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Distribution and Abundance of Witch Flounder in NAFO *Divisions* 3NO

by

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Commercial Catches and TAC History

Reported catches during the period 1971-84 ranged from a low of about 2,400 tons in 1980 and 1981 to as high as 15,000 tons in 1971 (Table 1; Fig. 1), however, from 1975-84 annual catches rarely exceeded 6,000 tons. With a substantial increase in effort in 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). For both 1995 and 1996 the catch was about 300 tons.

Historically this fishery was carried out by Canada and the former Soviet Union. 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). Only 2 tons (by-catch) were reported by Canada for 1994 and none in 1995 due to the moratorium. The increase in 1992 and 1993 was essentially the result of a quota transfer between Canada and 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 no catch since then.

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. A complete moratorium was introduced by the Fisheries Commission for directed fishing in 1995 and has continued through 1997.

Commercial Fishery Data

Due to the closure of the fishery in 1994 no Canadian commercial fishery data are available. However, commercial fishery data from the Canadian fishery prior to the moratorium are available for review in NAFO SCR Doc. 94/49, Serial No. N2420. Some length frequency data from both large and small trawlers of EU-Spain as taken in by-catch in Division 3N during 1994, however, are presented in Fig. 2 and 3 (data obtained from the Spanish National Research Report, SCS Doc. 95/15). Most fish caught were in the range of 35-45 cm for small trawlers and 35-53 cm for large trawlers (Fig. 2). Cumulatively, less than 20% of the small trawler catch was below 35 cm and less than 30% of the large trawler catch was below 35 cm (Fig. 3).

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 but still not cover the entire range of depth distribution of witch flounder as observed in other areas in recent years.

In addition to spring surveys, a time series of fall surveys was begun in 1990 for seasonal comparisons. Beginning with the 1995 fall survey the survey gear was changed from an Engel groundfish trawl to a Campelen shrimp trawl. Estimates of biomass and abundance from these surveys are presented but no conversions have been applied at this stage. Until the appropriate and agreed conversion factors have been applied to the data, the values from these surveys cannot be compared in the full context to those of the previous years using the Engel trawl.

Spatial Distribution

Comparative plots of geographic distribution from the spring and fall surveys expressed as mean weight (kg) of the catch for each set are presented in Fig. 4 for the period 1990-96.

All surveys indicate that the witch flounder resource has been and continues to be mainly distributed in Division 3O along the southwestern slope of the Grand Bank (Fig. 4). In most years the distribution is concentrated in the slope area of the continental shelf, however, in certain years they can be distributed significantly in over the shallower parts of the bank in larger strata. It is this variation in distribution from smaller to larger strata that is often responsible for the high variability in the annual biomass estimates. There is some evidence for differences in seasonal distribution, however, it is not necessarily consistent in its direction from year to year. In many instances the catches are too small to detect strong trends with any confidence.

Biomass Estimates

Total biomass estimates with confidence limits as well as biomass estimates by stratum are presented for the spring surveys in Tables 2 and 3 and for the fall surveys in Tables 4 and 5 for Div. 3N and Div. 3O, respectively. A plot of the divisional biomass estimates from both spring and fall surveys are presented in Fig. 5 and 6, respectively for illustration.

Estimated biomass from spring surveys (which is the longest time series) in Div. 3N has been at very low levels throughout the time period and in most years was less than 1,000 tons (Table 2; Fig. 5). For Div. 3O estimates of biomass showed considerable annual fluctuations on average between 6,000 and 12,000 tons particularly in the late 1980's considered to be related to distributional differences (Table 3; Fig. 5). Nevertheless, the estimates illustrate a sharp decline in the last few years with the estimate for 1993 near the lowest observed although survey coverage during 1991-93 has been the most complete in the time series. The biomass from the 1994 spring survey, on the other hand, estimated the biomass in Div. 3NO combined to be 6,800 tons largely as a result of good catches along the southwest slope of the Grand Bank in Div. 3O. The 1995 estimate was about 2,000 tons, again, similar to the very low 1993 value. Although not directly comparable, the 1996-97 estimates for Div. 3N using the Campelen trawl were maintained at the very low levels experienced by the Engel trawl surveys in the previous years (Fig. 5). The 1996 Campelen estimate was about the same as the 1991-92 Engel values but increased between 1996 and 1997 such that the 1997 estimate is about the same as the relatively high 1994 Engel value (Fig. 5).

Results of the fall surveys are presented in Tables 4 and 5 for Div. 3N and 3O, respectively with a comparison of biomass and abundance of spring versus fall surveys shown in Table 6 and illustrated in Fig. 7. With the exception of the higher 1990 estimate there is little in the way of trends within the fall survey data. Seasonally, the 1990 fall estimate was higher than in spring whereas for 1991 and 1992 the reverse was true. The 1993 shift is similar to that of 1990. The differences, however, especially for the 1991-93 surveys were not large and still put the biomass and abundance estimates in both instances among the lowest levels observed. While the 1994 spring estimate was in the higher range, the fall estimate was more similar to that of the fall of 1993. The 1995 spring estimate is again near the lowest observed.

Although the fall 1995-96 and spring 1996-97 surveys cannot be directly compared to previous years as stated above it is indicated that the spring 1996 biomass estimate is considerably lower than that of the 1995 fall estimate. It is in the same range of recent estimates from both spring and fall even though the new gear is generally much more efficient at catching flatfish. The fall 1995 and 1996 values are directly comparable and are of similar value. As well, the spring 1996 and 1997 values are also directly comparable and indicate a modest increase between the two years.

To illustrate the general difference between the catchability of the two gears the stratified abundance at length for the 1994-96 surveys are shown in Fig. 7 and 8 for spring and fall, respectively. It can be seen that the Campelen trawl is much more effective in catching the smaller fish compared to the Engel trawl which will inflate

the Campelen estimates. Nevertheless, fish larger than 35 cm are well represented in the surveys of both gear types and in fact there is an increase in the abundance of these larger size groups between 1995 spring (Engel) and 1996 spring (Campelen). Similarly, there is an increase in the estimates of these larger sizes between 1994 fall(Engel) and 1996 fall (Campelen).

Resource Status

Based on the data available it is difficult to fully evaluate the status of the stock, however, this may improve somewhat when all the survey data have been converted to allow direct comparisons between estimates from the two survey gear types. Although the perception of the stock has not changed markedly from last year the two most recent data points in both the spring and fall surveys at least suggest there may be some improvement in the stock. No recent aging data are available therefore it is not possible to comment on any recruitment prospects for the resource.

Table 1 . Catches and TACs (t) of Witch Flounder in Div. 3NO from 1971-97.

Year	Canada	USSR	Other	Total	TAC
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 a	4164	-	250 b	4414	5000
*1994 a	2	-	1117 b	1119	3000
1995 a	-	-	300 b	300	0
1996	32	-	283 b	315	0
1997	-	-	-	-	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. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Div. 3N during spring from 1971-96. (continued) Shaded areas indicate Campelen trawl surveys.

