

# Distribution and Concentration of Redfishes in Newfoundland and Labrador Waters

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## Abstract

Data from stratified-random bottom trawl surveys in 1978-80, extending from northern Labrador southward to the southern Grand Bank and westward off southern Newfoundland to the Gulf of St. Lawrence, were analyzed to estimate the relative distribution and concentration of the beaked redfishes, *Sebastes mentella* and *S. fasciatus* combined, and the golden redfish, *S. marinus*. The results indicated that beaked redfishes were distributed widely throughout the region except in shallow waters along the coasts and on the plateaus of banks, with the largest catches from 200-750 m on the west slope of Flemish Cap, the south and northeast slopes of Grand Bank, the northeast slopes of Funk Island Bank and Hamilton Bank, the north slope of Belle Isle Bank, and off Southwest Newfoundland. The golden redfish constituted a very minor portion of the total redfish catches, being found sporadically throughout the region at shallower depths (100-400 m), with the highest concentrations on Flemish Cap and northeast of Newfoundland in the vicinity of Funk Island Bank. The general patterns of distribution and concentration of redfishes, including the relative scarcity of *S. marinus* in most parts of the region, were similar to the published results of studies conducted during 1947-54.

## Introduction

Knowledge of the distribution and concentration of different species of redfishes is fundamental for basic biological studies, stock discrimination and biomass assessment. Templeman (1959) reported redfish distribution in the Northwest Atlantic based on research bottom-trawl surveys from 1947 to 1954, by considering the redfishes as a single group. He stated generally that redfish were distributed in deep channels of the Gulf of St. Lawrence and in deep water around the fringes of the banks in the Newfoundland and Labrador areas. The commercial fishing grounds have expanded to the north and to deeper water since the earlier surveys, and recent information on geographic and depth distributions have been derived from intensive stratified-random sampling rather than from the line surveys used by Templeman (1959). It has been known for some time that there are two and possibly three species of redfish in the Northwest Atlantic (Templeman and Sandeman, 1957; Marti, 1958; Barsukov, 1972; Barsukov and Zakharov, 1972; Litvinenko, 1974, 1980; Templeman, 1976, 1980; Ni, 1981a, 1981b). This paper attempts to verify Templeman's (1959) hypothesis on redfish distribution and to offer a better description of the spatial distribution and relative abundance of the golden redfish, *Sebastes marinus*, and the beaked redfishes, *S. mentella* and *S. fasciatus*.

Only two types of redfishes, golden and beaked, are recorded on the Canadian groundfish survey sheets, because the separation of *S. mentella* and *S. fasciatus* is very time-consuming and requires special skills (Ni, 1981a, 1981b). The distributions and concentrations of these two types were evaluated from

stratified-random bottom-trawl surveys during 1978-80. The overall geographic distribution and concentration of redfishes from these surveys are compared with the findings of Templeman (1959), and the relative abundance by depth is described for each of the golden and beaked redfishes.

## Materials and Methods

There were 1,331, 1,229 and 995 successful half-hour bottom-trawl sets recorded during stratified-random groundfish surveys in 1978, 1979 and 1980 respectively (Fig. 1). Fishing was conducted by the Canadian research vessel *A. T. Cameron* with the Yankee 41-5 otter trawl and by the chartered research vessel *Gadus Atlantica* with the 145 Engels highrise otter trawl, both gears having the codend lined with 29-mm mesh netting. The region covered include continental shelf and slope waters at bottom depths to 1,500 m off Labrador and Newfoundland (NAFO Sub-areas 2 and 3) and in the Gulf of St. Lawrence (Divisions 4R, 4S and 4T). Although there are undoubtedly catchability differences between the two vessels, no attempt was made to standardize the data. Consequently, the estimation of catch rates from these data must be based on the assumption that catchabilities of the two vessels are the same.

