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Distribution and abundance of witch flounder on Flemish Cap and in Flemish Pass based on Canadian and EU research vessel survey data

by

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Introduction

Small catches of witch flounder often have been reported from NAFO Division 3M as small by-catches in other groundfish fisheries but has never been a regulated species for this area. In recent years, witch flounder has been reported more frequently as a by-catch in the Greenland halibut fishery in the deep waters of Flemish Pass. Because Flemish Pass is artificially split by the dividing line between Division 3L and 3M concern has been expressed that those catches are likely to be more associated with the witch flounder stock in Divisions 2J, 3KL which has been under moratorium since the mid 1990's. As a consequence, it has been considered that witch flounder in Division 3M is probably a logical extension of the stock in Divisions 2J, 3KL which is distributed along the continental slope area to as far south as the deep eastern slope of the Grand Bank extending into Flemish Pass.

The purpose of this paper is to describe the distribution and abundance of witch flounder in NAFO Division 3M and hypothesize as to its potential relationship with the witch flounder resource in Divisions 2J, 3KL.

Materials and Methods

Source material is based on data collected during the following survey series:

1) stratified random surveys on Flemish Cap (Division 3M) by Canada during winter of 1978-85 using an *Engel 145'* groundfish trawl covering depths to 730 m,
2) Canadian Greenland halibut directed deepwater surveys in Divisions 3LM during summer 1991 and winter 1994 using an *Engel 145'* groundfish trawl covering depths to near 1500 m,
3) stratified random Canadian multispecies surveys carried out in Divisions 3LM during fall of 1996-2001 using a *Campelen 1800* shrimp trawl covering depths to near 1500 m and
4) stratified random EU groundfish surveys conducted in summer of 1988-2001 with an *Lofoten* groundfish trawl covering depths to 730 m.

Biomass estimates by stratum and year are shown in Tables 1 and 2 for the Canadian Flemish Cap surveys during 1978-1985 and the EU Flemish Cap surveys during 1988-2001, respectively and plotted together in Figure 1 for illustration.

Distribution patterns are illustrated by plotting witch flounder catches (kg) per set on topographic maps of the area using Surfer 8.00 software. The results are presented in Figures 2a-b; Figure 3; Figures 4a-c and Figures 5a-d, for the respective survey series described above.

In order to demonstrate the depth zones of highest density for witch flounder on Flemish Cap the survey biomass estimates by each of six depth zone for the Canadian and EU Flemish Cap surveys were converted to biomass per square nautical mile to remove the stratum area effect. For each year the relative density by depth was plotted as a percentage of the annual total and shown in Figures 6 and 7 for the Canadian and EU survey results, respectively.

Results

Biomass trends

Estimates of biomass have been generally low for all data examined. Except for a higher value (about 900 tons) in 1978, the Canadian survey estimates ranged between 200-400 tons with a small increasing trend between 1979 and 1985 (Table 1; Fig. 1). With the exception of an anomolously high value at the beginning of the EU survey series in 1988 at 900 tons there was an increasing trend from 300 tons in 1989 to 1000 tons in 1993 (Table 2; Fig. 1). This was followed by a declining trend to reach its lowest value of 200 tons by 1998. Since then there was an increase to near 500 tons by 2001 (Table 2; Fig. 1).

Distribution Patterns

Canadian Flemish Cap surveys from 1978-85 showed witch flounder to be widely distributed in small numbers over the west side of Flemish Cap particularly in depths between 128-366 m (Fig 2a,b). This pattern was generally maintained throughout the period.

The Canadian Greenland halibut directed survey in summer of 1991 along the slope area of Divisions 3KLM and into Flemish Pass caught virtually no witch flounder (Fig. 3). The winter survey in 1994, on the other hand, caught witch flounder in most sets on both the Grand Bank and the Flemish Cap sides of the Pass although sets in the central and deepest part of the Pass yielded no catch (Fig. 3).

The Canadian survey series from 1996-2001 (Fig. 4) show rather similar distribution patterns as the Canadian winter survey in 1994 (Fig. 3) with highest catches along the eastern slope of the Grand Bank. Except for one set in the 1998 survey, none were caught in the central deep parts of the Flemish Pass in this series of surveys. Catches on the Flemish Cap side of the Pass were mostly on shallower parts of the Cap (1996 survey) including the very shallowest parts of the Flemish Cap compared to the earlier Canadian survey series described above (Fig. 2).

EU surveys from 1988-2001 show that witch flounder are generally widespread over Flemish Cap in depths less than 366 m (Fig. 5) particularly in the earlier part of the data series. In the recent period, however, most have been caught on the very shallowest top of the Flemish Cap (Fig. 5).

Density with Depth

The depth zone of highest density in the Canadian survey series 1978-85 was 257-366 m in 1978 but moved progressively shallower to the 147-184 m zone by 1981 (Fig. 6). For most years including 1984-85 and the overall mean showed the highest density in 257-366 m.

The depth zone of highest density in the EU survey series 1988-2001 was in 9 of the 14 years the shallowest zone of 128-146 m (Fig. 7). For the remaining years, the highest density occurred in 147-184 m.

Conclusions

Based on the available distribution data it would seem that witch flounder resources in Division 3L and 3M are not strongly linked. In addition, however, the distribution pattern for witch flounder in the deep water of Flemish Pass in Division 3M would infer that any by-catch from this area particularly in the Greenland halibut fishery would have to be extremely small.

Table 1. Biomass estimates of witch flounder by stratum from Canadian surveys conducted in Div. 3M during 1978-85. Surveys were conducted using an Engel trawl and have NOT been converted to Campelen units.

Depth (m)	V1_Area	V4_Area	Stratum	1978	1979	1980	1981	1982	1983	1984	1985
128 - 146	342	342	501	0	0	0	0	0	12	0	6
147 - 184	838	838	502	31	7	21	51	2	18	28	35
185 - 256	628	628	503	13	14	12	30	6	8	47	28
	348	348	504	24	0	0	13	10	18	10	14
	703	703	505	53	26	95	19	35	82	59	13
	496	496	506	114	6	51	23	19	24	11	32
257 - 366	822	822	507	86	0	26	11	48	53	60	33
	646	646	508	46	6	9	4	12	19	14	35
	314	314	509	3	0	0	0	2	0	0	3
	951	951	510	305	124	90	119	80	30	100	40
	806	806	511	117	16	22	57	25	15	74	82
367 - 549	670	670	512	13	0	2	8	0	1	4	4
	249	249	513	0	0	0	0	0	0	0	0
	602	602	514	19	0	6	14	3	8	24	24
	666	666	515	96	6	22	25	.	21	31	19
	.	102	537	.	.	.	.	.	.	.	.
550 - 731	634	634	516	4	0	1	0	.	0	2	0
	216	216	517	0	0	1	0	.	0	0	0
	210	210	518	1	0	0	1	.	0	3	9
	414	414	519	13	9	0	5	.	0	0	2
	.	194	538	.	.	.	.	.	.	.	.
Biomass (t)				937	214	359	381	243	310	467	379

Table 2. Biomass estimates of witch by stratum from EU surveys couducted in Div. 3M during 1988-2001.
Surveys were conducted using an Alfredo groundfish trawl.

