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**Observations on the witch flounder
population in NAFO Subdivision 3Ps
from the commercial fishery and
research vessel survey data**

**Observations sur la population de plie grise
de la sous-division 3Ps de l'OPANO tirées
des données de la pêche commerciale et des
relevés scientifiques**

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Abstract

Landings from this stock over the last 20 years have fluctuated between 300t and 1000 t annually. From 1986-93 landings were relatively stable averaging around 1000 t annually. During the past five years landings averaged just over 500t but were as low as 250t in 1996. The main directed fishery is prosecuted by offshore otter trawlers complemented by a nearshore Danish seine fishery. However, in recent years it appears to be a mixed American plaice and witch flounder fishery by otter trawlers. During 2000-2002 the American plaice by-catch rates in the otter trawl directed witch flounder fishery ranged from 93-143% compared to less than 5% by Danish seiners. Although survey stock size indices since 1983 have been highly variable, the survey biomass index during recent years suggests that the biomass is on average about 75% of the 1983-90 average when catches were around 800t. The age and size structure observed in this stock since the early 1980s also appear to have remained stable with little change in growth pattern. Geographic distribution has not changed appreciably since 1983 except during the early to mid 1990's when fish disappeared from the 51-100 fath. depth zone coincident with extremely cold sea bottom water temperatures. In recent years the distribution appears to be returning to a more normal pattern. No measurable change in recruitment has been observed over the past 20 years.

Résumé

Au cours des vingt dernières années, les débarquements annuels de plies grises appartenant à ce stock ont varié entre 300 et 1 000 t. De 1986 à 1993, ils étaient relativement stables et se chiffraient en moyenne à environ 1 000 t. Au cours des cinq dernières années, ils ont été en moyenne légèrement supérieurs à 500 t, mais ont atteint seulement 250 t en 1996. La principale pêche dirigée est effectuée par des chalutiers à panneaux hauturiers et complétée par une flottille côtière de senneurs danois. Cependant, au cours des dernières années, il semble que les chalutiers à panneaux ont effectué une pêche mixte de la plie canadienne et de la plie grise. En effet, de 2000 à 2002, les taux de prises accidentelles de plie canadienne au cours de la pêche dirigée de la plie grise au chalut à panneaux ont varié entre 93 et 143 %, comparativement au taux de moins de 5 % pour la pêche par les senneurs danois. En dépit du fait que les indices de l'effectif du stock ont été très variables depuis 1983, les indices de biomasse des dernières années portent à croire que la biomasse se chiffre en moyenne à environ 75 % de la moyenne pour la période de 1983 à 1990, lorsque les prises atteignaient environ 800 t. Les structures d'âge et de taille pour ce stock semblent également stables depuis le début des années 1980, sans changement notable en ce qui concerne la croissance. La répartition géographique a peu varié depuis 1983, sauf au cours de la première moitié des années 1990 quand le poisson a disparu de la zone située entre 51 et 100 brasses de profondeur, lorsque les eaux de fond étaient extrêmement froides. Au cours des dernières années, la répartition semble redevenir plus normale. Le recrutement n'a pas varié de manière notable au cours des vingt dernières années.

Commercial Fishery

Description of the fishery

Catches of witch flounder in NAFO Subdivision 3Ps ranged between about 300 and 1000 t annually since the early 1970's when the catch was reported to be over 3800 tons (Table 1; Fig. 1). From 1986-93, annual catches were relatively stable averaging around 1000 tons, however, since then the average annual catch has been just over 400 tons (Table 1; Fig. 1). During the 1980's the catch was primarily a by-catch of other groundfish fisheries, however, in recent years with the severe declines in other major groundfish resources, in particular, cod and American plaice certain sectors of the fishing industry had come to depend more on catches delivered from this stock. The main participant is Canada (Newfoundland) with relatively small catches being taken by France (St. Pierre & Miquelon) (Table 1).

Catches have been taken primarily by Canadian (Newfoundland) trawlers (Table 2; Fig. 2) fishing offshore on St. Pierre Bank. Effort was usually concentrated along the deeper southwest slope of the bank in Statistical Area 3Psg (Table 3; Fig. 3 & 4) and at the tail of the bank into Halibut Channel in Statistical Area 3Psh. However, during the past 10 years or so nearly all the offshore otter trawler effort for witch flounder occurs in Statistical Area 3Psh (Table 3; Fig. 3 & 4).

Although the American plaice fishery in Subdivision 3Ps has been closed since 1994 the fishery for witch flounder does not appear to have been seriously hampered as bycatches of American plaice in the witch flounder fishery often exceed 100% (Fig. 4). Seine catches, on the other hand, have been clean with virtually no American plaice bycatch (Fig. 4).

The first total allowable catch (TAC) was established for this stock in 1974 at 3000 tons, which remained in effect until 1988 when it was reduced to 1000 tons (Fig. 1). It was further reduced to 500 tons in 1996 and 1997 but was increased again to 650 tons for 1998 and has remained at that level since then (Fig. 1).

Length Compositions

Length frequency distributions from the Canada (Newfoundland) offshore otter trawl fishery from 1996-2002 are presented in Figure 5. Most of the annual witch flounder catches are comprised of fish in the range of 35-50 cm with modes mostly in the range of 40-42 cm. Although some small variation in the size composition was apparent for 1996-1997 virtually no variability was observed for other years especially 2000-2002 (Fig. 6).

Data available from the seine catches for 2000-2001 are shown in Figure 6. The 2000 data were very similar to the otter trawl data, however, the 2001 length compositions were comprised mainly of witch flounder in the range of 30-42 cm with a mode in the range of about 33-38 cm (Fig. 6).

Research Vessel Surveys

Survey Biomass and Abundance Indices

Standard stratified random bottom trawl surveys during winter-spring were conducted by Canada (N) in NAFO Subdivision 3Ps using an *Engel 145'* High Rise otter trawl with bobbin footgear from 1983-1995. However, in late 1995 the standard survey gear was changed to a *Campelen 1800* shrimp trawl using rockhopper footgear. Therefore, all subsequent surveys were conducted using the new gear. Prior to the changeover, comparative fishing trials were carried out and length based conversion factors developed for the major species (witch flounder included) to allow for uninterrupted continuation of the survey time series. The details of the comparative fishing trials and development of the agreed conversion factors have been discussed in previous papers and won't be repeated here (see Bowering 1999 for witch flounder in Subdivision 3Ps). All data presented here are based on

Engel 145 data converted to *Campelen 1800* equivalents for 1983-1995 and true *Campelen 1800* data for 1996-2002. A map showing the survey area and strata is provided in Figure 7.

The estimated abundance and biomass indices by stratum and year are presented in detail in Tables 4 and 5, respectively. Graphic illustrations of biomass trends are shown in Figures 8 and 9. Figure 8 shows the entire series with 95% confidence limits on the true *Campelen 1800* estimates only. Figure 9 shows 95% confidence limits on all estimates in the time series, however, the 1984, 1990 and 1992 estimates have been omitted due to negative lower confidence limits.

Abundance and biomass indices have been highly variable over the 20 year period examined with little in the way of discernible trends (Tables 4 & 5; Fig. 8 & 9). The error bars on the annual estimates are extremely large in many cases probably reflecting the patchiness of the distributions. Nevertheless, the biomass estimates during the 1990's are lower than those of the 1980's. The lowest biomass value observed occurred in 1999 but values have increased since then with the 2002 value in the range of the 1980's estimates (Fig. 8 & 9).

An examination of survey indices by depth zone would suggest that up until about 1988 considerable biomass was estimated for nearly all strata surveyed in 93-183 m (51-100 fath) (Table 5). However, during 1990-97 few strata at these depths had any witch flounder biomass observed in them and for those that that did it was negligible (Table 5). More recently, witch flounder again appeared in higher abundance in this depth zone especially during the 1999-2000 surveys (Tables 5) but has declined again in 2001-2002. It is possible that the distribution shift to and from the area is related to bottom temperature. During the long period of absence the bottom temperatures were extremely cold being negative in all but one year from 1990-95 within this depth zone (Table 6). Prior to this period and since then (up to 2000), bottom temperatures within this depth zone were considerably higher with both the 1998 and 1999 temperatures well above the average of the entire period (Table 6). In 2001 and 2002 the bottom temperatures in this depth zone again were much cooler than average, concurrent with the low numbers of witch flounder found here.

Length Compositions

Length (cm) frequency distributions as estimated abundance at length from the true *Campelen 1800* surveys of 1996-2002 are illustrated in Figure 10 with the <20 cm range magnified in Figure 11 to examine for potential recruitment. Witch flounder were present in all surveys from 1996-2002 up to a length of at least 50 cm with most of the abundance occurring in the range of about 20-40 cm (Fig. 10). These observations are similar to the length compositions from 1983-1995 presented in the previous assessment (Bowering 1999). The number of fish estimated in the smaller size range of <20 cm was highly variable and there are no distinct modes of potentially strong year-classes that could be tracked from year to year (Fig. 11). However, in 2000-2002 there were higher numbers of witch flounder <10 cm estimated compared to 1996-1999 where very few were observed (Fig. 11).

Geographic Distribution

a) Annual Spring Groundfish Surveys 1999-2002

Distribution plots of witch flounder in Subdivision 3Ps are presented as Canadian survey catches (kg/set) for the survey years 1999-2002 (Fig. 12a-d). Witch flounder are distributed rather continuously in the deeper water along the southwestern slope of St. Pierre Bank and throughout the Laurention and Hermitage Channels. Few, if any, are caught on the shallow parts of St. Pierre Bank, Green Bank or Burgeo Bank. Recent surveys have been extended into Fortune Bay and Placentia Bay where some catches of witch flounder also have been encountered. The area of highest abundance in the offshore appears to be along the mid southwest slope of St. Pierre Bank although this is not necessarily consistent with the area of effort concentration by otter trawlers (Fig. 4). On the other hand, the area of highest abundance in the more coastal region appears to be in the inner part of Hermitage Channel just off Hermitage Bay where the Danish/Scottish Seiner effort has

concentrated (Fig. 4). Overall, the general distribution of witch flounder does not appear to have changed during the period shown here and is now much similar to the earlier years (Bowering 1999).

b) Unit 2 Redfish Surveys

Redfish directed surveys using stratified random design have been conducted in Unit 2 (NAFO Divisions 3P and 4V) using the *Campelen 1800* survey trawl during the summers of 1994-96, 2000 and 2002. The minimum depth surveyed was 183 meters but nevertheless covered the main witch flounder depths. The distribution plots for each individual year surveyed are presented in Figures 13a-f, respectively. Although catches were generally low, there were rarely any sets without some witch flounder (Fig. 13). Catch distribution was evenly spread throughout the area especially throughout the Laurention Channel. For deepwater species such as witch flounder it would appear that the Div. 3P-4V boundary is likely to be arbitrary with respect to stock boundaries. The few areas of higher catches are rather similar to the spring surveys described above indicating that there is little in the way of discernible seasonal distribution patterns.

Summary

- The average annual catch during the 1996-2002 period is about 440 tons or just under 60% of the 1983-90 average of 800 tons.
- The mean biomass index for 1996-2002 is about 75% of the 1983-90 period.
- The biomass index reached its lowest point in 1999 but has been increasing since then.
- Length frequency distributions indicate little appreciable change in the size composition of the population at least over the past 20 years.
- No indications of any measurable change in recruitment over the same 20 year period.
- Although relatively low in abundance the population is widely distributed and continuous throughout Subdivision 3Ps beyond the 50 fath contour and into the deeper waters of neighbouring NAFO Divisions (3Pn; 4Vs; 4Vn).

References

Bowering, W.R. 1999. Stock status of witch flounder in NAFO Subdivision 3Ps. CSAS Res. Doc. 99/144, 31p.

Table 1. Landings of witch flounder in Subdivision 3Ps by country during 1974-2002.

Year	COUNTRY							TOTAL
	CAN(MQ)	CAN(N)	FRA(SP)	POR	USSR	FRA(M)	CAN(M)	
1974	94	1605	47	40	-	-	-	1786
1975	-	1179	-	-	4	-	-	1183
1976	40	801	-	-	-	-	-	841
1977	-	3841	-	-	-	-	-	3841
1978	23	969	-	-	-	-	-	992
1979	-	561	-	-	-	-	-	561
1980	-	790	-	-	-	-	-	790
1981	-	412	53	-	-	-	4	469
1982	-	334	0	-	-	-	-	334
1983	-	154	125	-	-	-	-	279
1984	-	325	34	-	-	2	-	361
1985	-	376	118	-	-	2	-	496
1986	-	613	606	-	-	-	110	1329
1987	-	1131	71	-	-	53	18	1273
1988	-	475	53	-	-	6	102	636
1989	-	831	67	-	-	-	29	927
1990	-	940	-	-	-	-	31	971
1991	-	1056	-	-	-	-	59	1115
1992	-	1012	50	-	-	-	68	1130
1993	-	956	-	-	-	-	17	973
1994	-	429	-	-	-	-	2	431
1995	-	273	-	-	-	-	1	274
1996	-	250	-	-	-	-	6	256
1997	-	282	7	-	-	-	30	319
1998	-	452	43	-	-	-	4	499
1999	-	509	33	-	-	-	18	560
2000	-	332	7	-	-	-	7	346
2001	-	451	85	-	-	-	29	565
2002	-	494	23	-	-	-	1	518

**Data for CAN(N) and CAN(M) for 2002 are to October 2, 2002.

**Data for FRA(SP) were provided on October 7, 2002.

Table 2. Landings of witch flounder in Subdivision 3Ps by gear type during 1974-2002 for Canada (N) only.

