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The Status of the Witch Flounder Stock in Division 2J, 3K, and 3L

by

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¹La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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Abstract

Catches fluctuated between 3000 t and 4500 t from 1980 to 1991 and decreased in 1992 to 2300 t. Commercial catch rates varied widely during the 1980s reaching very high values in 1986 and 1989 perhaps reflecting increased concentrations of fish rather than higher stock sizes. Biomass estimates from research surveys decreased from about 40,000-45,000 t in the early 1980s to about 2500 t in 1992. The geographical distributions of witch in the surveys changed suddenly in 1986 after the 1985 fall survey. The area of distribution has gradually decreased since. The fishery in recent years has been prosecuted in depths deeper than those covered by the survey.

Résumé

Les prises ont fluctué entre 3 000 et 4 500 t de 1980 à 1991 et ont chuté à 2 300 t en 1992. Les taux de prises commerciales ont considérablement varié au cours des années 1980, pour atteindre des valeurs très hautes en 1986 et 1987, signes peut-être de concentrations accrues de poisson plutôt que d'une augmentation du stock. Les estimations de biomasse établies d'après les relevés de recherche sont passées d'environ 40 000-45 000 t au début des années 1980 à quelque 2 500 t en 1992. La distribution géographique de la plie dans les relevés a changé brusquement en 1986, après le relevé d'automne de 1985. La zone de distribution a progressivement diminué depuis. Ces dernières années, la pêche a eu lieu dans des eaux plus profondes que celles visées par le relevé.

Nominal Catches

The commercial fishery began for witch in this area in the early 1960s and increased steadily from about 51,000 t in 1963 to a peak of over 24,000 t in 1973 (Table 1; Fig. 1). Catches declined as rapidly as they began to 2800 t in 1980 and subsequently fluctuated between 3000 t and 4500 t to 1991. The catch in 1992 was just 2300 t, the lowest since 1964. Up until the late 1980s, the fishery was prosecuted by Poland, USSR, and Canada; however, in recent years, the fishery has been conducted mainly by Canada although significant catches are taken by EEC (Portugal) as part of an unregulated fishery in the NAFO Regulatory area of Division 3L. Most of the catch has been caught traditionally in Division 3K (Table 2; Fig. 1) except since 1986 where the catch in Division 3L has become significant due to this fishery in the NAFO Regulatory area of Division 3L. None of Division 3K extends outside the Canadian 200-mile zone, but there is a natural extension of the slope area beyond 200 miles in Division 3L.

Since 1988, there has been a very successful offshore Canadian fishery on spawning concentrations in the deep slopes of Division 3K especially in depths beyond 700 meters. Between 1988 and 1993, however, the area fished has become increasing smaller and substantially deeper. The fishery in the winter of 1993 was very poor according to log reports, and the only economic catch rates occurred in depths greater than 1400 meters which were at the limits of most domestic trawler capabilities. Catches quickly declined until they became too low for economic viability and the fishery stopped. It can be anticipated that the nominal catch in 1993 will likely be the lowest since the fishery began.

Catch and Effort

Little directed effort data are available for witch; however, for illustrative purposes a multiplicative analysis was conducted on information since 1973 where directed catch was assumed to be a catch comprised of more than 50% witch. The results are shown in Table 3 and Figure 2. The trends in catch rates are very difficult to interpret with any degree of confidence particularly in the late 1980s where catch rates fluctuated wildly. It is possible that the high points may be more a reflection of fish concentrating in deep areas at high density levels. It may further be hypothesized that declines in recent years are a reasonably true reflection of reduced biomass especially when it is known that the spatial distribution of the effort has been systematically reducing over time.

Commercial Catch at Age

Catch at age data from the commercial fishery are shown in Table 4 for the years 1981-92. There has clearly been a reduction in the number of age groups comprising the population with a maximum age of 17 in 1981 and 14 since about 1986. In fact, in the early to mid-1970s, there were fish in the population up to age 26 years old. Nevertheless, the age structure has been fairly consistent since 1985. While no stock recruitment relationship for this stock has ever been investigated, it is worth noting that by truncating more than 10 age groups off the older portion of the stock there may very well have been a reduction in the reproductive potential of the resource and subsequent recruitment.

Biological Surveys

Stratified-random surveys have been conducted in the fall in Div. 2J, 3K, and 3L since 1977, 1978, and 1981 respectively. In the past, for years when surveys were incomplete, biomass estimates for missing strata were obtained using multiplicative regression analyses. However, with more complete coverage in recent years and significant changes in distribution (which violates the assumptions of the model) values for missing strata were not estimated.

1) Biomass estimates:

For Division 2J, biomass estimates ranged from as high as 4100 t in 1986 to a low of just over

500 t in 1992 (Tables 5 and 6). In Division 3K, during 1979-85, there was a period of relative stability where most annual biomass estimates were over 30,000 t (Tables 7 and 8). Since that time, catches have declined considerably to 935 t in 1992 the lowest in the time series. For Division 3L, biomass estimates varied generally between 6000 t and 7000 t from 1981-88 but declined rapidly since then to a low of just under 1500 t in 1992 (Tables 9 and 10).

For the three divisions combined (Fig. 3), it can be seen that with the exception of 1990 there has been a very steady and systematic decline from about 1984 through 1992 with the estimate of about 3000 t in 1992 now lower than the existing TAC of 4000 t.

2) Biomass by Depth:

Estimates of biomass by depth are presented by division in Figures 4, 5, and 6 respectively for Divisions 2J, 3K, and 3L. It is clearly seen that, for all divisions in the earlier years of higher abundance, the biomass is distributed in depths generally less than 500 meters; however, for more recent times, particularly in the 1990s, most abundance is found in depths greater than 500 meters. Based upon these observations and the knowledge that the commercial fishery operates in much deeper zones, it is also evident that the depth constraints of the survey design is restrictive in measuring the complete biomass of this species more particularly in recent years.

3) Estimates of abundance at age:

Estimates of abundance at age from fall surveys are presented in Tables 11, 12, and 13 for Divisions 2J, 3K, and 3L respectively. In all cases, there were evidently older fish in the populations in the earlier period with a broader age range although it was not as explicit as in the commercial catch at age data. Age structure has been much more stable over the last 10 years or so although the actual abundance at age has been declining rapidly in the recent period.

Distribution

Annual distribution plots of witch flounder catches from research vessel surveys in Divisions 2J, 3K, and 3L during 1978-92 are presented in Figures 7-10 respectively. From the period 1978-85 the pattern of distribution is fairly consistent with the dominant division being Division 3K as expected. In fact, the distribution in those years is also consistent with distribution patterns previously published on data collected during the 1950s and 1960s. Between 1985 and 1986, however, there was a substantial change in the pattern culminated by a considerable reduction in biomass. The high abundance of witch usually associated with the deep channels on the western side of Funk Island Bank virtually disappeared. Throughout the late 1980s, area of distribution continued to shrink towards the southeast portion of Division 3K; and by 1990 it became clear that the only fish left appeared to be concentrated along the very deep slope area. Even more disturbing is that by 1992 the only area where witch flounder showed up in the survey area was in the deep slope area of the Sackville Spur ("Nose" of the Grand Bank) outside the Canadian 200-mile zone.

Conclusion

From the information presented here, it is quite clear that this stock has been reduced to levels far below anything observed in the past. It would seem also that, for the period when reductions were most dramatic, it is unlikely that fishing intensity would have been the most significant factor. On the other hand, having observed the shrinking area of distribution in recent years coupled with the fact that fishing was most intense in this area during prespawning aggregations, it is probable that fishing may have accelerated the decline over the last couple of years. It may be argued that because the fishery has recently been prosecuted well beyond depths occupied by the surveys, biomass estimates may be biased downwards. Nevertheless, since fishing has taken place in a very restricted area and in 1993 was a virtual failure, it is difficult to accept that this stock is not at a dangerously low level.

Table 1. Nominal catches of witch in Div. 2J3KL by country 1963-92.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Poland	USSR	UK	Others	Total
1963	17	3	0	259	89	7	570	945
1964	103	0	0	752	164	24	1	1044
1965	128	29	0	1876	2056	58	0	4147
1966	187	9	1045	559	1868	29	0	3697
1967	901	0	332	926	1933	9	0	4101
1968	446	0	358	1990	7834	33	5	10666
1969	1355	0	546	957	9726	1	0	12585
1970	4020	0	508	3566	9934	0	2	18030
1971	8030	75	508	5404	2018	9	9	16053
1972	5520	6	648	4013	7016	225	0	17428
1973	3761	1348	2327	11802	2834	258	2031	24361
1974	1868	1082	272	5302	6917	29	493	15963
1975	1352	446	374	4583	4763	0	687	12205
1976	2081	606	110	3828	3022	3	975	10625
1977	4371	300	203	3052	392	0	0	8318
1978	1979	23	58	3490	1345	1	8	6904
1979	1392	0	22	1855	150	22	656	4097
1980	1459	0	16	1235	45	0	68	2823
1981	2661	0	32	1385	85	0	31	4194
1982	1206	0	4	1151	552	0	68	2981
1983	1483	0	50	1005	516	0	34	3088
1984	2077	0	27	1617	1000	2	85	4808
1985	1305	26	33	565	1006	-	68	3003
1986	1199	2	7	3	21	-	2684	3916
1987	854	-	56	765	1057	-	1743	4475
1988	3270	-	10	760	4	-	110	4154
1989	4059	-	4	691	5	-	147	4906
1990 ^a	3271	-	-	-	-	-	294	3565
1991 ^a	2799	-	-	-	-	-	1209	4008
1992 ^a	1707	-	-	-	-	-	629	2336

^aProvisional

Table 2. Nominal catches of witch by Division in Div. 2J, 3K, and 3L.

Year	2J	% Catch 2J	3K	% Catch 3K	3L	% Catch 3L	Total
1963	38	4.02	263	27.83	644	68.15	945
1964	92	8.81	560	53.64	392	37.55	1044
1965	2547	62.73	1049	25.84	464	11.43	4060
1966	1268	34.30	2000	54.10	429	11.60	3697
1967	1357	33.09	1322	32.24	1422	34.67	4101
1968	1716	16.09	8119	76.12	831	7.79	10666
1969	4852	38.55	6457	51.31	1276	10.14	12585
1970	5604	31.08	9961	55.25	2465	13.67	18030
1971	1978	12.32	8462	52.71	5613	34.97	16053
1972	1443	8.33	11801	68.14	4074	23.52	17318
1973	1048	4.44	17624	74.61	4949	20.95	23621
1974	3497	21.91	10550	66.09	1916	12.00	15963
1975	1185	9.71	9621	78.83	1399	11.46	12205
1976	683	6.43	7533	70.90	2409	22.67	10625
1977	2267	27.25	5091	61.20	960	11.54	8318
1978	640	9.27	5761	83.44	503	7.29	6904
1979	188	4.59	3027	73.88	882	21.53	4097
1980	41	1.45	2496	88.42	286	10.13	2823
1981	110	2.62	3436	81.93	648	15.45	4194
1982	149	5.00	2198	73.73	634	21.27	2981
1983	200	6.48	2412	78.11	476	15.41	3088
1984	155	3.22	4000	83.11	658	13.67	4813
1985	160	5.33	1998	66.53	845	28.14	3003
1986	95	2.43	637	16.27	3184	81.31	3916
1987	1100	24.58	1141	25.50	2234	49.92	4475
1988	8	0.19	3189	76.77	957	23.04	4154
1989	5	0.10	3987	81.27	914	18.63	4906
1990 ^a	62	1.74	2494	69.96	1009	28.30	3565
1991 ^a	215	5.36	2235	55.76	1558	38.87	4008
1992 ^a	-	0.00	1232	52.74	1104	47.26	2336

^aProvisional

TABLE 3. ANOVA RESULTS, REGRESSION COEFFICIENTS AND STANDARDIZED CATCH RATE SERIES DERIVED FROM A MULTIPLICATIVE MODEL OF CATCH RATE DATA FOR WITCH FLOUNDER IN DIV. 2J3KL FOR THE PERIOD 1973-1992.

