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Length-weight Relationship, Condition Factor, Gonad Index and Stomach Contents of Greenland Halibut, Reinhardtius hippoglossoides, around Greenland in 1987

by

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Introduction

The Greenland halibut, Reinhardtius hippoglossoides, is one of the important fishery resources in the North Atlantic and the Bering Sea , where annual commercial catch up to 63000 t and 78442 t was recorded respectively (Alton et al., 1987). This species has been caught commercially by gill nets and long lines in inshore fishery, and by trawl in offshore fishery in the Northwestern Atlantic (Bowering, 1977).

In this paper, the authors describe some of the basic biological results for this species from a trawl survey in Greenland waters in 1987 carried out jointly by Japan Marine Fishery Resource Research Center (JAMARC) and the Trawling Company of the Greenland Home Rule (GTC). The survey aimed at investigating mainly the present status of major fishery resources and the possibility of finding unexploited fishing grounds. The survey consisted of scientific (stratified random trawl) surveys and fishing feasibility studies.

Materials and Methods

The survey area included NAFO Subarea 1 and ICES Area XIVb, outside 3 nautical miles from the base line, south of 70° N latitude. The Japanese stern trawler, Shinkai Maru (3395 gross ton), was used. A total of 494 tows was carried out at depths of 34-1180 m. The outline of the survey appears in Table 1.

Usually 20 specimens from all tows in the scientific studies and 20 specimens from 2 tows a day in the feasibility study were sampled to cover the most of the length range. Eight parameters on these specimens were collected: fork length (FL, in cruises 87-1 and 87-2) or total length (TL, in cruises 87-3 and 87-4) in mm, body weight in g, sex, gonad weight in 0.1 g, gonad

maturation stage, fullness of stomach, composition and overall weight of stomach contents in 0.1 g. Otoliths and scales were sampled for further studies. Due to insufficient correspondence between the scientific teams on board, different standards for fish length were used. The average and standard deviation of the percentage of FL against TL was 98.20 and 0.68 in cruise 87-3 (N=253) which can be used for conversion.

Linear regressions by least squares method of weight (g) on length (mm) were calculated after logarithmic transformation of the two variables.

Condition factor (CF) was calculated by the following formula:

$$CF=10^6 \ (BW-SCW)/L^3$$

where, BW: body weight in g
L: fork or total length in mm
SCW: stomach contents weight in g

Gonad index (GI) is the percentage of gonad weight against the total body weight.

Composition of stomach contents was calculated by the following formula:

$$Fi=(Ni/\sum_{i=1}^{n} Ni)(Nf/Nt)\cdot 100$$

where, Fi: frequency of food item i
Ni: number of stomach with food item i
Nf: number of stomach with any food
Nt: total number of stomach examined

Stomach contents weight index is the percentage of stomach contents weight against overall body weight.

Only data from the scientific study were used for length-weight relationship and condition factor because of the wider range and well-scattered data points than in the feasibility study.

Results

1. Length-weight relationship

Statistically significant differences ($P<0.01$) in the analysis of covariance were found in 1) coefficient of this relationship between males and females at the West coast ($F=14.72$, $df=1, 225$), and 2) intercept of y-axis between males and females at the East coast ($F=7.32$, $df=1, 246$). Comparison of the relationships between West and East coasts was not made due to the different length standards. Sex-separated length-weight relationships are shown in Figs. 1 and 2:

for females at the West coast, $BW=8.377\ FL3.379\ 10^{-7}$, N=103
for males at the West coast, $BW=2.285\ FL3.235\ 10^{-6}$, N=126

for females at the East coast, $BW=2.097\ TL3.247\ 10^{-6}$, N=122
for males at the East coast, $BW=2.285\ TL3.224\ 10^{-6}$, N=127

where, BW: body weight in g
FL: fork length in mm
TL: total length in mm

2. Condition factor

Relationship between length and condition factor is shown in Figs. 3-4. Condition factor was positively correlated with length of fish in both sex. It increased from about 7 in 200-300 mm fish to 10 or more in 800-900 mm females and to about 9 in 600-700 mm males.

3. Gonad index

Relationship between length and gonad index is shown in Figs. 5-7. The maximum value of gonad index in NAFO Division 1C+1D increased from 4 in August to 12 in November and December (Fig. 7). Females less than 600 mm and males less than 400 mm do not seem to mature. Although the locality was different, those in scientific study at the East coast in October (Fig. 6) were classified as intermediate, suggesting the synchronous development of gonads between both areas, which is in contradiction with Smidt (1969a) who found much larger larvae at the East coast, which may indicate an earlier spawning in that area than in the Davis Strait (bottom of page 176, vol. 1).

