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Witch Flounder in the Eastern Newfoundland Area, NAFO Divisions 2J3KL

by

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### Abstract

Nominal catches of witch flounder in Divisions 2J3KL have been less than 8000 t annually since 1977. A nominal catch of 4700 t in 1984 is the highest annual catch since 1978. Approximately 80% of the biomass of this stock is in Division 3K with 15% to 5% of the biomass located in Divisions 3L and 2J respectively. Recent biomass estimates from research vessel surveys indicate a minimum trawlable biomass estimate of about 45,000 t for the stock area. Long-term fishing mortality estimates on ages 8-13 (the major commercial age groups) was  $F = 0.34$  reflecting average annual removals of 8000-10,000 t. The  $F_{0.1}$  value for this stock is 0.35.

### Résumé

Les prises annuelles nominales de plie grise dans les divisions 2J3KL sont demeurées inférieures à 8 000 t depuis 1977. Celle de 1984, 4 700 t, est la plus élevée des prises annuelles depuis 1978. Environ 80 % de la biomasse de ce stock se trouve dans la division 3K; 15 % se trouve dans la division 3L et 5 % dans la division 2J. Selon les estimations établies d'après les relevés récemment effectués, la biomasse chalutable minimum se chiffre à environ 45 000 t dans la zone où se trouve le stock. La mortalité par pêche ( $F$ ) à long terme dans les âges de 8 à 13 ans (les plus importantes au point de vue commercial) est estimée à 0,34, ce qui signifie qu'en moyenne on capture chaque année 8 000 - 10 000 t. Le  $F_{0,1}$  de ce stock se chiffre à 0,35.

### Nominal catches

Nominal catches of witch flounder in this stock area reached a peak in 1973 at a level of 24,000 t. It has steadily declined since that time to a level of about 3,000 t in 1982 (Fig. 1). Preliminary figures for 1983 and 1984 are 2,986 t and 4,725 t respectively. The major processors of the fishery in 1984 were Can(N) with 1,886 t, Poland with 1,617 t, and the Soviet Union with 1,000 t. Most of the catch comes from Div. 3K followed by Div. 3L. Very little is taken in Div. 2J.

### Distribution

For management purposes, Div. 2J, 3K, and 3L are considered as a stock unit although it has been shown through stock delineation studies that there are at least three separate breeding stocks throughout the area. In order to show the distribution of witch in this stock area, mean numbers per 30 minute set per unit area from the 1977-83 surveys are shown in Fig. 2. The numbers of sets on which these data are based are shown in Fig. 3. It is clearly obvious that most witch are found in Div. 3K (Fig. 2) as reflected in the catch data (Fig. 1). In Div. 3L most are found along the Div. 3KL line with some found in deep water at the nose of the Grand Bank. In Div. 2J most are found in the Hawke Channel area near the Div. 2J3K line. For practical purposes, an analysis of Div. 3K data would probably suffice for assessing the status of this stock.

### Age composition - commercial

Some information on commercial age composition is available since 1976. For most years, the data are minimal and probably not fully representative of the fishery and are, therefore, not presented. The 1984 data, however, were quite good (Table 1) and the age composition of 1984 fishery is presented and compared to the 1976 age composition in order to show the shift in distribution and the reduction in the number of age groups comprising the commercial stock (Fig. 4). In 1976, the ages ranged up to 25 years old compared to 15 years old in 1984. In 1976, ages 7-16 years were almost equally represented in the catch whereas in 1984 about 75% of the catch is made up of ages 8-10.

### Age composition - research

As in the previous paper, the age compositions for Div. 3K only are presented. These were available from fall surveys from 1978-84 (Fig. 5). Although the age range has been reduced somewhat since 1978 the age distribution have been particularly stable over the period. The 1984 age composition is in fact almost a mirror image of the previous year and it would suggest that recruitment in this population is nearly constant over time.

### Biomass estimates from surveys

Estimates of biomass by stratum from fall surveys are presented in Tables 2, 3, and 4 for Div. 2J, 3K, and 3L respectively.

The estimate for Div. 2J in 1984 was 2,020 t compared to 2,751 t in 1983. In Div. 3K the 1984 estimate was 35,730 t compared to 36,090 t in 1983. In Div. 3L the first complete survey carried out in the area was the summer of 1984 which gave an estimate of 8,498 t. A similar survey in the winter of 1985 gave an estimate of 6,995 t. The total biomass estimate for all three divisions combined was 46,248 t if the Div. 3L summer survey is included and 44,745 t if the 1985 winter survey is included.

