. Apart from Atlantic cod, golden redfish (≥17 cm), deep sea redfish (≥17 cm) and unspecified juvenile redfish (<17 cm), the other stocks of American plaice (Llorett, 1996), Atlantic and spotted wolffish and starry skate increased in abundane and biomass off East Greenland, while their components off West Greenland decreased. For Atlantic cod and golden redfish (≥17 cm), the loss in stock sizes was more pronounced off West Greenland, and the recent enormous stock increases of deep sea redfish (≥17 cm) and unspecified juvenile redfish (<17 cm) happened off East Greenland only. Furthermore, all demersal fish stocks assessed separately showed more pronounced size reductions off West than off East Greenland with juvenile redfish (<17 cm) being the only exception.

Positive effects in fish abundance, biomass and size observed recently were almost exclusively restricted to East Greenland and the negative effects were more pronounced off West Greenland where only 5 % of the fish were distributed. This fact indicated the presence of a highly selective process causing high mortality rates and affecting adversely the recruitment. The increased effort of the shrimp fishery on traditional fishing grounds off West Greenland (Hvingel 1996) might have acted as this process because the applied gear is suspected to select efficiently small sized fish and there was no fishing effort recently directed towards groundfish. The disadvantageous development and poor status of various fish stocks off West Greenland is consistent with the effort distribution of the Greenlandic shrimp fleet expending around 175,000 hours trawling per year without any selective device off West Greenland and only 15,000 hours off East Greenland (Hvingel et al. a and b, 1996). This suggestion is supported by the loss in fish abundance, biomass and decrease in individual size of fish species which are known to be stationary like flat and wolffishes (Riget and Messtorff, 1988). The finfish by-catch of a standard survey haul side by side with a shrimp trawler in 1994 amounted to 28 % in weight, although the different catch procedure of the shrimp fishery prevented direct comparisons (Rätz, 1995). Due to unknown natural mortality rates of juvenile fish during their first years of life it seemed impossible to analytically quantify the impact of the shrimp fishery off West Greenland on the recruitment of demersal fish stocks even with the knowledge of by-catch figures.

Almost all shallow strata showed the same trend in near bottom temperature close to the swept area of the fishing stations. This trend was characterized by a very cold event in 1982-84, warmer conditions in 1985-86, a decreasing trend in 1987-89 and warming since then. The 1996 measurements were the highest of the past 15 years and indicated a contiuned positive trend. These findings were in agreement with the description of the climatic conditions around Greenland as derived from air tempertures and oceanographic standard sections (Stein, 1996). However, near bottom temperatures were found to differ between strata, the difference ranging

around 3 °C. In general, deeper, eastern and southern strata were warmer throughout the time series. Furthermore, the significant time effects were negative for the month and positve for the year of observation. The formulated multiple linear model of the near bottom temperature based on year, month, depth, latitude and longitude effects explained 31 % of the variation in temperature. The average or warmer near bottom temperatures during the 90s did not indicate any unfavorable environmental conditions for fish growth or reproduction.

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Table 1 Trawl parameters of the survey.

Gear	140-feet bottom trawl
Horizontal net opening	22 m
Standard trawling speed	4.5 kn
Towing time	30 minutes
Coefficient of catchability	1.0

Table 2 Specification of strata.

Stratum	geographic boundaries south	north	east	west	depth (m)	area (nm^2)
1.1	64°15'N	67°00'N	50°00'W	57°00'W	1-200	6805
1.2	64°15'N	67°00'N	50°00'W	57°00'W	201-400	1881
2.1	62°30'N	64°15'N	50°00'W	55°00'W	1-200	2350
2.2	62°30'N	64°15'N	50°00'W	55°00'W	201-400	1018
3.1	60°45'N	62°30'N	48°00'W	53°00'W	1-200	1938
3.2	60°45'N	62°30'N	48°00'W	53°00'W	201-400	742
4.1	59°00'N	60°45'N	44°00'W	50°00'W	1-200	2568
4.2	59°00'N	60°45'N	44°00'W	50°00'W	201-400	971
5.1	59°00'N	63°00'N	40°00'W	44°00'W	1-200	2468
5.2	59°00'N	63°00'N	40°00'W	44°00'W	201-400	3126
6.1	63°00'N	66°00'N	35°00'W	41°00'W	1-200	1120
6.2	63°00'N	66°00'N	35°00'W	41°00'W	201-400	7795
7.1	64°45'N	67°00'N	29°00'W	35°00'W	1-200	92
7.2	64°45'N	67°00'N	29°00'W	35°00'W	201-400	4589
Σ						37463

Table 3 Numbers of valid hauls by stratum, West, East Greenland and total, 1982-96.

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ
1982	20	11	16	7	9	6	13	2	1	10	3	12	1	25	84	52	136
1983	26	11	25	11	17	5	18	4	3	19	10	36	0	18	117	86	203
1984	25	13	26	8	18	6	21	4	5	4	2	8	0	5	121	24	145
1985	10	8	26	10	17	5	21	4	5	21	14	50	0	28	101	118	219
1986	27	9	21	9	16	7	18	3	3	15	14	37	1	34	110	104	214
1987	25	11	21	4	18	3	21	3	19	16	13	40	0	18	106	106	212
1988	34	21	28	5	18	5	18	2	21	8	13	39	0	26	131	107	238
1989	26	14	30	9	8	3	25	3	17	18	12	29	0	11	118	87	205
1990	19	7	23	8	16	3	21	6	18	19	6	15	0	13	103	71	174
1991	19	11	23	7	12	6	14	5	8	11	10	28	0	16	97	73	170
1992	6	6	6	5	6	6	7	5	0	0	0	0	0	6	47	6	53
1993	9	6	9	6	10	8	7	0	9	6	6	18	0	14	55	53	108
1994	16	13	13	8	10	6	7	5	0	0	0	0	0	6	78	6	84
1995	0	0	3	0	10	7	10	5	8	6	6	17	0	12	35	49	84
1996	5	5	8	5	12	5	10	5	7	9	5	13	0	9	55	43	98
Σ	267	146	278	102	197	81	231	56	124	162	114	342	2	241	1358	985	2343

Table 4 List of taxa, ranked by species importance based on catch in numbers as illustrated in Figure 2 and catch in weight, 1982-96.

Rank	Taxa	Catch in Numbers	Per Cent	Catch in Weight (kg)	Per Cent
1	*Sebastes spp.* <17cm	1171291	35.4	26947	2.4
2	*Sebastes mentella* ≥17 cm	696299	21	160495.6	14.6
3	*Sebastes marinus* ≥17 cm	499428	15.1	296618.3	27
4	*Gadus morhua*	480902	14.5	503240.2	45.7
5	*Hippoglossoides platessoides*	154710	4.7	26469.1	2.4
6	*Mallotus villosus*	142482	4.3	2366.7	0.2
7	*Anarhichas lupus*	42063	1.3	21357.4	1.9
8	*Ammodytes spp.*	34086	1	748.4	0.1
9	*Raja radiata*	15351	0.5	4702.7	0.4
10	*Micromesistius poutassou*	10901	0.3	2103	0.2
11	*Artediellus spp.*	8277	0.2	139	0
12	*Rheinhardtius hippoglossoides*	8148	0.2	3449.7	0.3
13	*Trisopterus spp.*	7154	0.2	136	0
14	*Trisopterus murrayi*	5039	0.2	102.6	0
15	*Eumicrotremus spinosus*	3683	0.1	157.4	0
16	*Melanogrammus aeglefinus*	3300	0.1	820.7	0.1
17	*Lycodes spp.*	3243	0.1	216.9	0
18	*Hippoglossus hippoglossus*	2927	0.1	11630.5	1.1
19	*Anarhichas minor*	2572	0.1	11250.8	1
20	*Cottunculus spp.*	2307	0.1	102.4	0
21	*Myoxoscephalus spp.*	2048	0.1	414.9	0
22	*Macrourus berglax*	2046	0.1	1766.5	0.2
23	*Leptoclinus maculatus*	1990	0.1	14.8	0
24	*Argentina silus*	1827	0.1	1175.8	0.1
25	*Boreogadus saida*	1705	0.1	46.9	0
26	*Anarhichas denticulatus*	1079	0	11459.8	1
27	*Aspidophoroides monopterygus*	874	0	13.4	0
28	*Molva dipterygia*	731	0	1806.3	0.2
29	*Triglops pingeli*	673	0	13.8	0
30	*Brosme brosme*	662	0	710.3	0.1
31	*Leptagonus decagonus*	644	0	14.1	0
32	*Gadus ogac*	531	0	786.6	0.1
33	*Coryphaenoides rupestris*	531	0	255.6	0
34	*Icelus bicornis*	466	0	2.8	0
35	*Myxine glutinosa*	460	0	17.1	0
36	*Gymnelus viridis*	442	0	3.6	0
37	*Liparis spp.*	387	0	22.3	0
38	*Careproctus spp.*	357	0	18.8	0
39	*Cyclopterus lumpus*	311	0	961.6	0.1
40	*Onogadus argentatus*	226	0	13.3	0
41	*Raja fyllae*	155	0	46.9	0
42	*Sebastes viviparus*	117	0	18.5	0
43	*Raja spp.*	111	0	124.5	0
44	*Trisopterus esmarkii*	90	0	4	0
45	*Lumpenus lampretaeformis*	86	0	2.3	0
46	*Glyptocephalus cynoglossus*	61	0	23.8	0
47	*Myctophidae spp.*	58	0	1	0
48	*Serrivomer beani*	39	0	1.9	0
49	*Somniosus microcephalus*	21	0	7343.5	0.7
50	*Pollachius virens*	20	0	129.5	0
51	*Paraliparis spp.*	20	0	1.6	0
52	*Raja lintea*	20	0	16.2	0
53	*Onogadus ensis*	12	0	0.2	0
54	*Squalus acanthias*	11	0	21.3	0
55	*Molva molva*	11	0	25.2	0
56	*Eumesogrammus praeciosus*	10	0	0.7	0
57	*Bathyraja spinicauda*	10	0	55	0
58	*Stomias boa*	6	0	0.2	0
59	*Notacanthus chemnitzii*	4	0	10.6	0
60	*Rhinonemus cimbrius*	3	0	0.1	0
61	*Chauliodus sloani*	3	0	0.2	0
62	*Raja bathyphila*	3	0	20.2	0
63	*Microstomus kitt*	2	0	1.3	0
64	*Pholis gunellus*	2	0	0.1	0
65	*Centroscyllium farbicii*	1	0	0.2	0
66	*Nemichthys scolopaceus*	1	0	0.1	0
Σ		3313030	100	1100421.5	99.9

Table 5 Diversity and eveness indices by stratum based on mean species composition, 1982-86

Stratum	Diversity	Eveness
1.1	2.113	3.553
1.2	1.378	3.784
2.1	1.435	3.611
2.2	1.897	3.807
3.1	1.362	3.466
3.2	2.006	3.829
4.1	1.546	3.401
4.2	0.928	3.367
5.1	0.382	3.401
5.2	0.659	3.638
6.1	0.826	3.466
6.2	0.897	3.497
7.1	-	-
7.2	1.441	3.761

Table 6 Abundance (1,000), biomass (tons) indices and mean individual weight (kg) aggregated for all fish species off West, East Greenland and total, 1982-96. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

	Abundance			Biomass			Mean Ind. Weight		
Year	West	East	Total	West	East	Total	West	East	Total
1982	352616	658706	1011322	266146	449802	715948	0.755	0.683	0.708
1983	244248	551135	795383	160329	522124	682453	0.656	0.947	0.858
1984	180404	207169	387573	71985	126314	198299	0.399	0.610	0.512
1985	239333	1506988	1746321	86761	277447	364208	0.363	0.184	0.209
1986	600868	707448	1308316	147124	430107	577231	0.245	0.608	0.441
1987	1301487	914311	2215798	686212	387093	1073305	0.527	0.423	0.484
1988	884305	525890	1410195	652776	316509	969285	0.738	0.602	0.687
1989	491261	654100	1145361	359753	437324	797077	0.732	0.669	0.696
1990	223097	913629	1136726	52888	278120	331008	0.237	0.304	0.291
1991	275449	1180593	1456042	18769	448608	467377	0.068	0.380	0.321
1992	194756	108910	303666	11155	39013	50168	0.057	0.358	0.165
1993	150061	8146016	8296077	6555	452251	458806	0.044	0.056	0.055
1994	126677	164907	291584	8196	21150	29346	0.065	0.128	0.101
1995	127282	5778887	5906169	3870	475162	479032	0.030	0.082	0.081
1996	442702	7362729	7805431	13206	979951	993157	0.030	0.133	0.127

