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An analytical assessment of the witch flounder stock in the Gulf of St. Lawrence (ICNAF Divisions 4R and 4S)

by

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Introduction

Although the largest proportion of the catch of witch flounder is taken as a by-catch of other commercial groundfish fisheries, it forms a major component of the Canadian groundfish resource. The fishery for witch began in the late 1940's with the establishment of the local otter-trawling fleet in Newfoundland. Exclusive fishing occurred in Fortune Bay in the early 1950's and became important in the Gulf of St. Lawrence when the Danish Seiners moved to St. George's Bay from Fortune Bay in 1956 because of much reduced catches and this fishery has been carried out ever since. In recent years the landings in the Gulf of St. Lawrence have increased rapidly to 5,300 tons in 1976 (Table 1) as the result of a winter fishery for cod in the vicinity of St. George's Bay. A precautionary quota of 3,500 tons annually was set for this area in the last couple of years based on catch statistics. This document presents the first analytical assessment of this witch stock in the Gulf of St. Lawrence.

Materials and Methods

Samples were collected from Canadian commercial trawler landings in 1975-77. The age and length composition and growth patterns (Fig. 1, 2 and 3) were considered sufficiently different enough to warrant separation of the sexes. Length frequencies were available from research vessel data for 1974-77 and these frequencies were plotted (Fig. 4) for comparison from year to year as well as comparison with the commercial otter trawl frequencies. The catch curves (Fig. 5) were constructed by

adjusting the age composition of catches for each year up to the total landings for that year. The total landings at age were then combined for the years 1976-77. The 1975 age data were deemed insufficient to be representative of the fishery for that year and therefore were not included in the catch curve calculations. A natural mortality of M = 0.20 was used for the males and M = 0.15 was used for the females in all calculations.

The mean selection lengths (l_c) were calculated for each year of 1975-77 separately, then a weighed average l_c was calculated based on the total landings for each year. The average l_c for males for 1975-77 was 35.07 cm and females 38.28 cm.

Von Bertalanffy growth curves were fitted to the 1976-77 commercial age-length data and the Beverton and Holt yield-per-recruit (Fig. 6) model was applied to males and females separately using the following parameters:

	Males	Females
W_∞ - asymptotic weight	1.014 kg	2.401 kg
K - growth coefficient (from Von Bertalanffy equation)	0.21	0.10
t_0 - theoretical age at length 0 cm (from Von Bertalanffy equation)	3.8 yrs	2.3 yrs
t_ρ - age at recruitment	7.0 yrs	7.0 yrs
$t_\rho{}^1$ - age at mean selection length	9.1 yrs	10.8 yrs
t_λ - age at last significant contribution to the fishery	18 yrs	26 yrs

Yield-per-recruit curves were then plotted for M = 0.20 (males) and M = 0.15 (females) and were computed up to F = 2.5.

Results

The length composition generally ranged from 28 cm to 52 cm for the males and from 28 cm to 60 cm for females (Fig. 1). The size composition was considerably greater for females than males as is usual with witch stocks in other areas. The peaks were consistent except for 1975 where peak sizes were somewhat lower than 1976 and 1977. The

age composition ranged from 6 years to 18 years for males and 6 years to 26 years for females with the first fully recruited age groups occurring at 11 years old for males and varying from 12 to 14 years old for females (Fig. 2).

The growth rate for males (Fig. 3) is apparently slightly faster than females up until age 14 years after which the growth rate of males drops off quickly. This seemingly faster growth rate in the males may, however,be influenced by the long life span of the females over the males in computing the curves since individual data points for females are higher in all cases for all ages up to 14 years with the exception of age 7 years.

The length frequencies from research vessel data are rather similar for 1974 through 1977 (Fig. 4) with the highest peaks in the same region as shown in the commercial frequencies. The fluctuations in the length compositions may be due to random fishing in different strata as opposed to direct fishing in a particular area. The pre-recruit section of the frequencies over the past couple of years indicates the possibility of good recruitment which may be indicative of the very good fishing of 1977 and again in 1978. Unfortunately, the age data are unavailable to determine any year-class strength.