GEAR					
YEAR	OTB	SEINES	OTHER	TOTAL	TAC
1974	1409	177	19	1605	3000
1975	684	491	4	1179	3000
1976	590	153	58	801	3000
1977	3387	454	-	3841	3000
1978	627	342	-	969	3000
1979	484	75	2	561	3000
1980	569	219	2	790	3000
1981	168	233	11	412	3000
1982	284	50	-	334	3000
1983	147	1	6	154	3000
1984	322	-	3	325	3000
1985	198	175	3	376	3000
1986	285	297	31	613	3000
1987	879	217	35	1131	3000
1988	260	153	62	475	1000
1989	557	196	78	831	1000
1990	635	244	61	940	1000
1991	789	195	72	1056	1000
1992	761	214	37	1012	1000
1993	712	183	61	956	1000
1994	131	288	10	429	1000
1995	3	270	-	273	1000
1996	78	171	1	250	500
1997	137	122	-	259	500
1998	259	191	2	452	650
1999	263	240	6	509	650
2000	153	166	13	332	650
2001	280	145	26	451	650
2002	361	103	30	494	650

**Data for 2002 are preliminary to October 2, 2002

Table 3. Landings of witch flounder in Subdivision 3Ps by statistical area from 1985-98.

Year	Statistical Area							
	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh
1985	15	113	-	36	12	26	94	120
1986	16	227	2	68	5	14	136	163
1987	49	151	1	52	7	44	236	539
1988	4	70	2	37	1	8	58	238
1989	11	167	2	8	-	12	73	476
1990	5	179	2	25	11	3	286	322
1991	4	71	3	10	-	6	115	590
1992	16	62	-	7	-	5	281	464
1993	4	259	-	7	-	-	88	593
1994	7	317	3	1	-	-	1	109
1995	16	213	40	2	-	-	1	2
1996	89	80	-	3	-	-	-	82
1997	20	51	-	-	-	-	16	148
1998	122	64	7	5	-	-	1	258
1999	72	141	9	3	22	-	3	279
2000	10	154	1	25	-	-	2	145
2001	9	159	2	9	-	-	1	303
2002	83	52	9	11	-	1	3	339

Note: There are years when some of the catch has not been reported by unit area.

Table 4: Witch abundance estimates (000s of fish) from research vessels surveys in NAFO Subdivision 3Ps from 1983-2002. Estimates are presented in Campelen trawl catch units.

Depth range (fathoms)	Strata	Vessel Trips	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Mean Date	30-Apr 1983	13-Apr 1984	13-Mar 1985	15-Mar 1986	7-Mar 1987	5-Feb 1988	9-Feb 1989	9-Feb 1990	10-Feb 1991	14-Feb 1992	13-Feb 1993
<30	314	974	0	0	0	0	0	0	0	0	0	0	19
	320	1320	532	0	0	0	0	0	0	0	0	0	318
31-50	293 ⁴	159	.	.	.	.	.	.	.	.	.	.	.
	308	112	0	0	0	0	0	31	0	0	0	0	0
	312	272	0	75	0	0	0	0	0	0	0	0	0
	315	827	284	796	0	265	0	341	179	0	0	0	0
	321	1189	0	0	0	0	0	0	0	0	0	0	0
	325	944	0	26	0	0	0	0	0	0	0	0	0
	326	166	0	0	.	0	0	0	0	0	0	0	0
	783 ¹	229	.	.	.	.	.	.	.	.	.	.	.
51-100	294 ⁴	135	.	.	.	.	.	.	.	.	.	.	.
	297 ⁴	152	.	.	.	.	.	.	.	.	.	.	.
	307	395	408	109	290	18	0	0	0	0	0	0	54
	311	317	0	414	55	5945	15	240	58	0	44	0	15
	317	193	9779	16487	252	544	9	690	0	0	0	119	0
	319	984	445	338	68	761	587	457	4010	.	60	0	0
	322	1567	39	620	0	162	0	36	0	0	0	0	0
	323	696	1548	48	319	19	383	38	41	0	0	0	0
	324	494	0	0	0	0	0	0	0	0	0	0	0
	781 ¹	446	.	.	.	.	.	.	.	.	.	.	.
782 ¹	183	.	.	.	.	.	.	.	.	.	.	.
101-150	295 ⁴	209	.	.	.	.	.	.	.	.	.	.	.
	298 ⁴	171	.	.	.	.	.	.	.	.	.	.	.
	300 ⁴	217	.	.	.	.	.	.	.	.	.	.	.
	306	363	620	58	317	1114	144	43	134	0	922	115	58
	309	296	556	183	828	305	122	231	163	244	529	305	27
	310	170	70	105	304	257	316	70	374	117	35	94	58
	313	165	1687	193	340	375	125	863	863	4142	340	1997	329
	316	189	6357	3874	4368	3952	4767	14975	5607	14403	143	14975	.
	318	129	1128	178	.	3443	178	1870	76	.	4662	102	288
	779 ¹	422	.	.	.	.	.	.	.	.	.	.	4941
780 ¹	403	.	.	.	.	.	.	.	.	.	.	.
151-200	296 ⁴	71	.	.	.	.	.	.	.	.	.	.	.
	299 ⁴	212	.	.	.	.	.	.	.	.	.	.	.
	705	195	957	429	912	1113	590	2106	1194	456	2133	1623	550
	706	476	5998	3372	2488	4273	5147	3536	2063	5959	8300	6627	2728
	707	74	444	198	.	403	512	192	294	.	6141	2309	678
	715	128	751	163	.	209	309	327	890	36	0	163	45
	716	539	1112	939	1691	4041	2373	2491	2892	3589	1987	2694	2002
201-300	708	126	531	370	.	628	370	121	853	.	3275	467	660
	711	593	10724	7853	11088	15114	6459	5760	9575	8593	9452	17582	3913
	712	731	6138	.	14857	10529	7161	6922	7077	7656	13652	18498	4264
	713	851	3715	.	5472	6848	8200	8252	5668	7150	13068	12742	8870
	714	1074	2252	.	.	9140	5055	10356	8532	8712	12254	8924	4588
301-400	709 ²	147	20	7	.	.	.	647	.	1631	.	508	
401-500	710 ¹	156	87	42	82	163	.	10	.	74	.	87	
501-600	776 ¹	159	.	.	.	.	.	.	.	.	.	.
601-700	777 ¹	183	.	.	.	.	.	.	.	.	.	.
701-800	778 ¹	166	.	.	.	.	.	.	.	.	.	.
Total ³			56,181	36,877	43,730	69,622	42,819	59,956	51,189	61,057	78,702	89,336	29,668
													42,903

¹ These strata were added to the stratification scheme in 1994.

² Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys.

All sets done in 710 prior to 1994 have been recoded to 709.

³ totals are for all strata fished .

⁴ These strata were added to the stratification scheme in 1997.

Table 4 Con'd. Witch abundance estimates (000s of fish).

Depth range (fathoms)	Strata	Vessel Trips Sets Mean Date sq. mi.	WT	WT	WT	WT	WT	WT	WT	WT	WT	
			150-151 166 15-Apr 1994	166-167 161 16-Apr 1995	186-187 148 22-Apr 1996	202-203 158 12-Apr 1997	219-220 176 21-Apr 1998	236-237 175 24-Apr 1999	313-315 171 2000	364-365 173 2001	418-419 177 2002	
<30	314	974	0	0	0	0	0	0	0	19	0	17
	320	1320	0	30	0	0	0	0	0	0	0	0
31-50	293	159	.	.	.	0	0	0	0	0	0	0
	308	112	0	0	0	0	0	0	8	0	0	0
	312	272	0	0	0	0	0	0	0	0	0	0
	315	827	0	0	0	0	0	16	72	116	0	0
	321	1189	0	0	73	0	0	0	0	98	0	0
	325	944	0	0	0	0	0	0	16	0	0	0
	326	166	0	0	0	0	0	23	0	0	0	0
	783	229	0	.	.	0	0	0	0	0	0	0
51-100	294	135	.	.	.	0	0	0	0	0	0	9
	297	152	.	.	.	63	0	660	385	0	0	21
	307	395	353	0	41	0	0	223	72	0	0	0
	311	317	33	87	0	0	15	1509	1875	0	0	15
	317	193	0	0	0	0	478	2217	6252	13	0	0
	319	984	0	406	1339	15	1946	846	2320	2927	1083	0
	322	1567	0	33	150	118	29	32	2254	1257	66	0
	323	696	0	0	22	24	207	46	432	32	16	0
	324	494	0	0	0	0	0	0	0	0	68	0
	781	446	0	0	0	0	0	0	14	0	0	0
782	183	0	0	.	0	0	13	0	0	0	0	
101-150	295	209	.	.	.	661	1073	14	1849	142	43	0
	298	171	.	.	.	354	502	955	223	729	1610	0
	300	217	.	.	.	371	2421	1030	410	338	254	0
	306	363	86	100	1493	766	188	610	1291	350	1572	0
	309	296	801	556	790	457	706	41	1112	81	163	0
	310	170	296	164	129	66	373	316	237	186	175	0
	313	165	5062	3007	898	295	1291	363	1634	1343	4188	0
	316	189	1430	1729	6071	11128	4901	2590	2093	7683	6851	0
	318	129	0	6548	719	311	825	201	687	2023	1659	0
	779	422	0	0	0	0	19	82	58	0	58	0
780	403	0	0	.	0	0	156	25	18	166	0	
151-200	296	71	.	.	.	352	191	102	469	230	932	0
	299	212	.	.	.	1492	2341	1721	3292	2189	3281	0
	705	195	581	711	891	1019	1085	440	858	1621	3353	0
	706	476	4240	7350	3318	2447	4551	1855	2588	3650	10968	0
	707	74	0	2698	75	59	148	23	229	289	87	0
	715	128	295	660	471	72	76	44	446	337	2283	0
	716	539	1394	756	5068	1598	2816	968	6790	2570	1823	0
201-300	708	126	1421	225	503	14294	193	29	160	104	83	0
	711	593	3063	7260	5364	2471	3446	3945	3707	2625	9609	0
	712	731	3557	14911	8195	4384	5499	3067	3455	6184	11329	0
	713	851	4313	6087	7036	6621	7682	4433	7336	7631	11336	0
	714	1074	2301	7461	7040	7394	6395	3892	4485	6446	9300	0
301-400	709	147	283	5955	718	.	1345	1336	1375	667	904	0
401-500	710	156	436	.	.	.	.	441	.	.	.	0
501-600	776	159	.	.	.	.	.	.	.	.	.	0
601-700	777	183	.	.	.	.	.	.	.	.	.	0
701-800	778	166	.	.	.	.	.	.	.	.	.	0
Total	3		29,943	66,736	50,401	56,832	50,780	34,295	58,646	51,665	83,322	0

Table 5: Witch biomass estimates (tons) from research vessels in NAFO Subdivision 3Ps from 1983-2002. Estimates are presented in Campelen trawl catch units.

Depth range (fathoms)	Vessel Trips	AN Sets	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT
			30-Apr 1983	13-Apr 1984	13-Mar 1985	15-Mar 1986	7-Mar 1987	5-Feb 1988	9-Feb 1989	9-Feb 1990	10-Feb 1991	14-Feb 1992
<30	314	974	0	0	0	0	0	0	0	0	0	0
	320	1320	200	0	0	0	0	0	0	0	0	0
31-50	293 ⁴	159	.	.	.	.	.	.	.	.	.	.
	308	112	0	0	0	0	0	7	0	0	0	0
	312	272	0	19	0	0	0	0	0	0	0	0
	315	827	134	273	0	68	0	76	44	0	0	0
	321	1189	0	0	0	0	0	0	0	0	0	0
	325	944	0	19	0	0	0	0	0	0	0	0
	326	166	0	0	.	0	0	0	0	0	0	0
	783 ¹	229	.	.	.	.	.	.	.	.	.	.
51-100	294 ⁴	135	.	.	.	.	.	.	.	.	.	.
	297 ⁴	152	.	.	.	.	.	.	.	.	.	.
	307	395	51	49	39	13	0	0	0	0	0	0
	311	317	0	139	27	1564	6	79	7	0	7	0
	317	193	3253	4662	75	144	4	154	0	0	0	42
	319	984	171	230	93	319	242	170	1716	.	21	0
	322	1567	31	121	0	24	0	10	0	0	0	0
	323	696	791	30	285	14	165	30	35	0	0	0
	324	494	0	0	0	0	0	0	0	0	0	0
	781 ¹	446	.	.	.	.	.	.	.	.	.	.
	782 ¹	183	.	.	.	.	.	.	.	.	.	.
101-150	295 ⁴	209	.	.	.	.	.	.	.	.	.	.
	298 ⁴	171	.	.	.	.	.	.	.	.	.	.
	300 ⁴	217	.	.	.	.	.	.	.	.	.	.
	306	363	208	16	101	177	61	23	74	0	57	14
	309	296	126	79	238	90	12	29	36	46	57	20
	310	170	34	65	128	138	51	33	117	77	9	7
	313	165	335	62	103	100	32	198	249	747	58	285
	316	189	1598	1139	1275	1198	1260	3595	1343	2830	28	3124
	318	129	286	35	.	1196	57	551	30	.	1538	17
	779 ¹	422	.	.	.	.	.	.	.	.	.	.
	780 ¹	403	.	.	.	.	.	.	.	.	.	.
151-200	296 ⁴	71	.	.	.	.	.	.	.	.	.	.
	299 ⁴	212	.	.	.	.	.	.	.	.	.	.
	705	195	208	124	243	267	211	596	325	137	467	331
	706	476	1216	817	621	1067	1461	935	481	1205	2032	1482
	707	74	117	44	.	152	180	62	116	.	2007	675
	715	128	173	48	.	84	112	93	248	28	0	43
	716	539	401	355	597	1321	938	920	918	1042	519	708
201-300	708	126	97	80	.	186	148	55	251	.	1741	167
	711	593	1540	1218	1517	2385	1239	1058	1572	1470	1417	3378
	712	731	940	.	2006	1557	1047	1228	944	1265	1946	3003
	713	851	566	.	786	1073	1769	1240	919	1066	2149	2113
	714	1074	371	.	.	2153	937	2010	1344	1580	2309	1871
301-400	709 ²	147	3	2	.	.	.	137	.	379	.	
401-500	710 ¹	156	15	11	13	28	.	4	.	17	.	
501-600	776 ¹	159	.	.	.	.	.	.	.	.	.
601-700	777 ¹	183	.	.	.	.	.	.	.	.	.
701-800	778 ¹	166	.	.	.	.	.	.	.	.	.
Total ³			12,865	9,640	8,147	15,315	9,929	13,155	10,907	11,492	16,757	17,280

Table 5 Con'd. Witch biomass estimates (tons).

