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Canadian Atlantic Fisheries  
Scientific Advisory Committee

CAFSAC Research Document 89/46

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Comité scientifique consultatif des  
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 89/46

Witch Flounder in Divisions 2J, 3K, and 3L

by

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## Abstract

Witch flounder has been exploited in this area since the early 1960s mainly by Canada; Poland; the Soviet Union; and, to a lesser extent, by FRG and GDR. More recently, catches have increased in the NAFO Regulatory Area of NAFO Division 3L by Portugal. Catches peaked at 24,000 t in 1973 then declined to an average of about 3,500 t annually since 1979. From 1981 to 1983, estimates of biomass for the stock area averaged 41,000 t; however, overall biomass has declined steadily since 1983 to a level of 20,000 t in 1988, which is now about half the earlier period. While it is difficult to evaluate precisely, at present, it appears that witch may have re-distributed to much deeper waters in recent years. The age span declined considerably since 1976, from a maximum age of 26 years old to 13 years old in 1981, and has remained relatively stable to 1988.

## Résumé

Divers pays pêchent la plie grise dans le secteur considéré depuis le début des années 1960, essentiellement le Canada, la Pologne, l'Union soviétique et, dans une moindre mesure, la République fédérale d'Allemagne et la République démocratique allemande. Récemment, les prises du Portugal dans le secteur réglementé de la Division 3L de l'OPANO ont augmenté. Les prises ont culminé à 24 000 t en 1973 puis, depuis 1979, sont tombées à une moyenne annuelle d'environ 3 500 t. De 1981 à 1983, les estimations de biomasse du stock considéré se sont chiffrées en moyenne à 41 000 t. Toutefois, la biomasse globale a constamment diminué depuis 1983, pour s'établir à 20 000 t en 1988, soit environ la moitié de ce qu'elle était auparavant. Bien qu'il soit difficile de le déterminer avec précision pour le moment, il semble que la plie grise se soit déplacée vers des eaux beaucoup plus profondes au cours des dernières années. La fourchette d'âges a considérablement diminué, puisque l'âge maximal, qui était de 26 ans en 1976, n'était plus que de 13 ans en 1981 et est demeuré ensuite relativement stable jusqu'en 1988.

### Nominal Catches

The commercial fishery began for witch in this area in the early 1960s and increased systematically from 945 t in 1963 to reach a peak at 24,361 t in 1973 (Table 1). In the late 1960s and early 1970s, the major countries prosecuting this fishery were Canada, Poland, and the Soviet Union and, to a lesser extent, the GDR and FRG (Table 1, Fig. 1). Catches declined since 1973 to much lower levels and have averaged about 3500 t annually since 1979 and are now taken mainly by Canada and Poland. In the earlier period, as the fishery developed, significant proportions of the catches came from Div. 2J (Table 2, Fig. 2) - particularly, during the late 1960s and, more sporadically, during the 1970s. In Div. 3L, the contributions to annual catches have been more consistent within the range of 10-20%. Division 3K, by far, comprises the most important proportion of overall catches and, during the early 1980s, accounted for more than 80% of the catch. The catch compositions during the more recent period, however, have been confounded by countries reporting large catches of witch in the NAFO Regulatory Area of Div. 3L (eg., Portugal 1986) (Table 2). Such catches are believed to be highly unlikely.

The fishery, over its history, has been comprised of a domestic inshore gillnet component and an offshore otter trawl component by both domestic and foreign trawlers (Table 3). There has never been an inshore fishery in Div. 2J; however, in Div. 3K and 3L, there have been large inshore components in the 1970s (Table 3) making up a third of the total catch. While proportionately the inshore catch is now much lower, it is still a significant force in this fishery. Provisional catches for 1988 (Table 4) show the catches by stock area for countries other than Can (N) and by division for Can (N). It should be noted that for the EEC, which now includes Spain and Portugal, the levels of catch are highly uncertain from 1986 onward.

In 1988, and again in 1989 (according to boat reports), there has been a highly productive fishery in the Canadian offshore fishery in Div. 3K - in depths of 700-1000 m, at the continental slope. Catches per day have been as high as 30-50 t. This fishery is conducted on a spawning concentration during winter and early spring months, and catch rates drop off quickly by the end of April and early May when the concentration breaks up. It is, therefore, quite probable that catch rates experienced at this time are not necessarily indicative of overall stock size.

### Biological Surveys

Stratified-random surveys have been conducted in the fall in Div. 2J, 3K, and 3L since 1977, 1978, and 1981 respectively. For years when surveys were incomplete, biomass and abundance estimates for missing strata were obtained by applying multiplicative regression analyses. Certain strata that were rarely or never fished and had a high likelihood of zero catches were not included in the analysis. In general, the results suggested very little difference between the actual estimates for the area surveyed and those corrected for missing strata by the multiplicative regression analyses.

#### - Biomass Estimates

For Div. 2J, biomass estimates ranged from 843 t in 1978 to 4142 t in 1986 (Table 5). From 1986, estimates declined - to 1061 t in 1988, the second lowest level in the time series. From Table 5, it can be readily seen that the highest catches are consistently in stratum 212 followed by 211 and 235. These strata are those that comprise the Hawke Channel area to the south of Hamilton Inlet

Bank (Fig. 3). In the early 1960s, during April, there were some notable catches by the research vessel A. T. CAMERON taken in this area - up to 3500 kg per 30-minute set. However, recent attempts by commercial trawlers, in the same month and area, did not catch any commercial amounts of witch.