Catch curves from the commercial age composition gave estimates of instantaneous total mortality of $Z = 0.90$ for the males and 0.55 for the females (Fig. 5). The yield curves (Fig. 6) indicate F_{max} occurring at 1.15 for males and 0.70 for females. The $F_{0.1}$ value for the males occurred at 0.33, considerably lower than the present F of 0.70. The $F_{0.1}$ for females was 0.21 also well below the present F of 0.40.

Discussion

The main fishery for witch in the Gulf of St. Lawrence is a directed effort in the mid-winter time in a localized area off St. George's Bay. Catches have been as high as 100-150 tons per week per ship in this area. This localization may be due to adverse environmental conditions during this time of year but is more likely to be a prespawning concentration similar to that which occurs in the Hawke Channel area. Bowering (1976) in studying the distribution of this species found that during other times of the year these animals are very dispersed in the Gulf of St. Lawrence with the exception of St. George's Bay where the muddy bottom is very favourable to this species.

Powles and Kohler (1970) suggested seasonal movements in and out of the Gulf due to hydrographic conditions, however, such does not seem the case since these high concentrations are now found inside

in winter time. With these changes in concentration from one season to another, it has been difficult to determine whether the witch in the southern Gulf of St. Lawrence area (ICNAF Division 4T),around Cape Breton, belongs to the same population as ICNAF Divisions 4RS. Little data are available for comparison; however, a commercial frequency was collected from 4T during 1977 and when compared to 4RS (Fig. 7) the 4T fish are considerably smaller than those caught in 4RS. Unfortunately, no further data are available to determine if these differences are real or if it is a difference in the geographical distribution by size. Powles and Kohler (1970) found definite size differences by depth which could very well be the case here.

The F values presented here probably reflect average catch levels over the past several years which averaged 3,500 tons annually. The high catch rates of the past couple of years may not necessarily be indicative of an increase in the stock inasmuch as it is a directed fishery at a particular time of year when the stock is very densely concentrated.

References

Bowering, W. R. 1976. Distribution, Age and Growth,and Sexual Maturity of Witch Flounder (Glyptocephalus cynoglossus) in Newfoundland Waters. J. Fish. Res. Bd. Can. 33-7, pp 1574-1584.

Powles, P. M. and A. C. Kohler. 1970. Depth distribution of various stages of witch flounder (Glyptocephalus cynoglossus) off Nova Scotia and in the Gulf of St. Lawrence.

Table 1. Nominal catches of witch flounder from ICNAF Divisions 4R and 4S, 1967-77.

	COUNTRY					
YEAR	Canada (M)	Canada (N)	UK	France (SP)	USA	TOTAL
1967	801	133	1	-	-	935
1968	582	679	-	6	-	1267
1969	1766	1401	-	13	-	3180
1970	1372	2023	-	1	2	3398
1971	565	1562	-	-	-	2127
1972	728	206	13	5	-	952
1973	236	649	-	2	-	887
1974	793	1718	-	9	-	2520
1975	409	1524	-	-	-	1933
1976	1762	3371	-	208	-	5341
1977	2689	1537	-	-	-	4263*