Depth range (fathoms)	Strata	Vessel	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419
Mean Date	Sets	136	130	166	161	148	158	176	175	171	173	177	
sq. mi.	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr	21-Apr	24-Apr					
		1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
<30	314	974	0	14	0	0	0	0	0	1	0	1	
	320	1320	0	64	0	19	0	0	0	0	0	0	
31-50	293 ⁴	159	.	.	.	.	0	0	0	0	0	0
	308	112	0	0	0	0	0	0	0	0	0	0	
	312	272	0	0	0	0	0	0	0	0	0	0	
	315	827	0	0	0	0	0	5	35	40	0	0	
	321	1189	0	0	0	0	0	0	0	1	0	0	
	325	944	0	0	0	0	0	0	0	0	0	0	
	326	166	0	0	0	0	0	0	0	0	0	0	
	783 ¹	229	.	.	0	.	.	0	0	0	0	0	
51-100	294 ⁴	135	.	.	.	.	0	0	0	0	0	1
	297 ⁴	152	.	.	.	.	2	0	122	93	0	8
	307	395	0	10	64	0	1	0	81	33	0	0	
	311	317	5	0	9	15	0	0	416	377	0	1	
	317	193	0	22	0	0	0	76	430	1301	1	0	
	319	984	0	0	0	93	618	8	829	265	548	884	
	322	1567	0	0	0	8	1	1	0	9	8	1	
	323	696	0	0	0	0	10	0	1	24	2	1	
	324	494	0	0	0	0	0	0	0	0	0	1	
	781 ¹	446	.	.	0	0	0	0	0	0	1	0	
	782 ¹	183	.	.	0	0	.	0	0	0	0	0	
101-150	295 ⁴	209	.	.	.	.	109	203	0	40	7	3
	298 ⁴	171	.	.	.	.	90	188	305	90	159	359
	300 ⁴	217	.	.	.	.	44	268	79	110	53	34
	306	363	16	7	30	24	72	42	35	51	18	86	
	309	296	15	50	104	87	31	53	52	22	82	13	
	310	170	29	5	63	22	11	11	40	90	31	34	
	313	165	59	471	1244	623	158	47	248	78	412	246	
	316	189	.	2175	333	209	1512	1802	857	619	359	1464	
	318	129	81	1462	0	1540	149	119	212	48	108	482	
	779 ¹	422	.	.	0	0	0	0	0	1	1	0	
	780 ¹	403	.	.	0	0	.	0	0	1	1	2	
151-200	296 ⁴	71	.	.	.	.	161	23	35	40	47	119
	299 ⁴	212	.	.	.	.	371	674	430	755	593	760
	705	195	89	175	128	161	142	158	215	71	141	234	
	706	476	764	1387	875	1442	571	491	873	316	507	570	
	707	74	234	200	0	666	12	15	36	8	43	77	
	715	128	14	106	68	139	90	20	12	23	68	75	
	716	539	528	366	304	208	1045	275	460	242	1128	400	
	716	539	528	366	304	208	1045	275	460	242	1128	400	
201-300	708	126	239	62	342	64	92	4988	29	3	20	21	
	711	593	846	1119	492	1078	667	328	464	471	418	350	
	712	731	891	515	662	2011	860	446	636	321	335	626	
	713	851	1526	554	690	903	718	846	625	451	535	600	
	714	1074	816	757	374	1136	747	1130	702	412	476	798	
301-400	709 ²	147	114	38	42	890	59	.	126	137	79	80	
401-500	710 ¹	156	21	1	57	.	.	.	.	39	.	.
501-600	776 ¹	159	.	.	.	.	.	.	.	.	.	.
601-700	777 ¹	183	.	.	.	.	.	.	.	.	.	.
701-800	778 ¹	166	.	.	.	.	.	.	.	.	.	.
Total ³			6,285	9,557	5,878	11,337	7,564	11,556	7,891	5,628	8,286	7,842	11,775

Table 6. Mean bottom temperature data by depth zone, from sets in the Subdiv. 3Ps surveys.

YEAR	SEASON	DEPTH RANGE (M)					ALL DEPTHS
		<55	56 - 92	93 - 183	184 - 275	>275	
1983	S	2.48	0.63	0.41	5.10	4.94	2.74
1984	S	1.67	0.94	1.49	6.38	5.68	2.96
1985	W	-1.15	-1.14	-0.14	6.09	6.18	2.37
1986	W	-0.75	-0.95	0.46	7.35	5.90	2.39
1987	W	-0.95	-0.72	0.14	5.84	5.17	1.80
1988	W	0.15	0.29	0.73	5.95	4.94	2.51
1989	W	-0.51	-0.37	0.03	4.20	5.15	1.91
1990	W	-0.90	-0.82	-0.29	3.73	5.14	1.71
1991	W	-0.28	-0.47	-0.14	4.06	4.99	1.91
1992	W	-0.86	-0.69	0.03	5.24	4.95	2.00
1993	W	-0.71	-0.75	-0.07	6.03	5.40	2.32
1993	S	-0.40	-0.98	-0.81	6.22	5.68	2.32
1994	S	0.53	-0.65	-0.58	3.65	5.24	1.85
1995	S	0.29	-0.59	-0.11	3.87	5.32	1.96
1996	S	1.11	0.35	0.87	4.22	5.30	2.46
1997	S	0.16	-0.43	0.02	4.10	5.13	1.90
1998	S	1.73	0.36	0.62	3.67	4.59	2.19
1999	S	2.61	0.71	0.98	4.31	4.99	2.69
2000	S	2.53	0.88	1.53	4.00	5.23	2.77
2001	S	0.69	-0.26	-0.05	3.43	4.90	1.91
2002	S	0.95	-0.06	0.07	4.03	5.29	2.15
Mean		0.40	-0.22	0.25	4.83	5.24	2.23

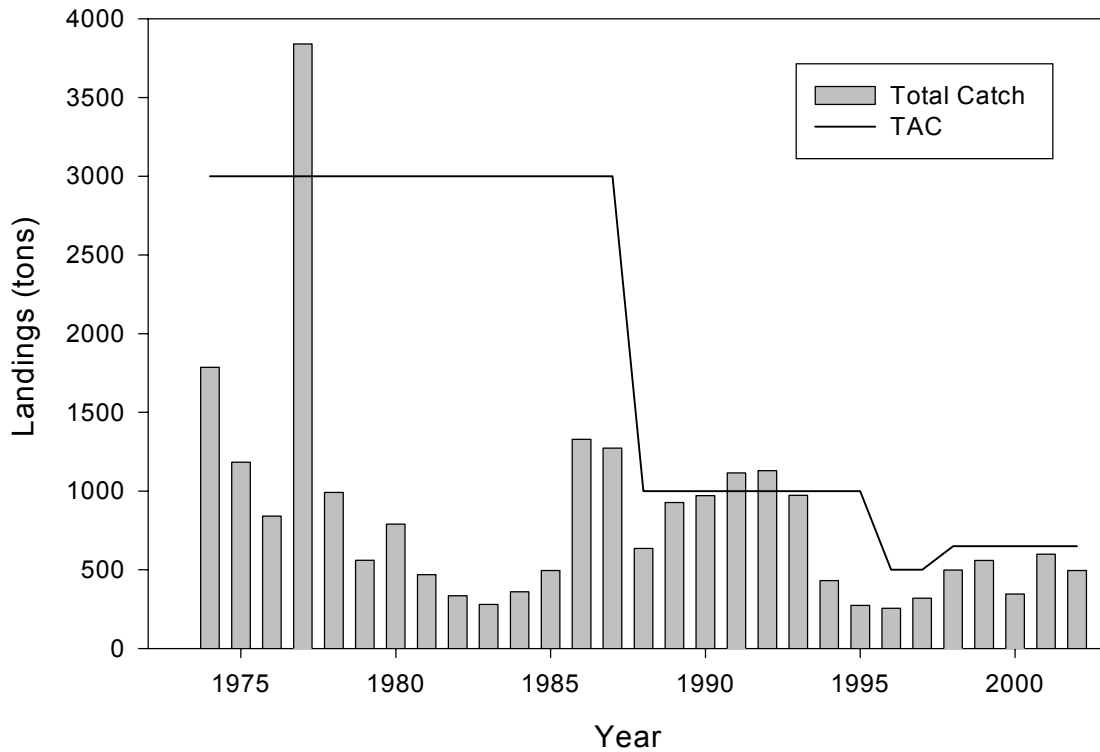


Fig. 1 Total landings and TACs of witch flounder from Subdivision 3Ps during 1974-2002. The 2002 data represent the catch to October 2.

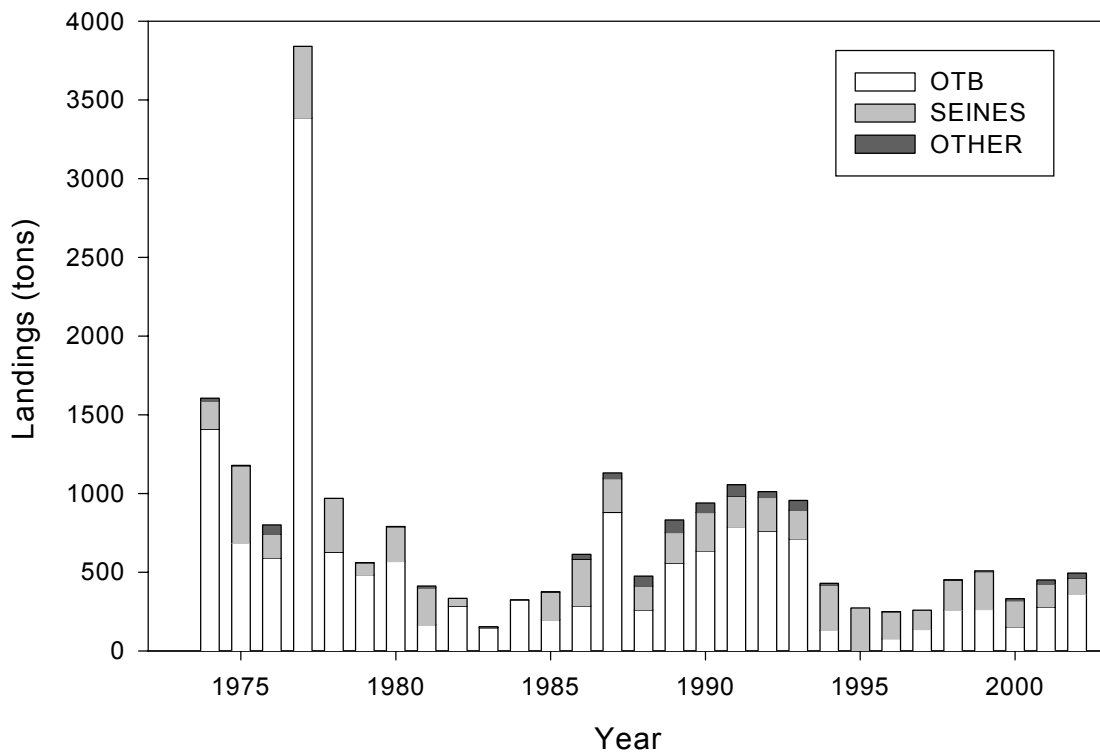


Fig. 2 Landings by gear type of witch flounder by Canada (N) from Subdivision 3Ps during 1974-2002. The 2002 data represent the catches to October 2.

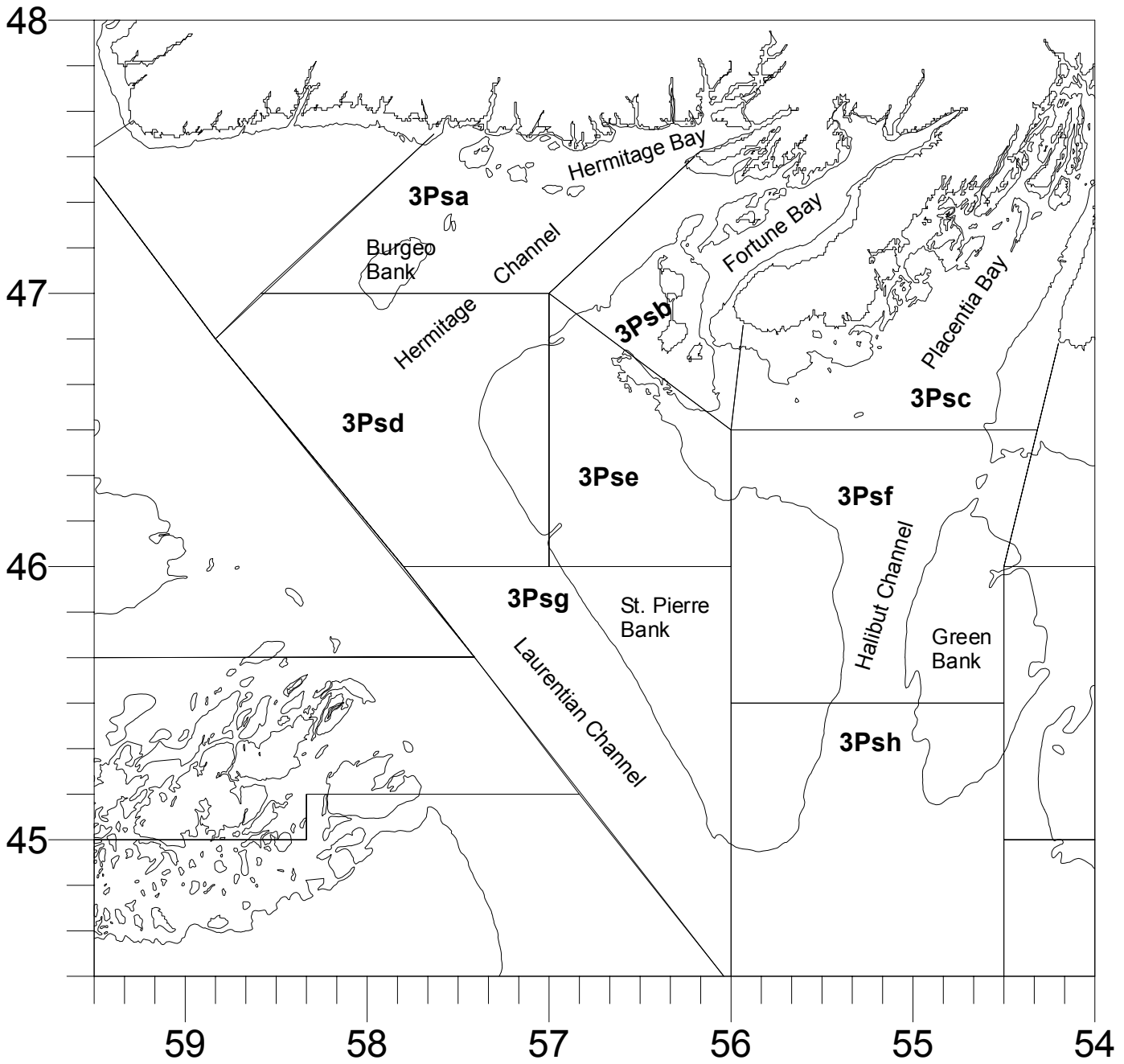


Fig. 3 Commercial catch reporting statistical areas for NAFO Subdivision 3Ps with the major place names mentioned in the text.