Stratum	Depth (fath)	Area (sq. n. m.)	Units (000s)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
375	<=30	1593	120	0	0	0	0	0	0	0	0	0	0	0	0
376		1499	113	0	0	7	0	0	0	0	0	0	0	0	0
Total				0	0	7	0	0	0	0	0	0	0	0	0
360	31-50	2992	225	61	404	366	898	101	0	0	18	92	0	0	0
361		1853	139	0	0	21	36	0	13	0	0	0	0	21	0
362		2520	189	44	38	0	96	0	0	0	0	0	0	0	0
373		2520	189	0	0	0	0	0	0	0	0	0	0	0	0
374		931	70	0	0	0	0	0	0	0	0	10	37	0	0
383		674	51	34	0	21	0	0	0	0	0	0	0	0	0
Total				138	442	408	1031	101	13	0	18	103	37	21	0
359	51-100	421	32	35	60	28	126	133	0	0	0	10	0	0	0
377		100	8	0	0	38	2	17	0	0	0	0	0	0	0
382		647	49	0	0	6	0	0	0	0	0	0	0	0	0
Total				35	60	72	128	150	0	0	0	10	0	0	0
358	101-150	225	17	186	20	76	13	14	27	0	23	65	51	2	51
378		139	10	12	18	91	14	17	0	4	12	0	0	0	0
381		182	14	4	20	55	38	0	38	0	0	0	0	0	0
Total				202	58	222	64	31	65	4	34	65	51	2	51
357	151-200	164	12	52	66	86	3	20	9	0	14	31	47	10	36
379		106	8	7	14	88	21	11	27	2	9	0	1	0	0
380		116	9	28	0	83	17	4	5	0	0	0	0	0	0
Total				88	81	256	42	35	41	2	23	31	48	10	36
723	201-300	155	12	-	-	-	-	-	-	32	43	30	21	26	16
725		105	8	-	-	-	-	-	-	27	9	18	23	0	5
727		160	12	-	-	-	-	-	-	0	3	23	10	0	0
Total				0	0	0	0	0	0	59	56	71	54	26	21
724	301-400	124	9	-	-	-	-	-	-	112	71	93	19	12	29
726		72	5	-	-	-	-	-	-	38	13	16	13	2	12
728		156	12	-	-	-	-	-	-	48	11	59	13	114	21
Total				0	0	0	0	0	0	198	95	168	45	128	62
752	401-500	134	10	-	-	-	-	-	-	-	-	-	14	-	-
756		106	8	-	-	-	-	-	-	-	-	-	15	-	-
760		154	12	-	-	-	-	-	-	-	-	-	13	-	-
Total				0	0	0	0	0	0	0	0	0	42	0	0
753	501-600	138	10	-	-	-	-	-	-	-	-	-	-	-	-
757		102	8	-	-	-	-	-	-	-	-	-	-	-	-
761		171	13	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
754	601-700	180	14	-	-	-	-	-	-	-	-	-	-	-	-
758		99	7	-	-	-	-	-	-	-	-	-	-	-	-
762		212	16	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
755	701-800	385	29	-	-	-	-	-	-	-	-	-	-	-	-
759		127	10	-	-	-	-	-	-	-	-	-	-	-	-
763		261	20	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
Biomass (tons)				462	641	965	1265	316	118	263	226	447	264	187	170
Lower limit				-120	96	463	-567	-1040	-8	-734	84	229	90	-580	10
Upper limit				1044	1182	1313	3097	1671	174	1259	348	669	437	954	331

Table 2. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Div. 3N during spring from 1971-96.

Stratum	Depth (fath)	Area (sq. n. m.)	Units (000s)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1982	1984
375	<=30	1593	120	36	0	0	0	0	-	0	11	0	0	0	0
376		1499	113	-	0	0	0	0	0	0	0	0	0	0	0
Total				36	0	0	0	0	0	0	11	0	0	0	0
360	31-50	2992	225	-	25	-	-	0	305	38	586	725	265	1316	1139
361		1853	139	0	0	0	0	203	0	63	0	19	70	24	83
362		2520	189	344	0	0	0	0	0	0	0	15	26	0	0
373		2520	189	0	0	0	0	-	0	0	59	15	0	0	0
374		931	70	0	0	0	0	0	-	0	0	0	0	0	0
383		674	51	34	0	0	-	-	0	0	0	0	0	0	0
Total				379	25	0	0	203	305	101	645	775	361	1340	1222
359	51-100	421	32	-	268	660	-	-	1368	58	-	86	44	190	134
377		100	8	-	0	0	8	0	-	99	0	10	19	0	6
382		647	49	-	0	0	0	-	0	30	0	0	39	0	0
Total				0	268	660	8	0	1368	186	0	96	102	190	140
358	101-150	225	17	-	50	41	-	-	-	102	-	19	5	42	21
378		139	10	12	5	14	30	-	-	50	123	79	26	21	13
381		182	14	6	12	0	0	15	-	74	155	35	17	14	17
Total				18	67	55	30	15	0	226	278	133	48	77	51
357	151-200	164	12	-	-	15	-	-	-	89	-	80	25	105	4
379		106	8	-	-	5	14	-	-	114	38	45	22	12	19
380		116	9	-	48	18	17	-	-	59	-	37	12	-	2
Total				0	48	39	32	0	0	262	38	161	59	117	25
723	201-300	155	12	-	-	-	-	-	-	-	-	-	-	-	-
725		105	8	-	-	-	-	-	-	-	-	-	-	-	-
727		160	12	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
724	301-400	124	9	-	-	-	-	-	-	-	-	-	-	-	-
726		72	5	-	-	-	-	-	-	-	-	-	-	-	-
728		156	12	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
752	401-500	134	10	-	-	-	-	-	-	-	-	-	-	-	-
756		106	8	-	-	-	-	-	-	-	-	-	-	-	-
760		154	12	-	-	-	-	-	-	-	-	-	-	-	-
Total								0	0	0	0	0	0	0	0
753	501-600	138	10	-	-	-	-	-	-	-	-	-	-	-	-
757		102	8	-	-	-	-	-	-	-	-	-	-	-	-
761		171	13	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
754	601-700	180	14	-	-	-	-	-	-	-	-	-	-	-	-
758		99	7	-	-	-	-	-	-	-	-	-	-	-	-
762		212	16	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
755	701-800	385	29	-	-	-	-	-	-	-	-	-	-	-	-
759		127	10	-	-	-	-	-	-	-	-	-	-	-	-
763		261	20	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
Biomass (tons)				432	408	754	70	218	1673	776	972	1165	570	1723	1438
Lower limit				-3282	-449	-984	29	-123	-1305	421	-264	409	286	-974	453
Upper limit				4847	1316	2491	126	560	4652	1115	2211	1921	852	3306	2424

Table 3. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Division 3O during spring from 1973-97.

Stratum	Depth (fath)	Area (sq. n. M.)	Units (ooos)	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985
330	31-50	2089	157	24	24	0	0	66	254	0	177	0	0	0
331		456	34	0	0	0	-	210	26	214	-	2	987	188
338		1898	142	1889	841	1530	517	20	46	627	-	40	100	4590
340		1716	129	-	0	282	0	73	406	0	52	9	17	82
351		2520	189	26	127	0	61	0	172	123	3689	74	422	165
352		2580	194	17	548	33	45	66	168	608	-	118	56	643
353		1282	96	1806	714	1136	845	1093	153	722	-	2293	2406	802
Total				3763	2253	2981	1467	1528	1225	2294	3917	2536	3987	6470
329	51-100	1721	129	0	-	3870	176	124	5	0	0	0	0	0
332		1047	79	-	267	975	762	846	31	1218	-	5718	1493	4833
337		948	71	199	48	465	258	89	0	154	-	119	32	2113
339		585	44	130	0	-	-	130	106	-	296	20	176	0
354		474	36	797	-	501	81	-	42	302	9	267	285	71
Total				1126	316	5812	1276	1188	185	1675	305	6123	1986	7018
333	101-150	147	11	-	8	18	3	17	4	37	-	220	5	27
336		121	9	6	11	144	62	14	3	114	-	136	5	5
355		103	8	2	21	39	-	-	3	21	15	99	31	101
Total				7	40	201	64	32	10	172	15	455	40	132
334	151-200	96	7	-	-	9	1	9	3	12	-	63	0	22
335		58	4	0	-	20	-	3	0	31	-	10	0	53
356		61	5	4	-	-	-	-	3	126	4	-	2	40
Total				4	0	30	1	13	6	169	4	72	2	115
717	201-300	166	12	-	-	-	-	-	-	-	-	-	-	-
719		76	6	-	-	-	-	-	-	-	-	-	-	-
721		76	6	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
718	301-400	134	10	-	-	-	-	-	-	-	-	-	-	-
720		105	8	-	-	-	-	-	-	-	-	-	-	-
722		93	7	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
764	401-500	105	8	-	-	-	-	-	-	-	-	-	-	-
768		99	7	-	-	-	-	-	-	-	-	-	-	-
772		135	10	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
765	501-600	124	9	-	-	-	-	-	-	-	-	-	-	-
769		138	10	-	-	-	-	-	-	-	-	-	-	-
773		128	10	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
766	601-700	144	11	-	-	-	-	-	-	-	-	-	-	-
770		128	10	-	-	-	-	-	-	-	-	-	-	-
774		135	10	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
767	701-800	158	12	-	-	-	-	-	-	-	-	-	-	-
771		175	13	-	-	-	-	-	-	-	-	-	-	-
775		155	12	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0
Biomass (tons)				4900	2609	9023	2809	2761	1426	4310	4241	9186	6015	13736
Lower limit				1960	1125	-24552	557	572	900	-434	-5549	-5569	3800	7922
Upper limit				7837	4093	42602	5059	4947	1951	9051	14030	23942	8228	19549

Table 3. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Division 3O during spring from 1973-97. (continued) Shaded areas indicate Campelen trawl surveys.

