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Trends in the Greenland Halibut fishery in Subarea 2 and Divisions 3K and 3L

by

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INTRODUCTION

The distribution of Greenland halibut extends from the Arctic to the southern parts of the Scotian Shelf in the Northwest Atlantic. The main fishing concentrations are, however, in ICNAF Subareas 1 and 2 and Divisions 3K and the northern part of Div. 3L. The first fishery for this species was during the 1950's and early 1960's by Canadian inshore fishermen in the east coast bays of Newfoundland using longlines. During recent years the Newfoundland fishery has changed to monofilament gillnets (165-203 mm mesh) and because of reduced catches in the coastal zone the fishery has moved progressively offshore and is now conducted primarily inside the ICNAF convention area.

When the Soviet and Polish fleets began observations in 1957-60 in the Newfoundland-Labrador area, Greenland halibut were caught in small quantities as by-catches of cod and redfish, however, with the start of exploratory fishing at great depths and the development of the grenadier fishery, Greenland halibut concentrations were discovered and became a very substantial by-catch of the foreign fleet. USSR and Poland of recent years take about 60-70% of the total catch of this stock.

Preliminary results of tagging programs in 1969, 1971 and 1973 conducted by the St. John's Biological Station (Fig. 1) suggest that Subarea 2 and Divisions 3KL comprise a single stock. Results of research programs of the USSR (Zilanov *et al.* Ms 1975; Chumakov, 1975) have suggested that the whole of Subareas 1, 2 and Divisions 3K and 3L comprise one interbreeding stock, however, for present assessment purposes Subarea 1 is kept separate from Subarea 2 and Divisions 3K and 3L.

MATERIALS AND METHODS

For this stock, there are two main types of fishing operations, the inshore gillnet fishery and the otter trawl fishery. Sampling of the inshore fishery has been in effect since 1970 and length and age compositions are presented in Fig. 2 and 3 for 1970-76. The main problem was obtaining proper samples from the offshore otter trawl fishery, and since this represents 70-80% of the total catch, it is by far the more important in assessment of the stock. Some length and age data were collected from the offshore area, mostly unsexed. Since there is a difference in the size at age and age composition of the sexes (Fig. 4) it was considered necessary to treat the sexes separately, consequently much data had to be omitted. For 1976 however, length frequencies were available from the USSR and Poland, with both length and age data being available from a special Canadian commercial fishing cruise in Divisions 2J and 3K (Fig. 5 and 6).

Length and age frequencies were plotted for 1975 and 1976 research data for Divisions 2J and 3K (Fig. 7 and 8). The data were collected by the Canadian research ship *A. T. Cameron* and the Federal Republic of Germany's research ships *Anton Dohrn* (1975 data) and *Walther Herwig* (1976 data).

Estimates of total mortality (Z) were computed from catch curves for males and females separately using the 1976 commercial offshore data (Fig. 9). Because the inshore gillnet fishery is more selective and represents the smaller proportion of the total fishery it was considered that the offshore otter trawl data would be more representative of the total stock. A natural mortality estimate of 0.20 was

used (Bowering and Pitt (1975)).

The Beverton and Holt yield per recruit model was applied to males and females separately (Fig. 10) using the following parameters:

		Males	Females
W_∞	- asymptotic weight	4.7 Kg.	56.4 Kg.
K	- from von Bertalanffy equation	0.21	0.05
t_o	- from von Bertalanffy equation	1.47 yrs.	-0.02 yrs.
t_p	- age at recruitment	5.0 yrs.	5.0 yrs
t_{p1}	- age at mean selection length	6.4 yrs.	5.8 yrs.
t_λ	- last age of significant contribution to fishery	11.0 yrs.	20.0 yrs.
M	- natural mortality	0.20	0.20

Estimates of F for 1974 and 1975 from previous assessments are placed on the yield curves as well as F for 1976 from this assessment.

RESULTS

The length composition of Greenland halibut taken by gillnets in the coastal bays of Newfoundland have shown definite change over the past seven years. In 1970 the modal size was 58-60 cms. (Fig. 2) with fish up to 102 cm. Over the past four years the modal size remained at 48-50 cm. with very few fish being taken over 70 cms. Greenland halibut enters the gillnet fishery at age 5 (Fig. 3) with the main contributions to the fishery coming from ages 7 and 8 depending upon the strength of the various year classes. It can be seen from Fig. 3 that over the past seven years the older individuals in the coastal area (mainly females) have been removed. In 1970 the fishery consisted of fish up to 16-17 years old, however, in recent years very few are taken beyond age 12 for either sex.

The only offshore data on commercial length and age composition was for 1976 (Fig. 5 and 6). The majority of the catches for Divisions 2J and 3K was the 32-70 cm. range (Fig. 5), however, Division 2G indicated a major proportion of large females taken by the USSR in the 70-100 cms. range. The only age data for offshore were from Canada 1976 for Divisions 2J and 3K (Fig. 6). Although some fish were caught at ages 2-4, no substantial numbers were taken below age 5. The majority of the catches were comprised of age 5-8 for Division 3K and 6-10 for Division 2J (Fig. 6). There were, however, more older larger fish taken in the more northerly areas.

Research data from 1975-76 for Divisions 2J and 3K indicate higher proportions of larger and older fish in Division 2J (Fig. 7 and 8), with many pre-recruits occurring in Division 3K. The 1971-1974 pre-recruit year classes appear to be quite strong in numbers which have increased consistently in the research catches from 1975 to 1976.