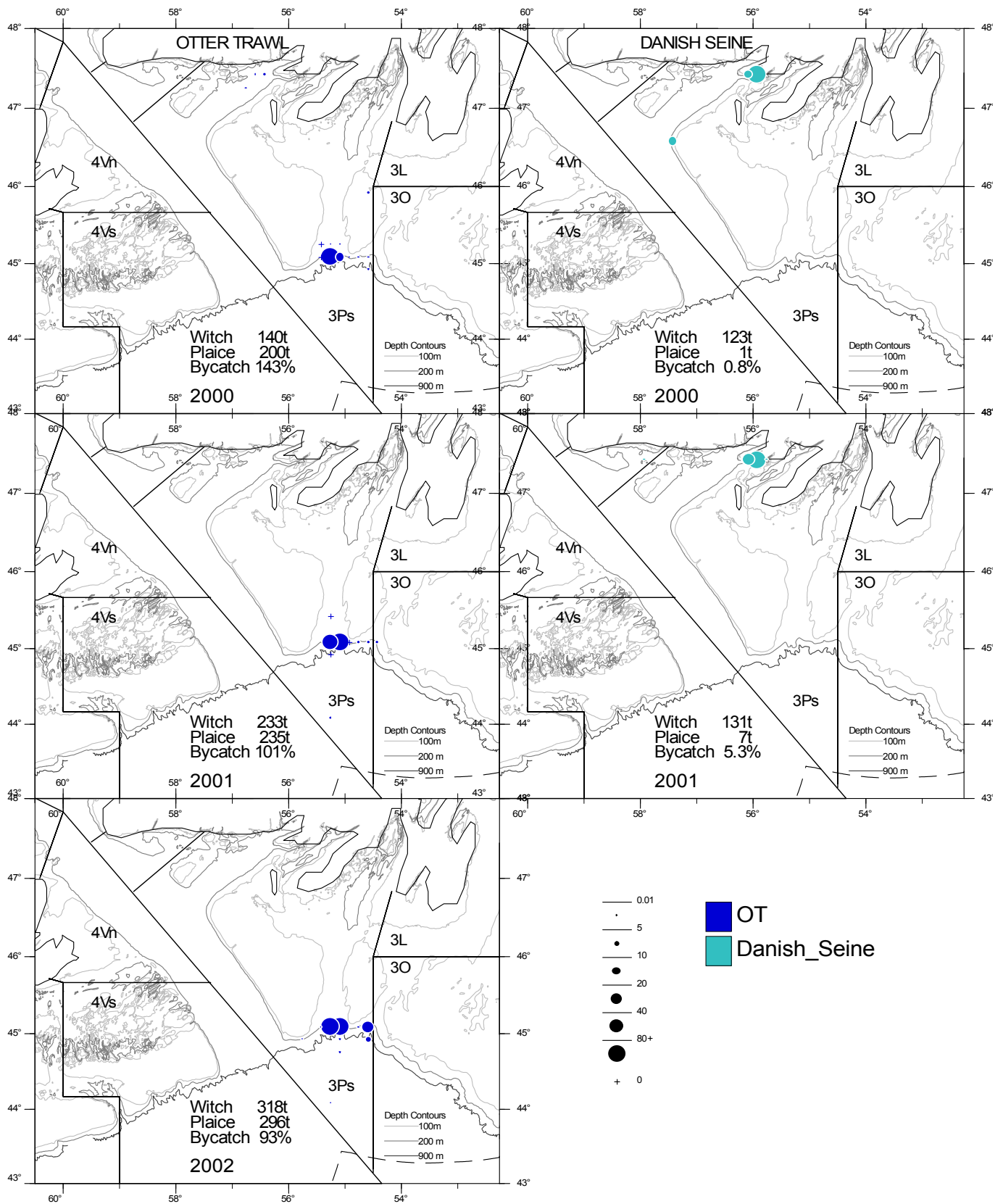


Fig. 4. Distribution of Can(N) Witch flounder catch (tons) from commercial fishery from 2000-2002. Represented is OTTER TRAWL and DANISH SEINE gears from directed witch fisheries denoting bycatch of American plaice. The data are aggregated by 10-minute square for Div. 3Ps where position was recorded on the logbook.

wibla 2000-2002 z:ifat bvo:ear:ACN

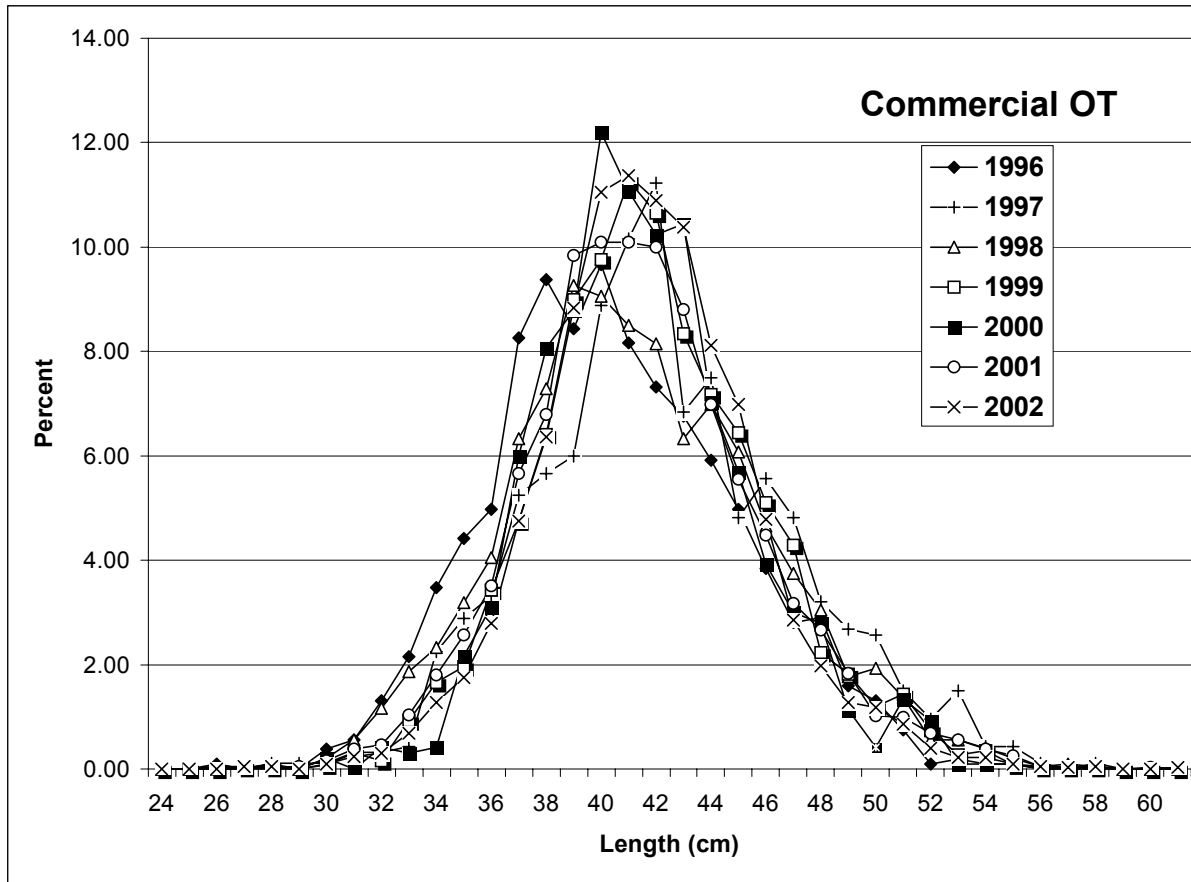


Fig. 5. Percent of witch flounder caught at length (cm) from the Canada (Newfoundland) commercial offshore otter trawl fishery in NAFO Subdivision 3Ps from 1996-2002.

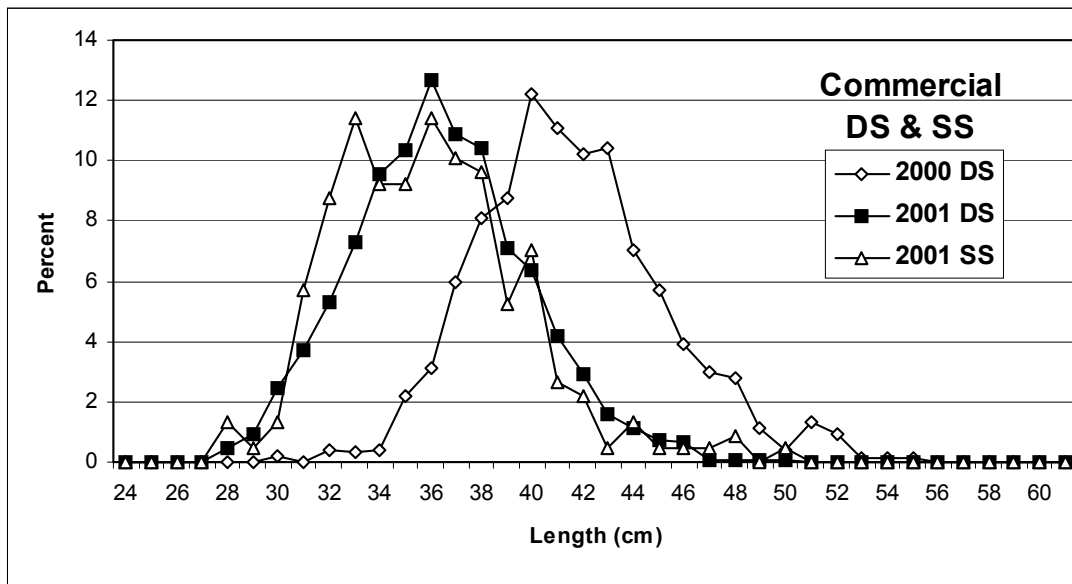


Fig. 6 Percent of witch flounder at length (cm) sampled from the commercial fishery in NAFO Subdivision 3Ps during 2000-2002.

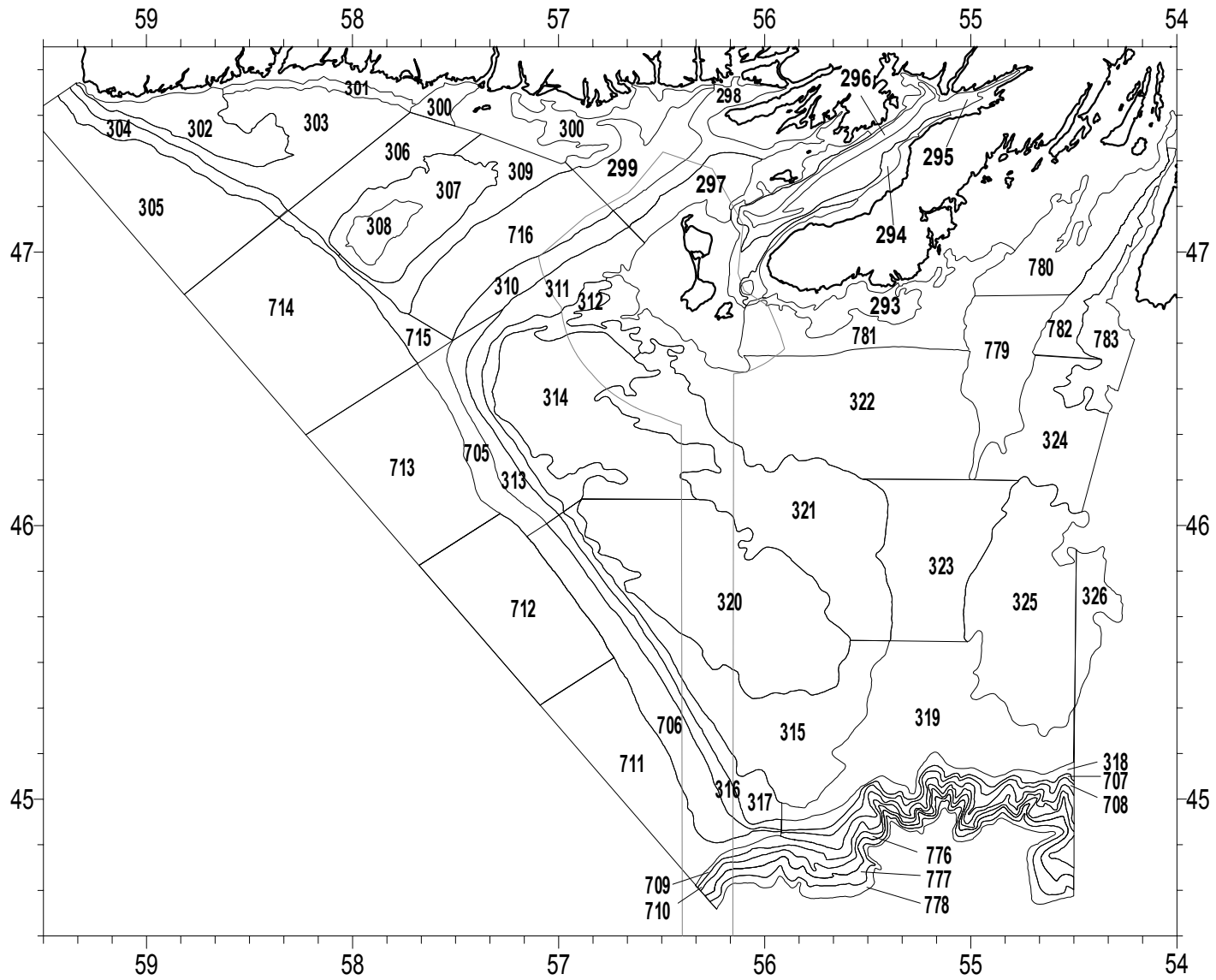


Fig. 7. The survey area in NAFO Subdivision 3Ps showing strata boundaries currently used in the spring research vessel bottom trawl surveys.

