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Estimates of biomass from an acoustic survey for capelin (*Mallotus villosus*) in Division 3L, May 1990

by

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Introduction

This paper presents the results of an acoustic survey of the NAFO Division 3L capelin stock during the period May 11-27, 1990. Using the calibration parameters provided by the Hydroacoustic Development Section, DFO, Newfoundland, biomass was estimated at 6.9 million metric tons.

Methods

Acoustic data were collected using the same data acquisition system as for previous surveys (HYDAS), with the exception of the transducer which was a new unit. Calibration parameters for the system were as follows:

Combined source level/receive sensitivity	48.0 dB
Fixed receiver gain	5.34 dB
TVG gain	20 log R
Attenuation coefficient	.012 dB/m
Pulse length	0.6 milliseconds
Bandwidth	3.3 kHz
Average beam pattern	-28.79 dB
Target strength	-34 dB/kg

Strata surveyed were identical to those surveyed in 1989 (Figure 1) with the exception of strata A and B which were extended to the east to the edge of the 500 meter depth contour (resulting in an increase in the total area surveyed from 66193 sq. km. to 69291 sq. km.). Parallel transects were selected randomly as recommended by CAFSAC Pelagic Subcommittee (O'Boyle and Atkinson 1989). Estimates of mean biomass and backscatter and their standard error were calculated the same as for the 1989 survey. As noted in previous surveys, the standard error indicates variability only from the survey sampling design and does not include any variability due to error in the target strength value used or measurement of the calibration parameters of the acoustic data acquisition system.

Fishing sets were conducted on an opportunistic basis throughout the survey with an attempt to have at least one set per transect and one set per twelve hour survey period. A random length/sex/maturity of 200 fish was selected from each set and a stratified age sample of 2 fish per sex per 0.5 cm. length was selected to construct an age length key. A length composition and age/length key was constructed for each acoustic strata to determine age composition and total survey age composition was compiled by summing the individual strata. Mean lengths at age and percent mature at age were calculated for each strata and total survey mean lengths at age and percent mature were calculated by weighting the individual strata parameters by the strata biomass estimates.

The historical acoustic data for the period 1982 to 1990 were contoured using the software package 'Surfer' and Figures 2-10 show the distribution of capelin over this period.

Results

Table 1 gives estimates of acoustic backscatter and biomass for each strata and for the total survey. Total biomass was estimated at 6.9 million metric tons with coefficient of variation of 0.115. Table 2 provides estimates of backscatter and biomass for each transect and shows the biological sampling carried out for each transect. Table 3 gives the total survey age composition for this survey and for the historical period acoustic surveys on this stock. Table 4 provides a summary of biological parameters for each strata in this survey.

References

O'Boyle, R. N., and D. B. Atkinson. 1989. Hydroacoustic survey methodologies for pelagic fish as recommended by CAFSAC. CAFSAC Res. Doc. 89/72. 12 p.

Table 1. Acoustic survey results for 1990 NAFO Division 3L

Strata	Transects sampled	Number of possible transects	Transect area	Transect area scattering coefficient Mean	Transect area scattering coefficient S.E.	Strata total backscatter	Biomass per transect (tons) Mean	Biomass per transect (tons) S.E.	Total biomass (tons)
A	5.	35.	409.2	19513.	4615.0	682949.	49014.0	11592.2	1715489.
B	5.	30.	447.6	25357.	3866.7	760705.	63693.5	9712.8	1910804.
C	5.	30.	429.1	14879.	3127.0	446373.	37374.6	7854.7	1121238.
D	4.	30.	363.2	16324.	8107.3	489735.	41005.3	20364.7	1230159.
E	3.	30.	319.7	8485.	2974.6	254550.	21313.3	7471.8	639400.
F	2.	30.	272.7	3642.	928.2	109269.	9149.1	2331.6	274473.
Total	24.	185.		14830.	349.0	2743581.	37251.7	876.7	6891563.
						.115			.115

Table 2. Backscatter, biomass, and biological sampling for each transect.

Strata	Transect Number	Transect length	Transect area	Area scattering	Total backscattering	Density	Transect biomass	# of sets	Lsms	Ages
A	1	221.0	409.2	29.	11957.	73.40	30035.	1	200	58
	2	221.0	409.2	86.	35220.	216.20	88469.	1	200	65
	3	221.0	409.2	60.	24485.	150.30	61503.	1	200	50
	4	221.0	409.2	26.	10573.	64.90	26557.	1	200	36
	5	221.0	409.2	37.	15329.	94.10	38506.	2	289	85
B	1	241.7	447.6	43.	19156.	107.50	48117.	2	400	96
	2	241.7	447.6	49.	21775.	122.20	54697.	1	200	48
	3	241.7	447.6	57.	25660.	144.00	64454.	1	200	43
	4	241.7	447.6	45.	20029.	112.40	50310.	1	200	55
	5	241.7	447.6	90.	40165.	225.40	100889.	2	400	87
C	1	231.7	429.1	55.	23728.	138.90	59602.	1	200	61
	2	231.7	429.1	48.	20756.	121.50	52136.	0	0	0
	3	231.7	429.1	17.	7499.	43.90	18837.	0	0	0
	4	231.7	429.1	24.	10403.	60.90	26132.	1	200	49
	5	231.7	429.1	28.	12009.	70.30	30166.	2	400	143
D	1	196.1	363.2	103.	37551.	259.70	94323.	0	0	0
	2	196.1	363.2	12.	4352.	30.10	10932.	0	0	0
	3	196.1	363.2	56.	20416.	141.20	51284.	1	200	56
	4	196.1	363.2	8.	2979.	20.60	7482.	1	200	55
E	1	172.6	319.7	18.	5613.	44.10	14099.	1	200	71
	2	172.6	319.7	45.	14433.	113.40	36254.	1	200	61
	3	172.6	319.7	17.	5409.	42.50	13587.	1	200	57
F	1	147.2	272.7	10.	2714.	25.00	6818.	1	200	50
	2	147.2	272.7	17.	4571.	42.10	11481.	0	0	0

Table 3. Numbers (billions) and biomass (thousands of tons) at age of capelin from NAFO Division 3L hydroacoustic surveys.