The yield curves were essentially flat-topped with F_{max} occurring at 1.28 for males and 0.35 for the females for M = 0.20 (Fig. 10). Estimated levels of $F_{0.1}$ (Gulland and Boerema, 1972) for males was 0.58 and 0.18 for females.

Estimates of total mortality from offshore commercial data (Fig. 9) for 1976 gave estimates of 0.47 for males and 0.39 for females. This is somewhat below $F_{0.1}$ for males and almost exactly $F_{0.1}$ for females with M = 0.20 (Fig. 10). These estimates are based on only one year's data and may not be totally representative of the actual average level of F over the past few years. The average level of removals over the past 10 years was 25,000-27,000 tons annually.

DISCUSSION

Landings from this stock increased from 1,600 tons in 1963 to over 36,000 tons in 1970-71 averaging around 25,000 tons annually (Table 1). In the 1960's the Canadian inshore fishermen accounted for most of the landings, however, in recent years these landings have declined mainly because of reduced availability of this species within the range of the inshore fleet. Relatively stable removals are now mainly accounted for by the increased catches of the offshore international fleet.

A total allowable catch of 30,000 tons was proposed for 1975 but was later increased by the Commission to 40,000 tons to account for incidental catches not reported to the Commission. In 1975, on the basis of assessment presented to the Assessments Subcommittee by Bowering and Pitt (1975) the TAC was set at 30,000 tons for 1976 and remained the same for 1977.

Results of research surveys by Canada, Federal Republic of Germany, and USSR as well as observations on commercial catches have indicated that immature individuals predominate the southern part of the range of this stock, that is, on the shelf and the continental slope. The relative number of mature fish increases from south to north, thus indicating a northern spawning migration (Fig. 1).

The size composition of Greenland halibut varies from one ICNAF division to another, with the average length tending to increase from south to north (Fig. 5 and 7). Bowering (In Press) in studying growth of Greenland halibut noted that the area from the northern Grand Banks to Hamilton Bank was inhabited mostly by immature fish with the same growth rate for both sexes. However, the growth rate for halibut of the total commercial fishery (Fig. 4) including more northerly fish shows a considerable difference in the growth rate between sexes. This is attributed to the presence of mature individuals from the north (Subarea 2), where the females are much larger and overtake the males in growth rate and have a longer life span.

It is evident from the information presented here, that it is very necessary to sample each division separately due to great differences in stock distribution in order to get a more precise estimate of the stock composition. Probably of the greatest importance is the fact that although it has been suggested by Zilanov *et al.* (MS 1975) that the TAC for this stock is too low, it must be realized that by far, the greatest effort is directed towards the immature portion of this stock with much less towards the mature portion. Until more information is available on the size of the spawning stock and some sort of regulated effort is directed towards each portion of the stock it is probably unwise to increase the TAC at the present time.

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Table 1. Nominal catches of Greenland halibut, Subarea 2 and Divisions 3K and 3L, 1963-76

YEAR	CANADA	DEN	FRG	GDR	ICE	NOR	POL	ROM	SPAIN	USSR	UK	PORTUGAL	OTHERS	TOTAL
1963	776	--	10	--	--	--	691	--	--	125	--	--	--	1,602
1964	1,757	--	35	2,396	--	--	1,834	--	--	302	--	--	--	6,324
1965	8,082	--	--	1,249	--	--	939	--	--	479	--	--	--	10,749
1966	16,209	--	355	1,324	--	--	1,114	--	--	242	--	--	--	19,244
1967	16,604	--	42	1,415	--	--	3,296	--	--	4,287	--	--	--	25,644
1968	13,322	--	4	4,122	--	--	5,806	--	--	8,732	--	--	--	31,986
1969	11,553	--	202	10,014	1	38	5,406	40	--	9,268	--	--	--	36,522
1970	11,706	--	13	9,158	--	606	8,266	225	--	7,384	--	--	--	36,412
1971	9,408	--	--	909	2	--	5,234	7	--	9,094	--	--	--	24,654
1972	8,952	970	86	402	--	1,389	6,986	120	3	10,183	731	--	--	29,822
1973	6,840	1,015	709	1,681	--	1,256	9,060	80	--	8,652	201	207	--	29,701
1974	5,744	4	529	2,701	--	--	7,105	--	--	9,019	1,051	--	--	25,153
1975	7,807	--	622	2,025	--	--	8,447	--	--	9,439	62	231	48	28,681
1976	9,062	--	974	1,512	--	6	5,942	--	--	6,454	1	--	--	23,951

