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Resource Status of Witch Flounder in NAFO Divisions 3NO

by

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Abstract

Biomass and abundance indices from Canadian spring surveys in Div. 3N have been at very low levels throughout the period since 1984. In most years the biomass index was estimated to be less than 1,000 tons or 2 million fish. For Div. 3O where most of the stock resides, estimates of stock size exhibited considerable annual fluctuations on average between 8,000 and 24,000 tons or 6-44 million fish particularly in the late 1980's. The data indicate an overall-declining trend in stock size with the estimates for the spring 1998 survey at the lowest level observed since 1984. Indices from Canadian fall surveys for Div. 3N are similar to the spring in both stock size estimates, which are very low but lack trend. Indices are highly variable for Div. 3O in the fall surveys and also lack any overall trend. Nonetheless, the estimates for each seasonal series are generally within the same numeric range.

Fisheries and Management

Catches in the 1960's peaked at 11,000-12,000 tons in 1967-68 and remained relatively high during the next several years (Table 1; Fig. 1). During the period 1971-84 catches ranged from a low of about 2,400 tons in 1980 and 1981 to as high as 15,000 tons in 1971 which is the highest recorded catch in the history of the fishery, however, from 1975-84 annual catches rarely exceeded 6,000 tons. Species specific catch statistics for flatfish prior to 1973 were largely developed from breakdowns of unspecified flounders and therefore should be quoted with caution.

As a result of an increase in fishing effort in the NRA during 1985 and 1986, especially by EU-Spain and EU-Portugal, catches rose rapidly to levels of 8,800 and 9,100 tons respectively. This increased effort was primarily concentrated on the "tail" of the Grand Bank in the NAFO Regulatory area of Division 3N. Non-Contracting parties such as South Korea, USA, Cayman Islands and Panama also contributed to increased catch levels during this period. Catches remained relatively high in 1987 and 1988 at 7,600 and 7,300 tons respectively. During 1990-93 estimated catches were in the range of 4,200-5,000 tons. The estimated catch for 1994 was still in the order of 1,100 tons despite there being a moratorium introduced on fishing this stock (Table 1; Fig. 1). The catch dropped to 300 tons in 1995 likely as a result of a substantial reduction in fishing effort for Greenland halibut where witch flounder comprises a by-catch. Since then catches have increased steadily and by 1999 was about 800 tons (Table 1; Fig. 1).

Historically, mostly Canada and the former Soviet Union conducted the fishery. Canadian catches fluctuated from between 1,200 and 3,000 tons from 1985-91 but increased to about 4,300 tons in 1992 and 4,200 in 1993 (Table 1). Very little catch has been taken since then due to the moratorium. The increase in 1992 and 1993 was essentially the result of a quota transfer to Canada by the Russian Federation. Catches by the USSR/Russian vessels declined from between 1,000 and 2,000 tons in the period 1982-88 to less than 100 tons in 1989-90 and little or no catch since then until 1999 when Russia reported a catch of 86 tons (Table 1).

The first total allowable catch (TAC) for this resource was introduced by ICNAF in 1974 at a level of 10,000 tons largely based on average historical catches (Fig. 1). This level remained in effect until 1979 when it was reduced to 7,000 tons in consideration of declining commercial catch rates. It was further reduced to 5,000 tons in 1981 and remained at that level to 1993. The Scientific Council advised that for 1994 catches from this stock should not exceed 3,000 tons. A TAC of 3,000 tons was agreed by the NAFO Fisheries Commission, however, it was also agreed that no directed fishery would be conducted for witch flounder in 1994 due to the poor state of the stock and to allow for rebuilding. The NAFO Fisheries Commission introduced a complete moratorium for directed fishing in 1995 which has continued through 2000.

Canadian Research Vessel Surveys

Stratified-random research vessel surveys have been carried out by Canada on the Grand Bank (including Div. 3NO) during spring since 1971 although during the early period coverage was limited and, in fact, for most years only surveyed to 366 meters. Since 1990, on the other hand, depth coverage was extended to 720 meters, which should be more representative of the stock distribution. Nevertheless, this still may not cover the entire range of depth distribution of witch flounder when compared to its distribution observed in other stock areas during recent years. In addition to spring surveys, a time series of fall surveys was begun in 1990 to investigate seasonal variation in stock distribution and abundance of various groundfish species. In fall 1998 the survey depth range was further extended to 1500 meters.

Beginning with the 1995 fall survey the survey gear was changed from an Engel groundfish trawl with steel bobbin footgear to a Campelen 1800 shrimp trawl with rockhopper footgear. The data from these surveys have now been converted from Engel trawl catches to Campelen 1800 trawl catch equivalents. Only the converted survey data are presented here.

Survey Biomass and Abundance Indices

Biomass estimates by stratum are presented for the spring surveys in NAFO Division 3N and 3O, respectively in Tables 2 and 3. Similar data are presented for abundance estimates from spring surveys in Tables 4 and 5, respectively. Fall survey results are shown in the same order as above for spring survey in Tables 6-9, inclusive. Graphical plots to better illustrate the comparative trends in stock biomass and abundance by season are presented by NAFO Divisions 3N and 3O separately and combined in figures 2-4, respectively.

Estimated biomass and abundance from spring surveys (which are the longer time series) in Div. 3N have been at very low levels throughout the period since 1984. In most years trawlable stock size was estimated to be less than 1,000 tons or 2 million fish (Fig. 2; Tables 2 and 4). For Div. 3O where most of the stock resides, estimates of stock size exhibited considerable annual fluctuations on average between 8,000 and 24,000 tons or 6-44 million fish particularly in the late 1980's (Fig. 2; Tables 3 and 5). The several high spikes in the time series appear related to distribution shifts between the deeper smaller strata and the more shallow large strata (see Fig. 6-9 for illustration). This would have the effect of giving lower estimates when fish are distributed deeper and higher estimates when fish are distributed more in over the bank. Nevertheless, the data indicate an overall-declining trend in stock size (Fig. 2 and 4) in both the lowere estimates and the spikes with the estimates for the spring 1998 and 1999 surveys at the lowest level observed since 1984 in both trends, respectively.

Results of the fall surveys for Div. 3N are similar to the spring in both stock size estimates, which are very low and lack trend (Fig. 3; Tables 6 and 8). The data trends for Div. 3O in the fall surveys are quite different than in the spring series (Fig. 3; Tables 7 and 9). There is an increasing trend for 1991-96, however, when the higher value for 1990 and the lower values for 1997 and 1998 are included the trend is removed (Fig. 3; Tables 7 and 9). Nonetheless, the estimates for each seasonal series are generally within the same numeric range. With Divisions 3NO combined, the most recent biomass and abundance estimates from the spring surveys are about the lowest observed and illustrate a declining trend since the beginning of the data series in 1984. The fall survey series for Divisions 3NO combined is less clear with no real trend in biomass. The high variability in annual estimates may also be related to distribution shifts similar to the spring series (see Fig. 10-13 for illustration). It should be emphasized as well that the more recent lower estimates are also based on more detailed survey coverage than in the earlier years (annual percentage contributions to the estimates are shown in Tables 2-9). Consequently, in reality the declining trends are stronger than illustrated in the figures.

Resource Status

Based on the 1998 and 1999 spring survey estimates it now appears that the resource remains at a relatively low level. The general trend in this longer (spring) survey series would in fact suggest that the stock might continue to decline despite a commercial fishing moratorium being in effect for several years, assuming that the 1999 value represent spikes in the time series. No aging data have been available since 1994 and are not expected to be available in the foreseeable future. Therefore, it is difficult to comment on any recruitment prospects for the resource. Population abundance at length from true *Campelen 1800* surveys in the fall of 1995-99 indicate a higher proportion of smaller fish in recent years especially in the 1998 and 1999 surveys (Fig. 5). However, it is quite variable from year to year which makes it difficult to track recruitment.

Table 1 . Catches and TACs (t) of Witch Flounder in Div. 3NO from 1960-2000.