4. Stomach contents

The stomach contents weight index was higher in smaller fish (as much as 15) and mostly less than 6 in larger fish at the East coast, whereas this tendency was not obvious at the West coast (Figs. 8 and 9). Food composition differed considerably by area (Fig. 10). The major food were fish (cod, redfish, Greenland halibut and bathypelagic fishes) and shrimps (mostly Pandalus borealis) in NAFO Division 1A+1B, whereas fish (mainly capelin and small redfish) was dominant in stomachs from the East coast.

In NAFO Division 1C+1D+1E, about 80 percent of fish had empty stomachs. Food composition in NAFO Division 1C+1D seemed relatively stable throughout the survey period (Fig. 11). These results may reflect poor food condition and/or low feeding activity.

In spite of the difference in the percentage of empty stomachs by area, there seemed to be a general shift in food composition by length of Greenland halibut: from invertebrates (shrimps, krill, squids) to fishes (Squalidae, Rajidae, Myctophidae, Paralepididae, Bathylagidae, Macrouridae, Moridae, Gadidae, Cottidae and Greenland halibut). Because the majority of trawl stations was on the continental shelf in Division 1A+1B whereas on the continental slope in Division 1C+1D, and the size of fish increased by depth (Yamada et al., 1988 MS), this tendency may be related to the migration from the continental shelf to the slope where the fish grows up.

References

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Table 1. Outline of the survey in the Greenland waters by Shinkai Maru in 1987.

Cruise	Area	Period	Type of study
87-1	NAFO SA1	Jul.15-Aug.12	scientific: stratified random trawl
87-2	NAFO SA1	Aug.19-22	scientific: stratified random trawl
87-2	NAFO SA1	Aug.22-Sep.27	fishing feasibility
87-3	ICES XIVb	Oct.4-28	scientific: stratified random trawl
87-4	NAFO SA1	Nov.3-Dec.8	fishing feasibility: for Greenland halibut
87-4	ICES XIVb	Nov.17-26	fishing feasibility: for redfish

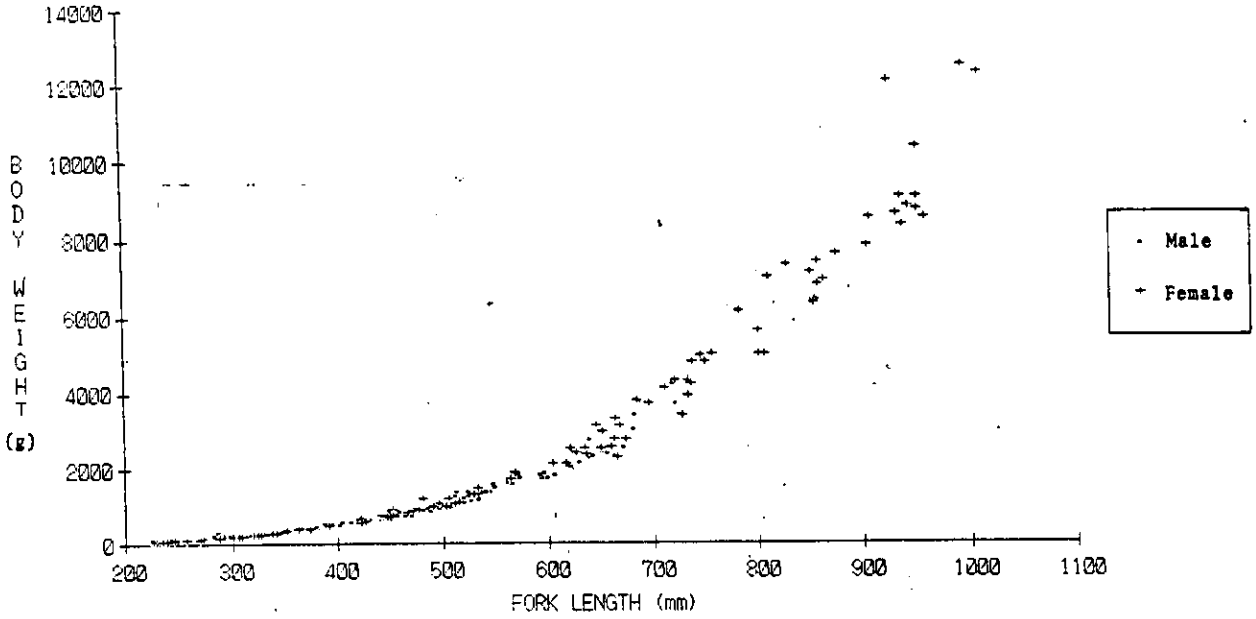

Fig. 1. Relationship between fork length and body weight of Greenland halibut at West Greenland in Cruise 87-1 and 2 (in part).

