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1983 Status Report on the 4VWX Redfish

by

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[1]This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the timeframes required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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[1]Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur des études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé du secrétariat.

Abstract

Landings of redfish in Division 4VWX decreased to 14,458 t in 1982 from 18,843 t in 1981. This decrease in catch was the result of decreased effort since all commercial catch rates series examined showed increases in 1982. Research vessel survey estimates indicate that an increase in redfish biomass has been observed in both 1981 and 1982. Estimates of redfish biomass below the 200 fathom line indicate that an additional 25% of total redfish biomass may reside there. Length-frequency estimates show very strong recruitment to the population at 8-9 cm. This incoming group is the largest observed in the past 10 years.

Résumé

Les débarquements de sébaste des div. 4VWX ont baissé à 14 456 t en 1982 par rapport à 1981, alors qu'ils étaient de 18 843 t. Cette diminution résulte d'un effort de pêche moindre, puisque toutes les séries de taux de capture commerciaux examinés montrent des augmentations en 1982. Les estimations découlant des relevés par navires de recherche révèlent une augmentation de biomasse de cette espèce, à la fois en 1981 et en 1982. D'après les estimations de biomasse à des profondeurs dépassant 200 brasses, il se peut qu'un autre 25 % de la biomasse totale de sébaste se trouve dans cette zone. Les fréquences de longueurs mettent en évidence un très fort recrutement de population à une longueur de 8-9 cm. Ce nouveau groupe est le plus considérable de la dernière décennie.

Summary of Fishery to 1982

Redfish landings from the Scotian Shelf reached a maximum of over 60,000 t in 1971, declined until 1979 to 13,154 t, increased in 1981 to 18,843 t, and declined again in 1982 to a provisional total landing of 14,458 t. At least a portion of the 1981 increase can be attributed to diversion of fishing efforts following the early filling of cod and haddock quotas.

A total allowable catch (TAC) was first imposed in 1974 (40,000 t) and subsequently reduced to 20,000 t between 1976 and 1979 whereupon it was increased to 30,000 t. This TAC remained in effect to 1982. This level of TAC was originally chosen because research vessel surveys were thought to indicate a trawlable biomass of about 200,000 t, and it was believed that redfish could support a 15% exploitation rate (CAFSAC 1980). The TAC's, quotas, and landings since 1974 are summarized in Table 1.

Methods

Previous work has shown that available data do not allow for satisfactory analytical assessments of Scotian Shelf redfish populations and hence none have been attempted. We present an update of available data on stock status. These data include landings (by division and country), catch rate series by major gear types, research vessel biomass estimates (using both arithmetic and geometric means), and research vessel length frequency distributions (both for the entire Scotian Shelf and by individual NAFO Division). During 1982, two redfish directed research vessel surveys were conducted in addition to the regular summer groundfish surveys. The data from these surveys were used to obtain biomass and length frequency estimates from areas not previously covered by the summer groundfish surveys. Commercial length frequencies, although available, involve too many uncertainties (eg. mesh size employed, discards; Clay 1979) to be of use in ascertaining stock status and are not presented.

Results and Discussion

Landings

Landings since 1928 are shown in Figure 1, the increase through the 1930's and 1940's has been interpreted as the initial exploitation of the surplus biomass of an unexploited population (Mayo and Miller 1975). This phase of exploitation was completed by the late 40's culminating in a landing of over 84,000 t in 1951. Landings decreased through the early 1950's, then rose slowly to a level of approximately 30,000 t through the early 1960's (landings by Division are given on Figure 2). Landings reached a second major peak in 1971 with a total of 65,893 t. These high values were the results of record landings by both Canada and the Soviet Union (25,000 and 20,000 t respectively). From 1972 to 1976 landings declined rapidly to a little over 18,000 t in 1976. This decline has resulted both from a withdrawal of the foreign fishery and a general decline in landings by Canadian vessels.

Commercial Catch Rate Series

Kenchington (1981) presented catch rate series for Canadian Maritimes and Quebec based (MQ) side trawlers (tonnage class 4), stern trawlers (tonnage class 5), and midwater trawlers (tonnage class 4). In addition catch rate series for U.S.A. side trawlers (tonnage class 4) were presented.

The fishery by United States vessels, during 1981, was limited to the Jordan Basin (5Y - 4X) and contributed only a very small proportion of the total landings for Division 4VWX. According to provisional statistics, this fishery was not in operation during 1982 (Table 1). This catch rate series has been discontinued. The midwater trawl series has been discontinued for the same reasons.

The remaining catch rate series and an equivalent series for Newfoundland (N) based vessels, are summarized in Table 2 and presented graphically in Figures 3 and 4. All of the catch rate series presented here were calculated by dividing total yearly effort into total yearly catch. Stern trawler catch rate series for both MQ. and N. (Figures 3 and 4) increased during the late 1950's and early 1960's. From the mid 1960's to the late 1970's these series demonstrated a variable but persistent decline. During the late 1970's this decline appears to have halted with the MQ series showing increases in both 1981 and 1982 and the N catch rate appearing to stabilize or increase slightly from 1981 to 1982. For the MQ series this gear type represented 26% of the total Canadian landings during 1982 while the N stern trawlers landed 18% of the total.

The side trawler catch rate series are more variable than those for the stern trawlers (Figures 3 and 4). For the Newfoundland series the decrease in catch rates from the mid 1960's to the late 1970's observed in the stern trawler series, is again evident, however, from 1979 to 1982 this series has shown a significant resurgence. For the MQ series this increase has been in evidence since 1976. These catch rate series are based on gear and tonnage class categories which, in 1982, represented 24% of the total Canadian landing for the MQ series and 12% for the Newfoundland series.

The combined landings represented by these four catch rates comprised 80% of the total Canadian 4VWX redfish landings during 1982.

Since the majority of redfish landings during any year occur during the third quarter a second series of catch rates were calculated using only data from this part of the year. These values are summarized in Table 3 and plotted on Figure 5 and 6. These series show generally the same patterns as those observed in the full year series. The major differences between them appears to be that the third quarterly values indicate increases in catch rates beginning earlier than those of the full year series. The stern trawler series for both Newfoundland and Maritime-Quebec data have shown a steady increase since 1979. The side trawler series for Newfoundland is rather sparse and variable but also indicates increasing catch rates since 1979. The MQ side trawler series is more complete and has been increasing since 1977.

Research Vessel Biomass Estimates

Arithmetic and geometric mean redfish biomass estimates for 1970 to 1981 are shown in Figure 7. The arithmetic series is extremely variable with year to year fluctuations of over 200,000 t between some years. Since redfish is a slow growing, long-lived species these cannot represent variations in actual biomass. It is difficult to state with certainty what this time series indicates in terms of redfish biomass, although in an general sense there does appear to have been a decrease throughout the mid 1970's.

The geometric series in somewhat less variable and shows the same decline in biomass estimates throughout the mid 1970's. In the later 1970's the rate of decline in redfish biomass appears to be somewhat reduced with the arithmetic series showing an increase in 1981 and 1982. The arithmetic and geometric means appear to parallel one another quite well, with the exception of 1975. On theoretical grounds, the geometric mean series is thought to better represent the trend in biomass, but its absolute values are depressed (Kenchington 1981, Sokal and Rohlf 1969).

The increased biomass estimated in 1982 must be interpreted with some caution. During 1982 the summer groundfish survey, which provides the data for these estimates, was conducted by the R.V. Lady Hammond instead of the R.V. A.T. Cameron which had been conducting these surveys since 1970. Preliminary analyses by Koeller and Smith (unpublished) indicate that catch per standard tow values observed from the Lady Hammond are, on average, somewhat higher than those of the A.T. Cameron. These comparisons are based on three comparative cruises and compared data for several species. From these analyses it would appear that the Lady Hammond catches approximately 1.65 times more redfish per tow than the A.T. Cameron. The preliminary nature of these results, coupled with the inherent variability of redfish catches, make interpretation of the 1982 biomass estimates rather more difficult than usual. If we assume that the conversion factor between the two research vessels is reliable the 1982 biomass estimates should be 77,761 t and 22,304 t for the arithmetic and geometric estimates respectively. These values still represent an increase over the 1981 values.

During 1982 two redfish directed surveys were conducted in Division 4VWX. The results of the March 1982 survey were reported in Zwanenburg (1982). Catch rates observed in waters deeper than those regularly fished by the summer groundfish surveys indicated a significant abundance of redfish at these depths. The following table summarizes estimates of redfish biomass for strata from 100 - 500+ fathoms. These values were calculated by the following relationship:

$$B_j = \frac{\sum_i^I C_{ij}}{S_j} \times T_j$$

where C_{ij} is the catch (in kg) of redfish in tow i in depth zone j. S_j is the total number of sets in depth zone j, T_j is the total number of trawlable units in depth zone j, and B_j is the estimated biomass of redfish in depth zone j. The number of trawlable units for depths below 100 fathoms were calculated assuming 100% trawlable bottom area (determined by planimetry) and a sweep area of 40,528 m^2 per standard tow (12.5 m effective trawl opening).