Year	Canada	USSR (Russia)	Other	Total	TAC
1960	-	-	-	5799	-
1961	-	-	-	4627	-
1962	-	-	-	1228	-
1963	895	485	803	2183	-
1964	1055	-	11	1066	-
1965	1324	849	4	2177	-
1966	3644	3828	50	7522	-
1967	2863	8565	75	11503	-
1968	1503	9078	18	10599	-
1969	479	4215	6	4700	-
1970	723	6039	1	6763	-
1971	178	14774	13	14965	-
1972	3419	5738	20	9177	-
1973	4943	1714	34	6691	-
1974	2807	5235	3	8045	10000
1975	1137	5019	12	6168	10000
1976	3044	2991	-	6035	10000
1977	3013	2742	4	5759	10000
1978	1165	2275	33	3473	10000
1979	1193	1868	16	3077	7000
1980	425	1994	1	2420	7000
1981	381	2044	-	2425	5000
1982	1760	1969	3	3732	5000
1983	1674	1942	-	3616	5000
1984	834	1955	13	2802	5000
1985	2746	1908	4117	8771	5000
1986	2937	1724	4470	9131	5000
1987	2829	1425	3342	7596	5000
1988	1927	1037	4361	7325	5000
1989	1241	81	2366	3688	5000
1990	2654	9	1516	4179	5000
1991	2624	-	2223	4847	5000
1992	4328	-	632	4960	5000
1993	4337	3	250b	4414	5000
1994a	2	-	1117b	1119	3000
1995a	-	-	300b	300	0
1996a	64	-	294b	358	0
1997a	19	-	493b	512	0
1998a	2	5	605	612	0
1999a	6	86	671	763	0
2000	-	-	-	-	0

*Note: Although a TAC of 3000 tons was agreed by the FC, it was also agreed that no directed fishing be conducted in 1994 due to the poor state of the stock.
a = Provisional Data b = Estimated

Table 2 Biomass (tons) of Witch flounder from surveys in Div. 3N during spring 1984-1999 (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum																
(meters)	Area (sq. n. mi.	Area (sq. n. mi.)																	
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	19	0	0	0	0	0	0	0	0	0	0	8	18
57 - 92	2992	2992	360	1715	89	629	461	1519	175	0	0	29	165	0	0	0	115	33	120
57 - 92	1853	1853	361	119	0	0	39	50	0	20	0	0	0	0	39	0	0	0	0
57 - 92	2520	2520	362	0	82	23	18	147	0	0	0	0	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	18	34	0	0	0	0	0
57 - 92	674	674	383	0	57	0	37	0	0	0	0	0	0	0	0	0	0	0	0
93 - 183	421	421	359	231	47	99	43	306	121	0	0	0	19	0	0	0	0	0	67
93 - 183	100	100	377	8	0	0	72	3	32	0	0	0	0	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	40	308	42	137	20	29	57	0	44	132	106	7	51	49	134	7
184 - 274	139	139	378	22	19	32	155	31	42	0	0	29	0	0	0	0	3	0	0
184 - 274	182	182	381	21	7	32	101	69	0	28	0	0	0	0	0	0	0	0	0
275 - 366	164	164	357	8	87	154	.	4	60	21	0	31	49	81	20	36	12	159	21
275 - 366	106	106	379	36	12	23	173	44	20	35	3	18	0	4	0	0	9	2	26
275 - 366	116	116	380	6	53	0	134	24	7	4	0	0	0	0	0	0	0	0	6
367 - 549	155	155	723	.	.	.	.	.	.	.	90	102	79	36	51	16	25	53	33
367 - 549	105	105	725	.	.	.	.	.	.	.	62	.	40	44	0	5	28	4	20
367 - 549	160	160	727	.	.	.	.	.	.	.	0	5	38	17	0	0	3	9	13
550 - 731	124	124	724	.	.	.	.	.	.	.	327	181	218	51	36	29	157	53	105
550 - 731	72	72	726	.	.	.	.	.	.	.	81	25	22	28	3	12	42	96	59
550 - 731	156	156	728	.	.	.	.	.	.	.	92	19	82	22	152	21	.	15	32
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	27	.	.	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	33	.	.	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	26	.	.	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Biomass (>366 m)											652	333	480	284	242	84	255	230	262
Percent >366 m											99.5	68.8	55.7	55.7	78.6	49.2	57.6	40.6	49.9
Biomass (all strata)				2205	761	1078	1401	2217	485	164	655	484	862	510	308	170	443	566	525

Table 3 Biomass (tons) of Witch flounder from surveys in Div. 3O during spring 1984-1999 (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum																
(meters)	Area (sq. n. mi	Area (sq. n. mi.)																	
57 - 92	2089	2089	330	0	0	0	0	22	0	0	0	0	0	0	0	0	0	21	121
57 - 92	456	456	331	1912	302	36	18	444	0	.	0	0	0	0	0	74	0	36	537
57 - 92	1898	1898	338	134	7806	1108	1184	3075	1827	434	0	109	295	0	228	870	0	357	780
57 - 92	1716	1716	340	40	146	0	21	0	0	15	0	147	0	0	0	0	0	0	0
57 - 92	2520	2520	351	688	211	385	222	978	217	109	0	0	0	0	0	0	0	0	21
57 - 92	2580	2580	352	82	951	225	1275	1330	664	1427	40	105	60	40	63	59	100	53	1196
57 - 92	1282	1282	353	4519	1122	1067	1609	7208	2486	1637	0	243	209	0	42	23	2	272	2209
93 - 183	1721	1721	329	0	0	0	0	789	48	27	494	0	0	5071	193	0	11	51	240
93 - 183	1047	1047	332	3779	8589	2485	3367	6829	1485	4599	2426	2182	359	58	1791	1180	235	460	981
93 - 183	948	948	337	50	4129	1415	1506	1061	1543	1627	1581	580	675	50	654	330	163	321	879
93 - 183	585	585	339	335	0	16	223	136	0	0	0	0	0	0	0	1	0	0	1
93 - 183	474	474	354	495	105	1231	233	345	47	240	144	149	841	0	0	36	0	226	1062
184 - 274	151	147	333	10	48	10	0	67	16	129	498	79	80	5196	162	7	109	25	27
184 - 274	121	121	336	12	7	43	25	63	0	53	492	1374	100	1057	62	180	293	23	47
184 - 274	103	103	355	45	181	38	71	0	97	126	136	16	34	129	43	86	48	50	18
275 - 366	92	96	334	0	42	42	18	22	23	26	20	108	20	860	15	150	362	4	7
275 - 366	58	58	335	0	98	18	2	51	22	92	42	1107	65	103	43	78	109	2	62
275 - 366	61	61	356	5	83	18	23	18	29	55	39	129	77	75	62	40	11	29	23
367 - 549	93	166	717	.	.	.	.	.	.	.	11	120	35	2375	53	465	4354	44	19
367 - 549	76	76	719	.	.	.	.	.	.	.	148	1024	49	14	18	137	601	15	16
367 - 549	76	76	721	.	.	.	.	.	.	.	76	48	31	72	18	16	19	38	37
550 - 731	111	134	718	.	.	.	.	.	.	.	35	29	104	221	80	71	37	33	38
550 - 731	105	105	720	.	.	.	.	.	.	.	217	134	182	95	15	21	150	32	20
550 - 731	93	93	722	.	.	.	.	.	.	.	18	49	150	217	206	89	87	31	71
732 - 914	.	105	764	.	.	.	.	.	.	.	.	.	.	60	.	.	.	.	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	.	.	75	.	.	.	.	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Biomass (>366 m)											504	1405	550	3128	390	800	5247	192	201
Percent >366 m											7.9	18.2	16.4	19.8	10.4	20.4	78.4	9.1	2.4
Biomass (tons)				12108	23820	8136	9799	22438	8503	10594	6415	7734	3364	15769	3748	3915	6691	2121	8411

Table 4 Abundance (000's) of Witch flounder from surveys in Div. 3N during spring of 1984-1999 by the Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum																
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)																	
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	26	0	0	0	0	0	0	0	0	0	0	34	34
57 - 92	2992	2992	360	2234	129	728	741	2641	220	0	0	59	225	0	0	0	132	65	244
57 - 92	1853	1853	361	153	0	0	32	36	0	28	0	0	0	0	36	0	0	0	0
57 - 92	2520	2520	362	0	95	25	27	173	0	0	0	0	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	43	43	0	0	0	0	0
57 - 92	674	674	383	0	62	0	31	0	0	0	0	0	0	0	0	0	0	0	0
93 - 183	421	421	359	405	58	232	58	985	203	0	0	0	29	0	0	0	0	0	203
93 - 183	100	100	377	14	0	0	186	7	83	0	0	0	0	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	77	557	93	279	31	46	93	0	93	294	232	31	77	83	261	15
184 - 274	139	139	378	48	29	48	354	86	115	0	0	96	0	0	0	0	9	0	0
184 - 274	182	182	381	25	13	42	163	75	0	25	0	0	0	0	0	0	0	13	0
275 - 366	164	164	357	23	180	553	.	11	237	56	0	90	124	102	23	40	30	373	259
275 - 366	106	106	379	66	36	68	423	102	44	109	7	44	0	22	0	0	18	6	102
275 - 366	116	116	380	8	88	0	247	32	8	8	0	0	0	0	0	0	0	0	8
367 - 549	155	155	723	.	.	.	.	.	.	.	288	341	256	53	181	45	51	149	96
367 - 549	105	105	725	.	.	.	.	.	.	.	166	.	101	87	0	13	235	26	51
367 - 549	160	160	727	.	.	.	.	.	.	.	0	11	55	22	0	0	11	33	33
550 - 731	124	124	724	.	.	.	.	.	.	.	1134	580	597	188	119	128	432	144	550
550 - 731	72	72	726	.	.	.	.	.	.	.	213	59	30	114	5	33	183	322	213
550 - 731	156	156	728	.	.	.	.	.	.	.	182	21	139	29	172	134	.	64	158
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	37	.	.	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	87	.	.	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	95	.	.	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Abundance > 366 m (000's)											1984	1013	1178	712	477	353	913	738	1101
Percent >366 m											99.6	72.7	62.3	64.1	84.1	75.0	77.1	49.5	56.6
Total abundance (000's)				3053	1246	1837	2595	4180	955	320	1991	1394	1892	1110	567	470	1184	1491	1947