* May change slightly

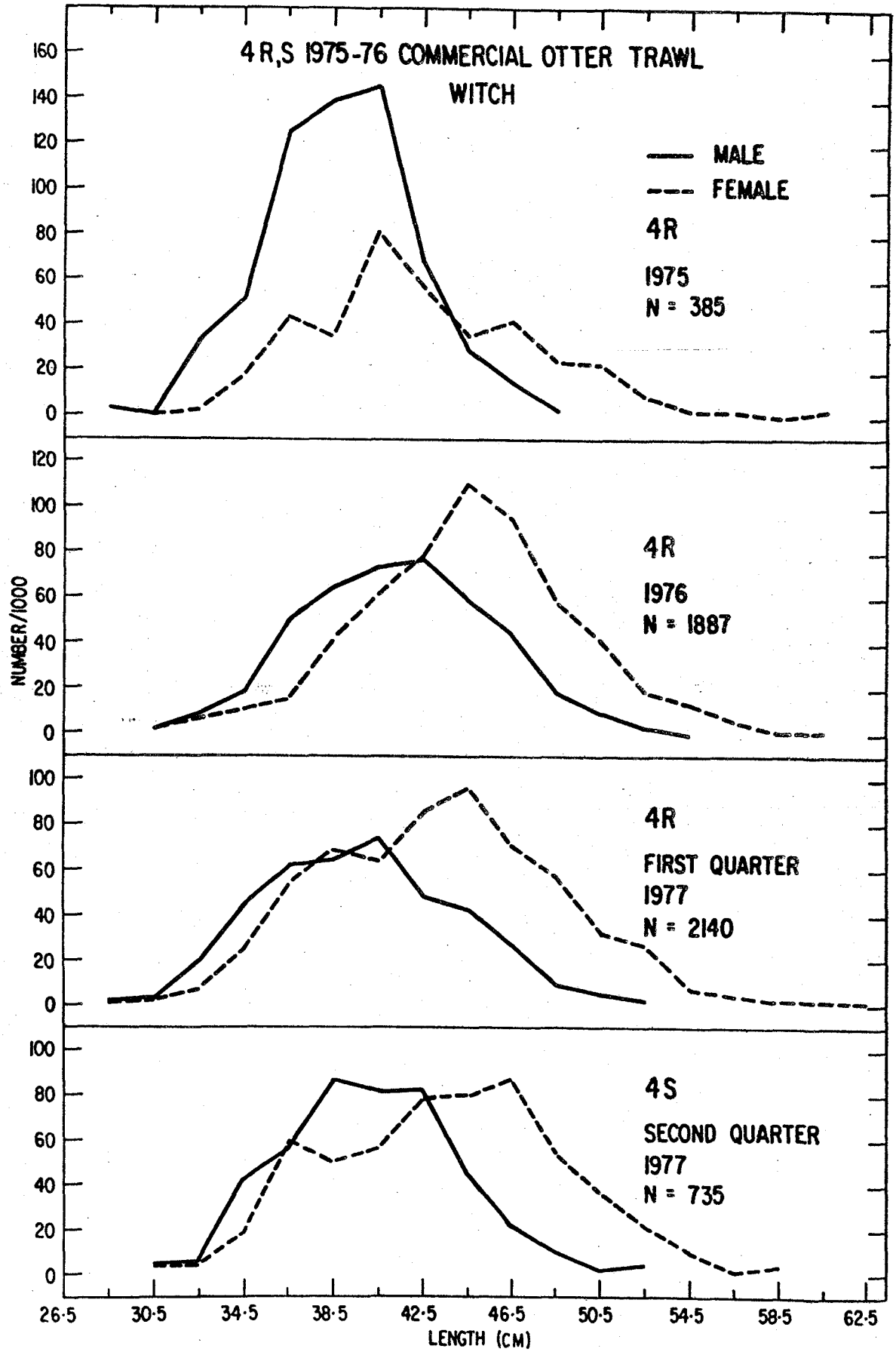

Fig. 1. Length composition of male and female commercial otter trawl witch from ICNAF Divisions 4RS, 1975-77.