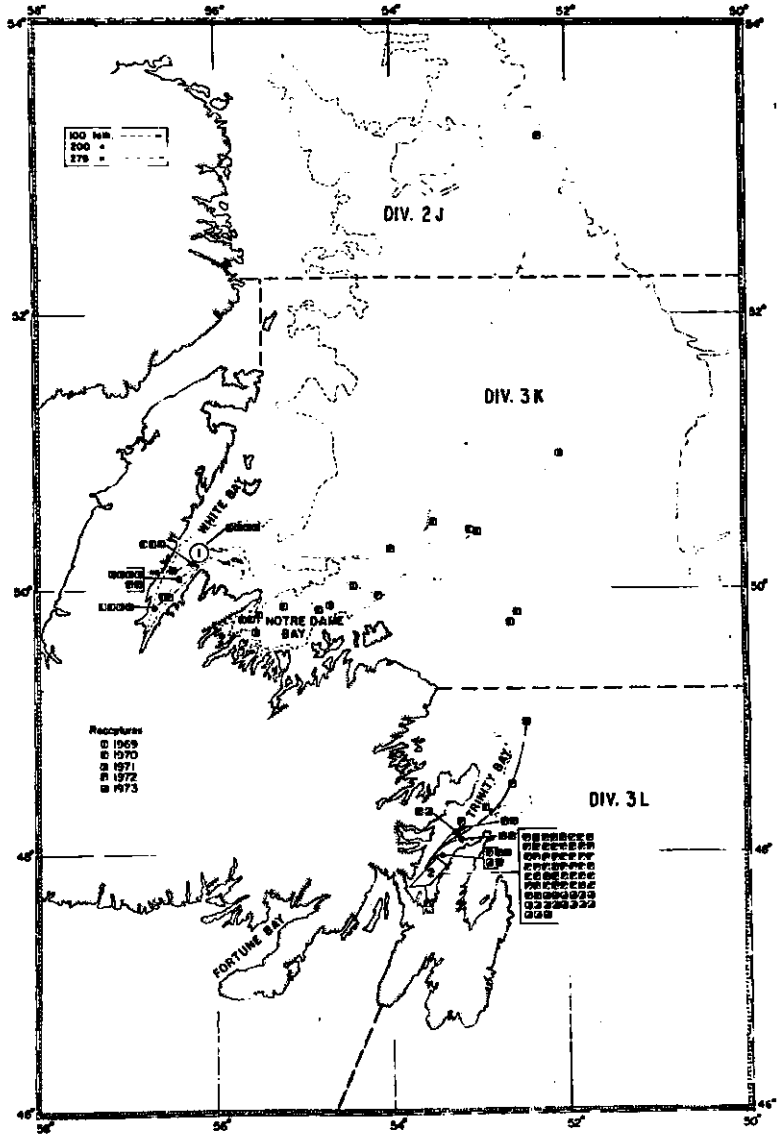

Fig. 1. Tagging results from two tagging programs with Greenland halibut by the St. John's Biological Station.

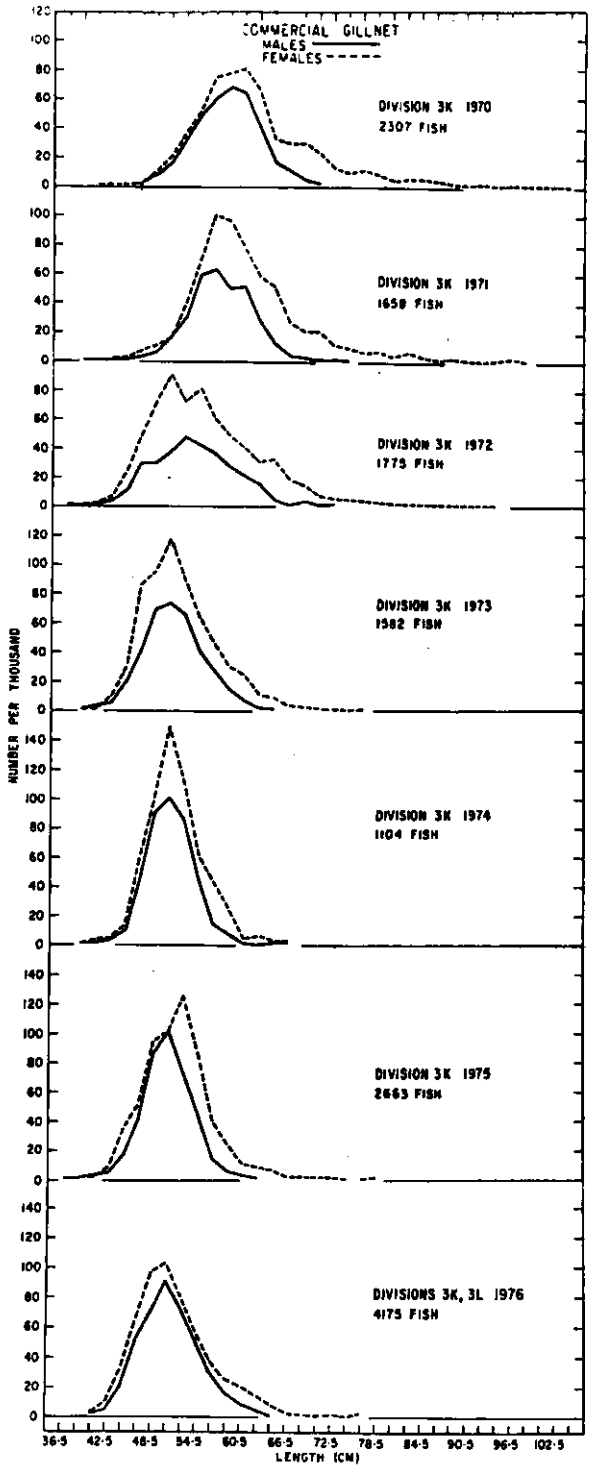

Fig. 2. Length distribution for male and female Greenland halibut from commercial gillnets in ICNAF Divisions 3K and 3L, 1970-76.