Depth (m)	V1_Area	V4_Area	Stratum	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
128 - 146	342	342	501	117	60	22	12	88	24	14	250	213	91	48	20	145	155
147 - 184	838	838	502	221	107	62	165	172	259	156	101	90	102	54	126	177	127
185 - 256	628	628	503	9	4	25	147	13	53	23	20	19	18	24	22	10	5
	348	348	504	18	0	0	0	0	30	9	7	58	15	17	25	6	9
	703	703	505	171	52	53	122	175	141	109	72	39	19	20	59	12	73
	496	496	506	25	17	29	24	57	90	69	19	20	0	4	19	6	22
257 - 366	822	822	507	35	30	32	42	31	39	28	24	0	16	6	15	0	6
	646	646	508	8	3	4	8	45	71	85	26	2	15	17	17	0	11
	314	314	509	6	0	18	6	23	5	28	92	4	5	0	1	21	1
	951	951	510	164	32	131	123	92	152	147	43	17	23	27	44	28	20
	806	806	511	107	21	30	108	89	130	37	14	8	5	15	16	3	2
367 - 549	670	670	512	2	0	6	2	6	1	3	7	0	0	3	11	0	1
	249	249	513	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	602	602	514	9	0	3	0	6	9	5	17	7	2	0	0	0	9
	666	666	515	15	8	5	3	18	31	57	10	31	4	5	4	5	19
550 - 731	634	634	516	0	0	0	6	3	1	3	2	0	0	0	0	0	0
	216	216	517	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	210	210	518	0	0	0	0	0	1	0	0	0	3	0	0	0	3
	414	414	519	4	2	0	1	3	9	16	0	0	0	0	0	0	0
Total Biomass (t)				909	335	420	769	823	1048	788	705	509	319	240	379	412	462

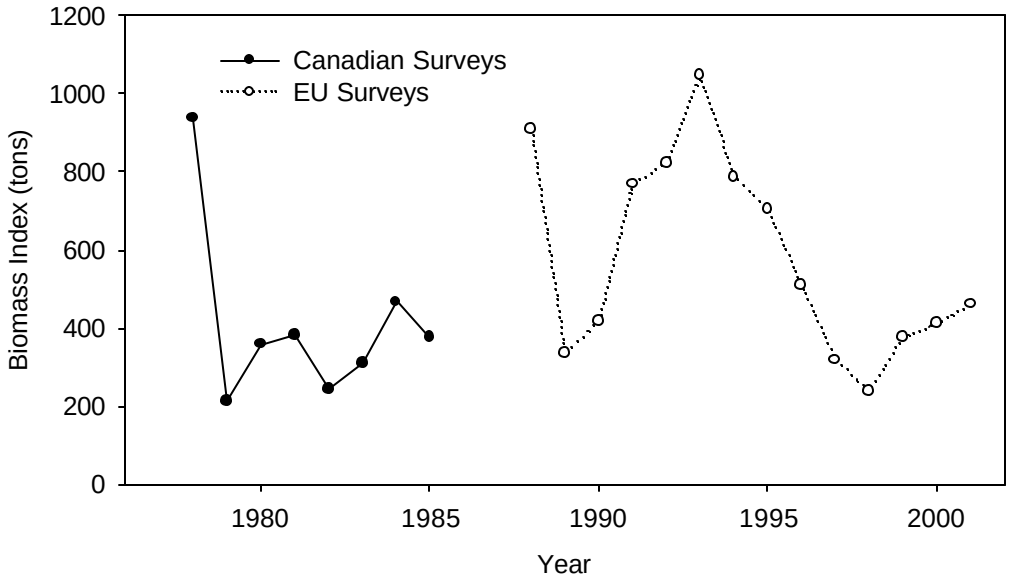

Fig. 1 Biomass indices for witch flounder from both Canadian and EU surveys conducted on Flemish Cap (Div. 3M) during 1978-1985 and 1988-2001, respectively.

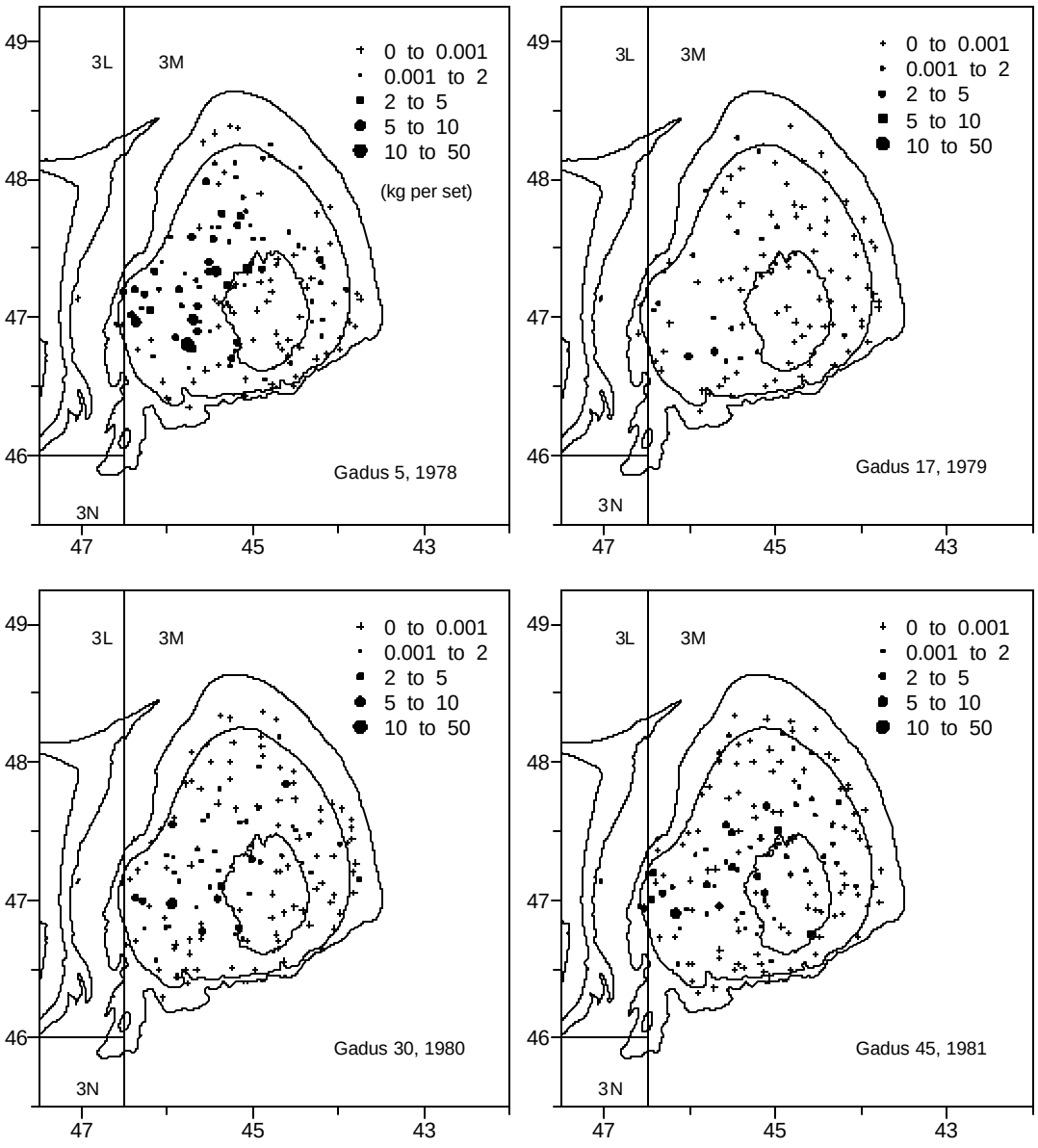

Fig. 2a Witch flounder catch (kg) per set distribution from Canadian surveys conducted on Flemish Cap during 1978-81 using the Engel survey trawl (no conversions applied). The 200m, 500m, and 1000m contours are shown.