### Mortality estimates

Since this fishery is mainly a by-catch fishery, obtaining useful CPUE data isn't possible. Therefore, calculating real time estimates of mortality is difficult. Only long-term estimates of mortality are readily obtainable from catch curves on Div. 3K survey data (Table 5). The long-term fishing mortality on ages 8-13 (the major commercial ages) was  $F = 0.34$  corresponding to average annual removals of 8,000-10,000 t. This is very near the  $F_{0.1}$  value of 0.35 for this stock.

Table 1. List of commercial length frequency and age-length key samples available for the Division 2J3KL witch stock for 1984.

Month	Country	Gear	NAFO Div.	No. meas.	No. aged	Catch (t)
Sept.	Can(M)	OT	2J	190		5
Sept.	Can(M)	OT	3K	249		91
Feb.	Can(N)	OT	3K	706		369
May	Can(N)	OT	3K	1283		1117
June	Can(N)	OT	3K	1122		1033
July	Can(N)	GN	3K	665		201
Sept.	Can(N)	GN	3K	574		87
June	Can(N)	GN	3L	1117		24
July	Can(N)	GN	3L	861		60
Aug.	Can(N)	GN	3L	1266		219
Sept.	Can(N)	GN	3L	536		118
March	Poland	OT	3K	5402		528
April	Poland	OT	3K	6442		873
Q1	Can(N)	OT	3K		196	
Q2	Can(N)	OT	3K		541	
Q3	Can(N)	GN	3K		249	
Q3	Can(N)	GN	3L		559	
Q4	Can(N)	GN	3K		90	
Q4	Can(N)	GN	3L		183	

Table 2. Average weight (kg) per 30-minute set of witch flounder from the autumn surveys of the research vessel Gadus Atlantica in Division 2J (no. of sets in brackets).

Stratum	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71,72 1982	Gadus 86,87,88 1983	Gadus 101, 102,103 1984
201	0.0(2)	0.0(3)	0.0(2)	0.00(3)	0.00(5)	0.00(6)	0.00(6)	0.40(3)
202	0.0(2)	0.0(2)	0.0(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
203	0.0(2)			0.00(2)	0.00(2)	0.83(3)	2.42(3)	0.00(2)
204	1.59(2)				2.65(2)	3.17(3)	0.33(3)	2.25(2)
205	0.0(4)	0.0(4)	0.0(2)	0.00(4)	0.00(8)	0.04(12)	0.00(8)	0.00(8)
206	0.43(11)	0.0(7)	0.0(8)	0.00(7)	0.00(11)	0.13(18)	0.00(14)	0.00(11)
207	0.0(5)	0.0(4)	0.0(5)	0.00(5)	0.00(9)	0.13(15)	0.00(10)	0.00(7)
208	3.46(4)	0.61(3)	0.91(2)	0.50(2)	2.50(2)	13.83(3)	1.50(2)	2.25(3)
209	0.52(7)	0.0(4)	0.0(5)	0.50(4)	0.00(6)	0.45(11)	0.64(7)	0.09(7)
210	1.58(6)	0.34(4)	2.84(2)	4.67(3)	0.25(3)	1.70(6)	0.00(2)	3.57(4)
211	12.26(2)	9.53(2)	0.0(2)	0.85(3)	1.75(2)	6.15(2)	0.20(2)	1.75(2)
212	26.06(4)				11.25(2)	19.46(5)	22.27(3)	11.33(3)
213	1.48(8)	2.50(4)	1.59(4)	0.40(5)	1.50(6)	1.70(10)	0.93(10)	0.65(5)
214	1.55(6)	0.69(4)	0.0(4)	0.00(3)	0.50(5)	0.75(8)	0.49(8)	0.38(4)
215	1.59(4)	0.27(5)	0.11(4)	0.00(2)	0.64(5)	0.39(9)	0.00(8)	0.33(3)
216	0.0(2)		1.24(2)	1.25(2)	1.25(2)	1.25(2)	2.33(3)	0.00(2)
217	0.0(3)				0.00(2)	0.00(2)	0.00(2)	
218	0.0(2)				0.00(2)	0.00(2)	0.00(2)	
219					0.00(2)		0.00(2)	
220								
221								
222	4.82(4)	2.86(3)	1.02(2)	1.25(2)	4.00(2)	6.17(3)	1.33(3)	0.83(3)
223	0.68(2)				2.00(2)	0.00(2)	0.00(2)	1.00(2)
224	0.0(2)				0.00(2)	0.00(2)	0.00(2)	0.00(2)
225	0.0(2)							
226								
227	2.72(4)				2.50(2)	5.30(5)	3.25(4)	1.50(3)
228	3.43(8)		3.63(4)	4.50(3)	1.08(6)	4.20(10)	1.58(6)	3.00(7)
229	2.67(4)	4.99(2)	4.43(2)	3.00(2)	2.00(2)	2.25(4)	1.76(4)	1.43(3)
230	0.0(3)				0.00(2)	0.00(2)	0.00(2)	0.75(2)
231	0.0(2)					0.00(2)	0.00(2)	0.00(2)
232	0.0(2)							
233								
234	0.0(2)	0.0(2)	0.0(2)	0.00(2)	0.00(2)	0.00(3)	0.00(2)	0.00(2)
235	17.76(4)				11.50(2)	9.00(3)	22.25(2)	11.17(3)
236	0.0(2)				0.85(2)	0.00(2)	0.00(2)	0.00(2)
Total weight (tons)	3,829	993	1,058	1,109	1,968	3,575	2,751	2,020