Table 5 Abundance (000's) of Witch flounder from surveys in Div. 3O during spring 1984-1999 by the Alfred Needler and Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum																
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)																	
57 - 92	2089	2089	330	0	0	0	0	32	0	0	0	0	0	0	0	0	73	36	210
57 - 92	456	456	331	3555	376	94	31	1004	0	.	0	0	0	0	0	63	0	94	1104
57 - 92	1898	1898	338	209	11894	1509	1944	5418	2480	587	0	131	479	0	305	1417	0	671	1973
57 - 92	1716	1716	340	59	210	0	26	0	0	52	0	142	0	0	0	0	0	0	0
57 - 92	2520	2520	351	924	231	495	267	1317	240	116	0	0	0	0	0	0	0	0	39
57 - 92	2580	2580	352	101	1807	431	2048	1839	928	1775	51	89	51	44	71	79	197	35	1814
57 - 92	1282	1282	353	9347	1235	1713	2146	13050	3880	2910	0	265	353	0	35	35	265	459	5055
93 - 183	1721	1721	329	0	0	0	0	1454	53	34	763	0	0	12263	521	0	35	68	623
93 - 183	1047	1047	332	11018	16592	6529	7230	16023	2852	10572	4513	5761	504	432	3925	2927	5665	1085	5045
93 - 183	948	948	337	130	9181	2634	3543	2641	2556	2608	3182	815	2087	87	1239	826	469	848	3709
93 - 183	585	585	339	443	0	80	268	134	0	0	0	0	0	0	0	161	36	80	36
93 - 183	474	474	354	1174	239	3282	456	619	196	359	261	261	1663	0	0	98	33	563	3208
184 - 274	151	147	333	21	156	35	0	145	52	332	1361	187	301	13447	425	30	277	140	267
184 - 274	121	121	336	25	17	175	67	208	0	158	1365	3287	266	3029	125	432	682	150	173
184 - 274	103	103	355	92	418	128	135	0	383	510	340	28	99	340	99	168	195	157	38
275 - 366	92	96	334	0	95	165	63	95	44	51	38	272	63	2238	40	462	880	7	161
275 - 366	58	58	335	0	203	40	8	148	68	331	109	2340	223	215	108	192	243	12	169
275 - 366	61	61	356	17	214	38	55	109	80	126	92	348	319	189	126	88	40	90	54
367 - 549	93	166	717	.	.	.	.	.	.	.	32	371	166	5960	228	1363	11566	710	237
367 - 549	76	76	719	.	.	.	.	.	.	.	288	2535	267	37	42	364	1161	150	112
367 - 549	76	76	721	.	.	.	.	.	.	.	235	209	94	193	42	42	63	214	152
550 - 731	111	134	718	.	.	.	.	.	.	.	282	122	512	1161	535	518	507	517	324
550 - 731	105	105	720	.	.	.	.	.	.	.	361	376	1026	498	43	101	518	186	104
550 - 731	93	93	722	.	.	.	.	.	.	.	45	166	512	518	601	274	819	177	364
732 - 914	.	105	764	.	.	.	.	.	.	.	.	.	.	217	.	.	.	.	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	.	.	501	.	.	.	.	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Abundance >366 m (000's)											1243	3779	2576	9086	1491	2662	14635	1954	1293
Percent >366 m											9.3	21.3	28.7	22.0	17.5	27.6	61.7	30.3	5.2
Total abundance (000's)				27114	42867	17347	18286	44236	13811	20521	13317	17705	8983	41371	8508	9639	23725	6449	24969

Table 6 Biomass (tons) of Witch flounder from surveys in Div. 3N during fall 1990-1999 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum										
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)											
<=56	1593	1593	375	0	73	.	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	0	0	14	0	22	0	0
57 - 92	2992	2992	360	265	171	1297	173	75	888	23	427	431	177
57 - 92	1853	1853	361	28	467	463	0	32	0	0	14	0	268
57 - 92	2520	2520	362	400	221	87	0	0	0	0	0	0	32
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	.	0	0	0	0	0	0	0
57 - 92	674	674	383	0	0	.	0	0	0	0	0	0	0
93 - 183	421	421	359	0	0	278	0	0	22	0	0	1213	1
93 - 183	100	100	377	0	.	0	0	8	0	0	0	0	0
93 - 183	647	647	382	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	0	20	66	24	0	74	0	11	30	19
184 - 274	139	139	378	0	41	15	0	0	0	0	1	0	0
184 - 274	182	182	381	.	0	.	0	0	0	0	1	0	0
275 - 366	164	164	357	0	234	9	187	43	85	0	27	0	.
275 - 366	106	106	379	4	.	4	0	0	0	1	7	0	0
275 - 366	116	116	380	.	0	.	0	0	0	0	0	1	2
367 - 549	155	155	723	.	41	.	163	180	57	15	28	74	27
367 - 549	105	105	725	.	.	15	376	46	19	0	135	10	33
367 - 549	160	160	727	.	.	.	0	38	0	0	29	7	4
550 - 731	124	124	724	.	172	.	414	180	104	60	197	72	181
550 - 731	72	72	726	.	.	.	310	54	48	40	21	38	34
550 - 731	156	156	728	.	.	.	.	153	35	21	76	78	106
732 - 914	.	134	752	.	.	.	.	.	.	.	.	120	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	124	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	88	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	0	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	0	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	46	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	0	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	0	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	0	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	0	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.
Biomass (>731 m)												379	
Percent >731 m												16.2	
Biomass (all strata)				696	1441	2235	1647	808	1346	160	993	2333	884

Table 7 Biomass (tons) of Witch flounder from surveys in Div. 3O during fall 1990-1999 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum										
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)											
57 - 92	2089	2089	330	122	67	79	0	0	247	0	72	168	208
57 - 92	456	456	331	22	315	134	0	0	108	0	0	256	946
57 - 92	1898	1898	338	2226	438	837	3966	2193	4685	503	1329	483	2736
57 - 92	1716	1716	340	173	280	63	0	0	204	0	22	0	415
57 - 92	2520	2520	351	1690	284	72	0	0	0	0	0	37	205
57 - 92	2580	2580	352	1415	896	1352	946	228	379	273	573	374	1491
57 - 92	1282	1282	353	2405	343	477	0	732	538	789	168	1066	2996
93 - 183	1721	1721	329	99	85	0	18	0	417	0	173	305	0
93 - 183	1047	1047	332	2102	155	1724	813	321	1114	4569	190	245	1664
93 - 183	948	948	337	1333	188	954	563	2132	421	492	322	479	978
93 - 183	585	585	339	1132	224	651	119	742	1911	0	481	261	.
93 - 183	474	474	354	1291	23	316	75	210	191	4647	215	201	103
184 - 274	151	147	333	221	11	22	30	92	26	.	4	6	33
184 - 274	121	121	336	82	151	76	298	13	35	32	19	19	67
184 - 274	103	103	355	.	497	93	120	25	16	343	6	14	110
275 - 366	92	96	334	24	16	0	9	17	4	.	5	1	7
275 - 366	58	58	335	194	25	25	30	18	1	23	0	1	23
275 - 366	61	61	356	.	11	7	430	98	7	60	3	4	32
367 - 549	93	166	717	30	.	.	0	32	37	.	12	42	260
367 - 549	76	76	719	110	2	.	65	6	1	226	19	9	10
367 - 549	76	76	721	.	18	.	169	67	21	54	6	14	67
550 - 731	111	134	718	.	.	.	22	68	8	.	68	47	53
550 - 731	105	105	720	.	.	.	73	0	13	68	.	2	17
550 - 731	93	93	722	.	9	.	81	21	14	39	12	12	26
732 - 914	.	105	764	.	.	.	.	.	.	.	.	75	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	18	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	173	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	24	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	17	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	4	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.
Biomass (>731 m)												311	
Percent > 731 m												7.15	
Biomass (all strata)				14671	4036	6884	7827	7013	10397	12117	3698	4356	12446