Year	Cruise	Age	1	2	3	4	5+	Total
1990	181	Numbers	18.9	353.2	169.0	55.6	1.9	598.6
		Biomass	6	2507	2862	1517	66	6958
1989	166	Numbers	3.4	314.8	96.2	11.0	1.4	426.8
		Biomass	2	1776	1643	358	50	3829
1988	151	Numbers	13.6	380.4	65.7	9.7	16.8	486.2
		Biomass	10	1953	1604	380	604	4551
1987	137	Numbers	0.3	88.1	18.3	38.9	4.0	149.6
		Biomass	<1	640	436	1358	142	2576
1986	124	Numbers	0	59.4	158.1	21.3	1.0	239.8
		Biomass	0	411	2653	600	33	3697
1985	109	Numbers	0.2	369.5	80.5	3.8	2.3	456.3
		Biomass	<1	1992	1253	107	74	3426
1984	93	Numbers	0.1	21.0	6.2	3.1	0.5	30.8
		Biomass	<1	129	121	88	15	353
1983	77	Numbers	<0.1	3.4	1.9	0.8	0.1	6.2
		Biomass	<1	25	35	22	2	84
1982	64	Numbers	<0.1	9.7	16.2	2.4	0.9	29.2
		Biomass	<1	49	327	61	29	466

Table 4. Age composition (%), mean length at age (L), and percent mature (%M)
for each strata from sampling data for the Division 3L survey.

Strata	Age	1	2	3	4	5+	Total	Number of samples
A	%	1.4	63.9	25.5	8.7	0.4		6
	L	77	122	149	174	189	133	
	%M	0.0	1.7	43.6	95.3	100.0	20.9	
B	%	0.3	76.5	21.6	1.5	0.1		7
	L	73	121	146	171	183	127	
	%M	0.0	1.2	26.1	87.6	100.0	7.9	
C	%	1.5	56.5	29.2	11.9	1.1		4
	L	65	118	155	177	185	136	
	%M	0.0	3.0	60.7	96.6	100.0	31.9	
D	%	15.1	30.3	39.2	15.1	0.2		2
	L	60	130	155	170	178	136	
	%M	0.0	26.0	70.1	96.3	100.0	50.2	
E	%	4.2	27.0	39.5	28.5	.7		3
	L	73	120	159	173	190	149	
	%M	0.0	15.1	82.9	98.2	100.0	65.7	
F	%	0.0	9.5	56.3	33.8	0.0		1
	L	-	130	152	169	-	183	
	%M	-	5.3	77.3	99.3	-	78.0	
Total	%	3.2	58.9	28.2	9.3	0.3		23
	L	64	122	151	173	186	168	
	%M	0.0	3.9	51.6	96.2	100.0	26.1	

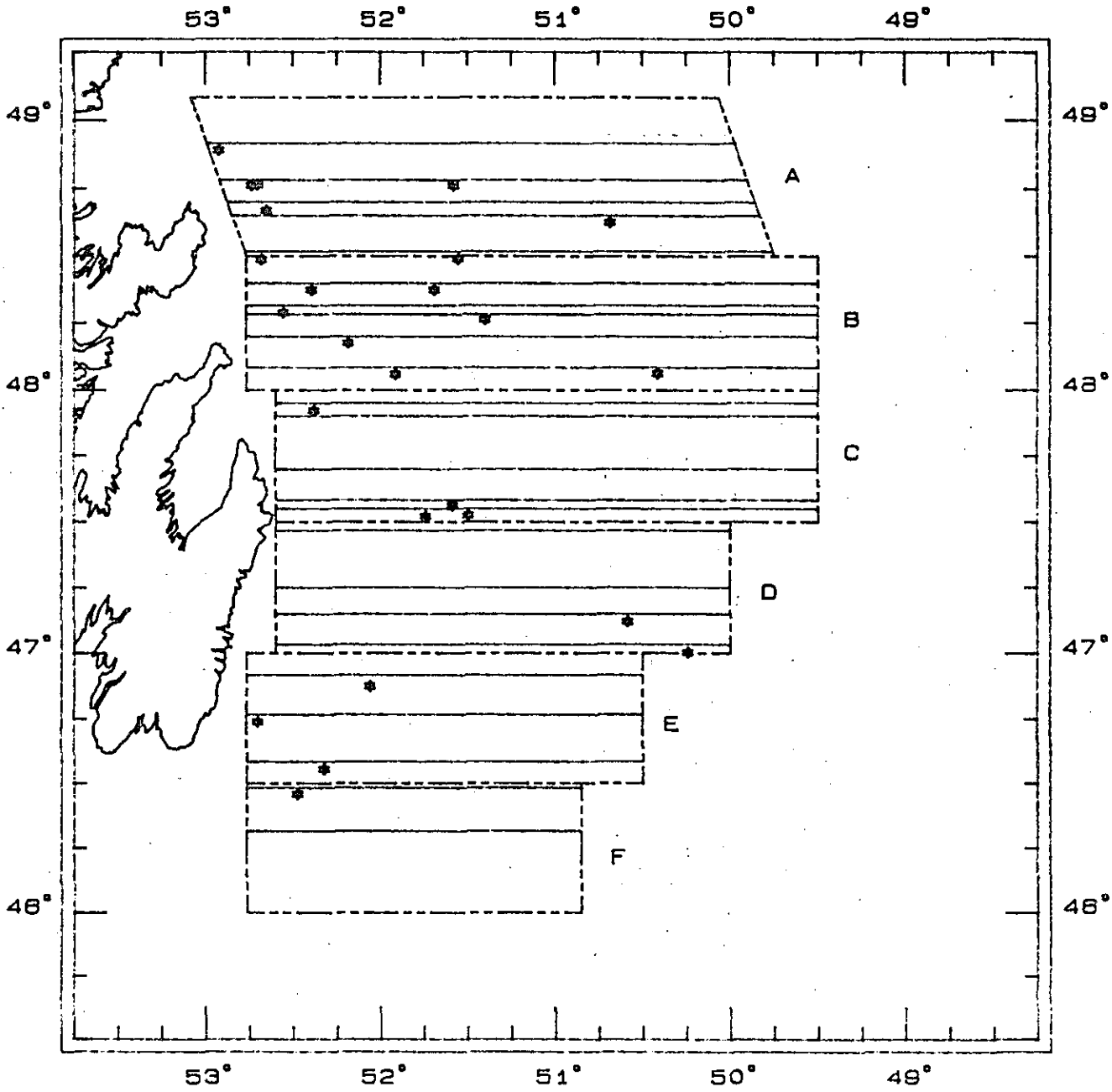

Figure 1. Strata, transects and sets for 3L capelin survey.