Yearly analysis of the geographic distribution of the redfishes indicated a generally similar pattern in all 3 years, and the catches were therefore averaged for the 3 years. The concentration was expressed as the average weight caught per half-hour set by unit areas of 30' latitude and 60' longitude for the two types

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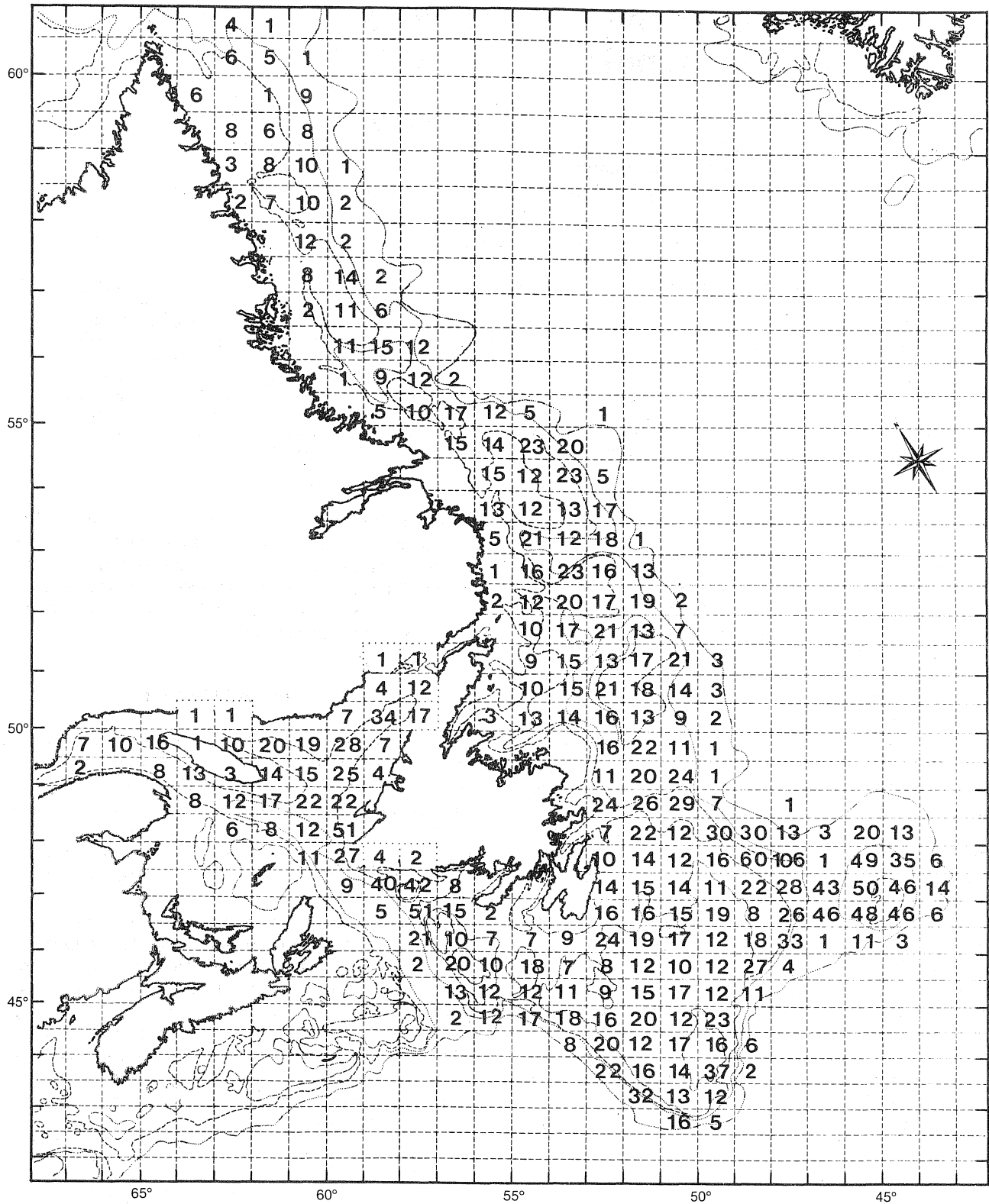


Fig. 1. Number of successful sets in stratified-random bottom-trawl surveys by Canadian research vessels, 1978-80.

