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An Assessment of Redfish on the Flemish Cap

by

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INTRODUCTION

Redfish directed effort on Flemish Cap was low during the 1960's but has increased in the 1970's. Recent catches peaked in 1972 and have ranged between 16,000 and 20,000 MT under quota regulation.

Commercial catch and effort data, Canadian research survey abundance estimates and aging data and commercial length frequencies were evaluated in this report. A generally stable condition was indicated for the stock by the above indices with some relatively good year-classes being recruited to the fishery.

MATERIALS AND METHODS

ESTIMATION OF CPUE

Redfish directed effort was defined to be those catches where redfish comprised 50% or more of the total catch. Fishing effort was standardized using the procedure developed by Gavaris, S. (1980). The standard chosen was USSR TC 7 and Can (MQ) TC 5 otter trawl vessels and the regression was weighted by $(\text{Catch} \times \text{Effort})^{0.25}$ (Table 1). Significant results were obtained from the multiplicative model with the normality assumptions satisfactorily met (Table 2).

CANADIAN RESEARCH SURVEYS

The Flemish Cap has been surveyed in a consistent manner by the Gadus Atlantica for the past four years, 1978-1981. The numbers of standard tows per trip have been 133, 95, 130 and 142 for 1978-1981 respectively. The age composition of the surveyed population was available for 1978, 1980 and 1981. The research abundance indices presented in this report were all based on the simple arithmetic mean; no adjustment was made for possible nonnormality of the data.

COMMERCIAL LENGTH FREQUENCIES

Samples of the length composition of the USSR midwater commercial redfish catches and an exploratory catch by bottom trawls were obtained from NAFO for 1980 and are presented in Fig. 1 and 2 respectively.

RESULTS AND DISCUSSION

CPUE

Missing values in the CPUE series were the result of redfish directed effort being an almost negligible proportion of the total catch in some years. The catch rate for 1979 was based on preliminary data.

The series suggested a decline in the stock during the '60's. Directed effort was generally low for much of this period. The very high rates reported for the early '70's suggested that a recovery had occurred. The amount of redfish directed effort increased substantially in 1972 and continued at a much higher level than in the previous decade. The catch rates from 1975 to 1979 were lower than those from 1972 to 1974 but a generally stable condition was indicated for the stock.

The missing catch rate values impeded the application of a general production model to the data. As the missing values occurred during a period of transition in the fishery, any interpolation would be difficult to make and could greatly influence the results. The period from 1968 to 1979, with complete data, would not appear to approximate equilibrium conditions and did not provide sufficient information to determine a nonequilibrium curve. Methods designed to simulate equilibrium conditions (i.e. Gulland's averaging method) have been shown to be generally unreliable (Sissenwine 1978; Roff and Fairbairn 1980).

The most recent general production model developed for Div. 3M redfish was based on the Gulland method and came up with an MSY and yield at 2/3 MSY effort of about 16-17 and 15 thousand tonnes respectively (Gavaris, C. A. 1980).

SURVEY ABUNDANCE ESTIMATES

In most years, Sebastes mentella redfish have mainly been found in the 140-400 fath depth zone. Estimates of total numbers and total biomass for all strata surveyed and for strata in the 140-400 fath depth zone only, showed a close correspondence (Table 3). The difference in 1981 was due mainly to one very large set at 242 m (Stratum 505), which included a large number of very small fish. The catch for Stratum 505, averaged over 1978-1980, was 25.7 fish to per tow while the mean catch per tow in 1981 was 2639 fish.

While the abundance estimates do vary from year to year, the overall trend suggested a stable condition for the stock. The results for 1979 appeared to be anomolous when compared with the other years. The fewer number of sets completed in that year may have been a factor, however, even at the 1979 sampling intensity, Div. 3M has been relatively heavily sampled.

The age distribution of mentella redfish computed separately as stratified mean catch per tow at age of males, females and unsexed and then summed is shown in Table 5, for 1978, 1980 and 1981. The 1970 and 1971 year-classes and possibly 1972 appeared to be relatively large. These year-classes are reaching commercial size and may be expected to have a positive impact on the commercial catch rates. The 1979 year-class, age 2 in the 1981 survey, was caught in significant numbers in four sets from three strata (Stratum 505, 509 and 510), all in the southwest quarter of the Flemish Cap. As small fish of 7-8 cm are not usually caught in such great numbers, it should prove very interesting to attempt to follow this year-class through the fishery to verify this first impression of an extremely large year-class. The older age groups of redfish appeared to be well represented in all the surveys.