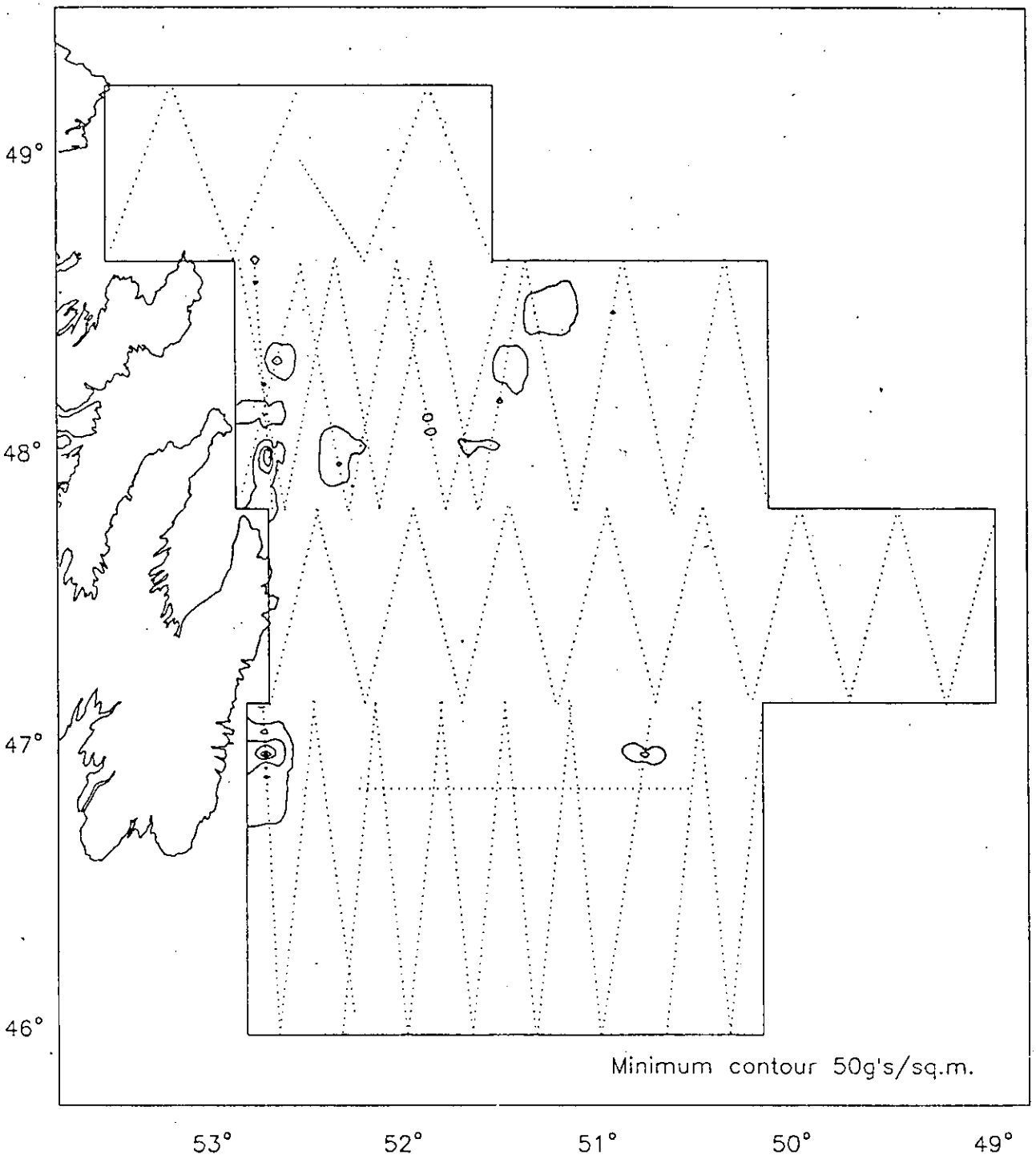

Figure 2. Division 3L capelin distribution – 1982

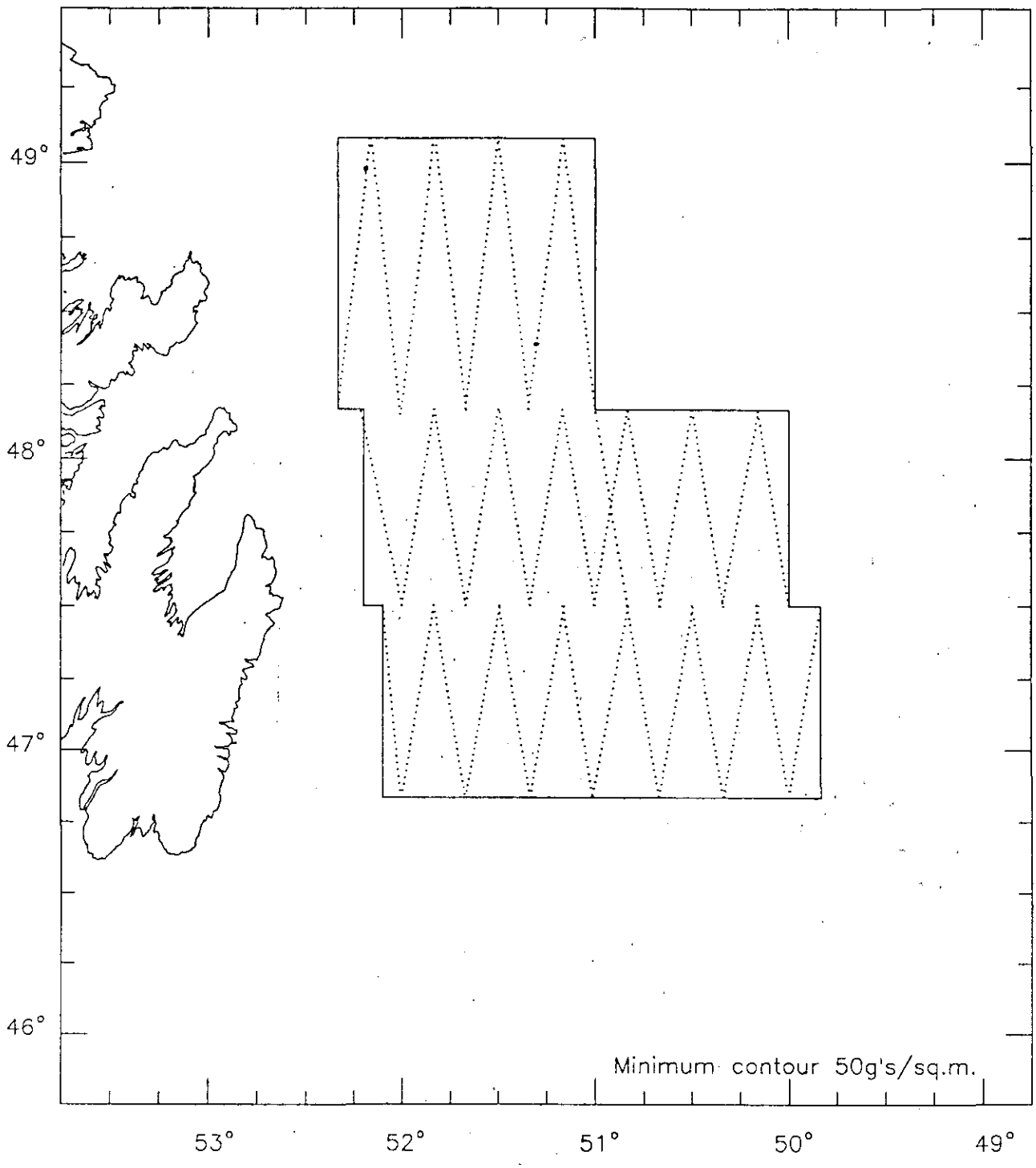