Stratum	Depth (fath)	Area (sq. n. M.)	Units (ooos)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997a
330	31-50	2089	157	0	0	13	0	0	0	0	0	0	0	0	0
331		456	34	17	1	222	0	-	0	0	0	0	0	74	0
338		1898	142	755	742	1728	1211	237	0	66	152	0	151	870	0
340		1716	129	0	14	0	0	5	0	75	0	0	0	0	0
351		2520	189	303	163	613	140	62	0	0	0	0	0	0	2
352		2580	194	136	841	813	391	1021	23	58	35	0	24	59	112
353		1282	96	741	1162	4205	1667	1035	0	144	122	0	-	23	2
Total				1951	2923	7595	3409	2360	23	343	310	0	175	1026	116
329	51-100	1721	129	0	0	425	31	16	289	0	0	2501	61	0	12
332		1047	79	1218	1804	3181	813	2320	1390	1088	201	24	885	1180	235
337		948	71	825	894	539	877	971	892	349	278	27	329	330	173
339		585	44	4	149	80	0	0	0	0	0	0	0	1	0
354		474	36	605	151	231	17	141	74	73	463	0	0	36	0
Total				2653	2999	4457	1739	3447	2645	1511	941	2552	1275	1547	420
333	101-150	147	11	3	0	33	5	67	222	33	28	2285	68	7	110
336		121	9	18	12	23	0	22	226	680	40	455	30	180	314
355		103	8	20	37	1	47	47	54	10	14	55	20	86	54
Total				42	49	57	52	136	502	722	82	2796	118	273	478
334	151-200	96	7	17	0	6	11	13	12	53	8	344	7	150	407
335		58	4	8	0	27	11	44	21	566	24	51	20	78	116
356		61	5	10	10	3	13	33	18	57	23	33	31	40	13
Total				35	11	36	35	90	51	677	55	428	58	268	536
717	201-300	166	12	-	-	-	-	-	4	26	11	603	17	465	4811
719		76	6	-	-	-	-	-	87	504	16	7	9	137	686
721		76	6	-	-	-	-	-	30	18	12	31	9	16	23
Total				0	0	0	0	0	121	547	38	641	35	618	5520
718	301-400	134	10	-	-	-	-	-	6	8	26	52	16	71	44
720		105	8	-	-	-	-	-	125	59	43	27	7	21	155
722		93	7	-	-	-	-	-	8	20	53	98	86	89	89
Total				0	0	0	0	0	139	88	122	177	109	181	288
764	401-500	105	8	-	-	-	-	-	-	-	-	22	-	-	-
768		99	7	-	-	-	-	-	-	-	-	-	-	-	-
772		135	10	-	-	-	-	-	-	-	-	13	-	-	97
Total				0	0	0	0	0	0	0	0	35	0	0	97
765	501-600	124	9	-	-	-	-	-	-	-	-	-	-	-	-
769		138	10	-	-	-	-	-	-	-	-	-	-	-	-
773		128	10	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
766	601-700	144	11	-	-	-	-	-	-	-	-	-	-	-	-
770		128	10	-	-	-	-	-	-	-	-	-	-	-	-
774		135	10	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
767	701-800	158	12	-	-	-	-	-	-	-	-	-	-	-	-
771		175	13	-	-	-	-	-	-	-	-	-	-	-	-
775		155	12	-	-	-	-	-	-	-	-	-	-	-	-
Total				0	0	0	0	0	0	0	0	0	0	0	0
Biomass (tons)				4681	5982	12146	5234	6033	3481	3888	1548	7107	1808	3915	7368
Lower limit				2502	3632	4795	2955	280	1299	1936	625	-342	901	2211	-51412
Upper limit				6848	8360	19555	7519	11781	5664	5833	2471	14556	2714	5619	66148

aPreliminary

Table 4. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Div. 3N during fall from 1990-96. Shaded areas indicate Campelen trawl surveys.

Stratum	Depth (fath)	Area (sq. n. m.	Units (000s)	1990 WT 102	1991 WT 113-4	1992 WT 128-9	1993 WT 144-5	1994 WT 160-1	1995 WT 176-7	1996 WT200AN253 TEL 41-42
375	<=30	1593	120	0	43	-	0	0	0	0
376		1499	113	0	0	0	0	0	14	0
Total				0	43	0	0	0	14	0
360	31-50	2992	225	148	95	734	79	52	888	38
361		1853	139	15	274	282	0	20	0	0
362		2520	189	269	129	54	0	0	0	0
373		2520	189	0	0	0	0	0	0	0
374		931	70	0	0	-	0	0	0	0
383		674	51	0	0	-	0	0	0	0
Total				432	498	1070	79	72	888	38
359	51-100	421	32	0	0	136	0	0	22	0
377		100	8	0	-	0	0	5	0	0
382		647	49	0	0	0	0	0	0	0
Total				0	0	136	0	5	22	0
358	101-150	225	17	0	11	40	13	0	74	0
378		139	10	0	16	8	0	0	0	0
381		182	14	-	0	-	0	0	0	0
Total				0	27	48	13	0	74	0
357	151-200	164	12	0	116	6	95	18	85	0
379		106	8	2	-	1	0	0	0	1
380		116	9	-	0	-	0	0	0	0
Total				2	116	7	95	18	85	1
723	201-300	155	12	-	24	-	83	87	57	15
725		105	8	-	-	8	192	18	19	0
727		160	12	-	-	-	0	21	<1	0
Total					24	8	275	126	76	15
724	301-400	124	9	-	69	-	163	73	104	60
726		72	5	-		-	149	27	48	40
728		156	12	-		-	-	88	35	21
Total					69		312	188	187	121
Biomass (ton				434	777	1269	774	409	1346	175
Lower limit				119	279	515	-174	103	393	3
Upper limit				749	1275	2019	1722	710	2298	348

Table 5. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Division 3O during fall of 1990-96. Shaded areas indicate Campelen trawl surveys.

Stratum	Depth (fath)	Area (sq. n. M.)	Units (ooos)	1990 WT 102	1991 WT 113-4	1992 WT 128-9	1993 WT144-5	1994 WT160-1	1995 WT 176-7	1996 WT200AN253 TEL41-42
330	31-50	2089	157	65	31	47	0	0	247	0
331		456	34	12	161	84	0	0	108	0
338		1898	142	1347	244	450	2144	1065	4684	503
340		1716	129	106	155	37	0	0	204	0
351		2520	189	1029	161	43	0	0	0	0
352		2580	194	926	515	863	559	136	379	80
353		1282	96	1795	183	301	0	419	538	789
Total				5280	1450	1825	2703	1620	6160	1372
329	51-100	1721	129	57	46	0	11	0	417	0
332		1047	79	1118	72	659	372	127	1114	4569
337		948	71	721	91	422	310	934	421	492
339		585	44	708	128	390	65	506	1911	0
354		474	36	775	14	158	39	109	191	4647
Total				3379	351	1629	797	1676	4054	9708
333	101-15	147	11	88	4	6	13	33	25	
336		121	9	34	59	29	133	5	35	32
355		103	8	-	213	35	46	11	16	343
Total				122	276	70	192	49	76	375
334	151-20	96	7	9	5	0	5	6	4	
335		58	4	97	8	9	13	6	1	23
356		61	5	-	6	3	166	44	7	60
Total				106	19	12	184	56	12	83
717	201-30	166	7	12	-	-	0	21	65	-
719		76	6	57	<1	-	25	3	1	226
721		76	6	-	7	-	73	28	21	54
Total				69	7	-	98	52	87	280
718	301-40	134	8	-	-	-	5	19	10	
720		105	8	-	-	-	23	0	13	68
722		93	7	-	3	-	31	8	14	39
Total				0	3	0	59	27	37	107
Biomass (tons)				8956	2106	3536	4033	3480	10426	11925
Lower limit				6402	1269	1792	930	1347	1796	-13750
Upper limit				11509	2942	5281	7137	5614	19058	37599

Table 6. Comparison of results from spring and fall research vessel surveys in 1990-97 for witch flounder in Div. 3NO. The 1995/96 fall-winter, 1996 spring and fall, and 1997 spring (Div. 3O) biomass and abundance estimates are not directly comparable to previous years due to a major change in survey gear.

