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An Assessment of Redfish on the Flemish Cap

by

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## INTRODUCTION

Nominal catches have varied greatly over the history of the fishery from over 50,000 t in 1958 and 1959 to an average of 3000 t from 1967 to 1970. Recent catches peaked in 1972 at 42,000 t and have ranged between 16,000 and 20,000 t since 1975 under quota regulation (Fig. 1).

The fleet composition of the directed fishery has changed greatly between 1959 and 1980. Prior to 1970, USSR tonnage class 4 otter trawl vessels were the main prosecutors of the fishery. From 1971 to 1975, USSR tonnage class 7 otter trawl vessels caught the bulk of the directed redfish catch. In 1974, midwater trawl gear was beginning to be used and since 1976 has caught the bulk of the catch. The midwater trawl fishery is mainly composed of USSR tonnage class 7 vessels with limited participation by Canadian tonnage class 5 vessels (26% in 1979 but none in 1980).

The data which were examined to evaluate the status of the stock were: catch and effort data from 1972 to 1980; commercial length frequencies for 1981 from USSR and Canadian midwater trawl vessels; and, research vessel information from Canada and USSR sources.

## MATERIALS AND METHODS

### Estimation of CPUE

Redfish directed effort was defined as those catches where redfish comprised 50% or more of the total catch. Since the fleet composition of the directed fishery changed between 1970 and 1971 and low levels of directed effort during the 1960's had resulted in missing values in the catch rate series (Gavaris 1981), catch and effort data from 1972 to 1980 only were evaluated in this assessment. The vessel types represented were USSR tonnage class 7 otter trawl and midwater trawl, Canada(N) tonnage class 5 otter trawl and midwater trawl, and Canada(MQ) tonnage class 5 otter trawl. Data were obtained from ICNAF/NAFO statistical bulletins, the 1980 data being preliminary.

Fishing effort was standardized using the method developed by Gavaris (1980). The regression of  $\ln$  (catch rate) versus vessel type, month and year categories, and weighted by effort, was used to obtain estimates of the power of the years relative to 1972 which was set equal to 1.

### Commercial Length Frequencies

Samples of the length composition of the USSR and Canada midwater trawl redfish catches were obtained for 1981. Catches by USSR tonnage class 7 midwater trawl vessels accounted for 66% of the directed redfish catch in 1980. A similar pattern would be expected in 1981.

### Research Vessel Surveys

Length frequencies were available from USSR research vessel surveys in 1981, using both midwater and bottom otter trawl gears.

The 1982 Canadian research vessel survey to the Flemish Cap did not sample all strata at depths greater than 370 m due to poor weather conditions. As such, the 1982 survey results were not representative of the population of large redfish. The length frequency from the 1982 survey is presented with that of 1981 for comparison of the distribution of small fish in the 2 yr. The age composition of the redfish population for 1978-81 was used to calculate Paloheimo Z values.

## RESULTS AND DISCUSSION

### CPUE

Significant results were obtained from the multiplicative model with the normality assumptions satisfactorily met (Table 1). The analysis indicated that the power of the midwater trawl gears were relatively higher than the bottom otter trawl gears. Although a seasonal pattern in the catch rates was not pronounced, the catch rates from December to March were generally lower than for other months during the year.

The relative powers of the years 1972-80 are shown in Table 2 and Fig. 2. A generally steady decline occurred through the 1974-78 period. Increases occurred in both 1979 and 1980, approaching the levels of the early 1970's. In last year's assessment (Gavaris 1981) the average catch rates for the 1975-1979 period were observed to be lower than those for 1972-74, which were the highest in the series. The stock was concluded to be in a stable condition however based on recent catch rates which were higher than most in the series and on good recruitment. The present analysis would suggest that the stock declined during the middle 1970's, relative to 1972-73 levels, until good recruitment entered the fishery in 1979-80.