Table 3. Average weight (kg) per 30-minute set of witch flounder from the autumn surveys of the research vessel Gadus Atlantica in Division 3K (no. of sets in brackets).

Stratum	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58,59 1981	Gadus 71,72 1982	Gadus 86,87,88 1983	Gadus 101, 102,103 1984
620	4.54(7)	3.30(7)	2.00(9)	0.45(10)	0.61(9)	0.55(10)	0.36(13)
621	3.97(7)	9.41(8)	1.25(10)	1.64(11)	0.69(14)	3.30(12)	1.11(14)
622				14.75(2)	7.50(3)	13.50(2)	10.00(4)
623	5.94(3)	6.57(3)	2.88(4)	5.41(4)	3.40(5)	6.75(6)	3.30(5)
624	6.51(3)	2.15(2)	1.75(2)	5.25(2)	6.00(4)	1.75(4)	4.88(4)
625	12.71(3)	32.51(3)	10.63(4)	16.88(4)	5.00(2)	18.00(3)	14.95(5)
626	47.79(4)	53.83(3)	9.33(3)	11.30(5)	39.60(5)	36.88(4)	12.67(6)
627				94.75(6)	63.00(7)	77.25(6)	63.75(8)
628	23.88(5)	52.65(2)	26.50(4)	10.83(6)	22.25(6)	46.83(6)	19.14(7)
629	48.73(3)	28.58(2)	34.67(3)	42.33(3)	23.25(2)	42.83(3)	20.75(4)
630		16.55(2)	6.03(2)	15.75(2)		12.25(2)	8.80(3)
631				60.90(5)	6.00(2)	46.30(5)	48.90(5)
632	13.77(3)	22.22(2)	5.77(2)	10.00(2)	8.00(3)	9.17(3)	
633	19.28(5)	14.02(6)	17.93(7)	6.32(8)	10.96(7)	12.49(12)	14.10(10)
634	2.72(5)	6.16(6)	5.50(5)	2.94(7)	5.60(11)	1.04(5)	5.25(7)
635	20.61(5)	16.87(5)	13.50(4)	10.80(5)	5.50(5)	3.52(6)	15.59(8)
636	17.25(3)	11.25(5)	12.20(5)	7.50(6)	5.85(10)	5.00(6)	22.72(8)
637	18.04(4)	28.02(4)	16.00(4)	17.00(6)	17.36(7)	35.32(5)	25.08(6)
638	17.43(5)	41.12(7)	26.42(6)	26.75(8)	14.62(15)	20.82(11)	40.35(10)
639	14.08(5)	10.44(2)	15.00(4)	11.23(6)	7.55(10)	26.71(7)	24.67(8)
640				3.25(2)	23.00(2)		21.25(2)
641				1.15(2)	1.25(4)	4.33(3)	0.00(3)
642				0.00(3)	0.33(6)		1.33(6)
643							
644							
645				0.50(2)	16.33(3)	13.25(2)	89.25(2)
646				0.25(2)	0.60(2)	18.50(2)	3.00(2)
647				0.00(2)	0.00(2)		
648							
649							
Total weight (tons)	23,996	31,632	19,517	31,210	22,220	36,090	35,730

Table 4. Average weight (kg) per 30-minute set of witch flounder from surveys of the research vessel A.T. Cameron and Wilfred Templeman in Division 3L (no. of sets in brackets)