Table 7 Abundance indices (1,000) by year, stratum, West and East Greenland and total for Atlantic cod (*Gadus morhua*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	5092	729	47957	1888	15114	3706	17790			468		6173		1449	92276	8090	100366	28
1983	431	467	16013	5170	14881	2326	10916			2228	1274	2276		2213	50204	7991	58195	25
1984	377	179	4714	171	5201	689	5353		4063			1750		790	16684	6603	23287	32
1985	19630	2428	13222	4395	10531	1638	7499		3564	373	3978	3348		1141	59343	12404	71747	33
1986	32438	1236	50908	229	37446	1321	22104			780	6950	6676		828	145682	15234	160916	32
1987	330944	1651	248002		154681		51114		18317	9832	6527	6081		878	786392	41635	828027	59
1988	92024	2423	338740	84935	47336	89	60946		7985	8085	2060	4375		1083	626493	23588	650081	48
1989	2497	920	27930	673	261502		65203		30906	38407	11600	9383		1436	358725	91732	450457	59
1990	965	513	4155	362	6014		10303	12213	4956	2524	4533	9041		4200	34525	25254	59779	43
1991	268	205	180	152	1027	611	1839	523	2343	1786	779	1958		3541	4805	10407	15212	29
1992	552	622	117	137	121	74	151	269						658	2043	658	2701	50
1993	566	457	176	127	80	31	0		1252	98	922	502		527	1437	3301	4738	36
1994	206	103	33	33	72	23	82	22						801	574	801	1375	36
1995					138	67	58	15	265	78	2933	3654		257	278	7187	7465	93
1996	152	126	76	38	121	0	298	0	290	0	260	382		515	811	1447	2258	38

Table 8 Biomass indices (t) by year, stratum, West and East Greenland and total for Atlantic cod (*Gadus morhua*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	2378	307	63684	2632	20319	8745	30426			1927		14563		7127	128491	23617	152108	25
1983	353	205	20215	7827	22806	9594	21374			6147	3512	11344		13154	82374	34157	116531	25
1984	824	234	7508	234	7218	1055	8493		10397			4110		5237	25566	19744	45310	34
1985	2528	251	12869	2351	10731	990	5952		7073	1356	9955	9437		5744	35672	33565	69237	39
1986	10641	484	26098	80	28510	1423	19483			2645	18631	16543		3366	86719	41185	127904	26
1987	283591	545	200632		116610		37210		10315	9054	9291	17616		5316	638588	51592	690180	63
1988	94175	1367	333848	77967	44593	93	55945		8750	18204	6162	16258		3572	607988	52946	660934	46
1989	727	228	25829	441	231239		75386		40614	127865	34957	31324		4786	333850	239546	573396	46
1990	224	114	3552	190	5778		13185	11388	9229	6813	12954	24408		12560	34431	65964	100395	34
1991	91	72	73	45	1208	589	2621	451	4236	5779	1263	7467		14006	5150	32751	37901	36
1992	135	195	23	36	21	14	81	102						1216	607	1216	1823	69
1993	135	88	49	33	44	10	0		862	60	1742	1076		1860	359	5600	5959	41
1994	27	33	6	23	23	11	4	13						2792	140	2792	2932	68
1995					26	13	11	7	93	185	1115	13750		382	57	15525	15582	155
1996	23	64	23	20	51	0	192	0	167	0	755	1004		1673	373	3599	3972	56

Table 9 Abundance indices (1,000) by year, stratum, West and East Greenland and total for golden redfish ≥17 cm (*Sebastes marinus*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	7015	6340	88792	5512	5736	14876	4087			195798		312132		38899	132358	546829	679187	55
1983	4025	3186	3355	6523	4043	5885	1697			140766	453	264813		14365	28714	420397	449111	53
1984	1324	3438	460	1209	10671	2776	4214		6888			47974		9890	24092	64752	88844	65
1985	4658	10451	6158	1569	3220	14441	4973		78118	32397	1787	141500		25944	45470	279746	325216	52
1986	6327	4324	2077	3483	21503	2883	2717			124613	470	298706		22234	43314	446023	489337	53
1987	906	653	1327		9612		659		50961	9422	245	507387		27920	13157	595935	609092	39
1988	831	2239	342	2255	5938	1954	731		3012	5015	148	132458		34352	14290	174985	189275	54
1989	421	422	776	690	6489		361		4003	33320	625	110663		76934	9159	225545	234704	60
1990	120	433	279	709	1038		146	2271	14974	72316	391	653009		37483	4996	778173	783169	75
1991	227	256	96	691	236	527	21	1671	1385	13237	172	64692		28201	3725	107687	111412	51
1992	126	106	73	190	193	477	192	835						32622	2192	32622	34814	151
1993	169	481	59	267	80	132	0		175	6043	77	54424		4170	1188	64889	66077	93
1994	111	325	156	167	65	46	151	247						3348	1268	3348	4616	41
1995					51	67	38	146	346	1521	153	38892		2060	302	42972	43274	97
1996	152	267	22	244	381	383	29	298	647	3145	494	21110		2366	1776	27762	29538	47

Table 10 Biomass indices (t) by year, stratum, West and East Greenland and total for golden redfish ≥17 cm (*Sebastes marinus*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	1798	1354	34440	2558	3206	9794	2532			155971		194379		30115	55682	380465	436147	54
1983	846	945	1572	3042	1873	4815	1084			161687	269	229541		15607	14177	407104	421281	61
1984	308	894	196	519	4935	2284	2089		3601			21281		12052	11225	36934	48159	55
1985	1020	1819	2968	472	1427	9209	2718		8613	22453	1317	65299		23762	19633	121444	141077	35
1986	1282	1215	752	1229	10122	1705	1762			43119	382	213268		24368	18067	281137	299204	38
1987	255	247	660		4954		438		9539	5346	106	230844		19327	6554	265162	271716	38
1988	146	404	118	942	2570	1342	382		1092	4930	68	98131		48262	5904	152483	158387	60
1989	182	137	272	249	2619		209		970	14920	442	54589		34360	3668	105281	108949	47
1990	39	149	75	275	479		79	1343	6761	27245	154	130530		14723	2439	179413	181852	45
1991	44	83	24	226	120	273	3	1007	725	10631	120	34265		62979	1780	108720	110500	98
1992	18	35	20	61	53	241	70	447						12076	945	12076	13021	130
1993	46	112	19	114	39	55	0		75	1377	30	20179		2899	385	24560	24945	68
1994	34	146	48	64	26	35	40	80						1540	473	1540	2013	38
1995					19	19	20	43	114	712	51	8896		1141	101	10914	11015	38
1996	64	102	4	60	128	118	8	132	139	1714	196	10855		1408	616	14312	14928	40

Table 11 Abundance indices (1,000) by year, stratum, West and East Greenland and total for deep sea redfish ≥17 cm (*Sebastes mentella*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	0	390	17	348	0	2360	0			9275		19370		58822	3115	87467	90582	65
1983	40	1011	70	2528	0	5236	0			15820	0	42393		28378	8885	86591	95476	42
1984	41	2967	7	1276	0	1115	0		18			34633		76541	5406	111192	116598	93
1985	0	369	31	27	55	328	0		34904	16909	105	38689		81487	810	172094	172904	47
1986	2141	414	38	292	5	444	0			6932	27	76655		67172	3334	150786	154120	36
1987	987	13679	42		56		0		0	18340	64	7182		62458	14764	88044	102808	45
1988	150	3187	25	777	60	4619	0		22025	28158	74	176639		25344	8818	252240	261058	58
1989	0	186	9	102	0		8		847	3067	0	72046		222281	305	298241	298546	60
1990	0	10	4	705	50		0	3881	329	12453	2354	13513		16046	4650	44695	49345	43
1991	0	0	0	0	0	652	0	1773	0	10707	46	724504		234748	2425	970005	972430	81
1992	0	35	0	15	0	106	0							60064	156	60064	60220	165
1993	0	24	0	159	7	0	0	0	62	3528	140	1258376		121927	190	1384033	1384223	86
1994	0	271	20	95	94	162	0	36						77891	678	77891	78569	168
1995					29	234	96	1468	265	24463	1173	2394064		83314	1827	2503279	2505106	55
1996	1527	619	0	236	0	1921	29	7135	396	176448	1215	4246101		75011	11467	4499171	4510638	64

Table 12 Biomass indices (t) by year, stratum, West and East Greenland and total for deep sea redfish ≥17 cm (*Sebastes mentella*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	0	96	6	114	0	893	0			5178		4843		22795	1109	32816	33925	68
1983	16	213	26	1158	0	2857	0			8701	0	21047		12747	4270	42495	46765	47
1984	6	798	4	490	0	472	0		2			12786		35202	1770	47990	49760	97
1985	0	96	15	11	27	110	0		2960	7169	40	17011		38533	259	65713	65972	35
1986	223	39	20	110	3	179	0			3943	15	29277		31333	574	64568	65142	36
1987	84	1184	9		31		0		0	4891	17	2328		23264	1308	30500	31808	46
1988	20	425	21	159	45	1878	0		3542	10166	9	55838		11607	2548	81162	83710	56
1989	0	23	7	15	0		1		90	655	0	21151		45452	46	67348	67394	63
1990	0	5	2	87	7		0	542	62	2741	329	1961		3275	643	8368	9011	44
1991	0	0	0	0	0	153	0	445	0	2959	30	211468		69454	598	283911	284509	80
1992	0	3	0	2	0	28	0							19856	33	19856	19889	160
1993	0	5	0	23	2	0	0	0	34	493	19	194675		34102	30	229323	229353	61
1994	0	31	3	10	12	25	0	3						7122	84	7122	7206	128
1995					5	25	10	159	29	2859	207	355946		16505	199	375546	375745	52
1996	5	55	0	19	0	235	4	689	13	24445	124	837222		14503	1007	876307	877314	59

Table 13 Abundance indices (1,000) by year, stratum, West and East Greenland and total for juvenile redfish <17 cm (*Sebastes spp.*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	1057	358	121	27	8	42	22			152		607		1553	1635	2312	3947	44
1983	3956	505	14	138	9	17	21			92	8	1709		859	4660	2668	7328	56
1984	5021	3714	20	219	141	28	14		129			693		206	9157	1028	10185	67
1985	4889	9615	54	2712	47	67	55		817414	149899	210	5068		98	17439	972689	990128	164
1986	10740	237636	113	1811	54	218	38			2651	69	12312		5757	250610	20789	271399	168
1987	12455	113990	4		20		18		2343	2580	132	8961		123715	126487	137731	264218	87
1988	19679	42481	0	107	20	139	0		1579	2983	896	13064		18457	62426	36979	99405	41
1989	7717	13160	3071	5370	18	0	69		1331	3171	150	4274		2155	29405	11081	40486	36
1990	11256	35932	15417	1538	73	0	6199	848	2267	3183	482	13708		4358	71263	23998	95261	52
1991	51939	59845	34871	22668	13692	2508	892	1541	45453	3051	209	1708		622	187956	51043	238999	38
1992	25715	19084	12691	17277	17463	13973	41	13718						1373	119962	1373	121335	54
1993	5460	39035	664	11331	355	2773	14		3401243	2403634	244	810639		6009	59632	6621769	6681401	111
1994	3405	12002	9827	4013	1189	1731	10843	9867						57889	52877	57889	110766	95
1995					399	10236	855	34694	274128	2671933	4072	188899		3061	46184	3142093	3188277	106
1996	457	14357	5210	9377	26961	11571	2488	107237	405272	223348	1373189	2423		3071	177658	2007303	2184961	98

Table 14 Biomass indices (t) by year, stratum, West and East Greenland and total for juvenile redfish <17 cm (*Sebastes spp.*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	37	13	6	1	0	2	1			11		36		72	60	119	179	41
1983	103	21	1	6	0	1	1			5	0	73		17	133	95	228	51
1984	91	104	1	5	5	1	1		4			19		9	208	32	240	71
1985	82	367	2	58	2	3	1		15335	7129	6	200		5	515	22675	23190	142
1986	454	6645	3	77	2	6	1			123	3	218		73	7188	417	7605	168
1987	265	5021	0		1		0		147	137	4	288		6502	5287	7078	12365	93
1988	218	1491	0	4	1	5	0		67	144	42	618		1414	1719	2285	4004	56
1989	111	270	22	49	0	0	1		81	167	7	317		135	453	707	1160	42
1990	99	369	63	20	0	0	9	2	67	118	20	833		268	562	1306	1868	58
1991	198	797	73	242	29	24	2	15	563	94	4	63		34	1380	758	2138	46
1992	152	385	49	111	74	220	1	65						18	1057	18	1075	54
1993	72	512	17	265	6	77	1		51857	75676	12	48523		260	950	176328	177278	90
1994	26	216	55	57	30	64	141	277						2704	866	2704	3570	132
1995					6	330	10	347	3834	40792	46	9749		190	693	54611	55304	97
1996	3	285	13	117	91	297	19	3301	5840	10853	26882	135		171	4126	43881	48007	96