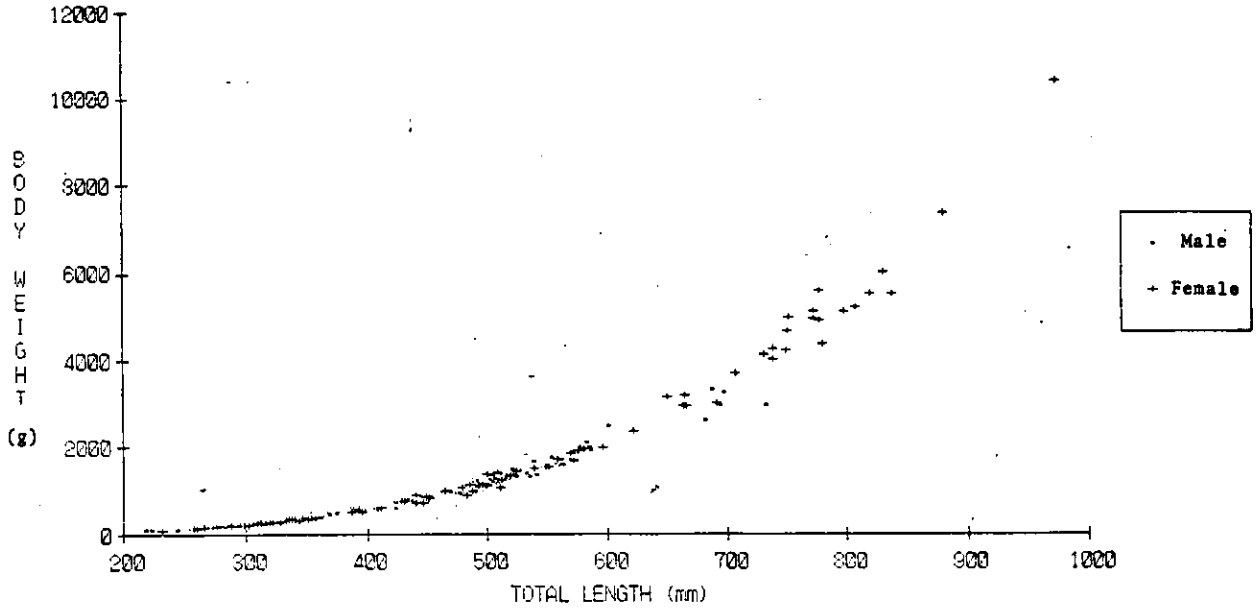

Fig 2. Relationship between total length and body weight of Greenland halibut at East Greenland in Cruise 87-3.

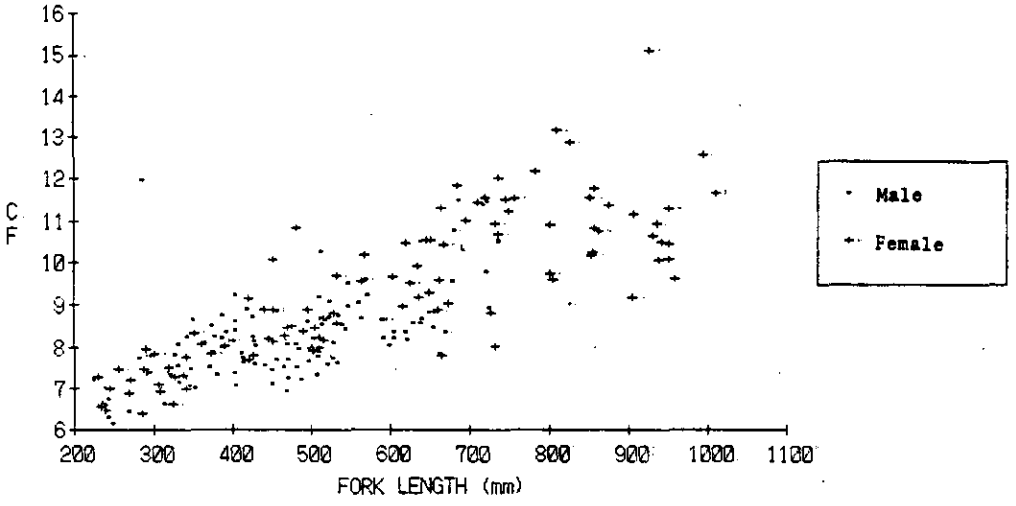

Fig. 3. Relationship between fork length and condition factor (CF) at West Greenland in Cruise 87-1 and 2 (in part).