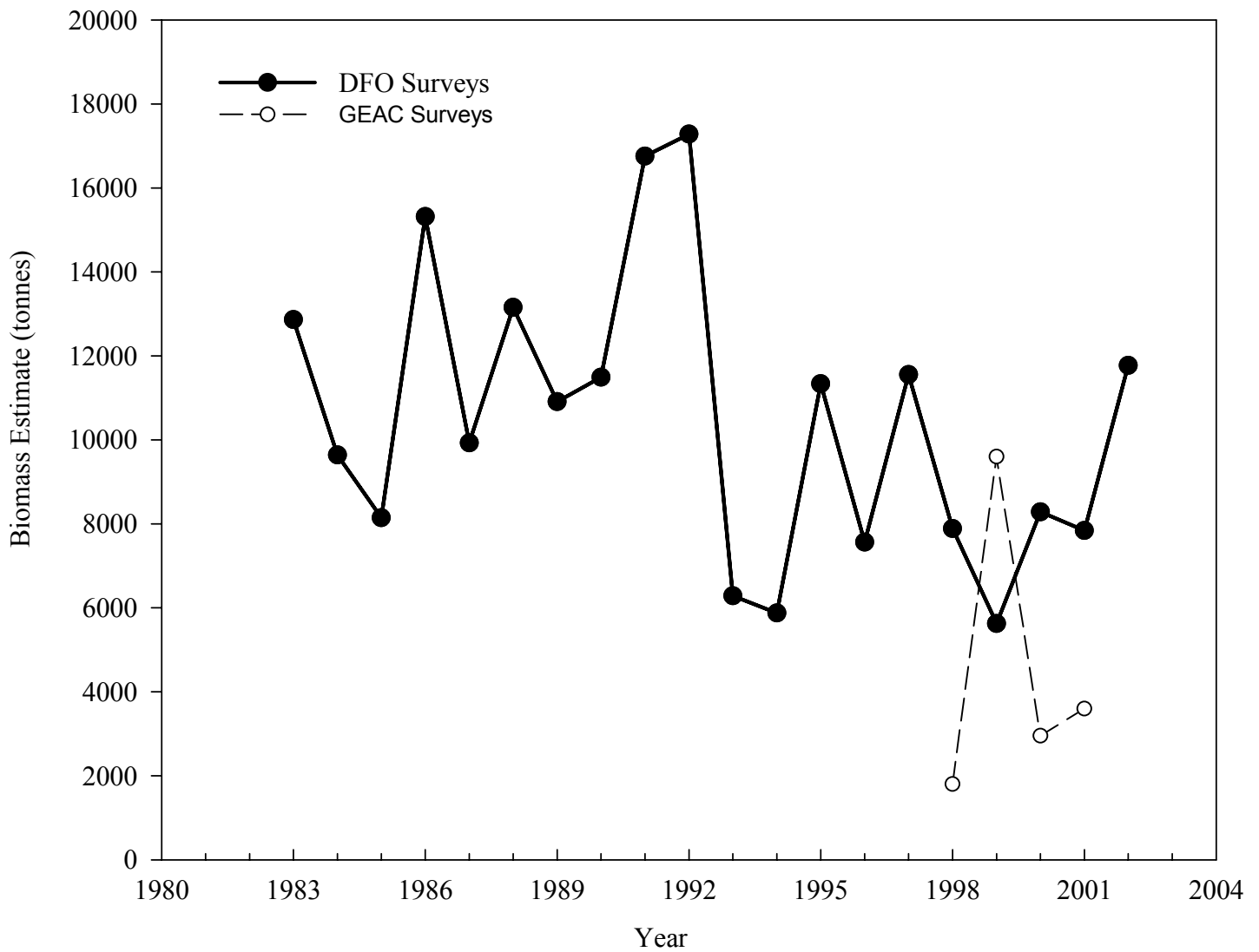


Fig. 8 Biomass indices of witch flounder in Subdiv. 3Ps from DFO surveys during 1983-2002 and GEAC surveys from 1998-2001.

Note: 1) 1983-84 & 1994-2000 DFO surveys were conducted in April.
 All other DFO surveys were in February-March.
 2) All GEAC surveys were conducted in November.

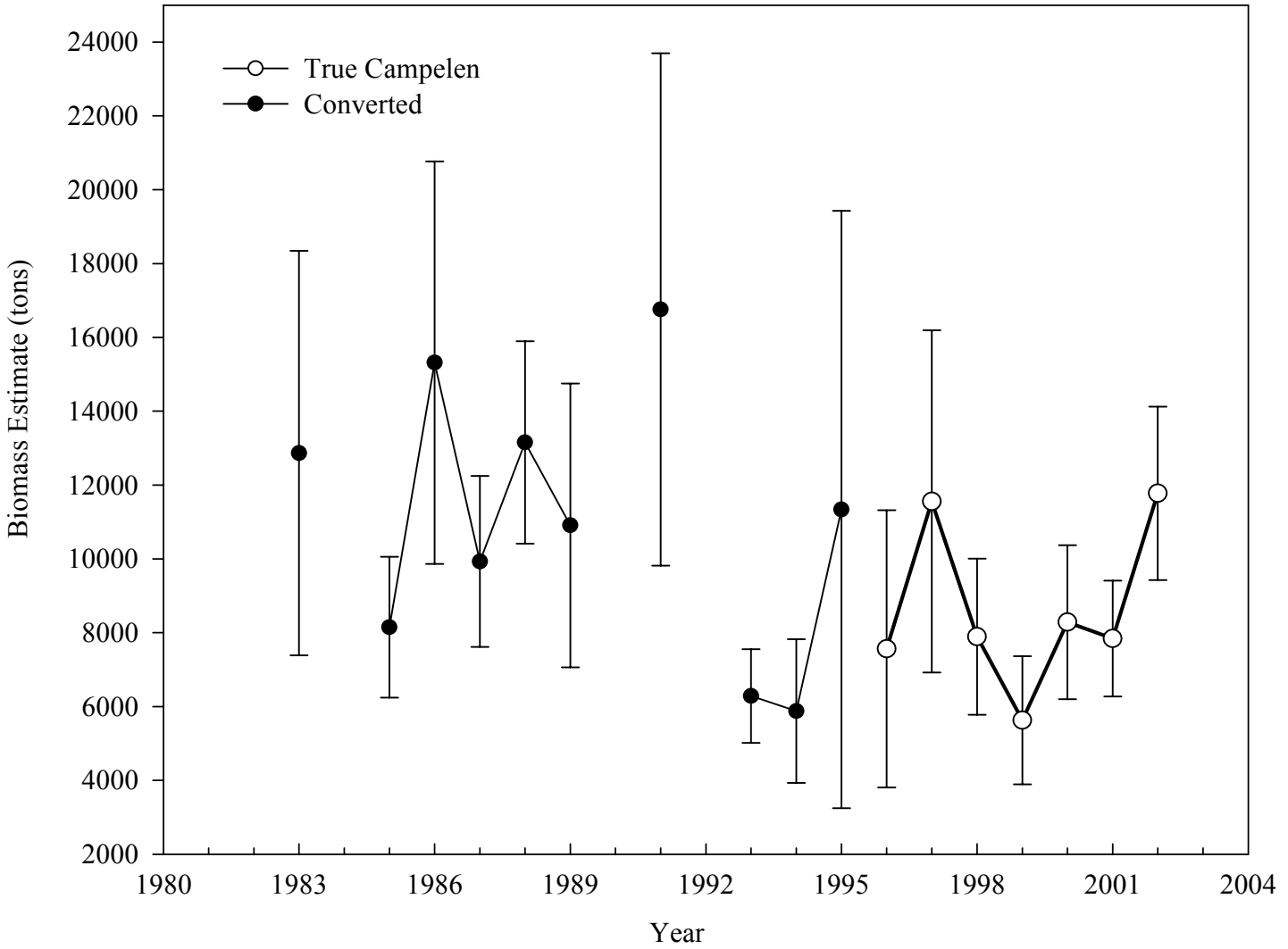


Fig. 9 Campelen biomass index of witch flounder in Subdiv. 3Ps from Canadian surveys during 1983-2002. The 95% confidence intervals are shown for the "true" Campelen survey estimates.

- Note:**
- 1) 1983-84 & 1994-2000 surveys were conducted in April.
 - 2) All other surveys were in Feb-Mar except 1993 which had surveys in both Feb and April.
 - 3) Estimates were omitted for 1984, 1990 and 1992 where lower confidence limits were negative.

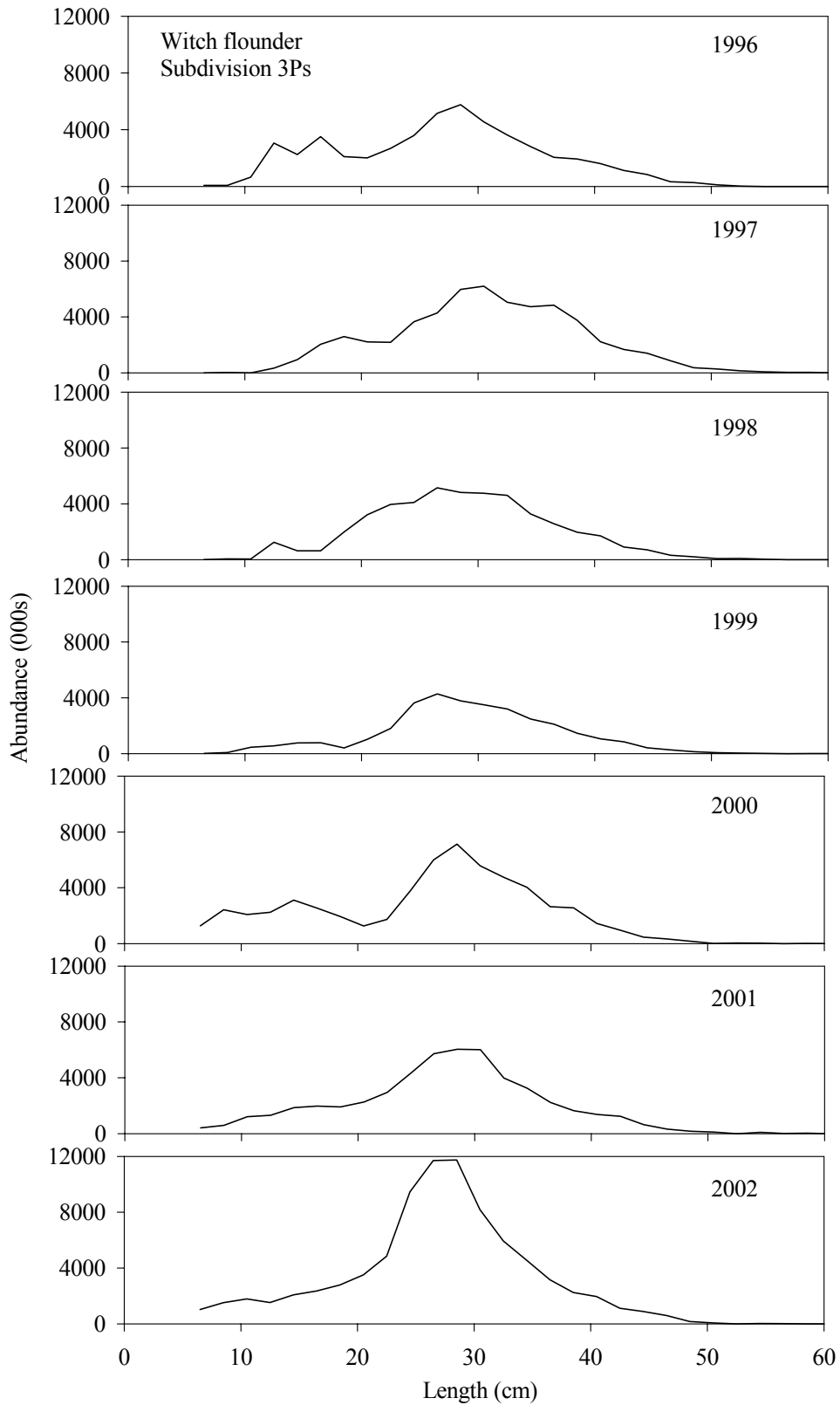


Fig. 10 Abundance (000s) at length (cm) of witch flounder from Canadian spring surveys in NAFO Subdivision 3Ps during 1996-2002.

