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ADDENDUM)

SCIENTIFIC COUNCIL MEETING - JUNE 1989

Biomass Estimates from two Hydroacoustic Surveys for Capelin (Mallotus villosus) in NAFO Divisions 3L and 3N and Observations of the Soviet Fishery for Capelin in Division 3NO

by

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Introduction

This paper presents the results of two acoustic surveys conducted on capelin in Divisions 3L and 3N. The survey of the Division 3NO stock was during the period June 22-July 3, 1988 and for the 3L stock during the period May 12-28, 1989. Capelin biomass was estimated at 560,814 tons for the Division 3NO stock and at between 3,015,068 to 7,145,499 tons for the 3L stock. A small directed fishery for mature capelin was conducted by the U.S.S.R. in Division 3NO in 1988. Catch rates and sampling data are presented for this fishery.

SUBSEQUENT TO THE JUNE 1989 MEETING, ADDENDUM I (PAGES 11 TO 15) WAS INSERTED FOR THE SEPTEMBER 1989 MEETING OF THE SCIENTIFIC COUNCIL.

Acoustic surveys methodology

Data were collected using the hydroacoustic data acquisition system (HYDAS) described by Stevens (1986). The equipment configuration was identical for both trips with the exception of the transducer which differed. The calibration of the HYDAS system for the May 1989 Division 3L survey differed significantly (3.2dB) from the calibration of the HYDAS system for the 1988 autumn Division 2J3K survey. The only difference in the HYDAS system between the October 1988 calibration and the May 1989 calibration was a removal of about 200 meters of the towing cable in May 1989 which would have been expected to result in an increase in the source level and receive sensitivity. However, both decreased which accounted for the differences between the two calibrations. In addition, approximately the same quantity of data was collected during May 1989 as during the May 1988 survey; this suggested that as a gross comparison the overall biomass in May 1989 was similar to that of May 1988. This was not the case as the final May 1989 estimate was much higher. Consequently, we have also provided a biomass estimate using the calibration parameters from the October 1988 2J3K survey. Calibration parameters of the data acquisition system for each survey are given in Appendix A. Two complete surveys of the 3NO stock were carried out. The first 3NO survey followed a uniform zig-zag design as in previous years (Figure 1.). The second 3NO survey was a uniform random parallel design where the survey area was subdivided into parallel strips of equal width and then one parallel transect was randomly located within each strip (Figure 2).

A special meeting of the Pelagic Subcommittee of CAFSAC was held in August 1988 to review the design and operation of pelagic acoustic surveys. It was recommended at this meeting that all pelagic acoustic surveys use a design of randomly selected parallel transects as this will produce an unbiased estimate of the mean and variance of the total backscatter volume which was not possible with the zig-zag transect pattern formerly used. Consequently, the random parallel design was used for the 1989 Division 3L survey (Figure 3.). The total area to be surveyed was subdivided into six blocks of equal width and 5 parallel transects were randomly selected in each block except block F which had only

four transects. Appendix B. shows the formulas used to derive estimates of mean biomass and variance as described by Cochran (1977). It should be noted that these formula account only for the variance attributable to sampling and do not take into account any error in the target strength value or the measurement of the calibration parameters for the acoustic data acquisition system.

Fishing sets were conducted on an opportunistic basis throughout the survey, it was attempted to have at least one set on each acoustic transect and at least one set for each 12 hour period. A random sample of 200 capelin was obtained from each midwater trawl set for length, sex, and maturity observations and a stratified age sample was selected from each length/sex/maturity sample. Length composition and an age/length key was constructed for each stratum from samples from the fishing sets within that stratum.

Acoustic surveys
Results

Division 3L Survey

Table 1a. and 1b. provided a summary of the acoustic survey data for each of the two calibrations (October 1988 and May 1989). The biomass estimate ranges from 3.0 to 7.1 million metric tons with standard deviations of 0.33 and 0.78 million tons respectively. Table 2. provides densities and biomass estimates for individual transects for each of the two calibrations. Table 3. provides numbers and biomass by age group over the historical time series of this survey. For 1989, numbers and biomass are presented for each of the two calibrations used. Table 4. provides percent at age, mean length, and percent mature by age group for each strata and for the total survey. There is a clear trend with larger older more mature fish occurring in the south and smaller younger immature fish in the north. During the survey of strata F, an attenuation problem developed in the data acquisition system which caused a negative bias of unknown magnitude in the biomass estimate for this strata.

