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Results of Two Acoustic Surveys for Capelin (*Mallotus villosus*) in NAFO Divisions 3L in 1991

by

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This paper presents the results of two acoustic surveys of the NAFO Division 3L capelin stock during the periods May 7-26, 1991 and June 25-July 12, 1991. Biomass estimates from the two surveys were 116,031 tons and 146,521 tons respectively.

Methods

Acoustic data were collected using a new data acquisition system manufactured by FEMTO Electronics. The data acquisition system is functionally the same as the HYDAS system used in all previous surveys. Calibration parameters for the system were as follows:

	May (GADUS 200)	June/July (GADUS 202)
Combined source level/receive sensitivity	53.5 dB	53.24 dB
Fixed receiver gain	11.15 dB	11.25 dB
TVG gain	20 log R	20 log R
Attenuation coefficient	.012 dB/m	.012 dB/m
Pulse length	0.6 msec	0.6 msec
Bandwidth	3.3 kHz	3.3 kHz
Average beam pattern	-28.79 dB	-28.79 dB
Target strength	-34 dB/kg	-34 dB/kg

During the May survey (GADUS 200), strata A and B could not be covered as there was extensive ice coverage in the area at that time (Fig. 1). Stratum C was extended to the eastward by 62 kilometers as concentrations of capelin were encountered at the eastern end of the limits of this stratum as it was surveyed in 1990.

The June-July survey (GADUS 202) (Fig. 2) covered the same strata as surveyed in 1990 with the exception of strata C and D which were extended to the eastward by 25 kilometers again because of capelin concentrations encountered at the eastern end of the 1990 limits of these strata.

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 surveys beginning in 1989. 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 (Figs. 1 and 2). 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.

Results

Tables 1 and 2 give estimates for each survey of acoustic backscatter and biomass by strata and for the total survey. Total biomass was estimated at 116,031 tons for the May survey and 146,521 tons for the June/July survey. Tables 3 and 4 provide estimates for each survey of backscatter and biomass by transect and shows the distribution of biological sampling. Table 5 gives the total survey age composition for each survey and for the historical period of acoustic surveys on this stock. Tables 6 and 7 provide a summary for each survey of biological parameters by strata.

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. Gadus 200, May 1991 - statistics for each strata and total survey

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)
C	7.	30.	544.3	1369.	613.7	41057.	3437.6	1541.6	103129.
D	5.	30.	363.2	81.	38.3	2429.	203.4	96.2	6102.
E	5.	30.	319.7	27.	13.5	825.	69.1	33.9	2072.
F	5.	30.	272.7	63.	38.8	1882.	157.6	97.5	4729.
Total	22.	120.		385.	28.8	46193.	966.9	72.3	116031.
						.351			.351

Table 2. Gadus 202, June/July 1991 - statistics for each strata and total survey.

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	34.	12.3	1175.	84.3	30.8	2950.
B	5.	30.	447.6	48.	8.1	1443.	120.9	20.4	3626.
C	5.	30.	475.0	183.	71.1	5491.	459.8	178.7	13794.
D	3.	30.	479.5	42.	21.3	1260.	105.5	53.4	3165.
E	3.	30.	319.7	866.	537.9	25990.	2176.1	1351.2	65283.
F	3.	30.	272.7	766.	469.4	22972.	1923.4	1179.0	57703.
Total	24.	185.		315.	22.5	58331.	792.0	56.6	146521.
						.350			.350

Table 3. Gadus 200, May 1991 - 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
C	1	293.9	544.3	1.	596.	2.75	1497.	0	0	0
	2	293.9	544.3	8.	4438.	20.48	11147.	2	400	88
	3	293.9	544.3	4.	2258.	10.42	5672.	1	200	54
	4	293.9	544.3	4.	1933.	8.92	4855.	1	200	42
	5	293.9	544.3	0.	98.	.45	245.	1	200	42
	6	293.9	544.3	0.	178.	.82	446.	2	400	137
	7	293.9	544.3	0.	80.	.37	201.	2	400	126
D	1	196.1	363.2	0.	19.	.13	47.	1	200	50
	2	196.1	363.2	0.	27.	.19	69.	1	200	58
	3	196.1	363.2	1.	224.	1.55	563.	2	400	79
	4	196.1	363.2	0.	38.	.26	94.	0	0	0
	5	196.1	363.2	0.	97.	.67	243.	0	0	0
E	1	172.6	319.7	0.	73.	.57	182.	0	0	0
	2	172.6	319.7	0.	3.	.02	6.	0	0	0
	3	172.6	319.7	0.	11.	.09	29.	0	0	0
	4	172.6	319.7	0.	45.	.35	112.	1	200	13
	5	172.6	319.7	0.	6.	.05	16.	0	0	0
F	1	147.2	272.7	0.	2.	.02	5.	0	0	0
	2	147.2	272.7	0.	21.	.19	52.	0	0	0
	3	147.2	272.7	0.	62.	.57	155.	0	0	0
	4	147.2	272.7	1.	213.	1.96	534.	0	0	0
	5	147.2	272.7	0.	16.	.15	41.	0	0	0