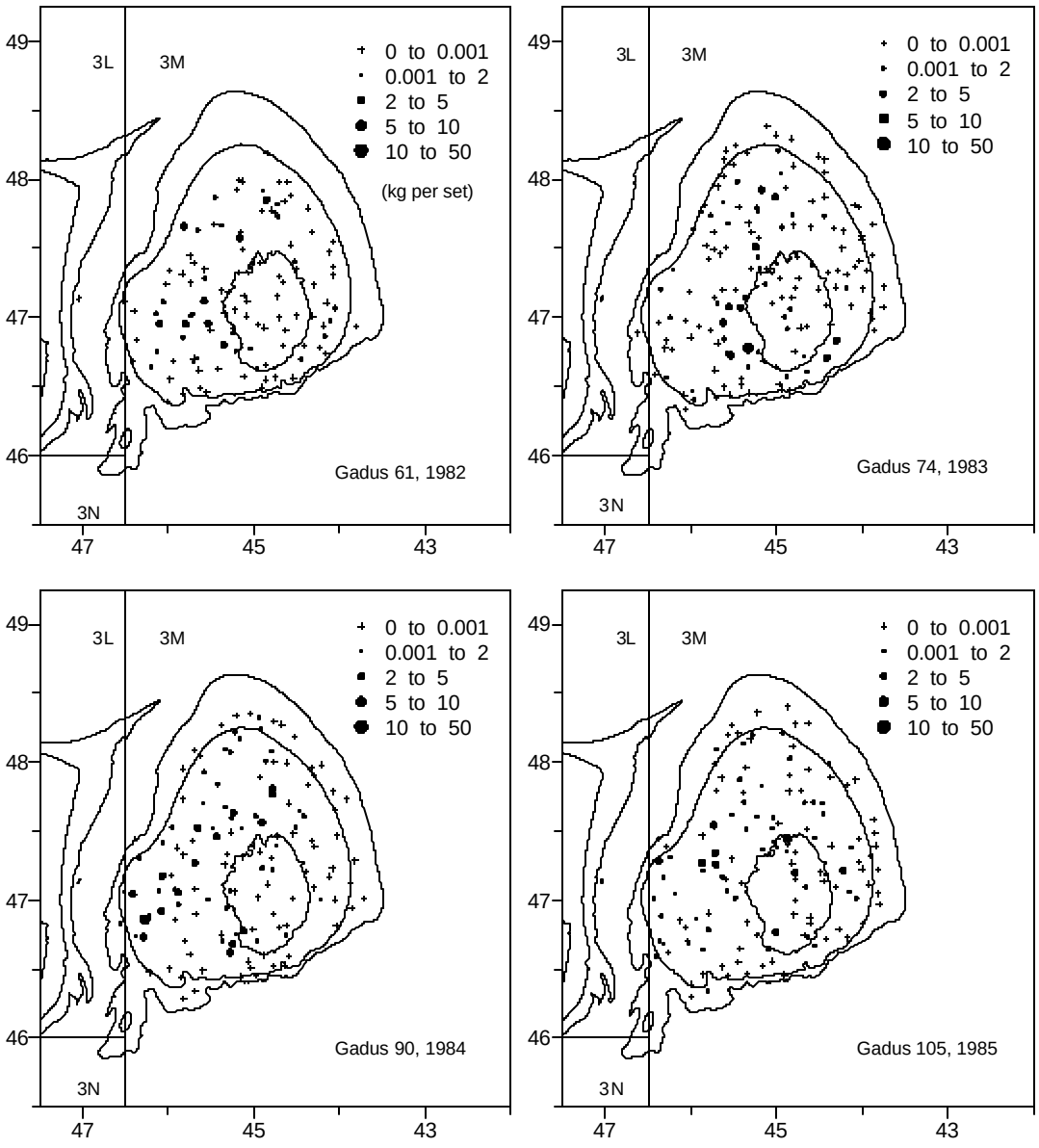

Fig. 2b Witch flounder catch (kg) per set distribution from Canadian surveys conducted on Flemish Cap during 1982-85 using the Engel survey trawl (no conversions applied). The 200m, 500m, and 1000m contours are shown.