The survey results for Sebastes marinus were much more variable than those for S. mentella, S. marinus being caught in fewer numbers and more sporadically. As illustrated in Table 4, S. marinus was mainly caught between 50-141 fath. The biomass index was at its highest in 1978 and its lowest in

1981. The percentage that S. marinus formed of the total redfish catch changed from 25% in 1978 to about 11% in 1979 and 1980 to only 3% in 1981 (Table 5). These results would suggest that S. marinus may not be an important component of the redfish stock on the Flemish Cap at the present time. By implication, the commercial fishery may be mainly dependent on the mentella component.

COMMERCIAL LENGTH FREQUENCIES

Length frequencies from the USSR commercial midwater trawl redfish fishery (Fig. 1) in 1980 indicated that a large proportion of the catch was based on fish 24-27 cm at depths of approximately 400 m. From Canadian aging, these would probably be the 1970 and 1971 year-classes. At a depth of 500 m, a peak occurred for 28 cm fish with a greater proportion of the catch coming from larger fish than at the shallower depths.

The length frequency sampled from bottom trawl gear (USSR exploratory survey) at 400-550 m showed the majority of the catch to be comprised of fish greater than 30 cm (Fig. 2).

CONCLUSIONS

The catch rates from 1972 to 1979 have fluctuated about the same level, suggesting a stable condition for the stock. Canadian research abundance indices for 1978 to 1981 were generally consistent, except for the 1979 survey. Relatively good year-classes recruiting to the fishery were indicated. These year-classes were evident in the USSR commercial length frequencies. Older ages were well represented in the age frequencies which also suggested that the stock has not been overexploited at the present catch level.

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Table 1. Nominal catches of redfish from 1959 to 1979. The proportion of the total catch used in estimating the CPUE series (standardized to USSR TC 7 and Can MQ TC 5 otter trawlers) is shown along with CPUE, its standard error and the standardized effort.

Year	Total	Prop.	Catch rate		Effort
			Mean	S.E.	
1959	51,977	0.909	1.407	0.095	36,929
1960	8388				
1961	15,517	0.715	1.504	0.236	10,314
1962	6958	0.499	0.974	0.176	7147
1963	7035	0.801	0.972	0.167	7240
1964	17,647				
1965	33,427	0.513	1.015	0.142	32,927
1966	7241				
1967	729				
1968	4963	0.894	0.897	0.147	5531
1969	2801	0.734	1.049	0.238	2670
1970	3168	0.634	1.316	0.283	2408
1971	8033	0.462	1.306	0.196	6153
1972	41,946	0.934	1.784	0.133	23,511
1973	22,352	0.893	1.679	0.180	13,313
1974	34,671	0.844	1.784	0.137	19,435
1975	16,075	0.738	1.476	0.131	10,892
1976	16,998	0.794	1.415	0.139	12,016
1977	20,072	0.619	1.572	0.166	12,772
1978	16,820	0.681	1.127	0.121	14,929
1979	20,074	0.692	1.393	0.130	14,410

Table 2. Results of standardization procedure. Type 1 variables are vessel-gear-tonnage class combination. Type 2 are years.

Regression of multiplicative model

Multiple R. 0.904
Multiple R squared. 0.817

Analysis of variance

Source of variation	DF	Sums of squares	Mean squares	F-value
Type 1	4	$1.89013^{E}1$	$4.72534^{E}0$	39.909
Type 2	16	$5.19607^{E}0$	$3.24754^{E-}1$	2.743
Regression	20	$9.74947^{E}1$	$4.87474^{E}0$	41.170
Residuals	184	$2.17863^{E}1$	$1.18404^{E-}1$	
Total	204	$1.19281^{E}2$		

Table 3. Canadian research survey results for Sebastes mentella, Division 3M. Total estimated population numbers and biomass based on all strata surveyed and on strata between 141-400 fath only are presented with the coefficient of variation of the estimate appearing in brackets.