Table 4. Gadus 202, June/July 1991 - 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	0.	80.	.49	201.	1	200	37
	2	221.0	409.2	0.	33.	.20	82.	0	0	0
	3	221.0	409.2	0.	11.	.07	29.	1	200	37
	4	221.0	409.2	0.	29.	.18	74.	0	0	0
	5	221.0	409.2	0.	15.	.09	37.	1	200	40
B	1	241.7	447.6	0.	69.	.39	175.	1	200	0
	2	241.7	447.6	0.	64.	.36	161.	2	200	104
	3	241.7	447.6	0.	34.	.19	85.	1	200	0
	4	241.7	447.6	0.	29.	.16	72.	2	72	75
	5	241.7	447.6	0.	45.	.25	112.	1	200	41
C	1	256.5	475.0	1.	433.	2.29	1088.	2	400	106
	2	256.5	475.0	0.	217.	1.15	546.	0	0	0
	3	256.5	475.0	0.	172.	.91	432.	1	200	65
	4	256.5	475.0	0.	51.	.27	128.	2	400	73
	5	256.5	475.0	0.	42.	.22	105.	1	200	43
D	1	258.9	479.5	0.	84.	.44	211.	2	285	75
	2	258.9	479.5	0.	15.	.08	38.	1	0	47
	3	258.9	479.5	0.	27.	.14	67.	2	200	76
E	1	172.6	319.7	1.	421.	3.31	1058.	1	200	40
	2	172.6	319.7	1.	241.	1.89	604.	2	200	86
	3	172.6	319.7	6.	1937.	15.22	4866.	3	600	100
F	1	147.2	272.7	6.	1685.	15.52	4232.	3	600	75
	2	147.2	272.7	1.	141.	1.30	355.	2	400	38
	3	147.2	272.7	2.	471.	4.34	1184.	3	600	61

Table 5. 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
1991	202	Numbers	34.9	7.0	1.1	0.3	0.1	43.4
		Biomass	54	56	24	10	2	146
	200	Numbers	18.7	7.7	3.2	0.5	<0.1	30.1
		Biomass	7	40	56	12	1	116
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 6. Gadus 202 - Age composition (%), mean length at age (L), and percent mature (%M) for each strata.

Strata	Age	1	2	3	4	5+	Total	Number of samples
A	%	5.9	91.2	2.1	0.8	0.0		3
	L	78	107	146	172	-	107	
	%M	0.0	0.1	58.0	100.0	-	2.2	
B	%	63.2	18.1	14.7	3.5	0.4		5
	L	56	120	156	179	182	87	
	%M	0.0	0.0	18.8	54.6	63.4	4.9	
C	%	0.2	65.3	25.8	6.4	2.3		6
	L	83	120	161	179	180	136	
	%M	0.0	1.7	80.2	100.0	100.0	30.5	
D	%	5.7	82.8	10.7	0.7	0.1		2
	L	68	117	158	178	181	119	
	%M	0.0	0.3	55.5	100.0	100.0	7.0	
E	%	51.5	42.5	4.4	1.3	.3		5
	L	82	123	159	174	175	104	
	%M	0.0	1.2	65.7	98.7	100.0	5.0	
F	%	96.9	2.0	0.7	0.3	0.1		8
	L	83	122	162	179	193	85	
	%M	0.0	3.1	83.3	100.0	100.0	1.1	
Total	%	80.2	16.2	2.6	0.8	0.2		29
	L	83	121	160	177	181	92	
	%M	0.0	1.4	72.6	99.4	100.0	3.1	

Table 7. Gadus 200 - Age composition (%), mean length at age (L), and percent mature (%M) for each strata.