In Div. 3K, during 1979-85, there appeared to be a period of relative stability where most annual biomass estimates were over 30,000 t (Table 6). The average for the period was, in fact, about 31,000 t. Estimates declined, since 1984 - to a level of 11,965 t in 1988, the lowest in the time series. For the last 3 years, however, estimates have been relatively stable at an average of about 14,000 t. Witch are spread out over a much wider area in this division with most fish being found due east of the 300 m contour - i.e., from strata 625 and 626 eastward (Fig. 4). It is also noteworthy that the average catches in strata 640 and 641 are much higher in recent years. This area is adjacent to stratum 642 where the recent very high catch rates of the commercial trawlers have been experienced during the winter/spring period. It is also important to realize that the period when the decline in biomass began (1984-85) was at the beginning of a very cold period which has been well documented for other groundfish species. It is not inconceivable, then, that survivors would tend to move into deeper, warmer water where they are not as adversely affected. This is particularly the case for witch, which is a relatively warm water fish.

In Div. 3L, biomass estimates of witch for the period 1981-88 have ranged between 4848 t in 1985 and 8078 t in 1982 (Table 7). Except for 1985, the biomass in Div. 3L has been relatively stable, averaging about 7800 t. Given the estimated declines in biomass for Div. 3K, Div. 3L now comprises nearly half of that in Div. 3K. The strata of highest abundance in Div. 3L are 345 and 346 (Fig. 5) which are natural extensions of strata 628 and 638 of Div. 3K (Fig. 4). Other strata of particular significance are 369, 386, and 387 along the northeastern edge and the Nose of the Grand Bank, largely inside the 200-mile limit.

Estimates of biomass for Divisions 2J, 3K, and 3L combined are shown in Table 8 and separately by division in Figure 6. From 1981 to 1983, biomass estimates averaged about 41,000 t; however, overall biomass has declined steadily since 1983 to a level of 20,357 t in 1988, which is now about half of the earlier period.

- Estimates of abundance at age

Estimates of abundance at age from the fall surveys are shown in Tables 9-11 for Div. 2J, 3K, and 3L respectively. For Div. 2J, catches ranged from age 4 to age 16 in 1977; however, in 1988, catches ranged from age 5 to age 12 (Table 9). Abundance indices varied but were at low levels over the time period. In Div. 3K (Table 10), the catches were comprised of many more age groups in earlier years with the oldest age in 1988 being 13 years compared to 16 years in 1978. Average abundance during the 1978-82 period was 35 million, 39 million during 1984-85, and 37 million over the 1978-85 period. In recent years (1986-88), the abundance averaged 17 million annually, less than half the previous period.

The abundance indices for Div. 3L (Table 11) were similar to those of the biomass in that they showed relative stability over the period 1981-88. The age

composition was also similar to that of Div. 3K although the abundance was much lower.

### Commercial catch at age

The commercial catch at age is presented for illustrative purposes (Table 12). While the age range and percent age composition probably represents the offshore fisheries reasonably well, there are some major concerns as to actual removals. For example, the large catches reported by EEC for Div. 3L are highly questionable. Catches by inshore gears - although small, in comparison to the offshore - are probably under-represented in the catch matrix because, logistically, there is difficulty in procuring samples. The age composition, nevertheless, is similar to the survey age composition.

### Prognosis

In the last review of this stock, CAFSAC observed that this population (more particularly in Div. 3K) appeared to have reached a new equilibrium compared to that of the mid-1970s. The maximum age appeared to be relatively stable at about 14 years old compared to 26 years old as recently as 1976. This situation appears not to have changed over the last few years; however, the estimated biomass for Div. 3K, in particular, has declined to a level which has remained stable since 1986, albeit at a level which is much lower than years prior to 1986. It is difficult, at this time, to determine the full cause and effect of this reduction. It is further complicated by the fact that the fishery in 1988 and 1989 was almost entirely prosecuted on the spawning concentration in Div. 3K (if the EEC reported catch in Div. 3L is ignored). As a result, it may be too early to determine if the present TAC is having a detrimental effect on this component of the resource. If the present fishing practice continues and the future surveys and age structures remain stable, one may conclude the present TAC to be appropriate if it reflects catch; if not, alternative measures would be required.

Table 1. Nominal catches of witch in Div. 2J3KL by country  
1963-88.

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 <sup>a</sup>	1198	2	7	3	21	-	2676	3907
1987 <sup>a</sup>	1184	-	56	765	164	-	70	2239
1988 <sup>a</sup>	3272	-	11	760	4	-	435	4482

<sup>a</sup>Provisional

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 <sup>a</sup>	160	5.33	1998	66.53	845 <sup>b</sup>	28.14	3003
1986 <sup>a</sup>	91	2.33	632	16.18	3184 <sup>b</sup>	81.49	3907

<sup>a</sup>Provisional<sup>b</sup>2500 t reported by Portugal in the NAFO Regulatory Area of Division 3L

Table 3. Nominal catches of witch by Division and gear component in Div. 2J3KL from 1967-88.

Year	2J	2J	3K	3K	3L	3L	Total
	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	
1967	0	1357	0	1322	188	1234	4101
1968	0	1716	37	8082	357	474	10666
1969	0	4852	79	6378	936	340	12585
1970	0	5604	1665	8296	1987	478	18030
1971	0	1978	2638	5824	4653	960	16053
1972	0	1443	2056	9745	2834	1240	17318
1973	0	1048	915	16709	2170	2779	23621
1974	0	3497	497	10053	880	1036	15963
1975	0	1185	391	9230	543	856	12205
1976	0	683	543	6990	1186	1223	10625
1977	0	2267	389	4702	453	507	8318
1978	0	640	215	5546	207	296	6904
1979	0	188	179	2848	412	470	4097
1980	14	27	127	2369	69	217	2823
1981	7	103	188	3248	240	408	4194
1982	0	149	119	2079	317	317	2981
1983	0	200	182	2230	197	279	3088
1984	0	155	288	3712	425	233	4813
1985	0	160	127	1871	591	254	3003
1986 <sup>a</sup>	0	91	202	430	301	2883	3907

<sup>a</sup>Provisional

Table 4. Provisional catches of witch in Div. 2J3KL for 1988.