Stratum	ATC 323,325 1981 (Fall)	ATC 333,334 1982 (Fall)	W. TEMPLEMAN 7, 8, 9 1983 (Fall)	W. TEMPLEMAN 16, 17, 18 1984 (Summer)	W. TEMPLEMAN 22, 23, 24 1985 (Winter)
328	-	-	-		
341	0.00(2)	0.20(4)	0.00(4)	0.25(4)	0.03(6)
342	0.00(3)	0.00(3)	0.00(4)	1.00(5)	0.00(8)
343	0.00(4)	-	0.00(3)	0.00(2)	0.00(3)
344	1.75(4)	0.00(3)	0.50(6)	1.25(4)	0.00(3)
345	19.88(4)	21.87(6)	34.63(8)	1.00(6)	0.00(7)
346	46.50(3)	18.63(4)	19.50(5)	27.00(7)	3.67(3)
347	2.83(3)	0.40(4)	0.33(6)	14.17(6)	14.88(4)
348	0.17(6)	0.60(5)	0.14(11)	4.33(6)	0.00(5)
349	0.00(7)	0.00(5)	0.00(9)	1.09(11)	0.03(8)
350	0.00(6)	0.00(2)	0.00(8)	1.00(14)	0.00(10)
363	0.00(4)	0.50(3)	0.00(3)	0.58(12)	0.00(9)
364	1.06(9)	0.46(11)	0.12(11)	0.63(8)	0.41(8)
365	0.25(4)	1.25(4)	0.00(5)	0.70(10)	0.08(12)
366	1.67(3)	3.50(6)	0.00(4)	1.00(4)	0.00(4)
368	0.50(2)	0.75(2)	-	0.82(11)	0.20(5)
369	5.75(2)	5.07(4)	1.75(6)	1.00(2)	3.75(2)
370	0.25(4)	0.00(6)	0.00(6)	2.86(7)	0.30(5)
371	0.00(4)	0.00(5)	0.00(5)	1.29(7)	0.00(7)
372	0.00(5)	0.00(7)	0.00(4)	0.29(7)	0.00(6)
384	-	0.00(4)	1.00(3)	0.54(13)	0.09(11)
385	0.00(8)	0.00(8)	0.00(5)	0.83(6)	0.00(4)
386	10.50(3)	1.75(4)	-	1.00(12)	0.00(11)
387	4.25(2)	13.83(3)	-	1.38(8)	0.70(5)
388	-	0.87(3)	-	1.67(3)	11.63(4)
389	-	4.38(4)	-	31.00(2)	10.33(3)
390	0.00(3)	0.00(4)	0.00(3)	1.50(6)	0.00(4)
391	-	0.00(2)	0.00(2)	0.67(3)	0.12(5)
392	-	0.00(2)	1.00(2)	0.00(2)	0.00(2)
729	-	-	-	4.00(2)	0.00(2)
730	-	-	-	8.50(2)	65.75(2)
731	-	-	-	4.50(2)	2.25(2)
732	-	-	-	24.50(2)	44.83(3)
733	-	-	-	11.00(2)	12.25(2)
734	-	-	-	5.25(4)	25.33(3)
735	-	57.25(2)	-	0.67(3)	79.00(2)
736	-	-	23.00(2)	14.67(3)	14.25(2)
Total weight (tons)	7,461	7,059	5,638	8,498	6,995



Table 5. Abundance estimates of witch flounder in Division 3K from autumn surveys. Only strata surveyed in all years are included.

Age	1978	1979	1980	1981	1982	1983	1984	Total
1								
2						27		27
3	48		214			14	46	322
4	172	171	127	105	120	25	64	784
5	2,280	1,891	160	172	355	260	386	5,504
6	2,345	4,684	687	429	555	486	882	10,068
7	4,705	10,595	4,346	4,051	3,711	2,411	2,252	32,071
8	6,465	9,162	4,876	5,581	5,372	5,898	6,076	43,430
9	4,475	4,308	4,421	3,326	4,002	6,556	6,789	33,877
10	3,454	3,577	4,010	2,246	1,754	4,799	4,643	24,483
11	2,570	1,713	1,789	1,062	1,030	2,661	2,485	13,310
12	1,949	644	1,212	575	113	769	1,429	6,691
13	1,001	175	830	71	16	267	544	2,904
14	369		138	14			20	541
15	175		25					200
16	40							40
Ages								
8-13								
Intercept	11.58	15.33	11.81	15.36	18.56	14.43	13.10	15.29
Slope	-0.35	-0.75	-0.39	-0.80	-1.15	-0.64	-0.50	-0.54
r	0.99	0.97	0.97	0.95	0.95	0.93	0.95	0.98
F	0.15	0.55	0.29	0.60	0.95	0.44	0.30	0.34