### Commercial Length Frequencies

Length frequencies from the USSR midwater trawl fishery (Fig. 3) in 1981 indicated that a large proportion of the catch was composed of 27-29 cm fish. A sample of the length composition of the redfish catch by Canada(N) midwater trawl vessel in 1981 (Fig. 4) showed a concentration on the same length groups. Length frequencies from USSR midwater trawl vessels for 1980 had shown an abundance of 24-27 cm fish in the catch. These data indicated that the fishery in 1980 and 1981 was largely based on the successful year-classes of the early 1970's. Increases in catch rates in 1979 and 1980 were likely due to these abundant year-classes recruiting to the fishery.

### Research Vessel Surveys

The length distributions of redfish in numbers per thousand, as surveyed by USSR research vessels in 1981, are shown in Fig. 5. Samples from bottom trawl gear from depths of 546-564 m showed some fish in the 27-29 cm group but a much larger proportion of 32-40 cm fish. The 27-29 cm fish showed up prominently in samples from bottom trawl gear from depths of 380-500 m and from midwater trawl gear at depths of 440-520 m. Of the two later length distributions, the one from midwater gear, which fished greater depths, showed a greater relative abundance of fish larger than 30 cm. These data suggested that 27-29 cm fish were most abundant at depths less than 500 m. The relative proportion at length of the redfish population could not be determined from the data.

The length distributions of redfish, represented as stratified numbers per tow, as surveyed by the Canadian research vessel GADUS ATLANTICA in 1981 and 1982 are shown in Fig. 6. The 1981 length distribution was dominated by 26-28 cm fish. Fish smaller than this length group were virtually absent from the population except for an abundance of 7-8 cm fish. Prospects for recruitment in the near future would, therefore, appear to be poor. The 1982 length distribution showed an abundance of fish at 7-8 cm and at 10-12 cm. The 10-12 cm fish, which probably were the same year-class first sampled in 1981, were more abundant in 1982 than in 1981. The 7-8 cm fish in 1982 were more abundant than the 7-8 cm fish had been in 1981. These data suggested that two good year-classes of pre-recruits have entered the population. Their impact on the commercial fishery, however, provided they continue to be abundant, would not be felt for many years. The length distribution of larger fish in 1982 was not considered to be representative of the population for the reason cited previously.

The age distributions for 1978-81, in stratified numbers per tow, from Canadian research surveys are presented in Table 3 and Fig. 7. Paloheimo Z's were calculated for the 1954-63 year-classes between individual years and groups of years. These year-classes were chosen because they were considered to be fully recruited in all years and excluded the oldest age groups. Values calculated using the 1979 survey were anomalous, the numbers at age for almost all year-classes being lower in 1979 than in neighbouring years. The F values obtained for the older age groups ranged between

.09-.12 (Table 4). A comparison of the redfish population length distribution from research (Fig. 6) with the length distribution of the commercial catch (Fig. 3-4) would suggest that the fishing mortality on the early 1970 year-classes may be greater than on the 1954-63 year-classes. If so, average fishing mortalities may be at about the  $F_{0.1}$  level (estimated between .12-.16 for various redfish stocks) during a period when catches have averaged below the present TAC of 20,000 t.

#### CONCLUSIONS

Catch rates increased in 1979 and 1980 from a relatively low level in 1978, largely due to the recruitment of the early 1970 year-classes to the fishery. These year-classes have appeared strong in the research surveys. Rough estimates of fishing mortalities in recent years suggested that fishing may be at about the  $F_{0.1}$  level during a period when catches have been below the TAC.

Prospects for recruitment in the near future, following the early 1970 year-classes, appeared to be poor based on Canadian research vessel surveys.

#### REFERENCES

- Gavaris, C. A. 1981. An assessment of redfish on the Flemish Cap. NAFO SCR Doc. 81/VI/53, Ser. No. N337, 7 p.
- Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Table 1. Results of the regression, weighted by effort, of  $\ln$  (catch rate) versus vessel type, month and year categories (Type 1, 2, and 3 respectively).