Year	Numbers ('000's)		Biomass (tonnes)	
	All strata	Strata (141-400 fath)	All strata	Strata (141-400 fath)
1978	573,397 (18)	570,533 (18)	271,995 (25)	271,101 (21)
1979	302,795 (15)	295,433 (15)	139,427 (16)	137,765 (16)
1980	682,010 (14)	680,338 (14)	265,075 (12)	264,213 (12)
1981	541,272 (22)	401,088 (18)	221,257 (23)	183,710 (18)

Table 4. Canadian research results for Sebastes marinus, Division 3M, 1978-1981. Estimated population numbers and biomass are presented based on all strata surveyed and on those strata between 80-200 fath only. The coefficient of variation appears in brackets. The estimated proportion of redfish on Flemish Cap that are S. marinus is also listed.

Year	Numbers ('000's) All strata	Numbers ('000's) Strata (80-200 fath)	Biomass (tonnes) All strata	Biomass (tonnes) Strata (80-200 fath)	Prop. marinus
1978	107,210 (43)	107,036 (43)	88,359 (43)	88,063 (43)	0.25
1979	24,343 (39)	24,320 (39)	17,096 (50)	17,066 (43)	0.11
1980	33,831 (77)	33,812 (62)	31,814 (86)	31,794 (68)	0.11
1981	7388 (56)	7388 (50)	6819 (58)	6819 (52)	0.03

Table 5. Mean numbers per tow at age of Sebastes mentella redfish from research surveys.

Age	1978	1980	1981
1	0	0	0.03
2	0	0.18	70.65
3	0.12	0.42	0.03
4	1.17	0.31	0.28
5	1.41	0.59	0.41
6	11.21	1.09	0.53
7	34.97	9.08	1.86
8	91.42	73.60	18.23
9	26.54	181.34	63.49
10	5.83	118.88	95.12
11	1.73	54.60	72.99
12	8.39	21.88	32.07
13	5.89	19.05	28.52
14	7.42	5.66	20.53
15	21.50	6.79	18.58
16	36.43	14.70	23.44
17	34.92	33.11	22.78
18	36.69	22.47	21.09
19	32.53	33.04	17.53
20	40.11	29.26	22.73
21	44.06	17.86	26.44
22	12.04	6.83	20.71
23	18.99	6.63	20.41
24	53.57	21.86	12.72
25	69.53	21.93	14.27
26	22.92	33.50	12.67
27	43.56	24.79	12.79
28	27.15	19.11	9.70
29	8.23	12.64	8.34
30+	21.51	70.27	9.78
NK	0.07	0.14	0.01
Total	723.71	860.80	683.16