Figure 3. Division 3L capelin distribution – 1983

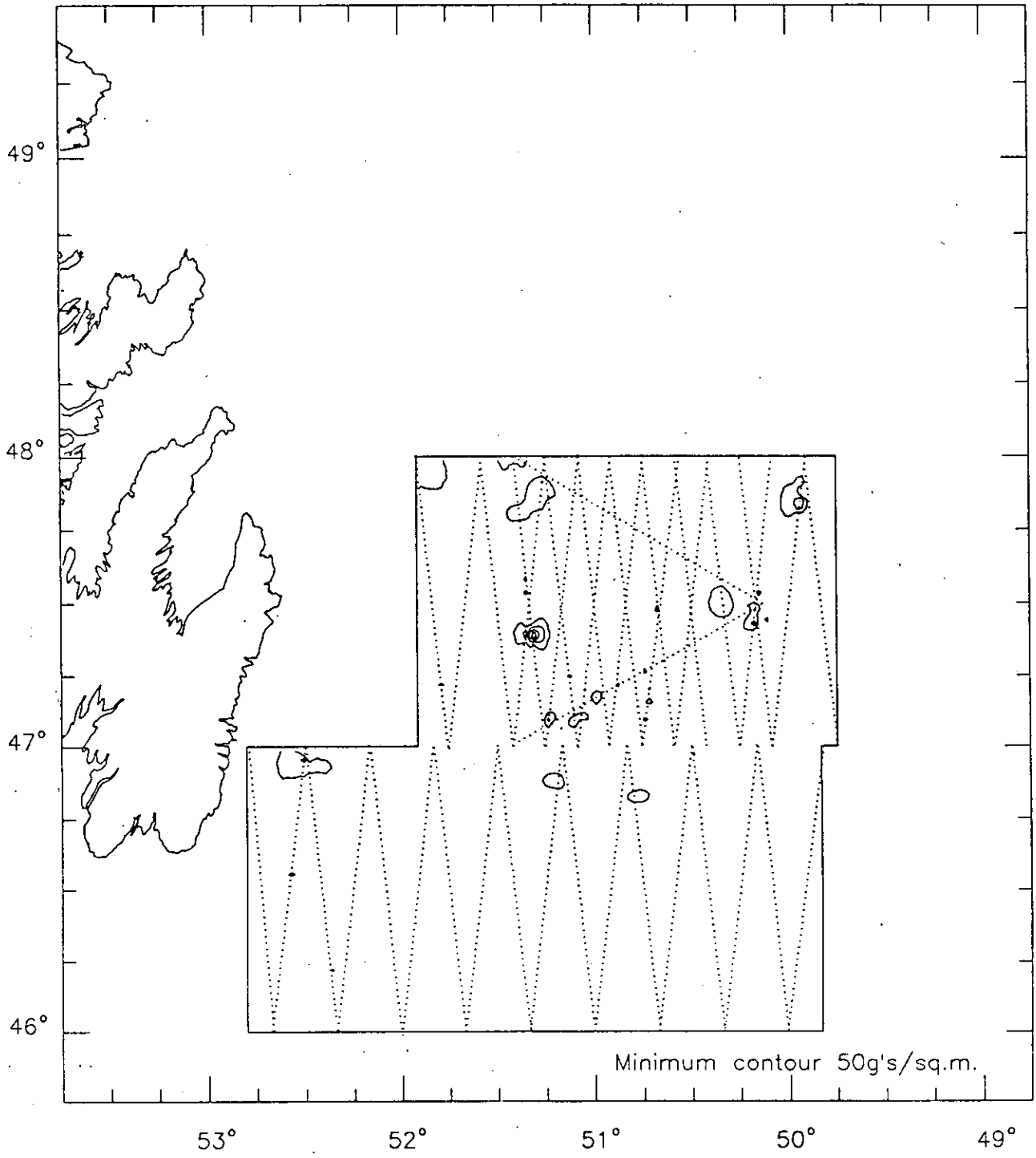

Figure 4. Division 3L capelin distribution - 1984

