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Results for selected species from a Canadian research vessel survey on Flemish Cap,  
NAFO Div. 3M, in 1996.

by

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**INTRODUCTION**

During autumn 1996, a trawl survey of NAFO Div. 3M was conducted by Canada, as part of an overall survey of Divs 2GHJ and 3KLMNO. The survey in Div. 3M was the first by Canada since a series of annual groundfish surveys in this area was terminated in 1985. Since then, annual summer surveys of Flemish Cap have been carried out by EU research vessels (1988-96), and Canada has conducted some deepwater surveys in the area in 1991, 1994, and 1995. This paper examines the results of the 1996 survey as they pertain to four groundfish : cod, beaked redfish (*S. fasciatus* and *S. mentella* combined), witch flounder, and American plaice. Data for some other species, such as Greenland halibut and shrimp, have been or will be presented elsewhere.

**METHODS**

Two vessels were used to conduct the survey : the *RV Wilfred Templeman* and the *RV Teleost*. The survey, as have the previous ones in Div. 3M, used the stratification scheme outlined in Bishop (1994), shown in Fig. 1. Sets were allocated proportional to stratum area, except for strata deeper than 731 m, which were assigned 2 sets regardless of size. The fishing gear used on both Canadian survey vessels was the Campelen 1800 shrimp trawl, outfitted with rock-hopper footgear and a 12.7 mm liner in the codend (see McCallum and Walsh (1996) for details on this trawl). SCANMAR equipment was used to monitor trawl performance at each fishing set, during which the trawl was towed along the bottom for 15 minutes at a speed of 3 knots. Catches were sorted by species, weighed and counted, and measurements and biological samples, including otoliths, were collected from several species. Estimates of trawlable abundance and biomass were calculated, accounting for swept area in the usual manner, using STRAP software (Smith and Somerton 1981). Strata with only one haul were excluded from the analyses. Plots of fish distribution, for both numbers and weights, were done with ACON software (Black 1993).

**RESULTS and DISCUSSION**

The *Wilfred Templeman* completed 68 sets between late September and mid-October, covering the strata shallower than 731 m. The *Teleost* completed 18 sets in the period Nov. 29 to Dec.4 , covering the strata deeper than 731 m on the western and northern slopes of Flemish Cap. Deepwater strata on the east and southern slopes were not fished during this survey. The use of the *Teleost* was necessary because the *Wilfred Templeman* was not able to fish at depths beyond 731 m. However, this resulted in a difference of about 7 weeks in the completion of the two components of the survey.

Tables 1 to 4 give a stratum by stratum breakdown of the catch numbers and weights, for cod, A. plaice, witch, and redfish (*mentella*) respectively. Cod were most abundant in the shallower strata, mainly 501-506 (Figs. 1-3, Table 1). No cod were caught in depths

greater than 366 m. The distribution of American plaice was similar (Figs. 4 and 5), although a few plaice were taken in depths down to 914 m (Table 2). Very few witch flounder were encountered during the survey (less than 1 fish per set on average). Most of the witch were also caught in strata 501-506 (Figs. 6 and 7, Table 3). Redfish was by far the most abundant groundfish found on the survey, and were distributed widely across Flemish Cap, with the exception of the shallowest areas (Figs. 8 and 9, Table 4). Catches were largest between depths of 257 and 549 m, with strata 510, 511, and 514 containing about 64% of the trawlable biomass.

Biomass and abundance estimates for each species, along with approximate 95% confidence intervals, are given in Table 5. There was reasonably good agreement between the biomass estimates from the Canadian survey and those of the EU survey conducted in July 1996 (Vazquez 1997). Values from the EU survey for cod, A.plaice, and beaked redfish were 8200 t, 3100 t, and 89,000 t respectively, compared to 9300 t, 2400 t, and 113,000 t for the same 3 species in the Canadian survey. The comparability of the trawls used in each survey is not known. Results from the 1996 survey have not been compared to the previous Canadian survey results (1978-85) because the earlier data were collected with an Engels trawl (McCallum and Walsh 1996), and have not been converted into Campelen trawl equivalents.

#### ACKNOWLEDGEMENTS

The authors thank all the people involved in conducting the survey in Div. 3M on the RV's *Wilfred Templeman* and *Teleost*, and the DFO staff who collected and processed the data.

#### REFERENCES

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Table 1. Catches of cod, with associated estimates of abundance and biomass, from Canadian survey in Div. 3M in 1996.

STRATUM	Max DPT	SETS	UNITS	CATCH	AV./SET	Numbers		CATCH	AV./SET	Weights	
						TOTAL NO.	VARIANCE			TOTAL WT.	VARIANCE
501	146	2	47500	88.0	44.0	2,090,000	98.0	48.7	24.3	1,155,438	50.5
502	183	6	116389	223.3	37.2	4,331,329	319.5	153.7	25.6	2,981,772	204.0
503	256	4	87222	67.3	16.8	1,468,241	386.5	66.3	16.6	1,444,739	399.4
504	256	2	48333	83.6	41.8	2,019,259	2403.6	51.6	25.8	1,247,000	935.0
505	256	5	97639	18.0	3.6	351,500	48.3	14.8	3.0	289,206	34.8
506	256	3	68889	40.8	13.6	936,379	31.2	44.4	14.8	1,019,811	76.6
507	366	5	114167	0.0	0.0	-	0.0	0.0	0.0	-	0.0
508	366	4	89722	7.1	1.8	159,506	12.6	5.3	1.3	119,630	7.1
509	366	2	43611	0.0	0.0	-	0.0	0.0	0.0	-	0.0
510	366	6	132083	1.9	0.3	41,582	0.2	3.0	0.5	67,045	0.6
511	366	5	111944	34.9	7.0	781,123	210.1	45.6	9.1	1,020,933	322.9
512	549	4	93056	0.0	0.0	-	0.0	0.0	0.0	-	0.0
513	549	2	34583	0.0	0.0	-	0.0	0.0	0.0	-	0.0
514	549	4	83611	0.0	0.0	-	0.0	0.0	0.0	-	0.0
515	549	3	92500	0.0	0.0	-	0.0	0.0	0.0	-	0.0
516	731	4	88056	0.0	0.0	-	0.0	0.0	0.0	-	0.0
517	731	2	30000	0.0	0.0	-	0.0	0.0	0.0	-	0.0
518	731	2	29167	0.0	0.0	-	0.0	0.0	0.0	-	0.0
519	731	3	57500	0.0	0.0	-	0.0	0.0	0.0	-	0.0
528	914	2	73611	0.0	0.0	-	0.0	0.0	0.0	-	0.0
529	1097	2	67778	0.0	0.0	-	0.0	0.0	0.0	-	0.0
530	1280	2	157500	0.0	0.0	-	0.0	0.0	0.0	-	0.0
531	1463	2	28194	0.0	0.0	-	0.0	0.0	0.0	-	0.0
532	1097	2	33056	0.0	0.0	-	0.0	0.0	0.0	-	0.0
533	914	2	13611	0.0	0.0	-	0.0	0.0	0.0	-	0.0
534	1097	2	67500	0.0	0.0	-	0.0	0.0	0.0	-	0.0
535	1280	2	12778	0.0	0.0	-	0.0	0.0	0.0	-	0.0
536	1463	2	15556	0.0	0.0	-	0.0	0.0	0.0	-	0.0
					6.29	12,178,919			4.82	9,345,574	

Table 2. Catches of A.plaice, with associated estimates of abundance and biomass, from Canadian survey in Div. 3M in 1996.