Table 15 Abundance indices (1,000) by year, stratum, West and East Greenland and total for American plaice (*Hippoglossoides platessoides*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	31584	5093	29597	5735	2844	2133	1042			912		1094		2939	78028	4945	82973	30
1983	46602	6481	55494	2870	2725	461	811			1095	210	2787		7268	115444	11360	126804	49
1984	18250	6258	53765	4366	2929	2244	1793		1311			2809		3812	89605	7932	97537	43
1985	21387	5973	22820	6186	2632	239	3162		1884	2823	422	7029		5966	62399	18124	80523	23
1986	22038	11393	58741	9556	2937	2388	4462			1817	186	10365		5105	111515	17473	128988	39
1987	23322	3314	26226		2356		1030		2415	5636	293	6758		2700	56248	17802	74050	26
1988	10963	3475	8026	5698	3565	799	1036		417	1638	180	8629		2807	33562	13671	47233	19
1989	9371	4454	11363	3775	8764	0	1445		722	637	304	4605		3652	39172	9920	49092	28
1990	8617	6464	8227	2614	1083	0	1492	605	995	1994	440	6417		5613	29102	15459	44561	25
1991	7826	4536	5168	1899	1517	639	1249	952	1327	3913	1240	8895		6964	23786	22339	46125	18
1992	8529	4997	3019	2704	1233	1707	1743	174						6696	24106	6696	30802	28
1993	5856	3284	1202	1213	631	694	398		1734	3996	1111	17920		4991	13278	29752	43030	17
1994	2212	3524	1488	1514	624	282	1661	189						2490	11494	2490	13984	21
1995					892	1190	1019	785	1293	3840	1557	21976		4249	3886	32915	36801	18
1996	3718	1337	956	1424	1946	772	1566	472	3549	4366	5842	25777		6773	12191	46307	58498	17

Table 16 Biomass indices (t) by year, stratum, West and East Greenland and total for American plaice (*Hippoglossoides platessoides*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	6048	947	7797	1151	919	376	156			265		211		682	17394	1158	18552	32
1983	7450	1154	11772	607	1008	88	166			340	53	747		2191	22245	3331	25576	41
1984	1704	761	8663	807	607	387	365		240			571		941	13294	1752	15046	45
1985	1940	601	3862	1062	520	49	321		329	654	68	1034		1596	8355	3681	12036	22
1986	2149	1147	8429	1385	703	452	460			844	45	2621		1867	14725	5377	20102	30
1987	3129	338	5470		645		228		992	1103	62	1245		799	9810	4201	14011	30
1988	919	293	1699	808	814	137	236		79	436	28	1586		752	4906	2881	7787	20
1989	520	296	1477	371	2120	0	288		110	115	54	847		737	5072	1863	6935	40
1990	393	397	1220	314	213	0	287	221	180	423	75	1073		918	3045	2669	5714	22
1991	349	399	487	260	265	125	188	172	213	1423	262	1748		1571	2245	5217	7462	18
1992	582	419	229	183	151	250	152	25						1063	1991	1063	3054	26
1993	324	222	83	102	67	71	26		174	418	159	2386		850	895	3987	4882	17
1994	145	416	134	143	64	34	109	28						631	1073	631	1704	25
1995					70	154	123	58	134	524	246	3275		835	405	5014	5419	21
1996	214	100	67	164	158	78	149	38	316	521	1195	3987		1163	968	7182	8150	22

Table 17 Abundance indices (1,000) by year, stratum, West and East Greenland and total for Atlantic wolffish (*Anarhichas lupus*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	11113	2956	3457	2318	1821	458	946			830		486		604	23069	1920	24989	23
1983	7570	3186	1720	485	1472	211	785			449	172	915		1831	15429	3367	18796	24
1984	5774	1278	1542	186	1382	111	750		1237			2807		2747	11023	6791	17814	27
1985	5372	2718	1420	369	955	999	906		1995	2645	386	3476		4249	12739	12751	25490	19
1986	4960	1705	1968	635	1500	512	811			1645	347	2444		6843	12091	11279	23370	19
1987	5326	1644	888		1023		686		4481	3648	638	4265		6925	9567	19957	29524	15
1988	4927	1833	892	449	1136	555	705		1825	4956	271	2797		4207	10497	14056	24553	21
1989	3672	674	1668	516	2900		1130		1249	2014	471	1639		3684	10560	9057	19617	21
1990	3511	1076	1980	295	1899		1048	606	2114	1182	622	2042		5336	10415	11296	21711	17
1991	2841	1011	967	756	2592	639	563	494	3232	2562	448	1625		2275	9863	10142	20005	21
1992	3013	375	1509	937	3360	916	947	2107						5437	13164	5437	18601	26
1993	4724	1713	703	425	573	326	384		1231	5380	112	5379		4452	8848	16554	25402	28
1994	1543	1197	1725	567	1225	153	4516	1046						5523	11972	5523	17495	48
1995					1349	563	528	705	2043	3976	601	5901		5051	3145	17572	20717	26
1996	713	943	253	381	2574	622	797	1076	4815	4210	1299	13100		8814	7359	32238	39597	21

Table 18 Biomass indices (t) by year, stratum, West and East Greenland and total for Atlantic wolffish (*Anarhichas lupus*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	9910	2974	5202	3926	2274	475	1241			854		202		207	26002	1263	27265	31
1983	3663	3441	2085	471	1770	271	1087			368	65	519		921	12788	1873	14661	31
1984	3089	673	1284	190	820	72	870		600			1211		754	6998	2565	9563	24
1985	1836	1134	1019	199	581	557	633		698	1329	65	1108		2155	5959	5355	11314	17
1986	1784	912	1440	434	973	458	768			794	97	988		3730	6769	5609	12378	16
1987	2192	520	574		1049		615		1625	1705	83	1688		4509	4950	9610	14560	16
1988	1104	384	798	299	881	340	697		848	1804	39	791		2559	4503	6041	10544	16
1989	689	222	620	247	1749		1037		436	900	134	800		1689	4564	3959	8523	19
1990	710	177	497	111	655		660	321	799	649	135	550		1897	3131	4030	7161	16
1991	457	165	160	161	675	149	249	214	1208	679	159	621		956	2230	3623	5853	20
1992	437	79	321	237	832	201	231	631						2221	2969	2221	5190	27
1993	647	315	101	80	130	67	108		403	1236	22	1125		1446	1448	4232	5680	22
1994	214	209	376	97	285	26	865	171						2291	2243	2291	4534	43
1995					248	69	131	113	592	793	101	2610		1809	561	5905	6466	25
1996	64	262	43	68	487	114	169	238	1231	972	412	4611		2452	1445	9678	11123	19

Table 19 Abundance indices (1,000) by year, stratum, West and East Greenland and total for spotted wolffish (*Anarhichas minor*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	382	154	352	152	129	14	325			105		49		124	1508	278	1786	29
1983	186	38	148	4	90	39	368			49	38	81		153	873	321	1194	32
1984	183	60	176	14	89	23	243		55			292		172	788	519	1307	30
1985	204	114	105	4	30	61	110		19	50	57	76		313	628	515	1143	33
1986	481	203	109	38	68	16	117			70	12	55		409	1032	546	1578	22
1987	306	211	63		129		238		107	102	32	131		248	947	620	1567	28
1988	232	151	44	15	145	33	315		220	44	26	112		172	935	574	1509	25
1989	245	131	50	25	281		112		92	65	7	10		297	844	471	1315	34
1990	107	201	38	19	100		151	6	118	142	56	175		211	622	702	1324	27
1991	335	141	27	33	54	5	76	51	173	43	13	115		129	722	473	1195	27
1992	42	47	15	107	36	23	14	29						200	313	200	513	63
1993	85	223	49	51	36	17	69		51	0	0	146		405	530	602	1132	35
1994	63	108	61	62	22	9	27	7						1259	359	1259	1618	79
1995					14	4	19	0	69	19	14	120		787	37	1009	1046	72
1996	0	56	55	38	18	11	0	7	66	117	25	179		916	185	1303	1488	45

Table 20 Biomass indices (t) by year, stratum, West and East Greenland and total for spotted wolffish (*Anarhichas minor*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	2195	470	1897	826	532	42	1989			409		90		179	7951	678	8629	43
1983	1674	256	656	6	562	183	2357			200	201	417		1007	5694	1825	7519	37
1984	848	196	1036	16	447	55	1358		316			1539		529	3956	2384	6340	34
1985	13	118	570	0	134	307	681		779	172	98	369		702	1823	2120	3943	44
1986	1155	307	567	63	371	35	1004			239	48	360		1312	3502	1959	5461	27
1987	654	125	334		1029		2035		1090	512	264	529		954	4177	3349	7526	29
1988	137	85	194	87	1141	101	3011		2007	177	151	756		674	4756	3765	8521	38
1989	373	32	168	40	1382		847		519	485	70	27		855	2842	1956	4798	36
1990	83	82	199	7	666		1216	3	859	576	128	1153		616	2256	3332	5588	31
1991	28	30	2	9	251	5	723	179	1547	239	55	663		195	1227	2699	3926	41
1992	7	6	0	7	30	4	36	35						1109	125	1109	1234	104
1993	65	40	16	33	34	17	210		283	0	0	194		843	415	1320	1735	43
1994	29	25	74	26	10	2	142	3						1772	311	1772	2083	76
1995					67	40	219	0	432	1	48	350		1550	326	2381	2707	64
1996	0	137	33	42	38	8	0	10	468	150	89	276		2460	268	3443	3711	68

Table 21 Abundance indices (1,000) by year, stratum, West and East Greenland and total for starry skate (*Raja radiata*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	5385	1625	1412	473	556	83	163			0		0		172	9697	172	9869	38
1983	4798	589	816	360	350	28	59			0	0	0		0	7000	0	7000	87
1984	2740	1673	653	505	149	481	114		37			146		309	6315	492	6807	42
1985	2241	2393	1846	689	397	56	256		0	0	0	18		166	7878	184	8062	44
1986	2178	2807	766	326	295	131	203			0	0	39		177	6706	216	6922	46
1987	1792	537	653		290		64		10	29	3	22		181	3336	245	3581	30
1988	3879	1046	995	769	334	39	85		4	44	0	37		73	7147	158	7305	39
1989	11966	2141	3860	694	607		150		11	0	0	30		187	19418	228	19646	38
1990	7142	1981	2489	548	272		549	345	10	49	7	0		489	13326	555	13881	51
1991	1970	480	1220	261	610	130	96	65	12	53	25	73		97	4832	260	5092	26
1992	4456	598	2843	1531	496	523	206	58						200	10711	200	10911	50
1993	2263	352	684	279	189	264	96		0	78	14	97		196	4127	385	4512	39
1994	2529	379	872	271	232	79	398	15						1059	4775	1059	5834	43
1995					181	301	115	15	0	0	7	34		315	612	356	968	59
1996	1273	126	429	76	115	111	58	29	53	26	25	179		324	2217	607	2824	29

Table 22 Biomass indices (t) by year, stratum, West and East Greenland and total for starry skate (*Raja radiata*), 1982-96. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ East	Σ	CI
1982	2992	810	1328	340	409	58	154			0		0		182	6091	182	6273	36
1983	969	193	703	132	332	27	58			0	0	0		0	2414	0	2414	34
1984	731	334	403	96	136	126	94		19			153		307	1920	479	2399	31
1985	494	427	803	181	159	46	57		0	0	0	23		217	2167	240	2407	23
1986	517	526	421	84	122	64	40			0	0	52		242	1774	294	2068	28
1987	415	149	306		185		12		20	45	1	11		221	1067	298	1365	29
1988	654	123	502	238	175	19	34		0	66	0	14		88	1745	168	1913	28
1989	2077	429	979	107	314		90		1	0	0	6		256	3996	263	4259	31
1990	977	263	528	56	91		113	201	0	24	0	0		610	2229	634	2863	45
1991	278	80	182	36	245	42	11	33	1	3	1	88		94	907	187	1094	28
1992	328	93	138	135	222	89	23	27						290	1055	290	1345	49
1993	343	88	82	31	29	24	3		0	2	0	61		177	600	240	840	28
1994	229	72	142	30	91	14	55	11						1315	644	1315	1959	62
1995					70	37	40	0	0	0	0	23		270	147	293	440	75
1996	95	24	38	23	21	16	9	13	18	6	1	113		194	239	332	571	44

Table 23 Number of temperature measurements by stratum and total, 1982-96.