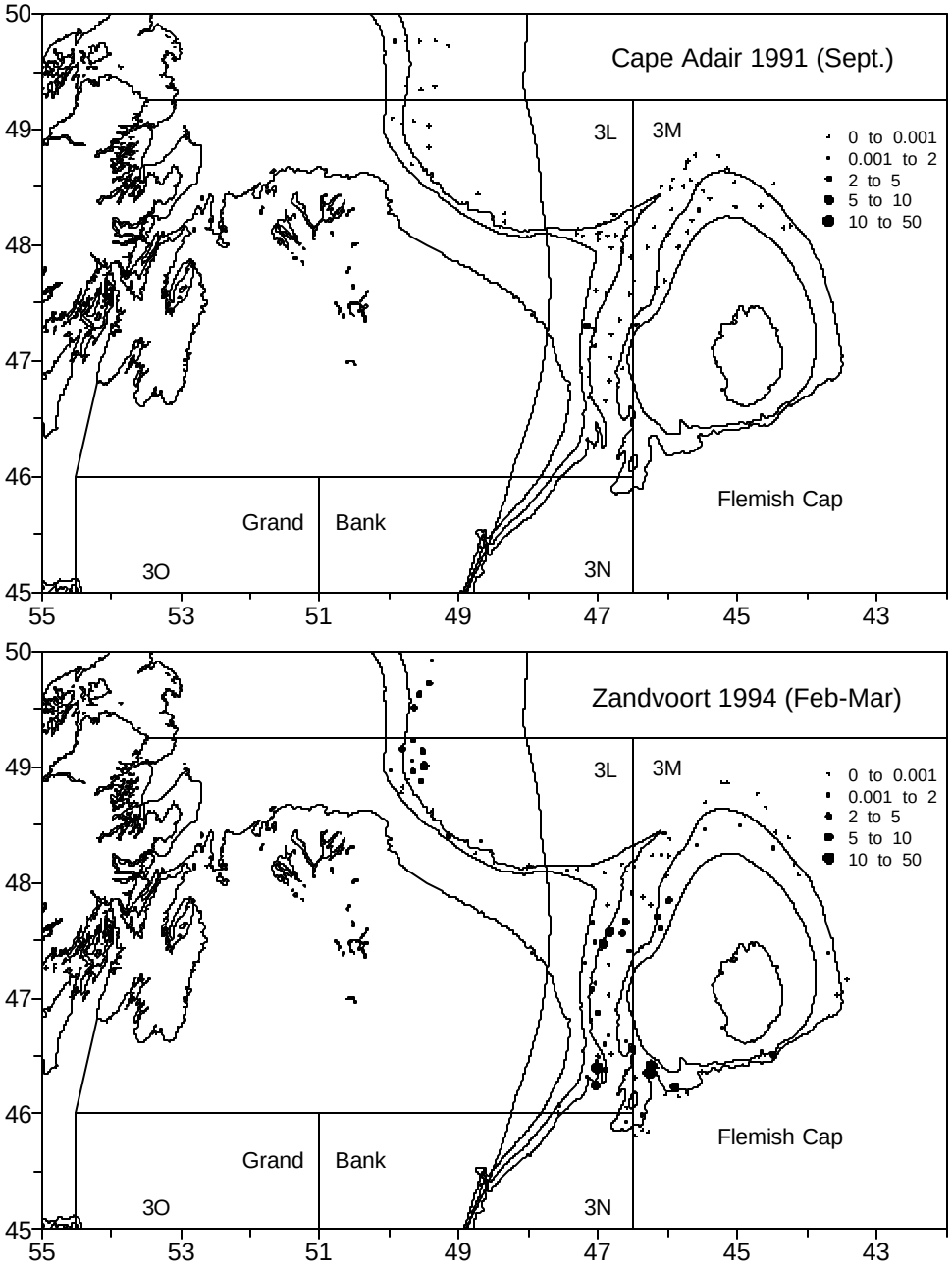

Fig. 3 Catch per set (kg) of witch flounder from Canadian deepwater surveys during 1991 and 1994. Surveys conducted using an Engel trawl.

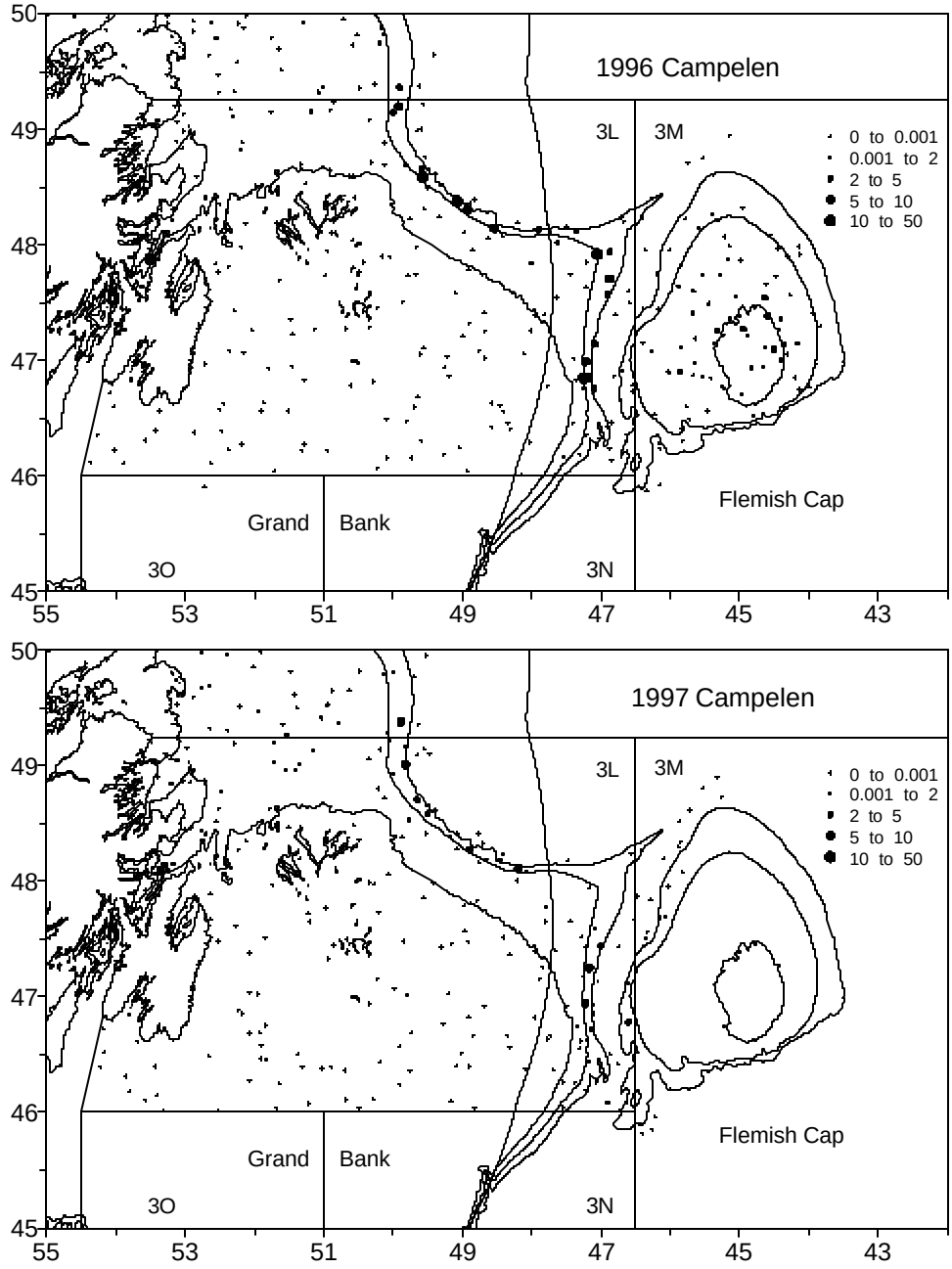

Fig. 4a Catch per set (kg) of witch flounder from Canadian fall surveys during 1996 and 1997. Surveys conducted using a Campelen trawl.