STRATUM	Max DPT	SETS	UNITS	CATCH	AV./SET	Numbers			CATCH	AV./SET	Weights	
						TOTAL NO.	VARIANCE				TOTAL WT.	VARIANCE
501	146	2	47500	13.0	6.50	308,750	60.5	8.8	4.40	209,000	33.6	
502	183	6	116389	24.3	4.05	471,098	10.6	20.4	3.41	396,554	5.5	
503	256	4	87222	3.8	0.94	82,377	1.2	4.7	1.17	102,244	1.8	
504	256	2	48333	3.6	1.78	85,926	6.3	2.3	1.16	55,852	2.7	
505	256	5	97639	41.8	8.36	815,827	119.0	37.0	7.39	721,985	76.0	
506	256	3	68889	27.0	9.00	620,000	171.0	17.8	5.92	407,593	63.2	
507	366	5	114167	6.2	1.24	142,074	1.0	4.2	0.84	96,407	0.7	
508	366	4	89722	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
509	366	2	43611	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
510	366	6	132083	15.7	2.61	344,884	6.6	10.7	1.78	235,304	5.2	
511	366	5	111944	6.7	1.33	149,259	2.4	4.4	0.87	97,541	2.1	
512	549	4	93056	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
513	549	2	34583	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
514	549	4	83611	2.0	0.50	41,806	1.0	0.03	0.01	627	0.0002	
515	549	3	92500	2.0	0.67	61,667	1.3	0.5	0.17	15,417	0.1	
516	731	4	88056	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
517	731	2	30000	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
518	731	2	29167	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
519	731	3	57500	1.8	0.59	34,074	1.1	1.2	0.39	22,148	0.4	
528	914	2	73611	2.0	1.00	73,611	2.0	2.0	1.00	73,611	2.0	
529	1097	2	67778	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
530	1280	2	157500	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
531	1463	2	28194	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
532	1097	2	33056	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
533	914	2	13611	2.0	1.00	13,611	2.0	0.8	0.40	5,444	0.3	
534	1097	2	67500	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
535	1280	2	12778	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
536	1463	2	15556	0.0	0.00	-	0.0	0.0	0.00	-	0.0	
					1.68	3,244,964			1.26	2,439,727		

Table 3. Catches of witch flounder, with associated estimates of abundance and biomass, from Canadian survey in Div. 3M in 1996.

STRATUM	Max DPT	SETS	UNITS	CATCH	AV./SET	Numbers		CATCH	AV./SET	Weights	
						TOTAL NO.	VARIANCE			TOTAL WT.	VARIANCE
501	146	2	47500	3.0	1.50	71,250	0.50	1.5	0.8	35,625	0.32
502	183	6	116389	20.7	3.45	401,819	3.23	13.3	2.2	257,580	2.65
503	256	4	87222	8.2	2.06	179,290	2.28	8.5	2.1	184,378	3.59
504	256	2	48333	0.9	0.44	21,481	0.40	0.4	0.2	10,741	0.10
505	256	5	97639	7.7	1.53	149,713	1.09	3.7	0.7	72,209	0.54
506	256	3	68889	8.9	2.96	204,115	7.23	3.5	1.2	81,161	1.32
507	366	5	114167	2.7	0.53	60,889	0.63	1.3	0.3	29,430	0.30
508	366	4	89722	0.0	0.00	-	0.00	0.0	0.0	-	0.00
509	366	2	43611	1.0	0.50	21,806	0.50	0.02	0.01	436	0.0002
510	366	6	132083	7.7	1.28	168,773	1.03	4.8	0.8	106,083	0.53
511	366	5	111944	5.6	1.11	124,383	0.64	3.9	0.8	86,545	0.23
512	549	4	93056	0.0	0.00	-	0.00	0.0	0.0	-	0.00
513	549	2	34583	0.0	0.00	-	0.00	0.0	0.0	-	0.00
514	549	4	83611	0.0	0.00	-	0.00	0.0	0.0	-	0.00
515	549	3	92500	2.0	0.67	61,667	0.33	1.1	0.4	33,608	0.10
516	731	4	88056	0.0	0.00	-	0.00	0.0	0.0	-	0.00
517	731	2	30000	0.0	0.00	-	0.00	0.0	0.0	-	0.00
518	731	2	29167	0.0	0.00	-	0.00	0.0	0.0	-	0.00
519	731	3	57500	2.8	0.93	53,241	0.01	1.2	0.4	22,787	0.07
528	914	2	73611	0.0	0.00	-	0.00	0.0	0.0	-	0.00
529	1097	2	67778	2.0	1.00	67,778	2.00	0.5	0.3	16,944	0.13
530	1280	2	157500	0.0	0.00	-	0.00	0.0	0.0	-	0.00
531	1463	2	28194	0.0	0.00	-	0.00	0.0	0.0	-	0.00
532	1097	2	33056	0.0	0.00	-	0.00	0.0	0.0	-	0.00
533	914	2	13611	2.0	1.00	13,611	2.00	0.8	0.4	5,104	0.28
534	1097	2	67500	2.0	1.00	67,500	2.00	0.7	0.4	23,625	0.25
535	1280	2	12778	0.0	0.00	-	0.00	0.0	0.0	-	0.00
536	1463	2	15556	0.0	0.00	-	0.00	0.0	0.0	-	0.00
					0.86	1,667,315			0.50	966,257	

Table 4. Catches of beaked redfish, with associated estimates of abundance and biomass, from Canadian survey in Div. 3M in 1996.