REGRESSION OF MULTIPLICATIVE MODEL					REGRESSION COEFFICIENTS (continued)						
MULTIPLE R.....		0.840			CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.	
MULTIPLE R SQUARED.....		0.706									
ANALYSIS OF VARIANCE											
SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE							
INTERCEPT	1	1.952E1	1.952E1		81	20	-0.171	0.540	2		
REGRESSION	31	2.896E1	9.340E-1	4.879	82	21	-0.183	0.500	4		
Country Gear TC (1)	4	3.270E0	8.176E-1	4.271	83	22	-0.249	0.523	3		
Month (2)	6	5.898E0	9.829E-1	5.135	84	23	-0.452	0.540	2		
Division (3)	2	6.640E-1	3.320E-1	1.734 (NS)	85	24	-0.630	0.512	3		
Year (4)	19	1.507E1	7.933E-1	4.144	86	25	0.660	0.655	1		
RESIDUALS	63	1.206E1	1.914E-1		87	26	-0.612	0.511	3		
TOTAL	95	6.053E1			88	27	0.050	0.486	6		
					89	28	0.621	0.487	6		
					90	29	0.095	0.496	8		
					91	30	-0.627	0.502	6		
					92	31	-0.910	0.493	9		
					PREDICTED CATCH RATE						
					YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
						MEAN	S.E.	MEAN	S.E.		
					1973	-0.1139	0.2127	0.883	0.389	24361	27597
					1974	-0.0854	0.1530	0.936	0.355	15963	17051
					1975	-0.1422	0.1273	0.896	0.312	12205	13619
					1976	-0.7750	0.2789	0.441	0.219	10625	24109
					1977	-0.5964	0.0459	0.593	0.127	8318	14026
					1978	-1.3308	0.0684	0.281	0.073	6904	24542
					1979	-0.5554	0.0432	0.619	0.128	4097	6622
					1980	-0.5054	0.0521	0.647	0.147	2823	4360
					1981	-0.2848	0.1252	0.778	0.269	4194	5391
					1982	-0.2967	0.0721	0.790	0.210	2981	3775
					1983	-0.3627	0.0791	0.737	0.205	3088	4192
					1984	-0.5662	0.1252	0.587	0.203	4808	8189
					1985	-0.7439	0.0952	0.499	0.152	3003	6017
					1986	0.5458	0.2188	1.702	0.760	3916	2301
					1987	-0.7254	0.0948	0.508	0.154	4475	8801
					1988	-0.0637	0.0416	1.013	0.206	4154	4103
					1989	0.5067	0.0428	1.790	0.369	4906	2741
					1990	-0.0189	0.0379	1.061	0.206	3565	3360
					1991	-0.7405	0.0446	0.514	0.108	4008	7801
					1992	-1.0243	0.0357	0.389	0.073	2336	6011
					AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.293						

Table 5. Average weight (kg) per 30-minute set of witch flounder from the autumn surveys of the research vessel GADUS ATLANTICA in Division 2J (# of sets in brackets).

Stratum	GADUS 3 1977	GADUS 12, 15 1978	GADUS 27, 29 1979	GADUS 42, 44 1980	GADUS 58 1981	GADUS 71, 72 1982	GADUS 86, 87, 88 1983	GADUS 101, 103 1984	GADUS 116, 117, 118 1985	GADUS 131, 132, 133 1986	GADUS 145, 146, 147 1987	GADUS 159, 160, 161 1988	GADUS 174, 175, 176 1989	GADUS 190, 191, 192 1990	GADUS 208, 209, 210 1991	GADUS 224, 225, 226 1992
201	0.0(2)	0.00(3)	0.00(2)	0.00(3)	0.00(5)	0.00(6)	0.00(6)	0.40(3)	0.00(6)	0.0(5)	0.00(6)	0.00(8)	0.00(8)	0.00(6)	0.00(3)	0.00(3)
202	0.0(2)	0.00(4)	0.00(4)	0.00(4)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.0(2)	0.00(2)	-	0.00(2)	0.00(2)	0.00(3)	0.00(3)
203	0.0(2)	0.00(3)	0.00(3)	0.00(4)	0.00(2)	0.83(3)	2.42(3)	0.00(2)	0.00(3)	0.30(2)	0.00(3)	0.00(2)	0.33(3)	0.00(2)	0.00(3)	0.00(3)
204	1.59(2)	0.00(2)	1.02(2)	-	2.65(2)	3.17(3)	0.33(3)	2.25(2)	0.00(2)	1.55(2)	0.35(2)	1.15(2)	1.34(2)	0.31(2)	0.00(3)	0.00(3)
205	0.0(4)	0.00(4)	0.00(2)	0.00(4)	0.00(8)	0.04(12)	0.00(8)	0.00(8)	0.00(8)	0.00(7)	0.00(10)	0.00(6)	0.00(10)	0.00(8)	0.00(2)	0.00(4)
206	0.43(11)	0.00(7)	0.00(8)	0.00(7)	0.00(11)	0.13(18)	0.00(14)	0.00(11)	0.00(14)	0.0(11)	0.00(14)	0.00(14)	0.00(13)	0.00(11)	0.00(6)	0.00(10)
207	0.0(5)	0.00(4)	0.00(5)	0.00(5)	0.00(9)	0.13(15)	0.00(10)	0.00(7)	0.00(13)	0.0(7)	0.00(11)	0.00(7)	0.00(10)	0.00(7)	0.00(2)	0.00(3)
208	3.46(4)	0.63(5)	1.70(4)	7.75(4)	2.50(2)	13.83(3)	1.50(2)	2.25(3)	13.33(3)	1.10(2)	0.00(2)	0.00(2)	0.17(2)	0.00(2)	0.00(3)	0.00(3)
209	0.52(7)	0.15(6)	0.29(7)	0.67(6)	0.00(6)	0.45(11)	0.64(7)	0.09(7)	0.83(9)	0.0(7)	0.00(8)	0.00(5)	0.00(8)	0.08(6)	0.00(7)	0.00(5)
210	1.58(6)	0.32(7)	1.76(4)	3.00(5)	0.25(3)	1.70(6)	0.00(2)	3.57(4)	0.00(4)	0.0(3)	0.45(4)	0.00(3)	0.25(4)	0.00(3)	0.00(7)	0.00(7)
211	12.26(2)	5.67(4)	2.38(4)	8.71(5)	1.75(2)	6.15(2)	0.20(2)	1.75(2)	1.50(3)	0.80(2)	0.80(2)	0.00(2)	0.82(2)	0.00(2)	0.00(5)	0.00(6)
212	26.06(4)	1.36(2)	13.15(2)	2.75(2)	11.25(2)	19.46(5)	22.27(3)	11.33(3)	19.25(4)	47.83(3)	15.43(4)	4.85(2)	7.18(4)	7.28(3)	0.85(2)	2.89(2)
213	1.48(8)	1.43(7)	1.04(7)	1.66(8)	1.50(6)	1.70(10)	0.93(10)	0.65(5)	0.40(9)	0.61(9)	0.52(9)	0.09(8)	0.27(9)	0.00(8)	0.00(14)	0.00(19)
214	1.55(6)	0.39(7)	0.00(6)	0.52(5)	0.50(5)	0.75(8)	0.49(8)	0.38(4)	0.67(6)	0.27(6)	0.00(6)	0.15(6)	0.03(6)	0.10(5)	0.00(15)	0.00(14)
215	1.59(4)	0.17(8)	0.07(6)	0.00(4)	0.64(5)	0.39(9)	0.00(8)	0.33(3)	0.00(6)	0.0(5)	0.00(7)	0.00(7)	0.00(6)	0.00(6)	0.00(15)	0.00(10)
216	0.0(2)	0.00(3)	0.62(4)	0.63(4)	1.25(2)	1.25(2)	2.33(3)	0.00(2)	0.00(2)	1.00(2)	0.25(2)	0.15(2)	0.30(2)	0.00(2)	0.00(3)	0.00(3)
217	0.0(3)	0.00(2)	0.57(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	-	0.00(2)	1.64(2)	1.90(2)	1.05(2)	2.13(2)	0.13(2)	0.00(3)	0.00(3)
218	0.0(2)	0.00(2)	-	0.00(2)	0.00(2)	0.00(2)	0.00(2)	-	0.25(2)	0.0(2)	1.75(2)	2.75(2)	1.32(2)	0.93(2)	0.25(2)	0.00(2)
219	-	-	-	-	0.00(2)	-	0.00(2)	-	0.00(2)	0.0(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
220*	-	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	4.82(4)	1.71(5)	0.51(4)	1.75(4)	4.00(2)	6.17(3)	1.33(3)	0.83(3)	0.85(2)	0.0(2)	0.00(2)	2.80(2)	0.77(2)	0.00(2)	0.15(3)	0.00(3)
223	0.68(2)	0.00(2)	0.00(2)	0.00(2)	2.00(2)	0.00(2)	0.00(2)	1.00(2)	0.00(2)	6.80(2)	4.95(2)	1.95(2)	3.80(2)	0.61(2)	0.51(3)	0.14(3)
224	0.0(2)	0.00(2)	0.0(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.75(2)	1.50(2)	3.20(2)	2.80(2)	0.40(2)	1.27(2)	0.98(2)
225*	0.0(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226*	-	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
227	2.72(4)	1.59(2)	0.86(2)	6.75(2)	2.50(2)	5.30(5)	3.25(4)	1.50(3)	2.25(4)	3.97(3)	5.15(4)	3.67(3)	2.63(4)	20.15(3)	2.04(6)	1.17(6)
228	3.43(8)	0.74(3)	2.64(6)	3.30(5)	1.08(6)	4.20(10)	1.58(6)	3.00(7)	0.36(7)	4.97(6)	0.44(7)	0.84(5)	0.76(8)	0.34(6)	0.00(3)	0.24(5)
229	2.67(4)	2.50(4)	2.55(4)	2.50(4)	2.00(2)	2.25(4)	1.76(4)	1.43(3)	0.73(3)	13.00(3)	0.50(3)	2.07(3)	7.32(3)	0.50(2)	0.44(3)	0.30(3)
230	0.0(3)	0.00(2)	-	0.50(2)	0.00(2)	0.00(2)	0.00(2)	0.75(2)	0.00(2)	1.65(2)	0.50(2)	5.45(2)	13.74(2)	24.75(2)	50.38(2)	8.78(2)
231	0.0(2)	0.00(2)	-	0.00(2)	-	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(20)	0.00(2)	20.38(2)	6.18(2)
232*	0.0(2)	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
233*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234	0.0(2)	0.45(5)	0.79(4)	0.00(4)	0.00(2)	0.00(3)	0.00(2)	0.00(2)	0.00(3)	0.0(2)	0.00(3)	0.00(2)	-	0.00(2)	0.00(3)	0.00(3)
235	17.76(4)	0.00(2)	9.30(2)	10.00(2)	11.50(2)	9.00(3)	22.25(2)	11.17(3)	7.75(2)	1.75(2)	2.50(2)	0.00(2)	1.16(2)	2.40(2)	0.54(3)	0.43(3)
236	0.00(2)	-	-	-	0.85(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.0(2)	0.00(2)	0.40(2)	-	1.31(2)	1.45(2)	2.52(2)
Estimated biomass (tons)	3,829	844	1,844	2,337	1,968	3,575	2,751	2,020	2,122	4,141	1,511	1,060	1,520	2,062	1,417	542
Corrected biomass estimates after MM adjustments	3,829	843	1,903	2,339	1,968	3,577	2,750	2,039	2,122	4,142	1,511	1,061	1,518	-	-	-