1982 redfish biomass estimates (t).

Depth Range (fms)	March 1982	July 1982	November 1982
100-200	14,935 (32)*	8,699 (15)	5,170 (30)
201-300	3,735 (26)	-	18,489 (25)
301-400	-	-	15,150 (12)
401-500	-	-	4,425 (14)
500+			0

* The numbers in parenthesis indicate the number of sets on which the estimate is based.

These estimates, although amenable to further analyses indicate significant amounts of redfish biomass below 200 fathoms. The November survey indicates that an additional 38,064 t of redfish are resident below 200 fathoms. In 1982 this amounts to approximately a 30% underestimate of total biomass by the summer survey in Division 4VWX which surveyed waters to a maximum depth of 200 fathoms only (the total biomass estimate for Division 4VWX from the July survey was 128,000 t)

Research Vessel Length Frequencies

Length frequency estimates based on July research vessel surveys and combined for all of Division 4VWX redfish are presented in Figure 8. All data from 1970 to 1982 is given in millions of fish per centimeter length groupings. Data for 1970-1973, and 1975-1978 show a large group of fish with a modal length frequency which gradually increases from 23 to 28 cm. Data for more recent years are rather more difficult to interpret mainly because of the smaller catches of redfish during these years. Within the time series there is evidence of relatively strong recruitment in 1974 (modal length 17 cm) and 1977 (modal length 14 cm). The large mode seen at 17 cm in 1974 is almost certainly the large 1971 year-class identified by previous investigators (eg. Mayo 1980). The 14 cm mode observed in 1977 can be followed quite clearly through to 1981. The 1982 survey, in addition to giving generally larger estimates of numbers at length, presents evidence of a very strong year-class (modal length 8 cm) coming in. A breakdown of the length frequencies by division shows that this strong year-class is mainly evident in 4Vn and to a lesser degree in 4Vs (Figure 9). A breakdown of redfish length-frequency distribution by Division for 1970-1981 was presented in Zwanenburg et al. 1982. The evidence for a strong year-class is corroborated by the results of the March and November redfish surveys. The March survey showed a large peak at 7 cm while the November surveys found large numbers of fish at 11 cm. When we consider that March to November spans the growing season, and that the July survey indicated a large peak at 8-10 cm, it is evident that all these peaks represent a single year-class. There is some further evidence of a second group of somewhat larger recruits. This group is evident at 10-11 cm in the March survey (Figure 10), 11-12 cm in the July survey in 4Vn and 4Vs and very evident at 14-15 and 16 cms in November (Figure 10). Whether the observations in November are of this same group is questionable since it implies a high growth rate for fish at 11-12 cm in March.

Summary

* If commercial catch rate indices are indicators of redfish stock abundance these indicate that redfish biomass declined during the early to mid 1970's whereupon a substantial resurgence became evident. This increase continues.

* Research vessel survey abundance estimates are highly variable but generally a decline in redfish biomass was in evidence during the 1970's. This decline continued until 1980. Data for 1981 and 1982 indicate an increase in redfish biomass. In addition to the general groundfish surveys, two surveys directed for redfish indicate some 38,000 t of redfish resident below 200 fathoms.

* Research vessel length-frequency estimates for 4VWX redfish indicate two strong length groups entering the population one at 8-9 cm and another at 15-16 cm. The smaller group appears to represent the largest group of recruits in the past 10 years.

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Table 1. TAC's, quotas, allowances, and catches since 1974.

	1974	1975	1976	1977	1978	1979		1980		1981	1982
TAC	40000	30000	20000	20000	20000	20000		30000		30000	30000
Landings	32837	27983	18459	17845	16094	13154		14116		18843	14458*
Canada:											
Quota	20000	14860	12000	13000	17500	13000	18000	18500	29000	18500	25000
Landings	15739	17025	12625	14712	13576		12240		13108	17753	14365*
France:											
Quota	1000	740	250	250	250	500[a]	500[a]	500[a]	500[a]	500[a]	500
Landings	420	186	279	63	121		20		21	3	-
Poland:											
Quota	1300	970		Subsequent catches included with "Others".							
Landings	803	230									
USSR:											
Quota	6600	4900	1000	500							
Landings	6692	4849	1021	175	Subsequent catches included with "Others".						
USA:											
Quota	10000	7430	6000	6000	1500	See "Others"		10500	0	0	
Landings	8891	5465	4446	2876	2147				885	661	-
Others:											
Quota	1100	1100	750	250[b]	750[b]	6500	1500	500	500	11000	4500
Landings	288	228	88	19	250		894		102	426	93*

- data not yet available
[a] St. Pierre vessels only
[b] By-catch only
* Provisional Statistics

Landings to 1980 are from ICNAF and NAFO Statistical Bulletins. Since 1979 quotas have been amended during the year; initial and final ones are given.

Table 2. Commercial Catch Rate Indices (t per hour) for 4VWX Redfish (full year values).

Year	Side Trawlers [TONNAGE CLASS 4] (Maritimes)	Side Trawlers [TONNAGE CLASS 4] (Newfoundland)	Stern Trawlers [TONNAGE CLASS 5] (Maritimes)	Stern Trawlers [TONNAGE CLASS 5] (Newfoundland)
1958	0.48			
59	0.38			
1960	0.33			
61	0.74	0.78		
62	0.47	0.54		
63	0.43	0.60		
64	0.67	0.53		
65	0.73	0.82		
66	0.89	0.94	0.85	1.14
67	0.63	0.92	0.67	1.06
68	0.69	0.89	0.35	0.87
69	0.66	0.78	0.96	0.73
1970	0.66	0.74	0.81	0.72
71	0.67	0.78	0.68	0.46
72	0.69	0.66	0.55	0.93
73	0.57	0.58	0.30	0.62
74	0.49	0.45	0.34	0.44
75	0.51	0.56	0.52	0.62
76	0.48	0.51	0.34	0.30
77	0.47	0.41	0.58	0.78
78	0.44	0.45	0.61	0.61
79	0.43	0.36	0.78	0.44
1980	0.42	0.36	0.62	0.55
81	0.56	0.33	0.77	0.57
82	0.66	0.38	0.91	1.05

Table 3. Commercial Catch Rate Indices (t per hour) for 4VWX Redfish (3rd quarter values).

Year	Side Trawlers [TONNAGE CLASS 4] (M & Q)	Side Trawlers [TONNAGE CLASS 4] (NFLD)	Stern Trawlers [TONNAGE CLASS 5] (M & Q)	Stern Trawlers [TONNAGE CLASS 5] (NFLD)
1958	0.52			
59	0.35			
1960	0.23			
61	0.38	0.84		-
62	0.46	0.52		-
63	0.53	0.57		-
64	0.64	0.52		-
65	0.80	0.78		-
66	0.80	0.85		-
67	0.77	1.19	0.56	-
68	0.59	0.96	0.87	-
69	0.86	0.83	0.88	0.81
1970	0.75	0.74	0.91	1.32
71	0.67	0.72	0.46	-
72	0.62	0.65	0.61	-
73	0.60	0.76	0.46	0.97
74	0.49	0.54	0.32	-
75	0.47	0.55	0.54	0.36
76	0.45	0.49	0.12	-
77	0.46	0.40	0.58	0.87
78	0.41	0.42	0.55	0.71
79	0.41	0.35	0.62	0.44
1980	0.46	0.35	0.67	0.57
81	0.53	0.36	0.65	0.60
82	0.59	0.38	1.01	1.06