STRATUM	Max DPT	SETS	UNITS	Numbers				Weights			
				CATCH	AV./SET	TOTAL NO.	VARIANCE	CATCH	AV./SET	TOTAL WT.	VARIANCE
501	146	2	47500	0.0	0.0	-	0	0.0	0.0	-	0.0
502	183	6	116389	28.6	4.8	554,233	136	2.2	0.4	43,230	0.8
503	256	4	87222	71.7	17.9	1,562,731	106	3.7	0.9	81,044	0.0
504	256	2	48333	35.6	17.8	859,259	632	7.0	3.5	168,630	24.3
505	256	5	97639	177.4	35.5	3,465,096	633	9.3	1.9	181,717	1.1
506	256	3	68889	808.9	269.6	18,574,486	32,293	54.8	18.3	1,258,881	261.3
507	366	5	114167	654.2	130.8	14,938,074	5,172	39.2	7.8	895,067	20.2
508	366	4	89722	828.8	207.2	18,589,946	15,748	23.8	5.9	533,349	25.5
509	366	2	43611	4157.0	2078.5	90,645,694	5,797,013	608.8	304.4	13,274,786	154390.1
510	366	6	132083	5925.1	987.5	130,434,738	2,353,414	983.1	163.8	21,640,656	107304.4
511	366	5	111944	8378.6	1675.7	187,586,549	8,393,864	1342.3	268.5	30,053,153	314278.4
512	549	4	93056	1711.1	427.8	39,807,099	42,901	402.3	100.6	9,359,838	963.3
513	549	2	34583	355.0	177.5	6,138,542	4,901	138.8	69.4	2,399,411	2631.0
514	549	4	83611	7549.4	1887.3	157,802,502	7,185,513	971.8	242.9	20,312,994	110757.9
515	549	3	92500	1454.0	484.7	44,831,667	15,865	273.3	91.1	8,426,750	1387.6
516	731	4	88056	143.2	35.8	3,152,389	1,333	48.8	12.2	1,074,058	241.0
517	731	2	30000	36.8	18.4	552,000	155	16.0	8.0	240,000	10.0
518	731	2	29167	129.9	64.9	1,893,771	6,893	31.0	15.5	451,524	402.8
519	731	3	57500	351.9	117.3	6,744,537	2,316	112.0	37.3	2,146,667	112.4
528	914	2	73611	7.0	3.5	257,639	5	1.2	0.6	44,903	0.3
529	1097	2	67778	0.0	0.0	-	0	0.0	0.0	-	0.0
530	1280	2	157500	0.0	0.0	-	0	0.0	0.0	-	0.0
531	1463	2	28194	0.0	0.0	-	0	0.0	0.0	-	0.0
532	1097	2	33056	0.0	0.0	-	0	0.0	0.0	-	0.0
533	914	2	13611	61.6	30.8	419,222	899	13.3	6.7	90,582	27.3
534	1097	2	67500	1.0	0.5	33,750	1	0.1	0.1	4,725	0.01
535	1280	2	12778	0.0	0.0	-	0	0.0	0.0	-	0.0
536	1463	2	15556	0.9	0.4	6,914	0	0.8	0.4	5,877	0.3
				376.56		728,850,838		58.22		112,687,840	

Table 5. Abundance and biomass estimates, with approx. 95% C.I., for 4 species from the Canadian survey in Div. 3M in 1996.

	Abundance (millions)			Biomass ('000 tons)		
	Upper	Mean	Lower	Upper	Mean	Lower
Cod	19.3	12.2	5.0	13.7	9.3	5.0
A. plaice	5.1	3.2	1.4	3.7	2.4	1.1
Witch	2.1	1.7	1.2	1.3	1.0	0.7
Redfish	1207.7	728.9	250.0	197.5	112.7	27.9

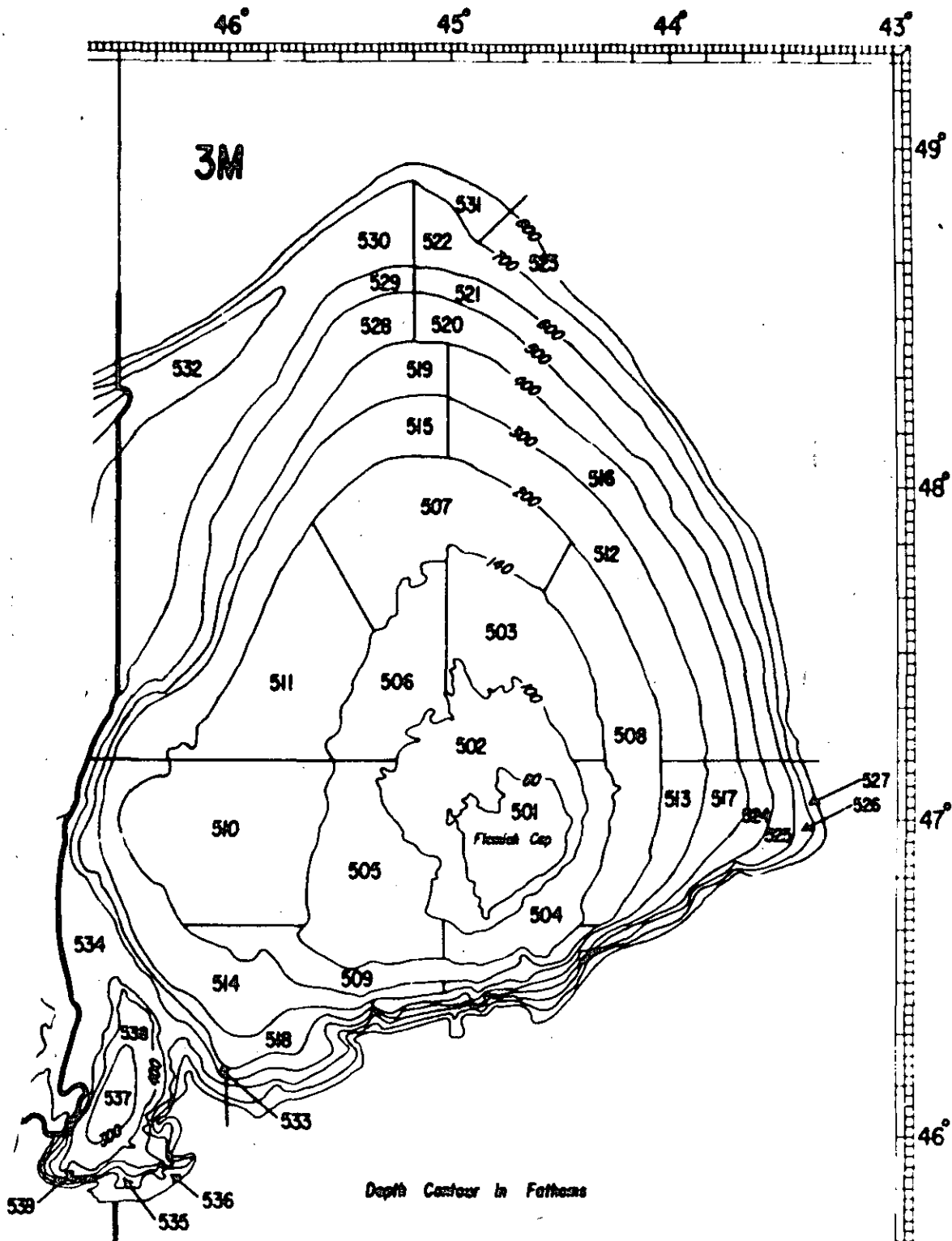


Fig. 1. Map of stratification scheme used for groundfish surveys in NAFO Div. 3M.

