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Yield per recruit assessment of Greenland halibut (Reinhardtius hippoglossoides),  
ICNAF Subarea 2 and Divisions 3K and 3L

by

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Introduction

In the convention area, the only significant Greenland halibut fishery occurs in Subareas 1, 2 and Divisions 3K and 3L. During the 1950's and 1960's the fishery for this species occurred primarily in Subarea 3 and was fished exclusively by Canadian (Nfld.) inshore fishermen in White, Notre Dame, and Trinity Bays and to a lesser extent Fortune Bay using mostly longlines. During recent years, the Newfoundland fishery has changed to monofilament gillnets (6½-8 inch mesh or 165-203 mm) and larger boats. Because of reduced catches inshore, the fishery has moved further offshore and is now primarily inside the convention area. Only 15-20% of the Greenland halibut, however, are removed by the Canadian inshore fishermen, the remaining 80-85% being taken by the larger European fleet (Table 1).

Results of tagging programs at the St. John's Biological Station (Pitt 1974) indicate that Subarea 2 and Divisions 3K and 3L are probably a single stock and are considered as a single unit for management purposes.

Materials and Methods

In preparing an assessment for Greenland halibut from this stock, a major difficulty was securing samples which would adequately represent the total commercial fishery. Since there was such a distinct difference in size at age and age composition of males and females (Fig. 5) it was necessary to use only data that were separated by sex, thus eliminating considerable data submitted to ICNAF Sampling Yearbooks with sexes combined. Data from the Canada (N) gillnet fishery were apparently not representative of the stock since the larger fish were not caught (Fig. 2) indicating that perhaps the larger fish do not move inshore. The only other available length frequencies were from USSR exploratory catches of 1973, and the only age-length keys were from Canadian research cruises in the same area and year. To show that the USSR exploratory catches adequately represented the commercial otter trawl catches, length frequencies were compared with the Polish commercial frequencies of 1974 with combined sexes and indicated a fairly similar distribution (Fig. 2). The Polish data could not be used in the assessment, however, since there was no separation of sexes. To make comparison, the frequencies were converted to 6-cm groups since USSR frequencies were in 3-cm groups and Polish and Canadian frequencies were in 2-cm groups (Fig. 2).

Estimates of total mortality ( $Z$ ) were computed from catch curves for males and females separately of the combined USSR and Canadian data (Fig. 3). No estimates of natural mortality are available for Greenland halibut; however, its life span is similar to that of cod (Pinhorn and Wells 1973) and American plaice (Pitt 1973); hence a value of 0.20 was used.

Von Bertalanffy growth curves were calculated for males and females (Fig. 1) and indicated considerable difference between the sexes. The Beverton and Holt yield per recruit model was applied to males and females separately (Fig. 4) using the following parameters:

	Males		Females	
$W_{\infty}$ - asymptotic weight	4.702	kg	56.402	kg
K - from von Bertalanffy equation	0.212		0.054	
$t_0$ - 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
$t_{\lambda}$ - last age of significant contribution to fishery	11.0	yrs	17.0	yrs
M - natural mortality	0.20		0.20	

### Results and Discussion

As previously mentioned, tagging data indicate that Greenland halibut throughout Subarea 2 and Divisions 3K and 3L, including Newfoundland coastal bays, probably constitute a single stock. Total landings from the stock increased from 1,600 tons in 1963 to over 36,000 tons in 1970-71 averaging around 25,000 tons (Table 1), however, the pattern of landings has changed somewhat. In the 1960's, the Canadian inshore fishery accounted for most of the landings, but in recent years these have declined mainly because of reduced availability of Greenland halibut within the range of the inshore fleet, so that the relatively stable level of removals has been mainly accounted for by increased catches by the offshore international fleet fishing on the slopes.

A total allowable catch of 30,000 tons was proposed for 1974 by the Assessment Subcommittee and increased by the Commission to 40,000 tons to take into account fish thought to be landed as incidental catches, but not reported to the Commission. The June Meeting recommended that this TAC be maintained for 1975 pending clarification of the discard reporting problem.