Survey	Index	Div. 3N	Div. 3O	Total
Spring 1990a	Abundance ('000)	145	9293	9438
	Biomass (t)	83	6031	6114
Fall 1990	Abundance	489	11351	11840
	Biomass	434	8955	9389
Spring 1991	Abundance	672	5880	6552
	Biomass	263	3482	3745
Fall 1991	Abundance	957	3212	4169
	Biomass	777	2106	2883
Spring 1992	Abundance	501	6982	7483
	Biomass	216	3885	4101
Fall 1992	Abundance	1700	6026	7726
	Biomass	1267	3536	4803
Spring 1993	Abundance	826	3214	4040
	Biomass	448	1548	1996
Fall 1993	Abundance	1463	6711	8174
	Biomass	774	4033	4807
Spring 1994	Abundance	429	15304	15733
	Biomass	264	7107	7371
Fall 1994	Abundance	724	6476	7200
	Biomass	407	3480	3887
Spring 1995	Abundance	247	3430	3677
	Biomass	187	1808	1995
Fall / Winter 1995/96	**Abundance**	**2470**	**24379**	**26849**
	Biomass	**1346**	**10427**	**11773**
Spring 1996	**Abundance**	**470**	**9639**	**10109**
	Biomass	**170**	**3915**	**4085**
Fall 1996	**Abundance**	**515**	**25516**	**26031**
	Biomass	**175**	**11925**	**12100**
Spring 1997	**Abundance**	**1360**	**25541b**	**26901**
	Biomass	**509**	**7368b**	**7877**

aNo strata deeper than 200 fm surveyed.
bPreliminary estimates

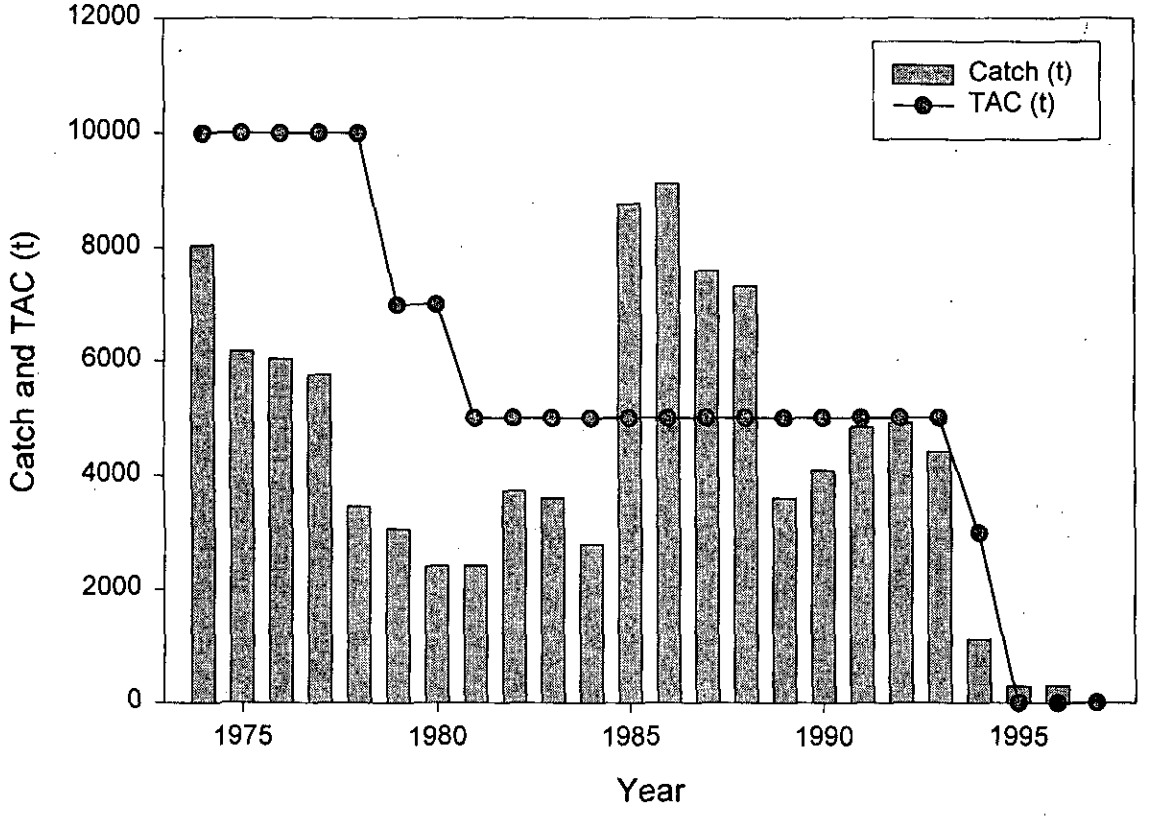
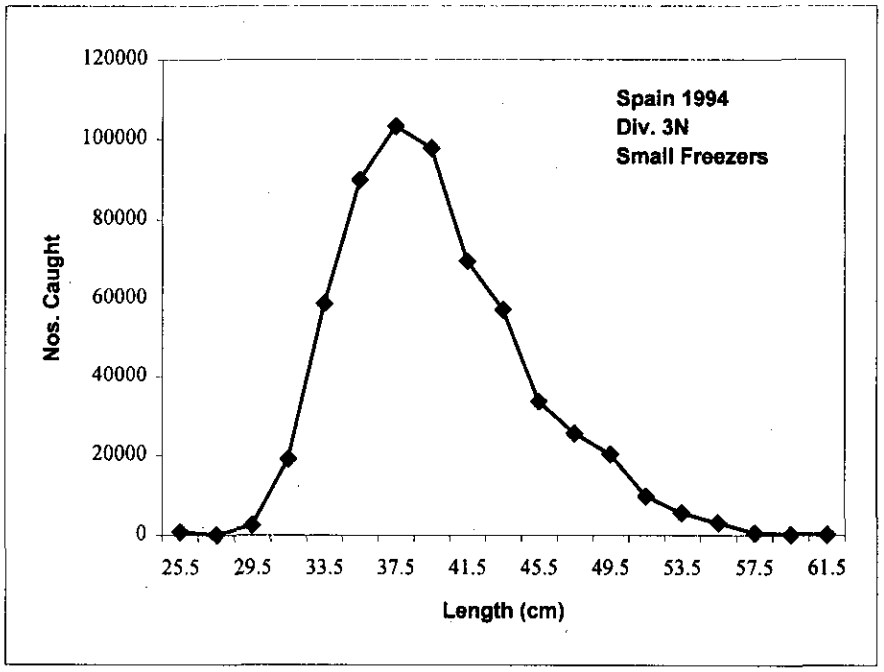


Fig. 1 Commercial catches of witch flounder in Div. 3NO from 1974-96 and TAC's from 1974-97. Catches in recent years include estimates of those not reported.