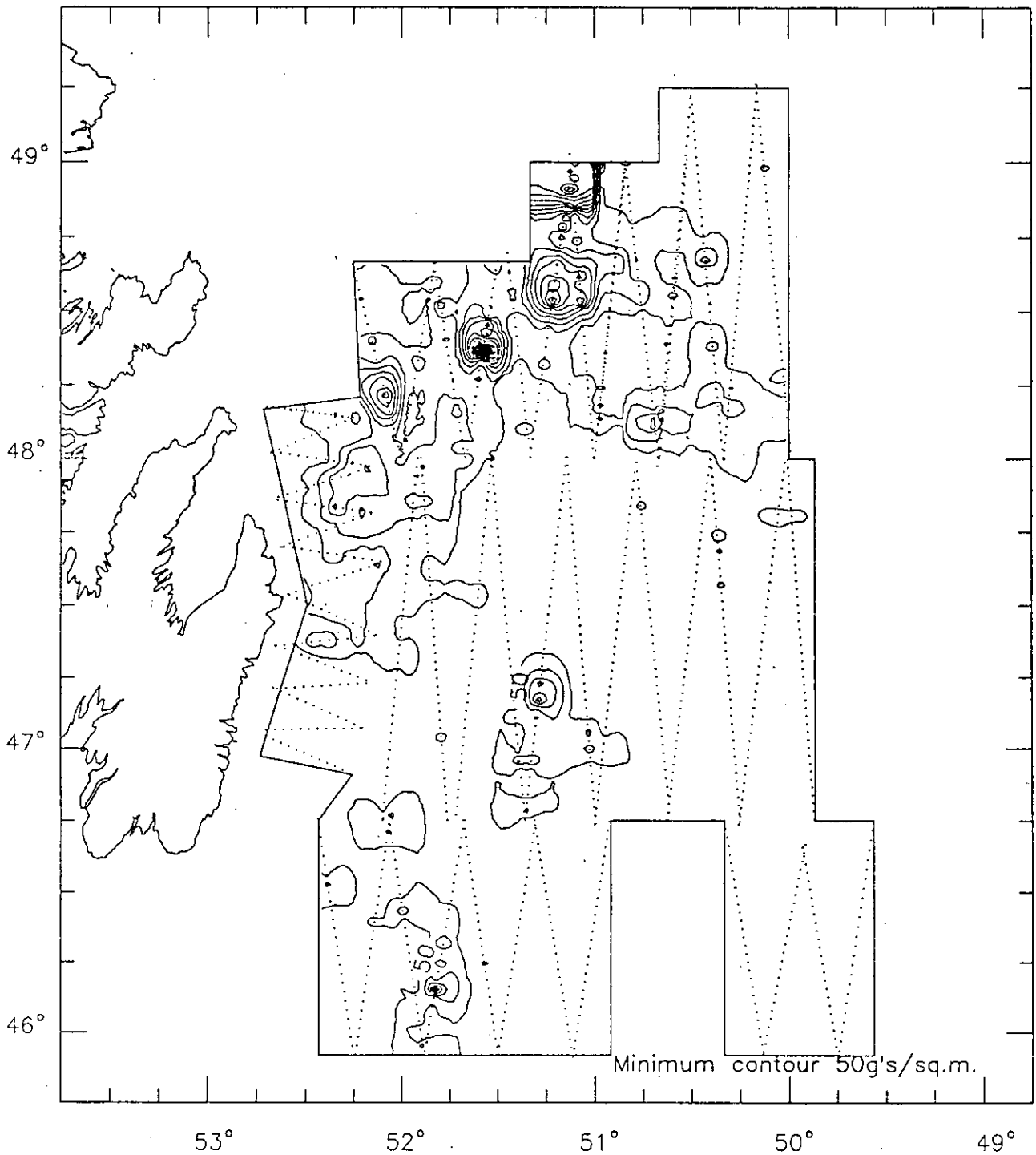

Figure 5. Division 3L capelin distribution – 1985

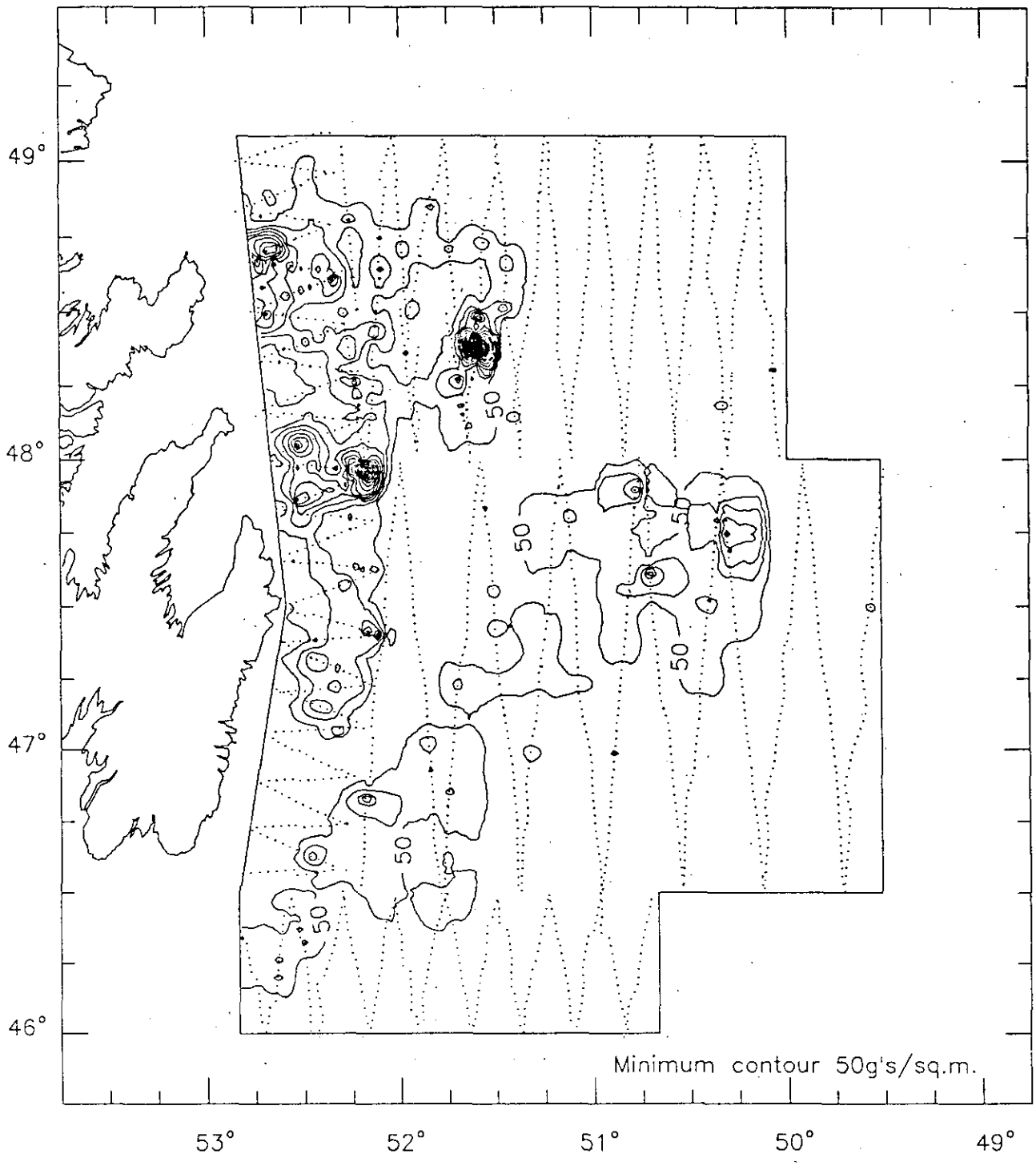