MULTIPLE R.....0.758  
 MULTIPLE R SQUARED.....0.574

ANALYSIS OF VARIANCE				
SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.459E1	4.459E1	
REGRESSION	21	1.234E1	5.875E-1	9.055
TYPE 1	4	6.360E0	1.590E0	24.508
TYPE 2	9	3.177E0	3.530E-1	5.441
TYPE 3	8	3.033E0	3.792E-1	5.845
RESIDUALS	141	9.147E0	6.487E-2	
TOTAL	163	6.607E1		

Table 2. The relative power of the years 1972-80 as an index of abundance of the redfish stock in Division 3M. The proportion of the nominal catch used in the standardization procedure is listed along with standardized effort. The average C.V. for the index was 0.09.

Year	Nominal catch	Proportion	Relative power		Effort
			Mean	S.E.	
1972	41,946	0.909	1.000	-	41,946
1973	22,352	0.893	1.013	0.077	22,056
1974	34,671	0.844	0.948	0.072	36,577
1975	16,075	0.738	0.804	0.070	19,993
1976	16,998	0.794	0.696	0.069	24,433
1977	20,072	0.619	0.865	0.095	23,199
1978	16,820	0.681	0.554	0.057	30,377
1979	20,074	0.691	0.753	0.076	26,666
1980a	15,966	0.653	0.874	0.106	18,271
1981a	13,203				

<sup>a</sup>Preliminary.

Table 3. The age composition (mean no. per tow) of Div. 3M Mentella redfish population, 1978-81, as determined by Canadian research vessel surveys.

AGE	MEAN NOS. PER TOW			
	1978	1979	1980	1981
1	0.00	0.57	0.00	0.03
2	0.00	2.77	0.18	70.65
3	0.12	1.23	0.42	0.03
4	1.17	1.11	0.31	0.28
5	1.41	0.95	0.59	0.41
6	11.21	3.63	1.09	0.53
7	34.97	9.60	9.08	1.86
8	91.42	34.73	73.60	18.23
9	26.54	44.63	181.34	63.49
10	5.83	8.16	118.88	95.12
11	1.73	2.31	54.60	72.99
12	8.39	1.41	21.88	32.07
13	5.89	1.70	19.05	28.52
14	7.42	2.66	5.66	20.53
15	21.50	17.68	6.79	18.58
16	36.43	10.45	14.70	23.44
17	34.92	28.41	33.11	22.78
18	36.69	37.36	22.47	21.09
19	32.53	14.34	33.04	17.53
20	40.11	8.14	29.26	22.73
21	44.06	11.39	17.86	26.44
22	12.04	12.36	6.83	20.71
23	18.99	16.27	6.63	20.41
24	53.57	24.87	21.86	12.72
25	69.53	15.19	21.93	14.27
26	22.92	14.35	33.50	12.67
27	43.56	11.85	24.79	12.79
28	27.15	11.45	19.11	9.70
29	8.23	9.75	12.64	8.34
30	21.51	23.08	70.27	9.78

Table 4. Paloheimo Z values were calculated using numbers at age from research surveys for Division 3M redfish (1954-63 year-classes). Assuming  $M = 0.1$ , F values ranged between 0.09 and 0.12. Results using 1979 data were anomalous.

Ages	1978 15-24	1979 16-25	1980 17-26	1981 18-27
Z between years	0.62	-0.24	0.22	
Z <sub>1978-80</sub>			0.19	
Z <sub>1978-81</sub>				0.20