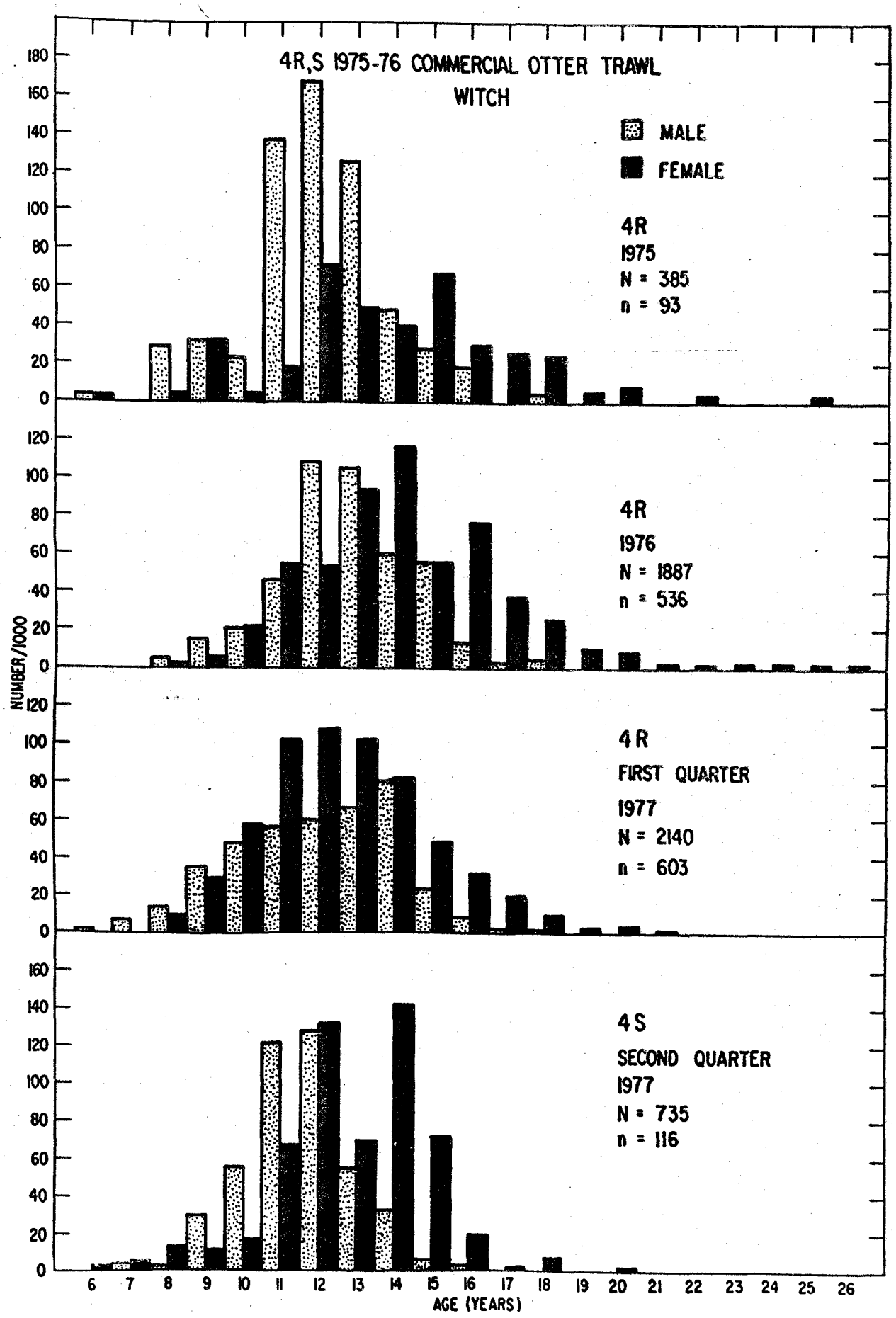

Fig. 2. Age composition of male and female commercial otter trawl witch from ICNAF Divisions 4RS, 1975-77.