Strata F contained the highest proportion of 3 year old spawning capelin and consequently the numbers and proportion of the 1986 yearclass are under-estimated by an unknown amount. 2 year old capelin of the 1987 yearclass were very abundant in the survey and this yearclass appears to be a strong one.

Division 3NO Survey

Table 5. provides a summary of the acoustic survey results for the two Division 3N surveys. The mean biomass using both survey estimates is 560,814 metric tons. Table 6. provides numbers and biomass at age over the historical period of this survey. Table 7. gives percent at age, mean length, and percent mature. 2 year old (97.4% mature) and 3 year old (99.9% mature) capelin of the 1986 and 1985 yearclasses were predominant.

U.S.S.R. Commercial Fishery

During the 1988 spring period, licenses were issued to Soviet trawlers to fish for capelin in the Canadian zone in Division 3NO. Canadian observers collected capelin samples and catch rate information (Foreign Cooperative Research, Dave Kulka, pers. comm.). A total catch of 4,738 tons was reported to NAFO while the observers reported a total directed capelin catch of 4,732 tons, a difference of only 6 tons. From observer reports, 1 ton was taken in Division 30 in April, 97 tons were taken in Division 3N in April and 4635 tons were taken in Division 30 in May. All of the fishing activity in Division 30 occurred in the northwest corner between 45 00N to 46 00N and 51 00W to 54 30W. The overall catch rates were 32.98 tons/day and 2.77 tons/hour.

A total of 11 samples, each with 200 fish randomly selected for length and a stratified age sample selected on the basis of two fish per 0.5 cm. length group per sex were analyzed. Age compositions in percent were as follows:

Age (Years)					
1	2	3	4	5	6
0.2	11.4	69.1	8.2	10.2	0.9

Acknowledgments

C. R. Stevens and the staff of the hydroacoustics development section calibrated the HYDAS system. R. Chaulk, F. Dawson, P. Eustace, and P. Williams assisted during the collection of the acoustic data and carried out the biological sampling. P. Eustace aged the capelin samples. M. Hynes assisted in preparation of the manuscript.

References

Cochran, W. G. 1977. Sampling techniques. 3rd Edition. John Wiley and Sons, New York, N.Y.

Stevens, C. R. 1986 A hydroacoustic data acquisition system (HYDAS) for the collection of acoustic data from fish stocks. Can. Tech. Rept. Fish. Aquat. Sci. No. 1520, 73 p.

Table 1a. Acoustic survey results for 1989 NAFO Division 3L survey using calibration parameters from October 1988 calibration.

		Statistics				
Strata	Biomass (b_h)	Sampled (n_h)	Total (N_h)	Area	Biomass ($\bar{y}_h$)	Std. Deviation $\sigma(\bar{y}_h)$
A	491268	5	35	375.3	14036.2	9582
B	772933	5	30	379.0	25764.4	12263
C	886177	5	30	429.1	29539.2	18666
D	400755	5	30	363.2	13358.5	9290
E	374345	5	30	322.1	12478.2	3630
F	89990	4	30	275.2	2999.7	1235
Total	3015468 ($\hat{y}_{st}$)	29	185 (N)		16300.0 ($\bar{y}_{st}$)	1787
St.Dev.	330636 $\sigma(\hat{y}_{st})$					$\sigma(\bar{y}_{st})$

Table 1b. Acoustic survey results for 1989 NAFO Division 3L survey using calibration parameters from May 1989 calibration.