(golden and beaked redfishes). The distribution of catches within each NAFO division was examined to determine the relative concentration of the two types by depth, for comparison with the suggestion of Templeman and Sandeman (1957) that *S. marinus* frequent the shallower part of the depth range inhabited by the redfishes.

## Results

Redfishes were caught in most parts of the region covered by the 1978-80 surveys from northern Labrador southward to the southern slope of the Grand Bank and westward off southern Newfoundland to the Gulf of St. Lawrence (Fig. 2). The largest catches were found on the slopes of Flemish Cap, the southern and northeastern slopes of Grand Bank, the northeastern slopes of Funk Island Bank and Hamilton Bank, the northern slope of Belle Isle Bank and off southwestern Newfoundland in Cabot Strait. Redfish were absent in shallow coastal areas, and on the shallow parts of Grand Bank, Hamilton Bank and Saglék Bank.

The distribution and concentration of beaked redfishes (Fig. 3) are essentially the same as those of all redfishes (Fig. 2), because golden redfish represented a small fraction of the total quantity of redfishes caught. However, *S. marinus* occurred sporadically in the Gulf of St. Lawrence, off Labrador, and around the edge of Grand Bank, and more frequently on Flemish Cap and northeast of Newfoundland (Fig. 4). The largest catches were obtained on the west and north slopes of Flemish Cap and in the vicinity of Funk Island Bank.

The average catches (by weight) of redfishes per set and the relative proportions of *S. marinus* are listed in Table 1 by depth interval and NAFO division. These data are illustrated symbolically in Fig. 5. The largest catches occurred at 501-750 m in Div. 2J, 3K and 3L, at 301-750 m in Div. 3M and 3O, at 201-500 m in Div. 3N and 4R, and at 301-400 m in Subdiv. 3Pn. The large catch in Div. 4T was obtained in a single set at 199 m and therefore may not be indicative of the distribution by depth in this area. As is evident from Table 1, beaked redfish constituted essentially the entire catches of redfishes in all depths and divisions except at 201-300 m in Div. 3K and at 201-400 m in Div. 3M, where the largest catches of golden redfish occurred.

## Discussion

The distribution of Atlantic redfishes in the Labra-

dor and Newfoundland areas, derived from stratified-random bottom-trawl surveys in 1978-80, was generally similar to results reported by Templeman (1959) from line surveys and sporadic trawling by the research vessel *Investigator II* during 1947-54. However, the earlier study lacked sufficient data from Div. 2G, 2H and 3K to make realistic comparison with the recent surveys feasible. For other parts of the region under consideration, comparison of Templeman's (1959) results with those from recent surveys indicates slightly higher catches of redfishes on Flemish Cap in recent years and reduced catches in Hermitage Channel off southern Newfoundland and on the southwest slope of Grand Bank.

Although catches from 3,555 successful half-hour sets over 3 years were analyzed in the present study, the sample size by unit area and by division-depth stratum was small in most cases. In areas where the number of sets were small (Fig. 1, Table 1) such as along steep slopes of banks, the results must be interpreted with caution; for example, along the southern edge of Grand Bank where the slope is very steep, bottom-trawling was difficult and resulted in few successful sets with large variation in catches. The same bias might be applicable to some extremely high catches of redfish (>5,000 kg per 30-min set) along the southeastern edge of Grand Bank and western Flemish Cap (Templeman, 1959, fig. 33), as those were from single tows. Nothing can be said about seasonal changes in distribution and concentration because the surveys of the various areas were conducted during specific times of the year.

The relative abundances of beaked and golden redfishes by depth (Table 1) offer basic guidelines for future sampling design in connection with life history studies and stock discrimination. The beaked redfishes tended to be concentrated in depths from 300 to 750 m in most divisions with good catches at 201-300 m in Div. 3N, 3P, 4R and 4S. Golden redfish were distributed sporadically over the region in small quantities with the greatest abundance at 201-300 m in Div. 3K and 101-400 m in Div. 3M, thus confirming the observations of Templeman and Sandeman (1957) that *S. marinus* occurs frequently at relatively shallow depths.