Country	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Month	Total
													Unk.	
CAN (SF)	0.015 <sup>a</sup>			0.065 <sup>a</sup>	0.211 <sup>a</sup>			0.214 <sup>a</sup>						1
	3K	6	1	132	1	0.044 <sup>a</sup>	0.002 <sup>a</sup>	1	1	0.003 <sup>a</sup>		4		143
	3L	0.314 <sup>a</sup>	0.085 <sup>a</sup>	3	0.362 <sup>a</sup>	12	11	1	5	1	3			4
EEC	247	147			25	7	1	2	1	2				432
GDR	4							3	4					11
POLAND		133	599		1	27								760
USSR												3	1	4
JAPAN												3		3
PORTUGAL														
NORWAY														
SPAIN														
TOTAL														
CAN (N)	2J (OT)							2						2
	2J (GN)							1						1
	3K (OT)	6	18	346	1583	13	4	1	1	8	9			1989
	3K (GN)							107	160	20				287
	3L (OT)		12	112	19	15	16	33	15	8	6	2	33	271
3L (GN)					4	7	231	225	46	24			537	
														4482

<sup>a</sup>Catches < 0.50 tons.



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 (no. 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, 102,103 1984	GADUS 116, 117,118 1985	GADUS 131, 132,133 1986	GADUS 145, 146,147 1987	GADUS 159, 160,161 1988
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)
202	0.0(2)	0.00(4)	0.00(4)	0.0(4)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.0(2)	0.00(2)	-
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)
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)
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)	0.0(7)	0.00(10)	0.00(6)
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)
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)
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)
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)
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)
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)	0.90(2)	0.80(2)	0.00(2)
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)
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)
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)
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)
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)
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)
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)
219	-	-	-	-	0.00(2)	-	0.00(2)	-	0.00(2)	0.0(2)	0.00(2)	0.00(2)
220 <sup>a</sup>	-	0.00(2)	-	-	-	-	-	-	-	-	-	-
221 <sup>a</sup>	-	-	-	-	-	-	-	-	-	-	-	-
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)
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)
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)
225 <sup>a</sup>	0.0(2)	-	-	-	-	-	-	-	-	-	-	-
226 <sup>a</sup>	-	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)
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)
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)	8.73(3)	13.00(3)	0.50(3)	2.07(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)
231	0.0(2)	0.00(2)	-	0.00(2)	-	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.0(2)	0.00(2)	0.00(2)
232 <sup>a</sup>	0.0(2)	0.00(2)	-	-	-	-	-	-	-	-	-	-
233 <sup>a</sup>	-	-	-	-	-	-	-	-	-	-	-	-
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)
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)
236	0.0(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)
Estimated biomass (tons)	3,829	844	1,884	2,337	1,968	3,575	2,751	2,020	2,122	4,141	1,151	1,060
Corrected biomass estimates after MM adjustments	3,831	843	1,904	2,341	1,968	3,578	2,750	2,041	2,122	4,142	1,511	1,061

<sup>a</sup>Excluded from MM analysis.

Table 6. 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
618 <sup>a</sup>	-	-	-	-	-	-	-	0.00(6)	0.0(5)	0.00(7)	0.00(6)
619 <sup>a</sup>	-	-	-	-	-	-	-	0.00(7)	0.0(5)	0.00(8)	0.00(7)
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)	0.61(9)	0.00(14)	0.00(12)
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)
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)
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)
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(3)	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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
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)
639	8.60(9)	8.22(4)	13.67(6)	11.23(6)	7.55(10)	26.71(7)	24.67(8)	12.25(8)	11.08(6)	4.46(7)	16.88(6)
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)
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)	-
642	0.00(2)	-	0.50(2)	0.00(3)	0.33(6)	-	1.33(6)	0.72(5)	-	0.56(5)	-
643 <sup>a</sup>	0.00(2)	0.00(2)	-	-	-	-	-	-	-	-	-
644 <sup>a</sup>	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)
646	0.00(2)	0.00(2)	1.75(2)	0.25(2)	0.60(2)	18.50(2)	3.00(2)	2.37(3)	-	3.50(2)	-
647	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	-	-	0.50(3)	-	-	-
648 <sup>a</sup>	0.00(2)	-	-	-	-	-	-	-	-	-	-
649 <sup>a</sup>	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
Corrected biomass estimates after MM adjustments	18,862	35,014	31,040	31,268	22,631	36,858	36,128	23,586	14,678	14,670	11,965

<sup>a</sup>Excluded from MM analysis

Table 7. 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 (no. 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
328	-	-	-	0.25(4)	0.00(8)	0.0(6)	0.00(4)	0.00(7)
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)
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)
343	0.00(4)	-	0.00(3)	1.38(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
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)
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)
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)
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)
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)
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)
350	0.00(6)	0.00(2)	0.00(8)	0.52(12)	0.00(9)	0.0(11)	0.00(9)	0.00(10)
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)
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)
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)
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)
368	0.50(2)	0.75(2)	-	1.50(2)	0.75(2)	8.57(2)	0.45(2)	1.75(2)
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)
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)
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)
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)
384	-	0.00(4)	1.00(3)	0.74(6)	0.00(8)	0.0(5)	0.00(6)	0.00(6)
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)
386	10.50(3)	1.75(4)	-	1.10(8)	4.36(5)	10.05(4)	12.25(4)	16.32(5)
387	4.25(2)	13.83(3)	-	2.00(3)	4.70(4)	2.50(2)	6.93(3)	20.63(4)
388	-	0.87(3)	-	28.50(2)	0.90(2)	-	12.25(2)	2.00(2)
389	-	4.38(4)	-	2.04(6)	1.20(5)	8.14(4)	2.28(4)	1.88(4)
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)
391	-	0.00(2)	0.00(2)	0.00(2)	0.75(2)	0.0(2)	0.25(2)	0.00(2)
392	-	0.00(2)	1.00(2)	3.50(2)	0.52(2)	1.00(2)	2.90(2)	0.75(2)
729	-	-	-	6.25(2)	11.25(2)	11.61(2)	-	-
730	-	-	-	4.50(2)	1.00(2)	-	-	-
731	-	-	-	15.25(2)	9.50(2)	-	-	-
732	-	-	-	10.25(2)	8.00(2)	-	-	-
733	-	-	-	4.75(4)	19.67(3)	-	-	-
734	-	-	-	1.17(3)	6.00(2)	-	-	-
735	-	57.25(2)	-	9.67(3)	1.50(2)	50.00(2)	-	-
736	-	-	23.00(2)	-	11.50(2)	30.56(2)	-	-
Estimated biomass (tons)	7,461	7,059	5,639	7,826	4,848	6,582	5,701	6,146
Corrected biomass estimates from MM analysis	9,212	8,078	7,449	7,899	4,848	7,653	6,850	7,331