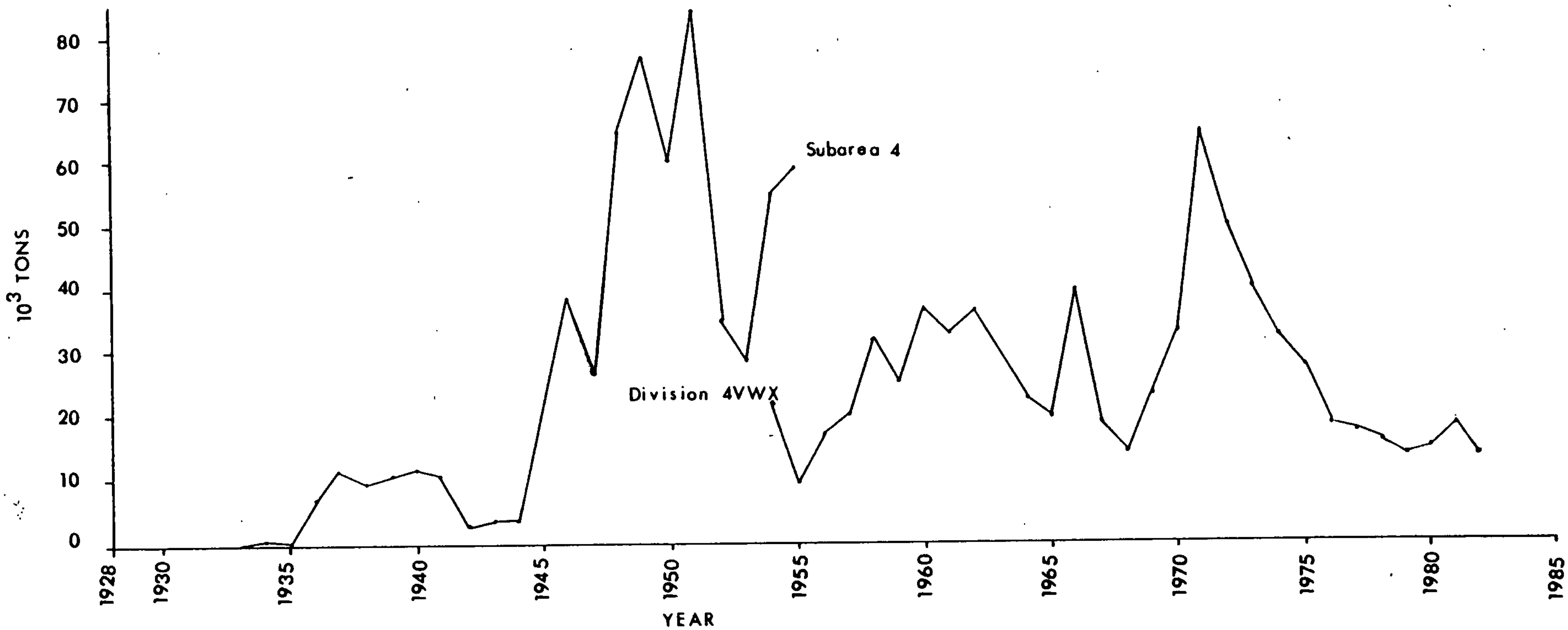


Figure 1. Commercial redfish landings from Subarea 4 (to 1955) and Division 4VWX (since 1954).

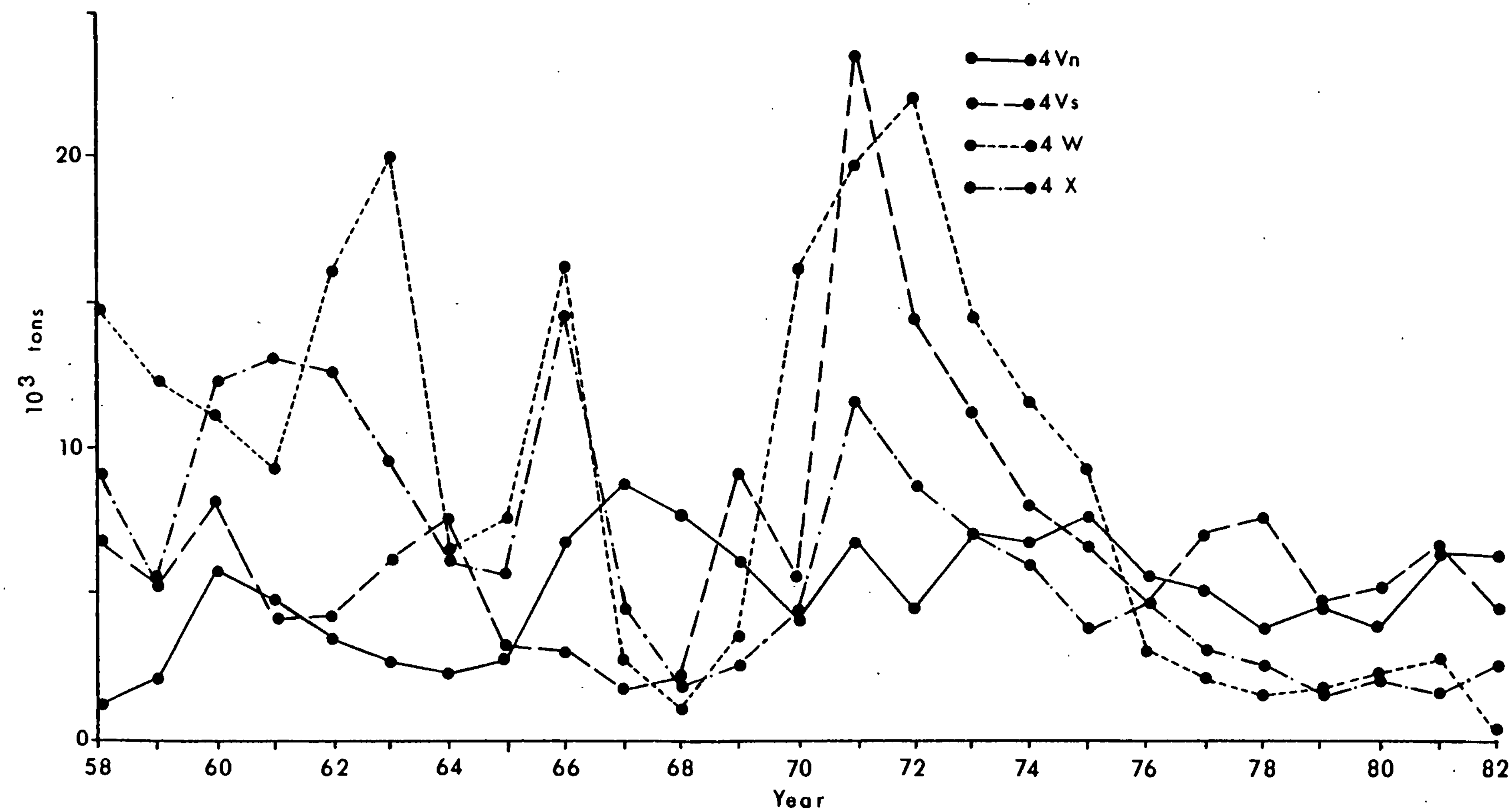


Figure 2. 4VWX redfish landings by division from 1958 to 1982.

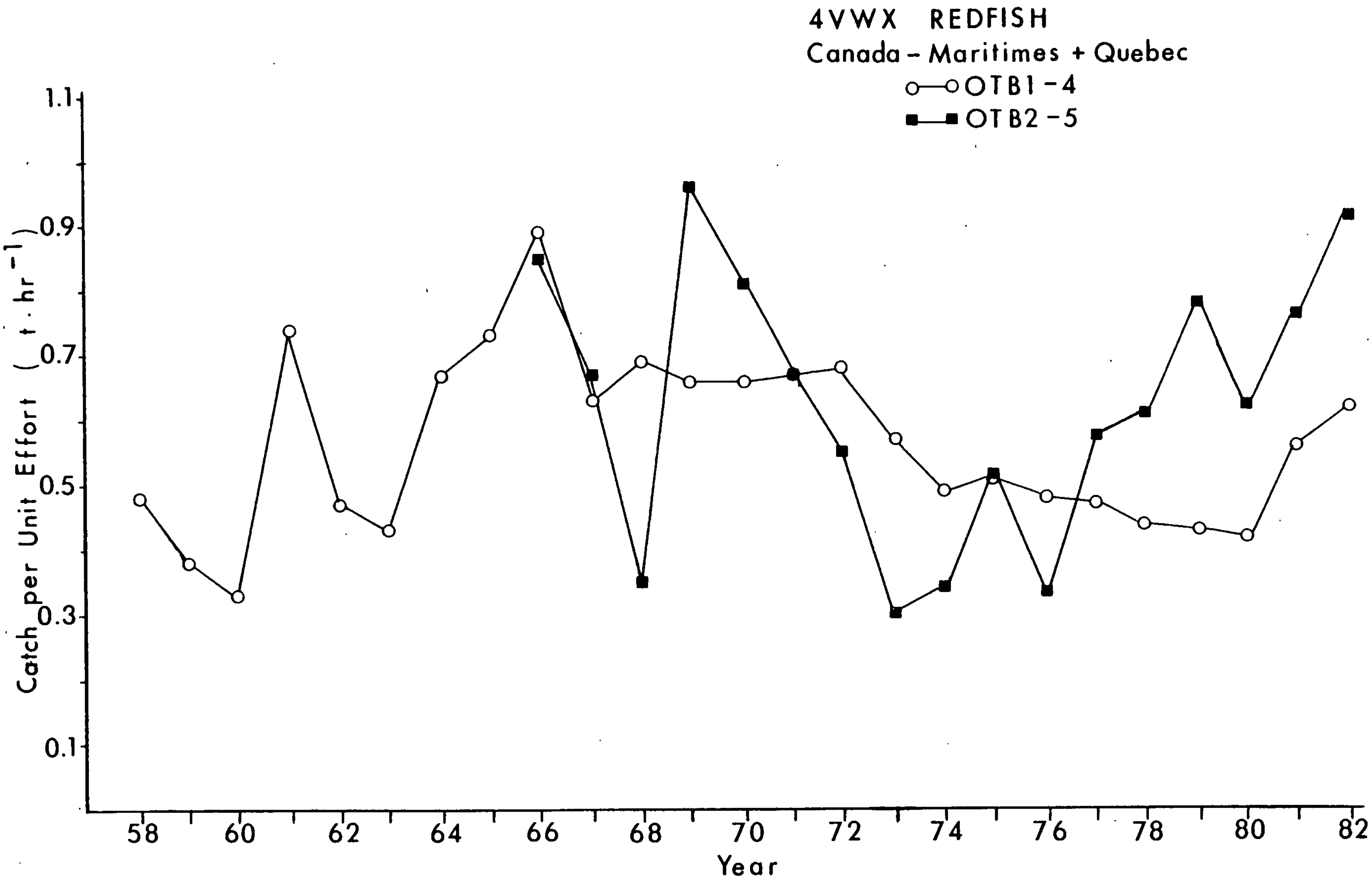


Figure 3. Catch rate series for Maritimes and Quebec based side (tonnage class 4) and stern trawlers (tonnage class 5). Catch rates were calculated from total yearly values of catch and effort for each category.