***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.**



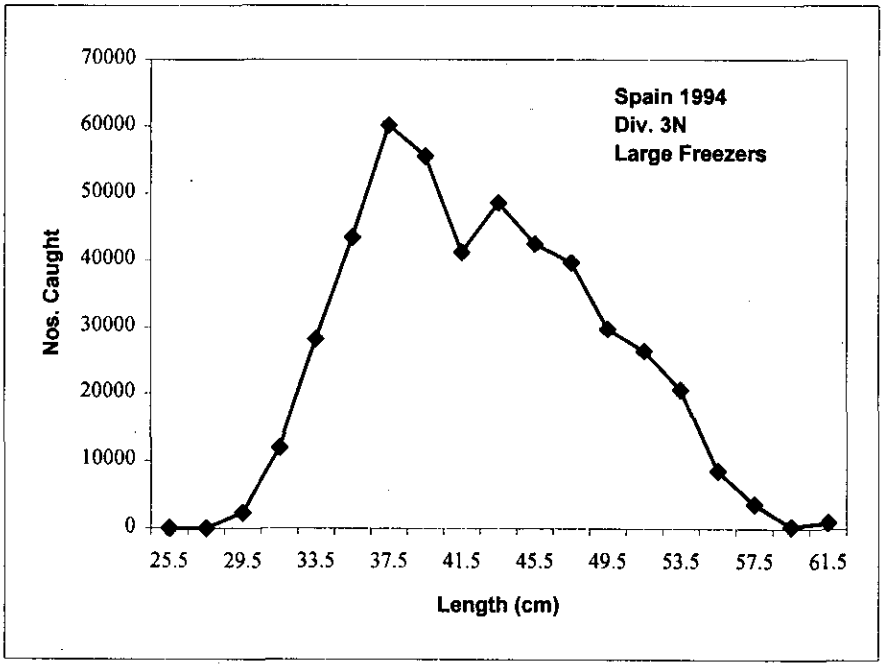
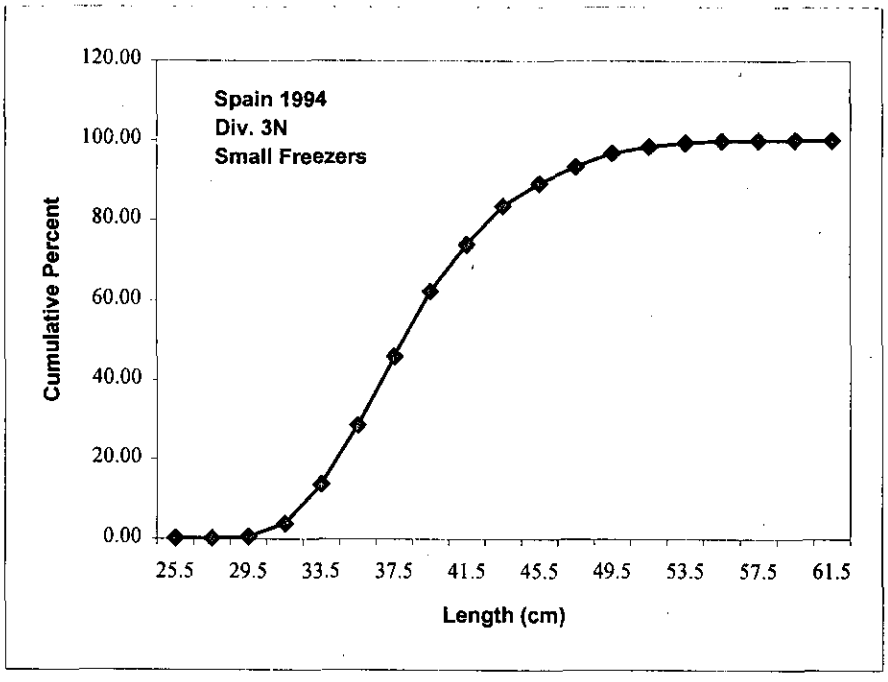


Fig. 2 Length frequency distributions of witch flounder in Div. 3N during 1994 from small and large Spanish commercial trawler catches.



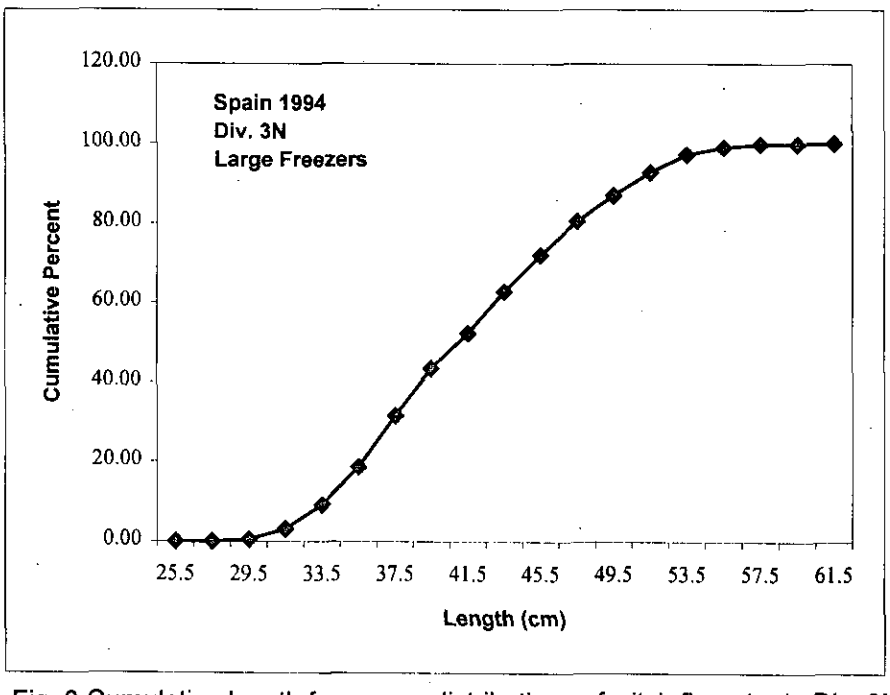


Fig. 3 Cumulative length frequency distributions of witch flounder in Div. 3N during 1994 from small and large Spanish commercial trawler catches.