Table 8. Adjusted biomass estimates from MM analyses.

Div.	1981	1982	1983	1984	1985	1986	1987	1988
2J	1968	3578	2750	2041	2122	4142	1511	1061
3K	31268	22631	36858	36128	23585	14678	14670	11965
3L	9212	8078	7449	7899	4848	7653	6850	7331
Total	42448	34287	47057	46068	30555	26473	23031	20357

Table 9. Estimated abundance at age ('000s) of witch in Div. 2J from a multiplicative analysis of fall survey data.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1												
2												
3												
4	10		10									
5	12	20	30			1			9	147	27	
6	12	40	115	13	7	42		17	3	288	42	158
7	190	220	414	308	228	838	257	125	145	1168	141	333
8	567	305	350	741	653	1583	988	577	817	1987	516	287
9	859	196	357	645	583	899	1112	720	837	1274	652	266
10	574	127	332	472	300	385	620	506	460	397	341	214
11	921	81	169	249	133	196	226	150	196	86	102	137
12	497	66	52	132	59	11	21	120	59	16	12	10
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

Table 10. Estimated abundance at age ('000s) of witch in Division 3K from a multiplicative analysis of fall survey data.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1									36		
2						72		13	18	16	
3	29	54	231	15	19	14	146	88	54		
4	471	415	195	606	485	158	376	460	573	179	245
5	3234	4027	387	997	1362	892	1590	2620	1548	448	1080
6	3608	6815	1354	1788	1717	1801	1838	2013	946	1517	801
7	4858	10981	7991	8838	6713	5635	4248	2477	3165	1857	1645
8	5109	9246	10273	11807	8923	10848	9878	9181	5822	4540	2760
9	3153	5546	7224	6763	5050	10819	11045	7943	3730	4632	2652
10	2416	3975	5777	4240	2214	7100	6942	4297	1938	2862	2650
11	1669	2521	2921	1871	1470	3847	3389	2075	763	1660	2108
12	1421	1316	1671	831	119	1100	2011	704	136	712	1311
13	798	545	960	108	19	368	707	86		29	81
14	278	37	161				25				
15	177		20								
16	18										
Total abundance ('000s)	27239	45478	39165	37864	28091	42654	42195	31957	18729	18452	15333

Table 11. Estimated abundance of witch in Div. 3L fall surveys using a multiplicative regression analysis.

	1981	1982	1983	1984	1985	1986	1987	1988
1		21						
2	33				13			
3	92	37						
4	60		34	103	13			
5	128	107		100	28	69		
6	194	178	106	162	26	19		16
7		743	96	297	200	269	126	228
8	1981	1966	1065	812	1085	1572	472	1048
9	2866	2239	2783	1697	1710	2752	1588	2183
10	3471	2157	2536	1993	1257	2028	2244	2024
11	1539	979	1420	1764	656	1327	1673	1328
12	96	454	365	1083	351	460	1060	948
13		133	67	409	76	84	268	35
14		24	38	60			63	
Total abundance ('000s)	10460	9038	8510	8480	5415	8580	7494	7810

Table 12. Commercial witch catch at age Div. 2J3KL.

Age	1981	1982	1983	1984	1985	1986	1987	1988
2	-	-	2	-	-	-	-	-
3	2	-	-	-	-	-	-	-
4	15	8	2	34	-	-	-	-
5	161	98	21	176	-	-	1	2
6	306	245	49	700	5	10	11	131
7	982	608	371	853	136	107	96	629
8	1382	1072	1266	1187	559	336	445	1241
9	755	1389	992	1685	833	429	724	1457
10	470	976	570	1579	859	381	790	1289
11	274	469	298	856	428	245	474	832
12	135	363	118	405	229	100	171	417
13	56	75	72	183	82	21	60	71
14	26	34	28	30	2	1	1	4
15	11	4	10	2	1	-	-	-
16	2	-	1	-	-	-	-	-
17	3	-	-	-	-	-	-	-