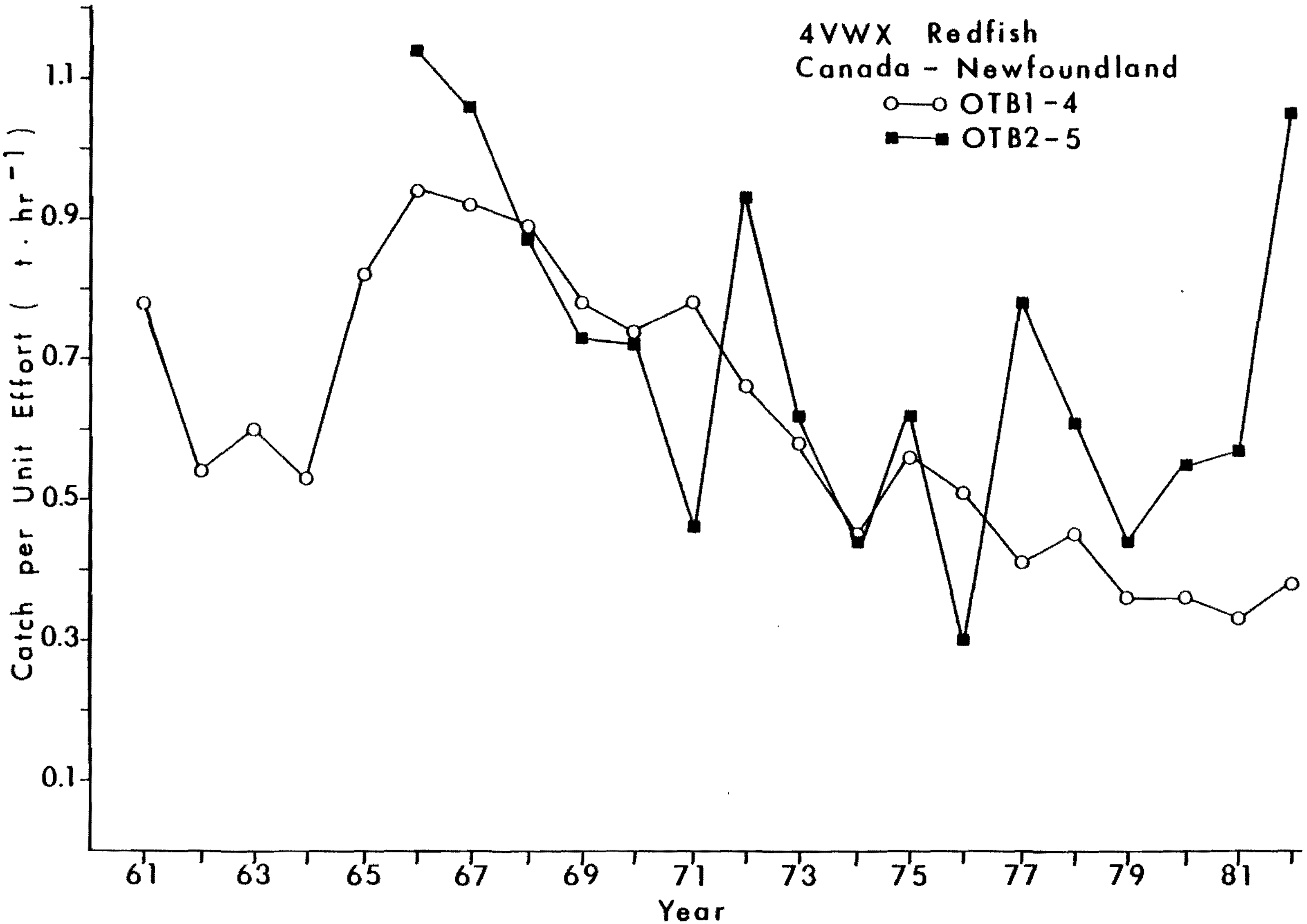


Figure 4. Catch rate series for Newfoundland based side (tonnage class 4) and stern trawlers (tonnage class 5). Catch rates were calculated from the total yearly values of catch and effort for each category.

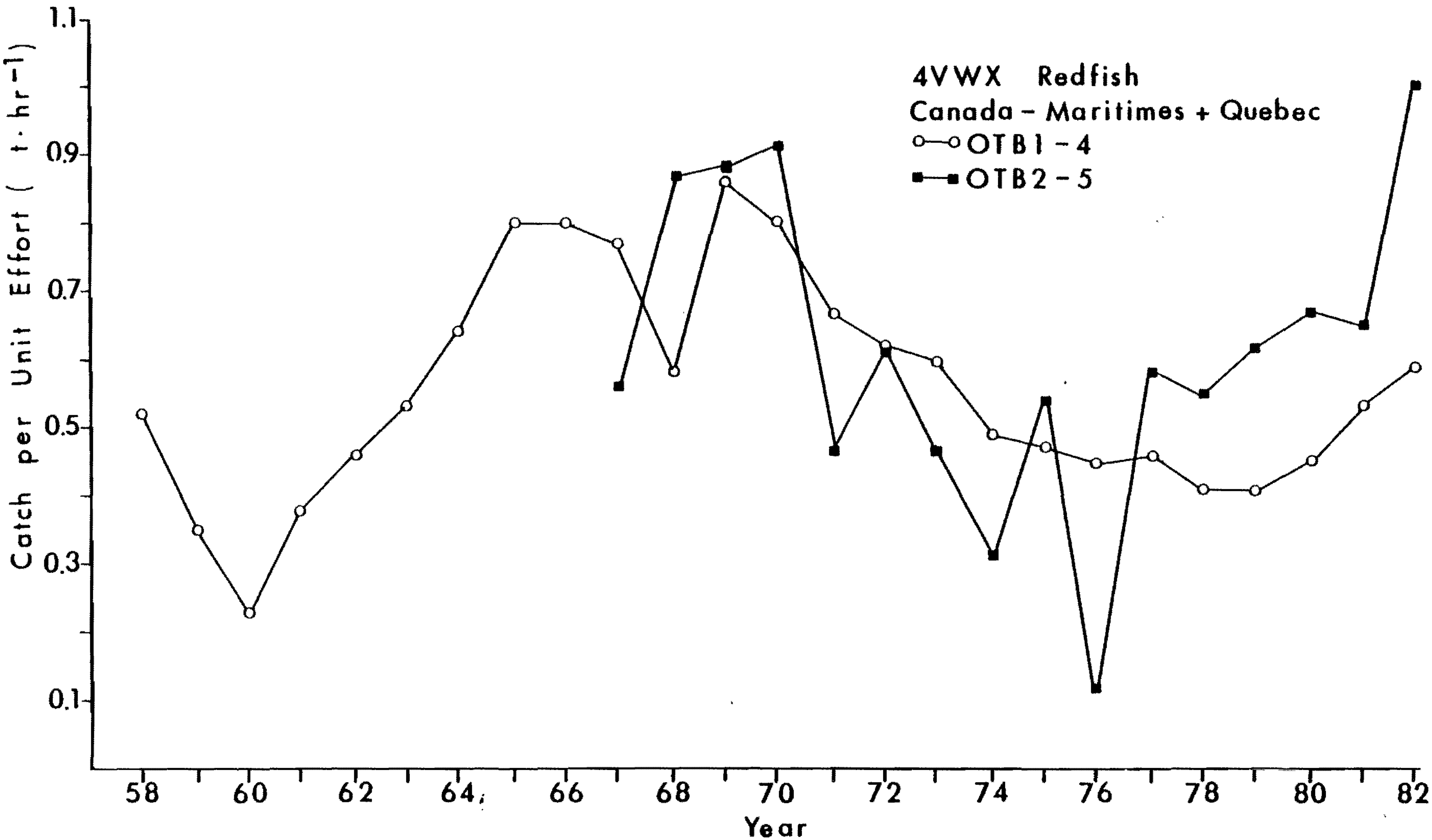


Figure 5. Catch rate series for Maritimes and Quebec based side (tonnage class 4) and stern trawlers (tonnage class 5). Catch rates were calculated from third quarterly values of catch and effort.