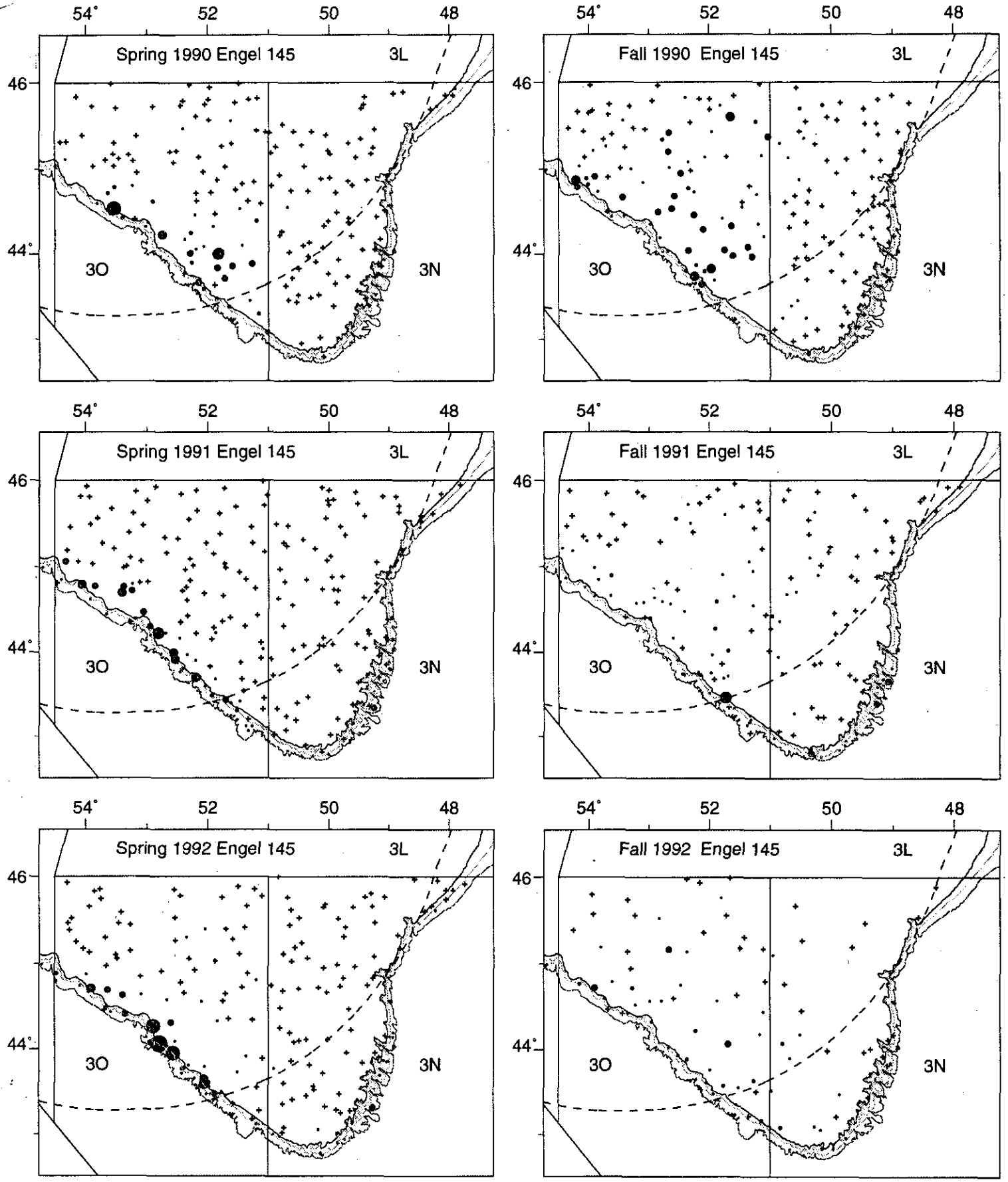


Fig. 4 Distribution of Witch catches from 1990 - 1992 spring and fall surveys to NAFO Divisions 3NO by the Canadian research vessel Wilfred Templeman

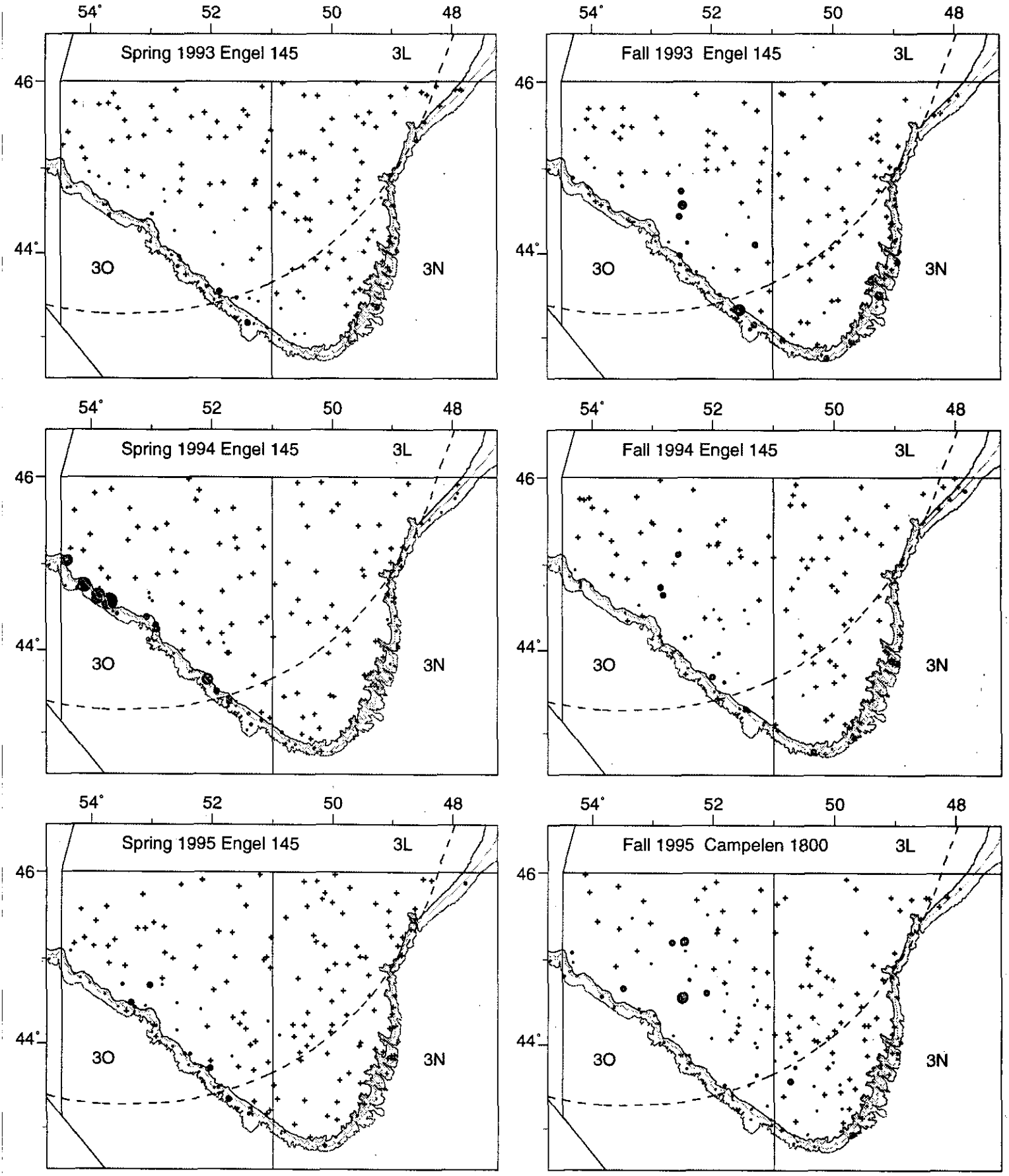


Fig. 4 Distribution of Witch catches from 1993- 1995 spring and fall surveys to NAFO Divisions 3NO by the Canadian research vessel Wilfred Templeman