Table 8 Abundance (000s) of Witch flounder from surveys in Div. 3N during fall 1990-1999 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum										
<=56	1593	1593	375	0	55	.	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	0	0	23	0	19	0	0
57 - 92	2992	2992	360	382	206	1646	320	103	1232	41	672	755	360
57 - 92	1853	1853	361	32	425	701	0	42	0	0	23	0	306
57 - 92	2520	2520	362	441	277	116	0	0	0	0	0	0	50
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	.	0	0	0	0	0	0	0
57 - 92	674	674	383	0	0	.	0	0	0	0	0	0	0
93 - 183	421	421	359	0	0	608	0	0	87	0	0	2722	29
93 - 183	100	100	377	0	.	0	0	7	0	0	0	0	0
93 - 183	647	647	382	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	0	46	108	31	0	234	0	31	93	46
184 - 274	139	139	378	0	105	19	0	0	0	0	9	10	0
184 - 274	182	182	381	.	0	.	0	0	0	0	7	13	0
275 - 366	164	164	357	0	384	23	338	135	180	0	60	0	.
275 - 366	106	106	379	7	.	15	0	0	0	19	22	0	0
275 - 366	116	116	380	.	0	.	0	0	0	0	0	8	8
367 - 549	155	155	723	.	53	.	330	394	117	21	88	313	85
367 - 549	105	105	725	.	.	36	701	173	49	0	237	29	101
367 - 549	160	160	727	.	.	.	0	44	11	0	55	11	11
550 - 731	124	124	724	.	444	.	1126	512	223	178	571	326	640
550 - 731	72	72	726	.	.	.	669	114	119	99	40	92	125
550 - 731	156	156	728	.	.	.	.	268	195	129	212	215	311
732 - 914	.	134	752	.	.	.	.	.	.	.	.	165	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	255	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	244	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	0	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	0	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	106	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	0	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	0	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	0	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	0	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.
Abundance >731 m (000's)												770	
Percent >731 m												14.4	
Total abundance (000's)				863	1995	3272	3515	1793	2470	488	2046	5355	2073

Table 9 Abundance (000s) of Witch flounder from surveys in Div. 3O during fall 1990-1999 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Depth Range	Old Stratum	New Stratum	Stratum										
(meter)	Area (sq. n. mi.)	Area (sq. n. mi.)											
57 - 92	2089	2089	330	131	144	72	0	0	517	0	96	335	383
57 - 92	456	456	331	42	502	125	0	0	408	0	0	596	4799
57 - 92	1898	1898	338	3264	627	1436	6893	4700	8459	522	2872	1723	7572
57 - 92	1716	1716	340	262	330	118	0	0	295	0	47	0	1652
57 - 92	2520	2520	351	1837	347	58	0	0	0	0	0	50	347
57 - 92	2580	2580	352	1597	1242	2011	1115	355	371	355	1141	754	1825
57 - 92	1282	1282	353	2822	485	941	0	1176	999	882	573	5467	5996
93 - 183	1721	1721	329	132	101	0	47	0	663	0	616	852	0
93 - 183	1047	1047	332	3625	396	5281	2064	960	5233	11954	1248	2544	7393
93 - 183	948	948	337	2347	424	2347	1043	5216	1435	717	1130	1613	3738
93 - 183	585	585	339	1556	241	724	121	966	2776	0	1086	356	.
93 - 183	474	474	354	1891	33	685	359	424	489	8955	489	782	391
184 - 274	151	147	333	582	52	83	62	312	187	.	192	147	152
184 - 274	121	121	336	222	466	216	633	42	549	208	100	215	300
184 - 274	103	103	355	.	1459	298	425	85	63	768	28	170	411
275 - 366	92	96	334	76	70	0	21	57	56	.	33	20	58
275 - 366	58	58	335	371	100	112	68	52	64	64	4	40	48
275 - 366	61	61	356	.	25	8	1255	252	40	113	13	34	75
367 - 549	93	166	717	122	.	.	0	96	703	.	46	833	2166
367 - 549	76	76	719	209	42	.	277	10	52	612	183	178	99
367 - 549	76	76	721	.	47	.	444	183	102	131	17	125	311
550 - 731	111	134	718	.	.	.	107	428	164	.	535	618	581
550 - 731	105	105	720	.	.	.	339	0	105	316	.	29	202
550 - 731	93	93	722	.	26	.	243	58	64	134	51	103	122
732 - 914	.	105	764	.	.	.	.	.	.	.	.	357	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	217	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	1514	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	165	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	180	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	35	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.
Abundance >731 m (000's)												2468	
Percent >731 m												12.3	
Total abundance (000's)				21086	7158	14515	15517	15369	23795	25731	10499	20054	38620

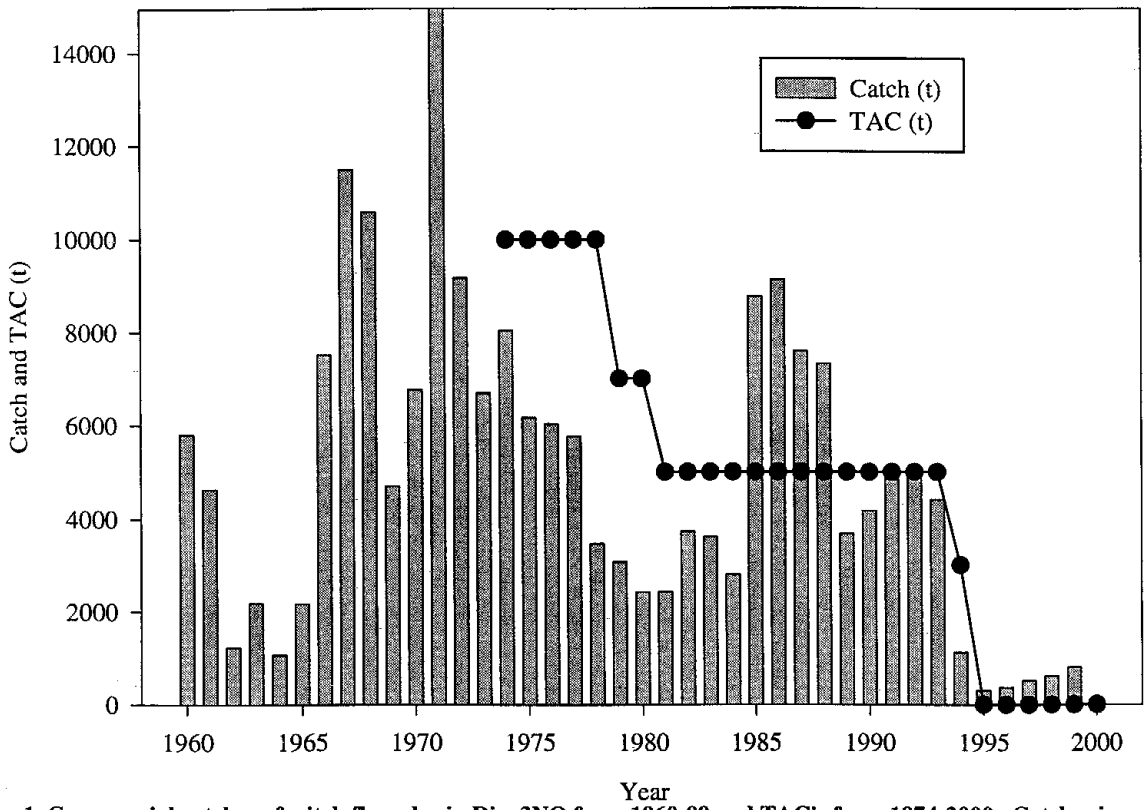

Fig. 1 Commercial catches of witch flounder in Div. 3NO from 1960-99 and TAC's from 1974-2000. Catches in recent years include estimates of those not reported.