		Statistics				
Strata	Biomass (b_h)	Sampled (n_h)	Total (N_h)	Area	Biomass ($\bar{y}_h$)	Std. Deviation $\sigma(\bar{y}_h)$
A	1164331	5	35	375.3	33266.6	22683
B	1831252	5	30	379.0	61041.7	29061
C	2100358	5	30	429.1	70012.0	44234
D	949477	5	30	363.2	31649.2	21985
E	886870	5	30	322.1	29562.3	8583
F	213211	4	30	275.2	7107.0	2938
Total	7145499 ($\hat{y}_{st}$)	29	185 (N)		38624.0 ($\bar{y}_{st}$)	4234
St.Dev.	783246 $\sigma(\hat{y}_{st})$					$\sigma(\bar{y}_{st})$

Table 2. Densities and biomass (y_{hi}) for individual transects

Strata	Transect	October calibration		May calibration	
		Density(g/m^2)	Biomass(tons)	Density(g/m^2)	Biomass(tons)
A	1	21.4	8031	50.8	19065
	2	21.8	8182	51.7	19403
	3	24.3	9120	57.6	21617
	4	38.1	14299	90.3	33890
	5	81.4	30549	192.8	72358
B	1	97.7	37028	231.5	87738
	2	89.9	34072	213.0	80727
	3	82.2	31154	194.7	73791
	4	50.1	18988	118.8	45025
	5	20.0	7580	47.3	17927
C	1	24.3	10427	57.5	24759
	2	30.3	13002	71.8	30809
	3	74.1	31796	175.6	75350
	4	130.6	56040	309.6	132849
	5	84.9	36431	201.1	86292
D	1	58.9	21392	139.5	50666
	2	48.3	17543	114.4	41550
	3	58.4	21211	138.3	50231
	4	8.6	3124	20.5	7446
	5	9.7	3523	23.0	8354
E	1	48.7	15686	115.4	37170
	2	42.1	13560	99.7	32113
	3	47.6	15332	112.7	36301
	4	21.6	6957	51.3	16524
	5	33.7	10855	79.8	25704
F	1	14.1	3880	33.5	9219
	2	14.3	3935	33.9	9329
	3	4.7	1293	11.1	3055
	4	10.5	2890	24.8	6825

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
1989	166	Numbers	3.0	249.3	75.4	8.5	1.1	337.3
(Oct cal.)		Biomass	2	1411	1287	278	38	3016
1989	166	Numbers	7.4	590.8	178.7	20.3	2.5	799.7
(May cal.)		Biomass	4	3343	3049	658	91	7145
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, and percent mature for each strata from sampling data for the Division 3L survey.

Strata	Age	1	2	3	4	5+	Total	Number of samples
A	%	0.4	74.6	20.9	3.7	0.4		4
	L	69	114	153	187	186	125	
	%M	0.0	0.6	49.5	99.1	100.0	14.9	
B	%	0.1	82.8	16.7	0.3	0.1		7
	L	63	115	144	177	173	120	
	%M	0.0	0.5	18.8	92.7	100.0	3.9	
C	%	0.2	83.2	14.3	2.0	0.3		9
	L	80	115	147	183	191	121	
	%M	0.0	1.3	43.9	98.0	100.0	9.6	
D	%	1.1	46.0	46.7	5.7	0.5		7
	L	68	117	154	174	192	137	
	%M	0.0	4.9	69.6	94.9	90.1	40.6	
E	%	8.3	37.0	48.0	5.7	1.1		7
	L	67	122	155	183	195	138	
	%M	0.0	11.5	75.2	98.8	100.0	47.0	
F	%	0.2	10.1	72.3	16.9	0.5		6
	L	70	131	163	180	194	163	
	%M	0.0	42.8	91.1	99.9	100.0	87.6	
Total	%	0.9	74.0	22.3	2.5	0.3		40
	L	68	115	151	181	189	125	
	%M	0.0	1.5	50.6	97.7	98.7	15.2	

Table 5. Acoustic survey results for NAFO Division 3N - 1988

	Survey 1. (Figure 1)	Survey 2. (Figure 2)
Mean density (grams/sq. meter)	27.0	24.5
Block area (sq.km.)	21968	21968
Total biomass (Metric tons)	593512	527964
# of transects	13	13
Minimum density	0.7	2.3
Maximum density	174.5	164.0
Transect #/Mean density	1 2.1	1 2.3
	2 0.8	2 3.0
	3 0.7	3 10.7
	4 1.4	4 164.0
	5 8.0	5 18.4
	6 3.1	6 22.5
	7 17.8	7 4.3
	8 22.1	8 20.6
	9 174.5	9 11.4
	10 37.2	10 13.1
	11 21.0	11 10.9
	12 64.8	12 15.5
	13 2.2	13 15.7

Table 6. Numbers (billions) and biomass (thousands of tons) at age of capelin from NAFO Division 3NO hydroacoustic surveys.