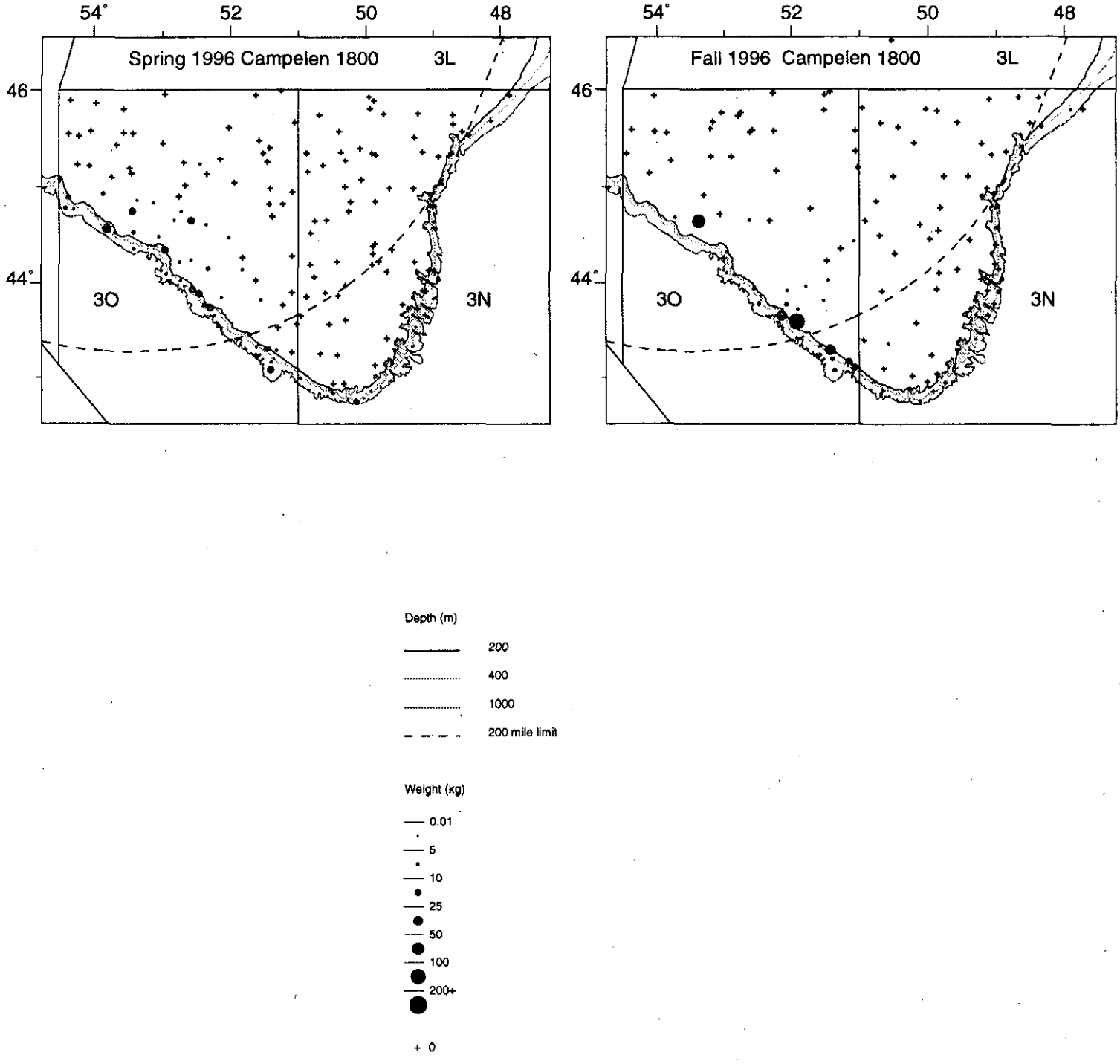


Fig. 4 Distribution of Witch catches from 1996 spring and fall surveys to NAFO Divisions 3NO by the Canadian research vessels Alfred Needler, Teleost and Wilfred Templeman

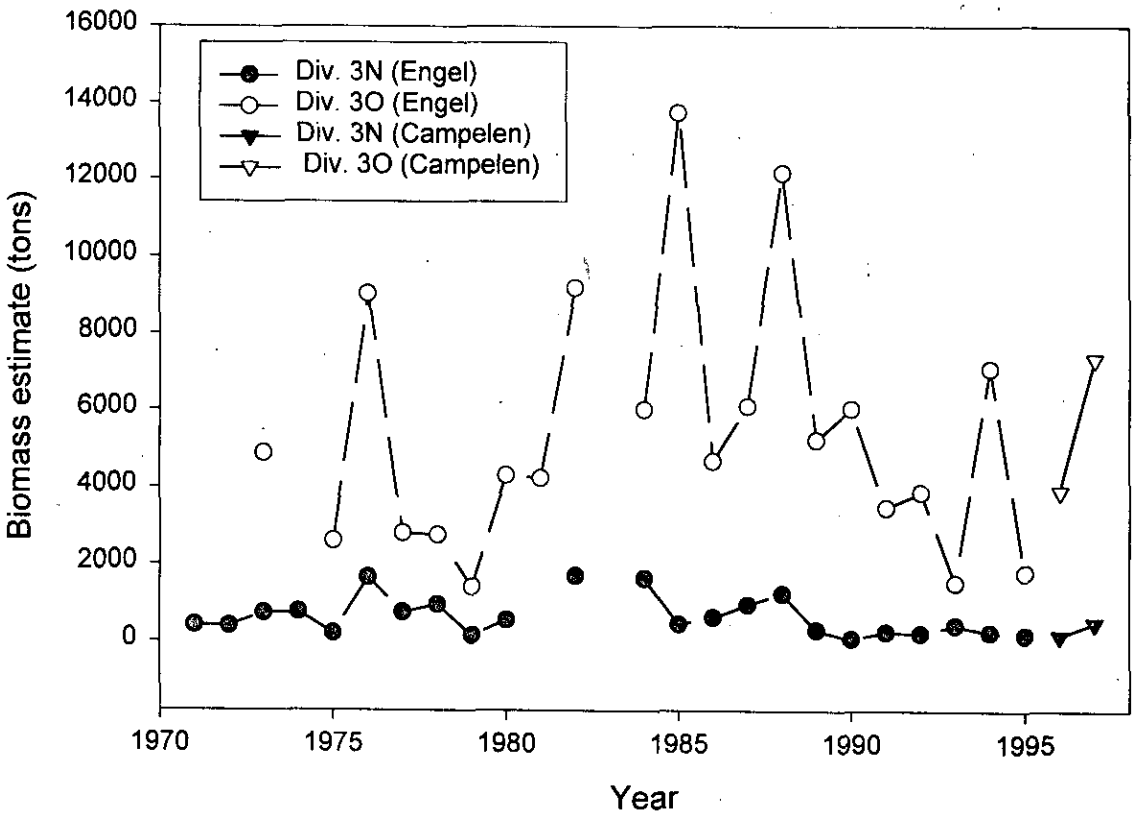


Fig. 5 Biomass estimates of witch flounder in Div. 3N and 3O from Canadian spring surveys during 1971-97 and 1973-97 respectively.

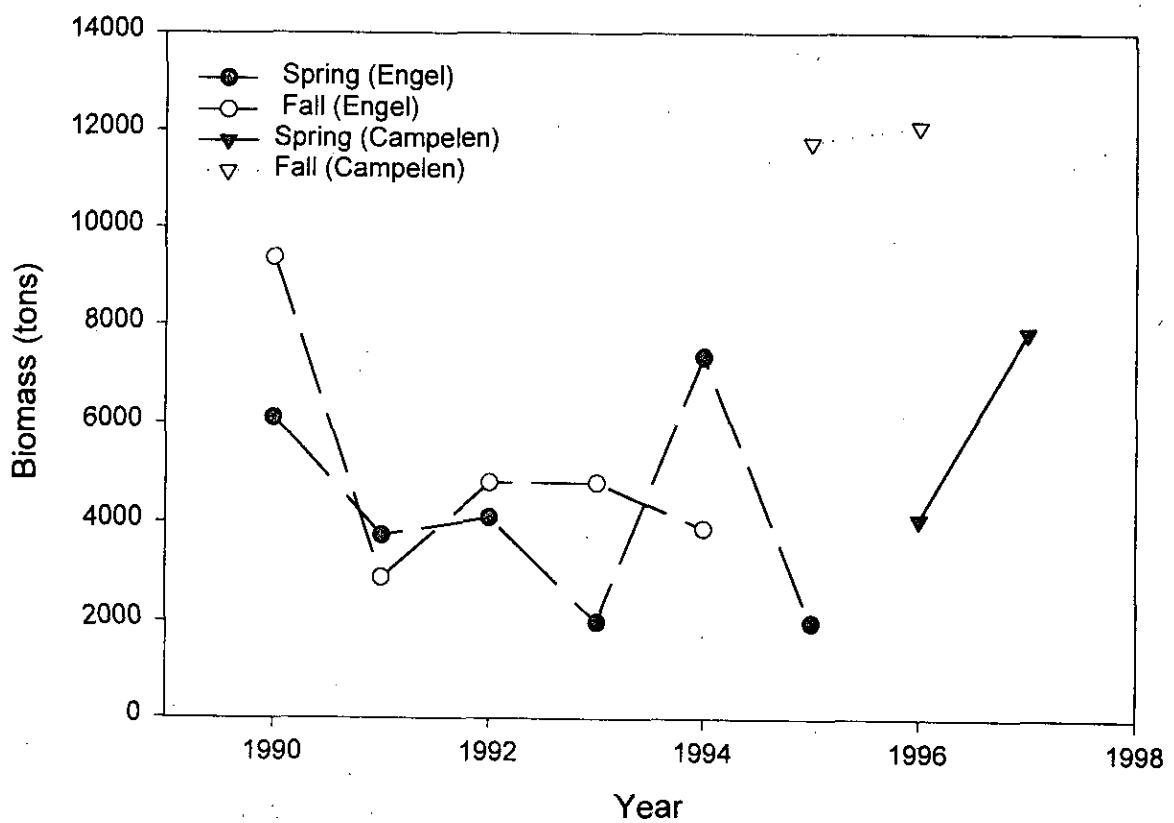


Fig. 6 Comparison of biomass of witch flounder from spring and fall surveys in Division 3NO.