***Note: Although a TAC of 3000 tons was agreed by the Fisheries Commission, it was also agreed that no directed fishing on witch flounder in Div. 3NO take place during 1994 due to the poor state of the stock.**

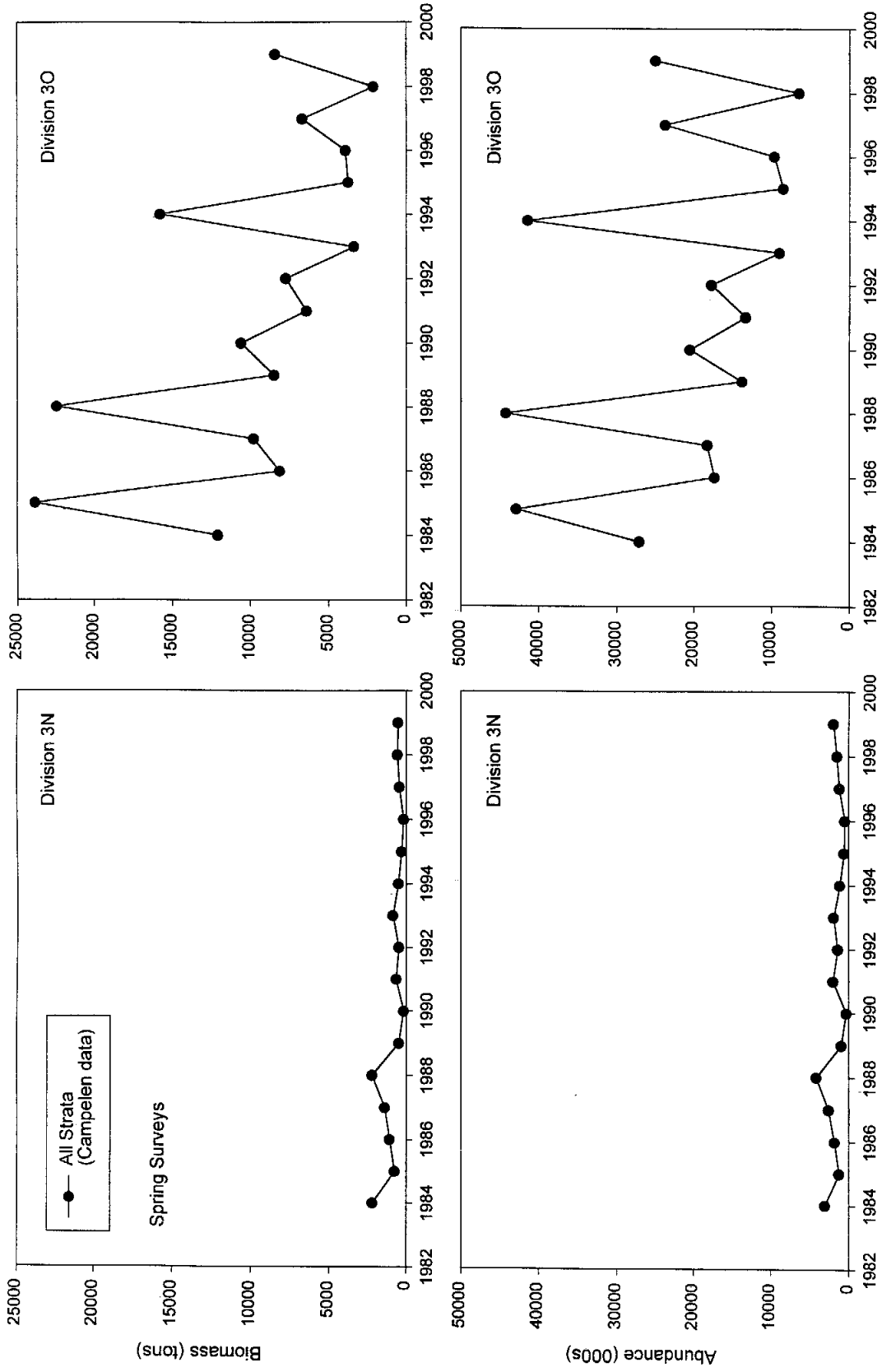

Fig. 2 Biomass (tons) and abundance estimates (000s) of witch flounder from Canadian spring surveys in Div. 3N and 3O during 1984-99.

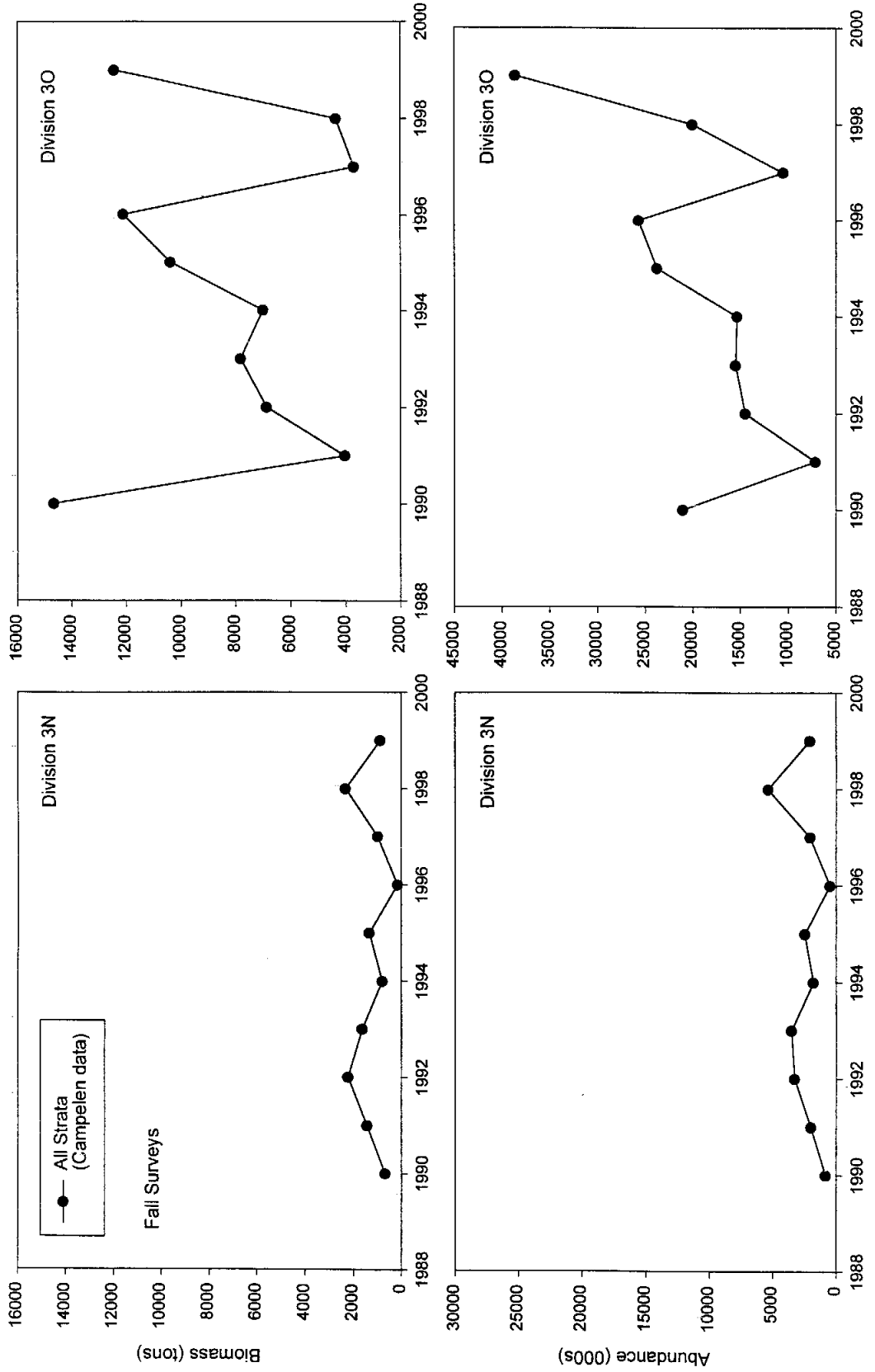

Fig. 3 Biomass (tons) and abundance estimates (000s) of witch flounder from Canadian fall surveys in Div. 3N and 3O during 1990-99.