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Σ West	Σ Eeast	Σ
1982	20	11	16	7	9	6	13	2	0	0	0	3	0	5	84	8	92
1983	26	11	25	11	17	5	18	4	1	6	3	14	0	7	117	31	148
1984	23	10	18	7	13	4	16	4	4	4	2	7	0	3	95	20	115
1985	10	8	26	10	17	5	21	4	5	21	14	49	0	28	101	117	218
1986	27	9	16	7	16	7	18	3	3	15	14	37	1	34	103	104	207
1987	25	11	21	4	18	3	21	3	4	6	3	16	0	7	106	36	142
1988	34	20	28	5	18	5	16	2	17	8	5	36	0	24	128	90	218
1989	23	10	23	8	3	2	22	3	13	11	9	23	0	11	94	67	161
1990	15	6	23	7	14	3	17	4	15	15	6	15	0	11	89	62	151
1991	16	9	21	5	12	4	13	1	0	0	0	0	0	0	81	0	81
1992	6	6	6	5	6	5	6	4	0	0	0	0	0	5	44	5	49
1993	9	6	8	6	10	8	7	0	8	5	6	18	0	14	54	51	105
1994	16	13	12	8	10	6	7	4	0	0	0	0	0	0	76	0	76
1995	0	0	3	0	10	7	10	5	8	6	6	17	0	12	35	49	84
1996	5	5	8	5	12	5	10	5	6	9	5	13	0	9	55	42	97
Σ	255	135	254	95	185	75	215	48	84	106	73	248	1	170	1262	682	1944

Table 24 Mean near bottom temperature (°C) by stratum and weighted total (by stratum area), 1982-96. Incomplete coverage of the survey area in 1982, 1984, 1991, 1992, and 1994!

Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Total
1982	2.54	3.627	1.953	3.1	3.256	3.633	2.623							4.6	3.138
1983	2.028	3.713	1.42	3.819	2.139	4.808	2.16			4.117		4		2.943	3.012
1984	1.365	2.79	1.617	3.886	2.462		2.519					4.129			2.698
1985	4.19	5.154	3.116	4.612	2.614	4.336	4.444		5.04	5.19	4.421	4.3		3.3	4.181
1986	3.669	4.393	4.014	5.073	4.203	5.066	4.102			4.796	4.042	4.516		3.347	4.136
1987	3.086	4.89	3.393		3.504		3.53			4.467		4.4		3.3	3.782
1988	2.548	4.328	3.034	4.956	4.228	5.234	4.333		4.479	4.56	4.298	4.578		3.792	3.958
1989	2.323	3.953	2.718	4.525			2.579		3.392	3.743	3.648	4.064		3.146	3.296
1990	2.497	3.922	3	4.809	3.421		2.516		4.395	4.57	3.252	4.019		3.025	3.46
1991	3.533	4.726	3.477	4.204	3.016		2.997								3.558
1992	3.9	4.418	2.911	4.457	2.985	4.691	1.938							3.472	3.49
1993	3.007	4.003	2.36	3.36	4.711	4.959	2.773		3.771	4.056	4.328	4.394		2.821	3.597
1994	2.914	4.436	3.747	4.641	3.848	5.109	3.773								3.62
1995					4.229	4.614	3.469	4.242	2.601	3.623	3.683	4.318		3.834	3.862
1996	4.614	5.506	4.414	5.688	5.61	5.7	5.057	5.732	4.505	5.129	5.32	4.903		2.848	4.709

Table 25 Parameters of a multiple linear correlation and regression model of near bottom temperature.

dependent variable: f()=near bottom temperure (°C)
independent variables: v=*year*
w=month
x=depth (m)
y=latitude (positive decimal)
z=longitude (negative decimal)

f(v,w,x,y,z)=-58.4364+0.0370v-0.3614w+0.0073x-0.1856y-0.0548z
n=1944, p<0.000000, r=0.55, r^2=0.31

Effect	Value	p-Level	Regression Weight
Intercept	-58.4364	0.000001	
Year	0.0370	0.000000	0.124176
Month	-0.3614	0.000000	-0.264087
Depth	0.0073	0.000000	0.553018
Latitude	-0.1856	0.000000	-0.280423
Longitude	-0.0548	0.000000	-0.325326

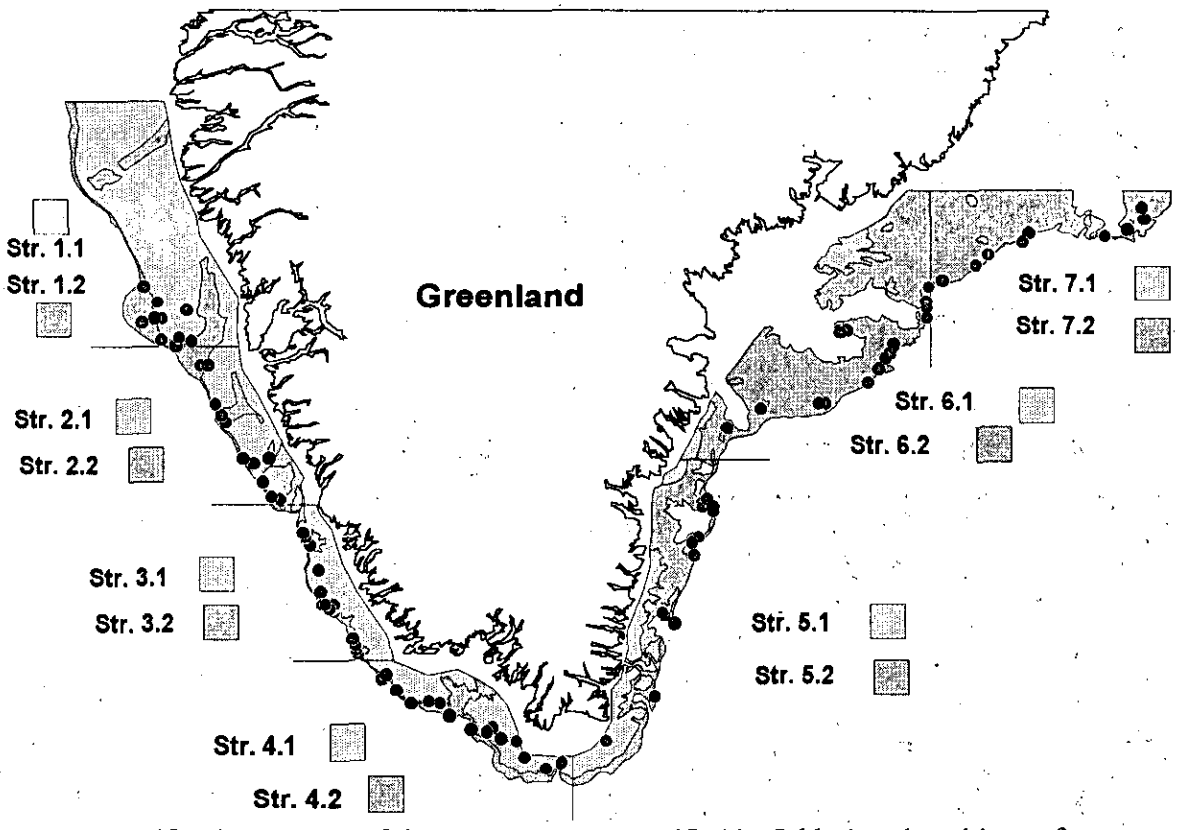

Fig. 1 Stratification scheme of the survey area as specified in Table 2 and positions of survey hauls in 1996.

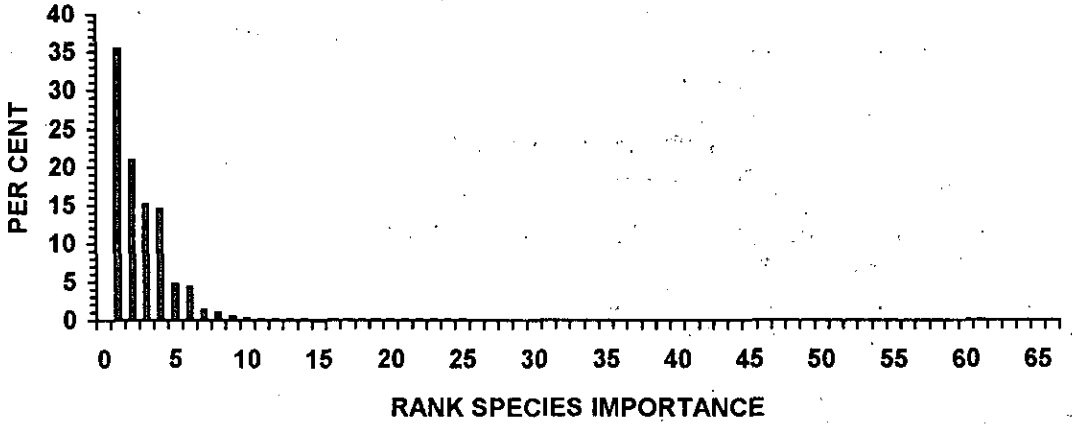

Fig. 2 Rank species importance in per cent of the total catch in numbers. Species were listed in Table 4 by rank order.

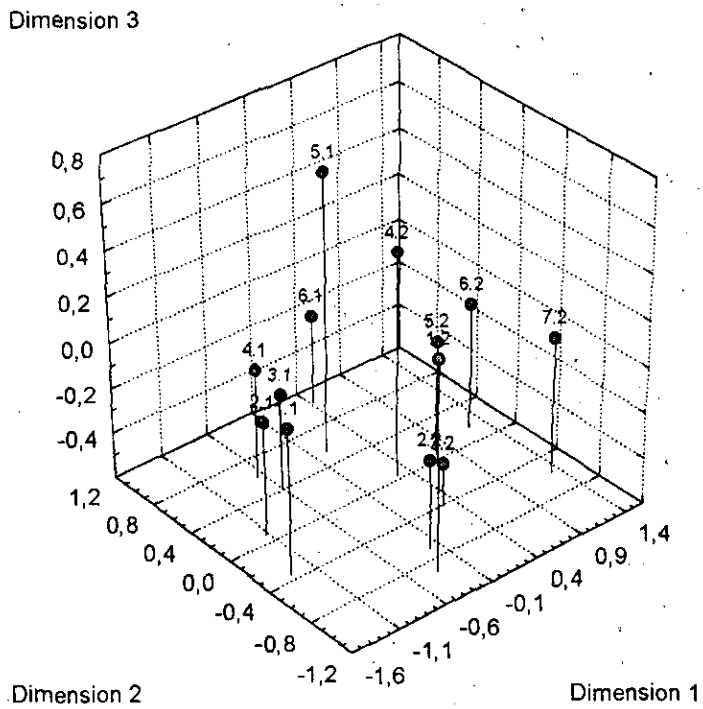

Fig. 3 Scatter plot of distances between strata (multidimensional scaling) based on log-transformed mean species composition, 1982-96. Distances were calculated applying the coefficient of Euclidean Distance.

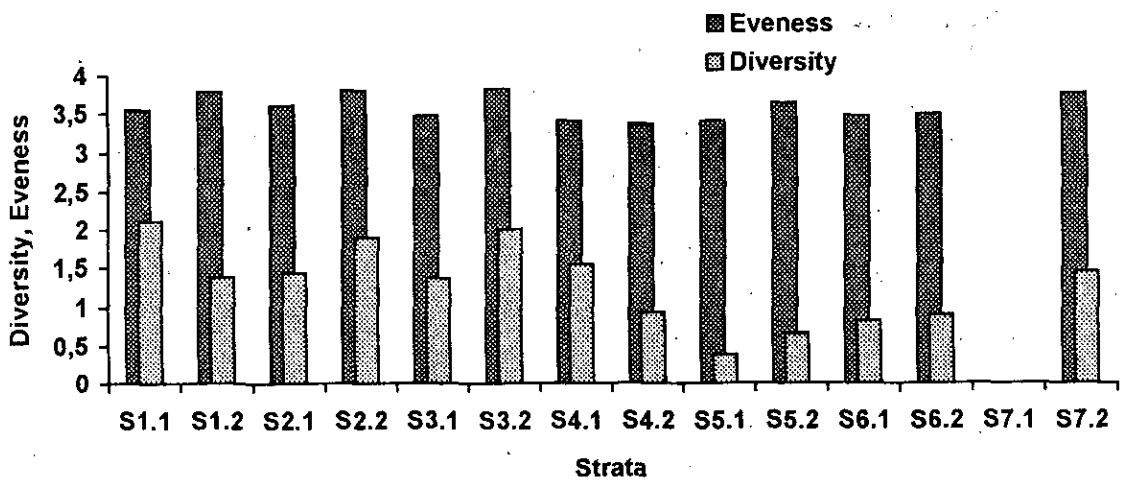

Fig. 4 Diversity and eveness indices by stratum based on mean species composition as listed in Table 5, 1982-96.