*Excluded from MM analysis

Table 6. Biomass (tons) by stratum of witch flounder from the autumn surveys of the GADUS ATLANTICA in Div. 2J.

Depth Range (m)	Area (sq. nm)	Stratum	Trawlable Units ('000)	Year																
				1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
101-200	1427	201	107	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	
	1823	205	137	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	
	2582	206	194	83	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	
	2246	207	169	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	
201-300	440	202	33	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	
	1608	209	121	63	18	35	81	0	54	77	11	100	0	0	0	0	10	0	0	
	774	210	58	92	19	102	174	15	99	0	207	0	0	26	0	15	0	0	0	
	1725	213	129	192	185	135	215	194	220	120	84	52	79	67	12	35	0	0	0	
	1171	214	88	136	34	0	46	44	66	43	33	59	24	0	13	3	9	0	0	
	1270	215	95	152	16	7	0	61	37	0	31	0	0	0	0	0	0	0	0	
	1428	228	107	368	79	283	354	116	450	169	322	39	533	47	90	81	36	0	26	
	508	234	38	0	17	30	0	0	0	0	0	0	0	0	0	-	0	0	0	
301-400	480	203	36	0	0	0	0	0	30	87	0	0	11	0	0	12	0	0	0	
	448	208	34	116	21	57	261	84	465	50	76	448	37	0	0	6	0	0	0	
	330	211	25	304	140	59	216	43	152	5	43	37	22	20	0	20	0	0	0	
	384	216	29	0	0	18	18	36	36	67	0	0	29	7	4	9	0	0	0	
	441	222	33	160	57	17	58	132	204	44	27	28	0	0	93	25	0	5	0	
	567	229	43	114	106	109	106	85	96	75	61	31	553	21	88	312	21	19	13	
401-500	354	204	27	42	0	27	-	70	84	9	60	0	41	9	31	36	8	0	0	
	268	217	20	0	0	11	0	0	0	0	-	0	33	38	21	43	3	0	0	
	180	223	14	9	0	0	0	27	0	0	14	0	92	67	26	51	8	7	2	
	686	227	51	140	82	44	348	129	273	167	77	116	204	265	189	135	1038	105	60	
	420	235	32	560	0	293	315	363	284	701	352	244	55	79	0	37	76	17	14	
501-750	664	212	50	1299	68	655	137	561	970	1110	565	959	2384	769	242	358	363	42	144	
	420	218	32	0	0	-	0	0	0	0	-	8	0	55	87	42	29	8	0	
	270	224	20	0	0	0	0	0	0	0	0	0	15	30	65	57	8	26	20	
	237	230	18	0	0	-	9	0	0	0	13	0	29	9	97	244	440	896	156	
751-1000	213	219	16	-	-	-	-	0	-	0	-	0	0	0	0	0	0	0	0	
	182	231	14	0	0	-	0	-	0	0	0	0	0	0	0	0	0	278	84	
	122	236	9	0	-	-	-	8	0	0	0	0	0	0	4	-	12	13	23	
1001-1250	324	220	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	177	225	13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	236	232	18	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1251-1500	268	221	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	180	226	14	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	180	233	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Grand Total	25033			3829	843	1883	2337	1968	3573	2726	2020	2122	4142	1511	1061	1520	2061	1417	542	
101-200	8078			83	0	0	0	0	53	0	43	0	0	0	0	0	0	0	0	
201-300	8924			1002	369	592	870	429	927	410	689	249	635	141	115	134	55	0	26	
301-400	2650			693	325	259	659	381	983	329	207	545	652	48	185	384	21	24	13	
401-500	1908			751	82	376	663	589	641	878	503	360	426	458	267	302	1132	129	76	
501-750	1591			1299	68	655	146	561	970	1110	578	967	2429	864	490	701	841	972	320	
751-1000	517			0	0	0	0	8	0	0	0	0	0	0	4	0	12	292	108	
1001-1250	737			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1251-1500	628			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
< = 400				1778.3	693	851	1528	810	1962	739	939	794	1288	189	300	517	76	24	38	
401-750				2050.3	150	1031	809	1149	1611	1988	1081	1328	2854	1322	757	1002	1973	1101	396	
> 750				0	0	0	0	8	0	0	0	0	0	0	4	0	12	292	108	

Table 7. 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 12, 15 1978	GADUS 27, 29 1979	GADUS 42, 44 1980	GADUS 58, 59 1981	GADUS 71, 72 1982	GADUS 86, 87, 88 1983	GADUS 101 102, 103 1984	GADUS 116, 117, 118 1985	GADUS 131, 132, 133 1986	GADUS 145, 146, 147 1987	GADUS 159, 160, 161 1988	GADUS 174, 175, 176 1989	GADUS 190, 191, 192 1990	GADUS 208, 209, 210 1991	GADUS 224, 225, 226 1992
618*	-	-	-	-	-	-	-	0.00(6)	0.0(5)	0.00(7)	0.00(6)	0.00(8)	0.00(4)	0.00(5)	0.00(3)
619*	-	-	-	-	-	-	-	0.00(7)	0.0(5)	0.00(8)	0.00(7)	0.00(8)	0.00(5)	0.00(4)	0.00(3)
620	2.65(12)	4.83(10)	1.79(12)	0.45(10)	0.61(9)	0.55(10)	0.36(13)	0.16(14)	0.0(9)	0.00(8)	0.00(7)	0.00(8)	0.00(5)	0.00(4)	0.00(3)
621	2.46(12)	13.07(11)	2.42(13)	1.64(11)	0.69(14)	3.30(12)	1.11(14)	1.20(15)	0.07(14)	0.17(12)	0.00(10)	0.13(17)	0.00(11)	0.00(5)	0.00(3)
622	3.39(2)	16.48(3)	25.25(2)	14.75(2)	7.50(3)	13.50(2)	10.00(4)	19.38(4)	2.75(2)	8.50(3)	0.07(3)	0.05(3)	0.28(2)	0.06(3)	0.22(3)
623	3.64(6)	6.52(4)	4.50(6)	5.41(4)	3.40(5)	6.75(6)	3.30(5)	5.50(6)	1.22(4)	1.16(5)	0.06(5)	0.04(6)	0.00(5)	0.00(6)	0.00(3)
624	4.09(7)	1.98(4)	1.15(4)	5.25(2)	6.00(4)	1.75(4)	4.88(4)	1.00(4)	0.80(2)	0.23(2)	0.00(3)	0.00(3)	0.09(4)	0.00(2)	0.00(3)
625	7.98(6)	23.72(5)	11.58(6)	16.88(4)	5.00(2)	18.00(3)	14.95(5)	14.58(5)	0.48(3)	1.30(4)	0.70(4)	0.03(4)	0.00(4)	0.00(3)	0.00(3)
626	29.51(7)	52.80(5)	55.40(5)	11.30(5)	39.60(5)	36.88(4)	12.67(6)	10.57(5)	0.45(4)	1.60(5)	0.14(5)	0.29(5)	0.26(4)	0.00(3)	0.15(3)
627	18.14(2)	23.59(3)	66.25(2)	94.75(6)	63.00(7)	77.25(6)	63.75(8)	25.64(7)	8.40(5)	9.88(6)	6.72(5)	2.41(6)	0.82(5)	0.01(3)	0.18(3)
628	20.49(7)	55.17(5)	33.00(6)	10.83(6)	22.25(6)	46.83(6)	19.14(7)	21.67(6)	6.05(4)	3.88(5)	0.26(5)	1.13(4)	0.00(5)	0.00(3)	0.33(3)
629	29.65(6)	28.58(2)	41.40(5)	42.33(3)	23.25(2)	42.83(3)	20.75(4)	17.38(4)	4.27(3)	9.00(3)	2.65(2)	0.39(3)	0.76(2)	0.00(4)	0.06(3)
630	14.52(2)	11.74(4)	16.02(4)	15.75(2)	-	12.25(2)	8.80(3)	4.12(4)	2.40(2)	2.63(3)	2.03(3)	0.26(3)	0.00(2)	0.00(3)	0.14(3)
631	8.18(2)	12.26(3)	16.17(3)	60.90(5)	6.00(2)	46.30(5)	48.90(5)	30.36(7)	19.82(4)	10.78(6)	3.35(6)	1.45(7)	0.38(6)	1.41(6)	1.34(3)
632	7.43(7)	13.32(4)	4.26(4)	10.00(2)	8.00(3)	9.17(3)	-	4.67(3)	2.00(2)	0.45(2)	0.55(2)	1.60(2)	0.00(2)	0.05(10)	0.08(13)
633	10.84(9)	12.37(10)	16.90(10)	6.32(8)	10.96(7)	12.49(12)	14.10(10)	8.97(12)	6.09(8)	3.97(11)	7.21(8)	3.64(10)	1.06(11)	0.48(25)	0.30(18)
634	4.09(9)	5.07(8)	5.79(7)	2.94(7)	5.60(11)	1.04(5)	5.25(7)	1.80(9)	1.34(5)	0.85(11)	1.78(6)	0.61(7)	0.00(7)	0.00(25)	0.06(25)
635	13.49(9)	15.59(8)	11.92(6)	10.80(5)	5.50(5)	3.52(6)	15.59(8)	5.49(7)	0.11(6)	0.92(6)	2.16(5)	1.11(7)	0.10(6)	0.00(4)	0.17(3)
636	10.25(7)	10.89(7)	12.21(7)	7.50(6)	5.85(10)	5.00(6)	22.72(8)	4.84(8)	1.77(4)	2.86(7)	5.50(6)	2.50(5)	0.32(7)	0.00(3)	0.00(3)
637	10.11(9)	19.77(7)	12.67(6)	17.00(6)	17.36(7)	35.32(5)	25.08(6)	21.21(7)	5.50(4)	7.03(6)	2.08(8)	1.69(5)	0.00(5)	0.00(6)	0.28(3)
638	13.31(8)	38.64(9)	18.93(9)	26.75(8)	14.62(15)	20.82(11)	40.35(10)	31.32(11)	41.63(4)	26.88(10)	34.06(8)	15.32(11)	1.29(9)	1.31(25)	0.26(25)
639	8.60(9)	8.22(4)	13.67(6)	11.23(6)	7.55(10)	26.71(7)	25.67(8)	12.25(8)	11.08(6)	4.46(7)	16.88(6)	3.28(8)	3.27(7)	0.40(3)	0.05(25)
640	5.45(2)	-	8.00(2)	3.25(2)	23.00(2)	-	21.25(2)	48.33(3)	86.75(2)	108.75(2)	63.00(2)	56.53(2)	7.55(2)	7.80(3)	0.56(3)
641	0.00(2)	0.00(2)	0.50(2)	1.15(2)	1.25(4)	4.33(3)	0.00(3)	17.00(4)	-	27.37(3)	-	-	175.68(2)	14.73(2)	0.00(2)
642	0.00(2)	-	0.50(2)	0.00(3)	0.33(6)	-	1.33(6)	0.72(5)	-	0.56(5)	-	-	23.58(3)	10.45(2)	6.77(2)
643*	0.00(2)	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-
644*	0.00(2)	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-
645	0.34(2)	-	0.00(2)	0.50(2)	16.33(3)	13.25(2)	89.25(2)	9.97(3)	-	128.50(2)	22.75(2)	9.27(2)	32.92(2)	3.64(3)	0.38(3)
646	0.00(2)	0.00(2)	1.75(2)	0.25(2)	0.60(2)	18.50(2)	3.00(2)	2.37(2)	-	3.50(2)	-	-	6.05(2)	3.23(3)	0.86(3)
647	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	-	-	0.50(3)	-	-	-	-	7.55(2)	12.12(3)	2.90(3)
648*	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
649*	0.00(2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Estimated biomass (tons)	18,855	33,896	31,002	31,210	22,220	36,090	35,730	23,569	14,589	14,667	11,967	5,474	11,297	2,458	935
Corrected biomass estimates after MM adjustments	18,862	34,984	31,040	31,268	22,520	36,823	36,128	23,585	14,649	14,670	11,947	5,444	-	-	-