The values of F calculated from 1973 data (Fig. 3) were 0.13 and 0.48 for females and males respectively (assuming M = 0.20). The fishing mortality rate calculated for males could be viewed with some skepticism. However, its position on the yield curve (Fig. 4) in relation to the  $F_{0.1}$  level is comparable to that of the females. These values probably represent average removals during 1963-73 of about 25,000 tons.

On this basis, the 1974 recommendation of 30,000 tons seems justified on the basis of known landings. If data on by-catches becomes available, then the TAC could be increased by an appropriate amount.

In setting the TAC however, one consideration might be the stock level that should be maintained to provide sufficient numbers for a viable inshore fishery. Although at present we have no way of knowing precisely what this level is, catches by the inshore fishermen would seem to indicate that the fishery may already be beyond this point.

### References

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- Pitt, T. K. 1973. An assessment of American plaice on the Grand Bank, ICNAF Divisions 3L and 3N. Intern. Comm. Northw. Atlant. Fish. Res. Bull. No. 10, 1973, pp. 63-77.
1974. The Greenland halibut fishery of Subarea 2 and Divisions 3K and 3L. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/2, Serial No. 3144.

Table 1. Nominal catches of Greenland halibut, Subarea 2 and Divisions 3K and 3L, 1963-74.

YEAR	CANADA	DEN.	FRG.	GDR.	ICE.	NOR.	POL.	ROM.	SPAIN	USSR	UK	PORTUGAL	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

Table 1 (cont'd)

YEAR	CANADA	DEN.	FRG.	GDR.	ICE.	NOR.	POL.	ROM.	SPAIN	USSR	UK	PORTUGAL	TOTAL
1969	11,553	--	202	10,014	1	38	5,406	40	--	9,268	--	--	36,522
1970	11,706	--	13	9,158	--	660	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	--	--		1,051	--	

\* USSR Landings not yet received.

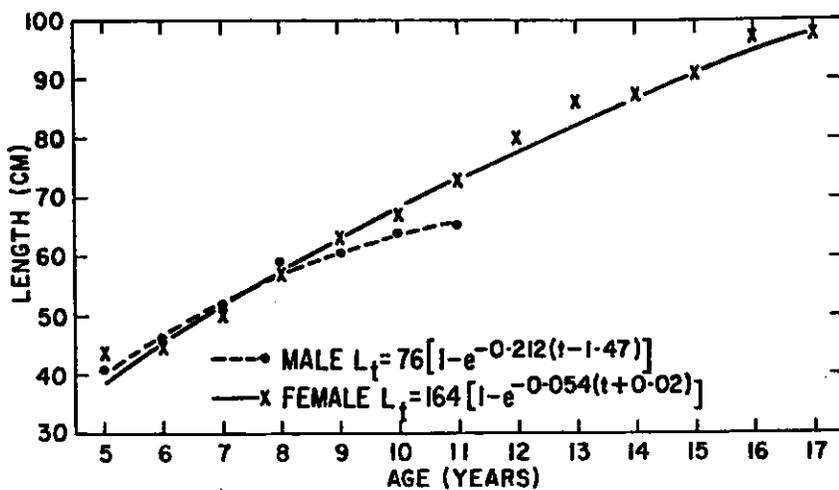


Fig. 1. Growth curves of Greenland halibut for ICNAF Subarea 2 and Divisions 3K and 3L