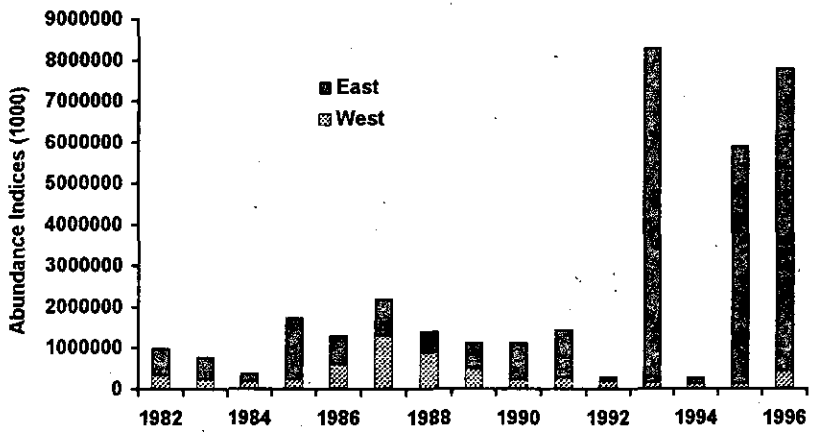

Fig. 5 Abundance indices off West, East Greenland and total for all fish species aggregated as listed in Table 6, 1982-96. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

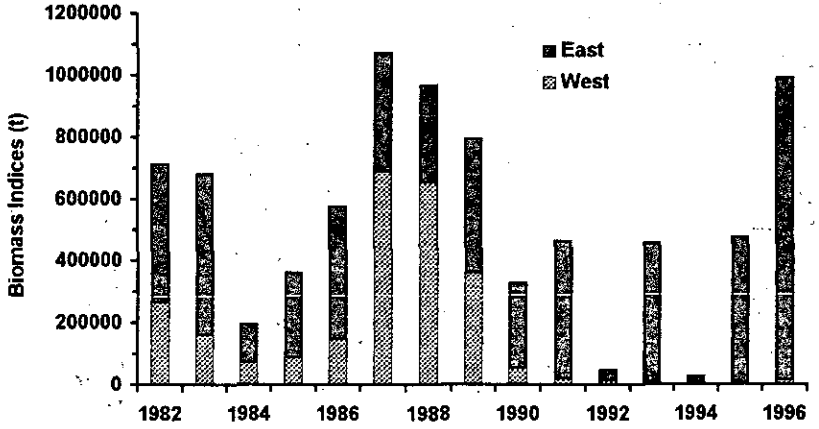

Fig. 6 Biomass indices off West, East Greenland and total for all fish species aggregated as listed in Table 6, 1982-96. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

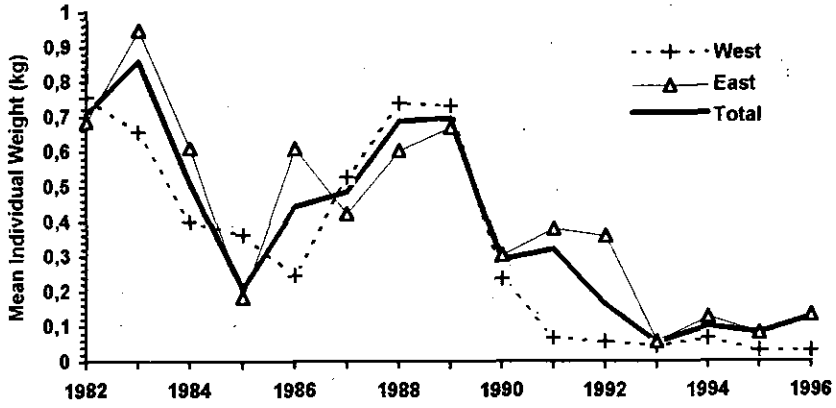

Fig. 7 Mean individual fish weight off West, East Greenland and total as listed in Table 6, 1982-96. Incomplete survey coverage off East Greenland in 1984, 1992 and 1994!

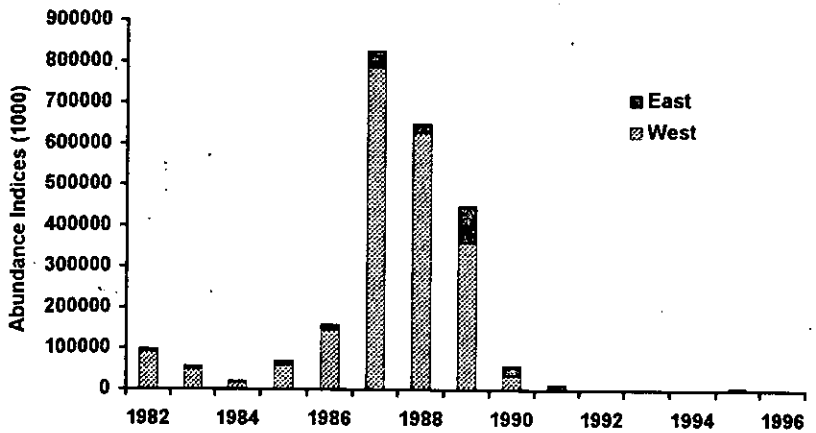

Fig. 8 Abundance indices off West, East Greenland and total for Atlantic cod (*Gadus morhua*) as listed in Table 7, 1982-96.

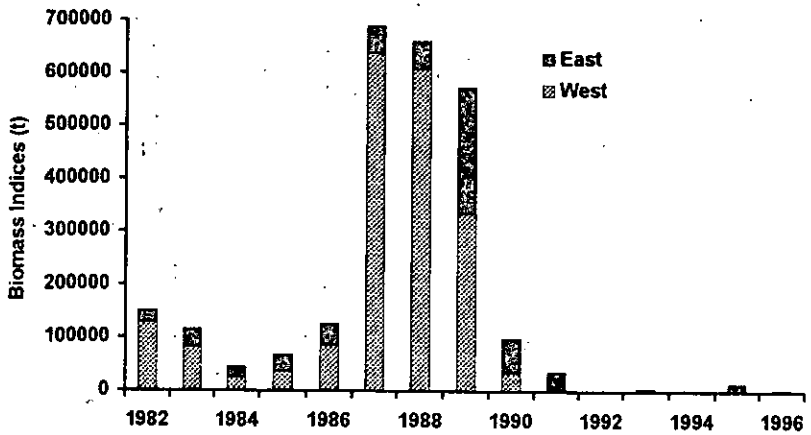

Fig. 9 Biomass indices off West, East Greenland and total for Atlantic cod (*Gadus morhua*) as listed in Table 8, 1982-96.

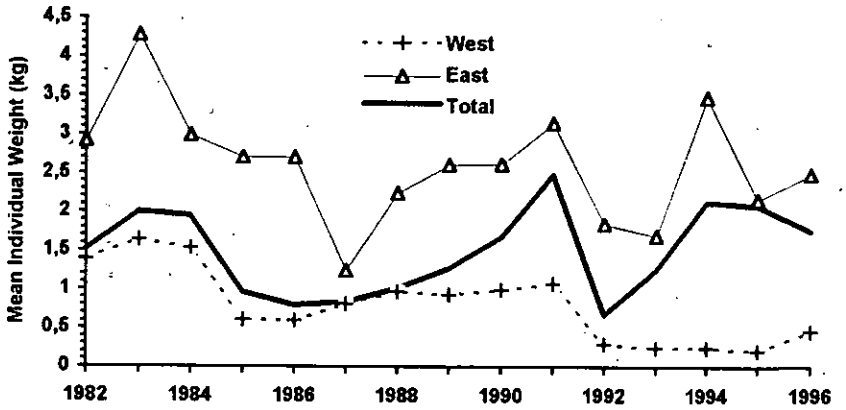

Fig. 10 Mean individual weight off West, East Greenland and total for Atlantic cod (*Gadus morhua*) as derived from Tables 7 and 8, 1982-96.

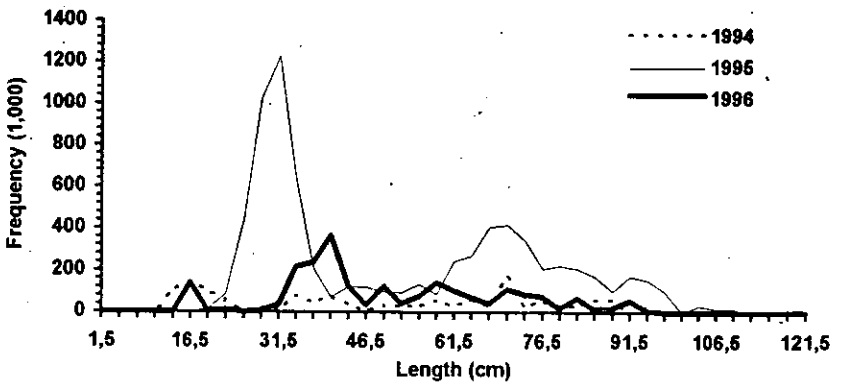

Fig. 11 Length composition for Atlantic cod (*Gadus morhua*), 1994-96.

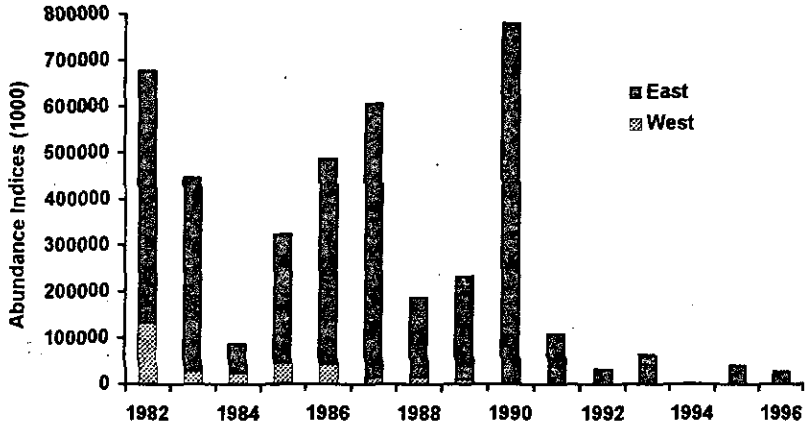

Fig. 12 Abundance indices off West, East Greenland and total for golden redfish ≥17 cm (*Sebastes marinus*) as listed in Table 9, 1982-96.

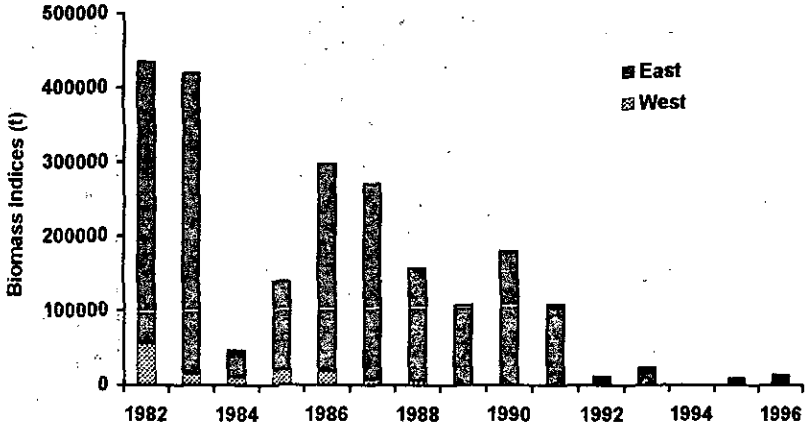

Fig. 13 Biomass indices off West, East Greenland and total for golden redfish ≥17 cm (*Sebastes marinus*) as listed in Table 10, 1982-96.

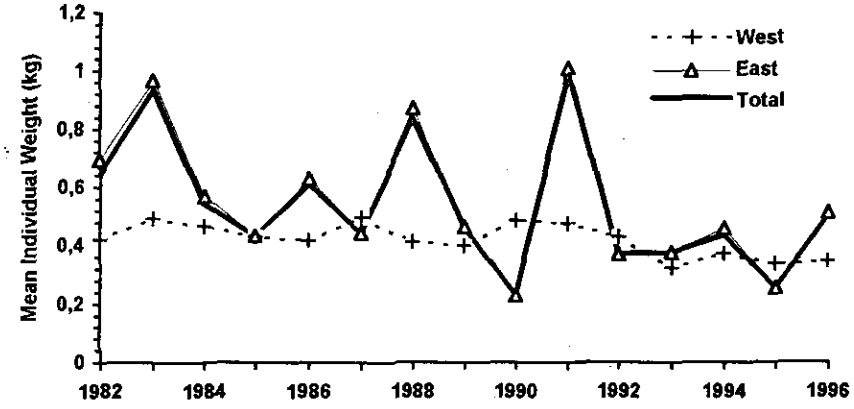

Fig. 14 Mean individual weight off West, East Greenland and total for golden redfish ≥17 cm (*Sebastes marinus*) as derived from Tables 9 and 10, 1982-96.