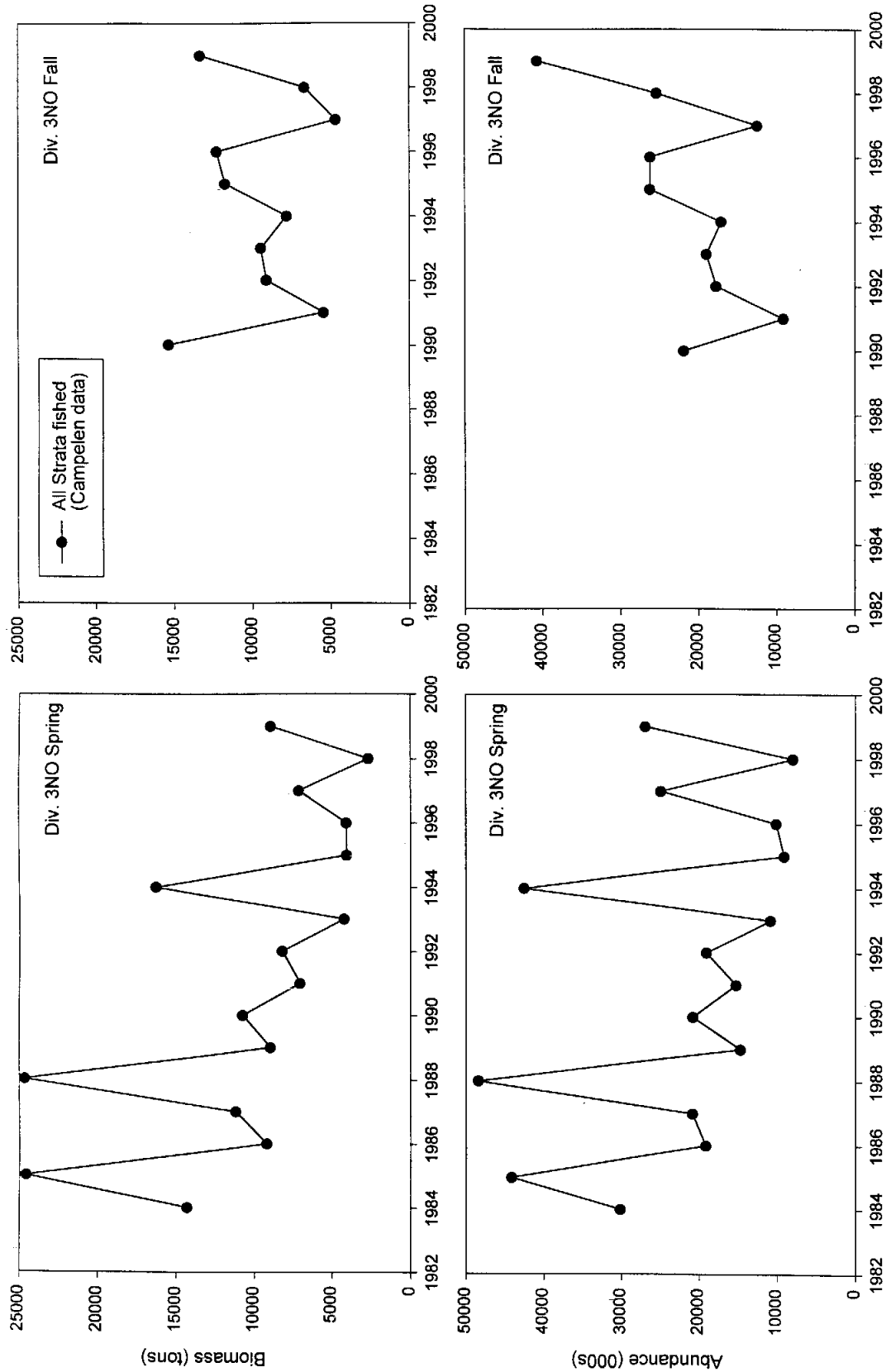

Fig. 4 Comparison of biomass (tons) and abundance estimates (000s) of witch flounder for converted data from Canadian spring (1984-99) and fall (1990-99) surveys in Div. 3NO combined.

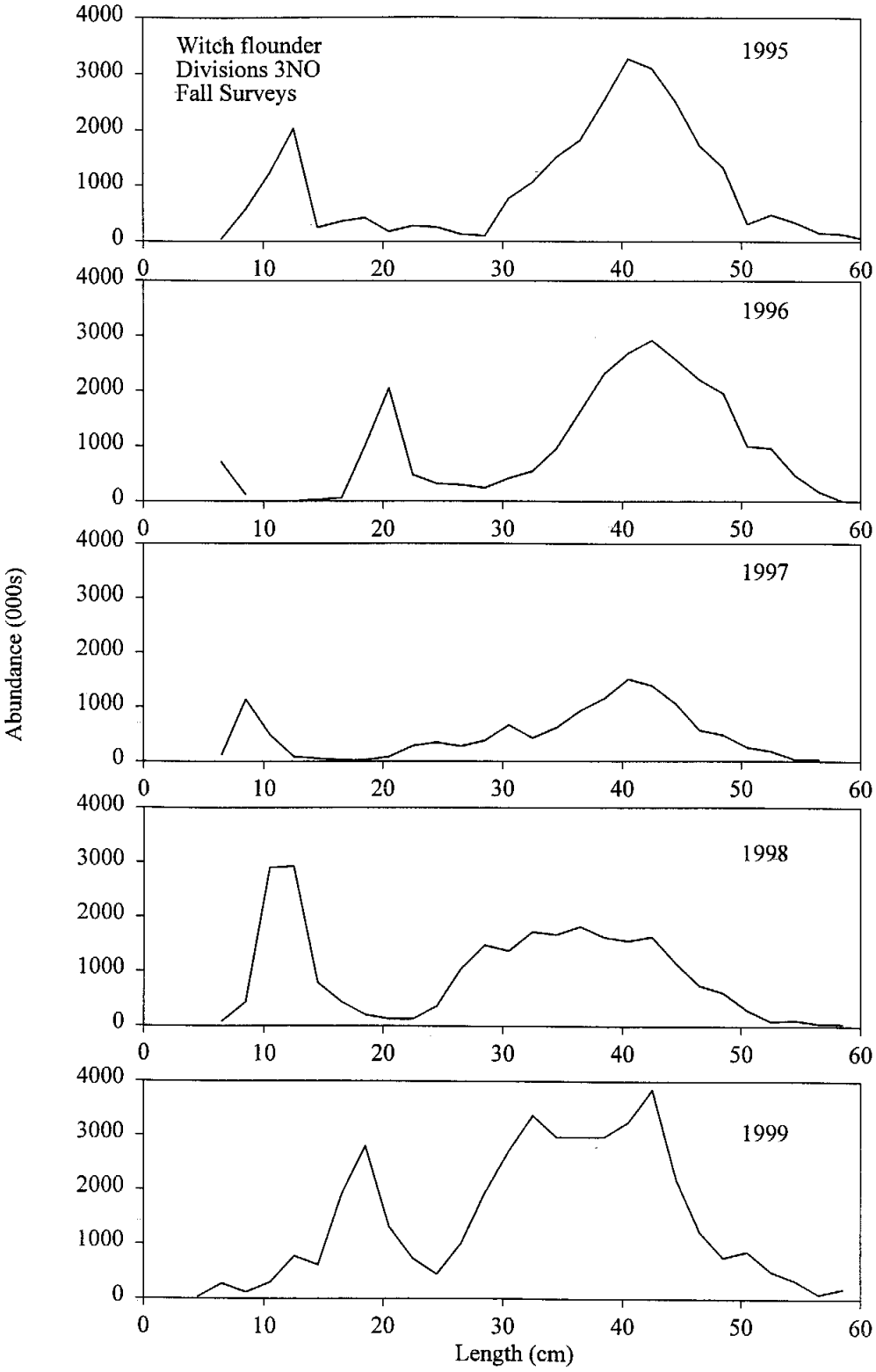

Fig. 5 Length frequency distributions of witch flounder from fall surveys in 1995-99 using the Campelen 1800 shrimp trawl.

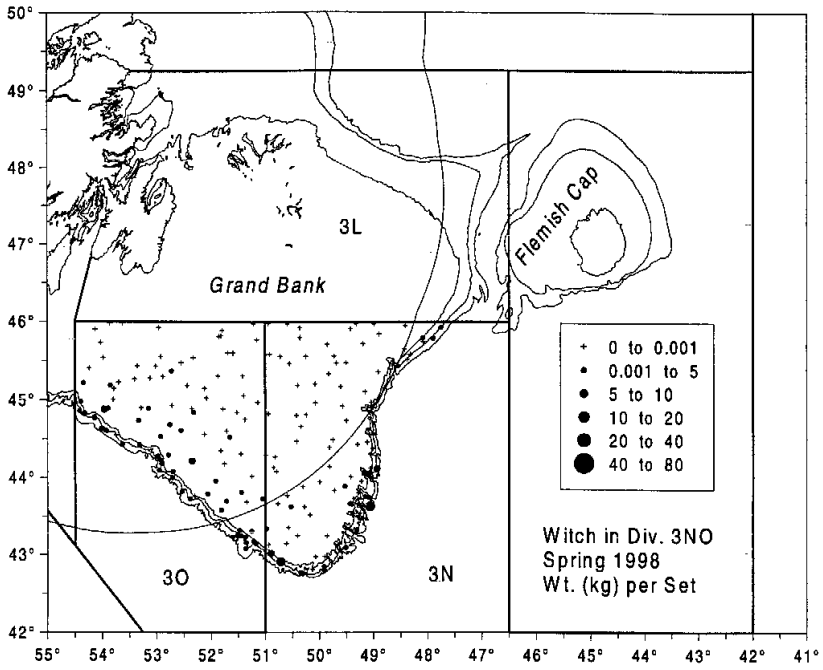

Fig. 6 Weight (kg) per set of Witch flounder from Canadian spring surveys in Div. 3NO during spring 1998.