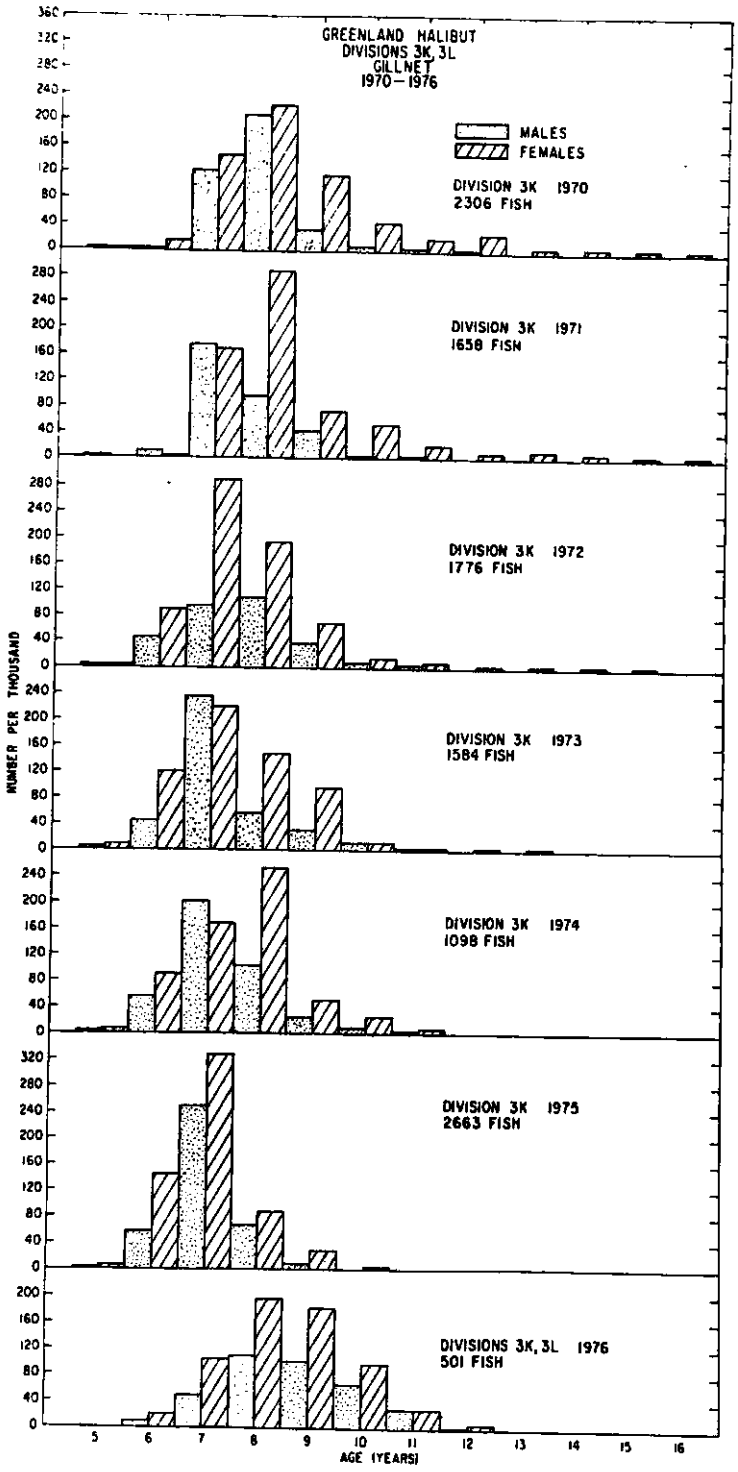

Fig. 3. Age distribution for male and female Greenland halibut from commercial gillnets in ICNAF Divisions 3K and 3L, 1970–76.

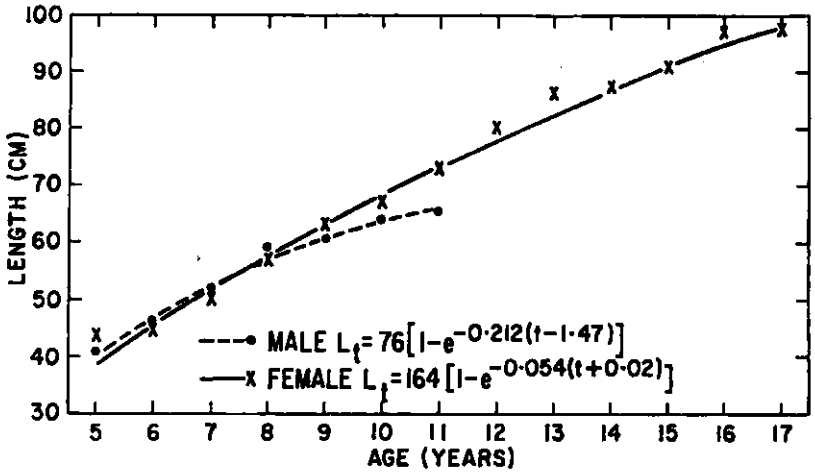

Fig. 4. Growth curves for male and female Greenland halibut in ICNAF Subarea 2 and Divisions 3K and 3L.