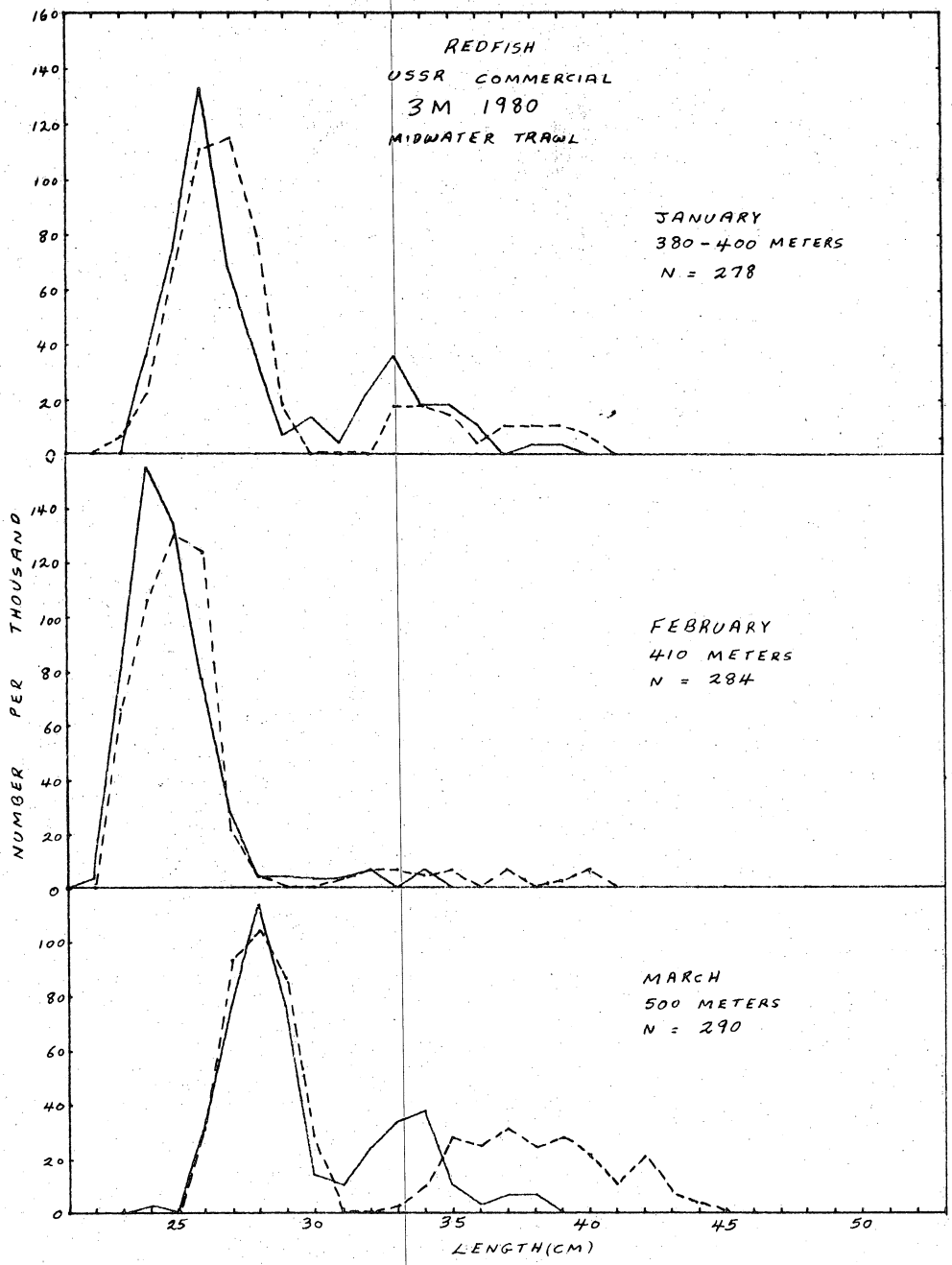

Figure 1.

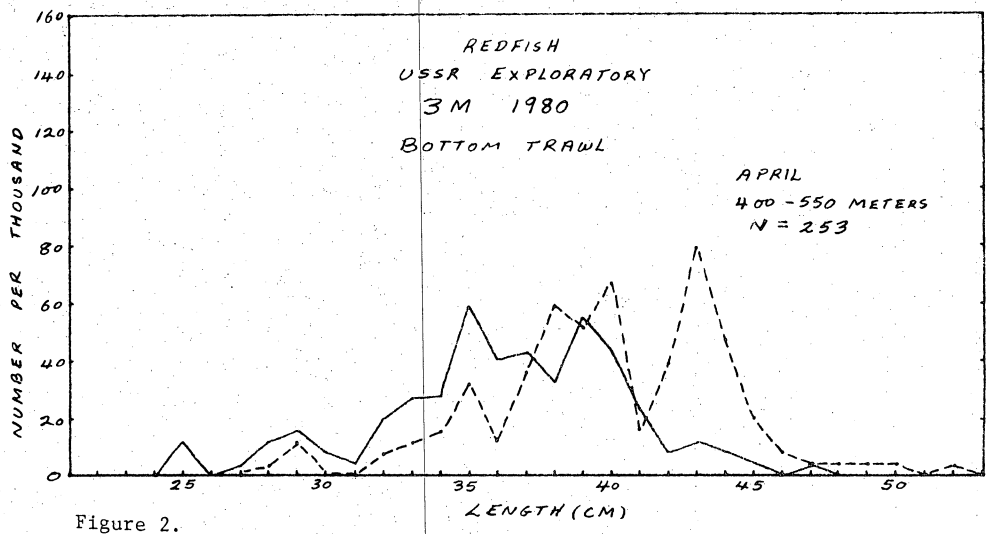

Figure 2.