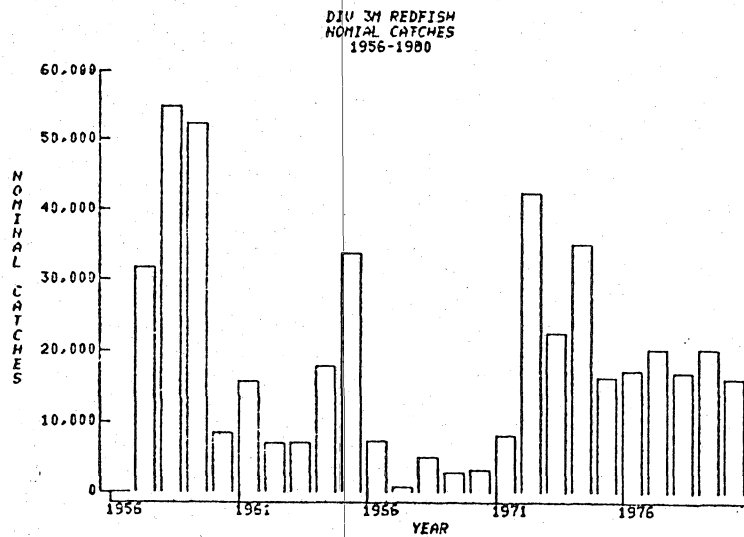


FIGURE 1. NOMINAL CATCHES OF REDFISH (MT) IN DIV. 3M FROM 1955-1980.

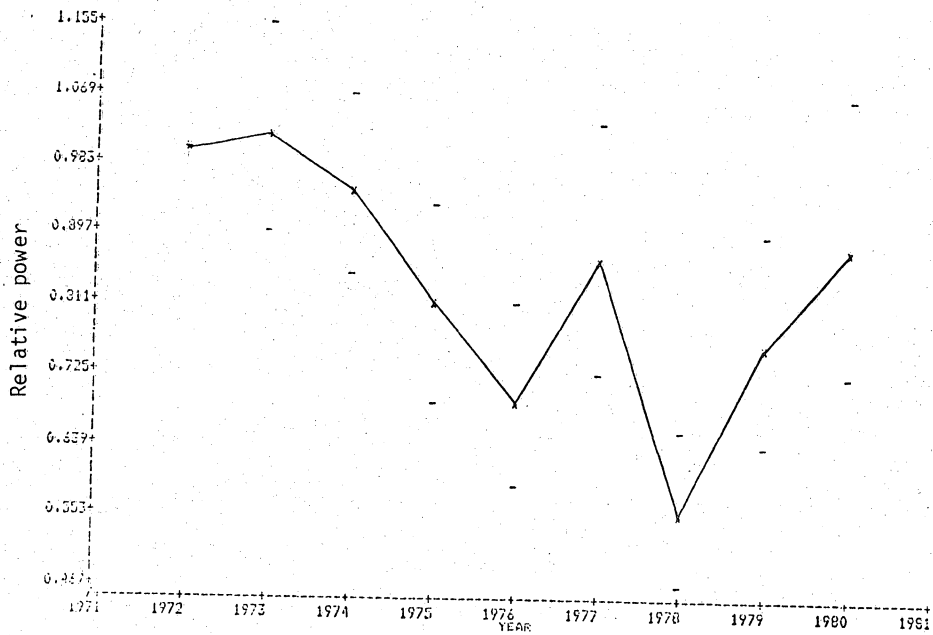


Fig. 2. Trend in relative power of years from 1972-81 (with 95% C.I.) for Div. 3M redfish. An upward trend was indicated in 1979 and 1980. Data for 1980 is preliminary.