It was impossible to estimate the relative distribution and concentration of the two species of beaked redfishes, *S. fasciatus* and *S. mentella*, from the available catch records, but some indication of the distribution of these species in the area of interest was discussed by Ni (1982) based on meristic frequencies.

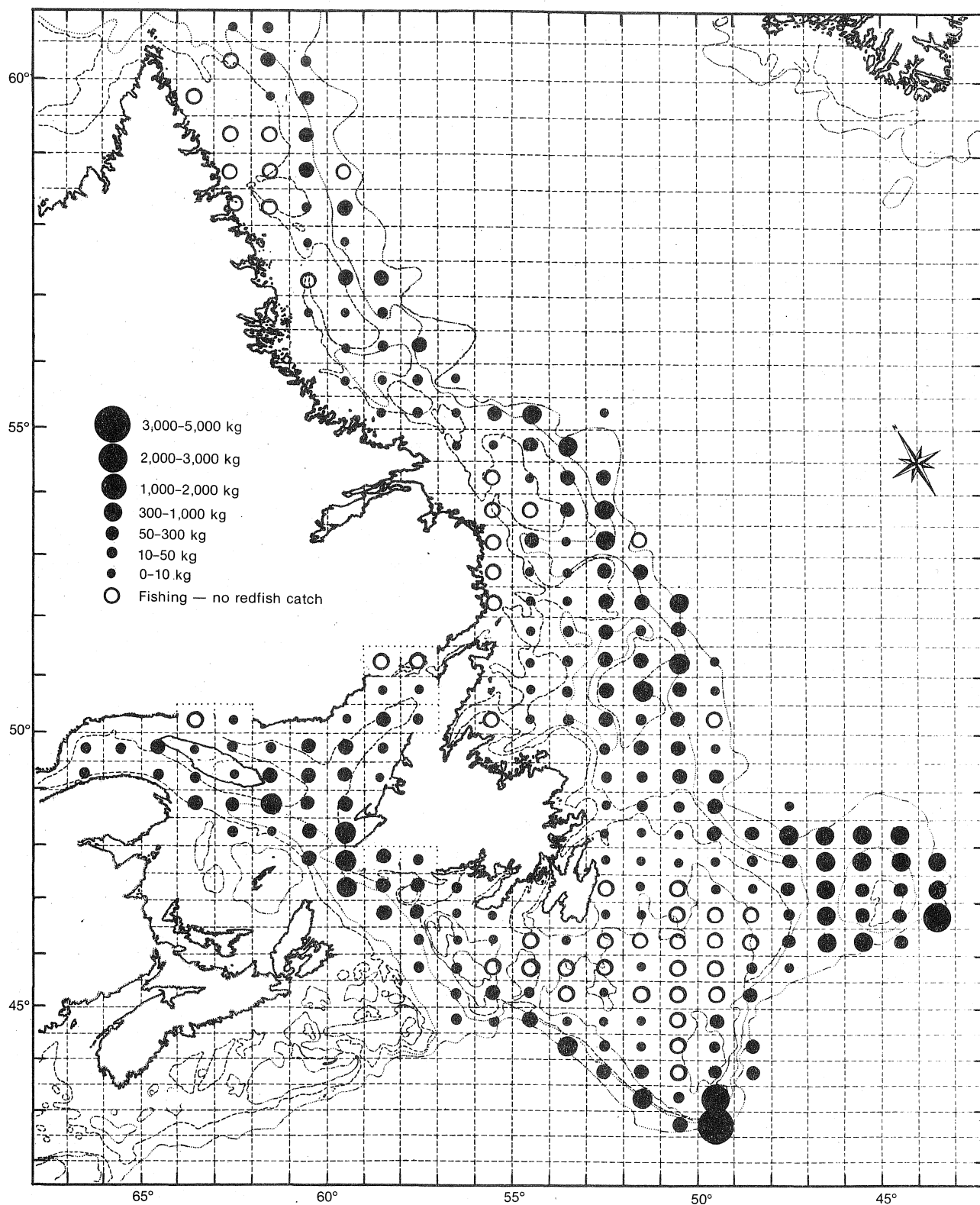


Fig. 2. Distribution and concentration of all redfishes based on average catch per set in bottom-trawl surveys, 1978-80.