Figure 6. Division 3L capelin distribution – 1986

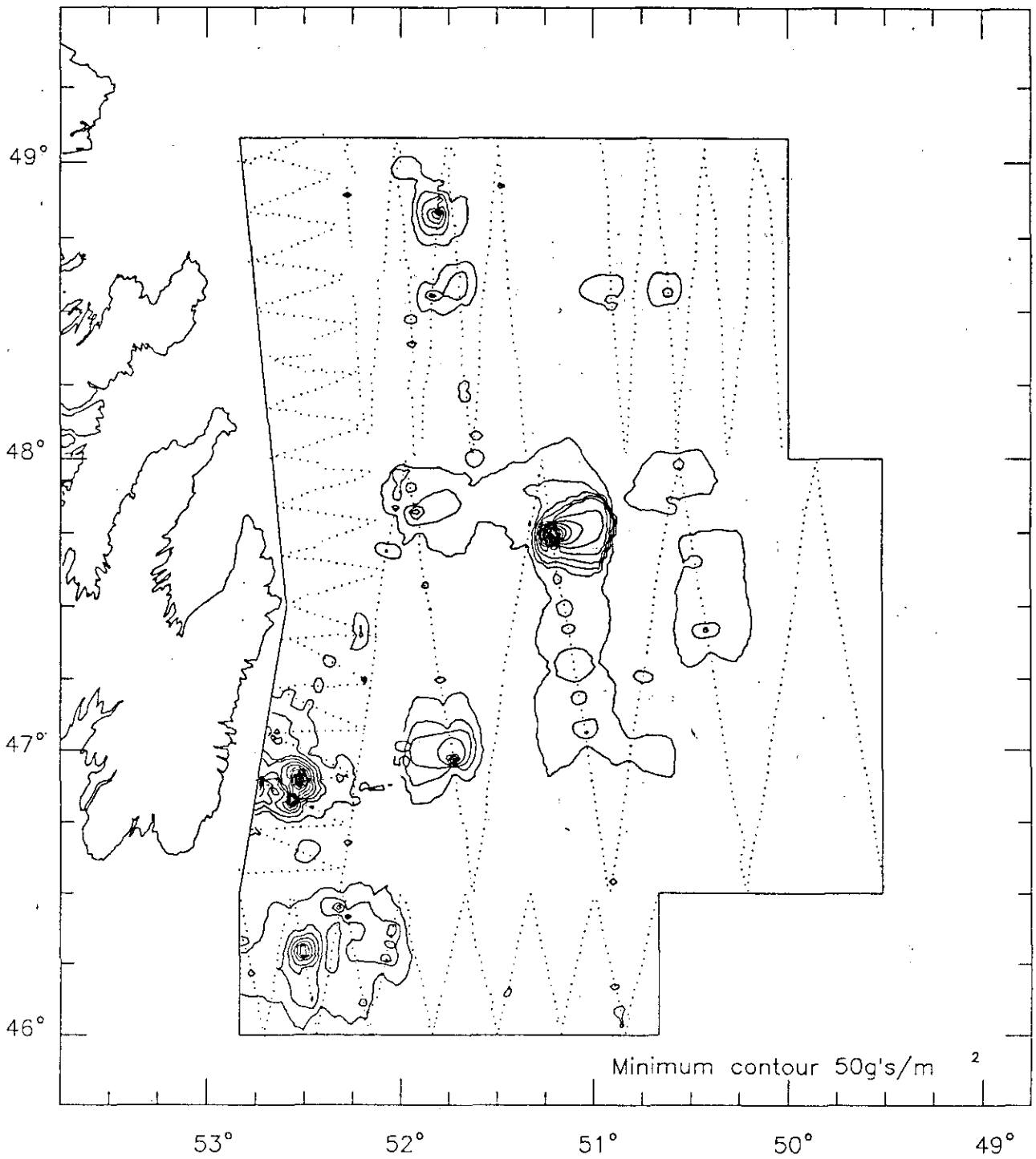

Figure 7. Division 3L capelin distribution – 1987