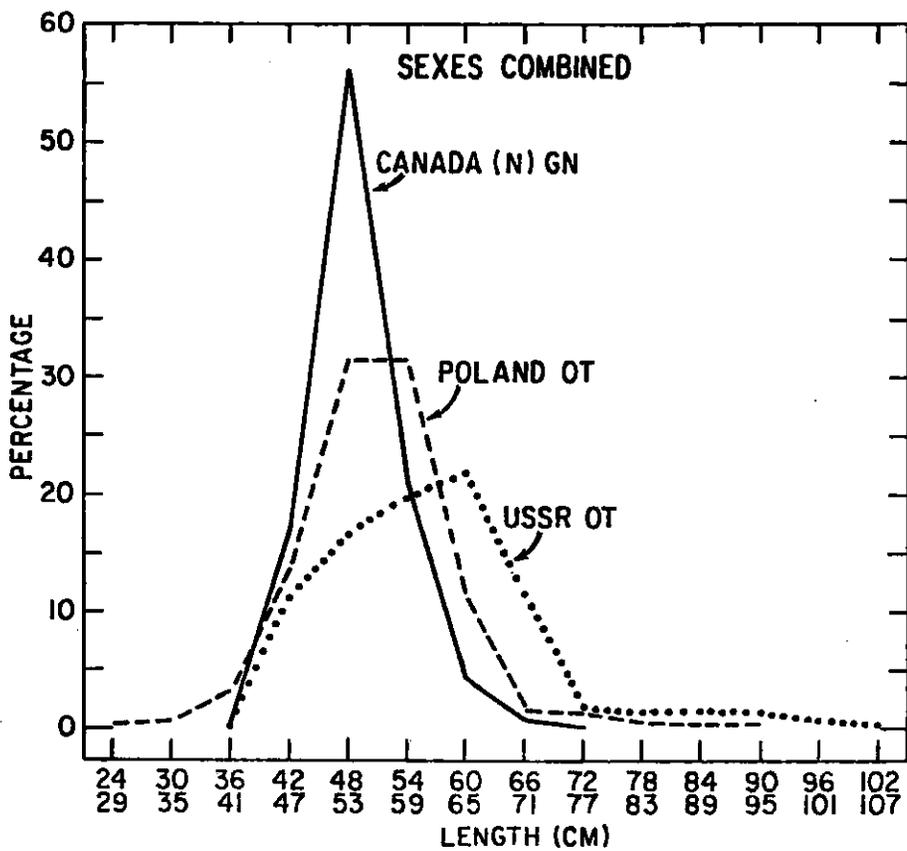


Fig. 2. Comparison of length distributions of commercial catches of Canada (N), Poland and USSR.