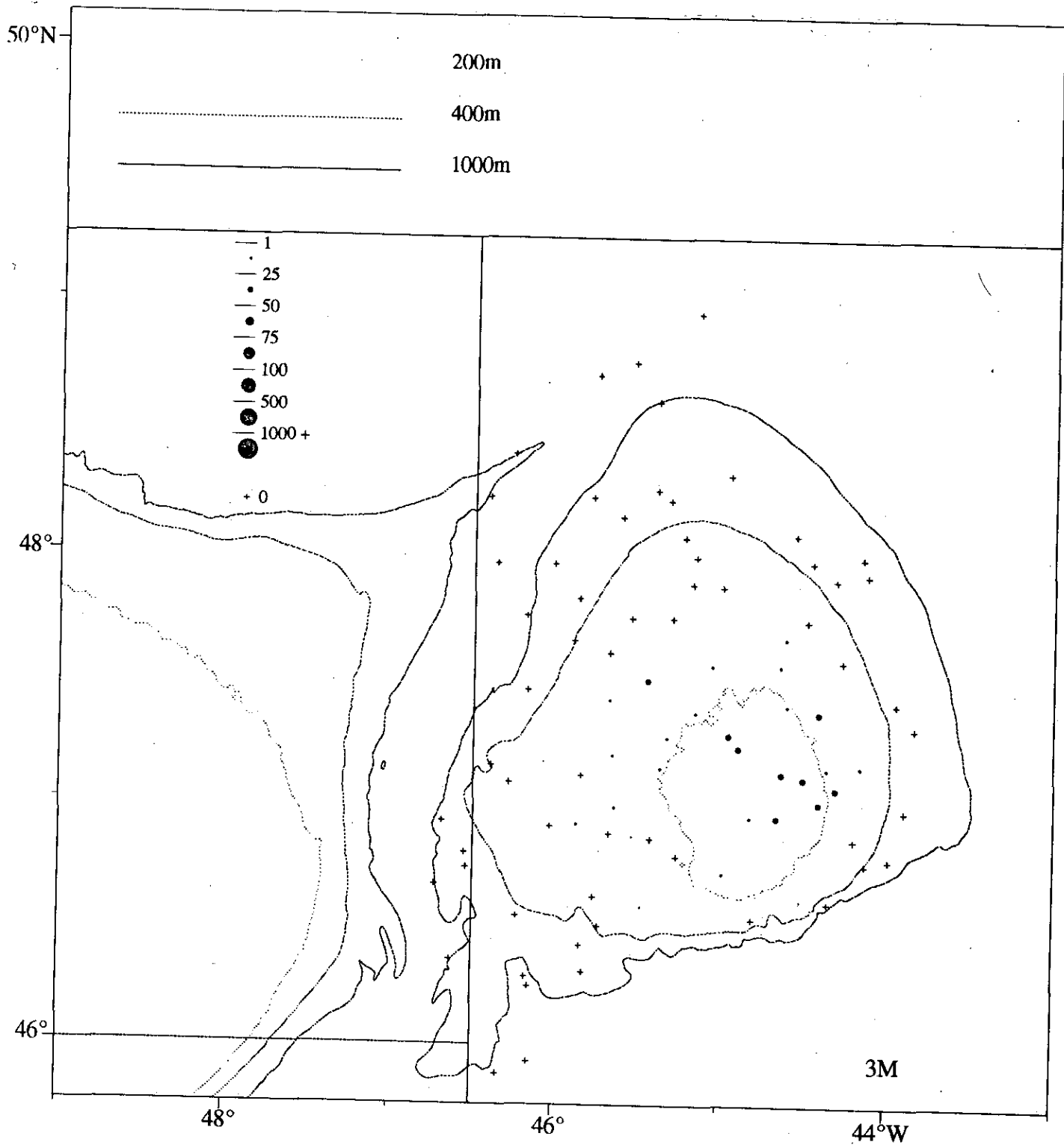


Figure 2 Cod distribution in numbers from the Canadian 1996 fall research vessel survey in Div. 3M.