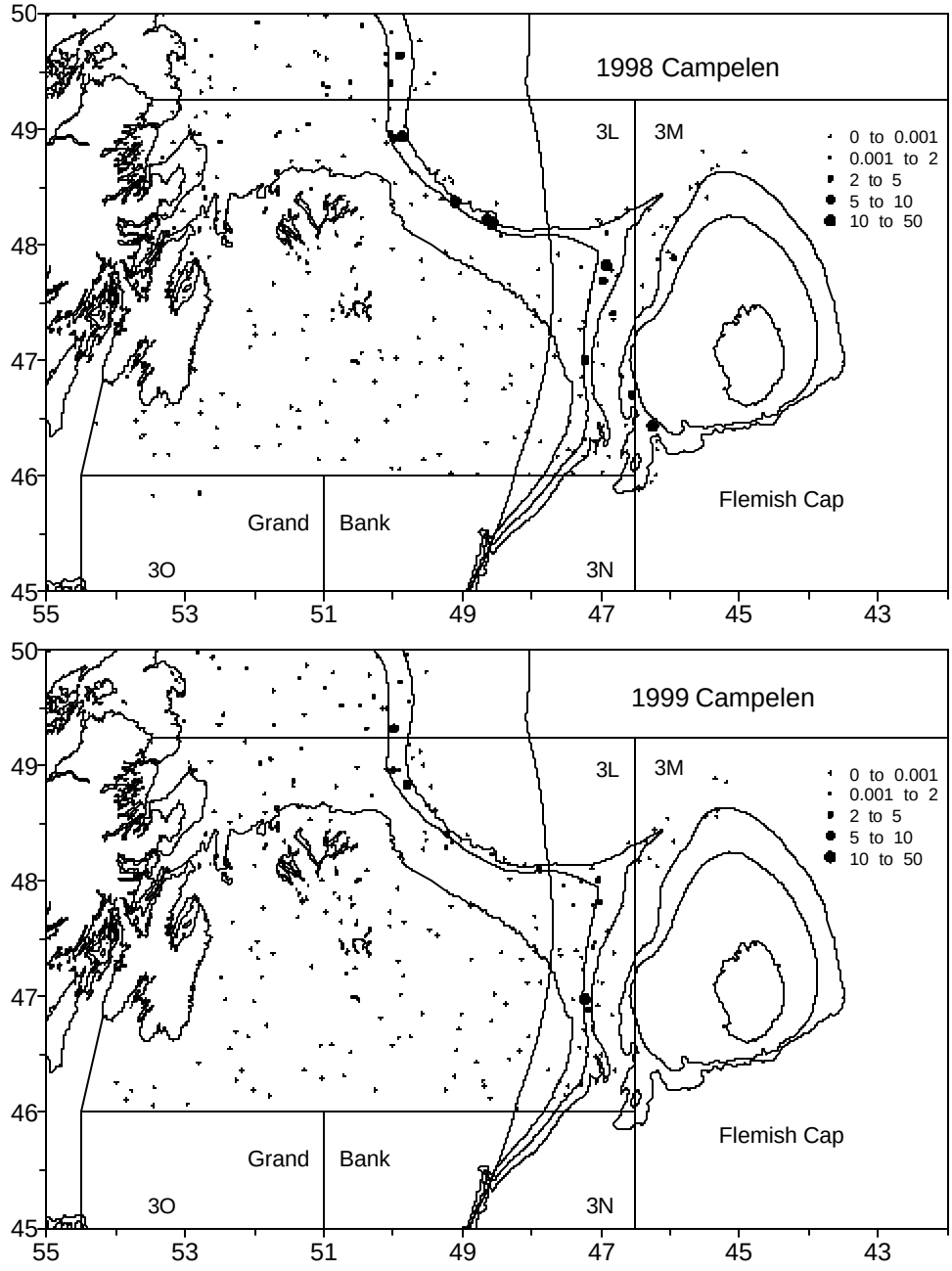

Fig. 4b Catch per set (kg) of witch flounder from Canadian fall surveys during 1998 and 1999. Surveys conducted using a Campelen trawl.

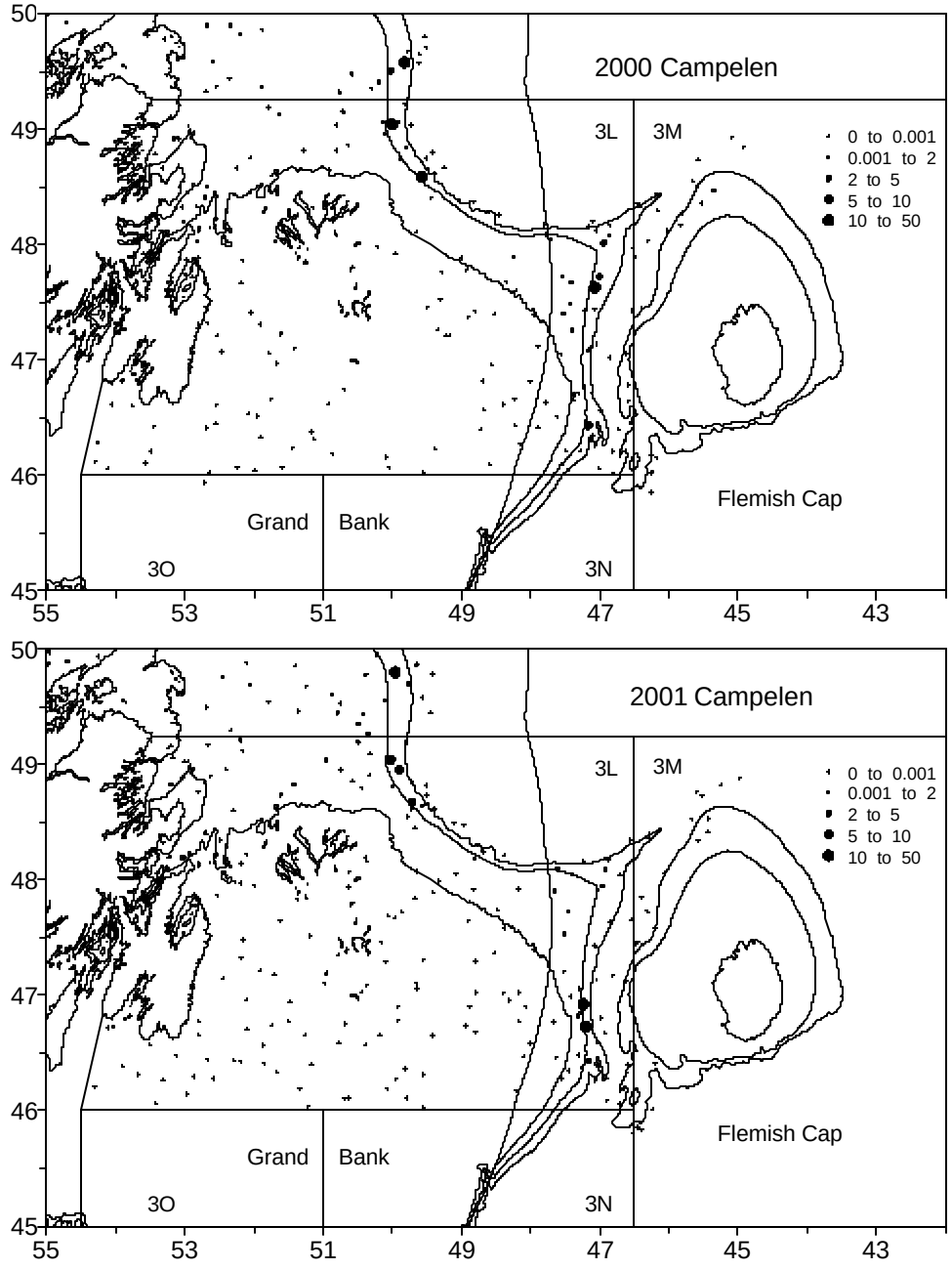

Fig. 4c Catch per set (kg) of witch flounder from Canadian fall surveys during 2000 and 2001. Surveys conducted using a Campelen trawl.