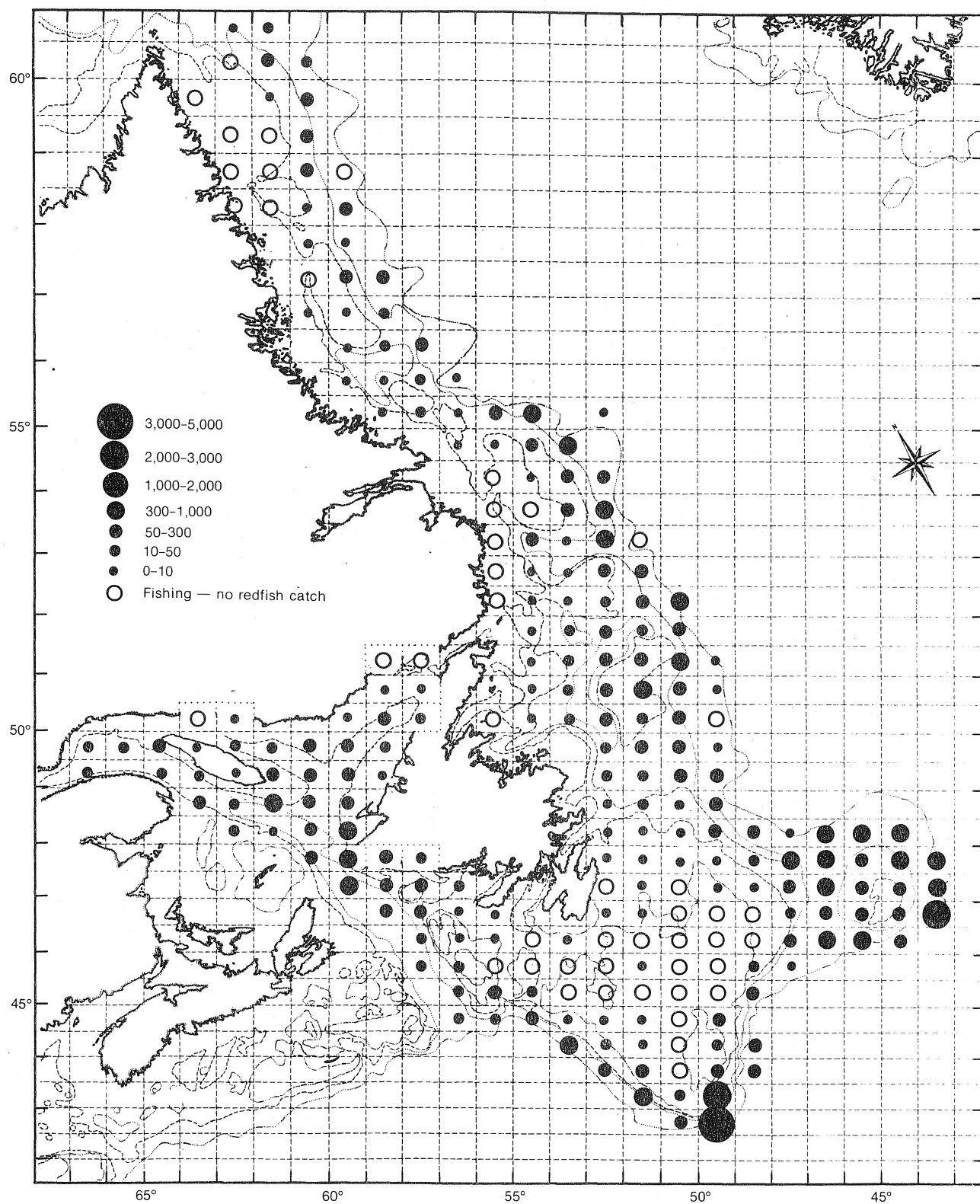


Fig. 3. Distribution and concentration of beaked redfishes based on average catch per set in bottom-trawl surveys, 1978-80.