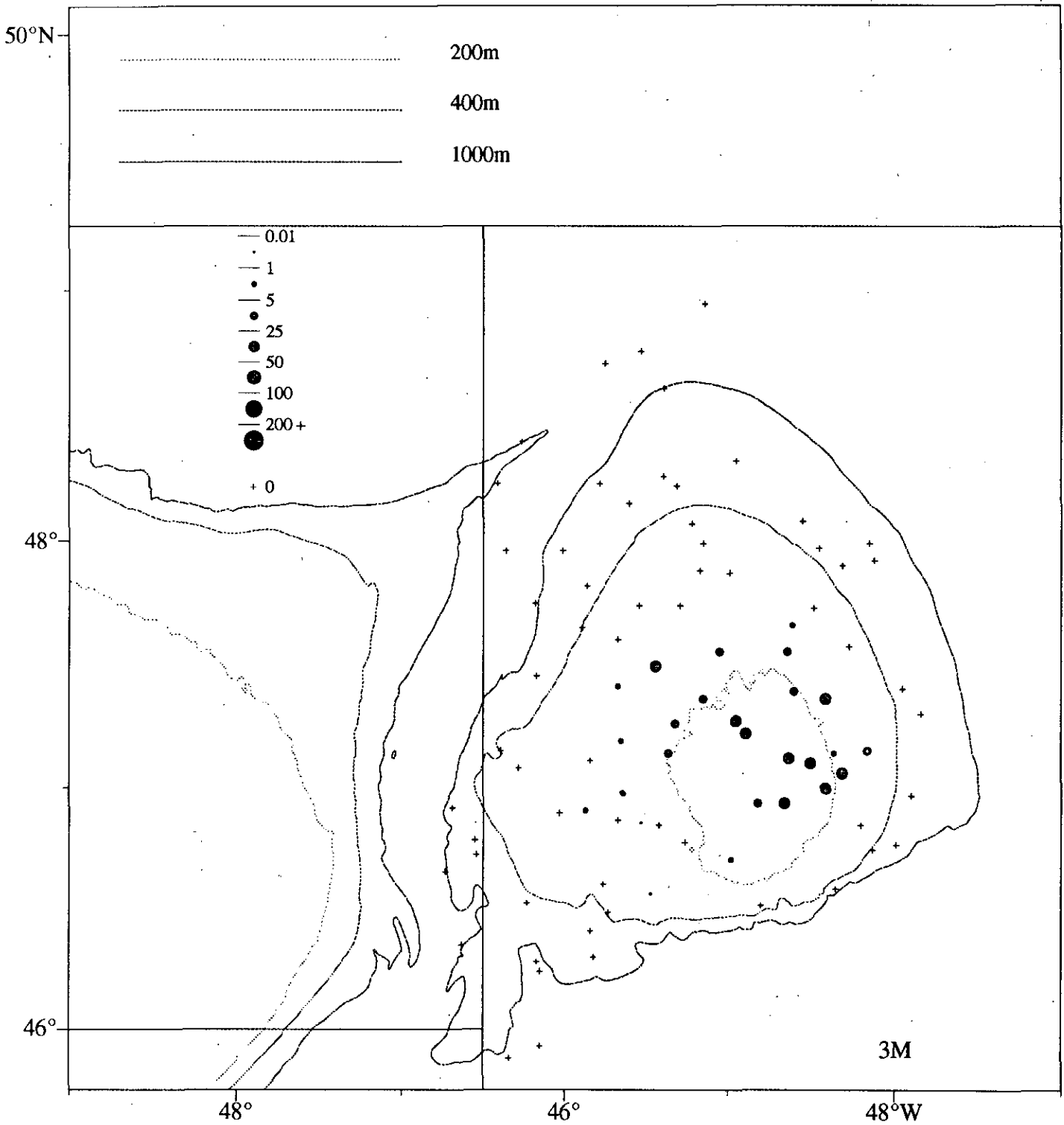


Figure 3 Cod distribution in round weight (kg) from the Canadian 1996 fall research vessel survey in Div. 3M.

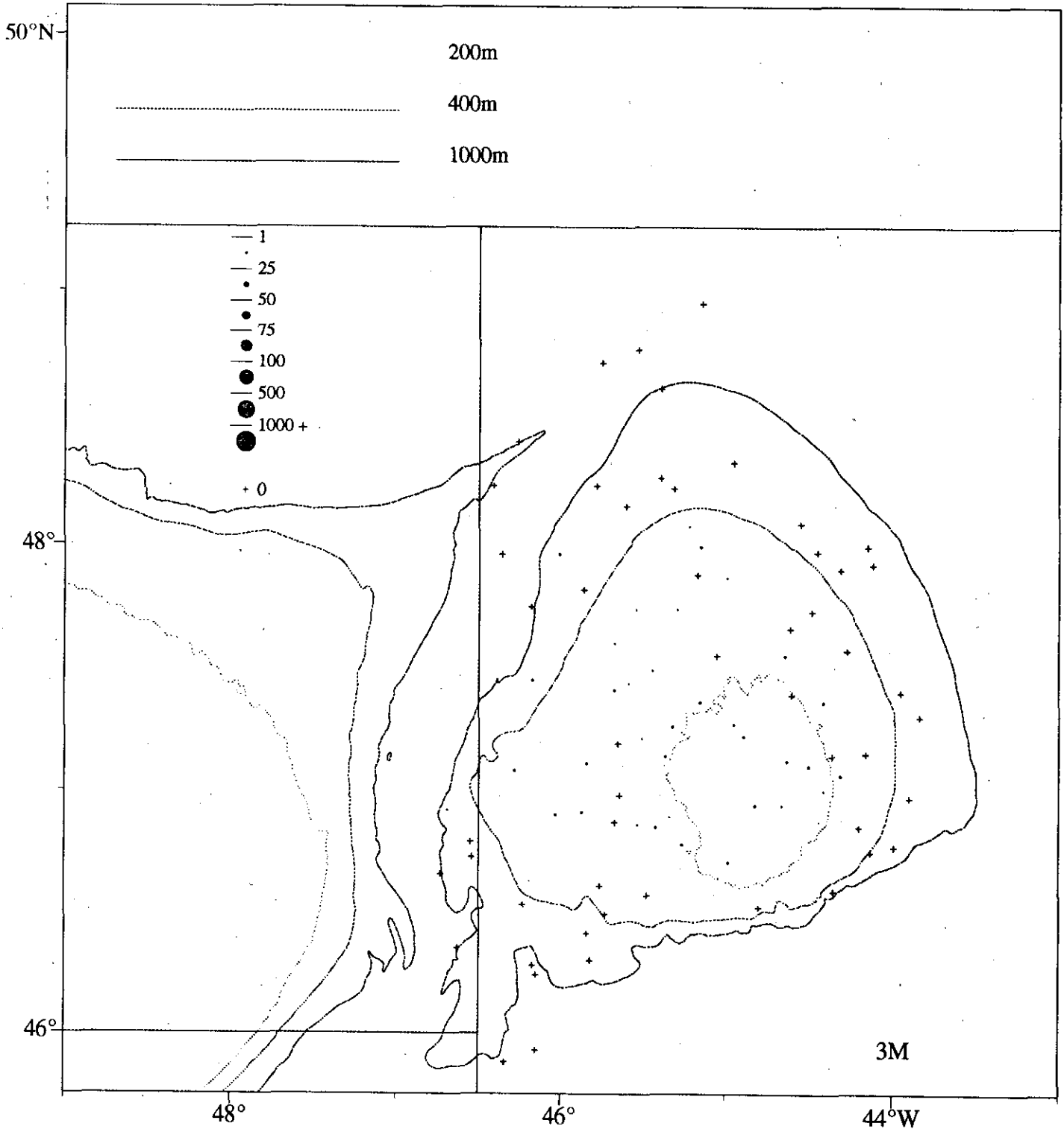


Figure 4 American plaice distribution in numbers from the Canadian 1996 fall research vessel survey in Div. 3M.