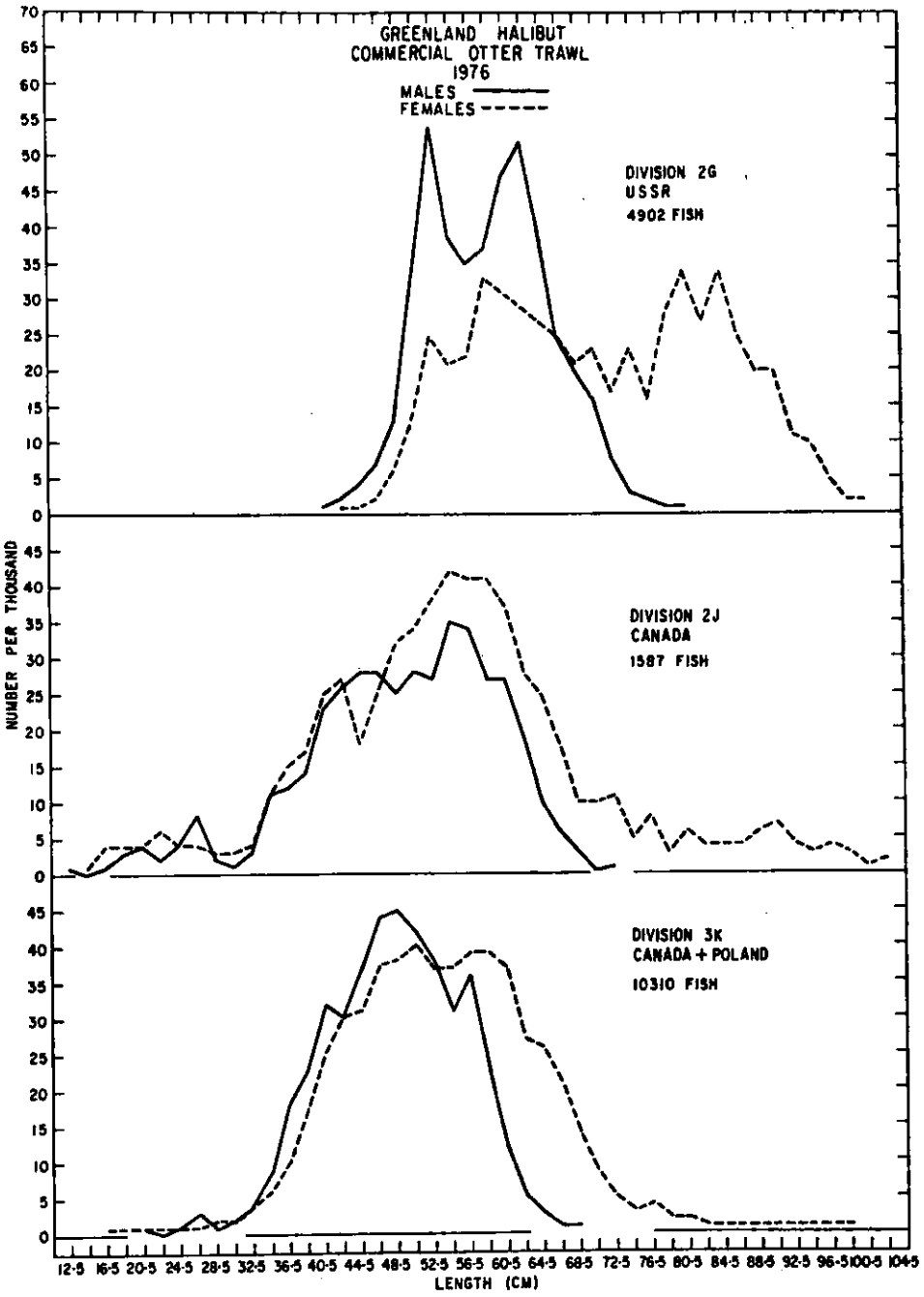

Fig. 5. Length distribution for male and female Greenland halibut from Canadian, Polish and Soviet commercial otter trawl in ICNAF Divisions 2G, 2J and 3K, 1976.