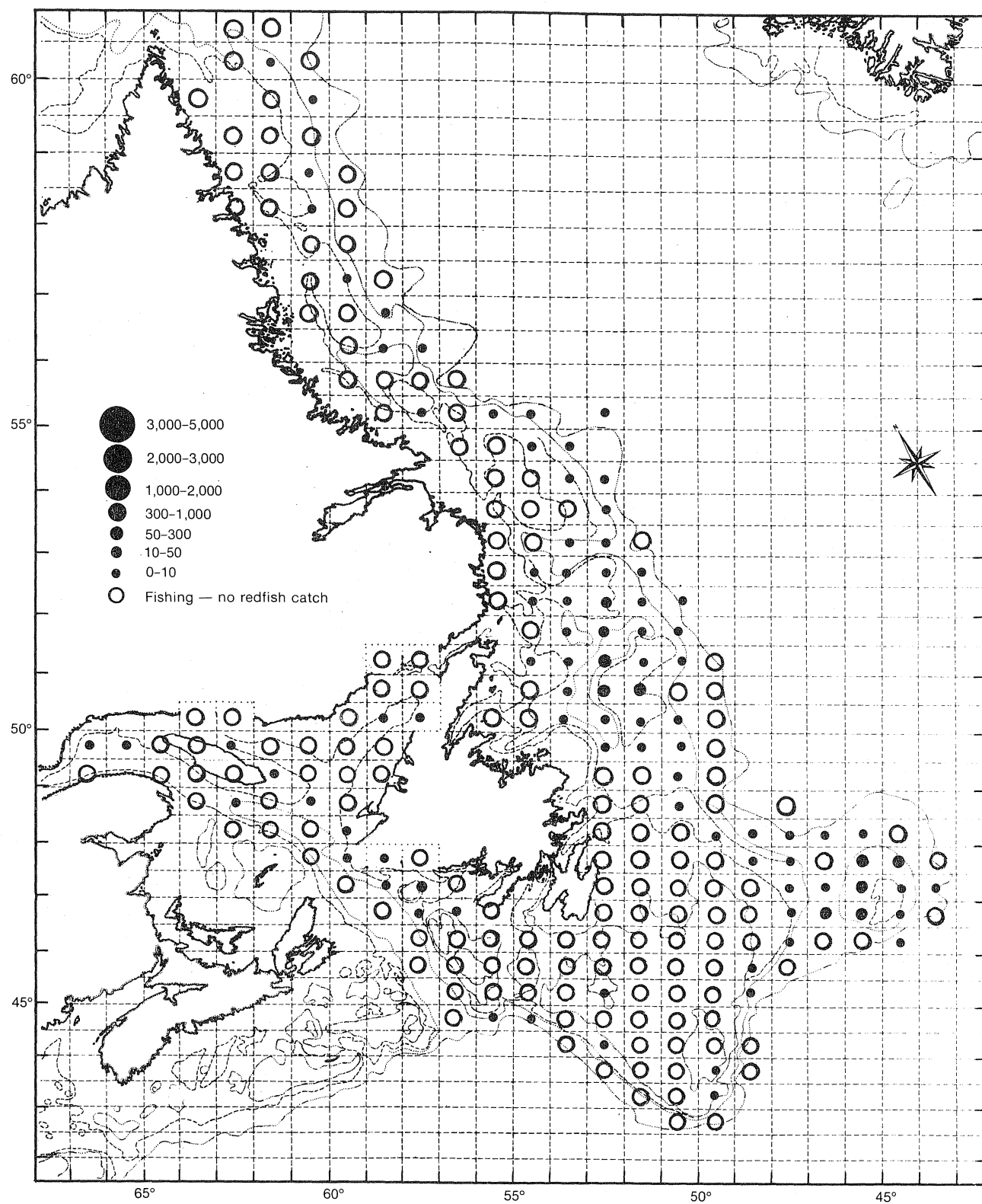


Fig. 4. Distribution and concentration of golden redfish based on average catch per set in bottom-trawl surveys, 1978-80.