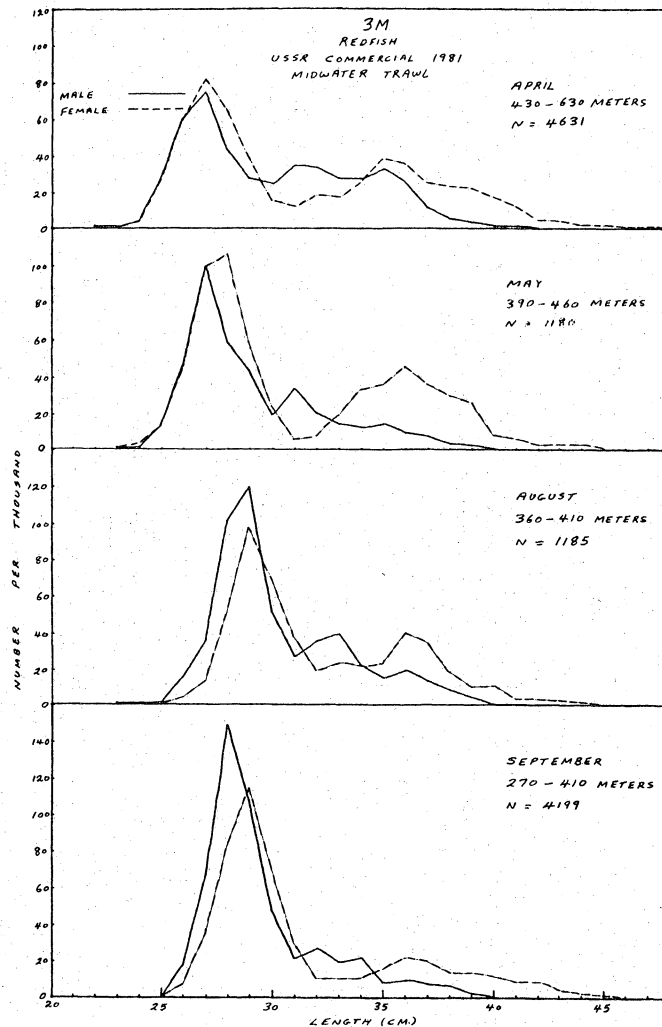


Fig. 3. Length frequencies of Div. 3M redfish from the USSR commercial midwater trawl fishery in 1981.

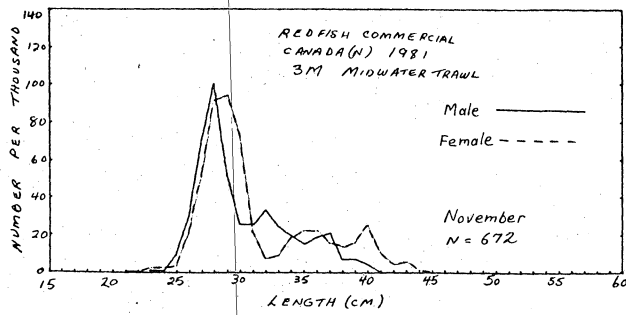


Fig. 4. Length frequency sample of Div. 3M redfish from the Canadian(N) commercial midwater trawl fishery in November 1981.

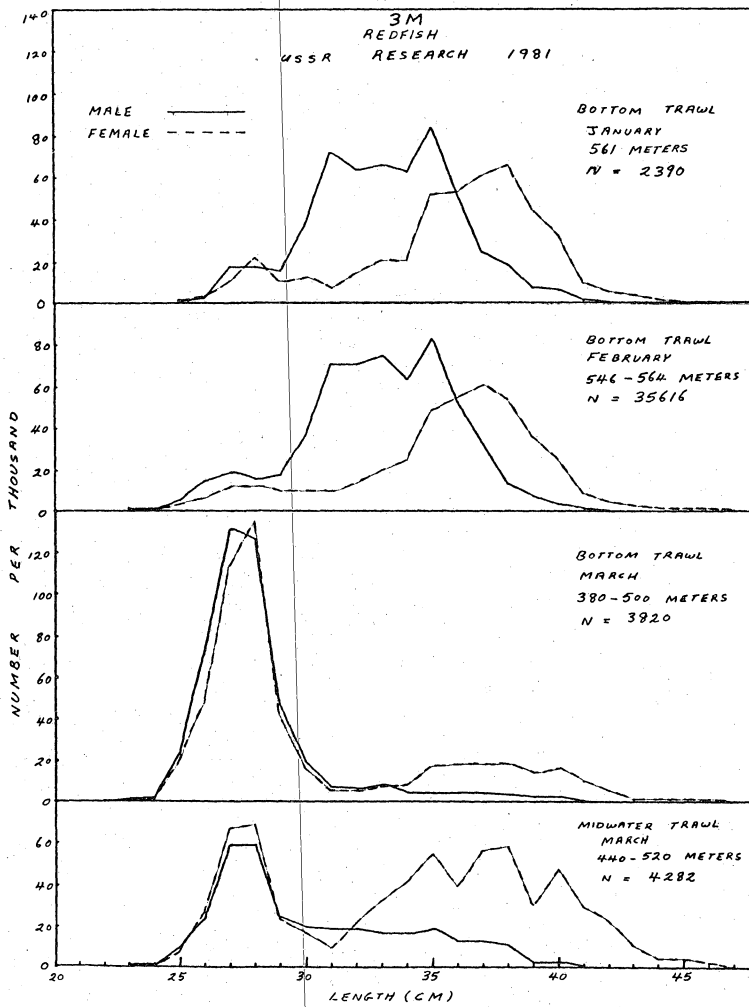


Fig. 5. Per mille length frequencies of Div. 3M redfish by depth as sampled by USSR research vessels in January-March 1981 using bottom trawl gear and in March 1981 using midwater gear.