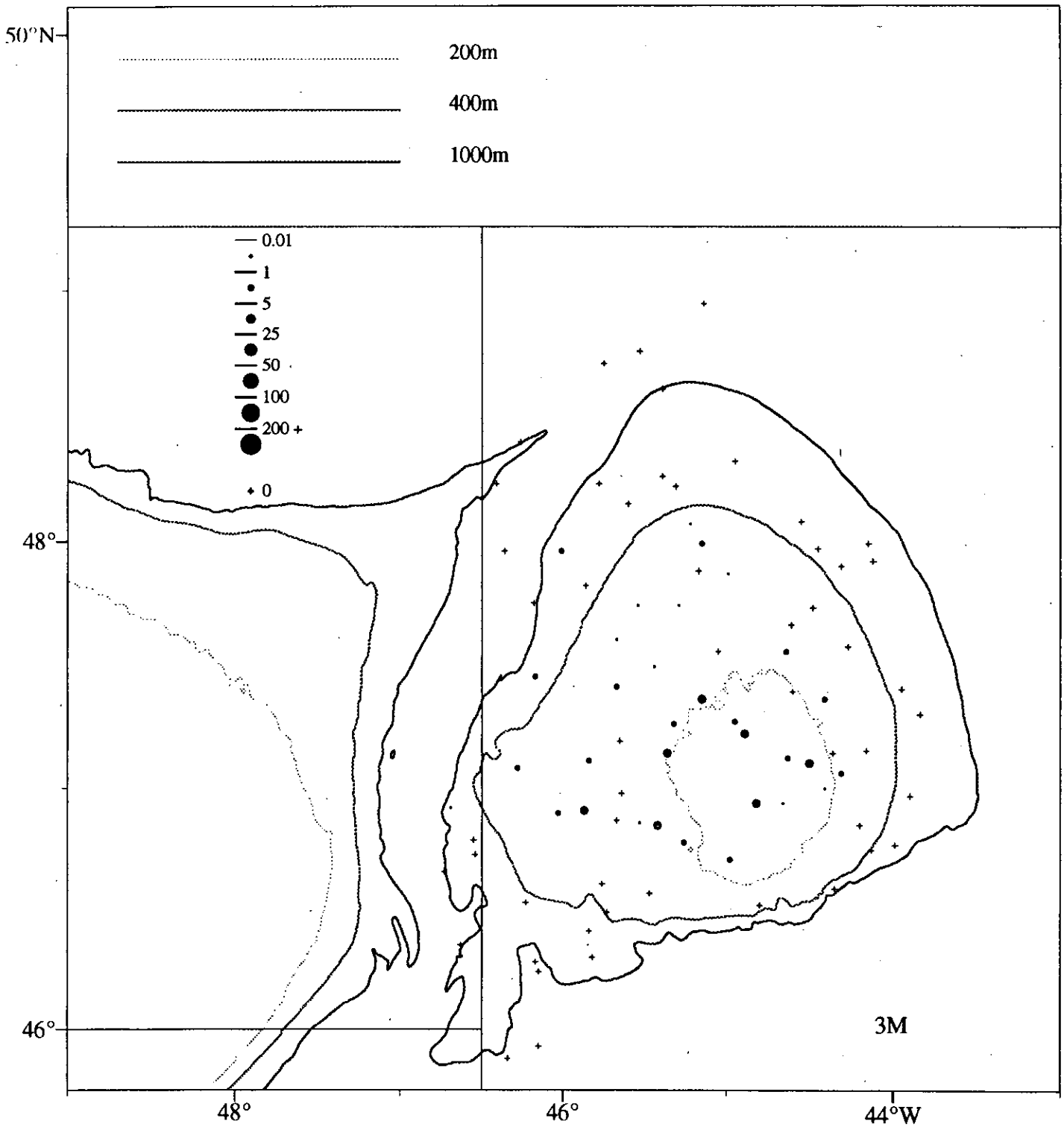


Figure 5 American plaice distribution in round weight (kg) from the Canadian 1996 fall research vessel survey in Div. 3M.