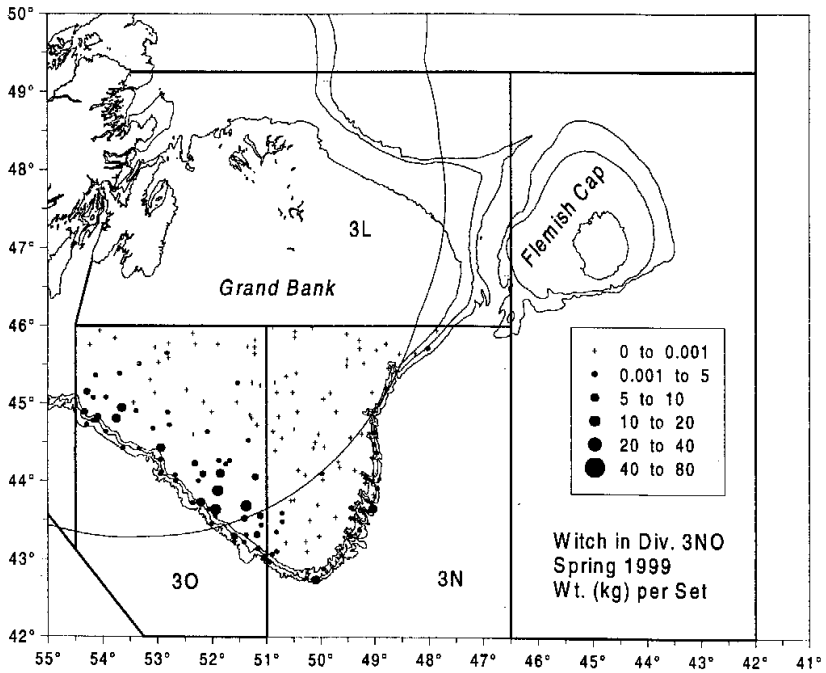

Fig. 7 Weight (kg) per set of Witch flounder from Canadian spring surveys in Div. 3NO during spring 1999.

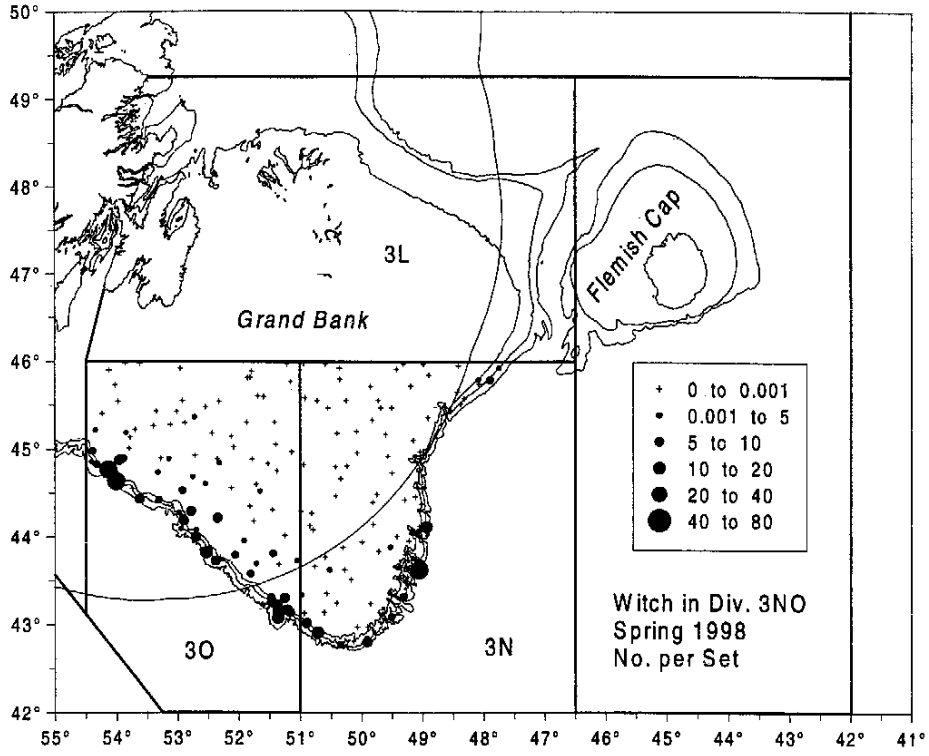

Fig. 8 Number per set of Witch flounder from Canadian spring surveys in Div. 3NO during spring 1998.

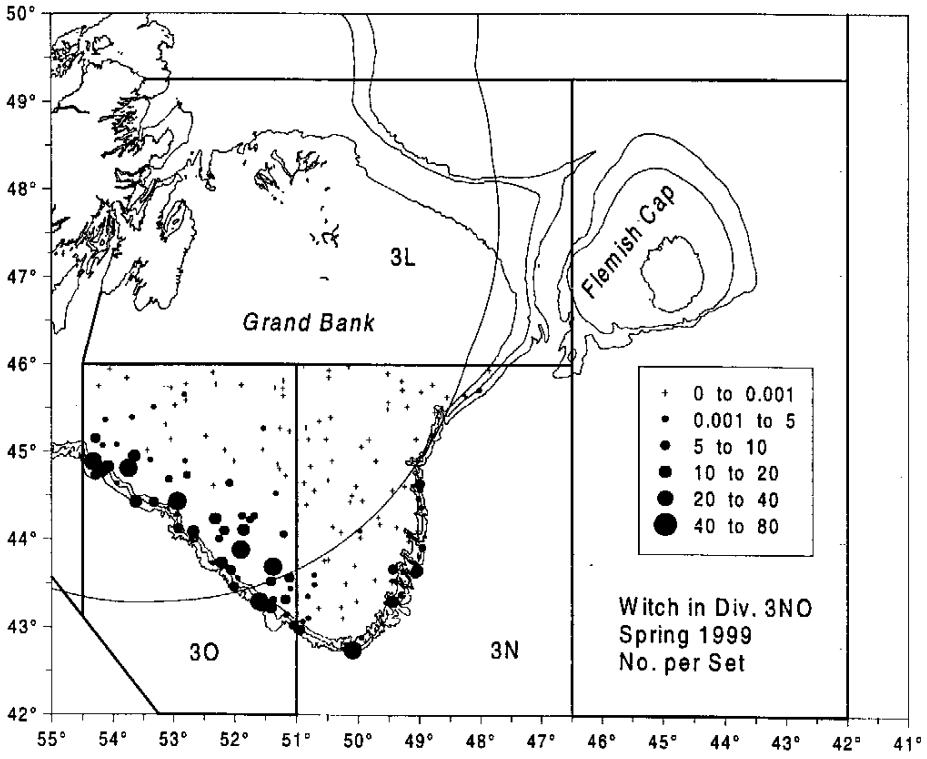

Fig. 9 Number per set of Witch flounder from Canadian spring surveys in Div. 3NO during spring 1999.