Year	Cruise	Age	1	2	3	4	5+	Total
1988	153	Numbers	2.6	11.9	11.2	1.6	2.2	29.5
		Biomass	12	166	250	56	76	560
1987	139	Numbers	2.1	0.7	2.4	4.5	0.4	10.1
		Biomass	3	12	63	139	13	230
1986	126	Numbers	1.1	0.6	15.0	5.9	0.2	22.8
		Biomass	2	9	319	160	5	495
1985	111	Numbers	0.2	5.9	6.5	0.5	0.1	13.2
		Biomass	<1	59	135	16	2	212
1984	96	Numbers	1.6	0.3	2.2	0.8	0.2	5.1
		Biomass	3	4	48	27	6	88
1983	80	Numbers	0	0.2	3.6	3.8	0.5	8.1
		Biomass	0	2	85	115	17	219
1982	66	Numbers	0	0.1	16.8	0.6	0.1	17.6
		Biomass	0	1	396	17	5	419
1981	52	Numbers	<0.1	0.6	7.8	1.8	0.4	10.6
			<1	3	158	49	13	223

Table 7. Age composition, mean length at age, and percent mature for each strata from sampling data for the Division 3N survey.

Strata	Age	1	2	3	4	5+	Total	Number of samples
E+F	%	8.8	40.2	37.9	5.4	7.6		21
	L	106	142	161	185	186	152	
	%M	2.4	97.4	99.9	100.0	100.0	100.0	