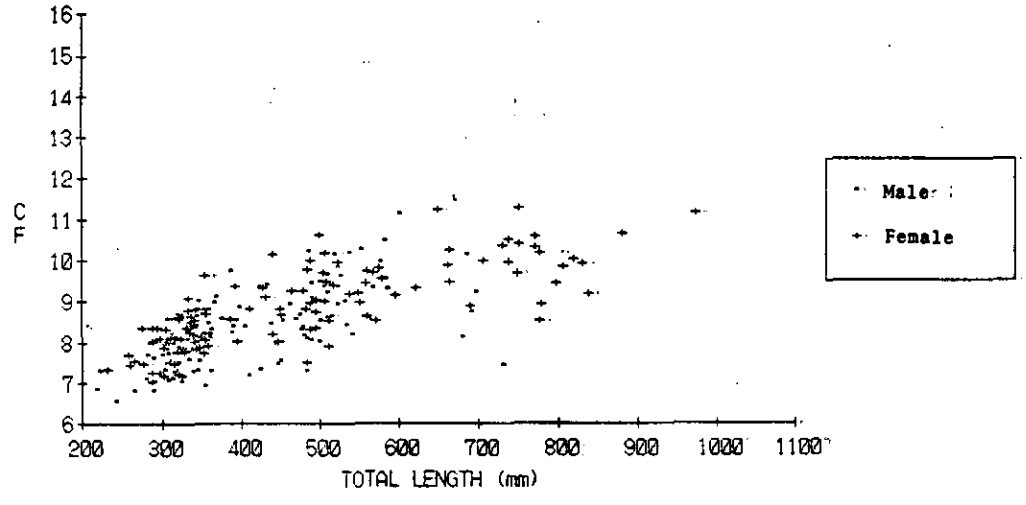

Fig. 4. Relationship between total length and condition factor (CF) of Greenland halibut at East Greenland in Cruise 87-3.

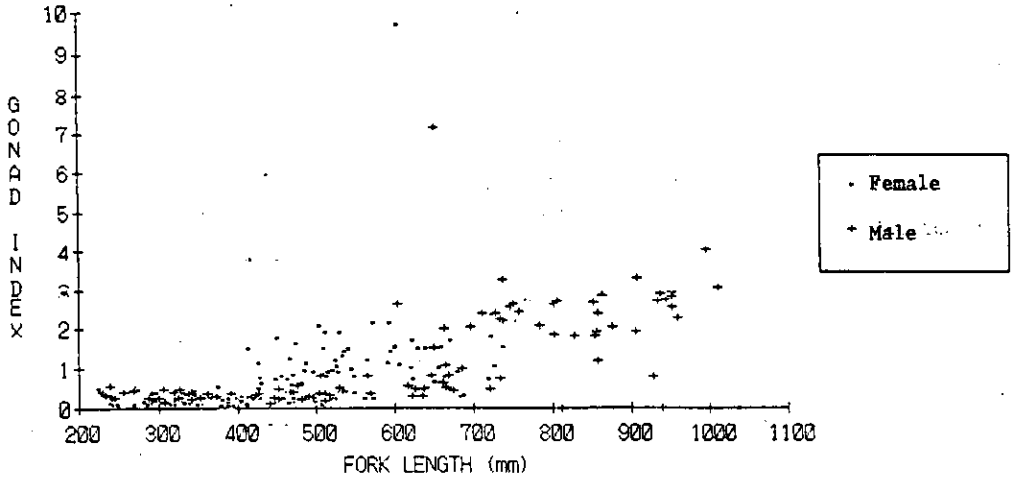

Fig. 5. Relationship between fork length and gonad index of Greenland halibut at West Greenland in Cruise 87-1 and 87-2 (in part).