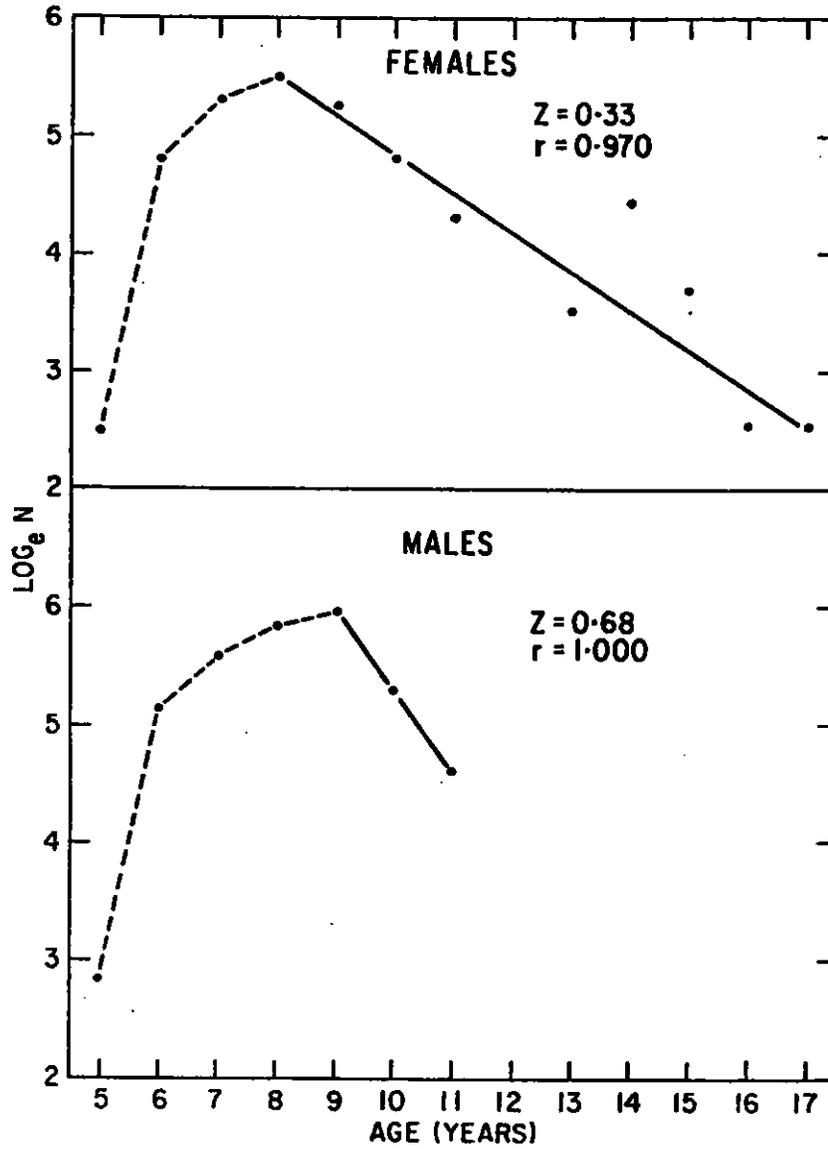


Fig. 3. Catch curves of Greenland halibut from USSR exploratory frequencies and Canadian research age-length keys for 1973.

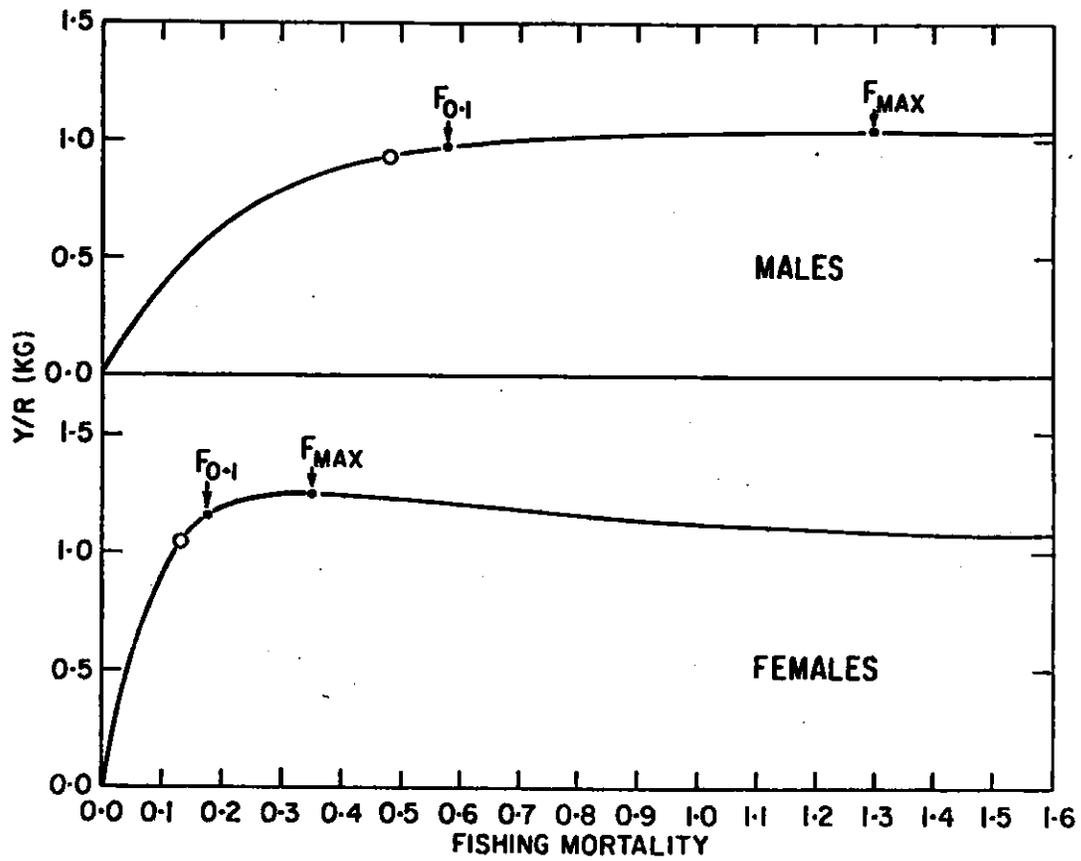


Fig. 4. Yield per recruit curves for male and female Greenland halibut for 1973 USSR and Canadian combined data.