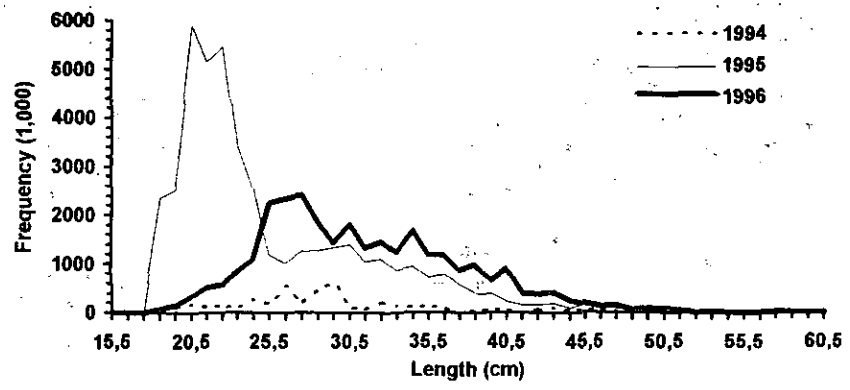

Fig. 15 Length composition for golden redfish ≥17 cm (*Sebastes marinus*), 1994-96.

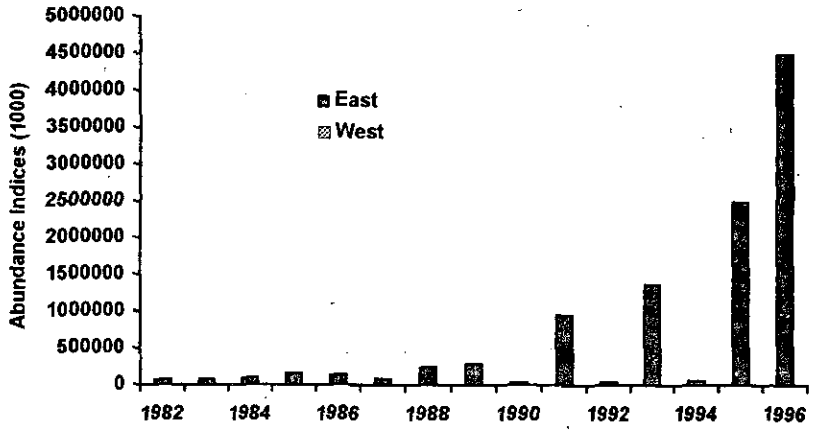

Fig. 16 Abundance indices off West, East Greenland and total for deep sea redfish ≥17 cm (*Sebastes mentella*) as listed in Table 11, 1982-96.

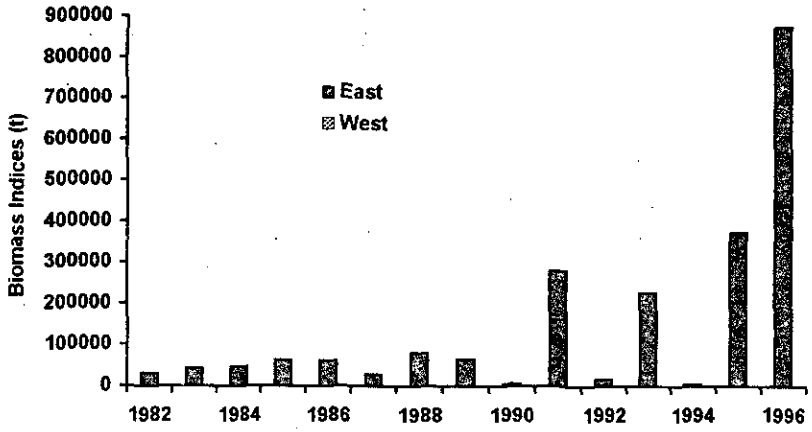

Fig. 17 Biomass indices off West, East Greenland and total for deep sea redfish ≥17 cm (*Sebastes mentella*) as listed in Table 12, 1982-96.

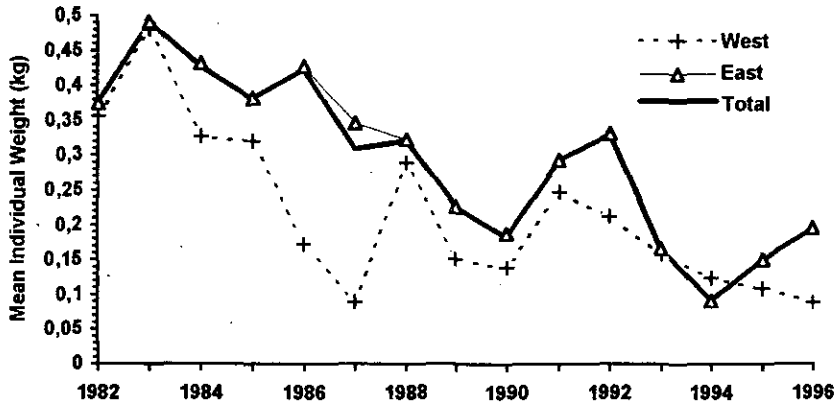

Fig. 18 Mean individual weight off West, East Greenland and total for deep sea redfish ≥17 cm (*Sebastes mentella*) as derived from Tables 11 and 12, 1982-96.

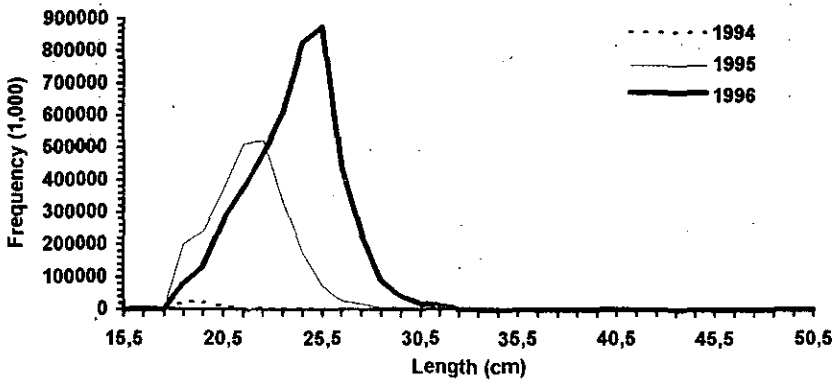

Fig. 19 Length composition for deep sea redfish ≥17 cm (*Sebastes mentella*), 1994-96.

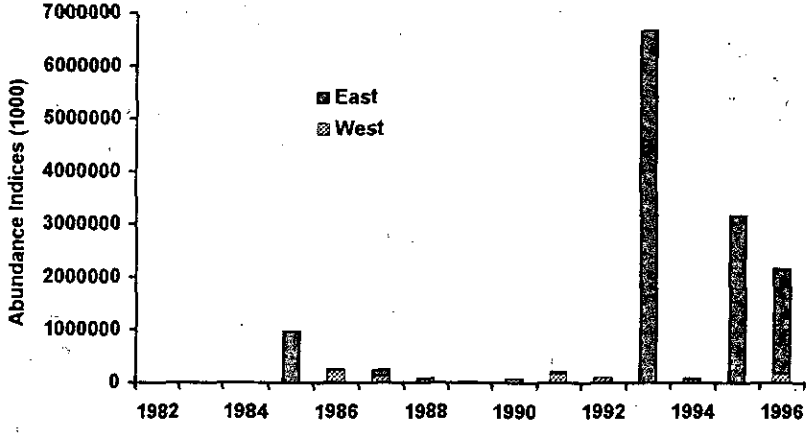

Fig. 20 Abundance indices off West, East Greenland and total for juvenile redfish <17 cm (*Sebastes spp.*) as listed in Table 13, 1982-96.

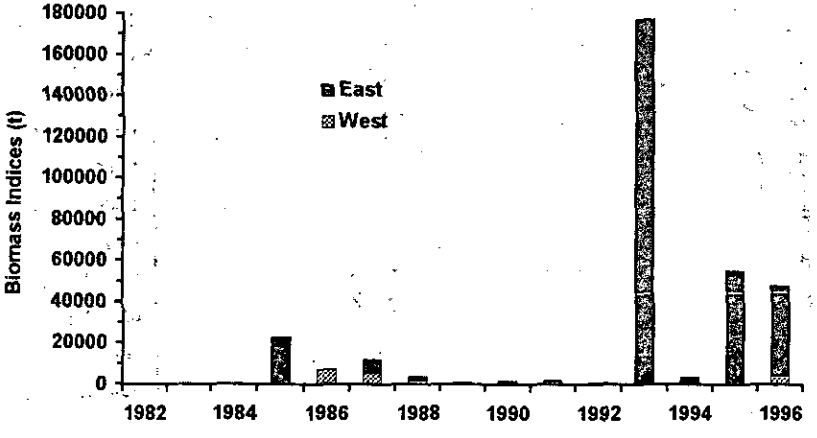

Fig. 21 Biomass indices off West, East Greenland and total for juvenile redfish <17 cm (*Sebastes spp.*) as listed in Table 14, 1982-96.

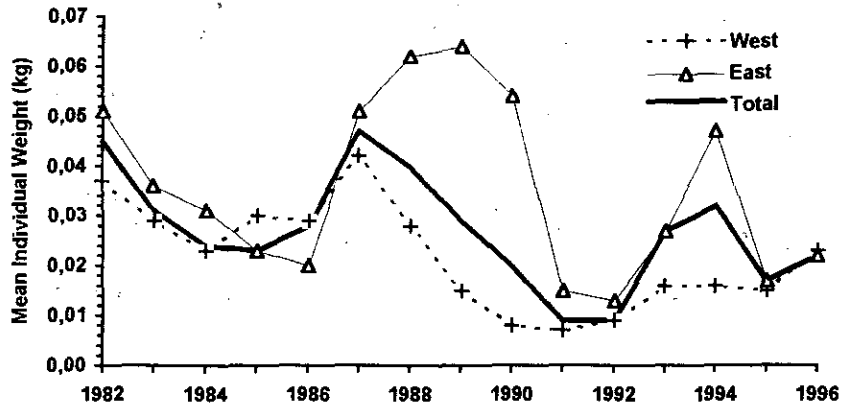

Fig. 22 Mean individual weight off West, East Greenland and total for juvenile redfish <17 cm (*Sebastes spp.*) as derived from Tables 13 and 14, 1982-96.

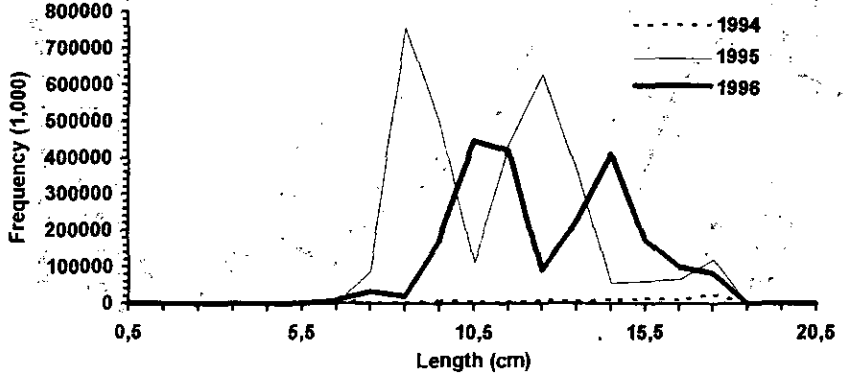

Fig. 23 Length composition for juvenile redfish <17 cm (*Sebastes spp.*), 1994-96.

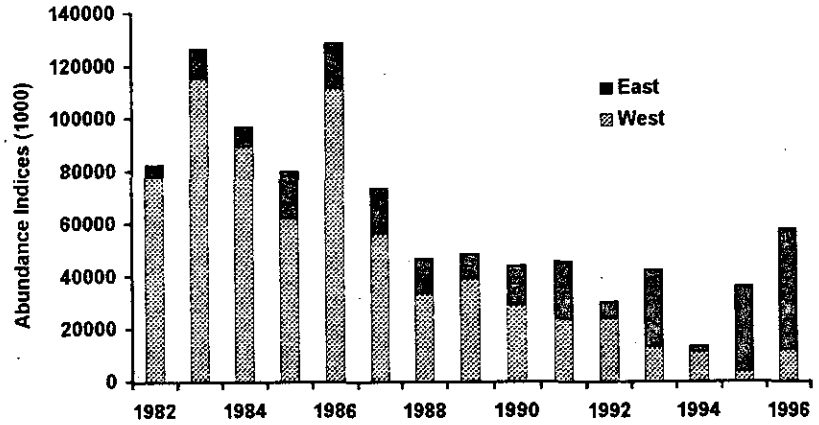

Fig. 24 Abundance indices off West, East Greenland and total for American plaice (*Hippoglossoides platessoides*) as listed in Table 15, 1982-96.