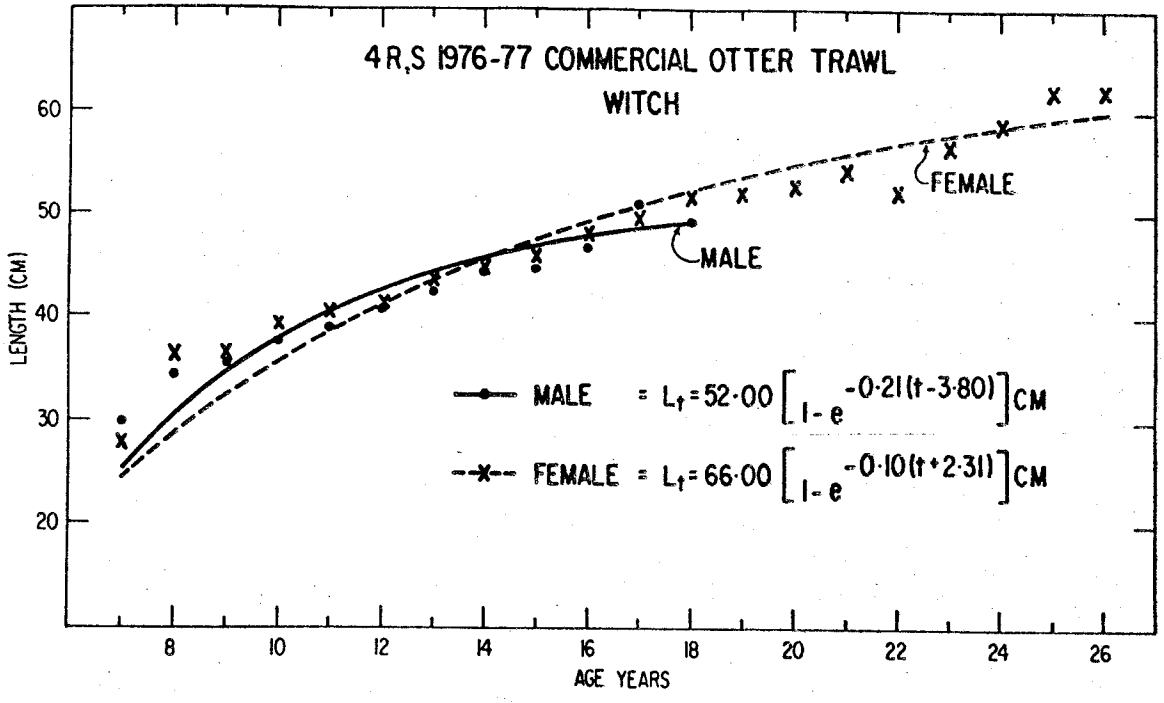

Fig. 3. Growth curves of male and female commercial otter trawl witch from ICNAF Divisions 4RS, 1976-77.

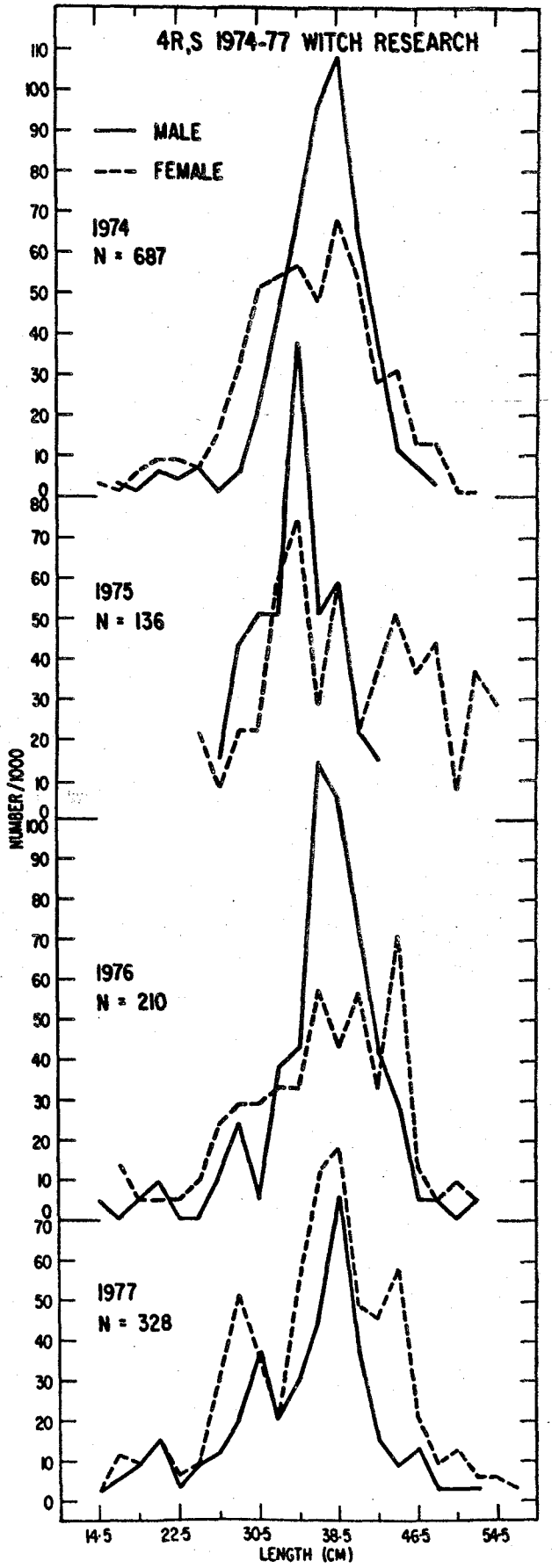

Fig. 4. Length frequency distribution of male and female witch 1974-77 from research vessel data, ICNAF Divisions 4RS.