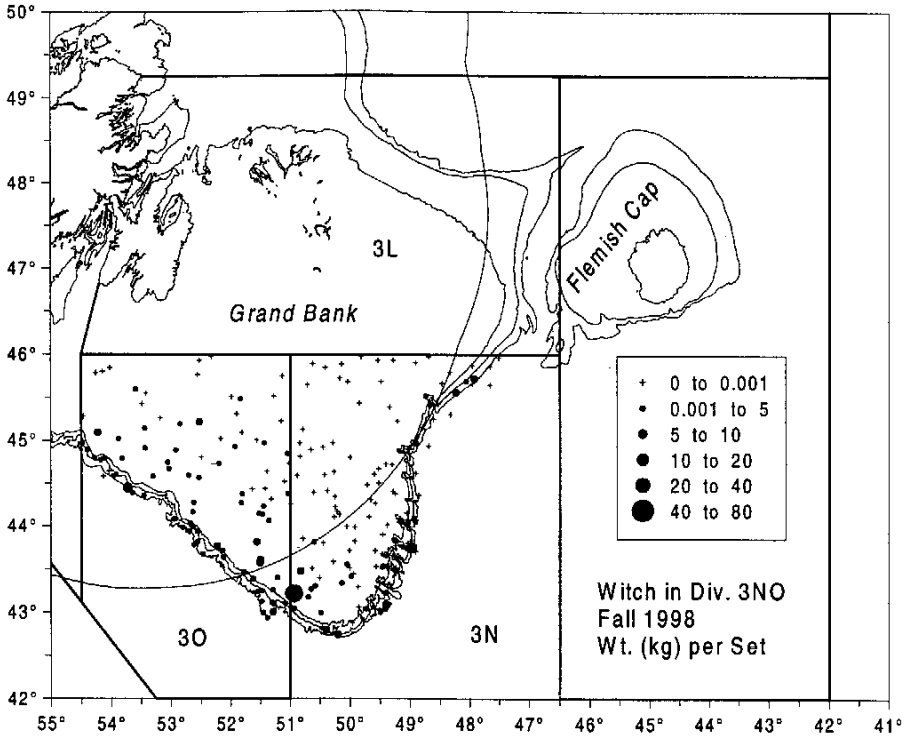

Fig. 10 Weight (kg) per set of Witch flounder from Canadian fall surveys in Div. 3NO during fall 1998.

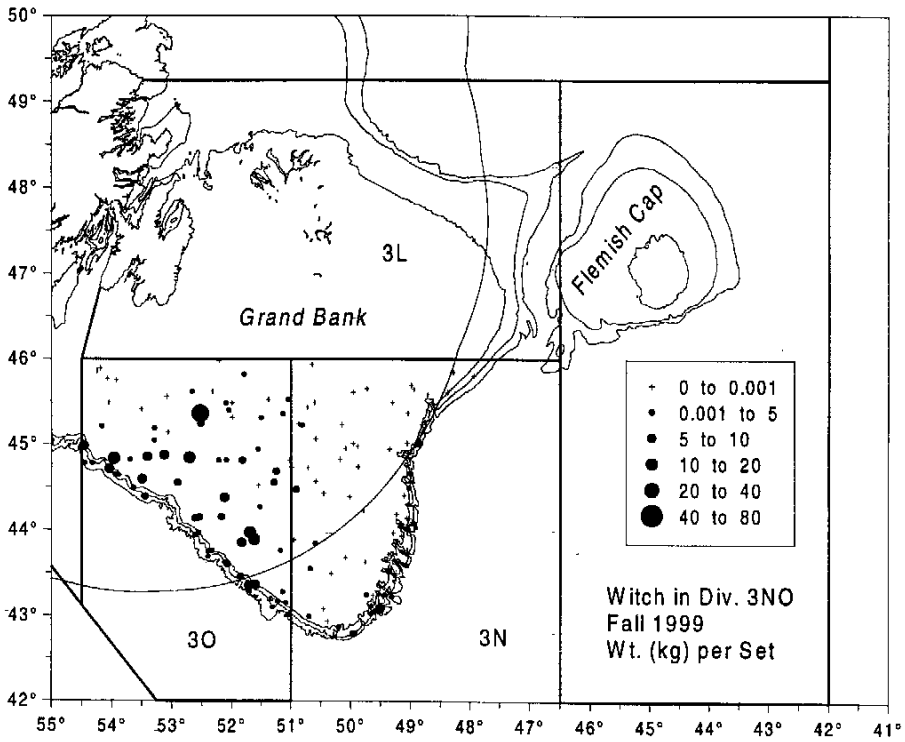

Fig. 11 Weight (kg) per set of Witch flounder from Canadian fall surveys in Div. 3NO during fall 1999.

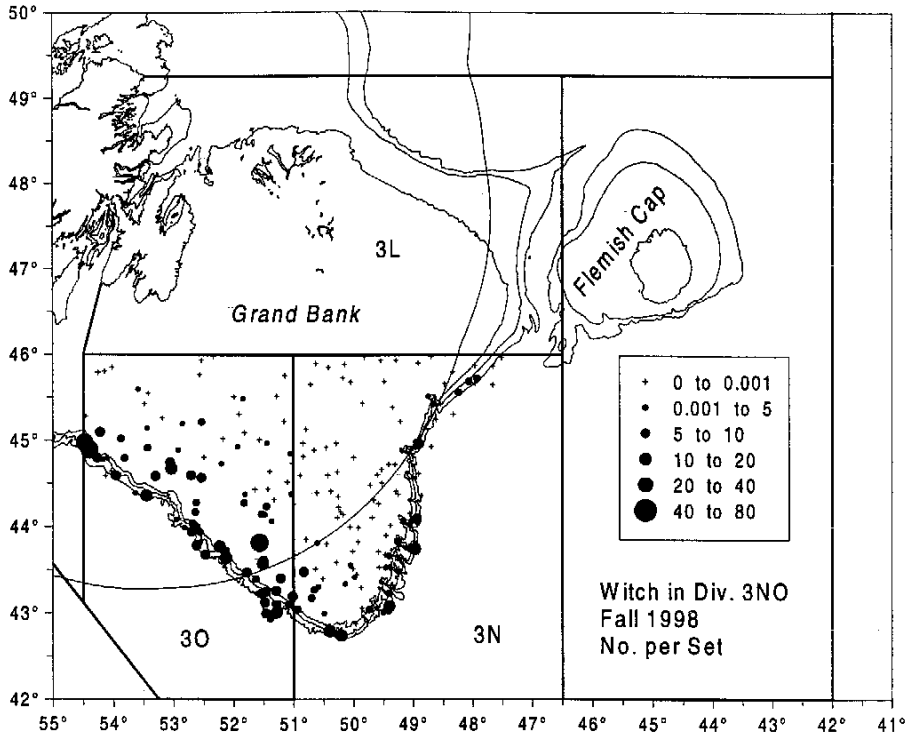

Fig. 12 Number per set of Witch flounder from Canadian fall surveys in Div. 3NO during fall 1998.

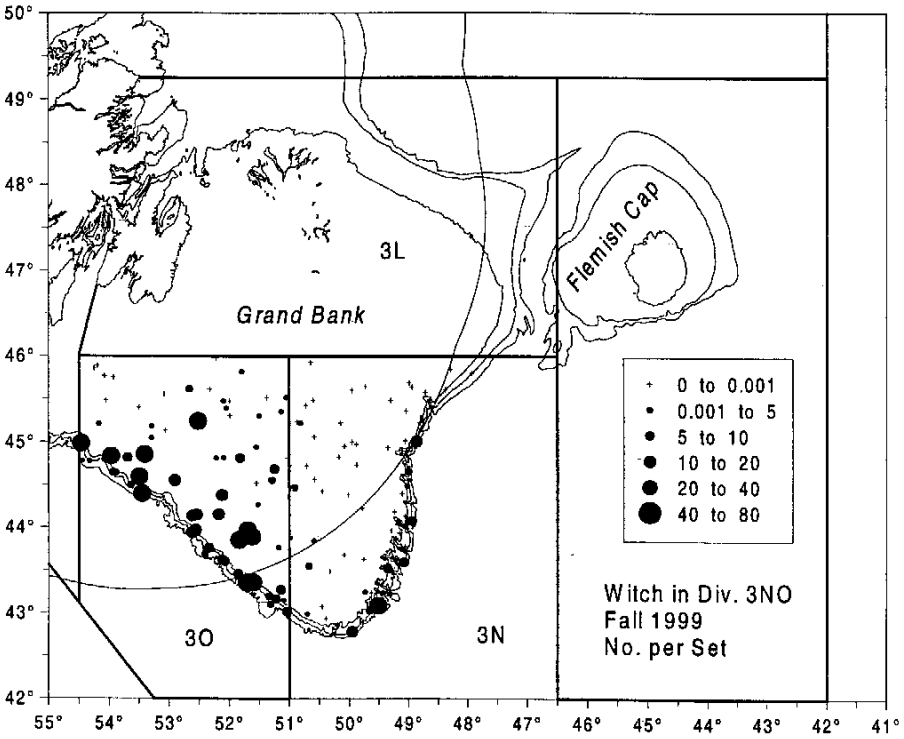

Fig. 13 Number per set of Witch flounder from Canadian fall surveys in Div. 3NO during fall 1999.