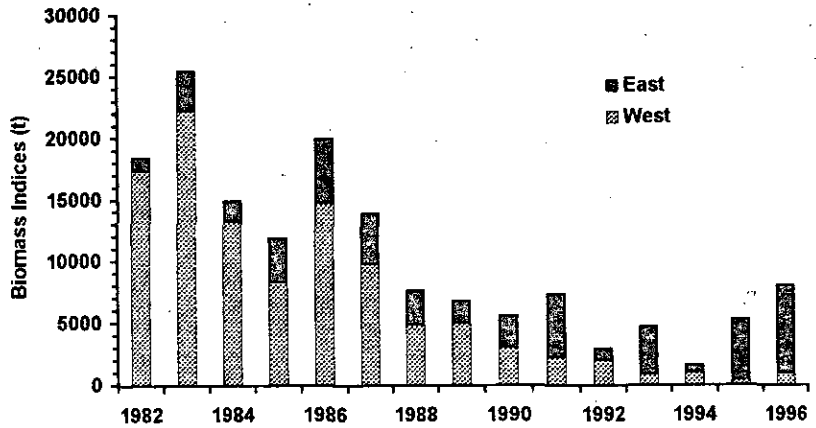

Fig. 25 Biomass indices off West, East Greenland and total for American plaice (*Hippoglossoides platessoides*) as listed in Table 16, 1982-96.

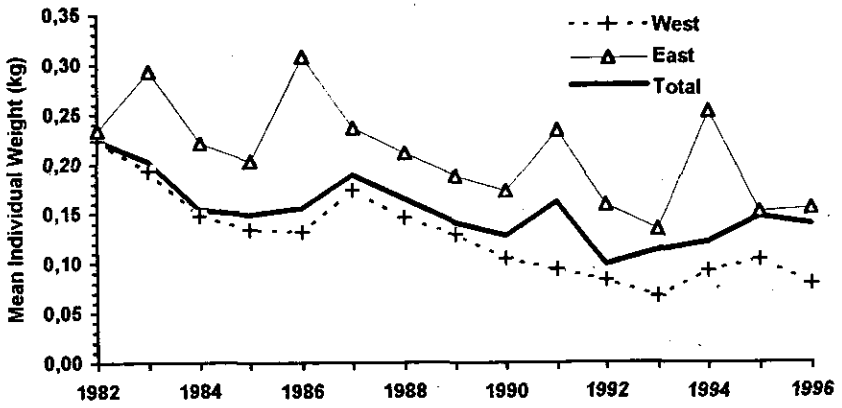

Fig. 26 Mean individual weight off West, East Greenland and total for American plaice (*Hippoglossoides platessoides*) as derived from Tables 15 and 16, 1982-96.

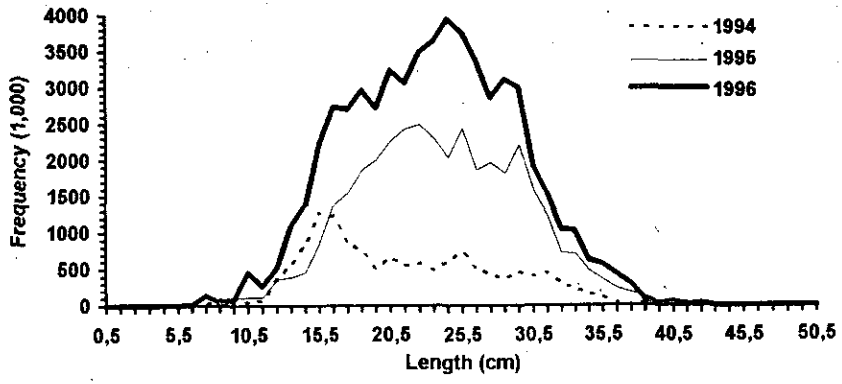

Fig. 27 Length composition for American plaice (*Hippoglossoides platessoides*), 1994-96.

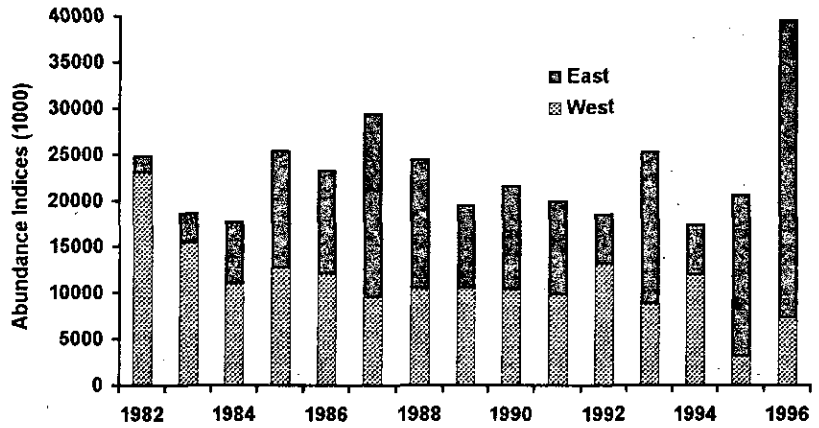

Fig. 28 Abundance indices off West, East Greenland and total for Atlantic wolffish (*Anarhichas lupus*) as listed in Table 17, 1982-96.

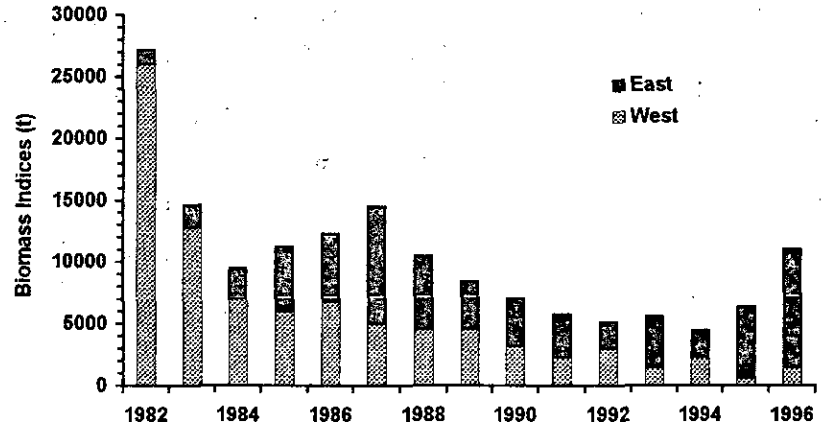

Fig. 29 Biomass indices off West, East Greenland and total for Atlantic wolffish (*Anarhichas lupus*) as listed in Table 18, 1982-96.

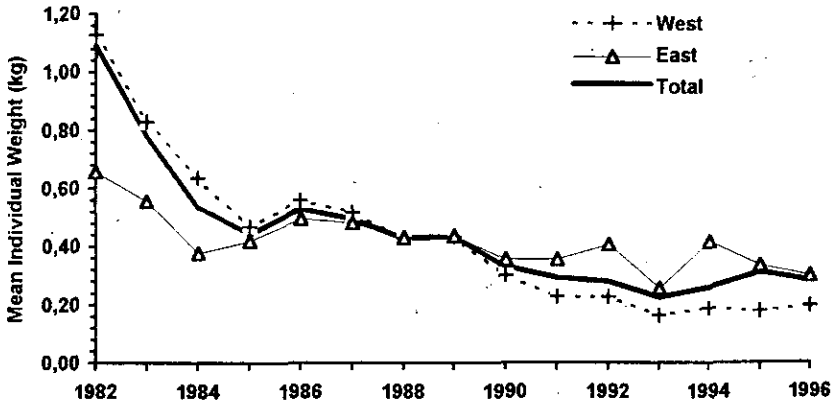

Fig. 30 Mean individual weight off West, East Greenland and total for Atlantic wolffish (*Anarhichas lupus*) as derived from Tables 17 and 18, 1982-96.

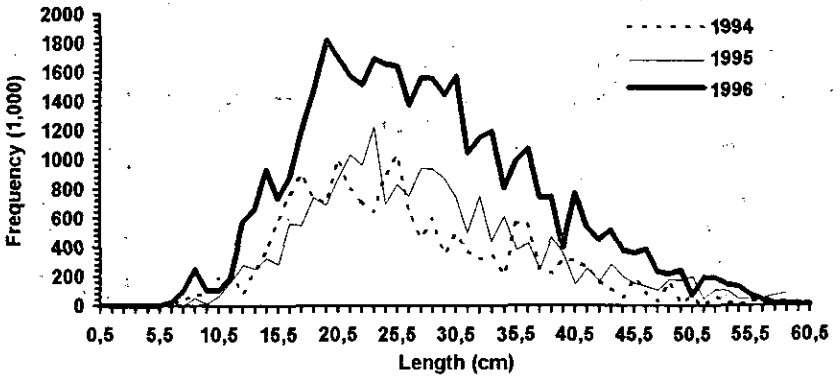

Fig. 31 Length composition for Atlantic wolffish (*Anarhichas lupus*), 1994-96.

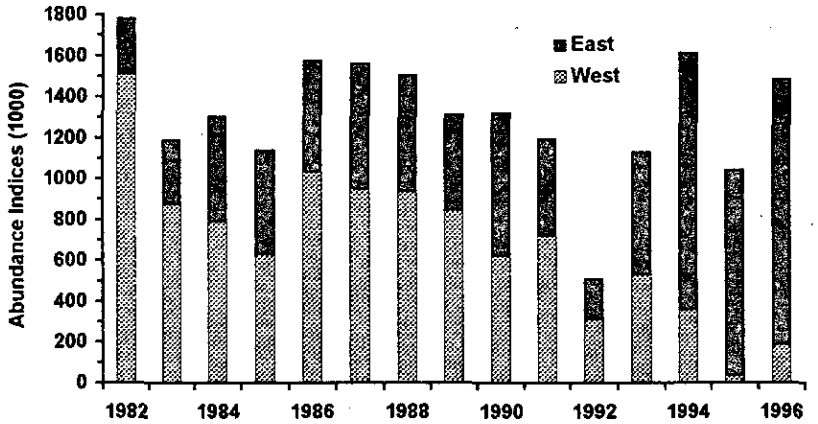

Fig. 32 Abundance indices off West, East Greenland and total for spotted wolffish (*Anarhichas minor*) as listed in Table 19, 1982-96.

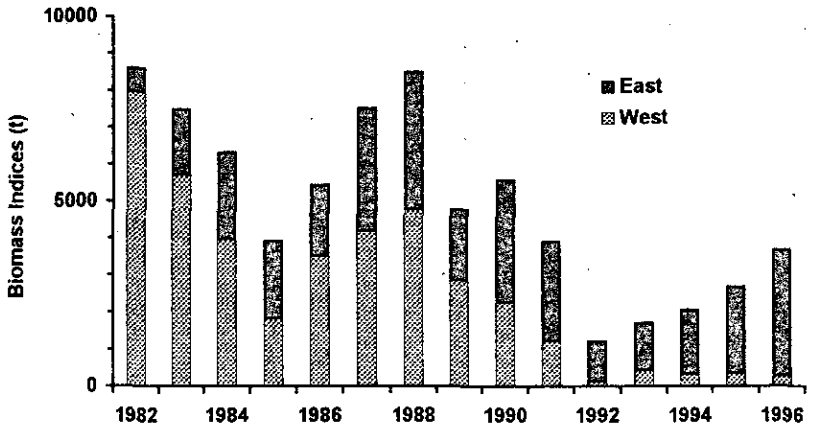

Fig. 33 Biomass indices off West, East Greenland and total for spotted wolffish (*Anarhichas minor*) as listed in Table 20, 1982-96.

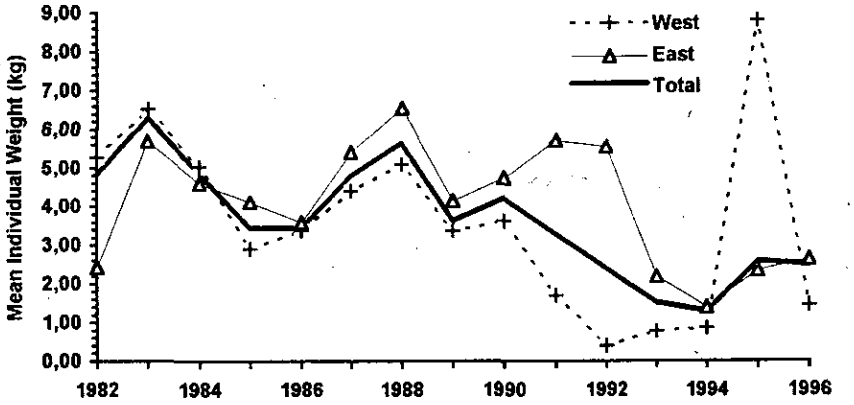

Fig. 34 Mean individual weight off West, East Greenland and total for spotted wolffish (*Anarhichas minor*) as derived from Tables 19 and 20, 1982-96.