TABLE 1. Distribution of redfish catches in the Labrador and Newfoundland areas and in the Gulf of St. Lawrence by NAFO divisions and depth intervals. (A = total number of sets, B = number of sets with redfishes, C = number of sets with beaked redfishes, D = number of sets with golden redfish.)

NAFO Div.	Depth interval (m)	Number of sets				Mean weight per set (kg)			Percent golden redfish <sup>a</sup>
		A	B	C	D	All redfish	Beaked redfishes	Golden redfish	
2G	101-200	51	2	2	—	+	+	—	—
	201-300	32	17	17	1	2.0	1.9	0.1	4.33
	301-400	7	6	6	—	111.2	111.2	—	—
	401-500	7	7	7	1	125.1	124.6	0.5	0.41
	501-750	10	10	10	2	79.0	78.4	0.7	0.86
	1,251-1,500	1	—	—	—	—	—	—	—
2H	<100	3	1	1	—	0.2	0.2	—	—
	101-200	36	4	4	—	0.4	0.4	—	—
	201-300	24	9	9	—	3.4	3.4	—	—
	301-400	24	24	24	2	110.2	109.5	0.7	0.62
	401-500	14	14	14	3	40.2	39.1	1.1	2.67
	501-750	17	14	14	1	38.2	38.1	0.1	0.35
	751-1,000	4	4	4	—	2.6	2.6	—	—
	1,001-1,250	2	2	2	—	4.8	4.8	—	—
	1,251-1,500	1	—	—	—	—	—	—	—
2J	101-200	70	6	6	1	0.1	0.1	+	6.69
	201-300	143	89	84	31	26.6	25.4	1.2	4.50
	301-400	82	76	76	21	268.8	267.7	1.0	0.39
	401-500	36	35	35	8	250.8	249.4	1.4	0.55
	501-750	28	27	27	6	363.6	361.0	2.6	0.72
	751-1,000	5	3	3	—	4.5	4.5	—	—
	1,001-1,250	5	1	1	—	3.6	3.6	—	—
	1,251-1,500	2	—	—	—	—	—	—	—
3K	101-200	1	—	—	—	—	—	—	—
	201-300	194	173	169	48	94.3	58.6	35.7	37.82
	301-400	152	150	149	44	151.9	148.6	3.3	2.16
	401-500	32	30	30	7	151.1	150.1	1.0	0.68
	501-750	12	12	12	1	362.2	362.0	0.3	0.07
	751-1,000	11	9	9	—	4.9	4.9	—	—
	1,001-1,250	6	1	1	—	0.2	0.2	—	—
	1,251-1,500	6	3	3	—	1.0	1.0	—	—
3L	<100	138	—	—	—	—	—	—	—
	101-200	244	37	37	—	0.4	0.4	—	—
	201-300	187	149	147	24	38.9	38.6	0.3	0.64
	301-400	165	163	163	13	127.5	127.3	0.3	0.21
	401-500	27	27	27	2	282.2	280.8	1.5	0.52
	501-750	27	27	27	6	307.6	306.8	0.8	0.26
	751-1,000	2	1	1	—	0.5	0.5	—	—
	1,251-1,500	2	—	—	—	—	—	—	—
3M	101-200	62	42	19	36	3.7	1.1	2.6	70.46
	201-300	165	160	141	132	201.1	40.5	160.6	79.86
	301-400	120	120	119	69	375.5	330.5	45.0	11.98
	401-500	41	41	41	4	678.9	678.6	0.3	0.04
	501-750	49	49	49	3	892.4	892.3	0.1	0.01
3N	<100	152	—	—	—	—	—	—	—
	101-200	27	9	8	1	0.7	0.6	0.1	7.27
	201-300	46	40	39	4	1,053.3	1,053.2	0.1	0.01
	301-400	22	22	22	1	534.4	534.4	+	+
	401-500	9	9	9	1	709.5	709.0	0.5	0.06
	501-750	10	10	10	—	156.9	156.9	—	—
3O	<100	139	8	7	1	+	+	+	28.33
	101-200	38	19	19	—	118.3	118.3	—	—
	201-300	42	42	42	1	194.3	194.3	0.1	0.03
	301-400	28	28	28	2	592.3	592.0	0.4	0.06
	401-500	2	2	2	—	2,820.6	2,820.6	—	—
	501-750	5	5	5	—	1,277.8	1,277.8	—	—
3Ps	<100	57	3	3	—	0.1	0.1	—	—
	101-200	85	51	51	6	34.7	33.6	1.1	3.27
	201-300	80	80	80	8	216.3	211.4	4.9	2.26
	301-400	32	32	32	1	84.1	83.9	0.3	0.34
	401-500	11	11	11	—	68.6	68.6	—	—
	501-750	1	1	1	—	5.9	5.9	—	—