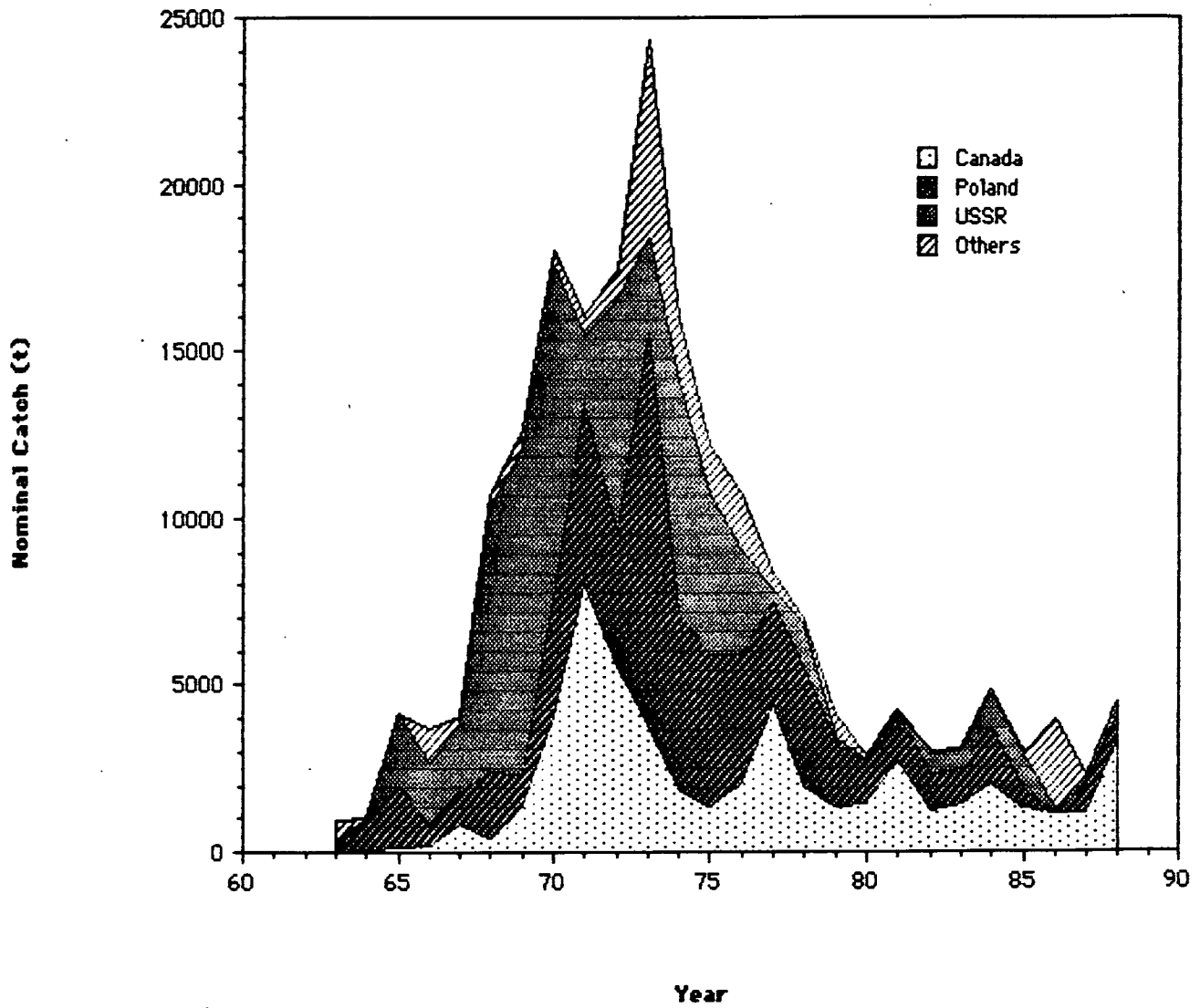
**Nominal Catch of Witch in Div. 2J3KL**

Fig. 1. Nominal catches of witch in Div. 2J3KL from 1963-1988.

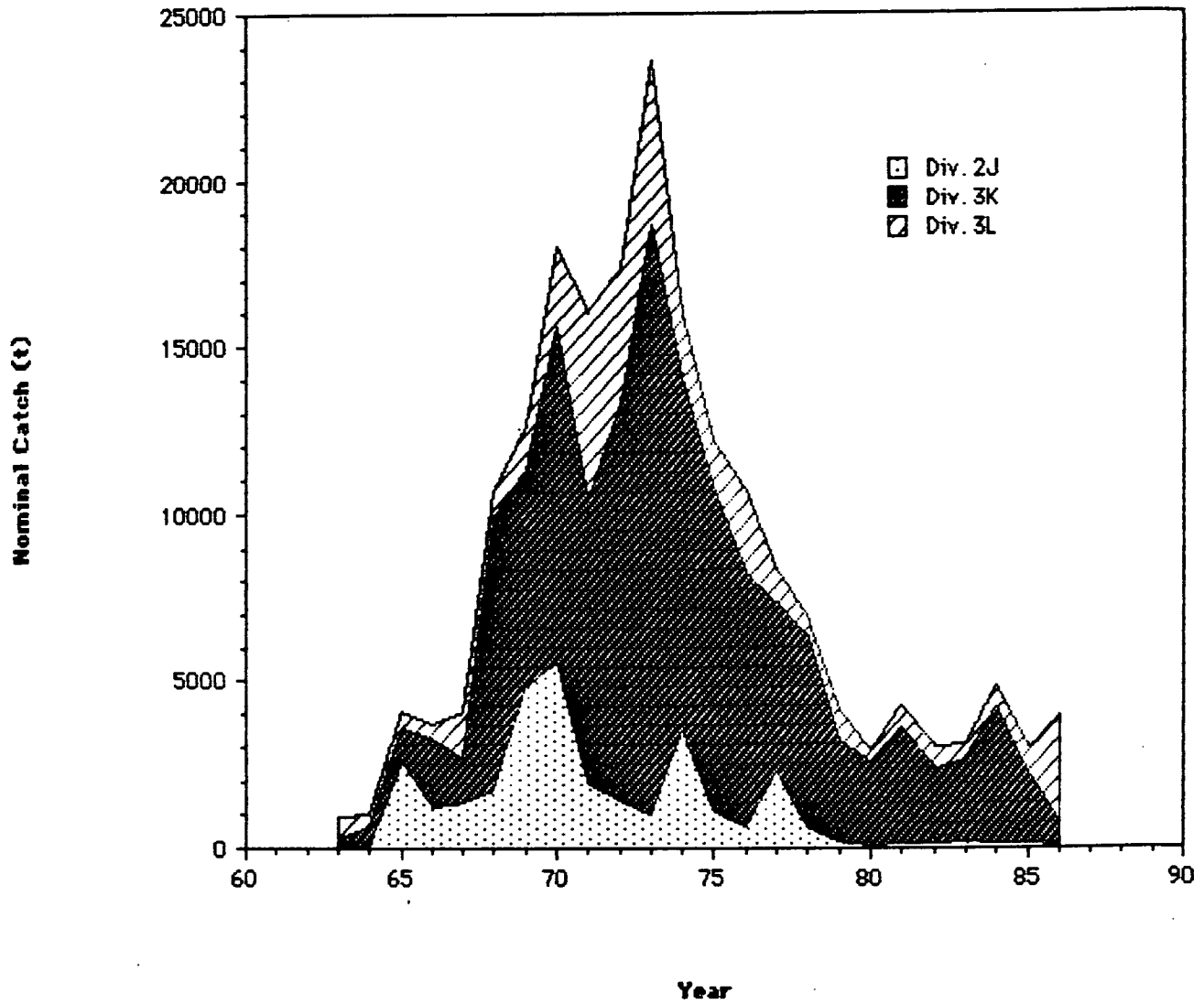
**Nominal Catch of Witch in Div. 2J3KL**