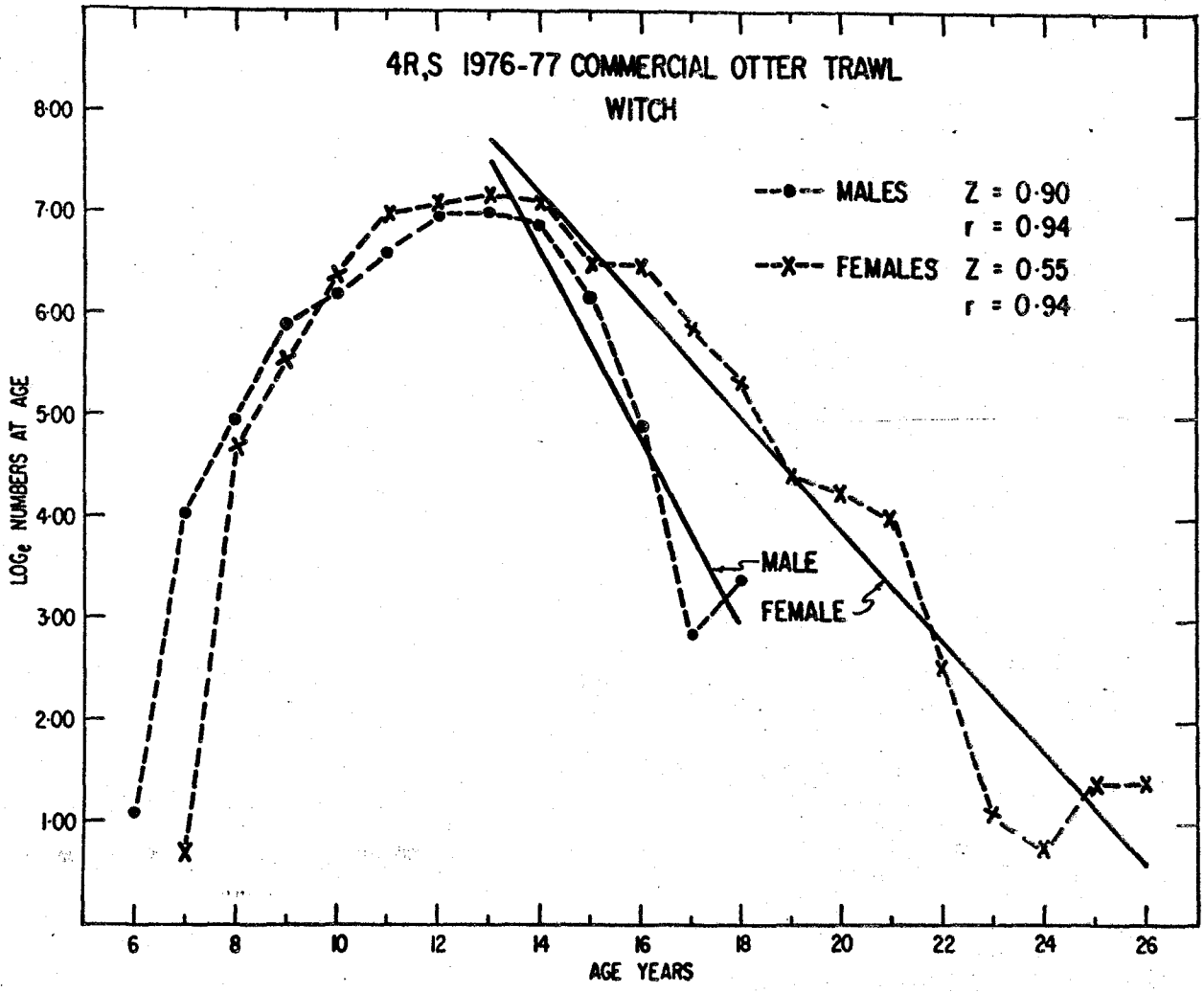

Fig. 5. Catch curves of male and female witch from commercial otter trawl catches 1976-77, ICNAF Divisions 4RS.