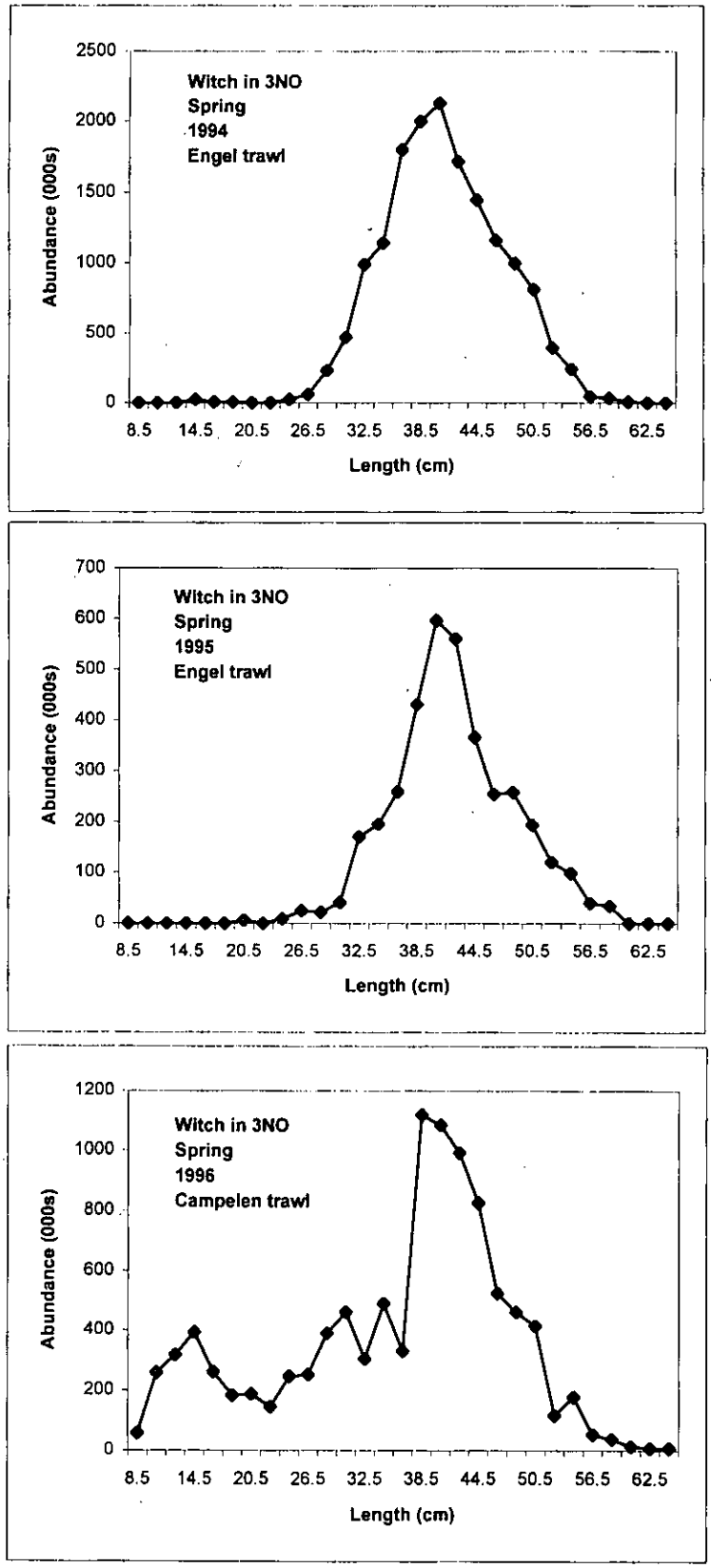


Fig. 7 Abundance at length of witch flounder from Canadian spring surveys in Div. 3NO combined during 1994-96.

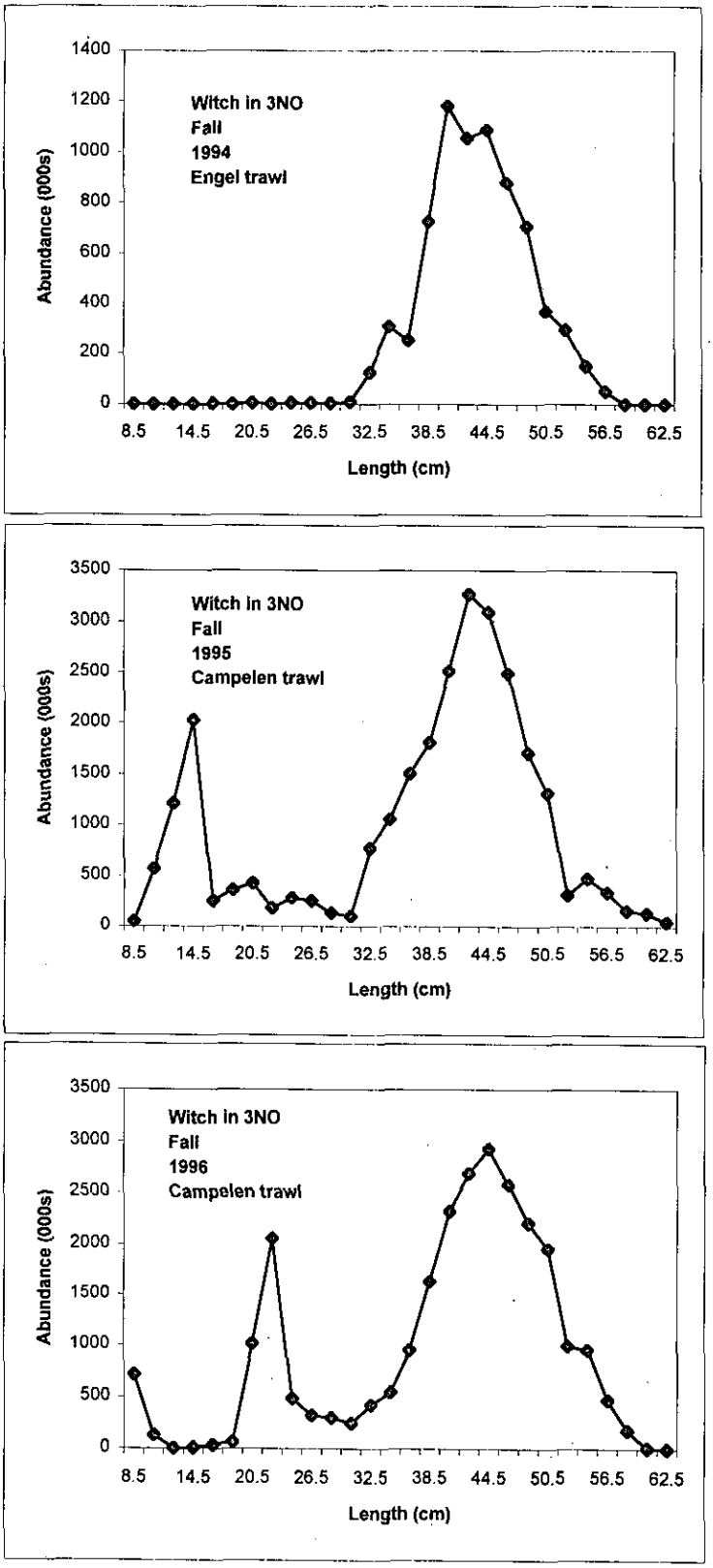


Fig. 8 Abundance at length of witch flounder from Canadian fall surveys in Div. 3NO combined during 1994-96.