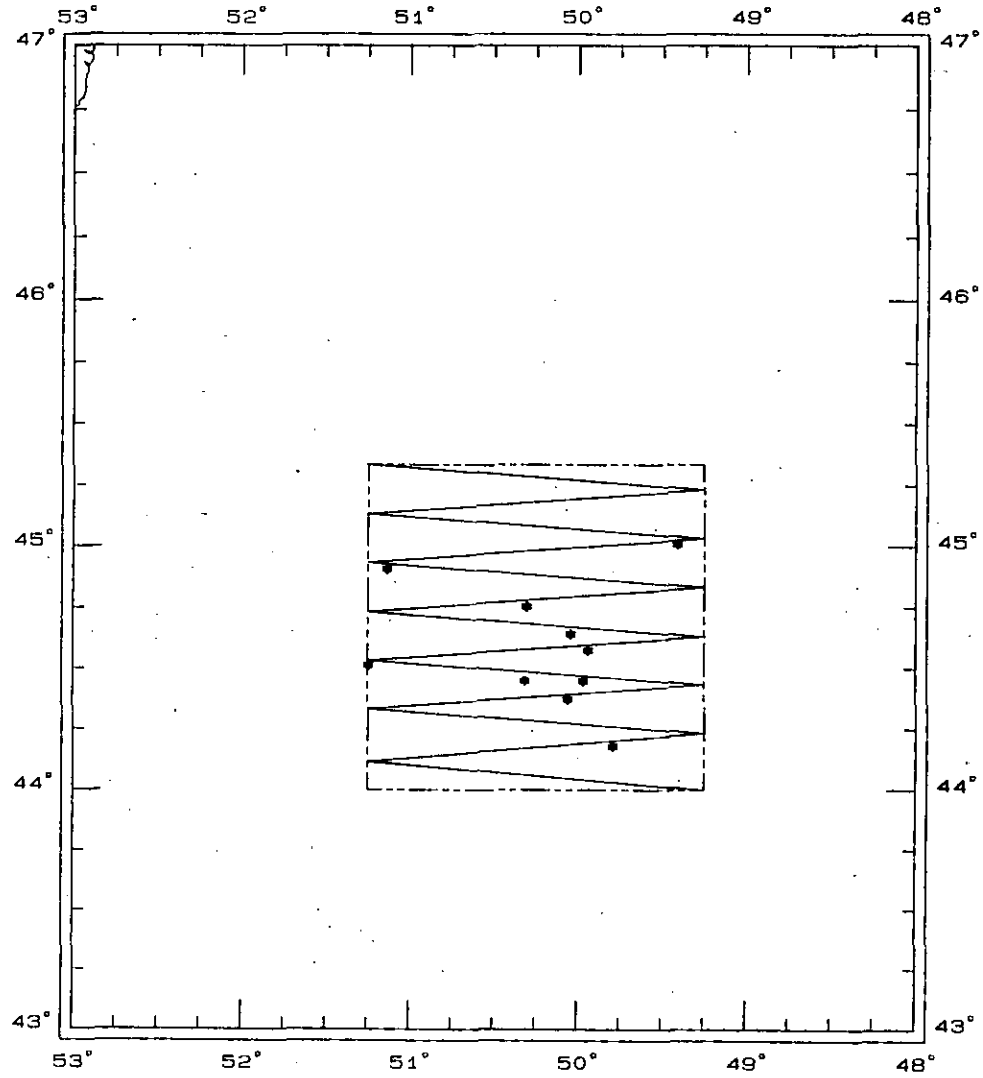

Fig. 1. Acoustic survey strata, transects, and set locations for the uniform zig-zag survey of NAFO Div. 3N, June-July 1988.