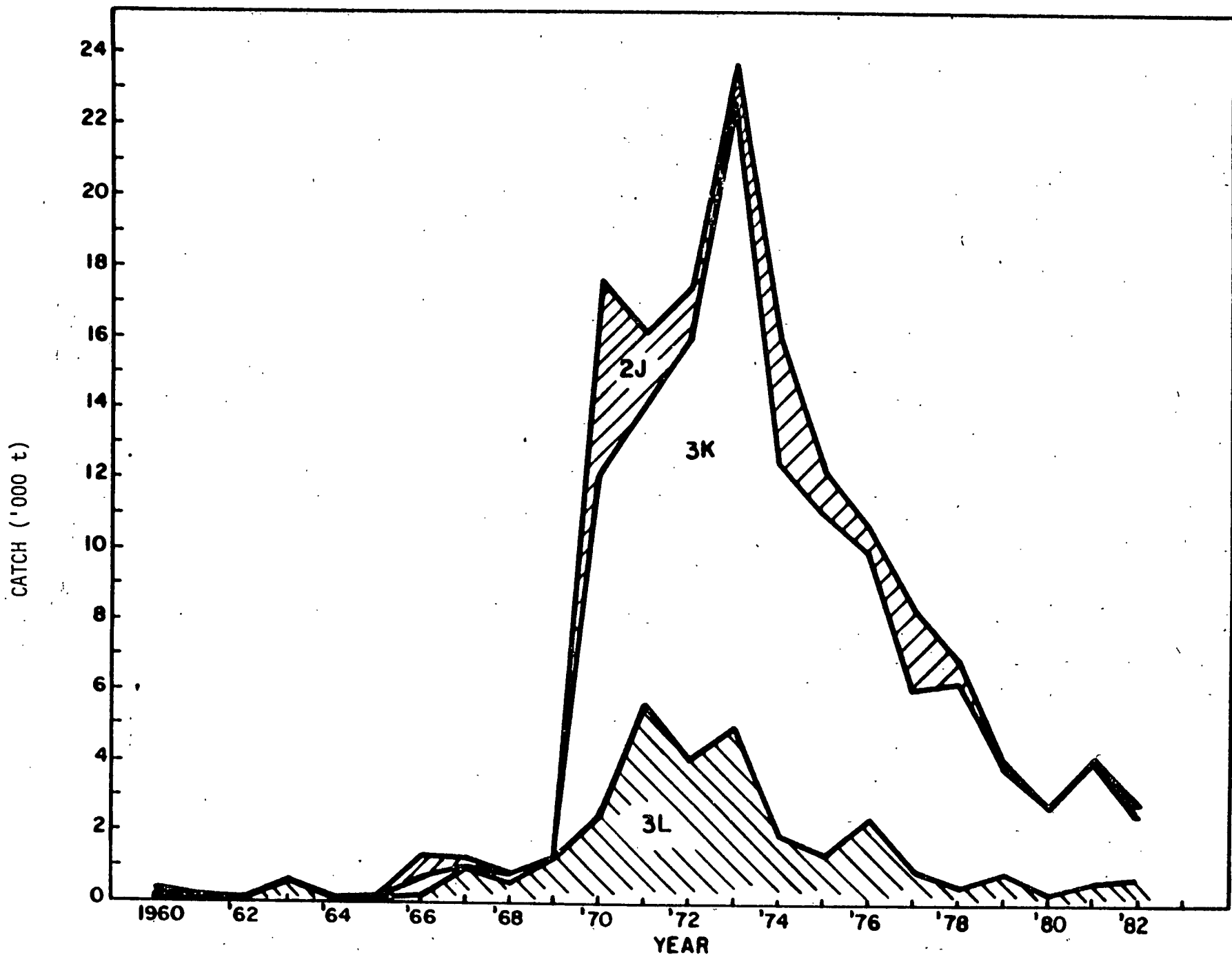


Fig. 1. Nominal catches of witch flounder in NAFO Div. 2J, 3K, and 3L from 1960-82.