*Excluded from MM analysis

Table 8. Biomass estimates (tons) by stratum of witch flounder from autumn surveys of the GADUS ATLANTICA in Div. 3K .

Depth Range(m)	Area (sq. nm.)	Stratum	Trawlable units ('000)	Year															
				1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
101-200	1455	618	109	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	
	1588	619	119	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	
201-300	2709	620	203	539	982	364	92	124	112	73	33	124	0	0	0	0	0		
	2859	621	215	528	2805	519	352	148	708	238	258	15	36	0	28	0	0		
	668	624	50	205	99	58	263	301	88	245	50	40	12	0	0	5	0		
	447	632	34	249	447	143	336	268	308	-	157	67	15	18	54	0	2		
	1618	634	121	497	616	703	357	680	126	638	219	163	103	216	74	0	0		
	1274	635	96	1290	1491	1140	1033	526	337	1491	525	11	88	207	106	10	0		
	1455	636	109	1119	1189	1334	819	639	546	2481	529	193	312	601	273	35	0		
	1132	637	85	859	1680	1077	1445	1475	3001	2131	1802	467	597	177	144	0	0		
301-400	1027	623	77	281	503	347	417	262	520	254	424	94	89	5	3	0	0		
	850	625	64	509	1513	739	1077	319	1148	954	930	31	83	45	2	0	0		
	919	626	69	2036	3642	3822	780	2732	2544	874	729	31	110	10	20	18	0		
	1085	628	81	1669	4493	2688	882	1812	3814	1559	1765	493	316	21	92	0	0		
	495	629	37	1102	1062	1538	1573	864	1591	771	646	159	334	98	14	28	0		
	544	630	41	593	479	654	643	-	500	359	168	98	107	83	11	0	0		
	2179	633	164	1773	2023	2764	1034	1793	2043	2306	1467	996	649	1179	595	173	79		
	2059	638	155	2057	5972	2926	4134	2260	3218	6236	4841	6434	4155	5264	2368	199	202		
	1463	639	110	944	903	1501	1233	829	2933	2819	1345	1217	490	1854	360	359	44		
	401-500	632	622	47	161	782	1198	700	356	640	474	919	130	403	3	2	13	3	
1194		627	90	1626	2114	5938	8492	5646	6924	5714	2298	753	886	602	216	73	1		
1202		631	90	738	1106	1459	5495	541	4178	4412	2739	1788	973	302	131	34	127		
198		640	15	81	-	119	48	342	-	316	718	1289	1616	936	840	112	116		
204		645	15	5	-	0	8	250	203	1367	153	-	1968	348	142	504	56		
501-750	584	641	44	0	0	22	50	55	190	0	745	-	1200	-	-	7701	646		
	333	646	25	0	0	44	6	15	462	75	59	-	87	-	-	151	81		
751-1000	931	642	70	0	-	35	0	23	-	93	50	-	39	-	-	1648	730		
	409	647	31	0	0	0	0	0	-	-	15	-	-	-	-	232	372		
1001-1250	1266	643	95	0	0	-	-	-	-	-	-	-	-	-	-	-	-		
	232	648	17	0	-	-	-	-	-	-	-	-	-	-	-	-	-		
1251-1500	954	644	72	0	0	-	-	-	-	-	-	-	-	-	-	-	-		
	263	649	20	0	-	-	-	-	-	-	-	-	-	-	-	-	-		
Grand Total	34228			18861	33903	31130	31268	22260	36135	35881	23585	14593	14670	11970	5475	11297	2458		
101-200	3043			0	0	0	0	0	0	0	0	0	0	0	0	0	0		
201-300	12162			5287	9309	5337	4696	4162	5226	7297	3571	1080	1164	1219	678	49	2		
301-400	10621			10964	20591	16979	11773	10870	18313	16133	12316	9552	6334	8559	3466	778	325		
401-500	3430			2611	4002	8714	14743	7136	11945	12283	6828	3961	5845	2193	1331	737	303		
501-750	917			0	0	66	57	70	652	75	804	0	1287	0	0	7853	726		
751-1000	1340			0	0	35	0	23	0	93	66	0	39	0	0	1880	1102		
1001-1250	1498			0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1251-1500	1217			0	0	0	0	0	0	0	0	0	0	0	0	0	0		

Table 9. Average weight (kg) per 30-minute set of witch flounder from fall surveys of the research vessel A. T. CAMERON, WILFRED TEMPLEMAN, and ALFRED NEEDLER in Division 3L (# of sets in brackets).