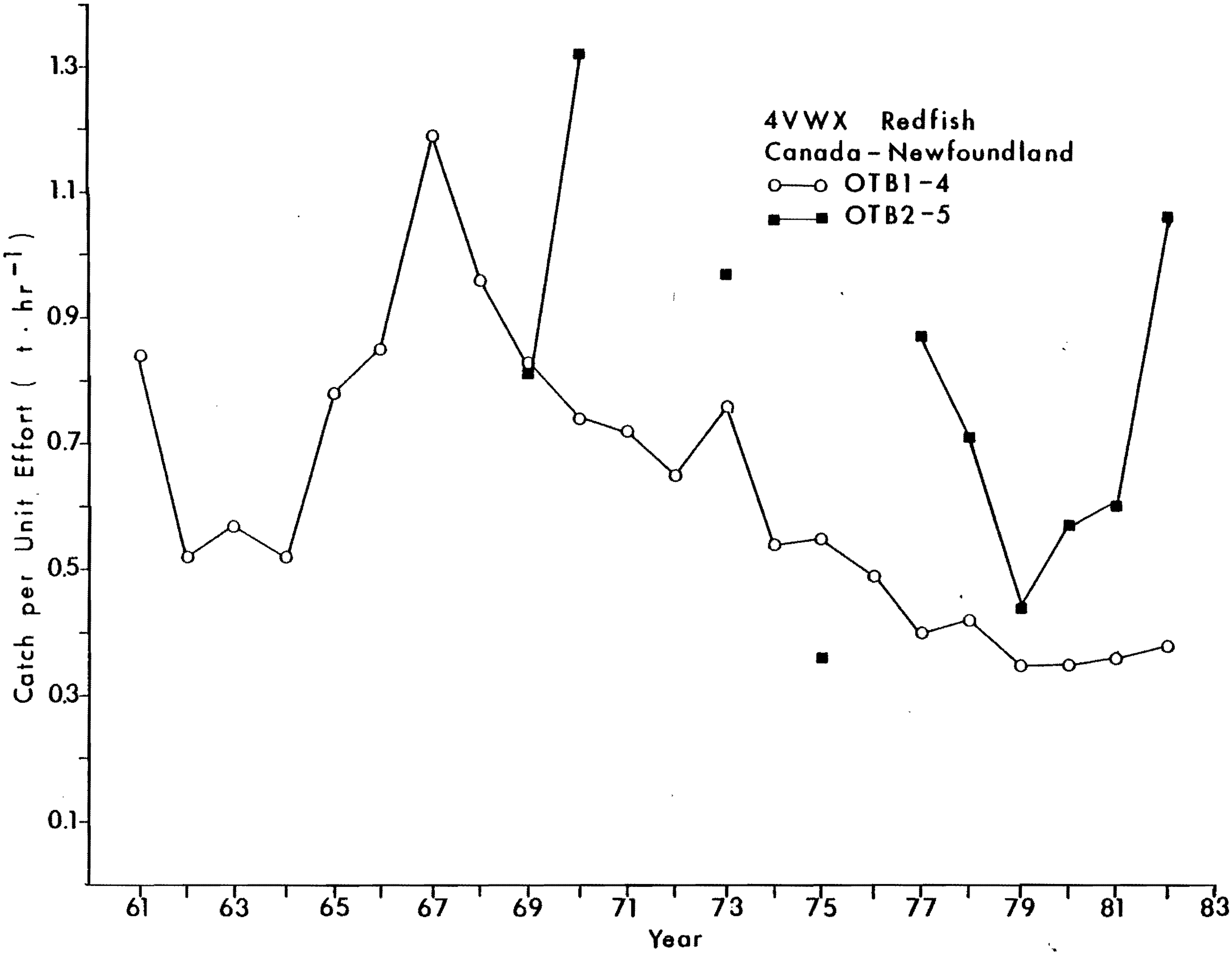


Figure 6. Catch rate series for Newfoundland based side (tonnage class 4) and stern trawlers (tonnage class 5). Catch rates were calculated from third quarterly values of catch and effort.