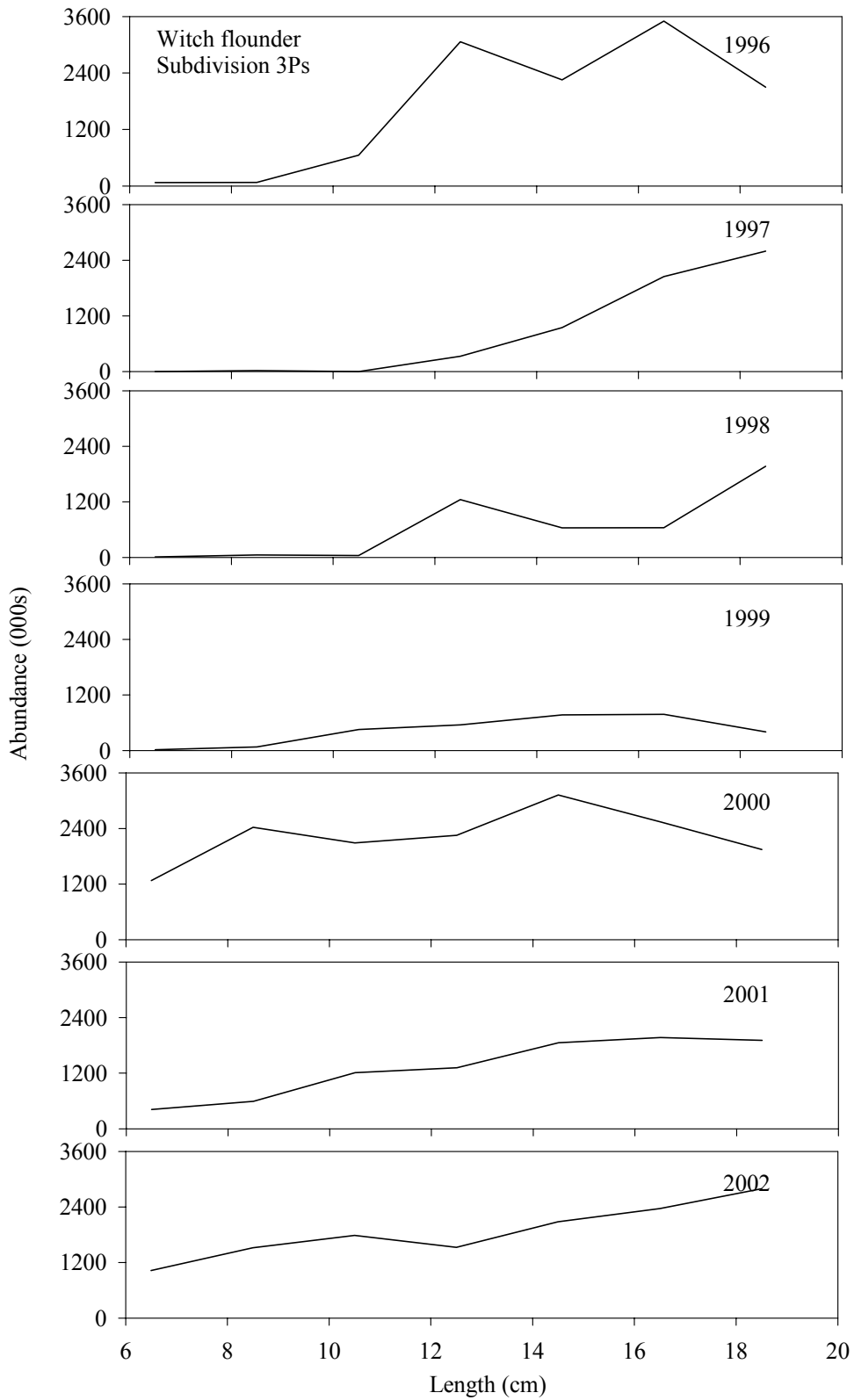


Fig. 11 Abundance (000s) at length (cm) (for lengths less than 20cm) of witch flounder from Canadian spring surveys in NAFO Subdivision 3Ps during 1996-2002.

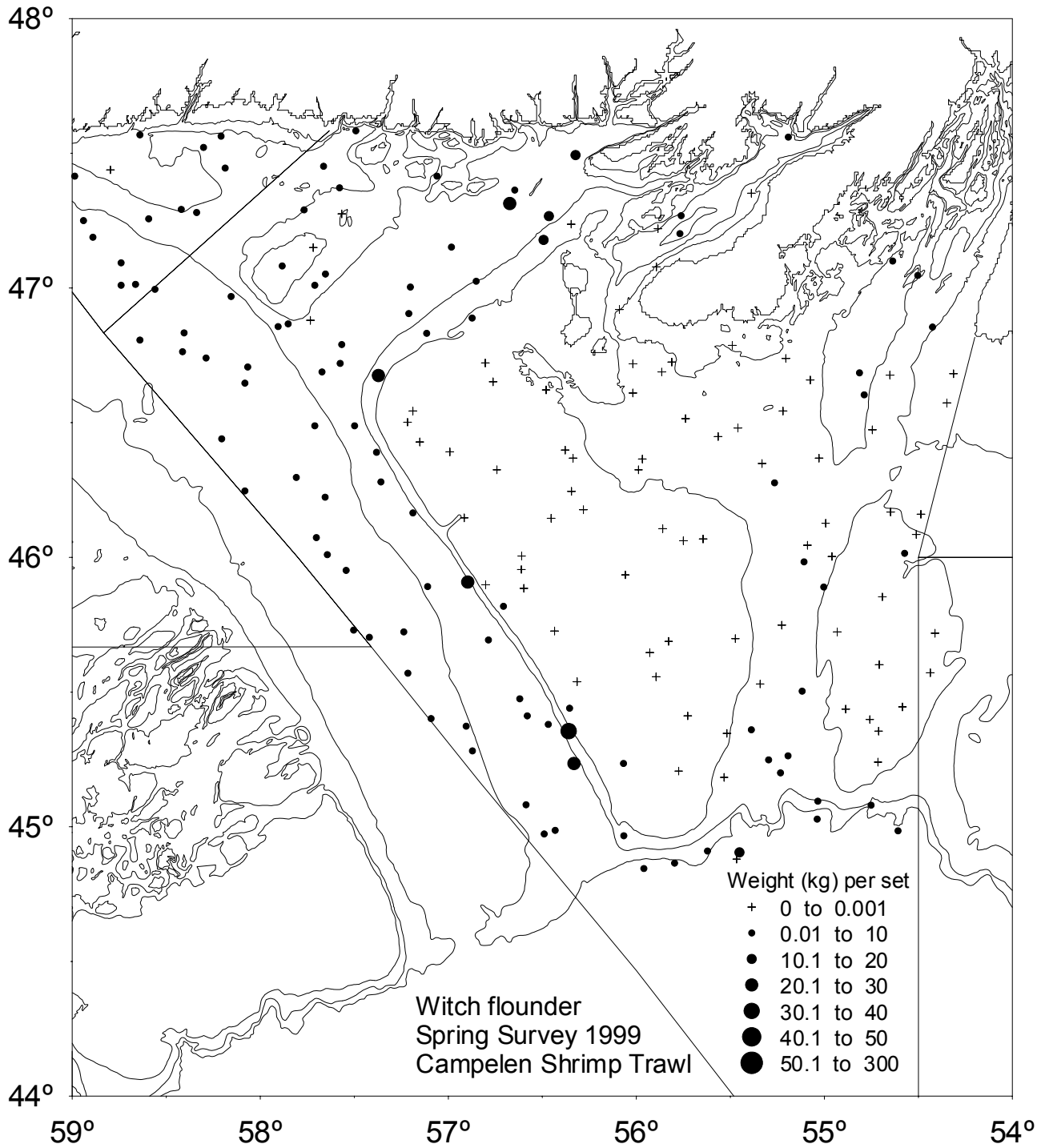


Fig. 12a Witch flounder distribution (kg/set) from Canadian spring 1999 surveys conducted using a Campelen shrimp trawl.

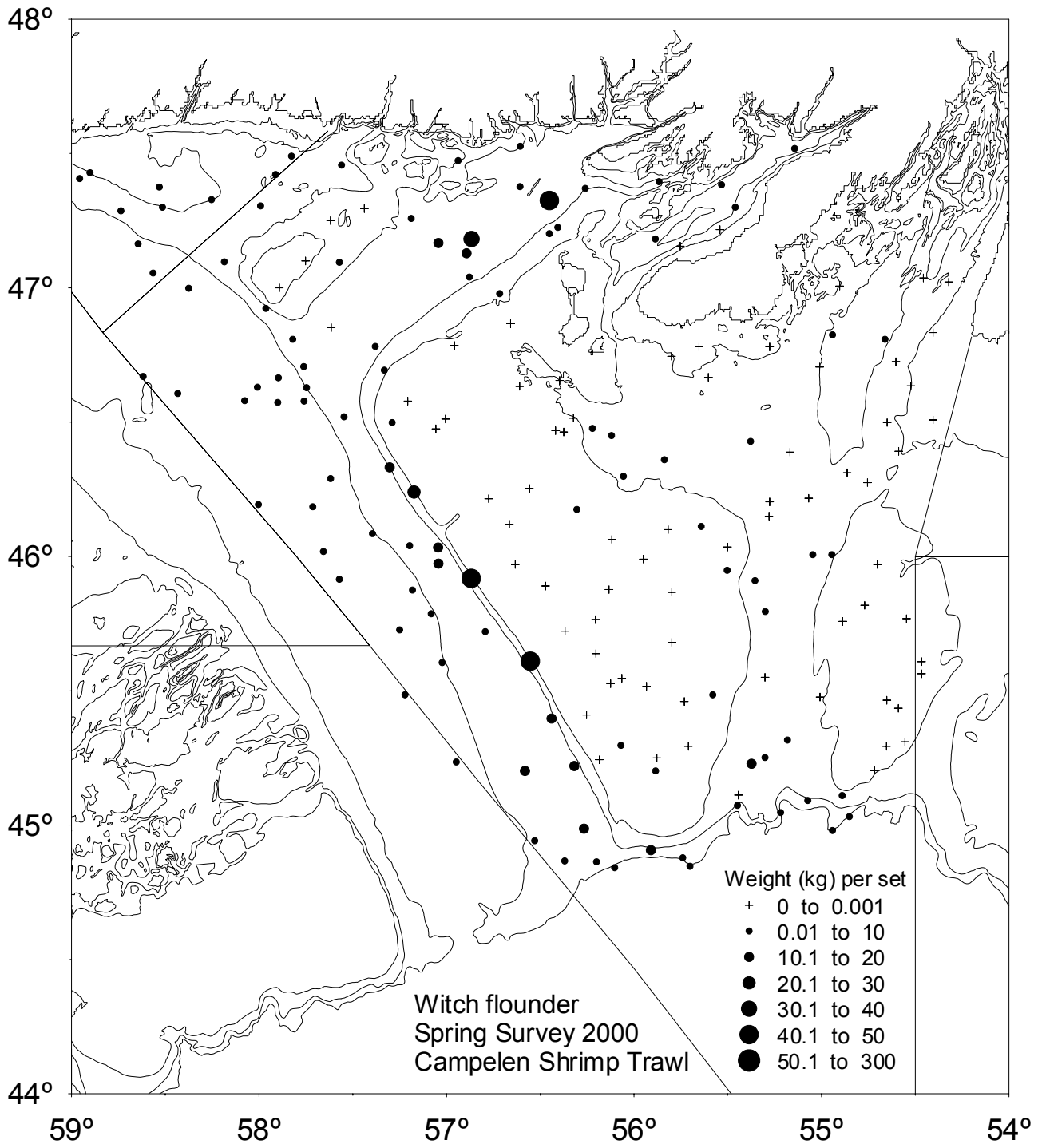


Fig. 12b Witch flounder distribution (kg/set) from Canadian spring 2000 surveys conducted using a Campelen shrimp trawl.

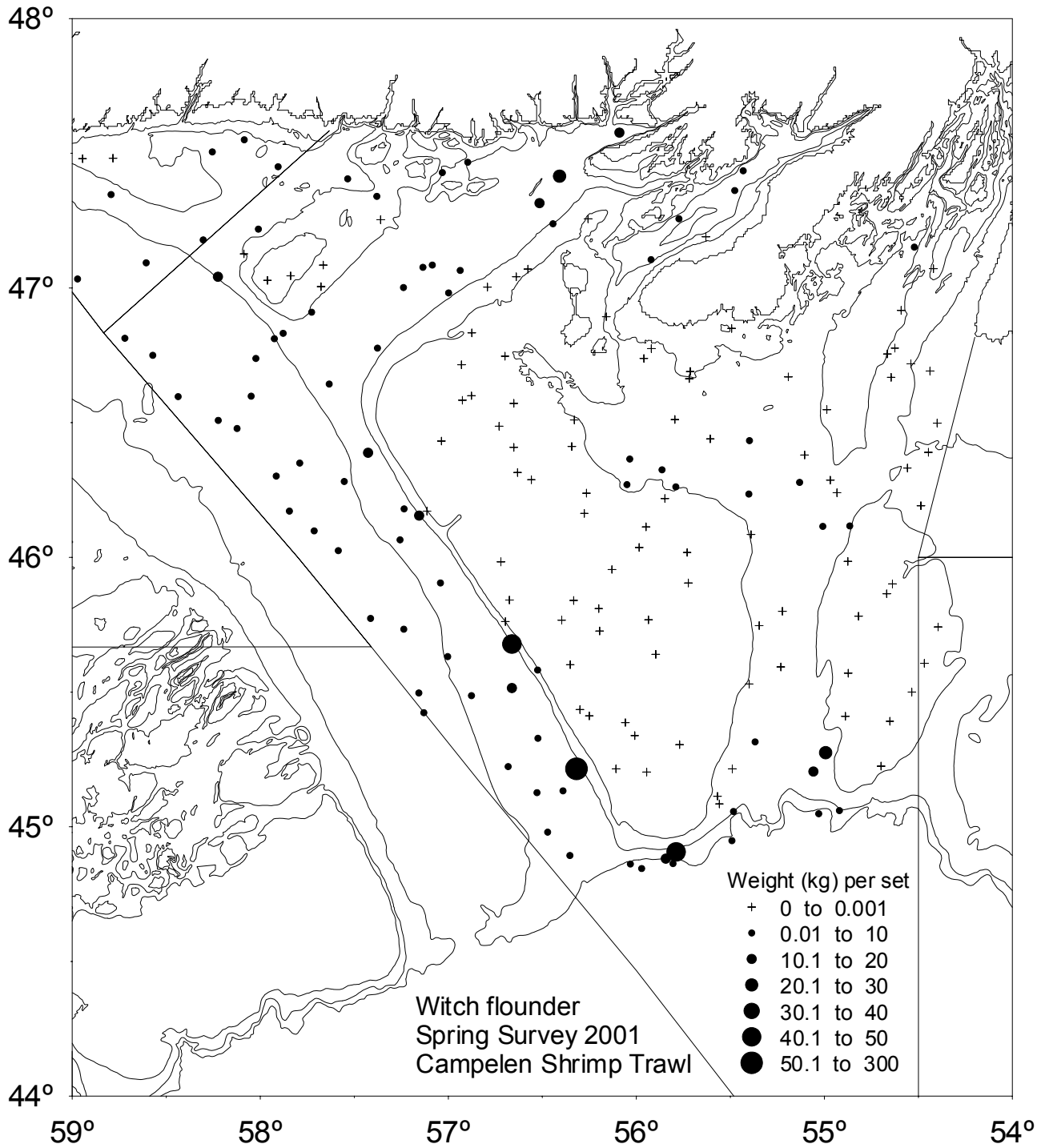


Fig. 12c Witch flounder distribution (kg/set) from Canadian spring 2001 surveys conducted using a Campelen shrimp trawl.