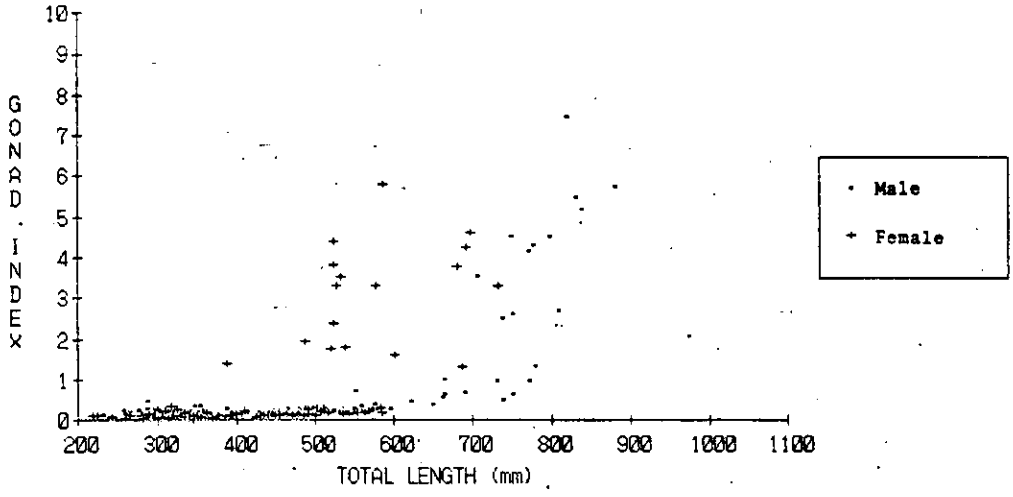

Fig. 6. Relationship between total length and gonad index of Greenland halibut at East Greenland in Cruise 87-3.

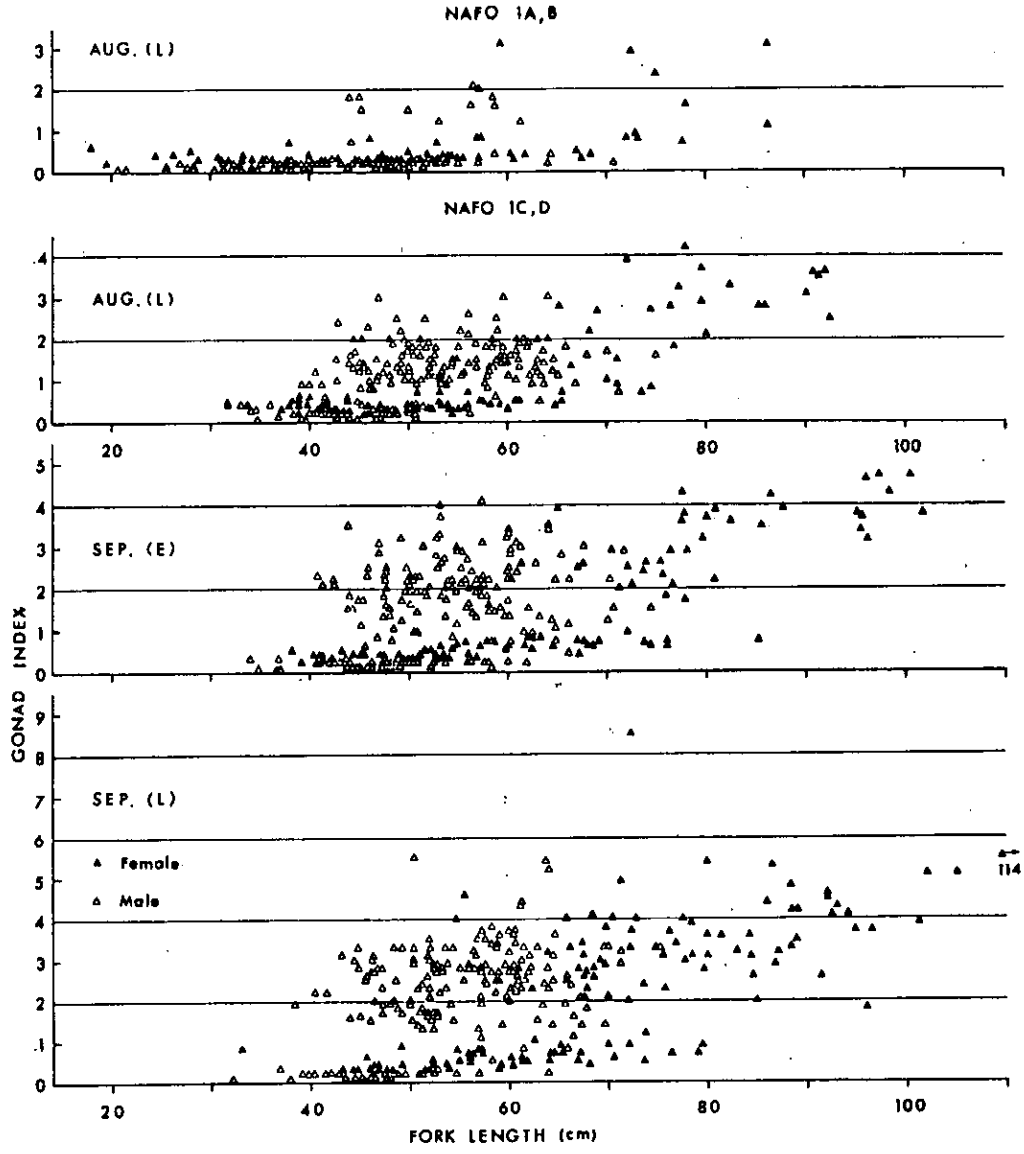

Fig. 7. Relationship between length and gonad index of Greenland halibut by NAFO Division and by month at West Greenland in 1987. (E) and (L) denote the early (1 - 15th) and late (16 - 31th) in the month, respectively.