Fig.2 Nominal catch of witch in Div. 2J3KL by division.



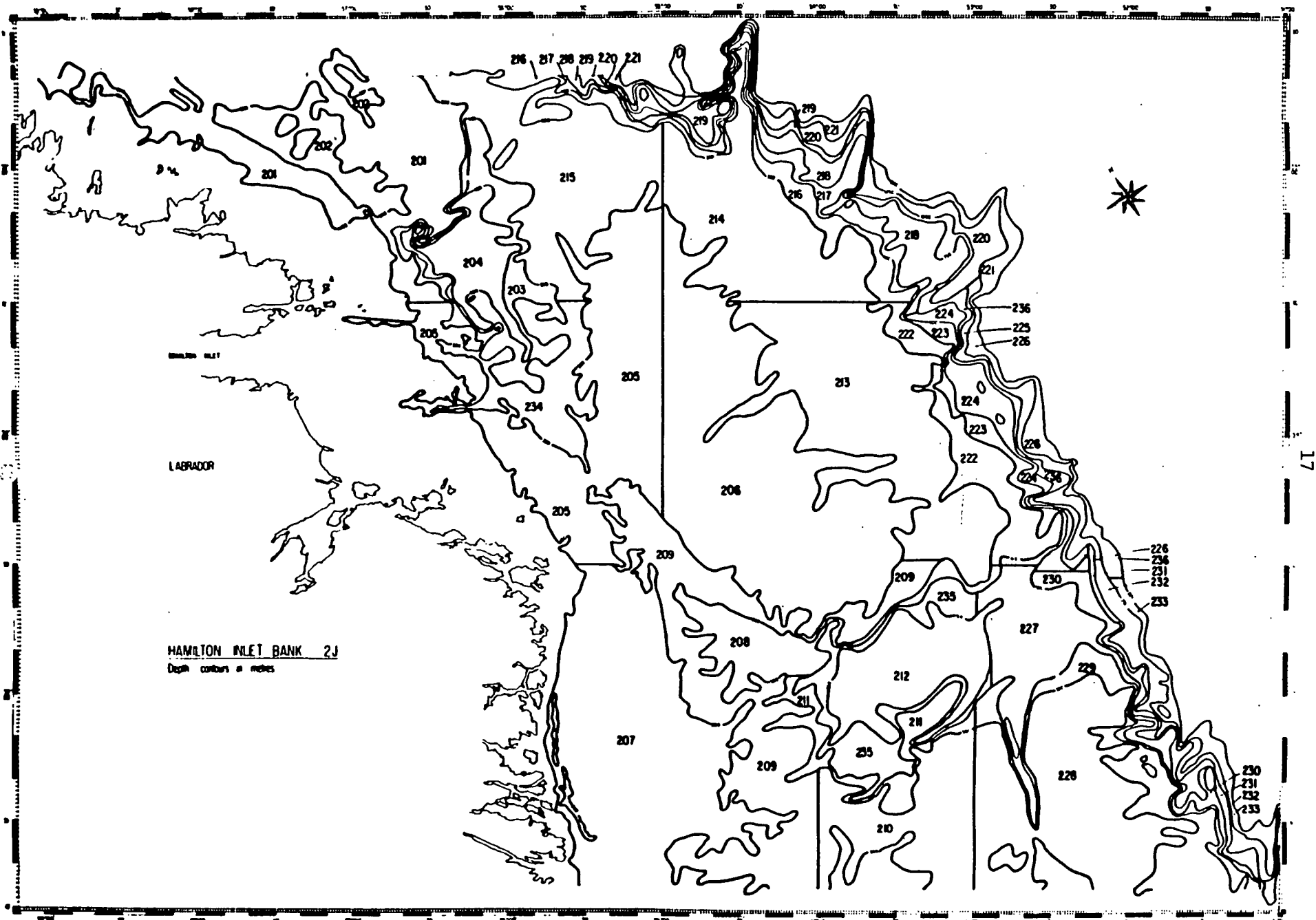


FIG 3. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 2J.