Strata	Age	1	2	3	4	5+	Total	Number of samples
C	%	16.7	55.7	23.8	3.5	0.4		9
	L	68	113	153	169	172	117	
	%M	0.0	4.9	88.6	99.1	98.8	27.6	
D	%	41.1	35.5	20.3	3.0	0.0		4
	L	66	101	150	169	-	99	
	%M	0.0	9.7	98.6	100.0	-	26.4	
E	%	98.5	1.5	0.0	0.0	0.0		1
	L	67	93	-	-	-	67	
	%M	0.0	0.0	-	-	-	0.0	
Total	%	62.1	25.5	10.7	1.6	0.2		14
	L	67	112	153	169	172	93	
	%M	0.0	5.0	89.3	99.2	98.8	12.5	

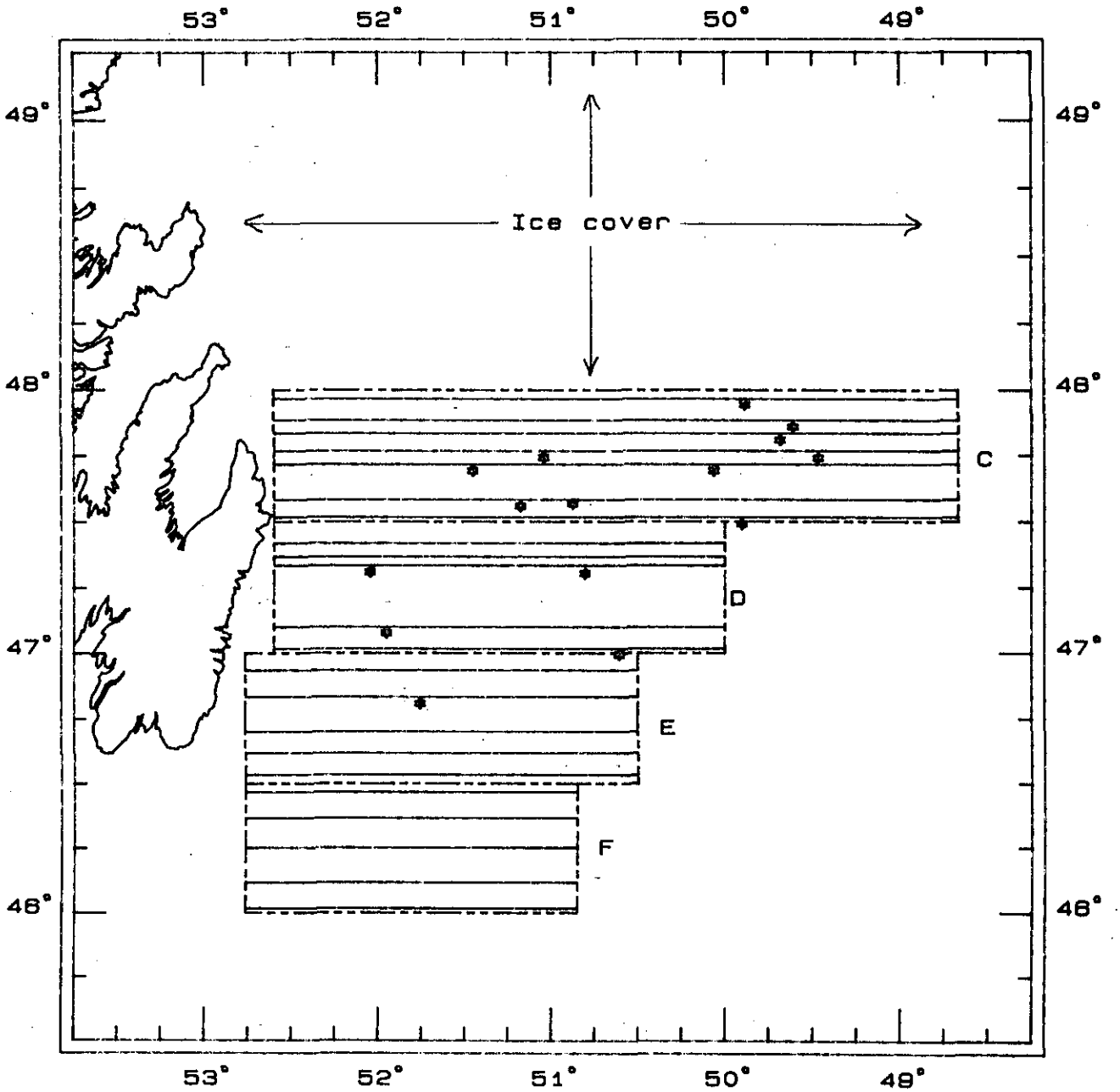

Figure 1. Gadus 200 cruisetrack and set locations

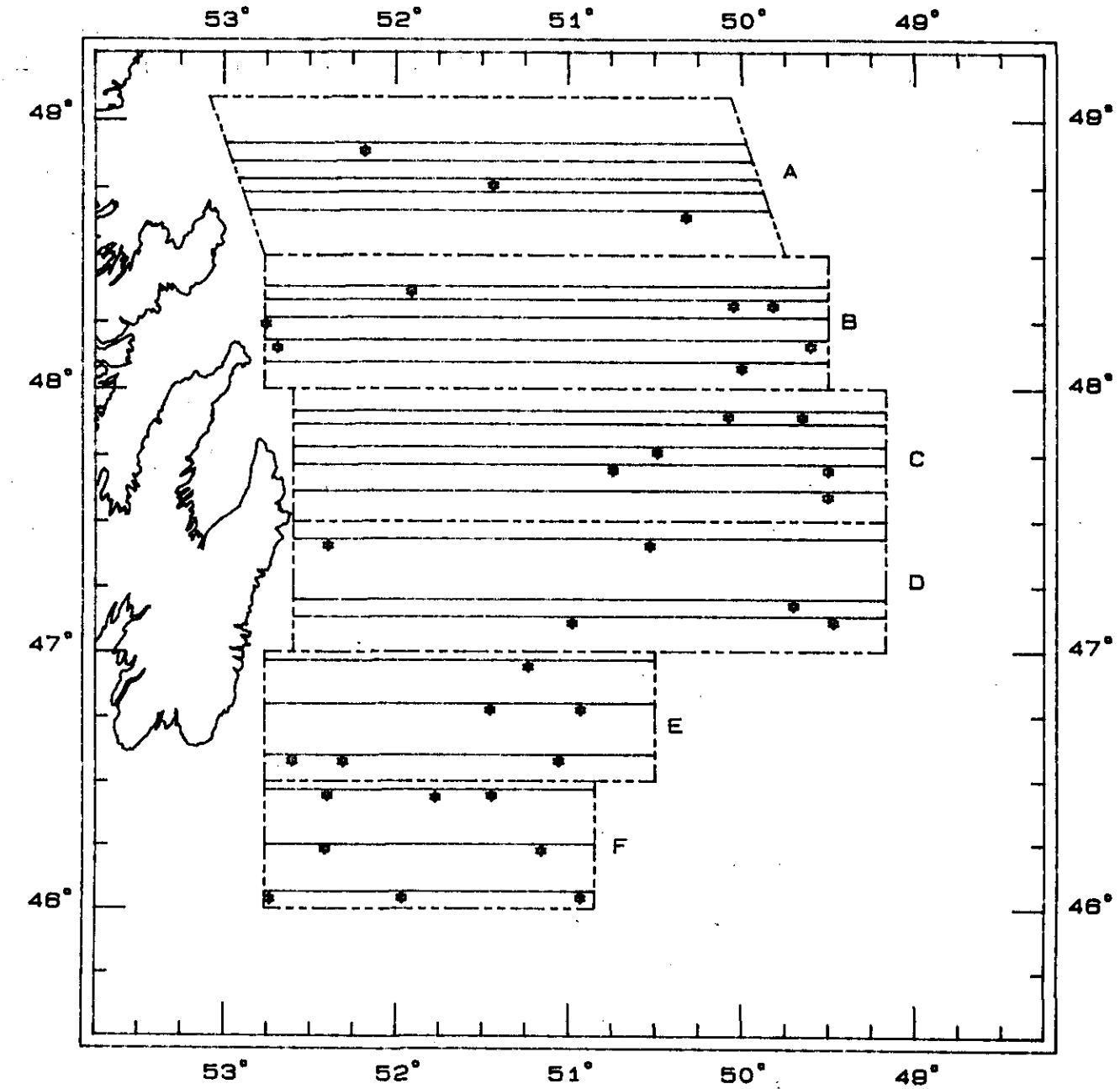

Figure 2. Gadus 202 cruisetrack and set locations