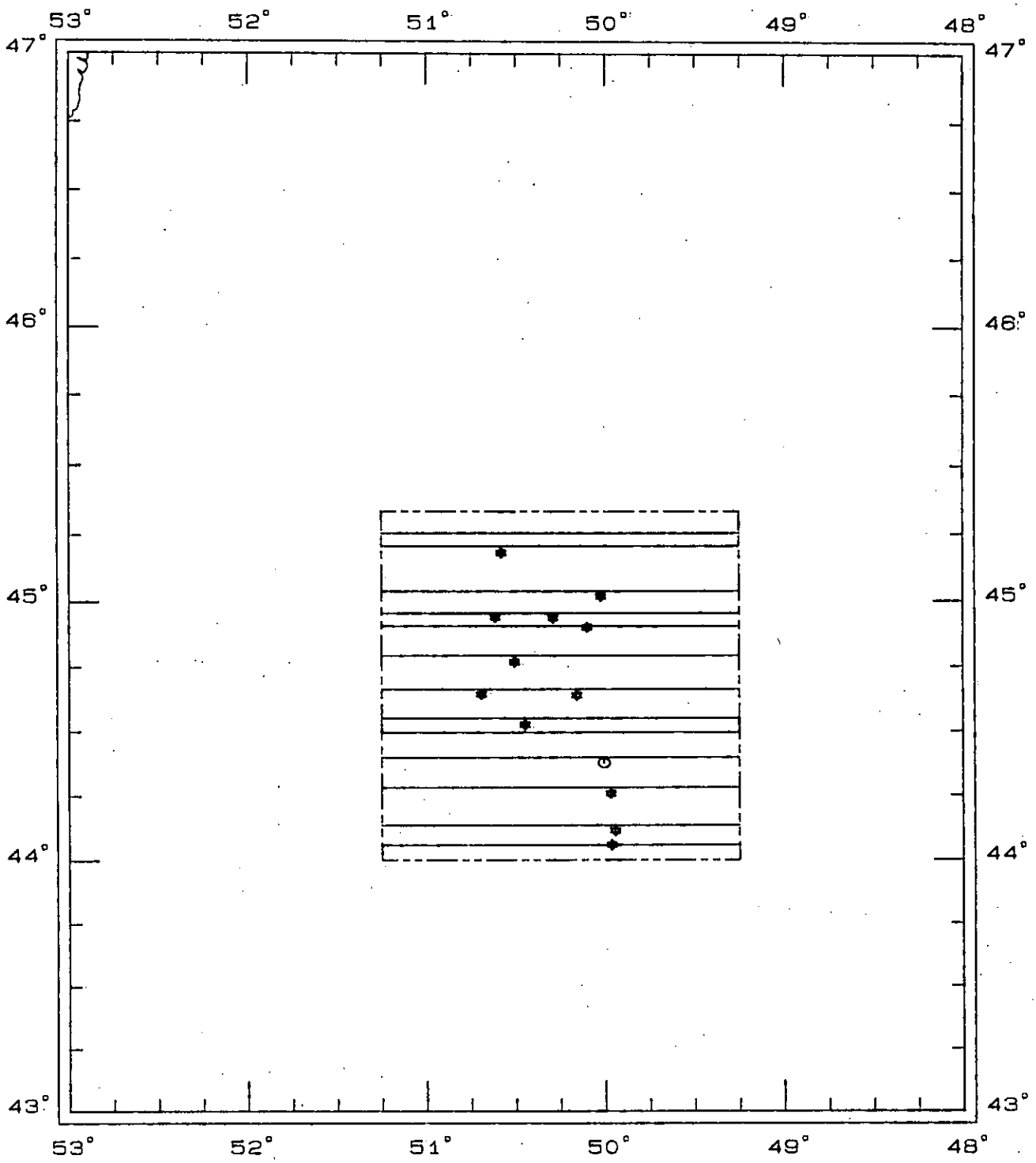

Fig. 2. Acoustic survey strata, transects, and set locations for the uniform random survey of NAFO Div. 3N, June-July 1988.