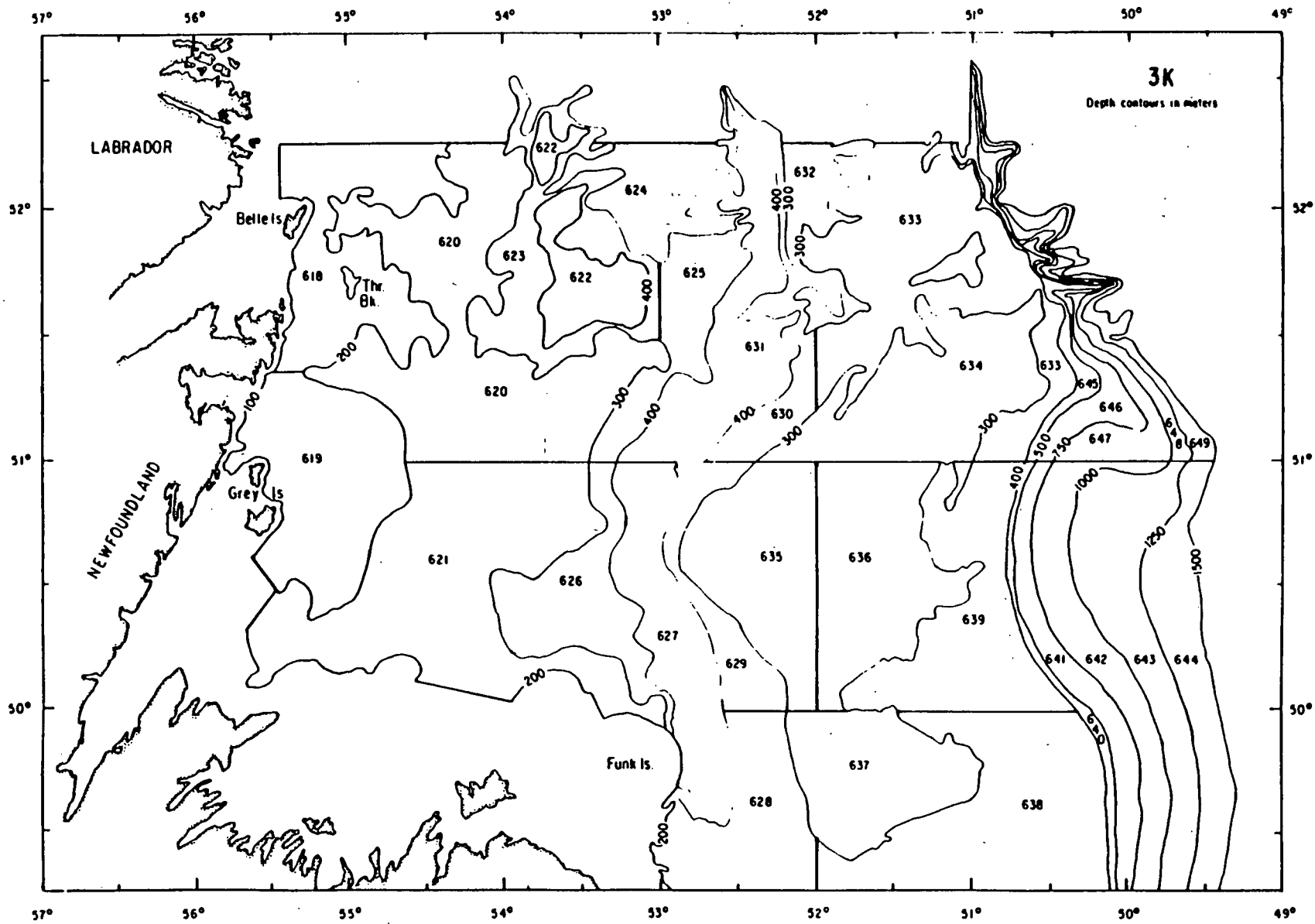


FIG 4. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 3K.