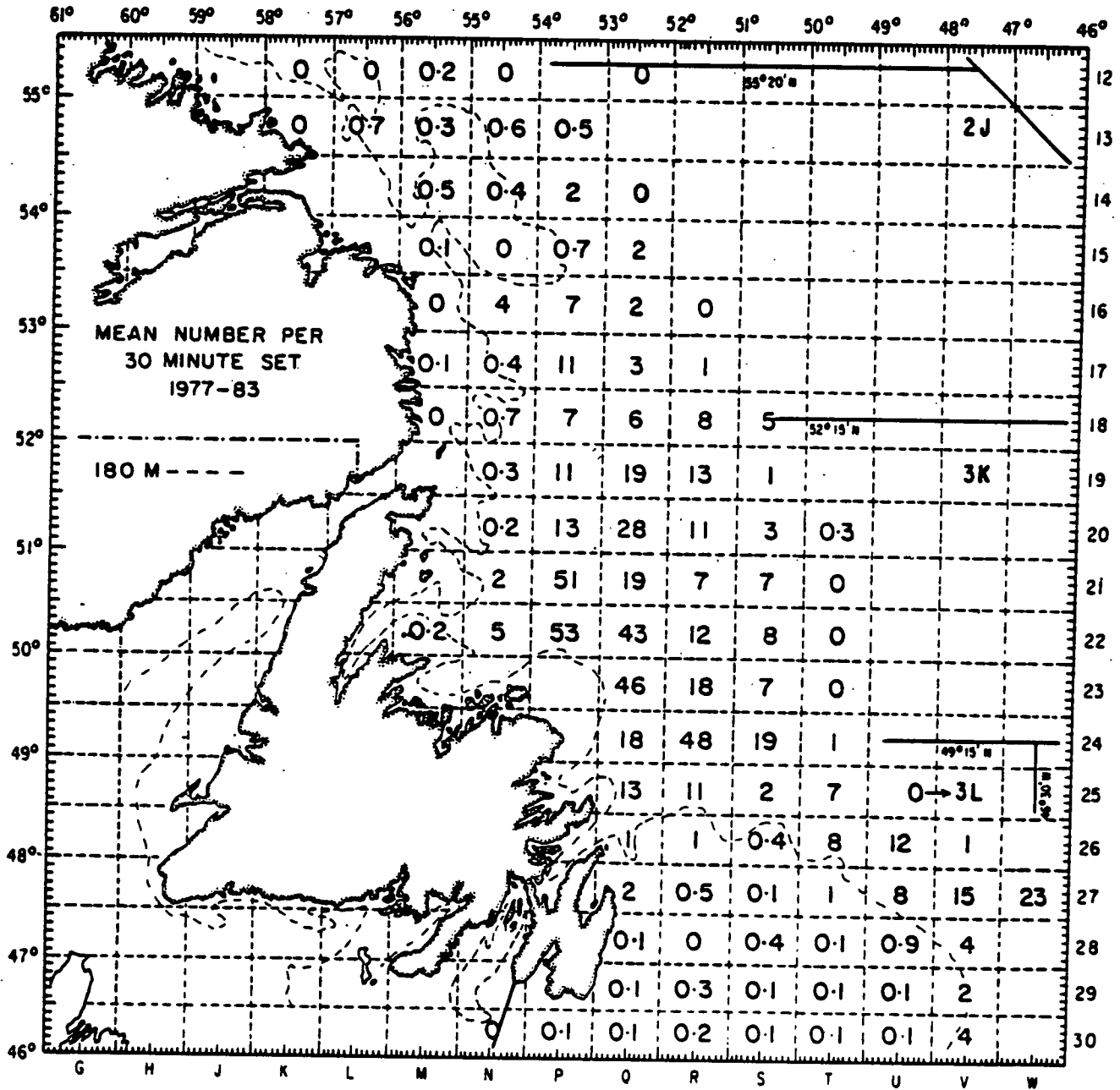


Fig. 2. Mean number per 30 minute set per unit area of witch flounder in NAFO Div. 2J, 3K, and 3L from research vessel surveys 1977-83.