TABLE 1. (continued).

NAFO Div.	Depth interval (m)	Number of sets				Mean weight per set (kg)			Percent golden redfish <sup>a</sup>
		A	B	C	D	All redfish	Beaked redfishes	Golden redfish	
3Pn	101-200	14	14	14	5	30.6	30.4	0.3	0.91
	201-300	12	12	12	—	219.4	219.4	—	—
	301-400	11	11	11	—	1,069.9	1,069.9	—	—
	401-500	11	11	11	—	254.5	254.5	—	—
4R	<100	5	1	1	—	1.6	1.6	—	—
	101-200	90	68	68	—	19.3	19.3	—	—
	201-300	85	84	84	3	309.5	309.4	0.1	0.02
	301-400	32	32	32	1	485.6	485.6	+	0.01
	401-500	9	9	9	—	393.8	393.8	—	—
	501-750	2	2	2	—	254.0	254.0	—	—
4S	<100	13	3	3	—	0.1	0.1	—	—
	101-200	59	42	42	3	26.7	26.6	0.1	0.36
	201-300	88	88	88	7	180.4	180.2	0.2	0.13
	301-400	43	39	39	1	99.6	99.6	+	0.02
	401-500	15	15	15	—	78.8	78.8	—	—
4T	101-200	1	1	1	—	1,080.5 <sup>b</sup>	1,080.5 <sup>b</sup>	—	—
	201-300	13	12	12	—	26.5	26.5	—	—
	301-400	15	15	15	—	16.7	16.7	—	—
	401-500	4	4	4	—	10.8	10.8	—	—

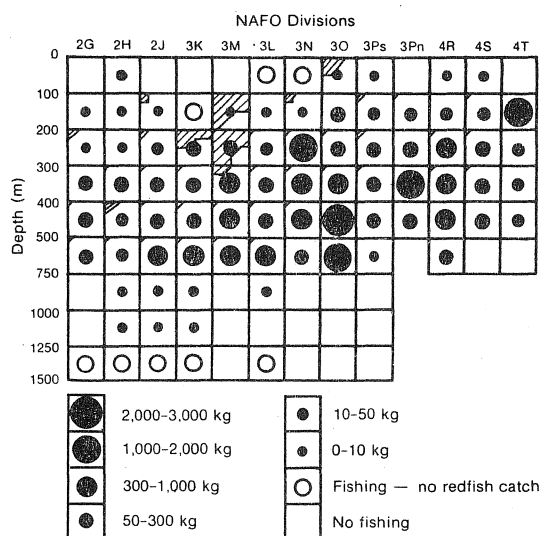
<sup>a</sup> Percentages were calculated before rounding of mean weights per set.<sup>b</sup> Catch from depth of 199 m.

Fig. 5. Distribution and concentration of redfishes by depth and division, based on average catch per set in bottom-trawl surveys, 1978-80. (The shaded areas represent percentages of golden redfish caught relative to the catches of all redfishes.)

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