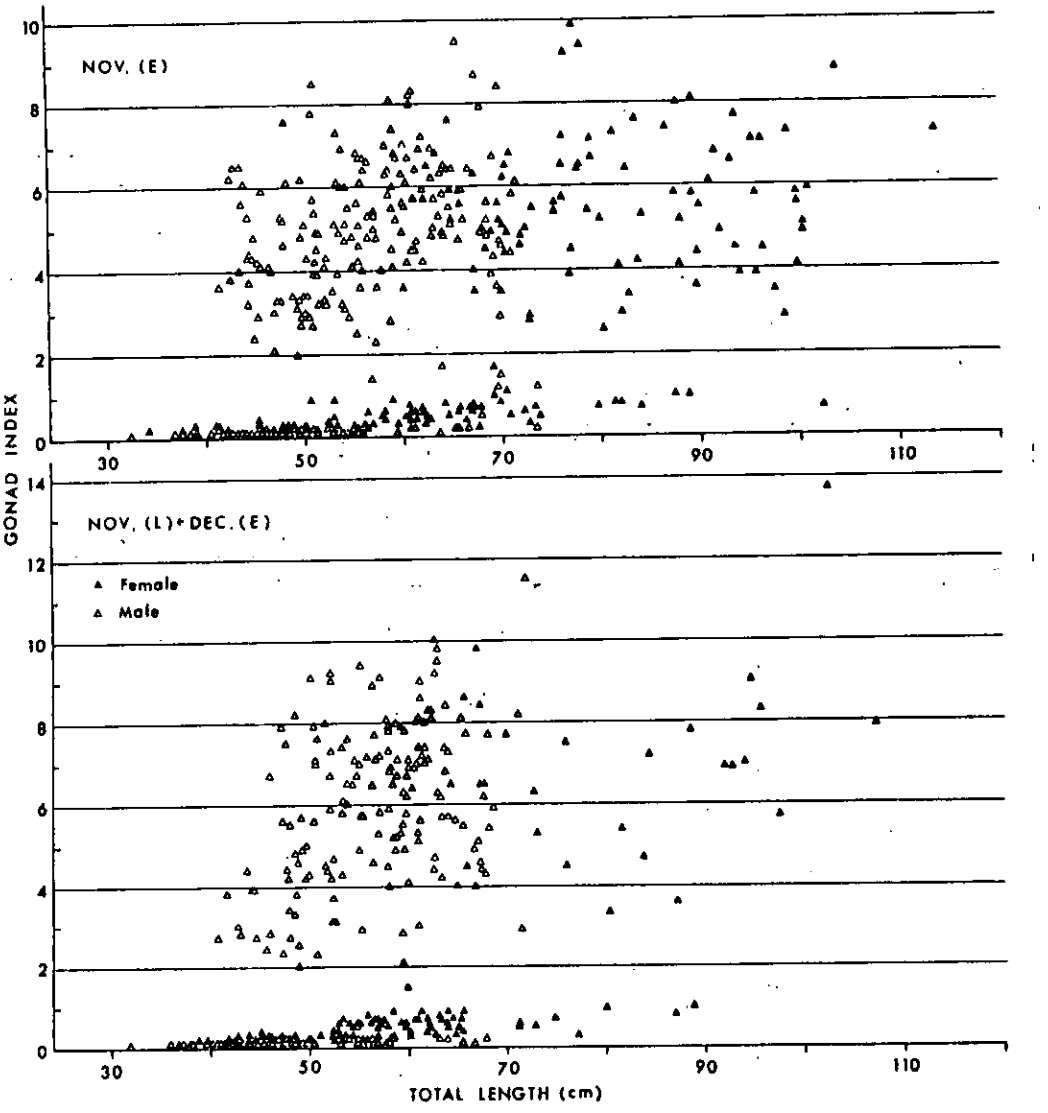

Fig. 7. (continued)