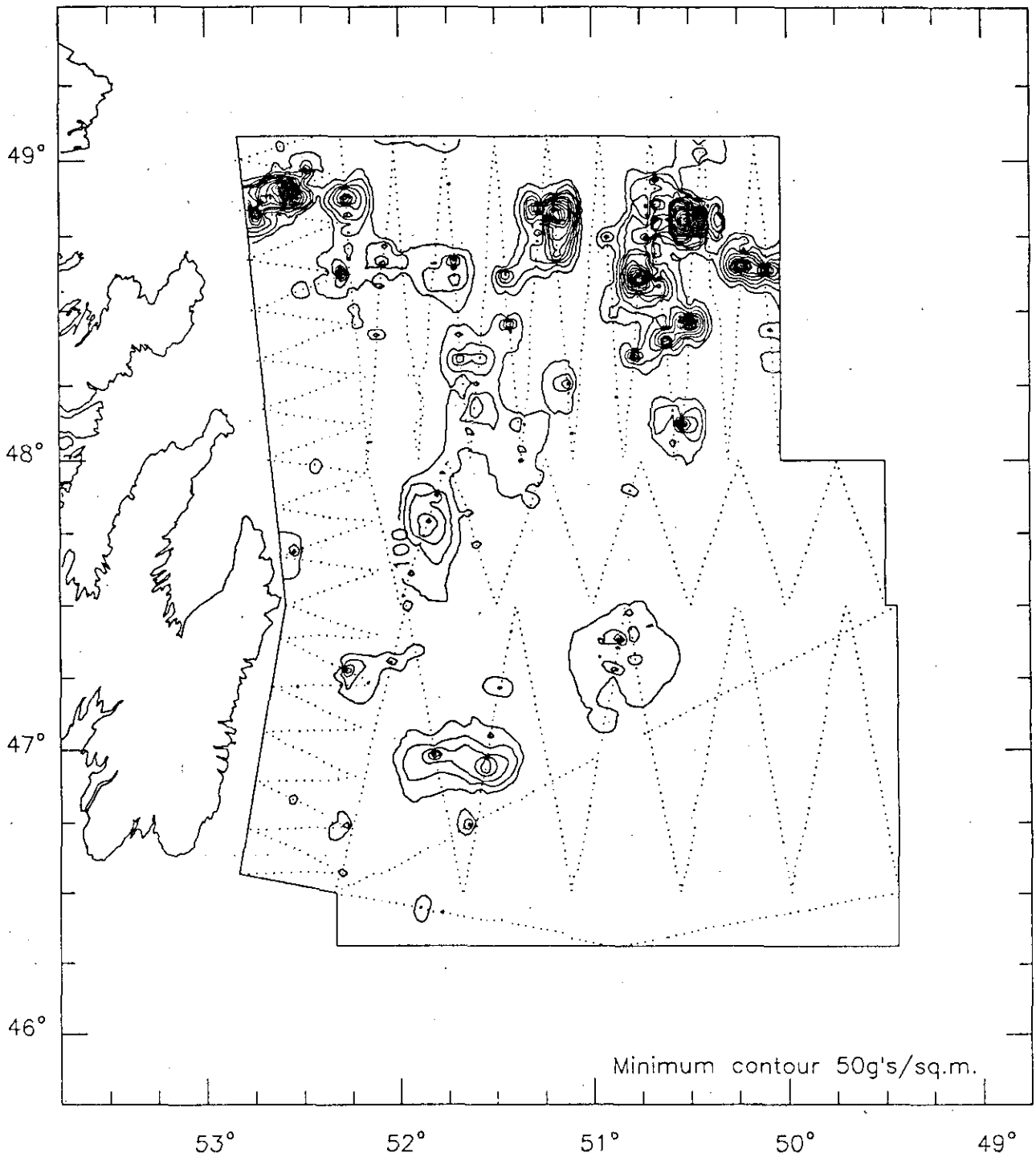

Figure 8. Division 3L capelin distribution – 1988

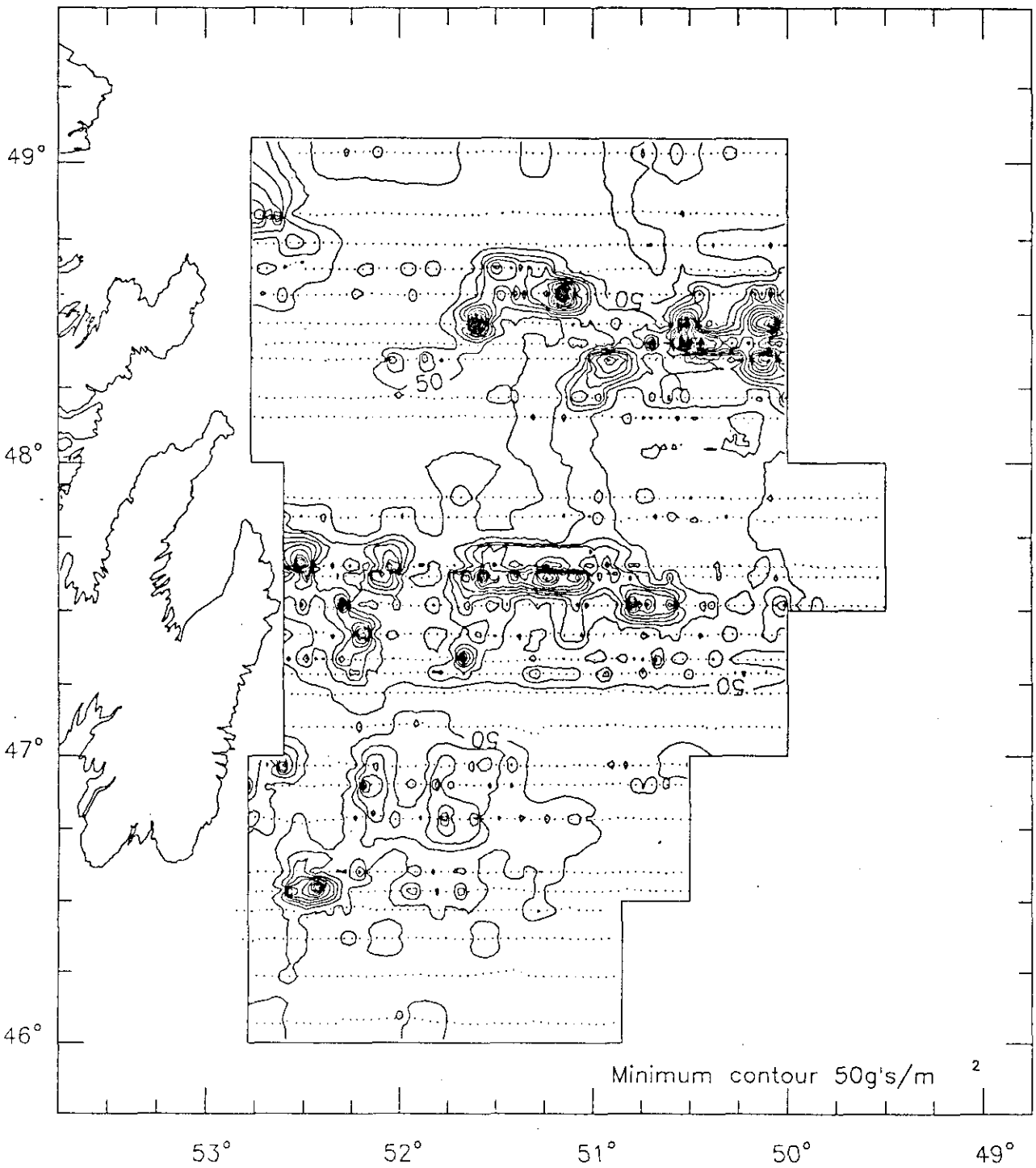