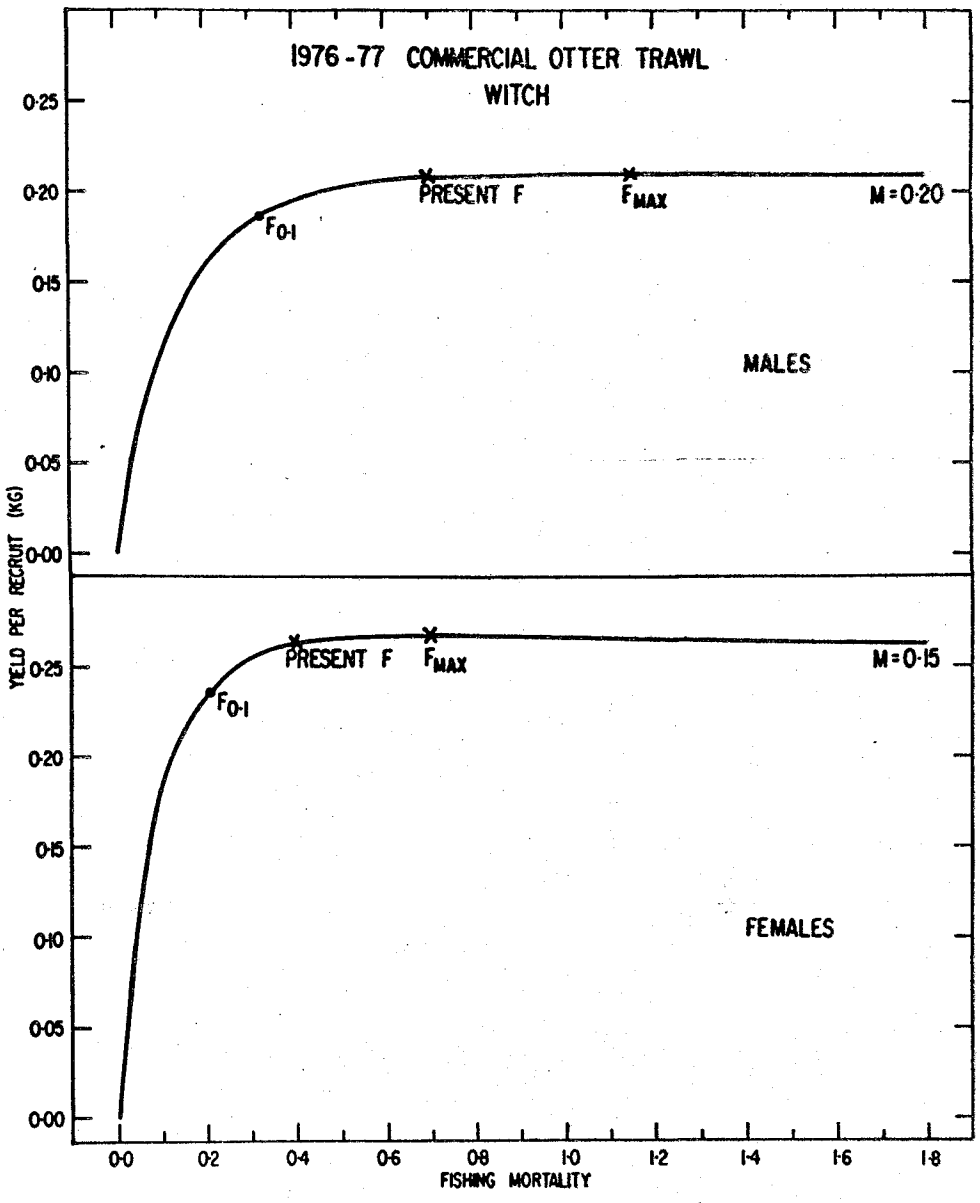

Fig. 6. Yield-per-recruit curves for male and female witch, ICNAF Divisions 4RS.