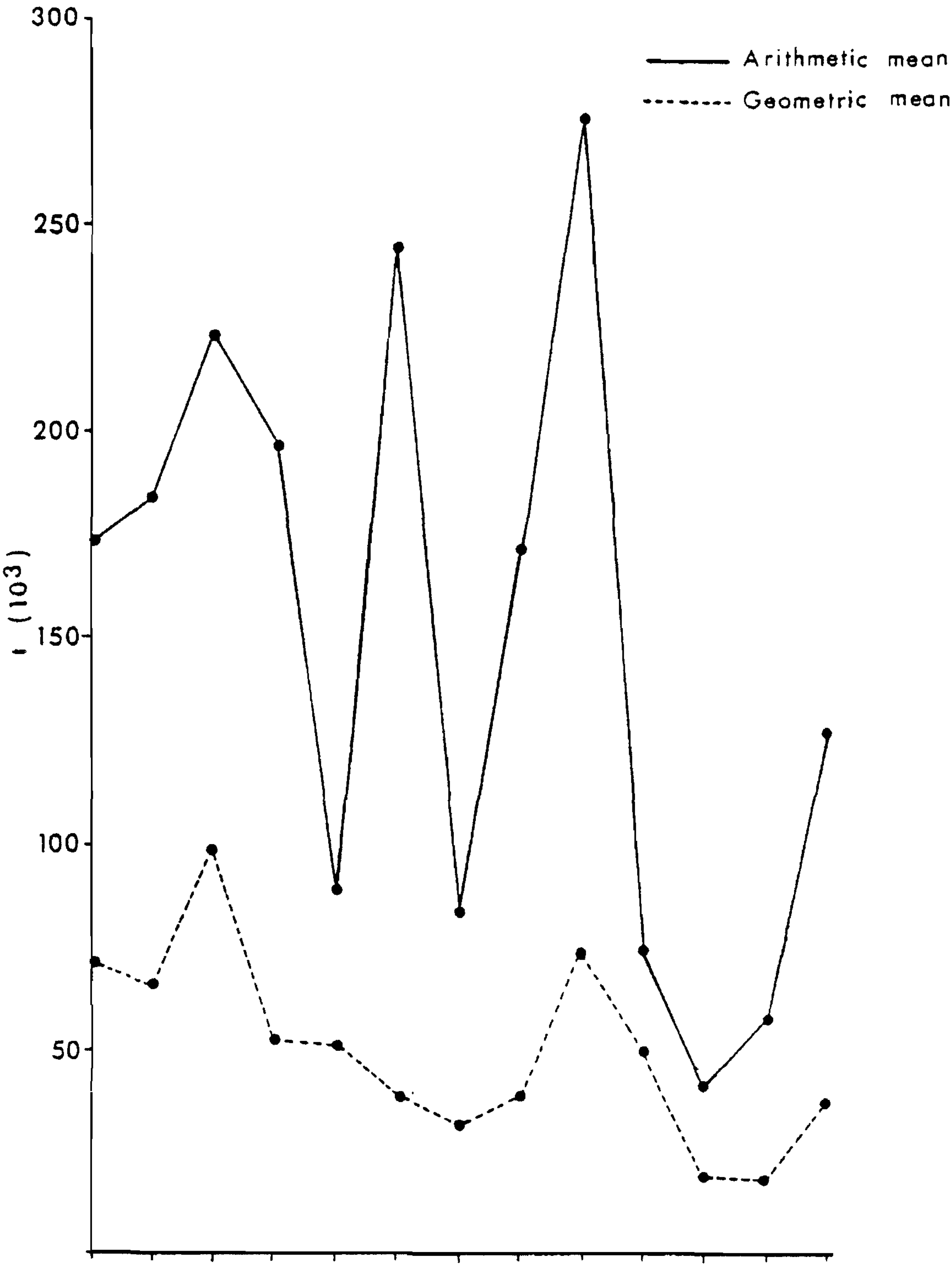
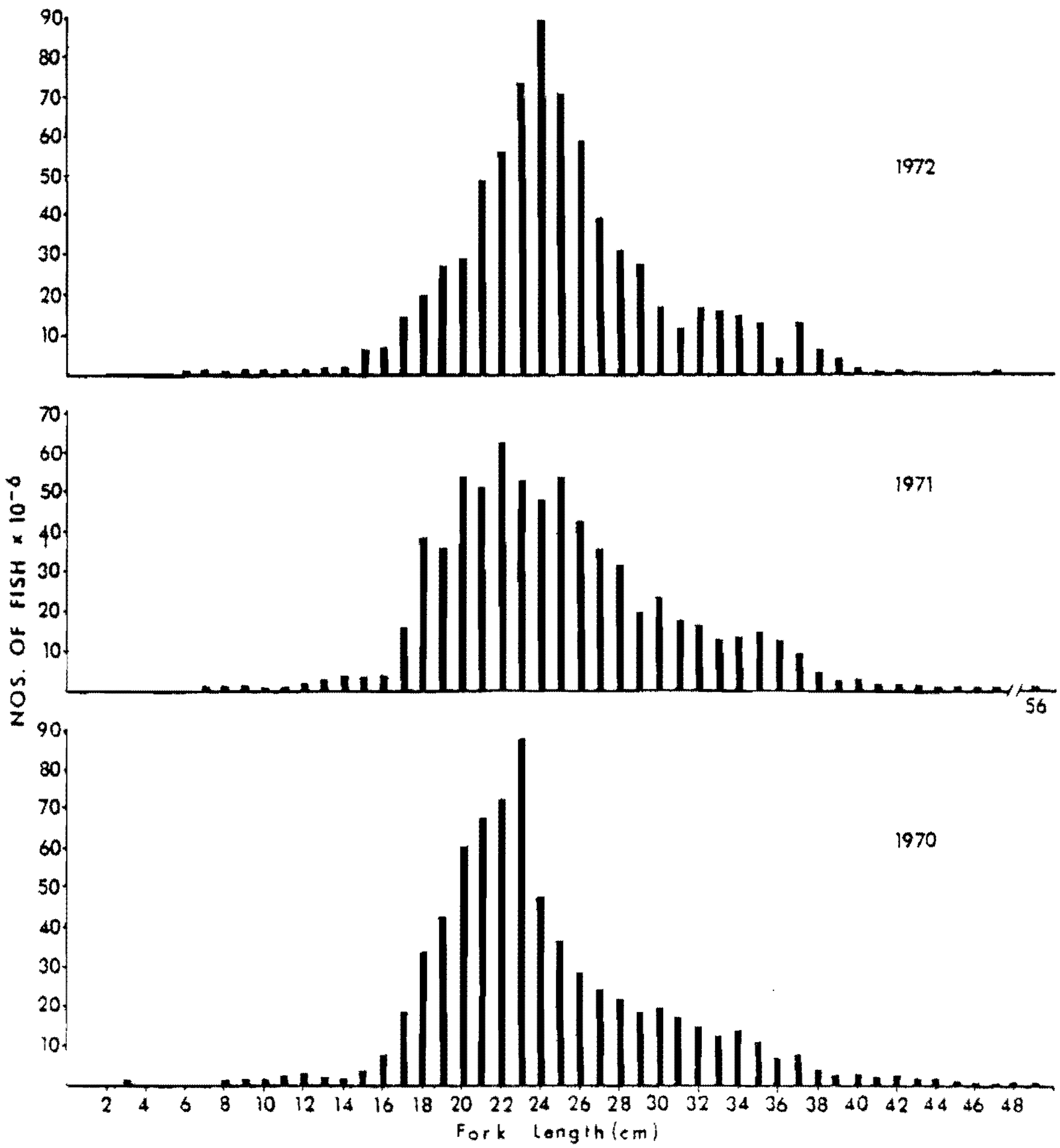
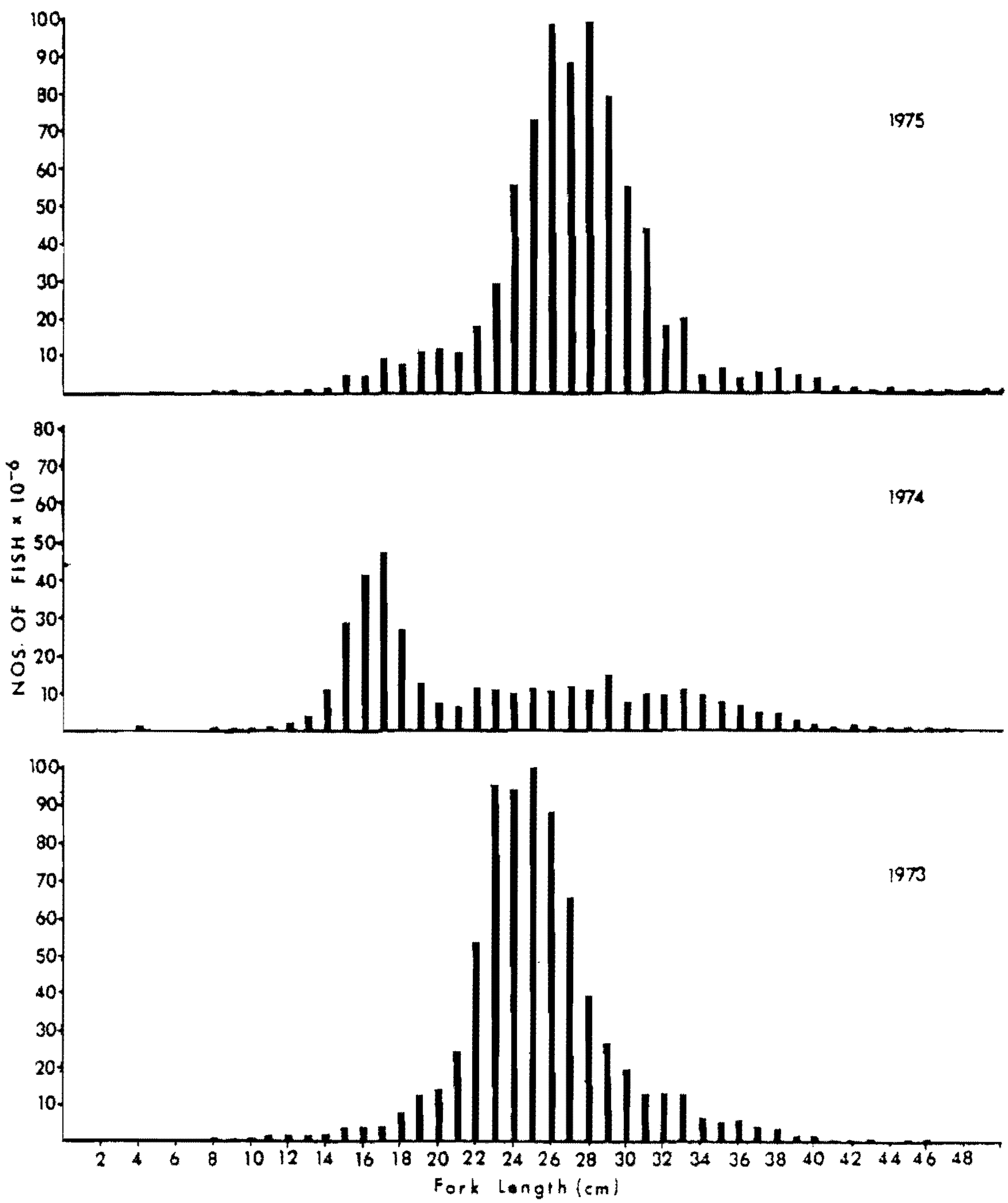


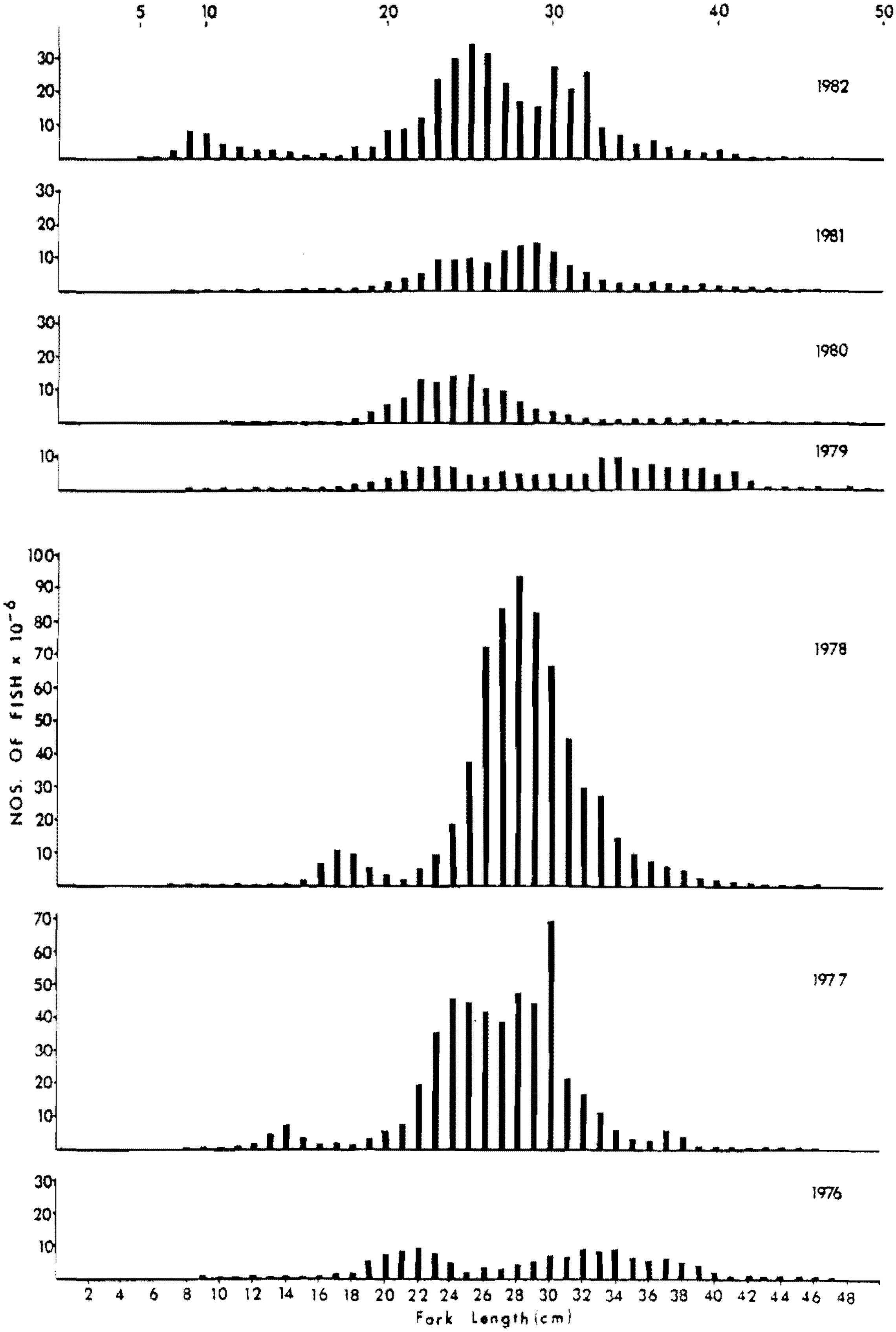
Figure 7. Division 4VWX redfish biomass estimates from research vessel surveys.