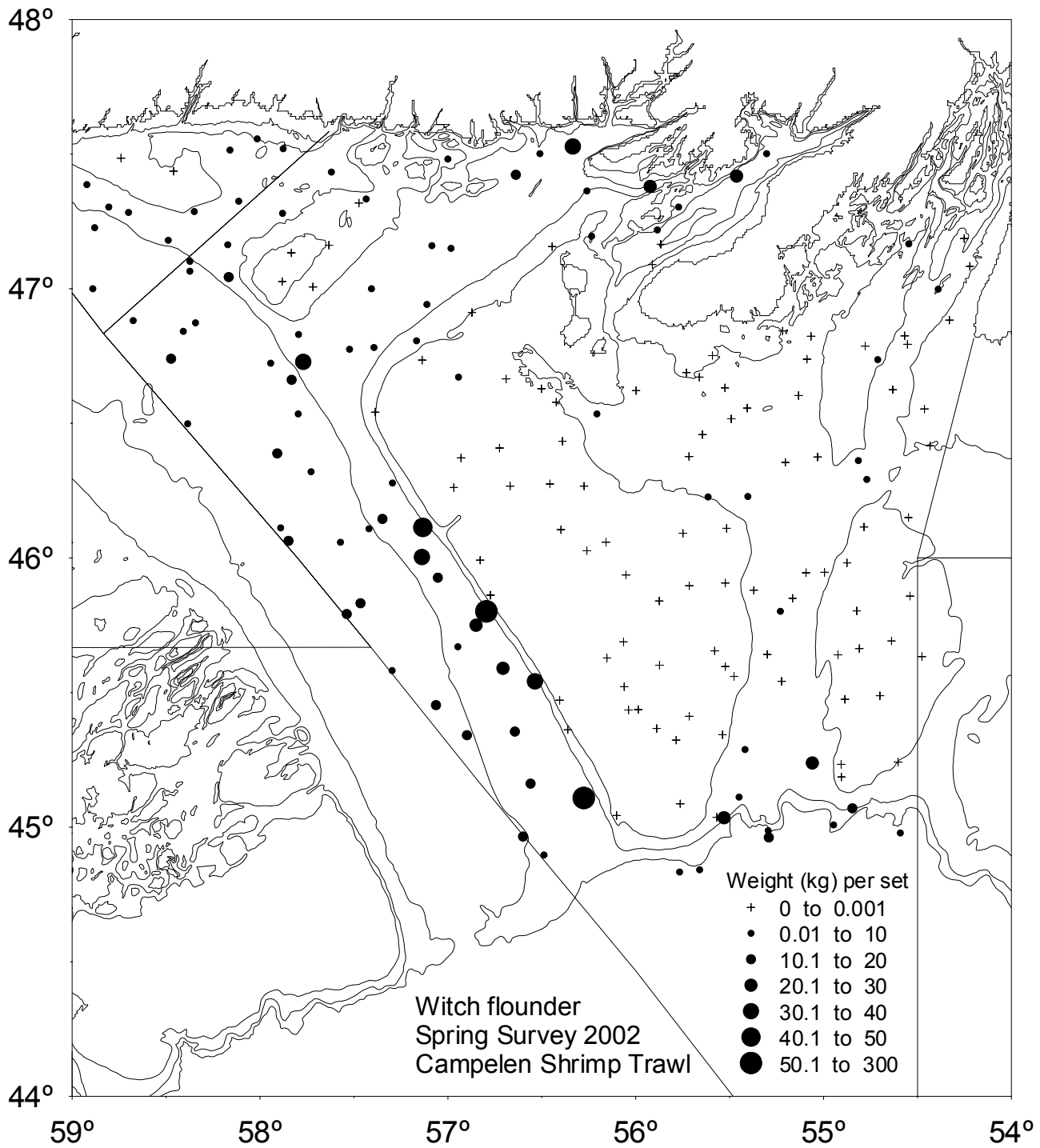


Fig. 12d Witch flounder distribution (kg/set) from Canadian spring 2002 surveys conducted using a Campelen shrimp trawl.

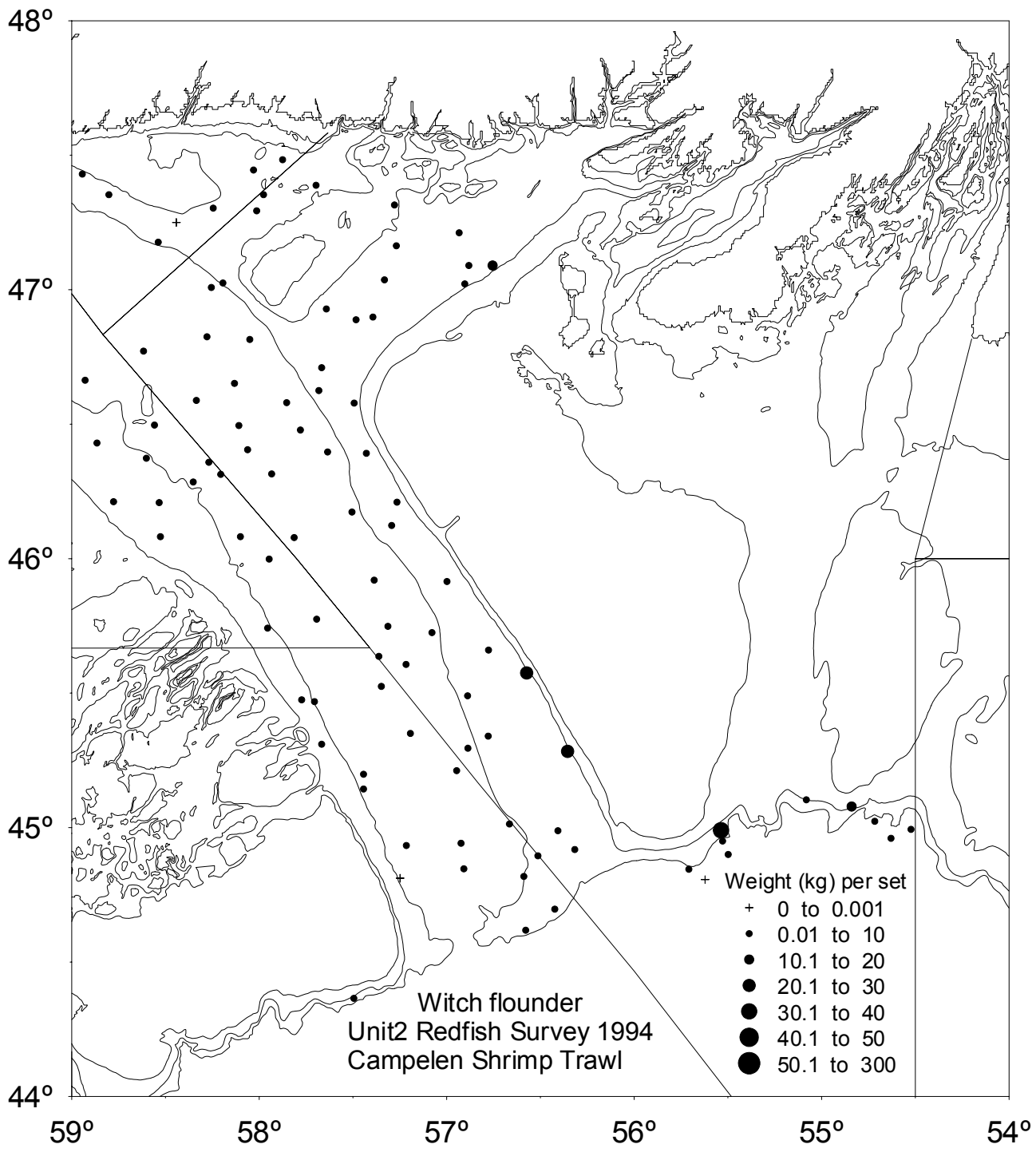


Fig. 13a Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 1994 using a Campelen shrimp trawl.

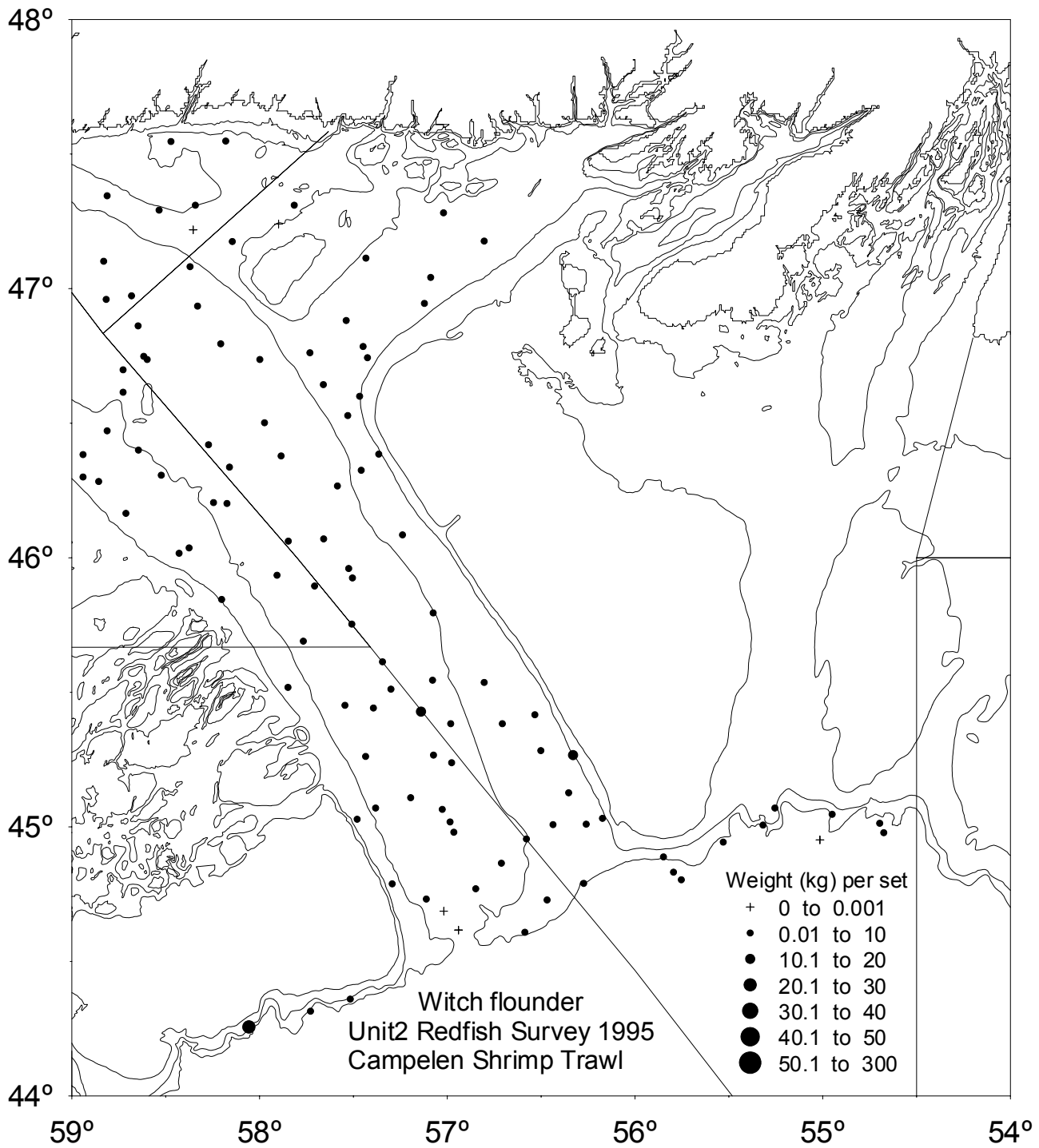


Fig. 13b Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 1995 using a Campelen shrimp trawl.