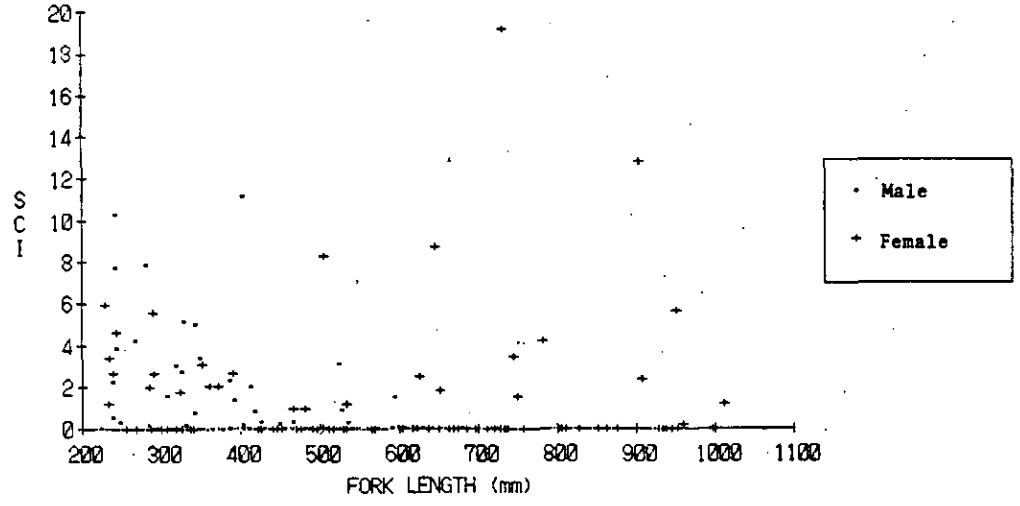

Fig. 8. Relationship between fork length and stomach contents weight index (SCI) of Greenland halibut at West Greenland in Cruise 87-1 and 87-2 (in part).

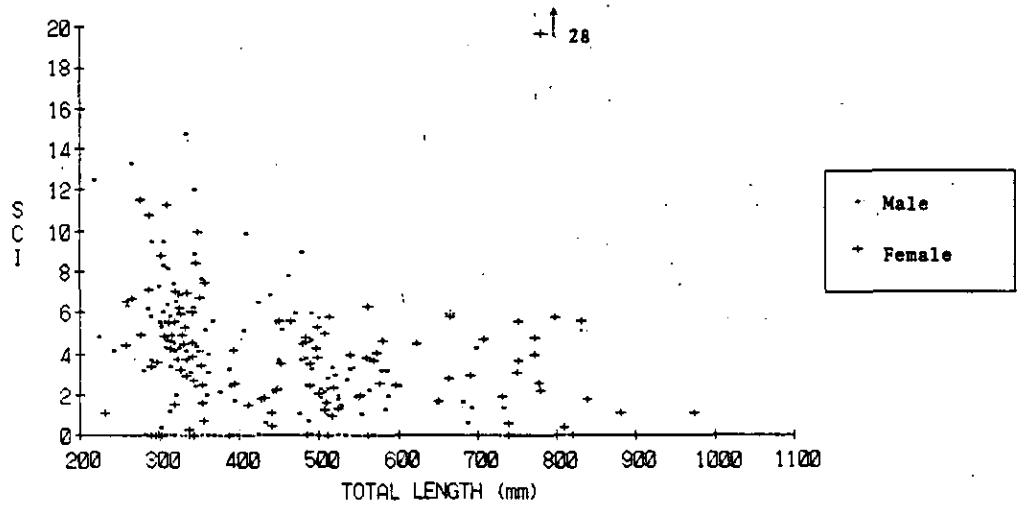

Fig. 9. Relationship between total length and stomach contents weight index (SCI) of Greenland halibut at East Greenland in Cruise 87-3.