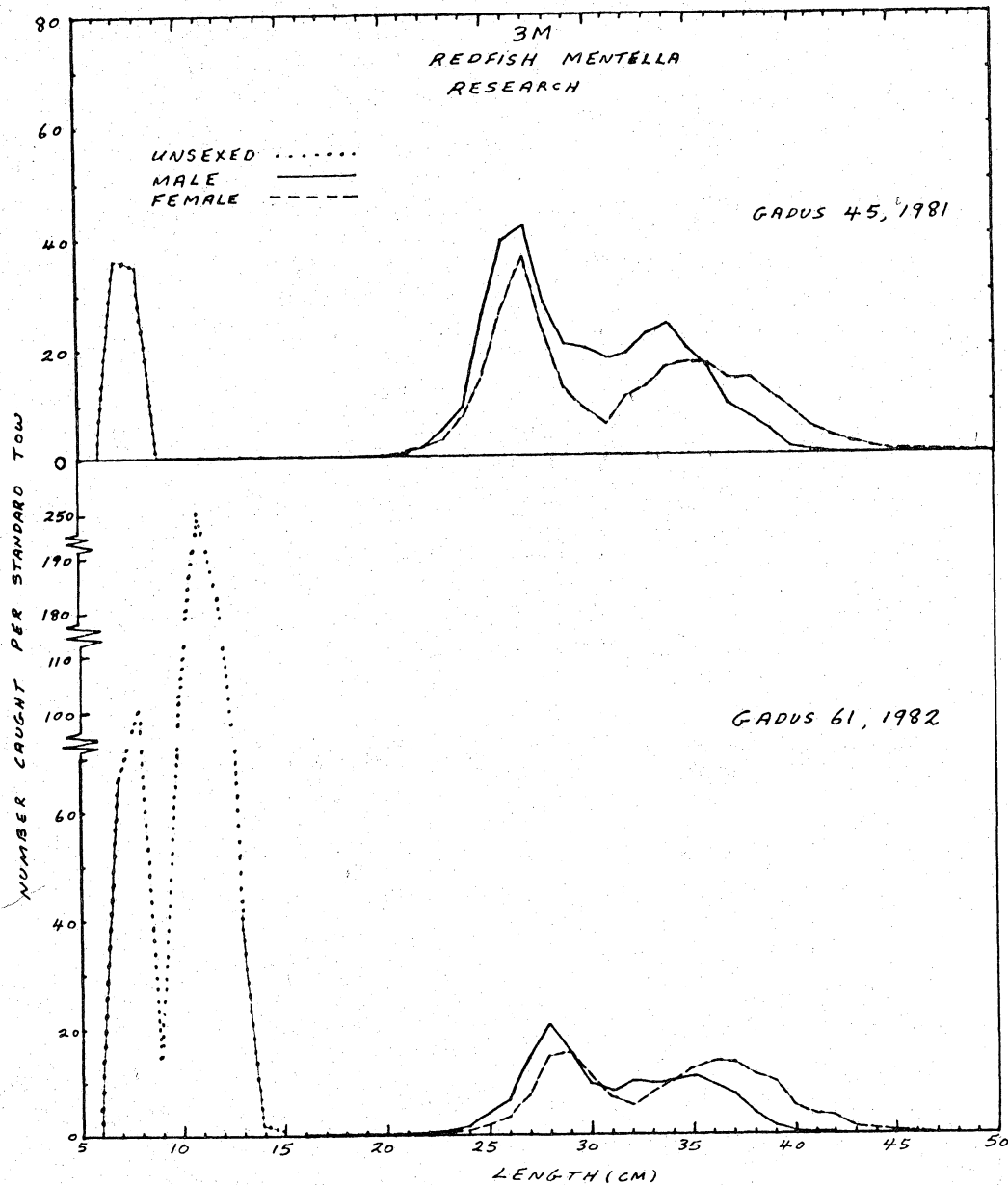


Fig. 6. Length frequencies of Div. 3M redfish as determined by Canadian research vessel surveys in 1981 and 1982. An apparently strong year-class of 7-8 cm fish which were first caught in the 1981 survey, showed up more prominently in the 1982 survey along with an