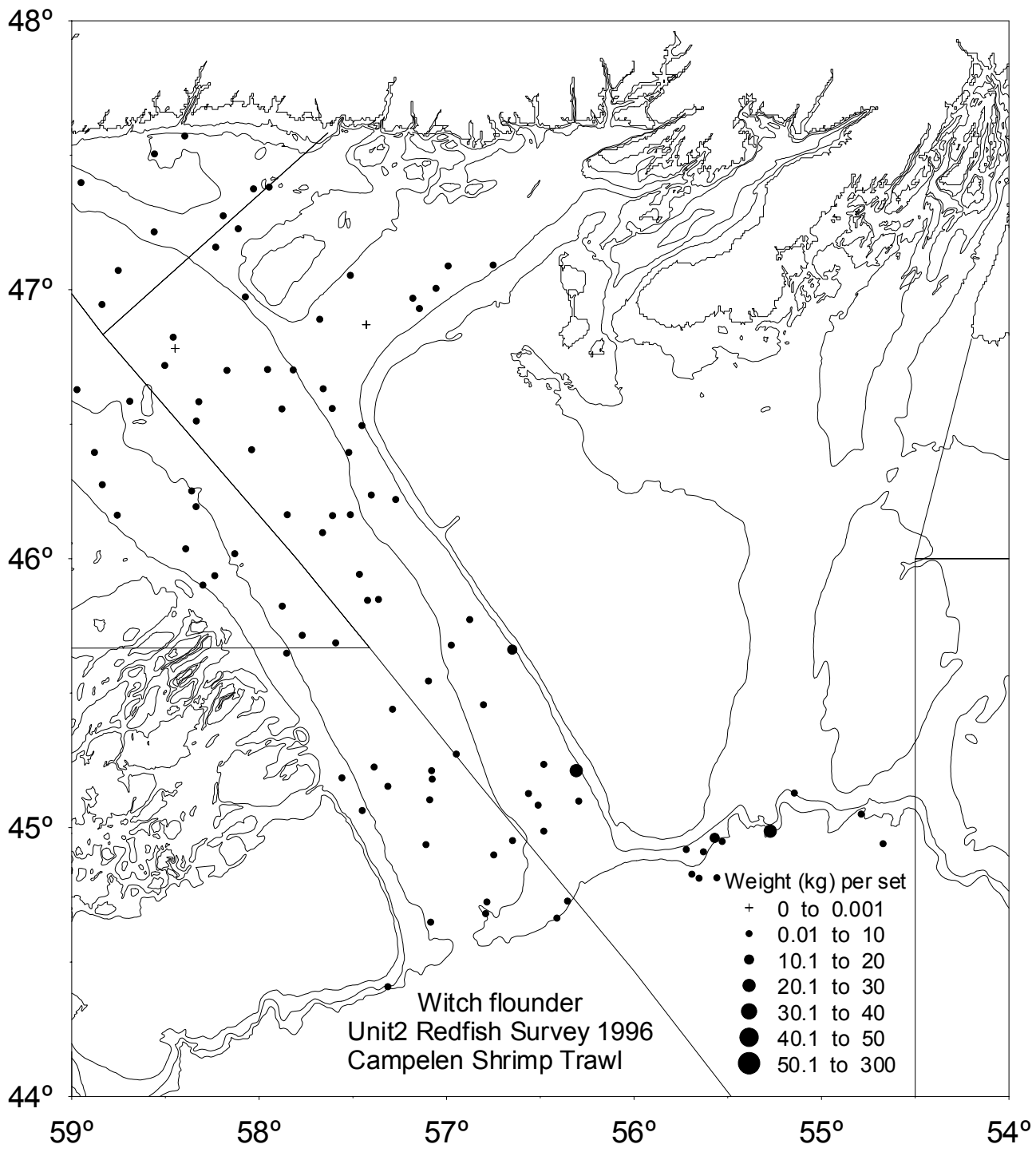


Fig. 13c Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 1996 using a Campelen shrimp trawl.

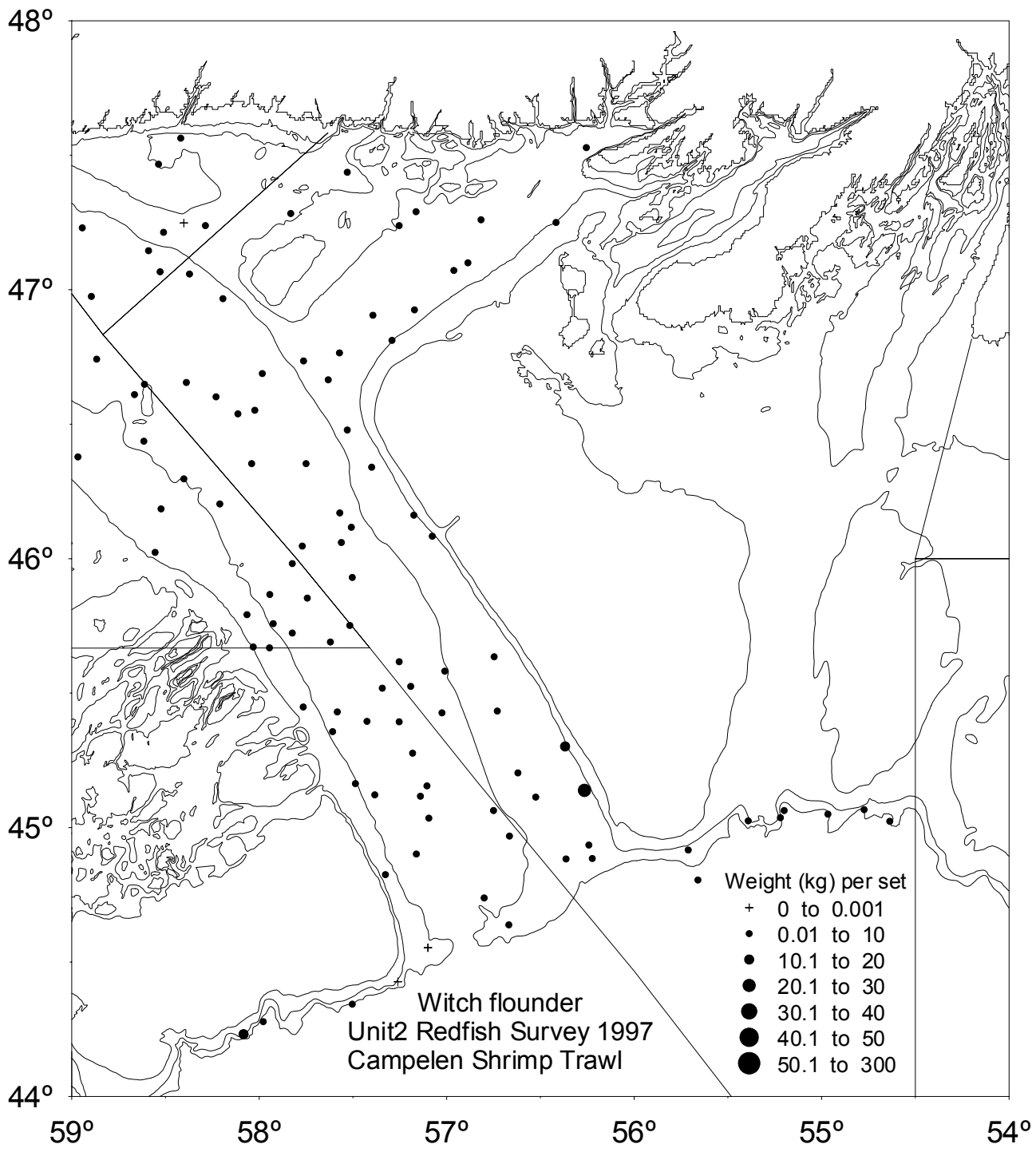


Fig. 13d Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 1997 using a Campelen shrimp trawl.

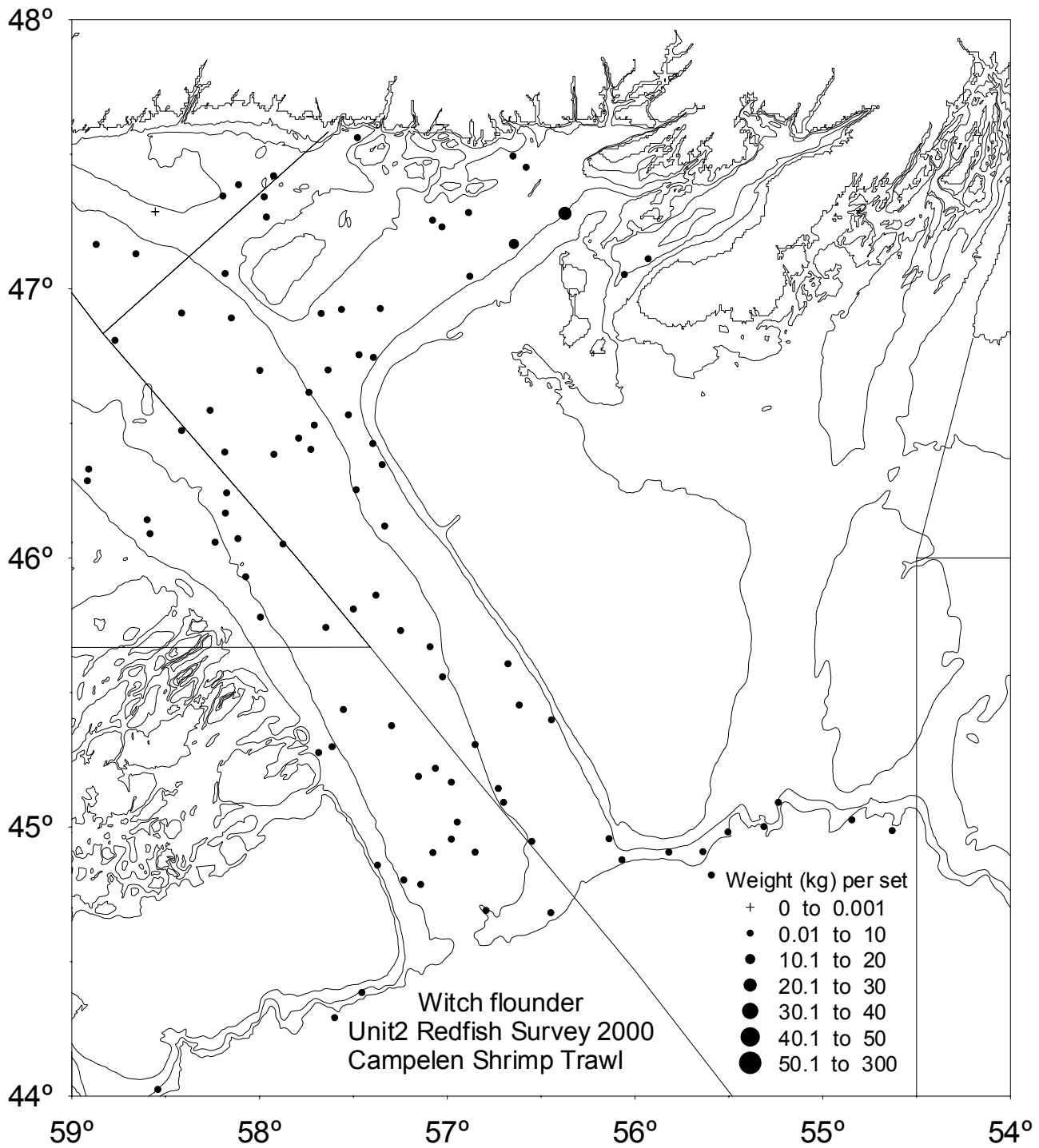


Fig. 13e Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 2000 using a Campelen shrimp trawl.

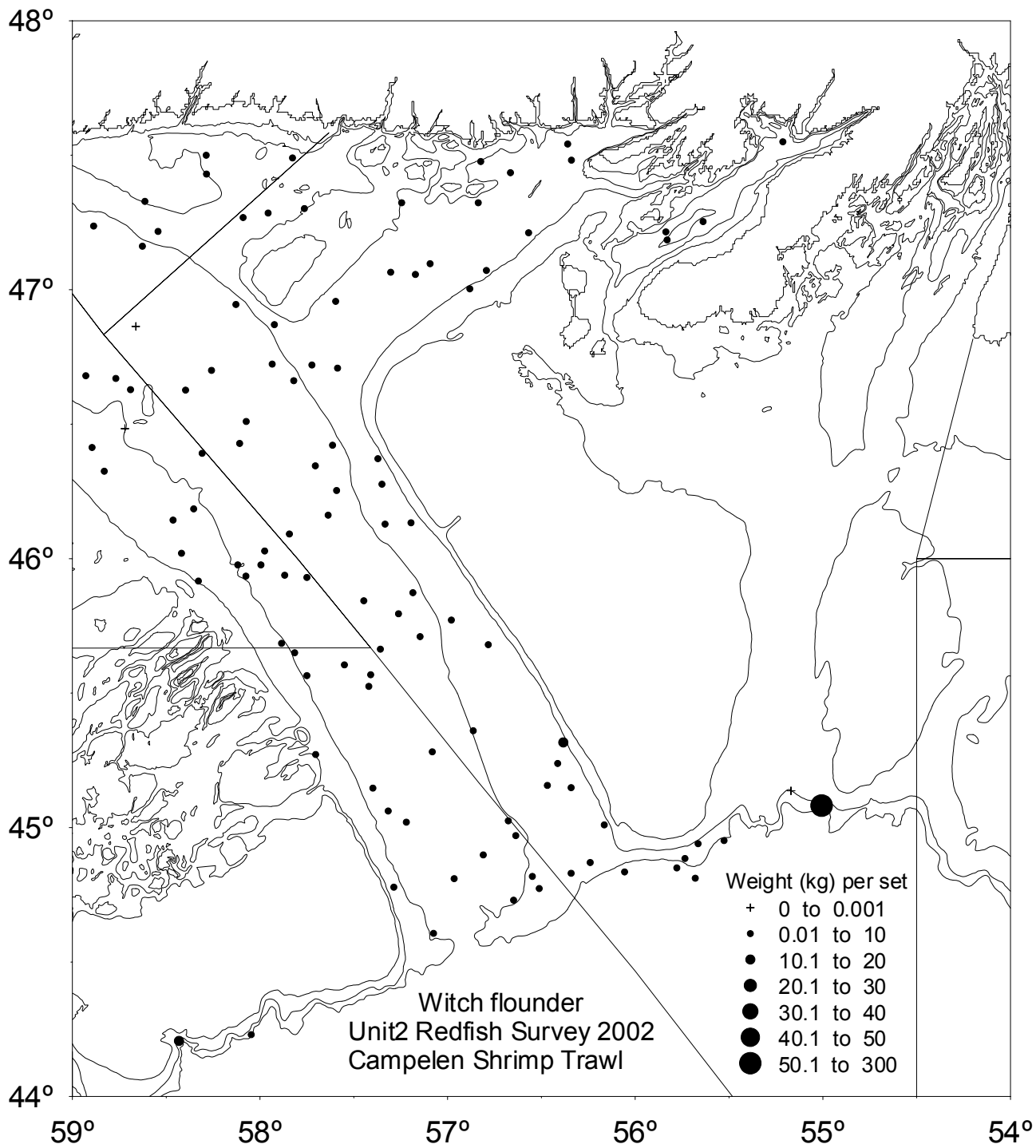


Fig. 13f Witch flounder distribution (kg/set) from the Canadian Unit2 Redfish survey conducted in summer 2002 using a Campelen shrimp trawl.