Stratum	ATC 323,325 1981	ATC 333,334 1982	W.T. 7,8,9 1983	W.T. 16,17,18 1984	W.T. 37,38,39 1985	A.NEEDLER 72 1986	W.T. 65 1987	W.T. 78 1988	W.T. 87 1989	W.T. 101 1990	W.T. 113, 114,115 1991	W.T. 128, 129,130 1992
328	-	-	-	0.25(4)	0.00(8)	0.0(6)	0.00(4)	0.00(7)	0.00(7)	0.00(5)	0.00(3)	0.00(3)
341	0.00(3)	0.20(4)	0.00(4)	1.30(5)	0.00(7)	0.0(7)	0.17(9)	0.17(8)	0.00(8)	0.00(6)	0.00(3)	0.00(3)
342	0.00(3)	0.00(3)	0.00(4)	0.00(2)	0.00(3)	0.0(3)	0.00(3)	0.00(3)	0.00(3)	0.00(2)	0.00(2)	0.00(3)
343	0.00(4)	-	0.00(3)	1.38(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(2)
344	1.75(4)	0.00(3)	0.50(6)	0.75(6)	0.06(9)	0.06(7)	0.88(4)	0.00(7)	0.00(7)	0.00(6)	0.00(2)	0.00(2)
345	19.88(4)	21.87(6)	34.63(8)	25.07(7)	7.11(9)	3.25(4)	24.50(2)	12.79(7)	16.43(7)	3.07(5)	0.00(4)	0.08(4)
346	46.50(3)	18.63(4)	19.50(5)	12.58(6)	20.60(5)	32.62(3)	11.63(4)	18.60(5)	14.25(4)	18.18(3)	1.61(15)	0.21(14)
347	2.83(3)	0.40(4)	0.33(6)	4.00(6)	0.00(4)	0.37(4)	0.00(2)	1.44(5)	0.80(5)	0.00(2)	0.00(4)	0.00(2)
348	0.17(6)	0.60(5)	0.14(11)	1.38(11)	0.00(14)	0.0(5)	0.00(9)	0.15(10)	0.00(9)	0.00(11)	0.00(4)	0.00(4)
349	0.00(7)	0.00(5)	0.00(9)	1.05(14)	0.00(10)	0.57(9)	0.00(10)	0.11(9)	0.00(10)	0.55(7)	0.00(5)	0.00(5)
350	0.00(6)	0.00(2)	0.00(8)	0.52(12)	0.00(9)	0.0(11)	0.0(9)	0.00(10)	0.00(10)	0.00(8)	0.00(16)	0.00(4)
363	0.00(4)	0.50(3)	0.00(3)	0.41(8)	0.00(10)	0.20(7)	0.00(9)	0.00(10)	0.00(9)	1.18(8)	0.15(17)	0.24(25)
364	1.06(9)	0.46(11)	0.12(11)	0.59(10)	0.00(18)	0.46(5)	0.00(14)	0.11(14)	0.00(11)	0.09(12)	0.00(4)	0.00(5)
365	0.25(4)	1.25(4)	0.00(5)	0.72(4)	0.00(8)	0.64(5)	0.29(6)	0.14(5)	0.00(4)	0.00(4)	0.35(3)	0.00(3)
366	1.67(3)	3.50(6)	0.00(4)	1.02(11)	1.94(9)	1.69(4)	1.10(7)	0.67(7)	0.86(7)	0.27(6)	0.00(21)	0.03(24)
368	0.50(2)	0.75(2)	-	1.50(2)	0.75(2)	8.57(2)	0.45(2)	1.75(2)	4.50(2)	2.13(2)	0.81(6)	0.35(10)
369	5.75(2)	5.07(4)	1.75(6)	3.11(7)	5.33(6)	5.77(3)	2.85(4)	10.10(5)	4.00(5)	4.00(4)	1.31(9)	0.00(8)
370	0.25(4)	0.00(6)	0.00(6)	1.11(7)	0.00(9)	0.0(2)	0.20(6)	0.00(7)	0.00(6)	0.00(5)	0.00(3)	0.00(3)
371	0.00(4)	0.00(5)	0.00(5)	0.29(7)	0.00(7)	0.0(3)	0.00(5)	0.00(6)	0.00(4)	0.00(5)	0.00(3)	0.00(3)
372	0.00(5)	0.00(7)	0.00(4)	0.48(13)	0.00(17)	0.0(9)	0.00(13)	0.05(13)	0.00(12)	0.17(10)	0.03(26)	0.00(24)
384	-	0.00(4)	1.00(3)	0.74(6)	0.00(8)	0.0(5)	0.00(6)	0.00(6)	0.00(5)	0.00(7)	0.00(18)	0.00(19)
385	0.00(8)	0.00(8)	0.00(5)	0.95(12)	0.00(12)	0.20(8)	0.19(9)	0.09(13)	0.00(11)	0.00(4)	0.00(5)	0.00(5)
386	10.50(3)	1.75(4)	-	1.10(8)	4.36(5)	10.05(4)	12.25(4)	16.32(5)	2.60(5)	1.77(4)	2.60(3)	0.00(3)
387	4.25(2)	13.83(3)	-	2.00(3)	4.70(4)	2.50(2)	6.93(3)	20.63(4)	18.00(3)	41.44(3)	1.59(5)	0.53(3)
388	-	0.87(3)	-	28.50(2)	0.90(2)	-	12.25(2)	2.00(2)	3.00(2)	0.00(2)	2.40(3)	3.54(3)
389	-	4.38(4)	-	2.04(6)	1.20(5)	8.14(4)	2.28(4)	1.88(4)	0.25(4)	0.79(3)	0.00(3)	0.22(3)
390	0.00(3)	0.00(4)	0.00(3)	0.83(3)	0.00(7)	0.0(6)	0.00(8)	0.00(8)	0.00(7)	0.00(6)	0.00(3)	0.00(3)
391	-	0.00(2)	0.00(2)	0.00(2)	0.75(2)	0.0(2)	0.25(2)	0.00(2)	0.00(2)	0.00(2)	1.78(3)	0.56(3)
392	-	0.00(2)	1.00(2)	3.50(2)	0.52(2)	1.00(2)	2.90(2)	0.75(2)	0.00(2)	0.00(2)	0.00(3)	0.00(3)
729	-	-	-	6.25(2)	11.25(2)	11.61(2)	-	-	-	1.98(2)	12.20(3)	10.22(2)
730	-	-	-	4.50(2)	1.00(2)	-	-	-	-	-	5.34(2)	0.31(2)
731	-	-	-	15.25(2)	9.50(2)	-	-	-	-	19.70(2)	5.85(3)	12.72(3)
732	-	-	-	10.25(2)	8.00(2)	-	-	-	-	0.93(2)	6.28(2)	22.67(2)
733	-	-	-	4.75(4)	19.67(3)	-	-	-	-	28.19(2)	35.73(3)	10.13(3)
734	-	-	-	1.17(3)	6.00(2)	-	-	-	-	5.20(2)	2.73(2)	0.45(2)
735	-	57.25(2)	-	9.67(3)	1.50(2)	50.00(2)	-	-	-	-	5.57(3)	5.58(3)
736	-	-	23.00(2)	-	11.50(2)	30.56(2)	-	-	-	14.98(2)	38.46(2)	3.88(2)
Estimated biomass (tons)	7,461	7,059	5,639	7,826	4,848	6,582	5,701	6,146	4,500	6,228	3,015	1,489
Corrected biomass estimates from MM analysis	9,054	8,017	7,297	8,272	4,902	7,153	6,800	7,280	4,893			

Table 10. Biomass estimates (tons) by stratum of witch flounder from fall surveys of research vessels in Div. 3L

Depth Range (m)	Area (sq. nm.)	Stratum	Trawlable Units ('000)	Year											
				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
57-91	2071	350	155	0	0	0	81	0	0	0	0	0	0	0	0
	1780	363	134	0	67	0	55	0	27	0	0	0	158	20	32
	1121	371	84	0	0	0	24	0	0	0	0	0	0	0	0
	2460	372	185	0	0	0	89	0	0	0	9	0	31	6	0
	1120	384	84	-	0	84	62	0	0	0	0	0	0	0	0
93-183	1519	328	114	-	-	-	29	0	0	0	0	0	0	0	0
	1574	341	118	0	24	0	154	0	0	20	20	0	0	0	0
	585	342	44	0	0	0	0	0	0	0	0	0	0	0	0
	525	343	39	0	-	0	54	0	0	0	0	0	0	0	0
	2120	348	159	27	95	22	220	0	0	0	24	0	0	0	0
	2114	349	159	0	0	0	167	0	90	0	17	0	87	0	0
	2817	364	211	224	97	25	125	0	97	0	23	0	19	0	0
	1041	365	78	20	98	0	56	0	50	23	11	0	0	27	0
	1320	370	99	25	0	0	110	0	0	20	0	0	0	0	0
	2356	385	177	0	0	0	168	0	35	34	16	0	0	0	0
	1481	390	111	0	0	0	92	0	0	0	0	0	0	0	0
184-274	1494	344	112	196	0	56	84	7	7	99	0	0	0	0	0
	983	347	74	209	30	24	295	0	27	0	106	59	0	0	0
	1394	366	105	175	366	0	107	203	177	115	70	90	28	0	3
	961	369	72	415	366	126	224	384	416	206	729	289	289	94	0
	983	386	74	775	129	-	81	322	742	904	1204	192	131	192	0
	821	389	62	-	270	-	126	74	502	141	116	15	49	0	14
	282	391	21	-	0	0	0	16	0	5	0	0	0	38	12
275-366	1432	345	107	2137	2351	3722	2695	764	349	2634	1375	1766	330	0	9
	865	346	65	3019	1210	1266	817	1338	2118	755	1208	925	1180	105	14
	334	368	25	13	19	-	38	19	215	11	44	113	53	20	9
	718	387	54	229	745	-	108	253	135	374	1112	970	2233	86	29
	361	388	27	-	24	-	772	24	-	332	54	81	0	65	96
	145	392	11	-	0	11	38	6	11	32	8	0	0	0	0
367-549	186	729	14	-	-	-	87	157	162	-	-	-	28	170	143
	216	731	16	-	-	-	247	154	-	-	-	-	319	95	206
	468	733	35	-	-	-	167	691	-	-	-	-	990	1255	356
	272	735	20	-	1169	-	197	31	1021	-	-	-	-	114	114
550-731	170	730	13	-	-	-	57	13	-	-	-	-	-	68	4
	231	732	17	-	-	-	178	139	-	-	-	-	16	109	393
	228	734	17	-	-	-	20	103	-	-	-	-	89	47	8
	175	736	13	-	-	302	-	151	401	-	-	-	197	505	51
Grand Total	38723			7463	7059	5640	7824	4848	6582	5702	6146	4500	6228	3016	1491
57-91	8552			0	67	84	311	0	27	0	9	0	189	26	32
92-183	17452			296	314	48	1174	0	273	96	112	0	106	27	0
184-274	6918			1769	1161	207	917	1006	1870	1469	2225	645	496	324	29
275-366	3855			5398	4348	4999	4467	2404	2828	4137	3801	3856	3797	276	156
367-549	1142			0	1169	0	699	1033	1183	0	0	0	1337	1634	819
550-731	804			0	0	302	255	405	401	0	0	0	302	729	456

Table 11. Estimated abundance at age ('000s) of witch in Div. 2J from research vessel surveys.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
4	10		10													5
5	12	20	30			1			9	147	27		130	105	166	34
6	12	40	115	13	7	42		17	3	288	42	158	314	136	754	238
7	190	220	414	308	228	838	257	125	145	1168	141	333	559	654	655	259
8	567	305	350	741	653	1583	988	577	817	1987	516	287	631	470	668	236
9	859	196	357	645	583	899	1112	720	837	1274	652	266	407	102	296	130
10	574	127	332	472	300	385	620	506	460	397	341	214	214	306	211	100
11	921	81	169	249	133	196	226	150	196	86	102	137	118	104	123	34
12	497	66	52	132	59	11	21	120	59	16	12	10	23	16	10	25
13	247	23	14	71	19		3	15	6							
14	98	6		7												
15	98	3														
16	86															
	4171	1087	1843	2638	1982	3955	3227	2230	2532	5363	1833	1405	2421	1892	2887	1058

Table 12. Estimated abundance at age ('000s) of witch in Division 3K from research vessel surveys.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1									36				18		
2						72		13	18	16				81	
3	29	54	231	15	19	14	146	88	54					15	75
4	471	415	195	606	485	158	376	460	573	179	245	342	25	89	192
5	3234	4027	387	997	1362	892	1590	2620	1548	448	1080	1154	221	226	83
6	3608	6815	1354	1788	1717	1801	1838	2013	946	1517	801	590	605	475	118
7	4858	10981	7991	8838	6713	5635	4248	2477	3165	1857	1645	598	957	620	193
8	5109	9246	10273	11807	8923	10848	9878	9181	5822	4540	2760	1303	1579	647	437
9	3153	5546	7224	6763	5050	10819	11045	7943	3730	4632	2652	1414	1035	668	279
10	2416	3975	5777	4240	2214	7100	6942	4297	1938	2862	2650	1139	1870	566	127
11	1669	2521	2921	1871	1470	3847	3389	2075	763	1660	2108	867	1539	406	133
12	1421	1316	1671	831	119	1100	2011	704	136	712	1311	301	665	105	75
13	798	545	960	108	19	368	707	86		29	81	26	281	6	
14	278	37	161				25								
15	177		20												
16	18														
Total Abundance ('000s)	27239	45478	39165	37864	28091	42654	42195	31957	18729	18452	15333	7708	8794	3903	1721

Table 13. Estimated abundance ('000s) of witch in Div. 3L from research vessel surveys.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1		21										
2	33				13							
3	92	37										
4	60		34	103	13							5
5	128	107		100	28	69				54	31	87
6	194	178	106	162	26	19		16	20	139	195	67
7		743	96	297	200	269	126	228	155	119	215	124
8	1981	1966	1065	812	1085	1572	472	1048	1058	129	321	376
9	2866	2239	2783	1697	1710	2752	1588	2183	1570	618	673	342
10	3471	2157	2536	1993	1257	2028	2244	2024	1165	619	979	533
11	1539	979	1420	1764	656	1327	1673	1328	984	1105	746	482
12	96	454	365	1083	351	460	1060	948	554	718	446	264
13		133	67	409	76	84	268	35	123	336	86	9
14		24	38	60			63			24		
Total abundance ('000s)	10460	9038	8510	8480	5415	8580	7494	7810	5629	3919	3692	2291