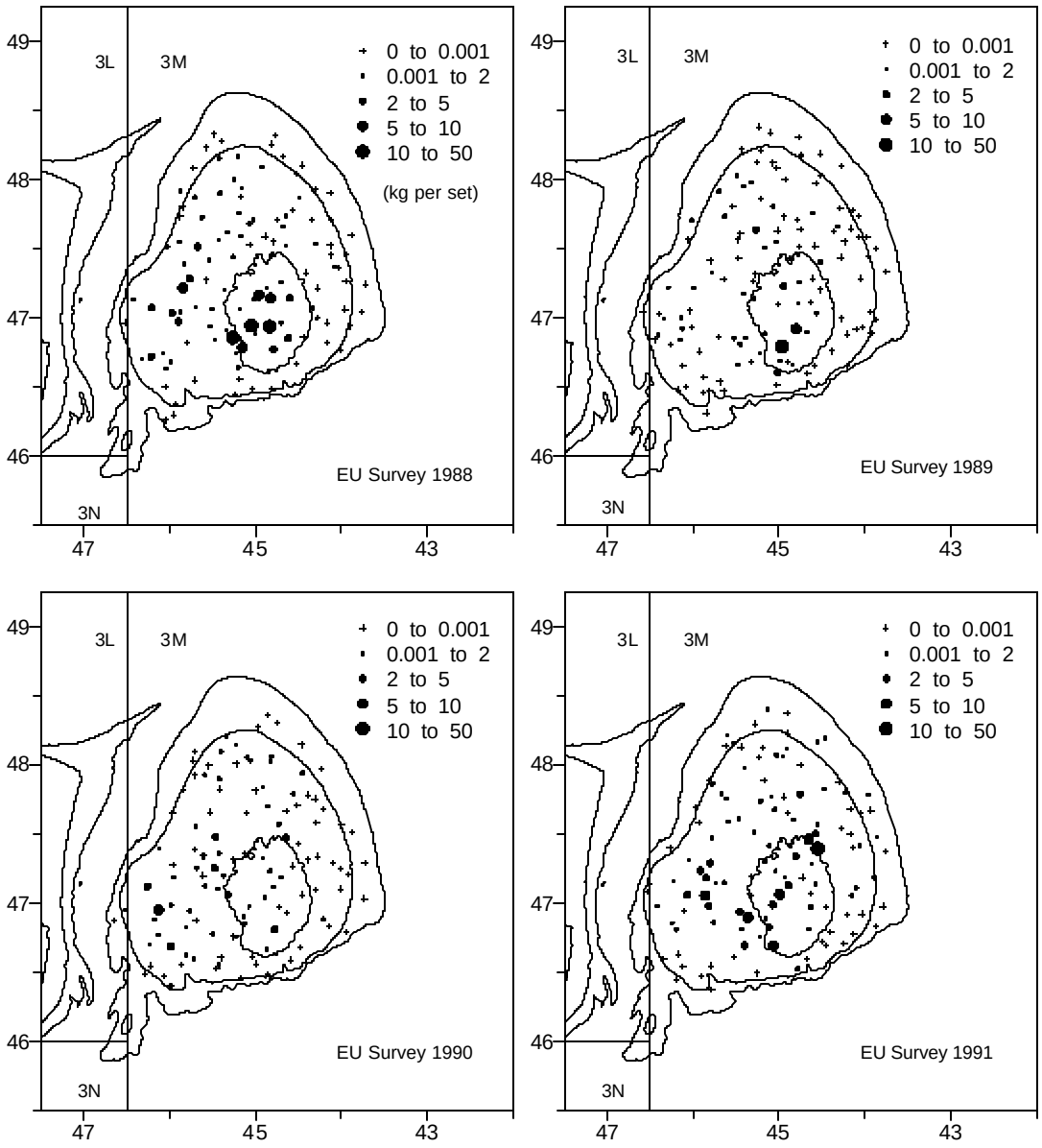

Fig. 5a Witch flounder catch (kg) per set distribution from EU summer surveys conducted on Flemish Cap during 1988-91 using the Alfredo survey trawl (no conversions applied). The 200m, 500m, and 1000m contours are shown.

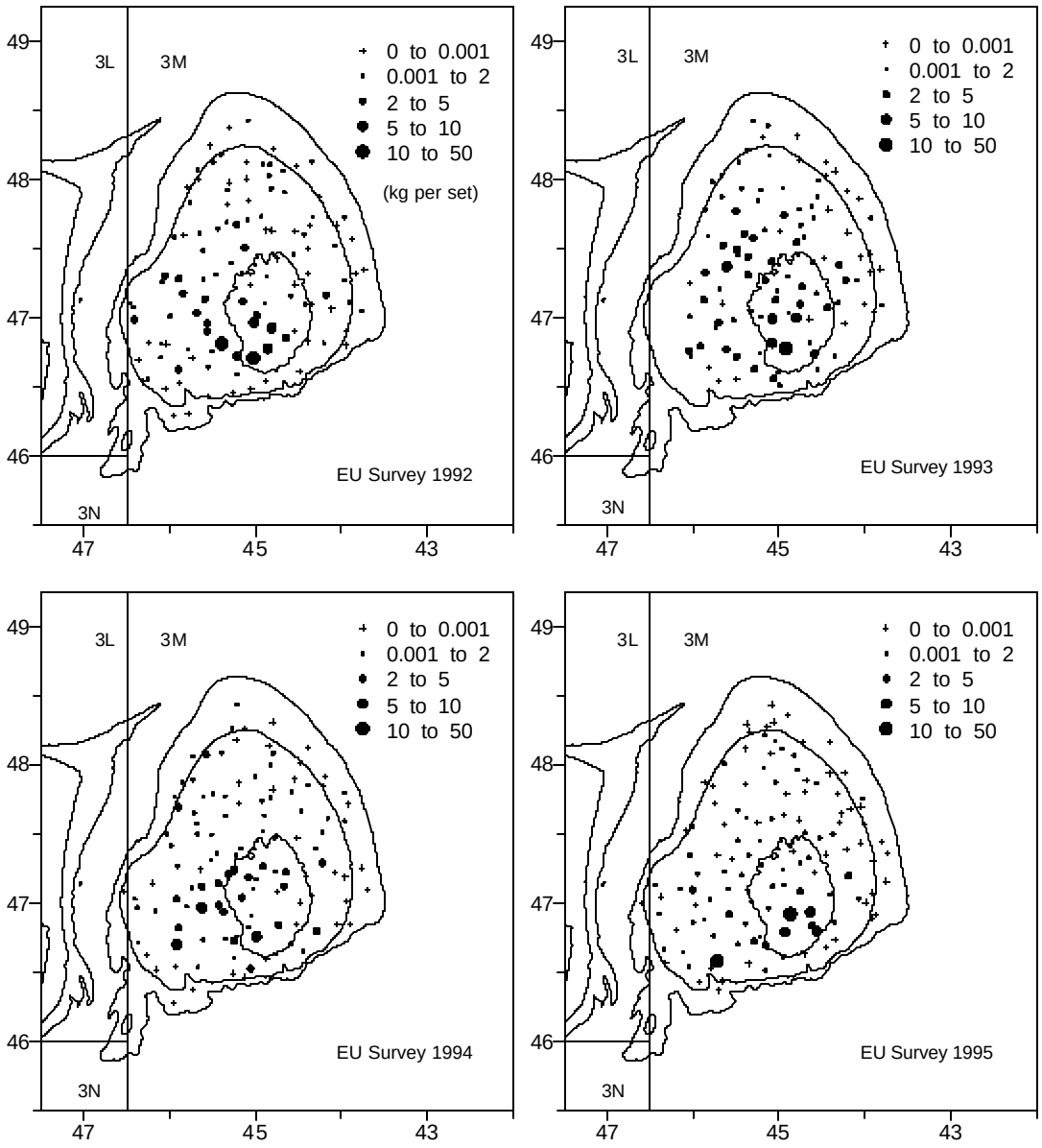

Fig. 5b Witch flounder catch (kg) per set distribution from EU summer surveys conducted on Flemish Cap during 1992-95 using the Alfredo survey trawl (no conversions applied). The 200m, 500m, and 1000m contours are shown.