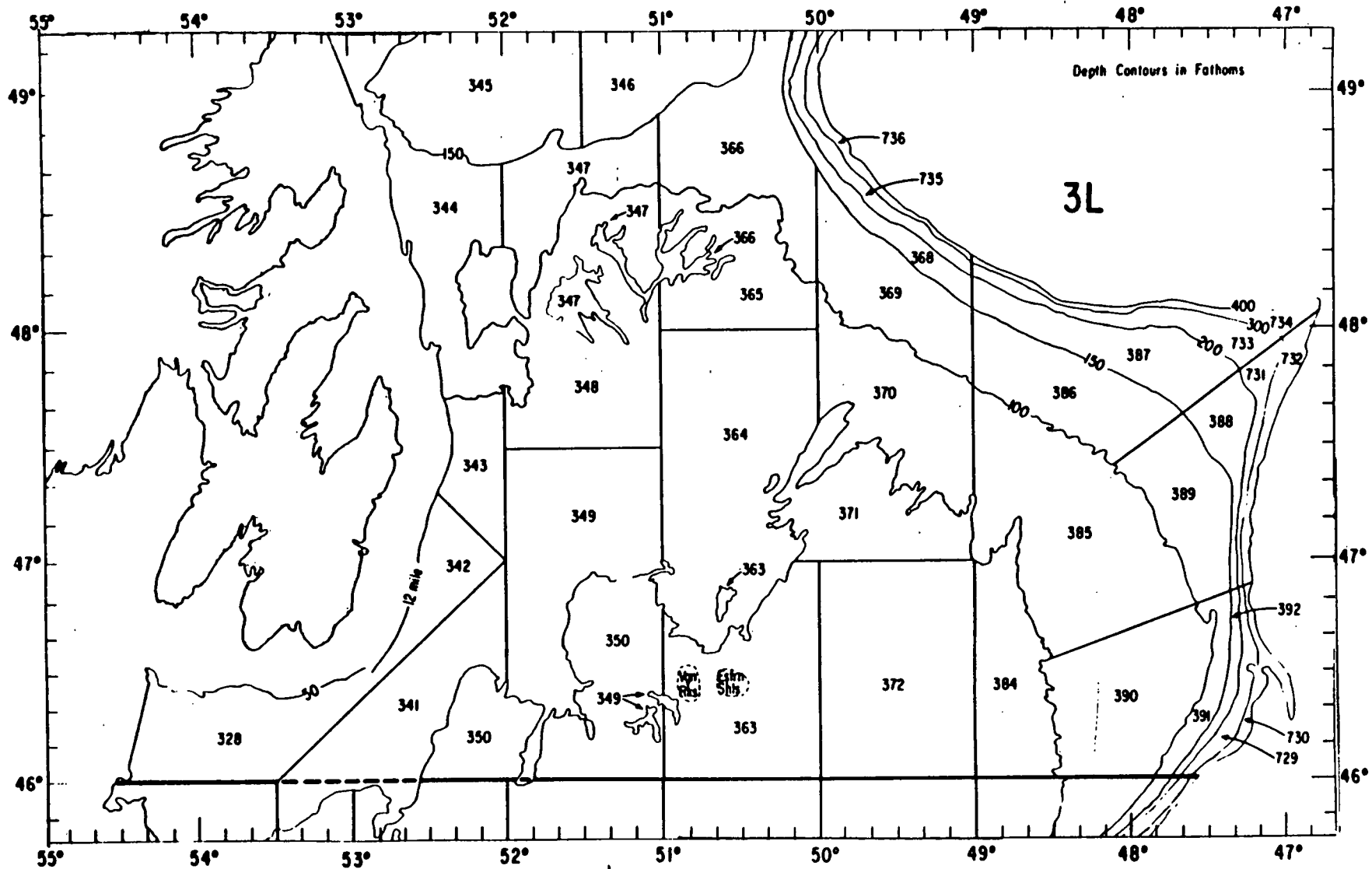


FIG. 5. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 3L.

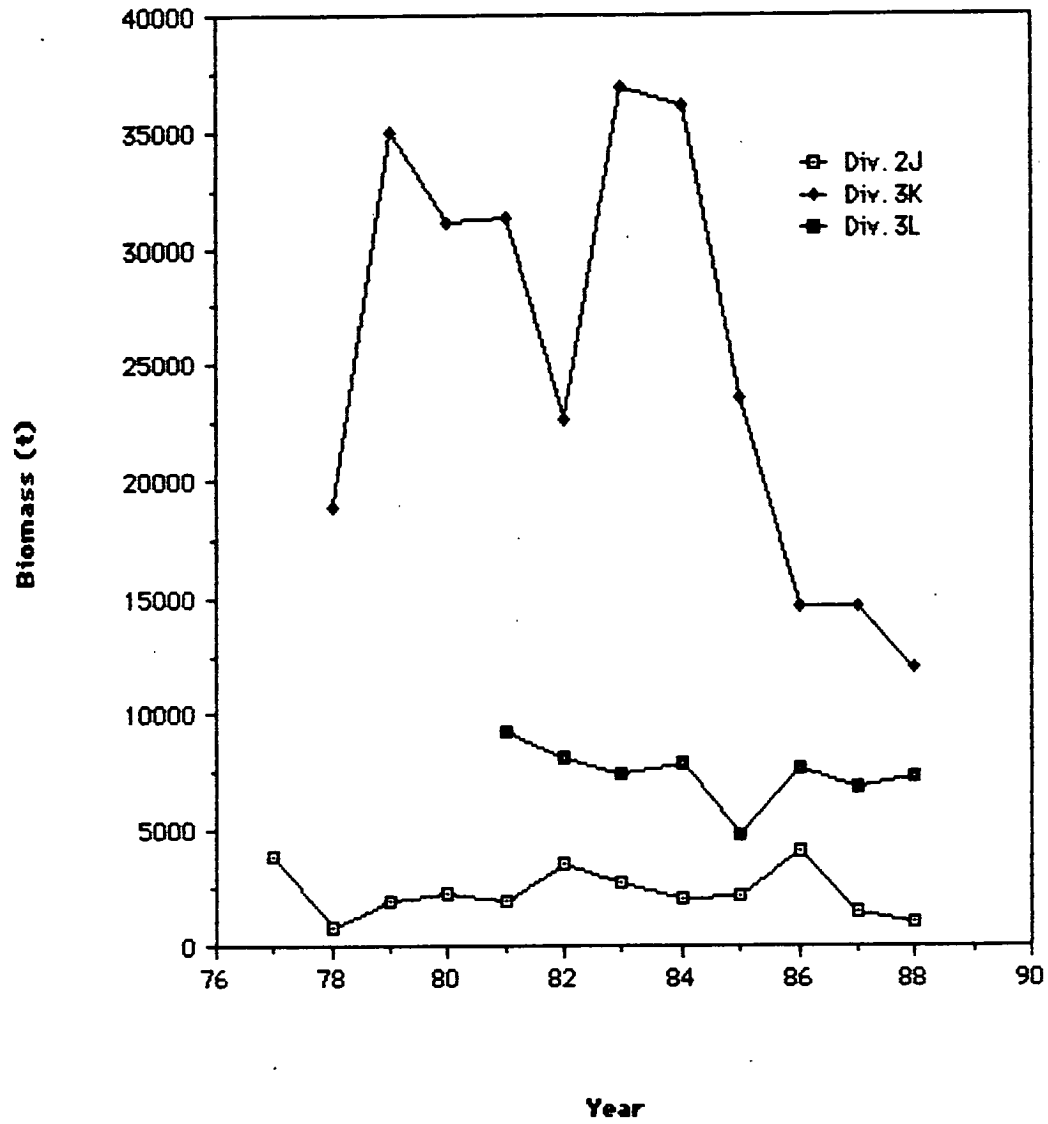
**Biomass Estimates of Witch in Div. 2J3KL**

Fig.6. Biomass estimates of witch by division in Div. 2J3KL.