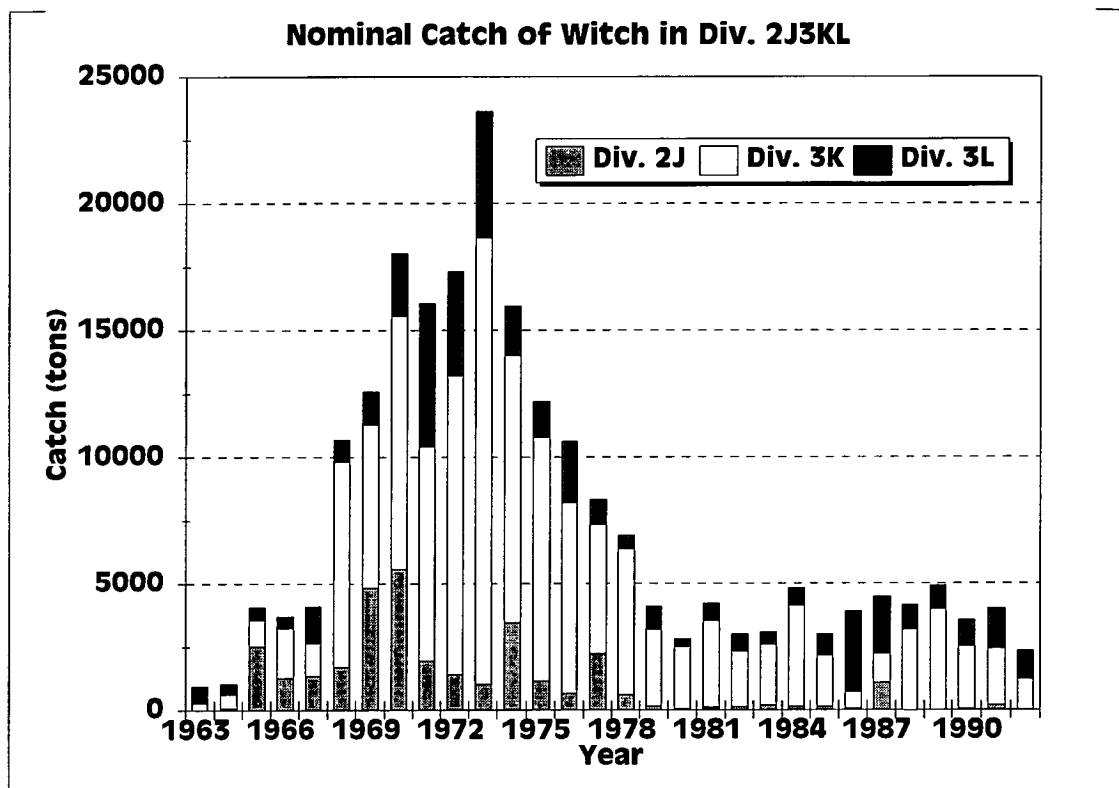


Fig. 1. Nominal catch of witch flounder in NAFO Div. 2J, 3K and 3L from 1963-92.

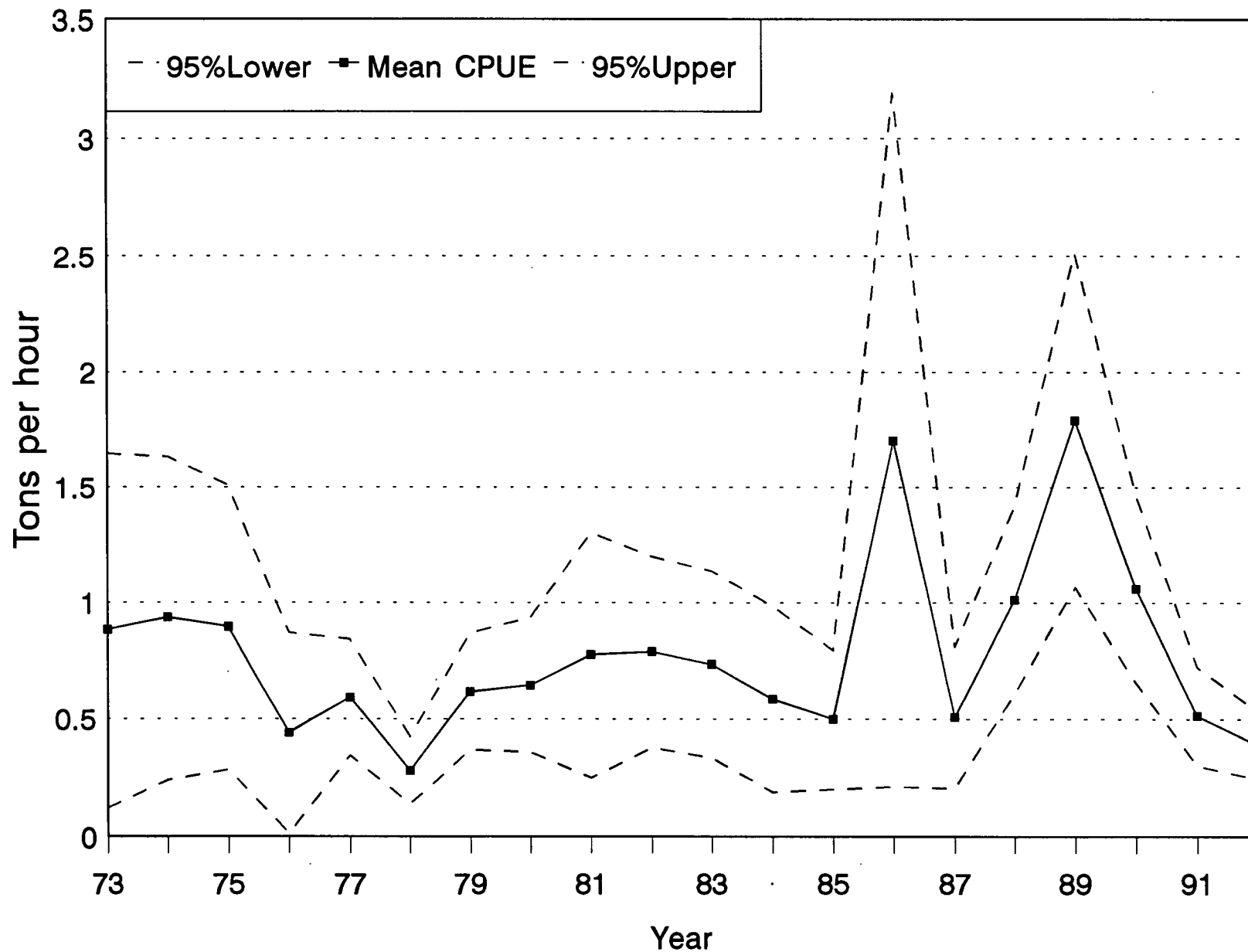


Fig. 2. Standardized CPUE with 95% confidence intervals for Witch flounder in Div. 2J3KL from 1973-1992.

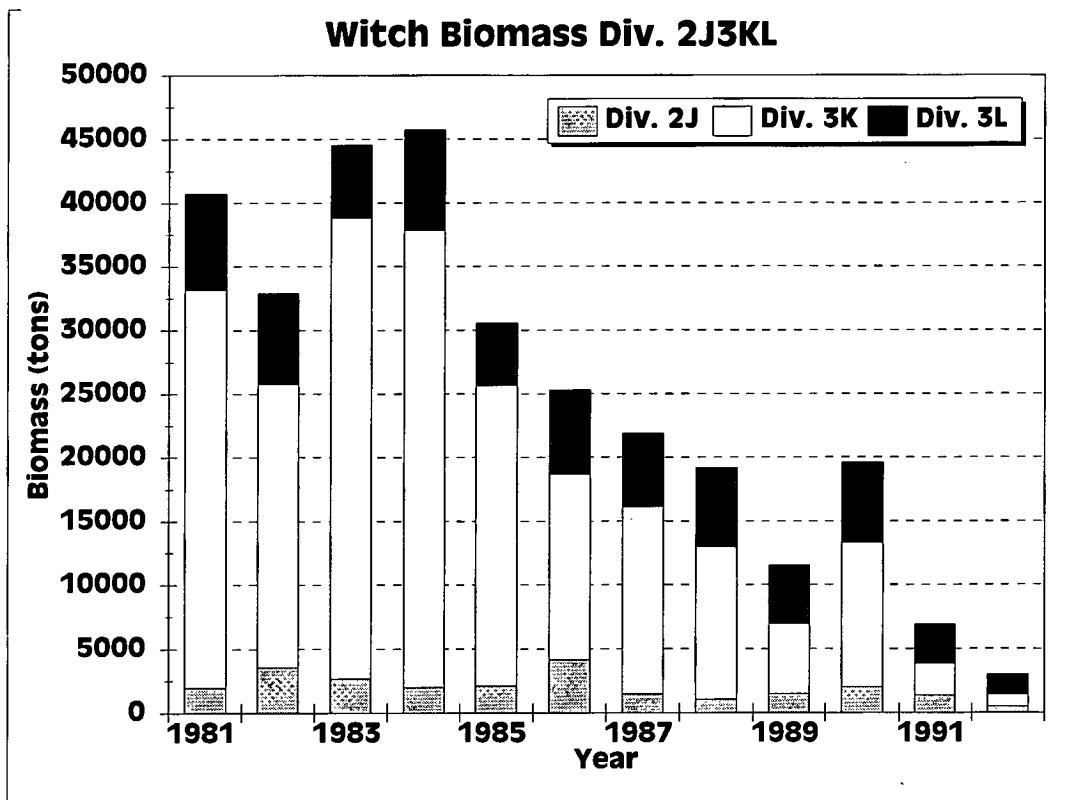


Fig. 3 . Biomass estimates of witch flounder in Divisions 2J, 3K 3L from research vessel surveys during 1981-92 (autumn).