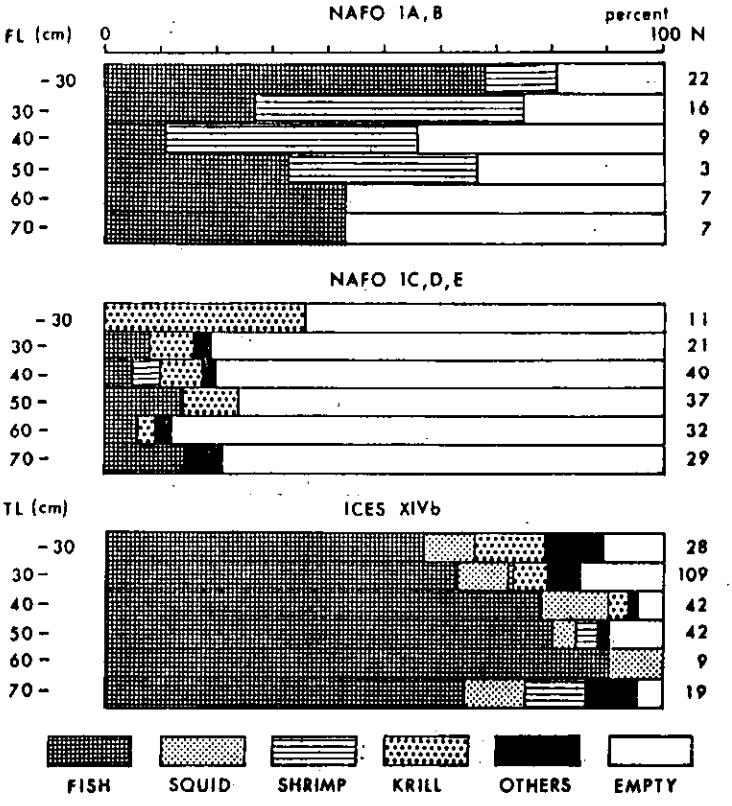

Fig. 10. Condition of stomach contents of Greenland halibut by area and length class around Greenland in Cruise 87-1, 87-2 (in part) and 87-3.

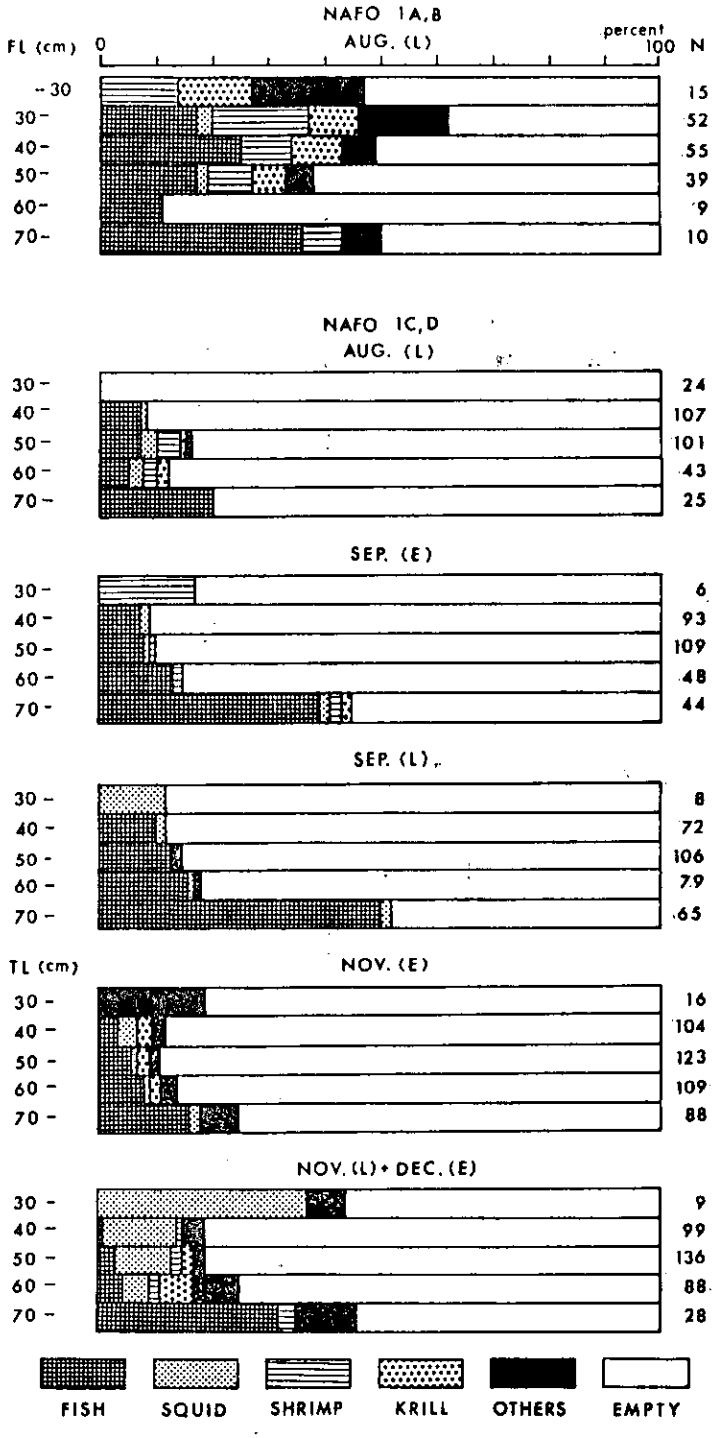

Fig. 11. Condition of stomach contents of Greenland halibut by area, month and length class at West Greenland in Cruise 87-2 (in part) and 87-4.