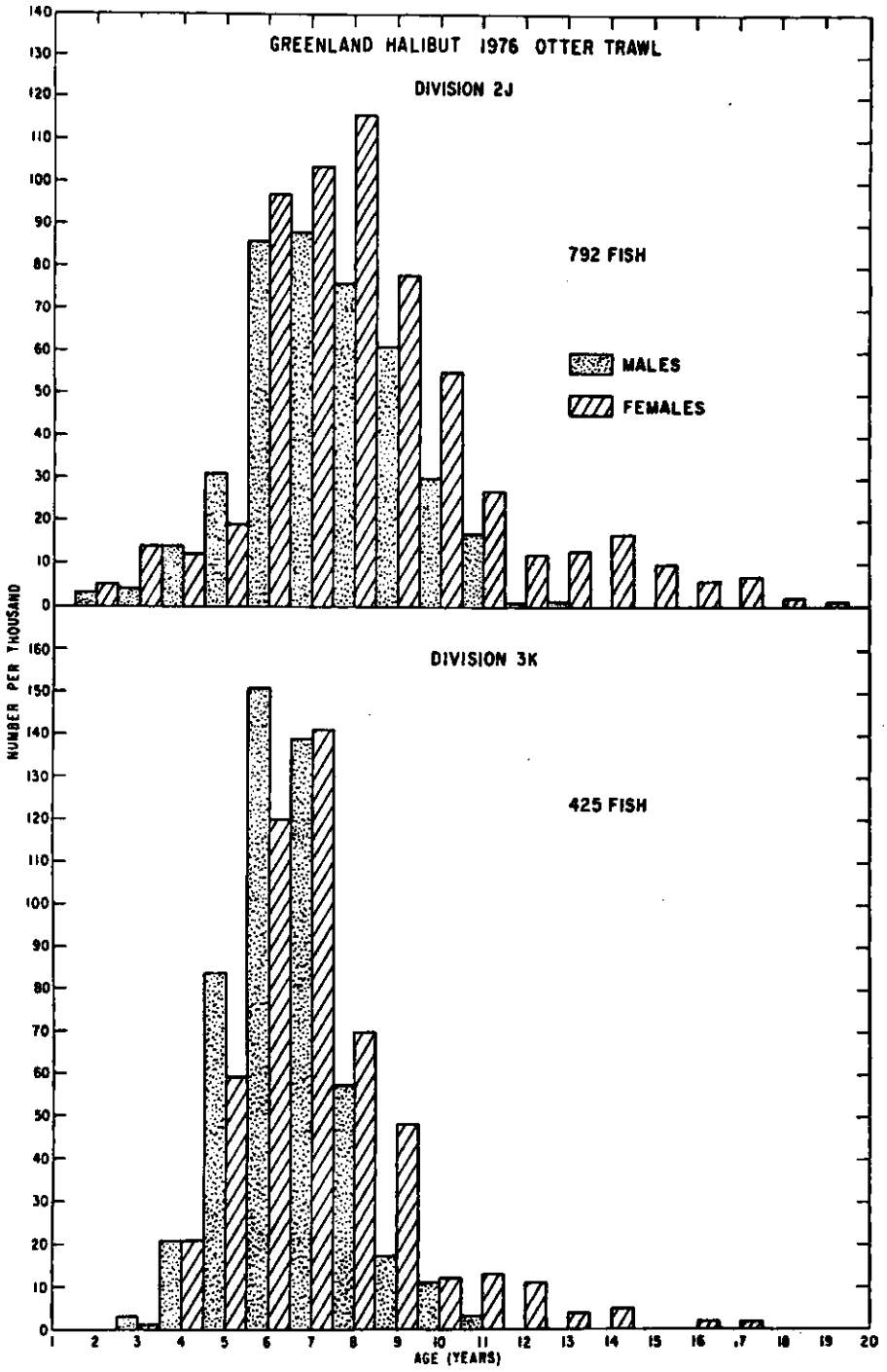

Fig. 6. Age distribution for male and female Greenland halibut from commercial otter trawl in ICNAF Divisions 2J and 3K, 1976.