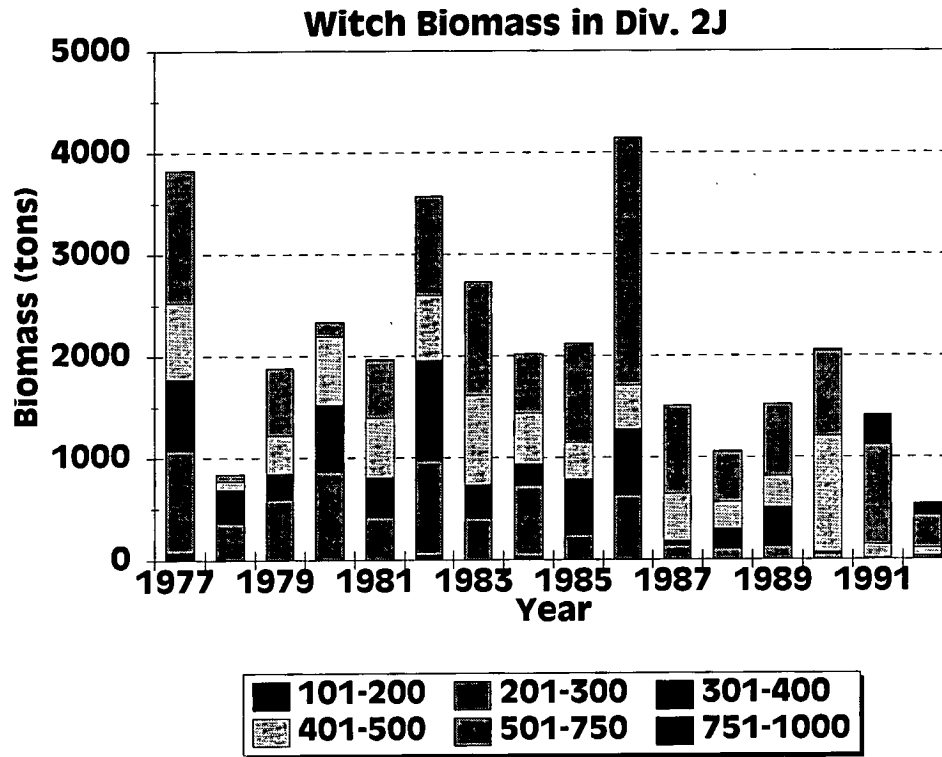


Fig. 4 . Biomass estimates of witch flounder in Division 2J from research vessel surveys during 1977-92 (autumn).

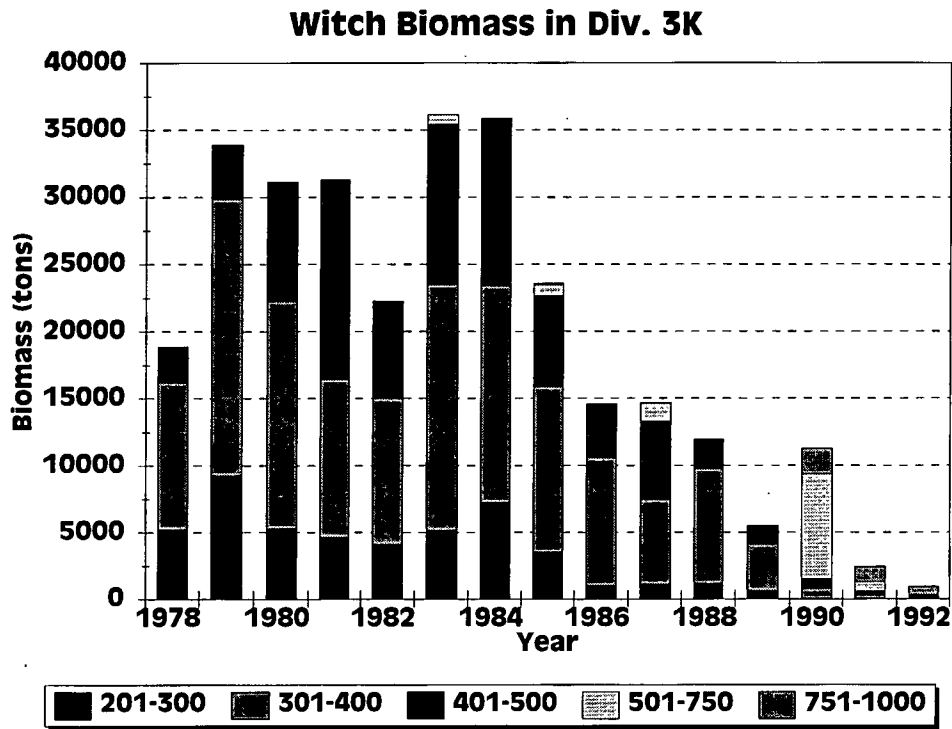


Fig. 5 . Biomass estimates of witch flounder in Division 3K from research vessel surveys during 1978-92 (autumn).

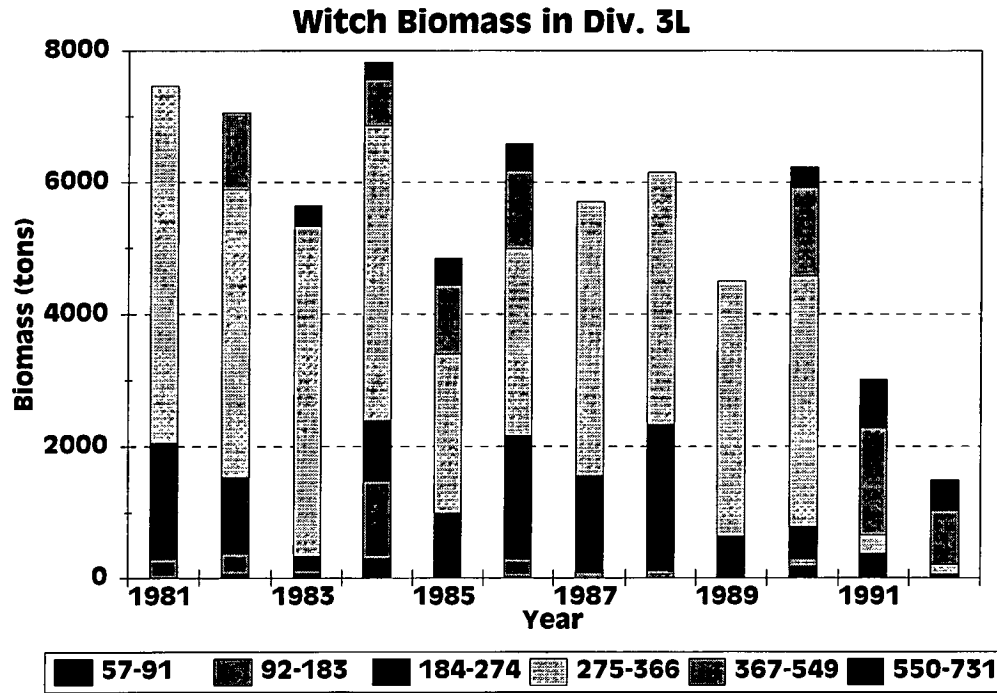


Fig. 6 . Biomass estimates of witch flounder in Division 3L from research vessel surveys during 1981-92 (autumn).

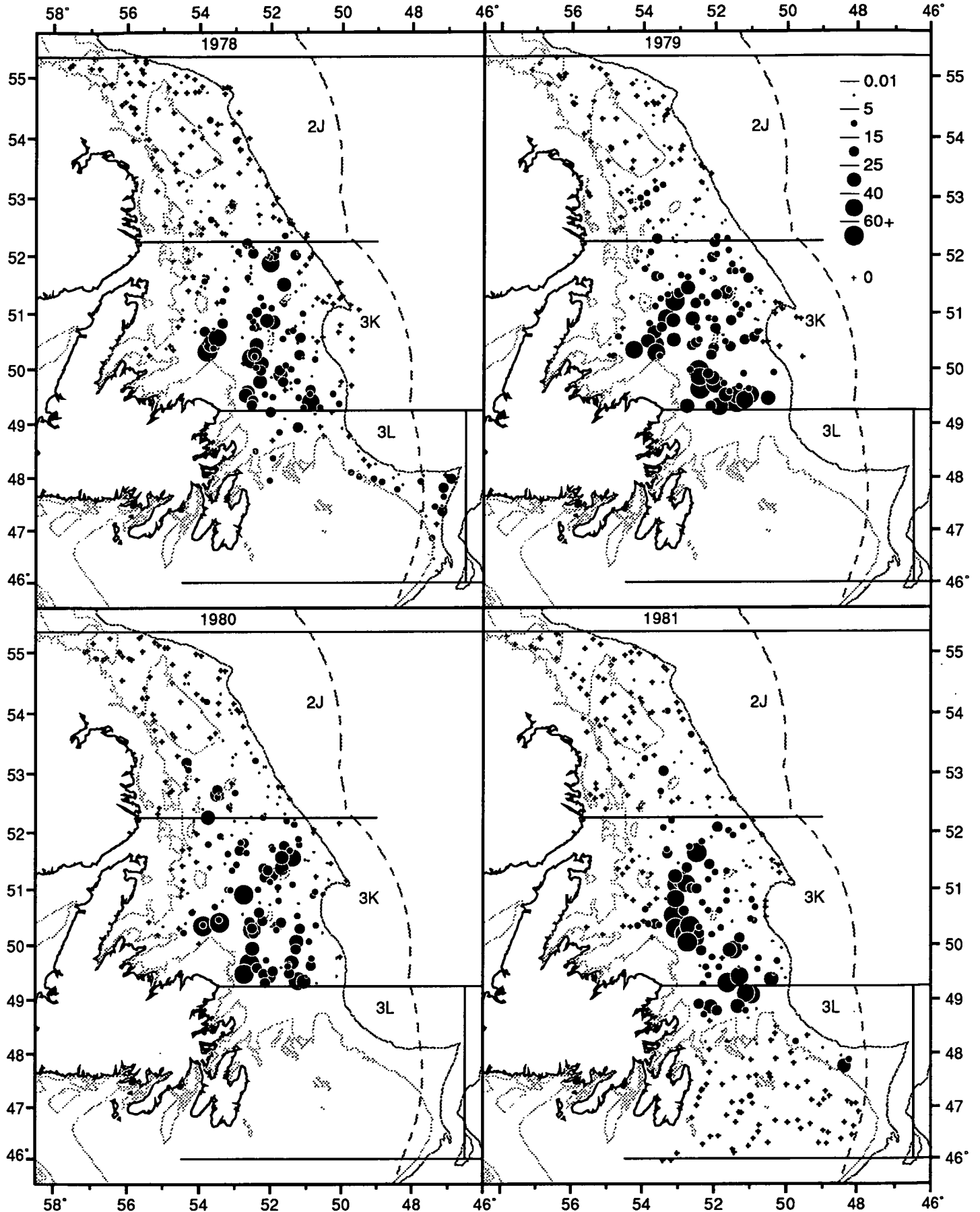


Fig. 7. Distribution of witch catches from 1978-1981 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 800m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