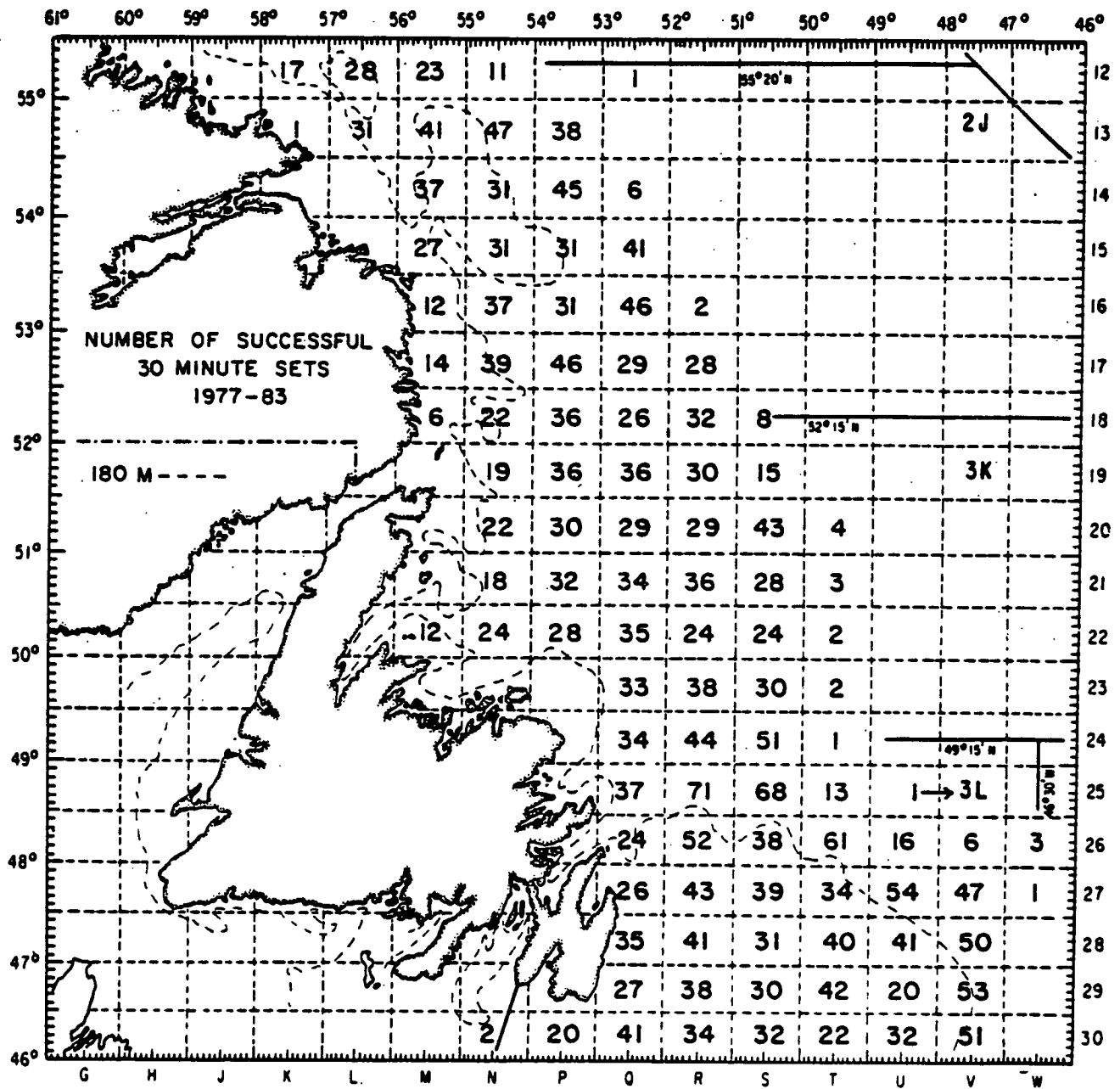


Fig. 3. Number of successful sets per unit area from research vessel surveys 1977-83 in NAFO Div. 2J, 3K, and 3L.