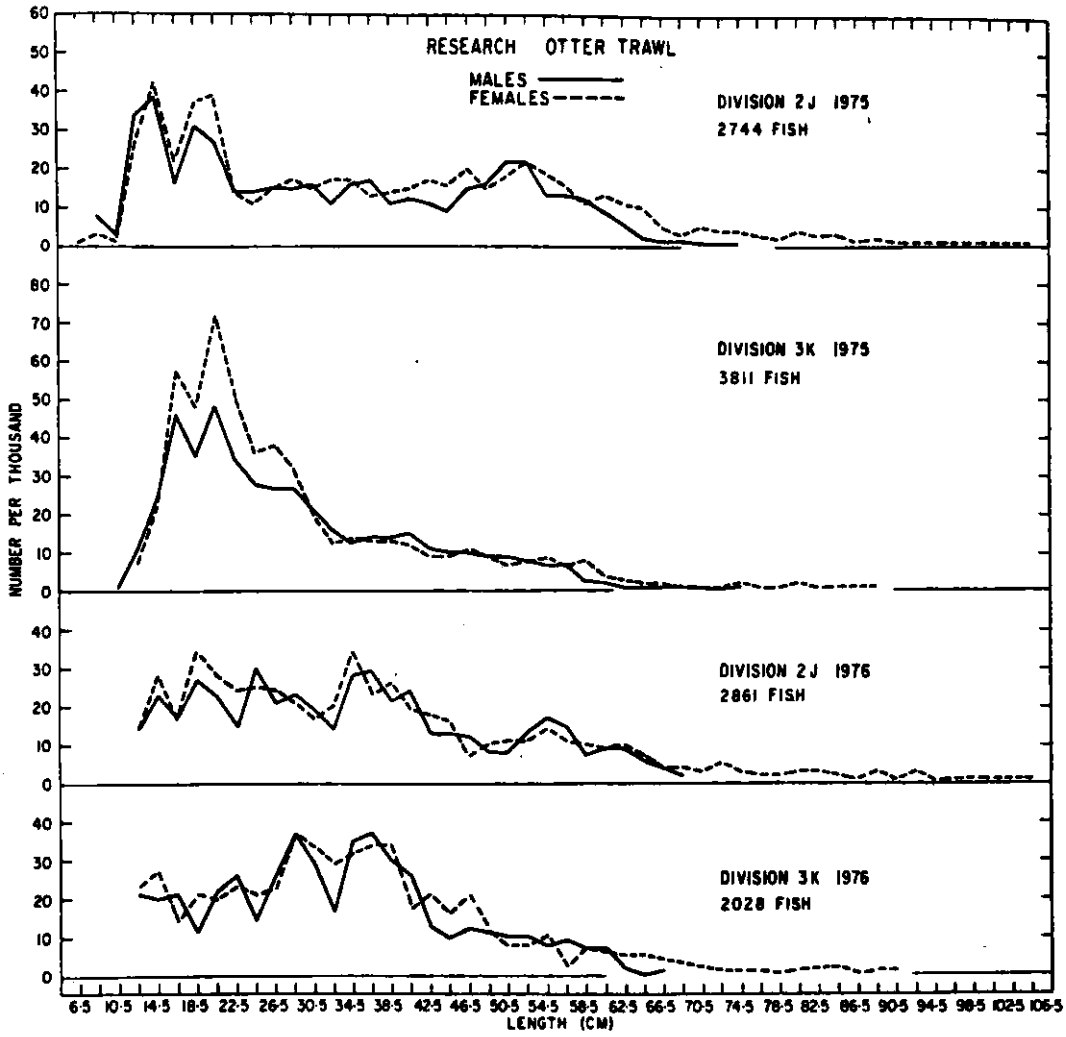

Fig. 7. Length distribution for male and female Greenland halibut from research otter trawl in ICNAF Divisions 2J and 3K, 1975-76.

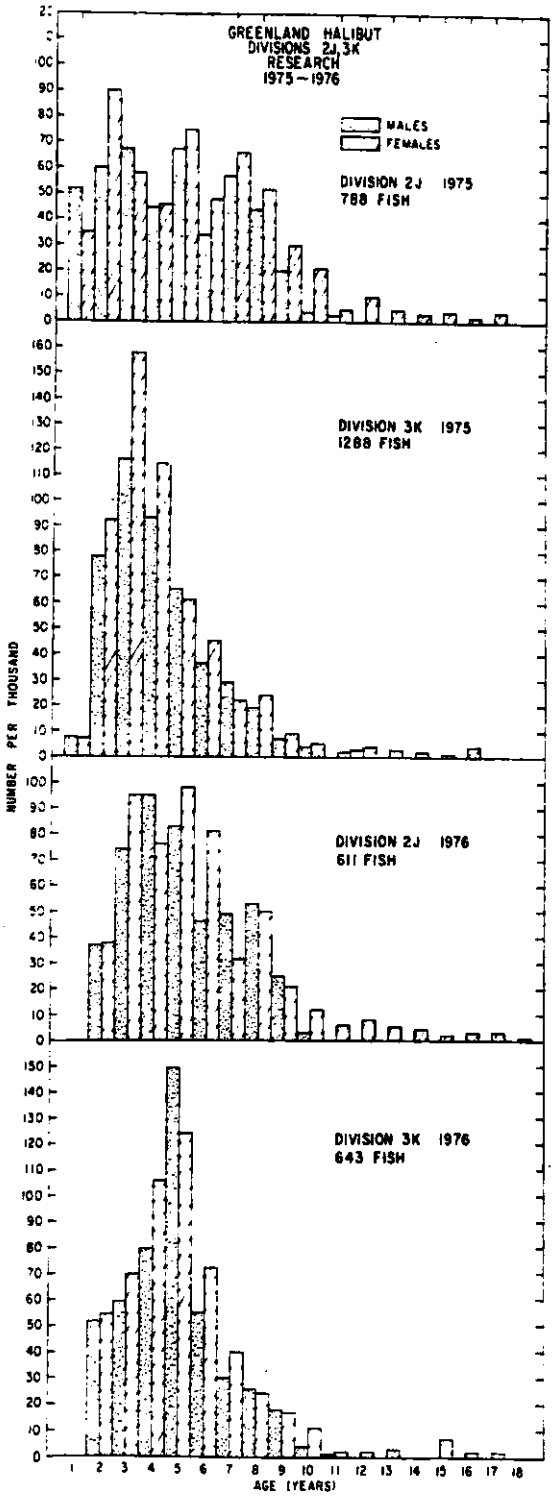

Fig. 8. Age distribution for male and female Greenland halibut from research otter trawl in ICNAF Divisions 2J and 3K for 1975-76.