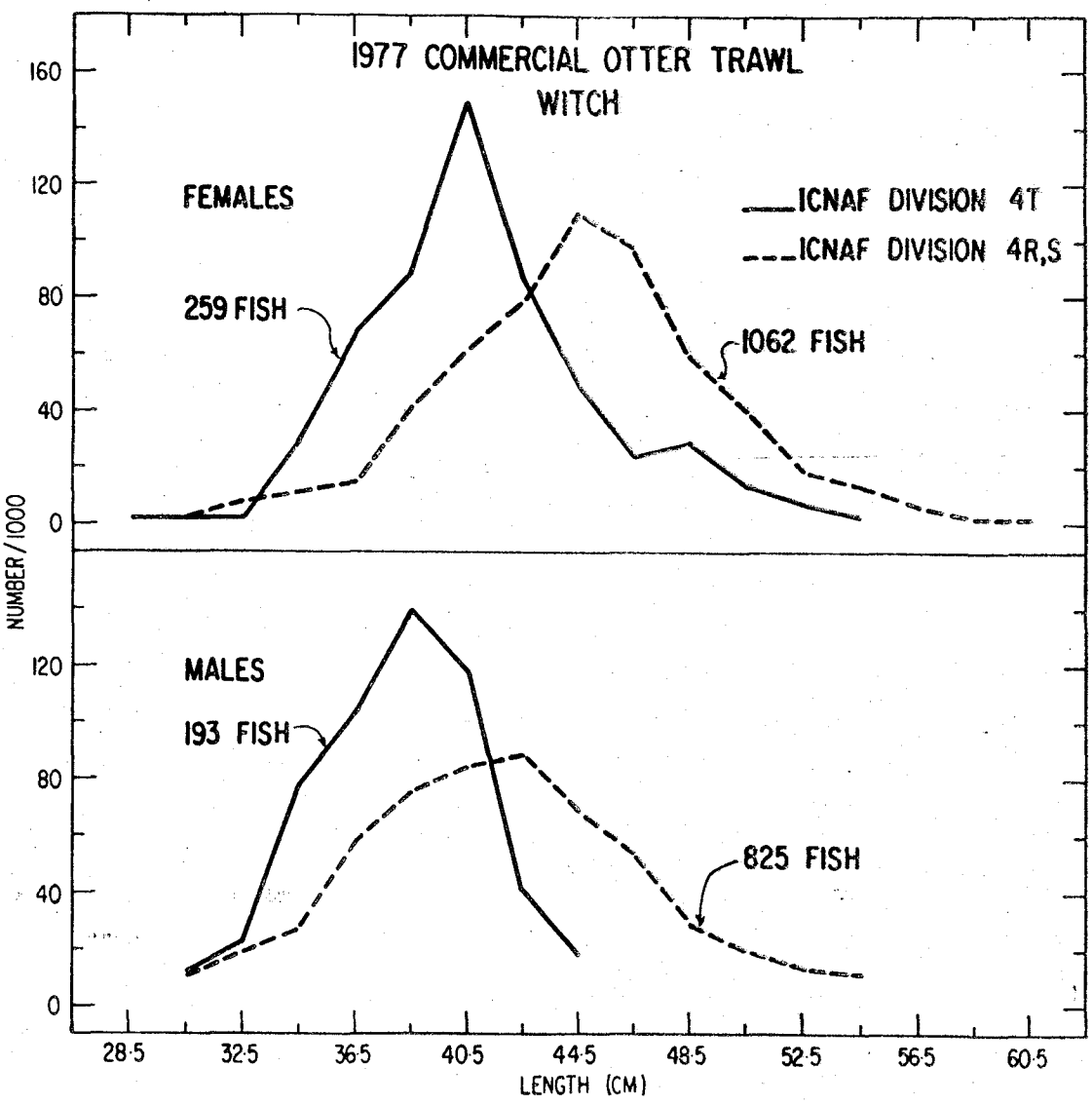

Fig. 7. A comparison of male and female witch length frequency composition for ICNAF Divisions 4RS and 4T from commercial otter trawl, 1977.