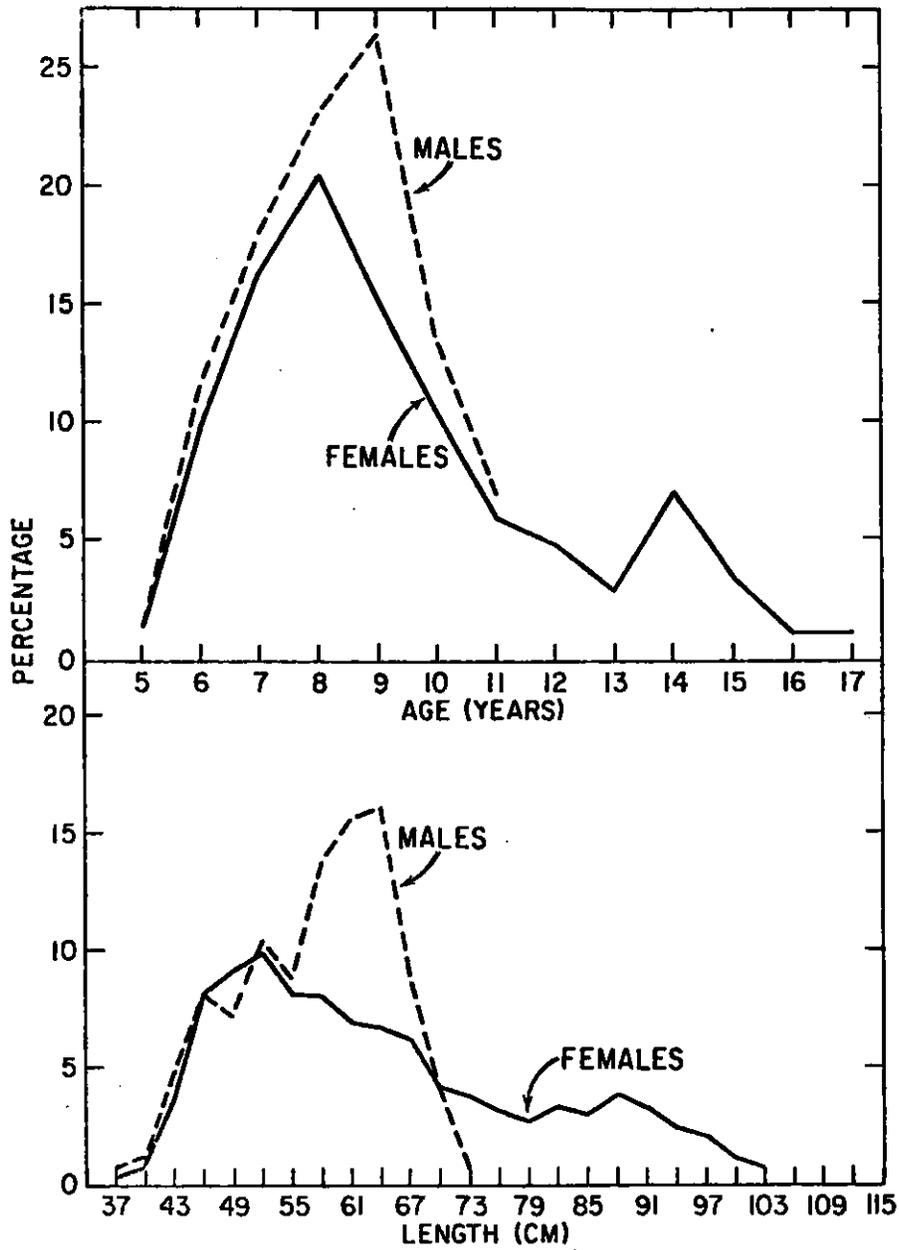


Fig. 5. Age and length distributions of male and female Greenland halibut for 1973 USSR and Canadian combined data for Sub-area 2 and Divisions 3K and 3L.