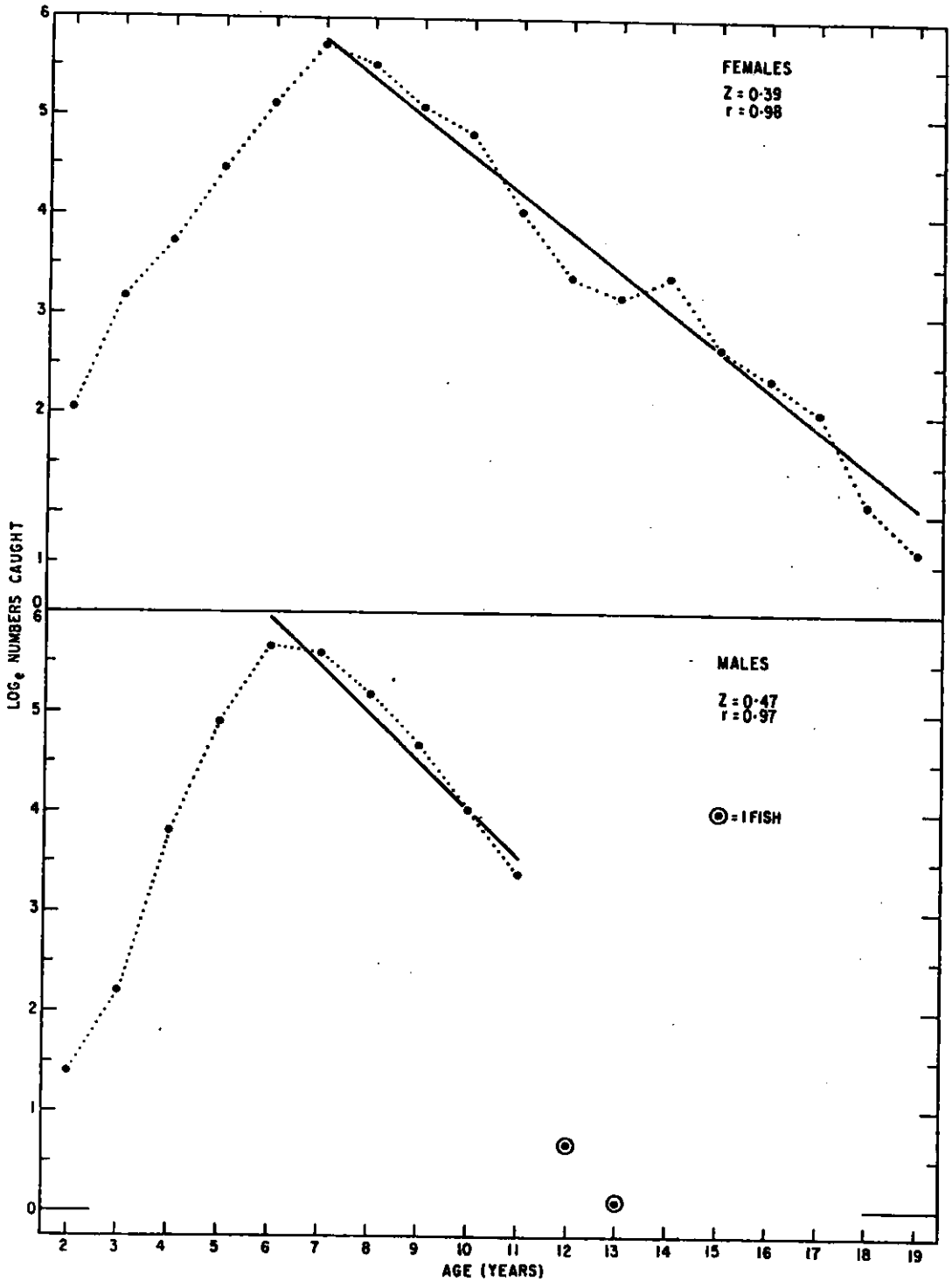

Fig. 9. Catch curves for male and female Greenland halibut from commercial otter trawl.

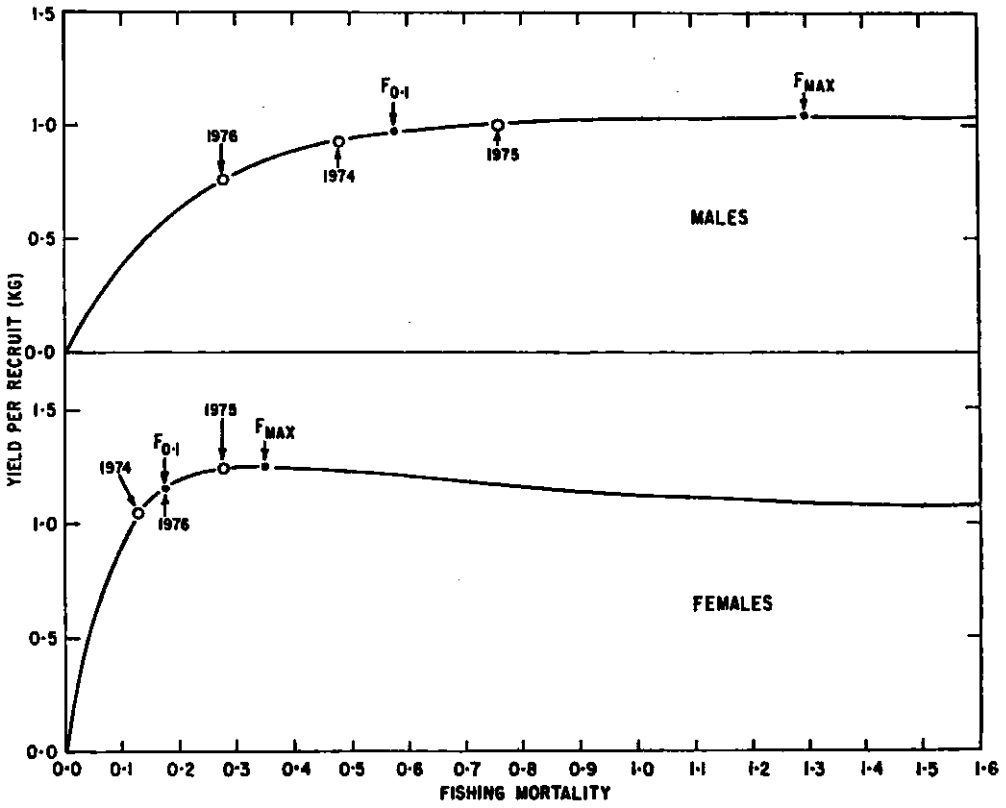

Fig. 10. Yield per recruit curves for commercial male and female Greenland halibut, 1974-76.