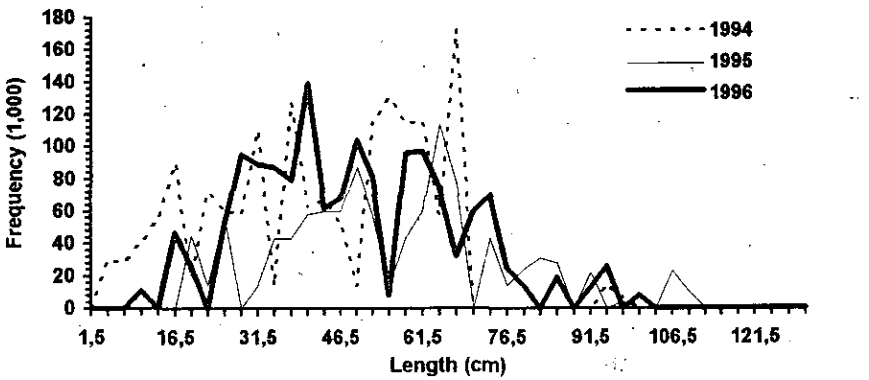

Fig. 35 Length composition for spotted wolffish (*Anarhichas minor*), 1994-96.

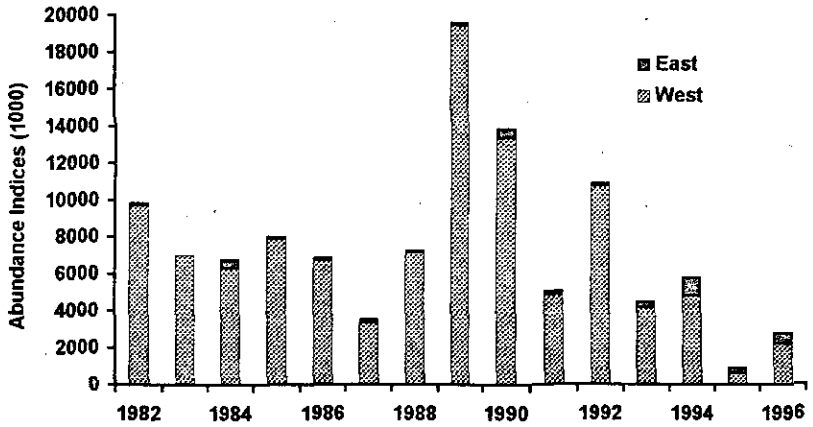

Fig. 36 Abundance indices off West, East Greenland and total for starry skate (*Raja radiata*) as listed in Table 21, 1982-96.

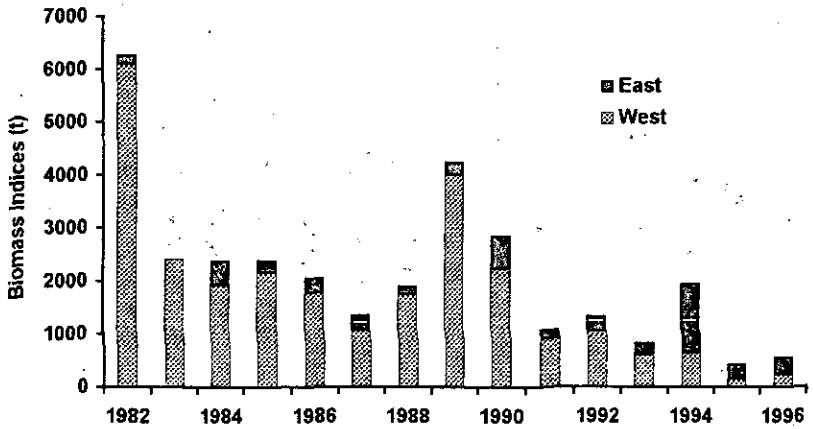

Fig. 37 Biomass indices off West, East Greenland and total for starry skate (*Raja radiata*) as listed in Table 22, 1982-96.

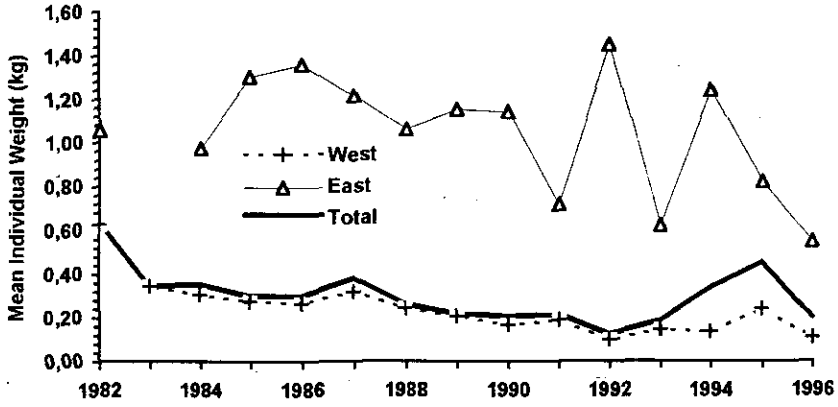

Fig. 38 Mean individual weight off West, East Greenland and total for starry skate (*Raja radiata*) as derived from Tables 21 and 22, 1982-96.

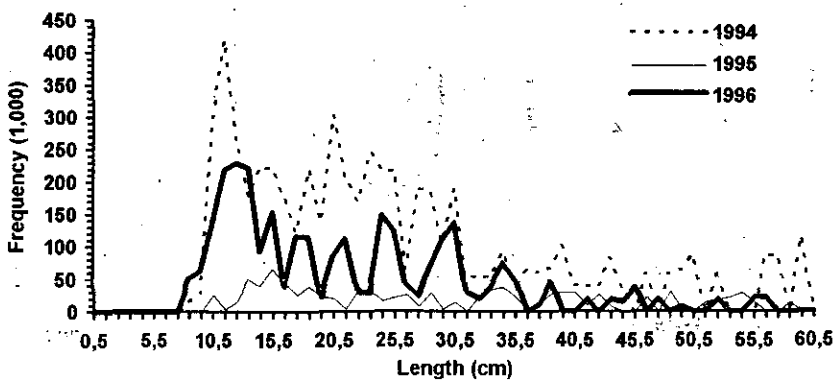

Fig. 39 Length composition for starry skate (*Raja radiata*), 1994-96.

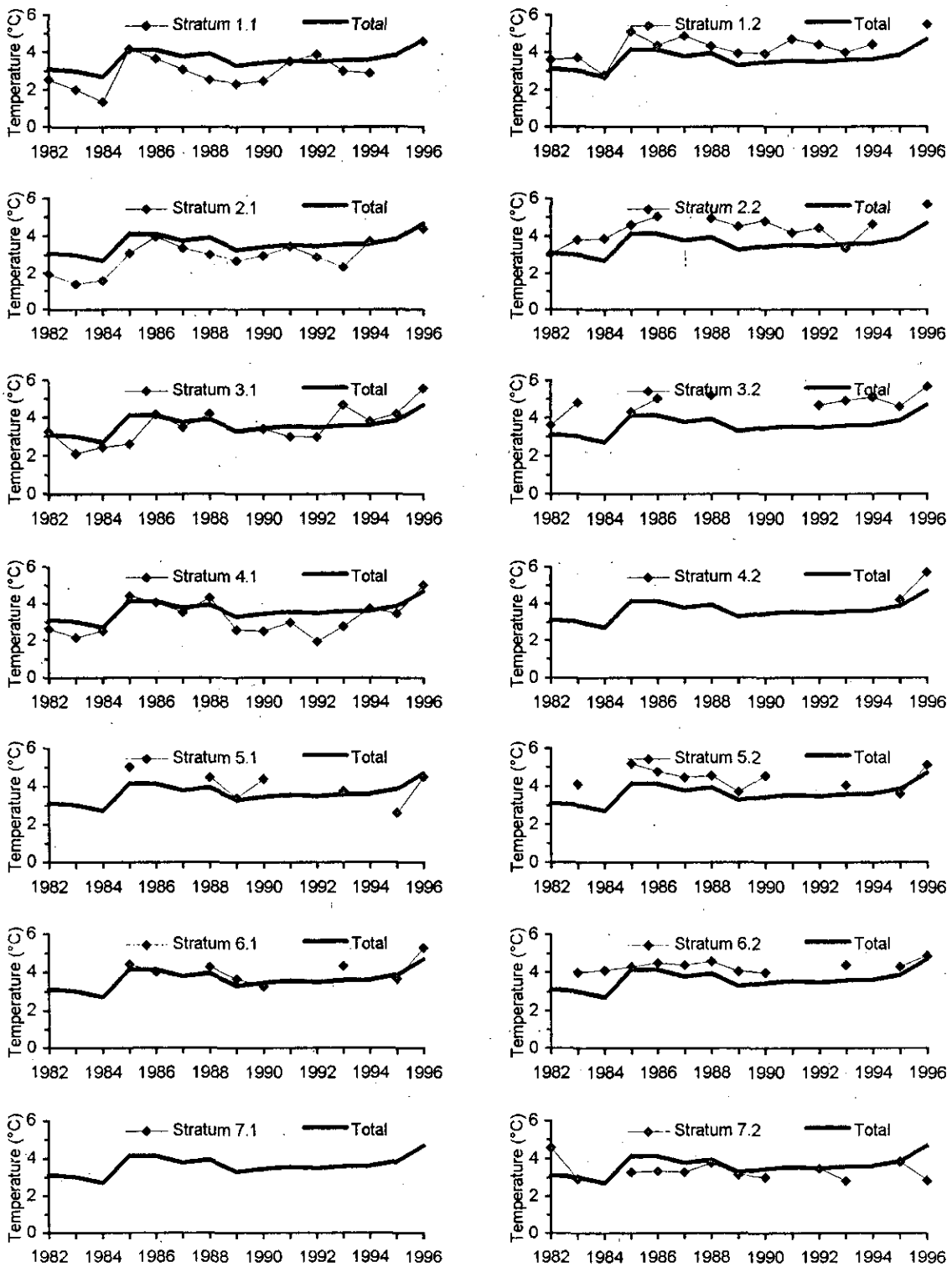

Fig. 40 Mean near bottom temperature by stratum and total off Greenland as listed in Table 24, 1982-96. Weighted (by stratum area) mean temperature off Greenland is illustrated as a bold line, respectively.

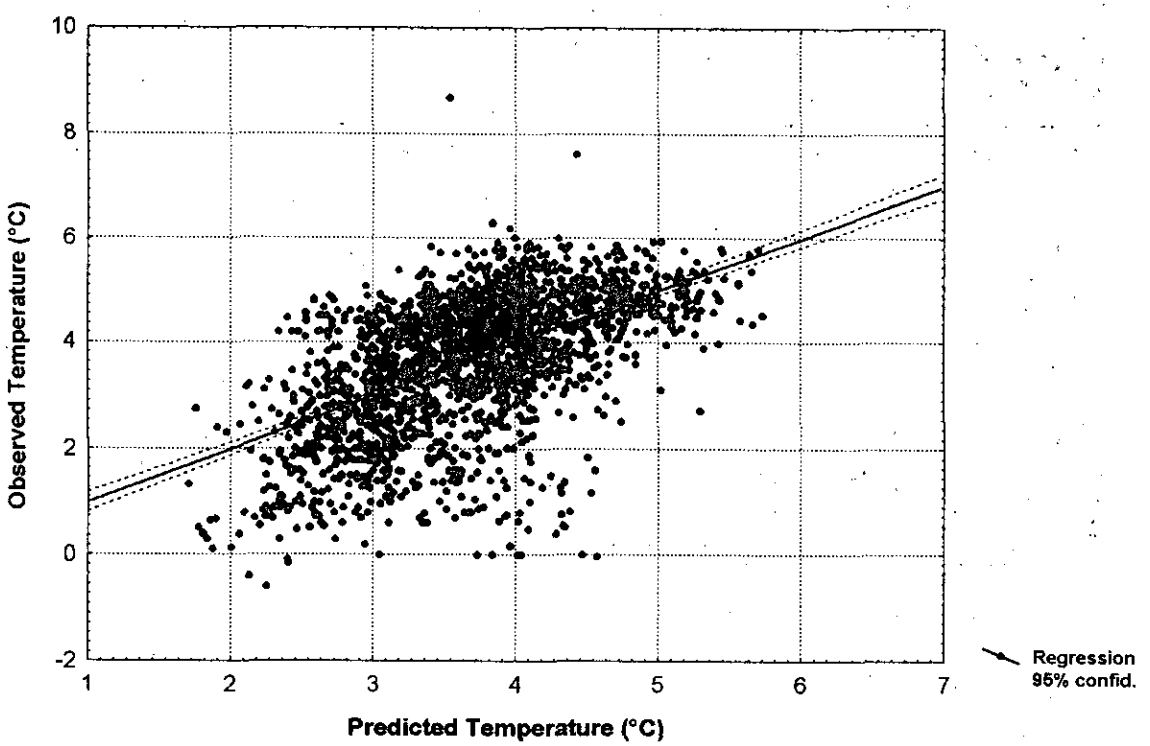

Fig. 41 Near bottom temperature model based on significant year, month, depth, and position effects as specified in Table 25.