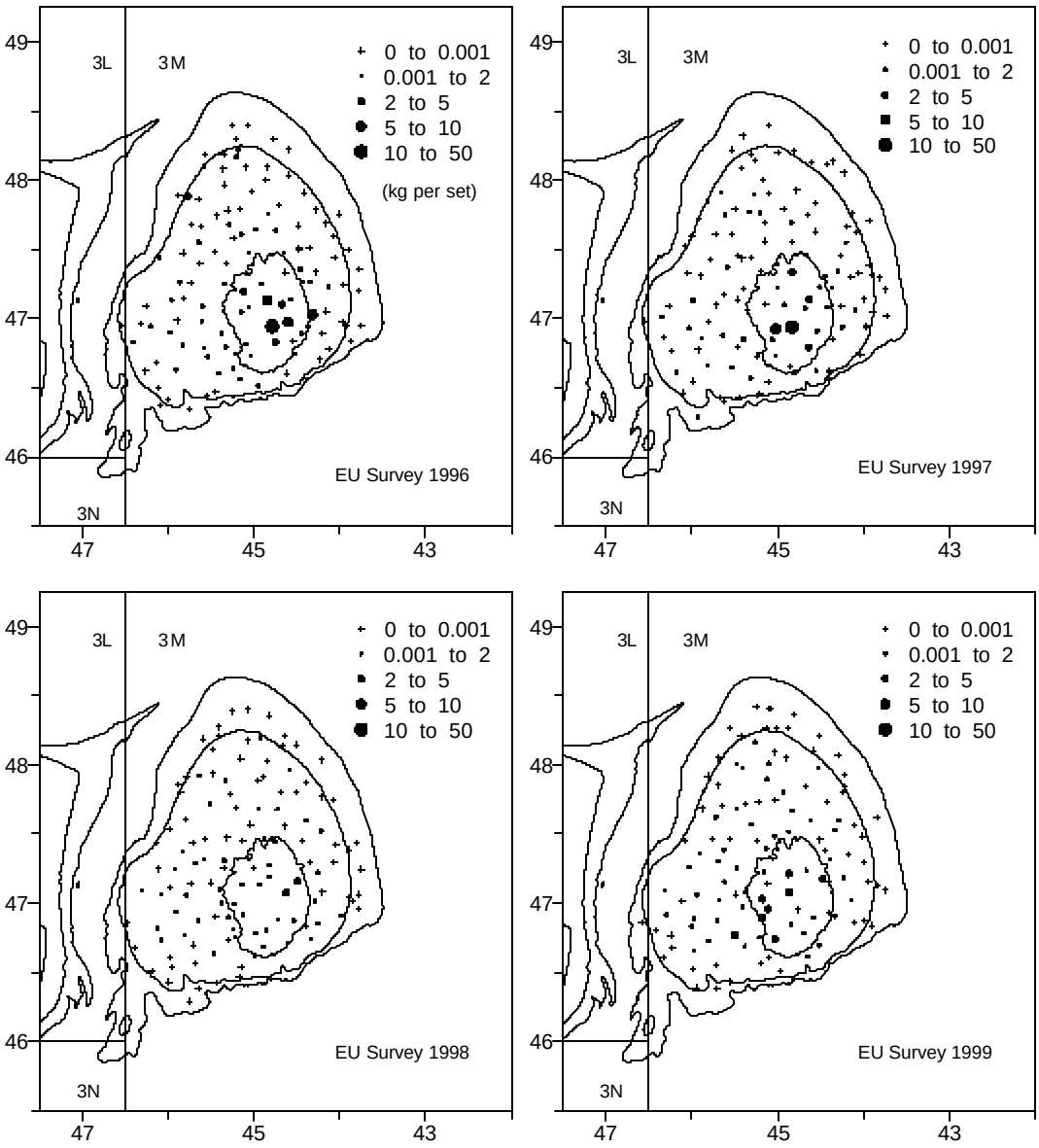

Fig. 5c Witch flounder catch (kg) per set distribution from EU summer surveys conducted on Flemish Cap during 1996-99 using the Alfredo survey trawl (no conversions applied). The 200m, 500m, and 1000m contours are shown.

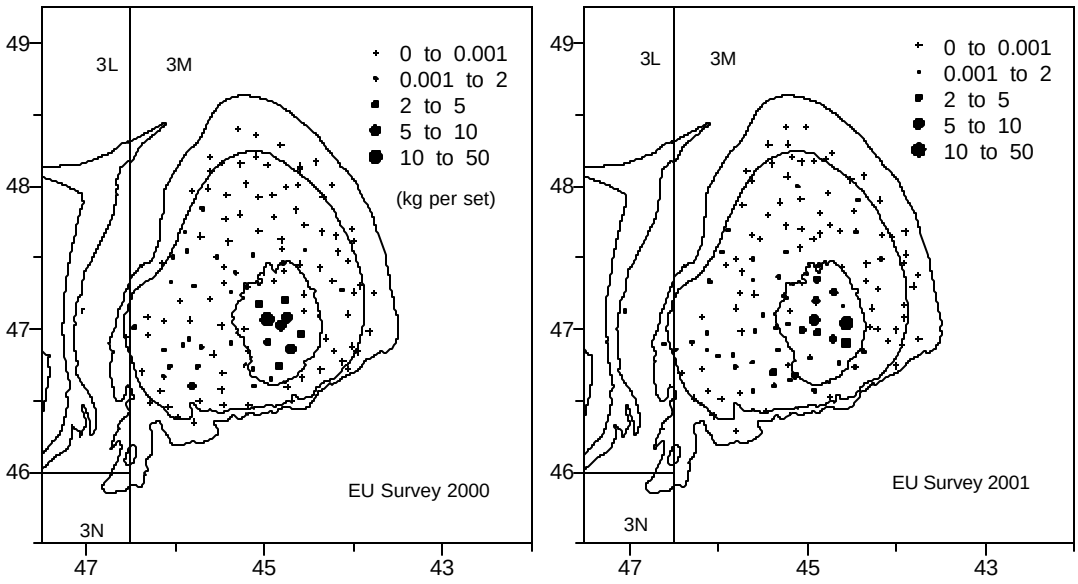

Fig. 5d Witch flounder catch (kg) per set distribution from EU summer surveys conducted on Flemish Cap during 2000-01 using the Alfredo survey trawl. The 200m, 500m, and 1000m contours are shown.