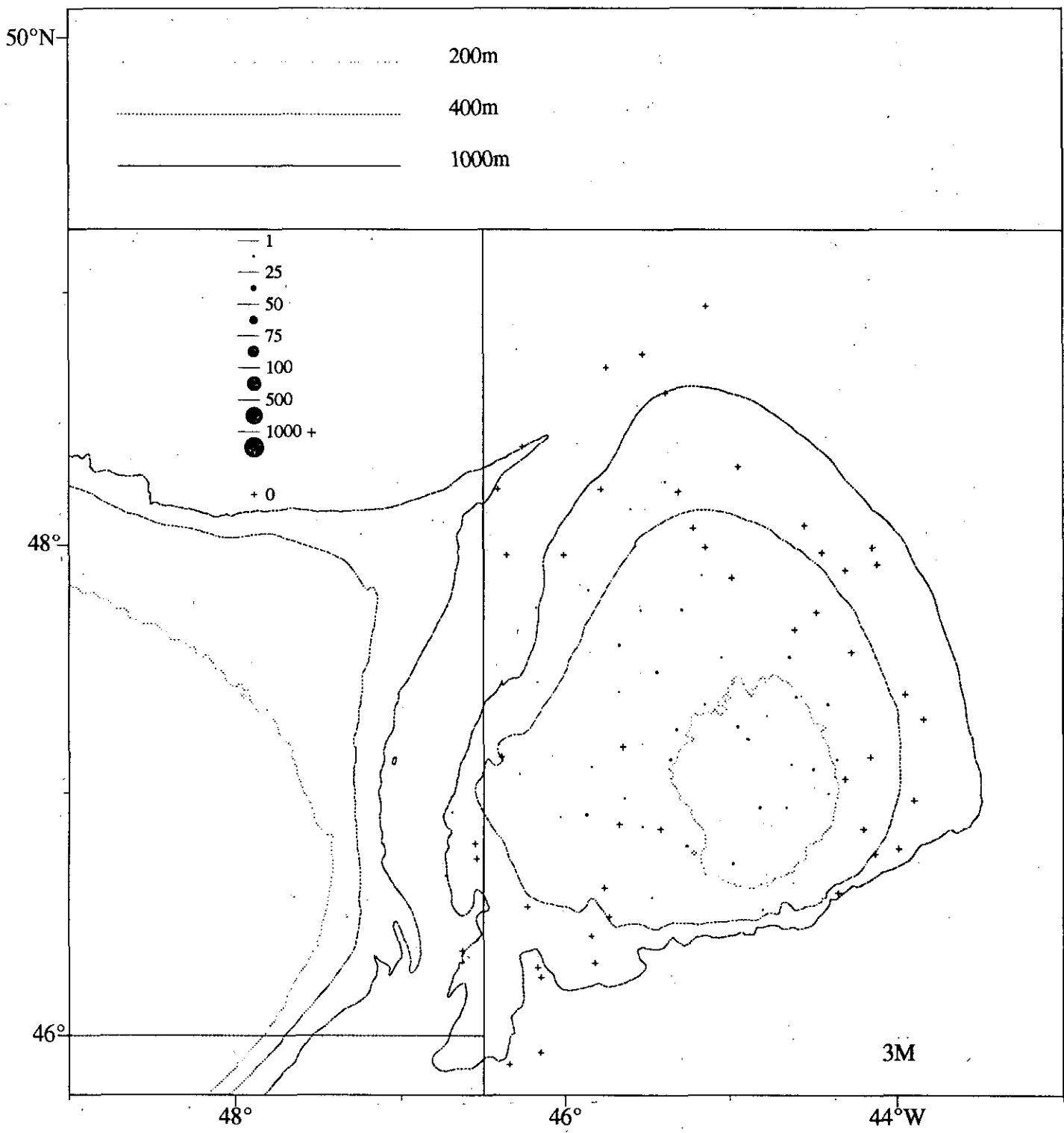


Figure 6. Witch flounder distribution in numbers from the Canadian 1996 fall research vessel survey in Div. 3M.

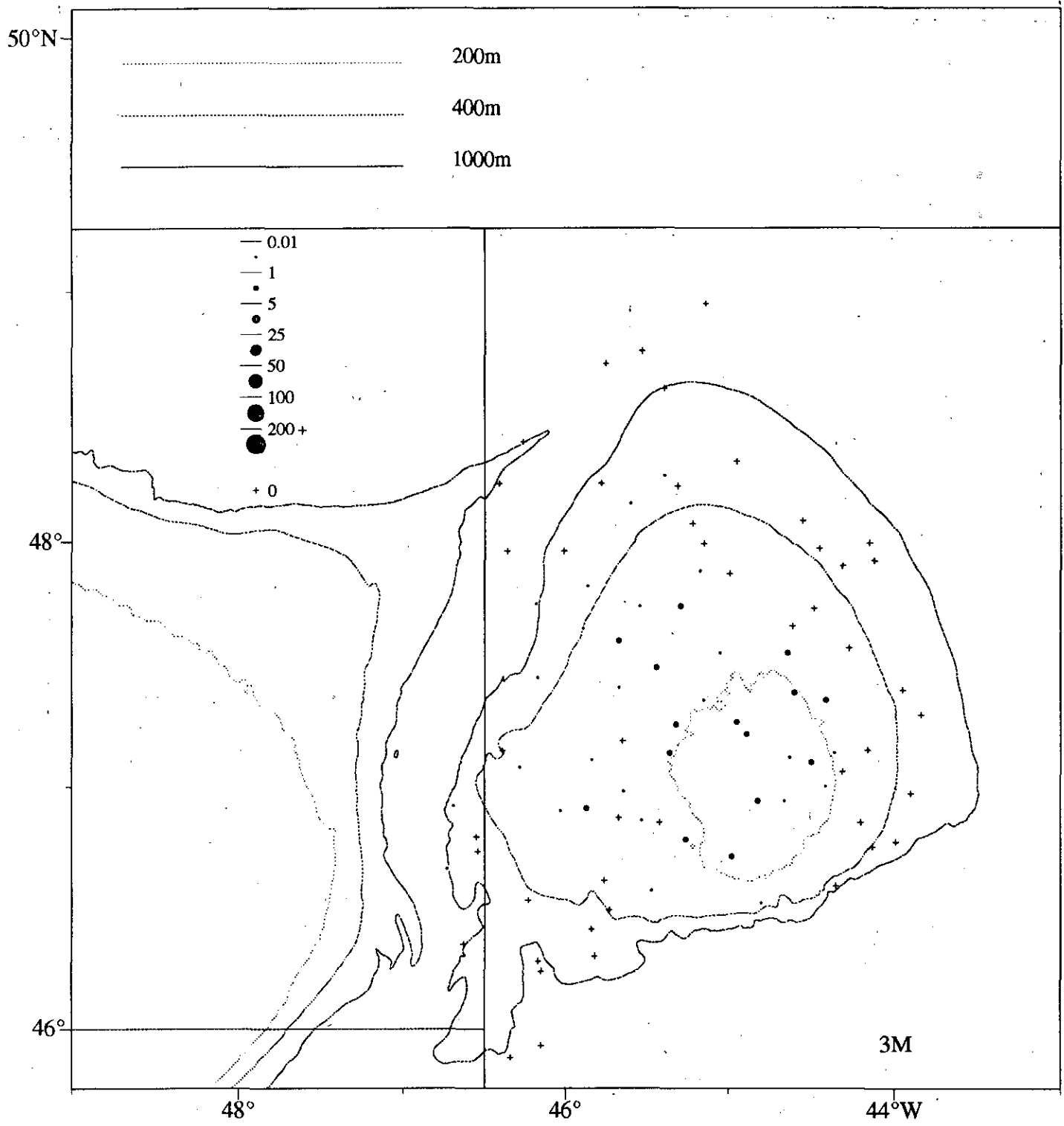


Figure 7 Witch flounder distribution in round weight (kg) from the Canadian 1996 fall research vessel survey in Div. 3M.