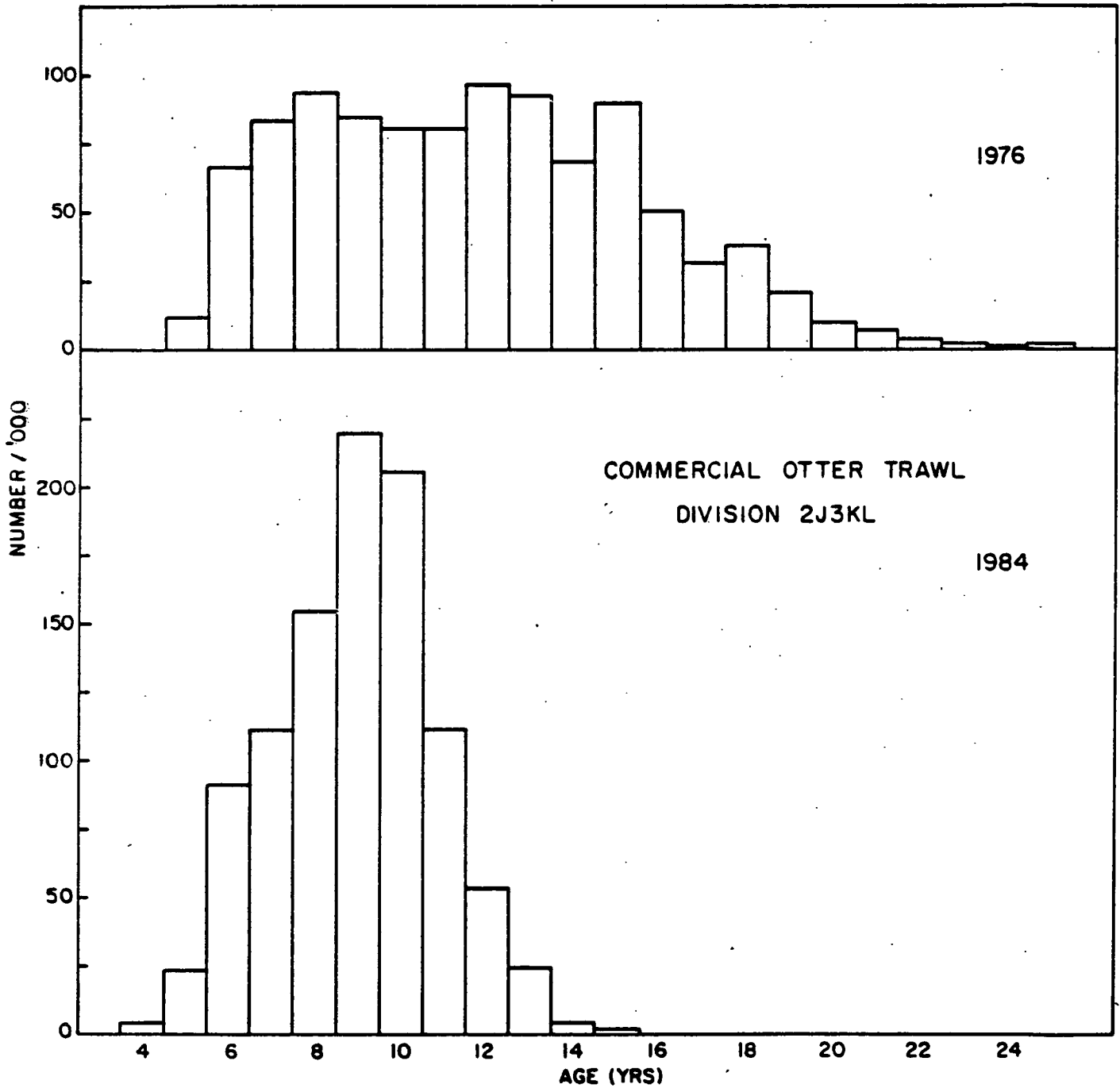


Fig. 4. Commercial age composition of witch flounder in NAFO Div. 2J, 3K, and 3L for 1976 and 1984.

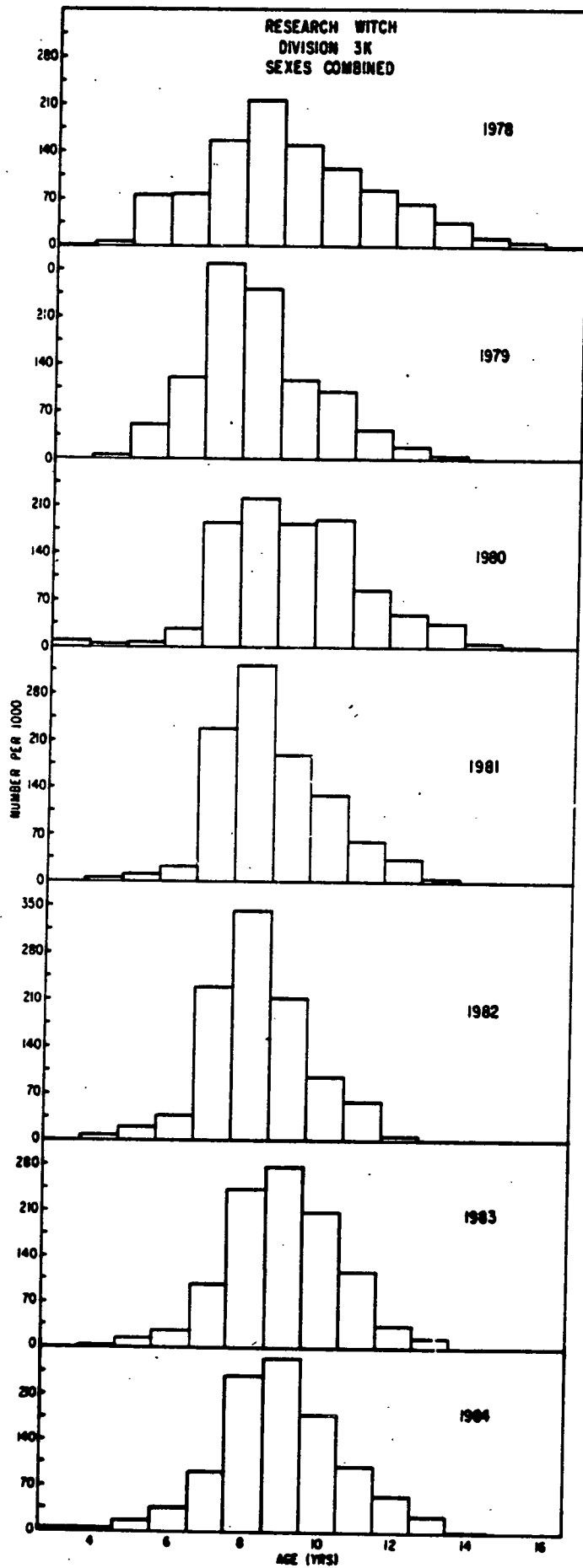


Fig. 5. Age composition of witch flounder in NAFO Div. 3K from research vessel surveys, 1978-84.