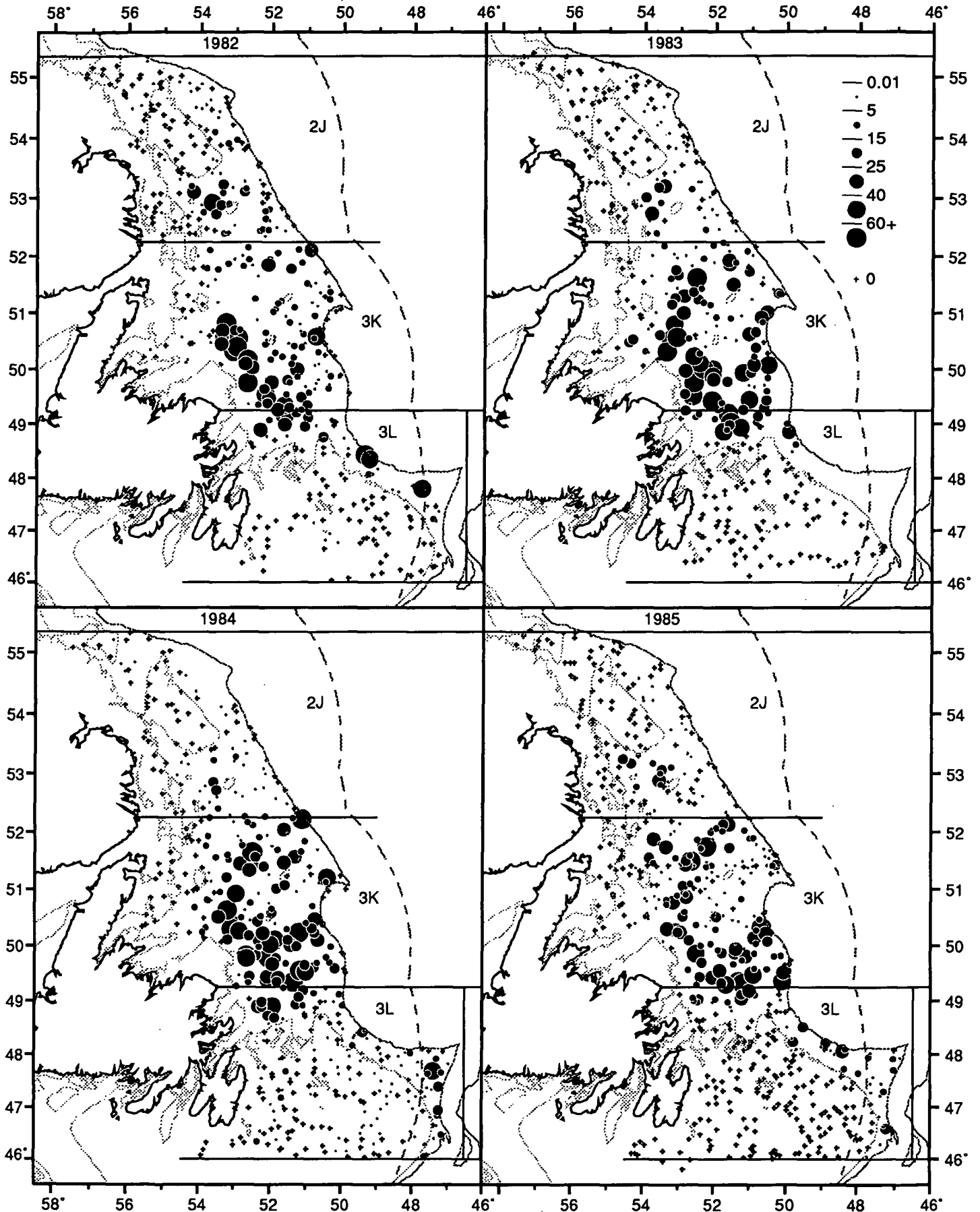


Fig. 8. Distribution of witch catches from 1982-1985 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 800m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

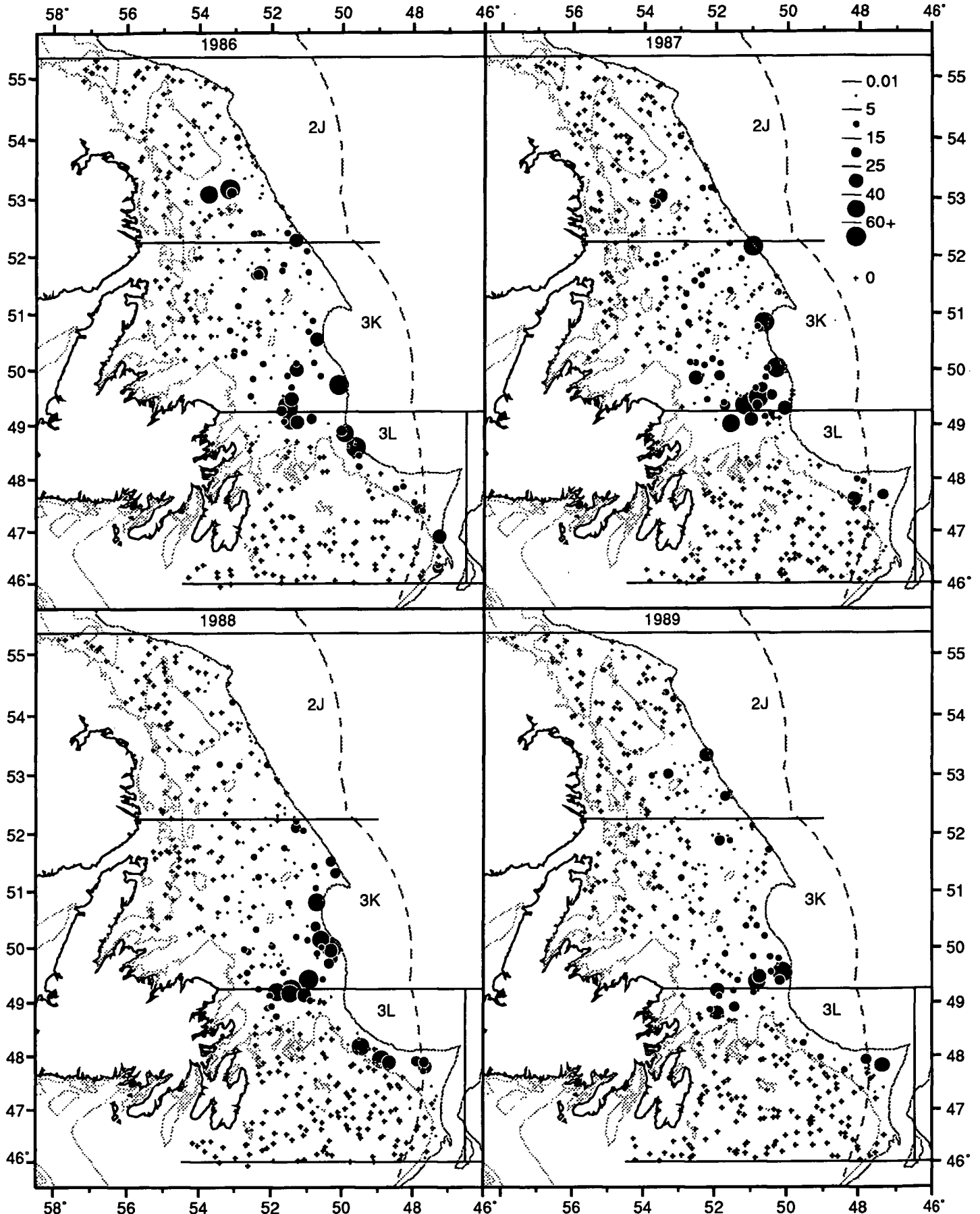


Fig. 9. Distribution of witch catches from 1986-1989 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 800m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

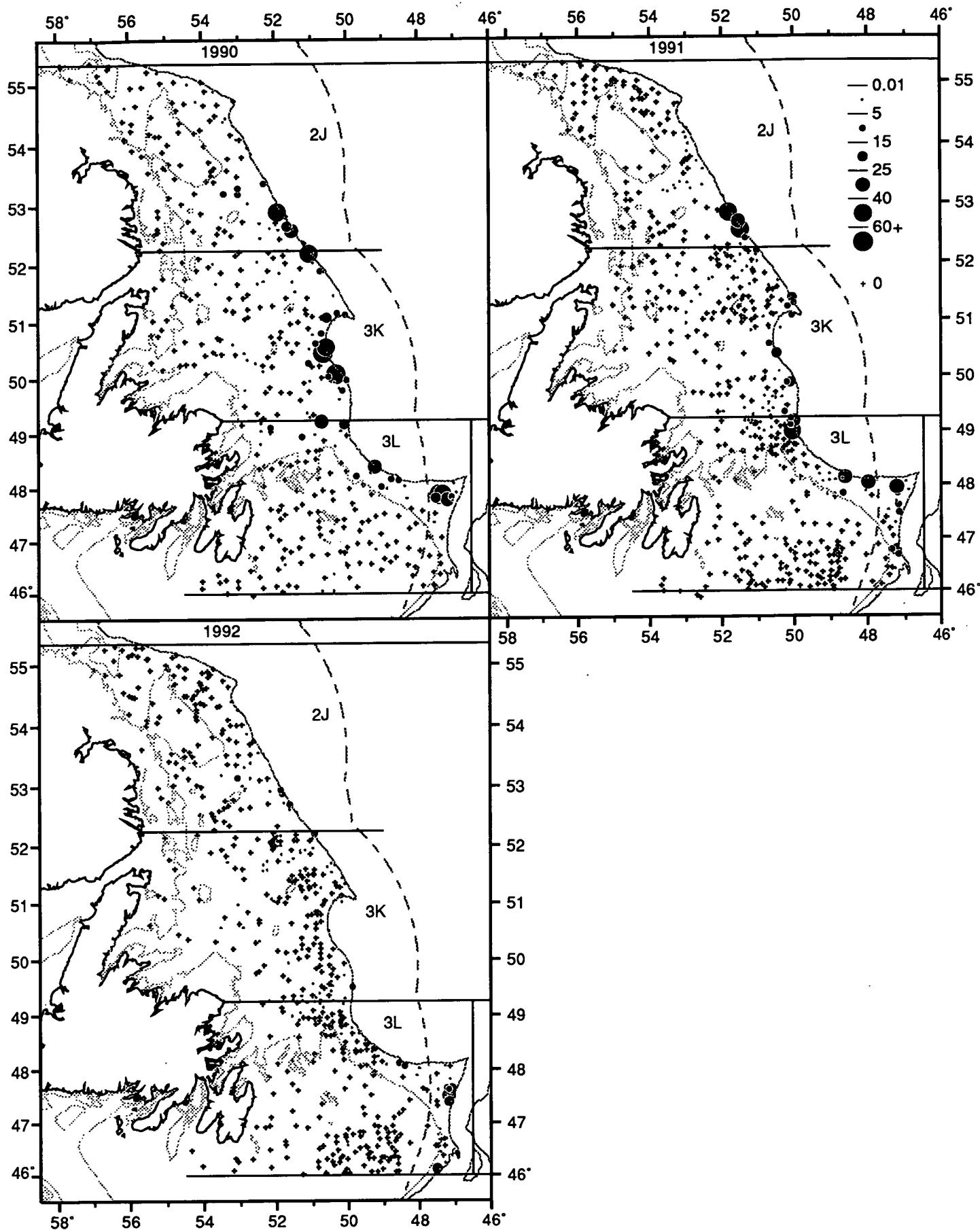


Fig. 10. Distribution of witch catches from 1990-1992 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 800m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.