Figure 8. Research vessel estimates of length-frequency distribution for Division 4VWX redfish from 1970 to 1982.
(Pages 20-22 inclusive).



1972
1971
1970
NOS. OF FISH × 10⁻⁶
90
80
70
60
50
40
30
20
10
56
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Fork Length (cm)


1975
1974
1973
NOS. OF FISH × 10^{-6}
Fork Length (cm)


5 10 20 30 40 50
1982
1981
1980
1979
1978
1977
1976
NOS. OF FISH × 10^{-6}
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Fork Length (cm)

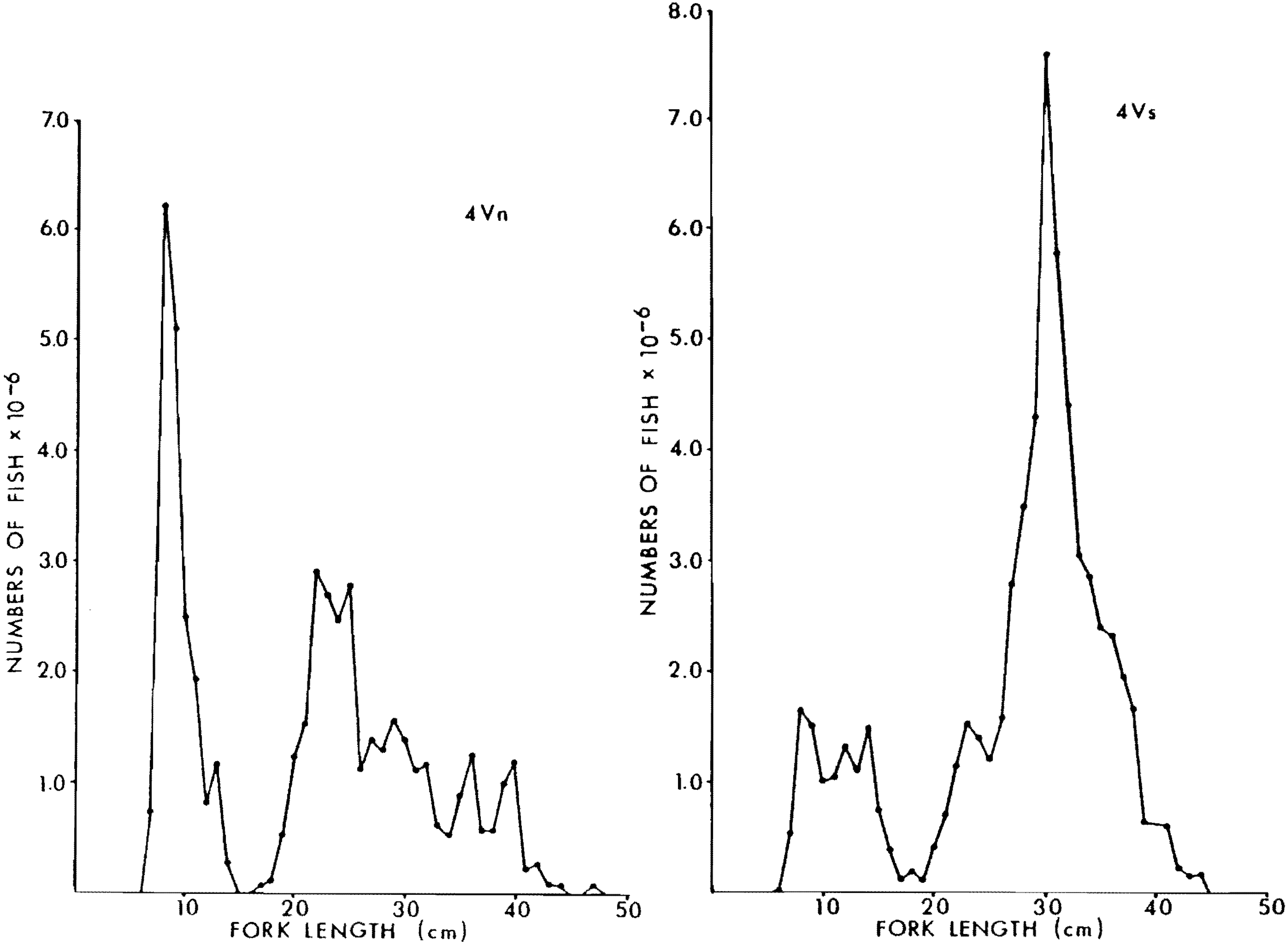
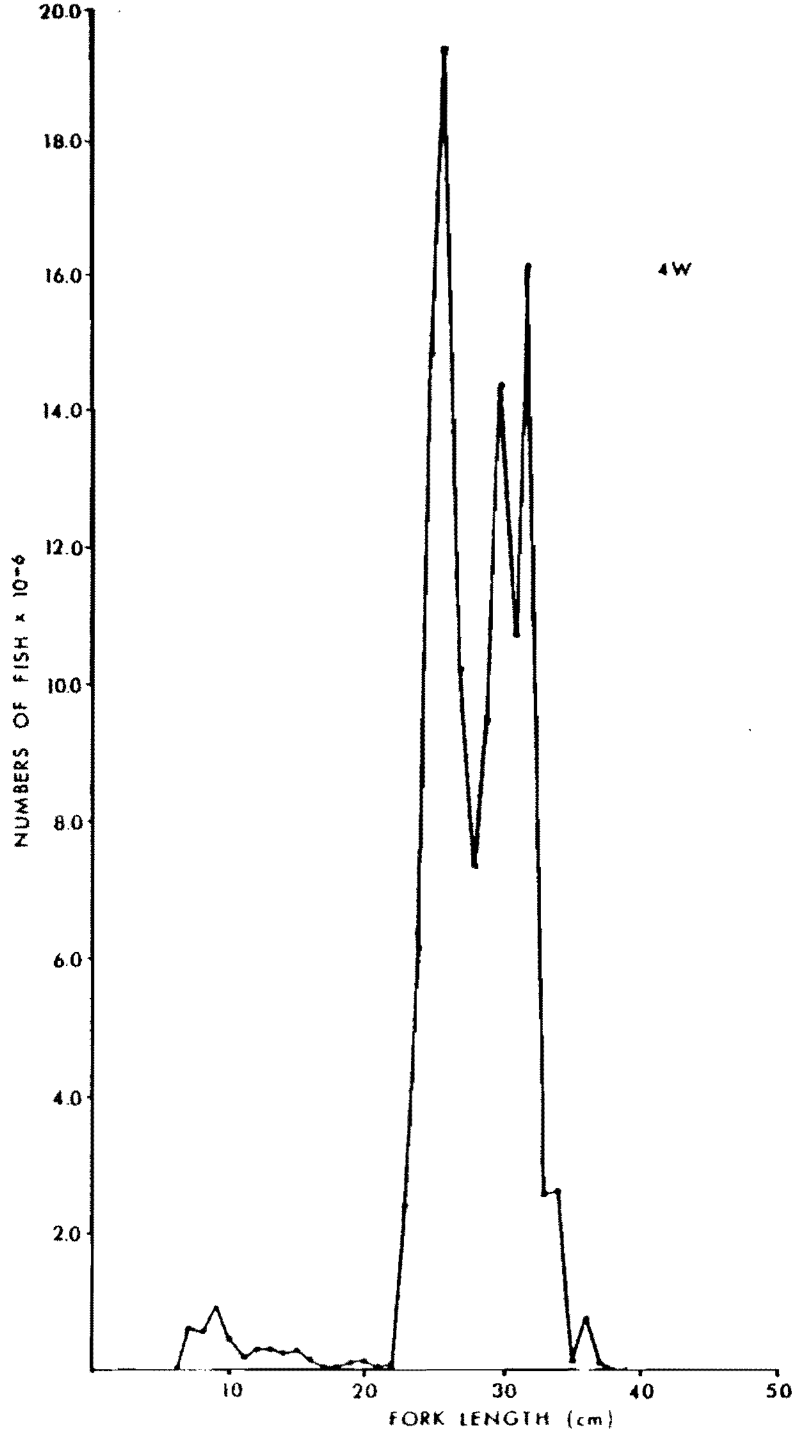


Figure 9. Length-frequency distribution of redfish in Divisions 4Vn and 4Vs as estimated from the July 1982 research vessel survey.