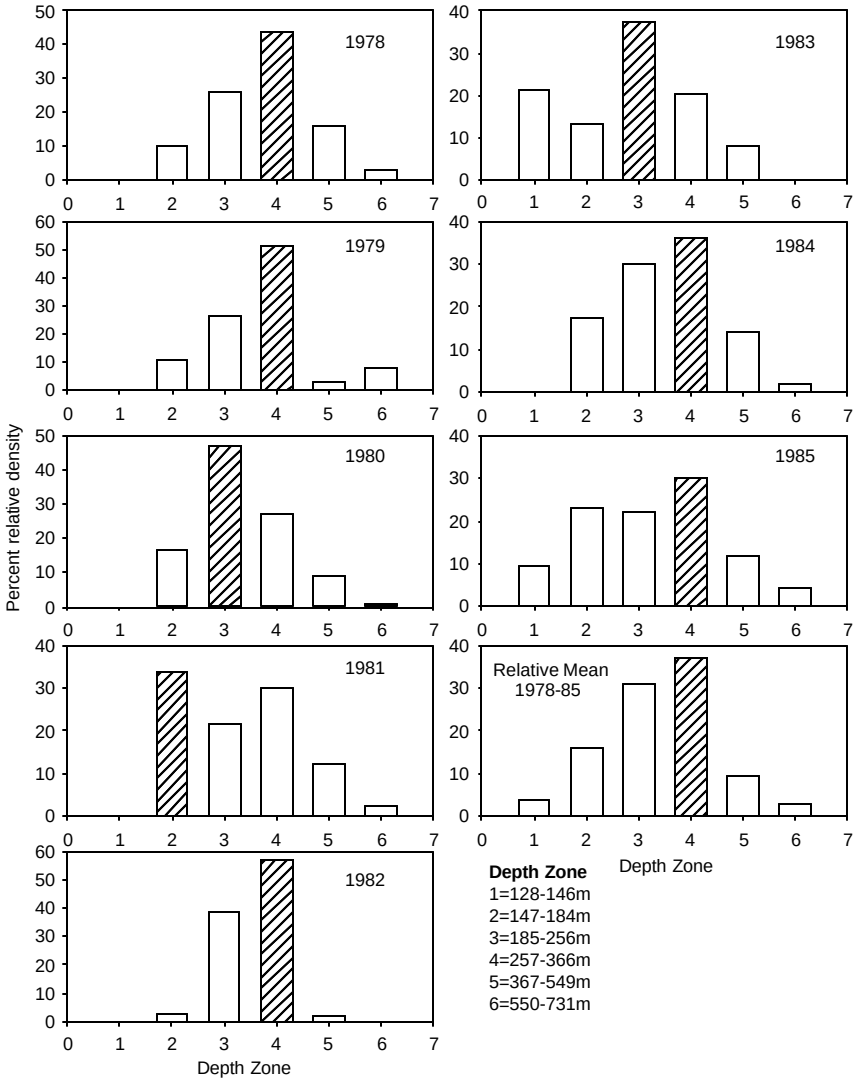

Fig. 6 Density of witch flounder in Div. 3M by depth zone from Canadian surveys conducted during 1978-85. Density expressed as biomass per square nautical mile as a percentage of annual total.

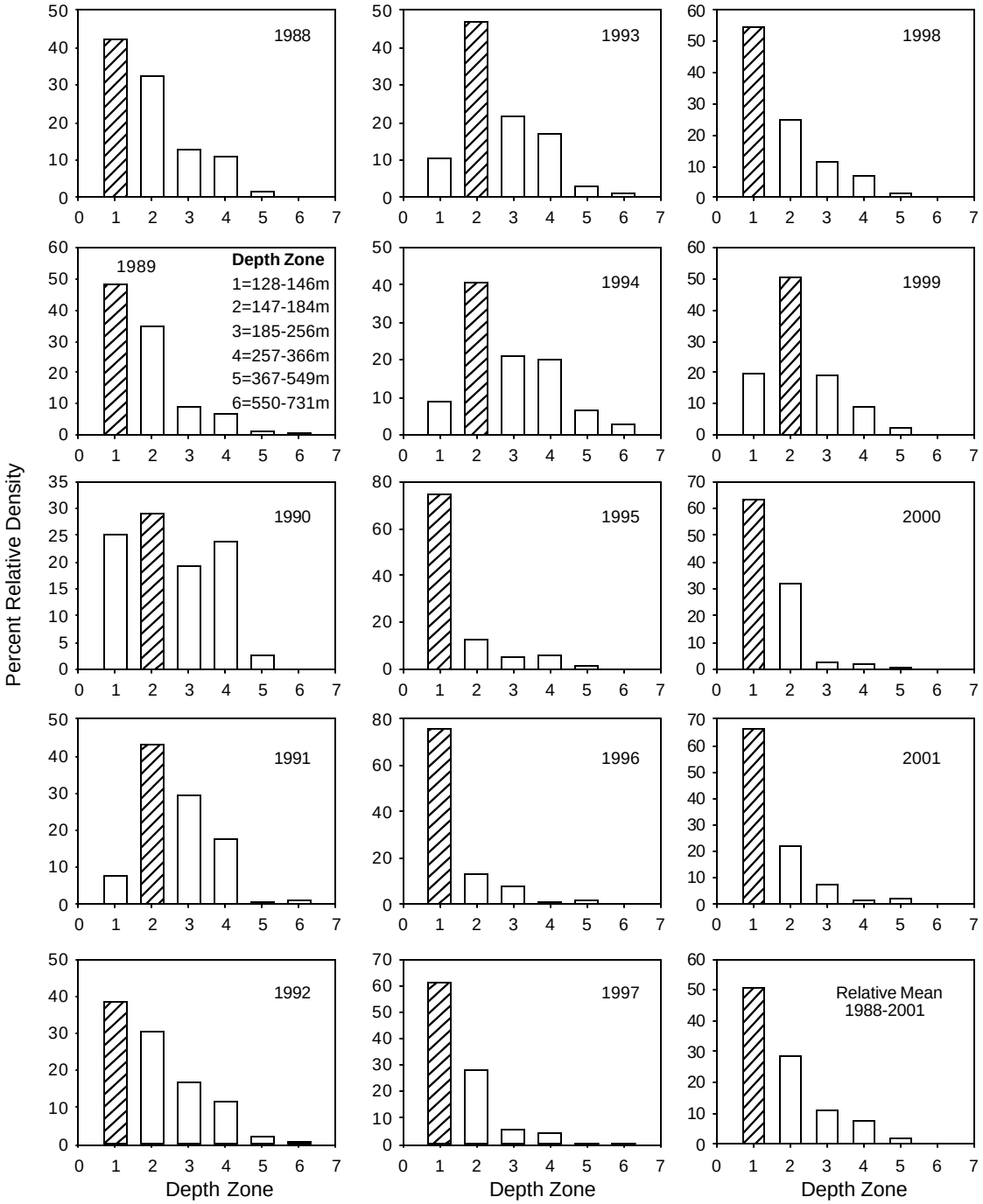

Fig. 7 Density of witch flounder in Div. 3M by depth zone from EU surveys conducted during July, 1988-2001. Density expressed as biomass per square nautical mile as a percentage of annual total.