additional year-class of 7-8 cm fish. The length frequency of larger redfish in 1982 was not representative of the population as not all depths were sampled.



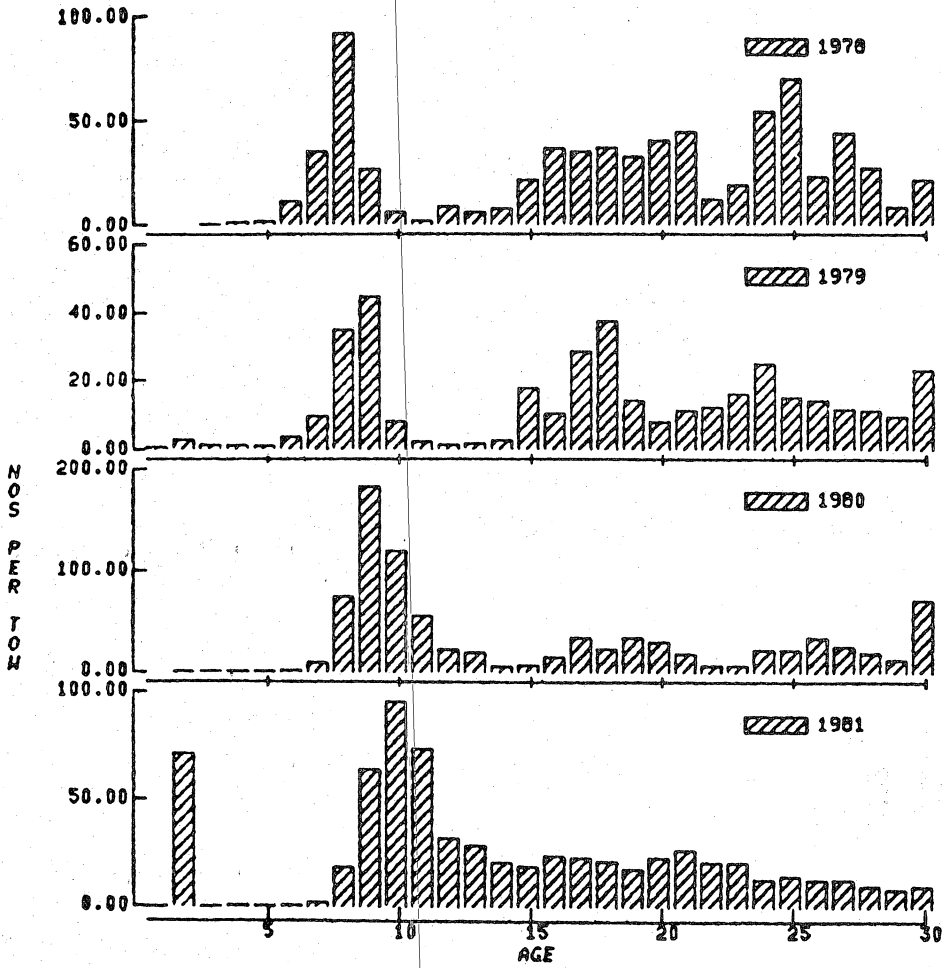


FIGURE 7. AGE COMPOSITION OF 3M REDFISH (NOS PER TOW) AS DETERMINED BY CANADIAN RESEARCH VESSEL SURVEYS 1978-1981