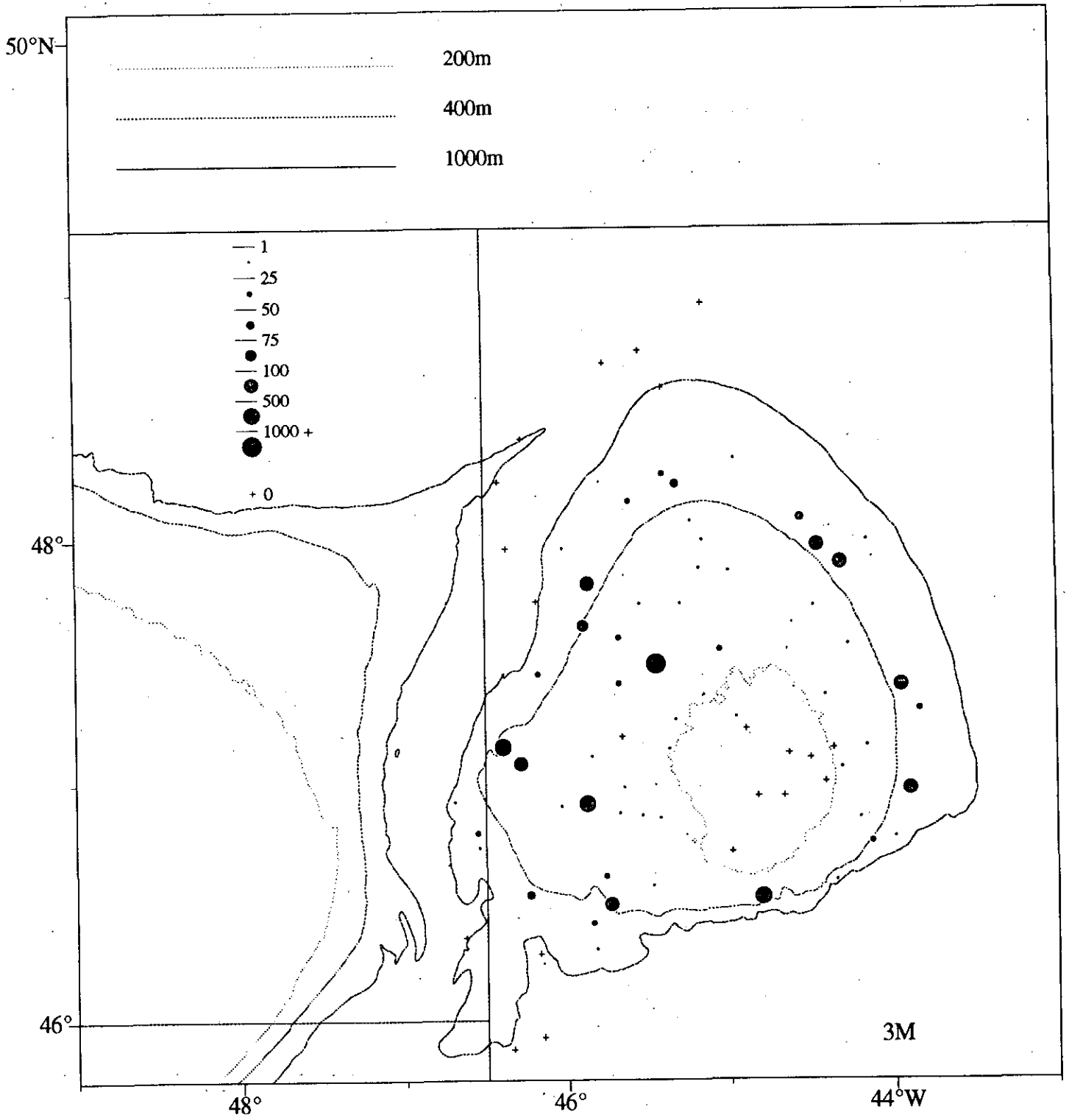


Figure 8 Redfish distribution in numbers from the Canadian 1996 fall research vessel survey in Div. 3M.

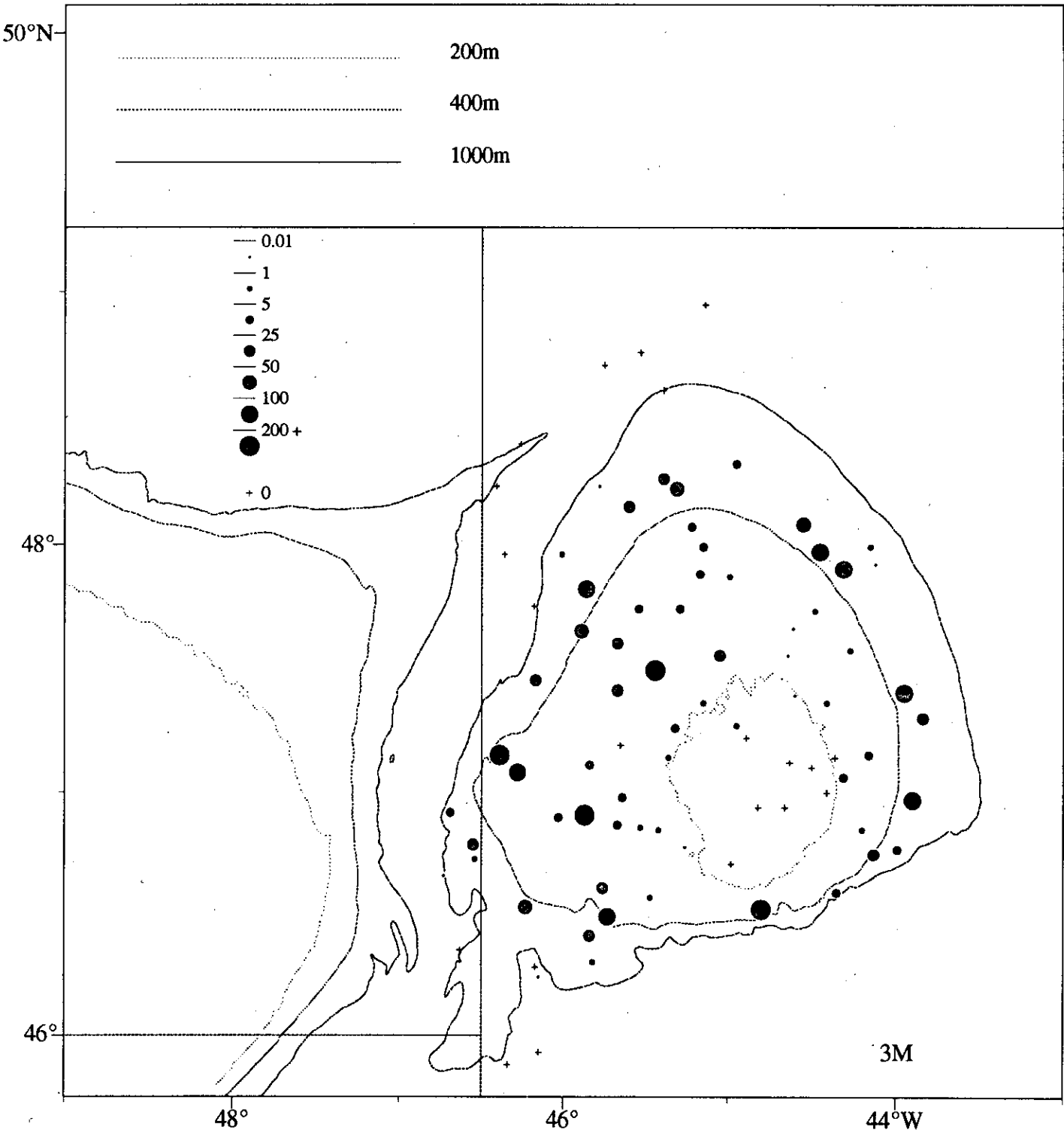


Figure 9 Redfish distribution in round weight (kg) from the Canadian 1996 fall research vessel survey in Div. 3M.