Figure 9. Division 3L capelin distribution – 1989

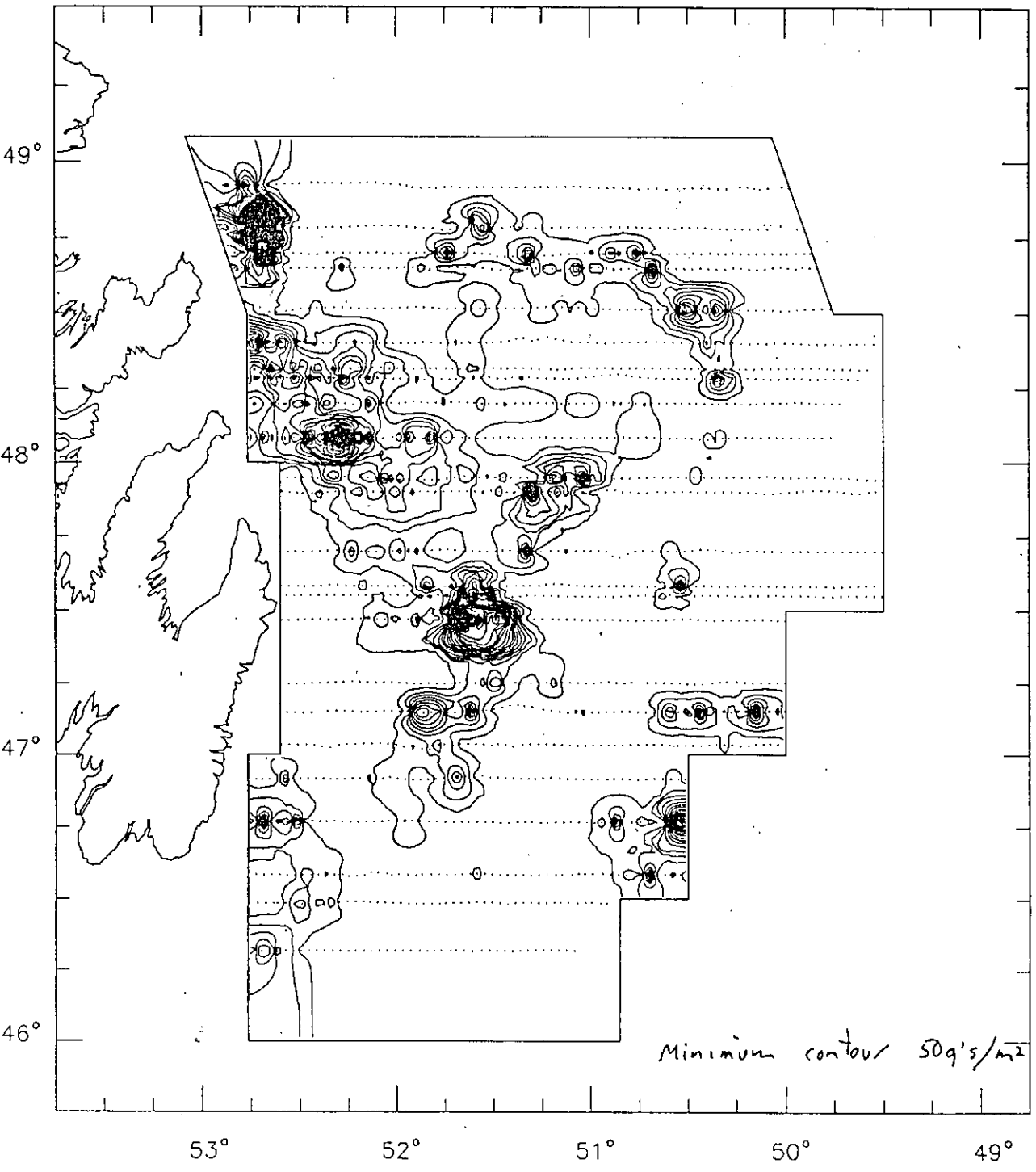

Figure 10. Division 3L capelin distribution – 1990