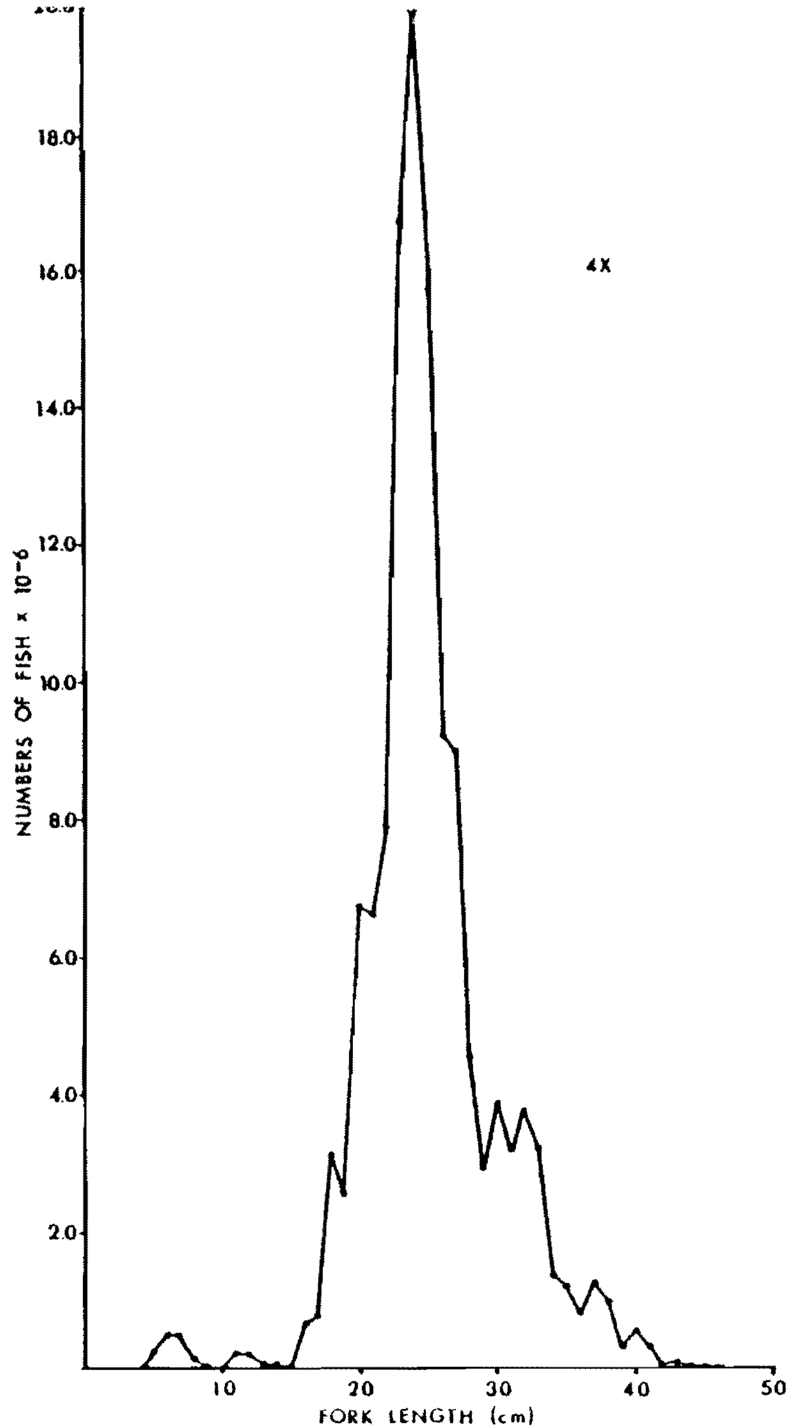


Figure 9. (Cont'd) Length-frequency distribution of redfish in Divisions 4W and 4X as estimated from the July 1982 research vessel survey.

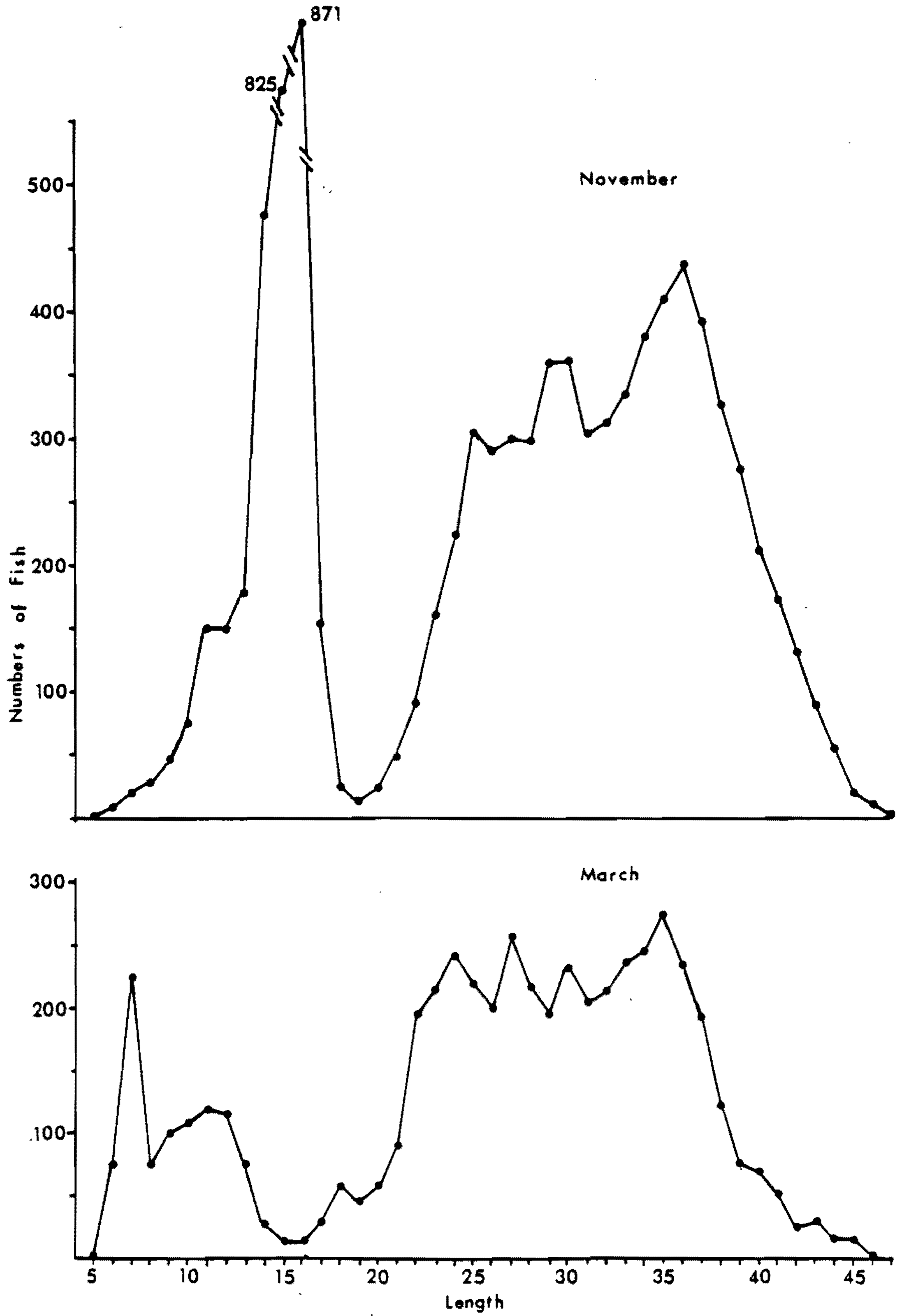


Figure 10. Length-frequency distributions of redfish in Divisions 4VWX estimated from the March and November redfish directed surveys.