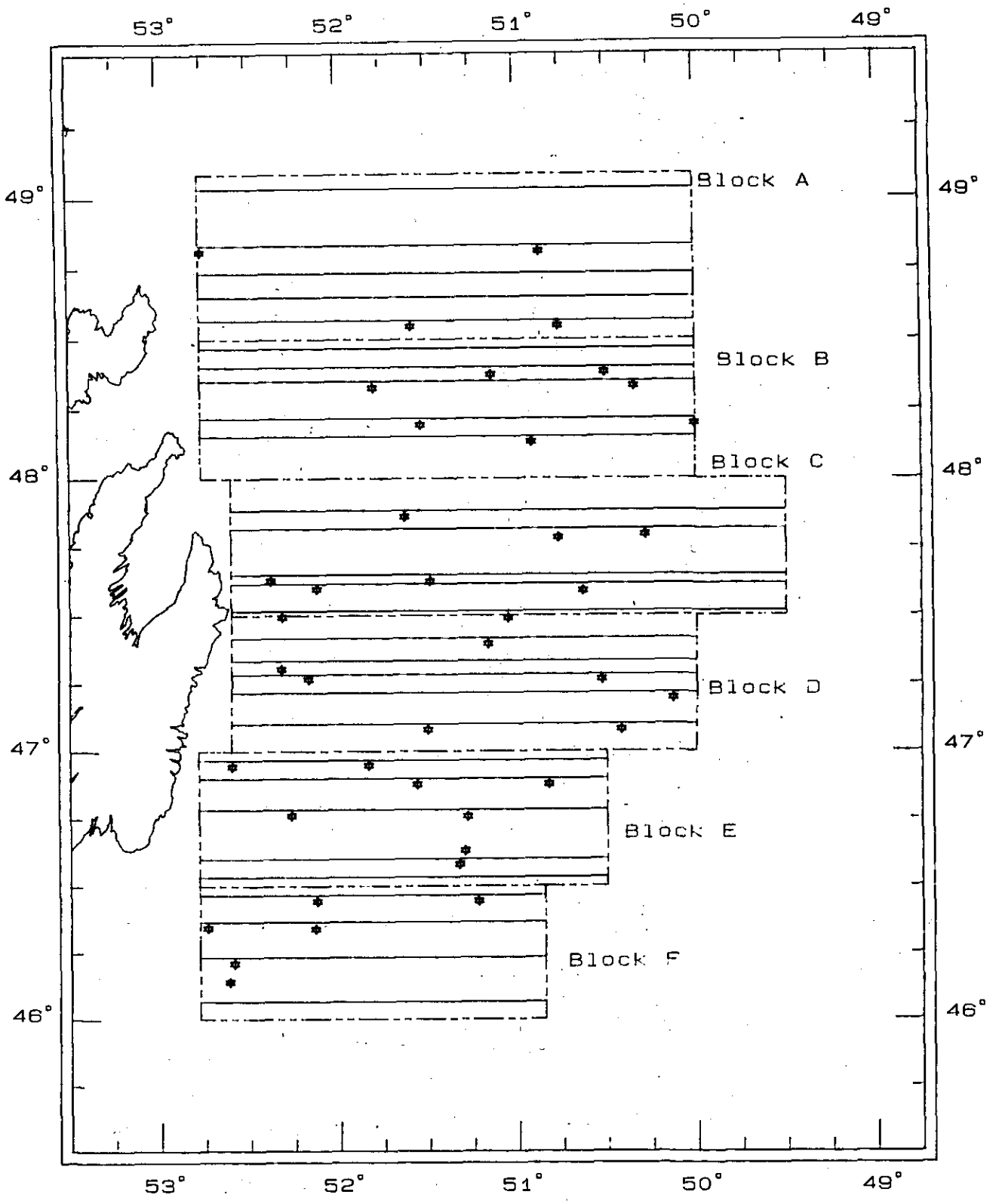

Fig. 3. Acoustic survey strata, transects, and set locations for NAFO Div. 3L, May, 1989.

Appendix A.
Calibration Parameters

Parameter	Gadus 153	Gadus 166 Oct 1988 Cal.	Gadus 166 May 1989 Cal.
Source level (dB)	125.9	125.4	123.27
Receive sensitivity (dB)	-67.7	-73.1	-74.71
Fixed gain (dB)	-4.4	5.40	5.86
Beam pattern (dB)	-29.4	-29.4	-29.7
Target strength (dB/kg)	-34	-34	-34
Pulse length (millisecs)	0.6	0.6	0.6
Attenuation (dB/meter)	.0120	.0120	.0120

Appendix B. Formula for calculating estimates of means, variances, and total biomass for acoustic surveys.

Cochran (1977) was used as the basis for the following definitions of total survey biomass and variance and mean biomass and variance for individual strata of the acoustic survey. The following assumptions apply to the survey design. All strata or survey blocks are rectangular in shape. All transects are parallel and are orientated in an east-west direction. Navigational precision dictates that transects be no closer than one nautical mile. A sampling unit is considered to be an area one nautical mile wide by the transect length.

The following definitions from Cochran (1977) then apply:

L - the number of strata (or blocks)

N_h - total number of sampling units (or transects) in the h^{th} stratum

n_h - number of units sampled in the h^{th} stratum

$N = \sum_{h=1}^{L} N_h$ - total number of units for the survey

y_{hi} - biomass estimated for the i^{th} unit in the h^{th} stratum

$W_h = N_h / N$ - weighting factor for the h^{th} stratum

$\bar{y}_h = \frac{\sum_{i=1}^{n_h} y_{hi}}{n_h}$ - mean biomass per unit for the h^{th} stratum

$\sigma^2(\bar{y}_h) = \frac{\sum_{i=1}^{n_h} (y_{hi} - \bar{y}_h)^2}{n_h - 1}$ - variance of the mean biomass per unit for the h^{th} stratum

$b_h = y_h N_h$ - biomass of the h^{th} stratum

$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h$ - stratified mean biomass per unit (for the entire survey)

$\sigma^2(\bar{y}_{st}) = 1/N^2 \sum_{h=1} \frac{N_h (N_h - n_h) \sigma^2(\bar{y}_h)}{n_h}$ - variance of the stratified mean

$\hat{y}_{st} = N y_{st}$ - estimate of the total survey biomass

$\sigma^2(\hat{y}_{st}) = N^2 \sigma^2(\bar{y}_{st})$ - variance of the estimate of total biomass for the survey

ADDENDUM
(September 1989)

Introduction

Subsequent to the June, 1989 NAFO assessments subcommittee meeting, an error was discovered in the calibration of the acoustic data acquisition system (HYDAS) that was used to collect the data for the May 1989 Division 3L capelin acoustic survey. The revised biomass estimate is substantially lower, 3,828,531 tons, than that presented at the June meeting, 7,145,499 tons. An explanation of the calibration changes along with revisions of tables for the Division 3L survey, the appendix listing calibration parameters, and projections of stock size for 1990 are presented in this addendum.

Adjustment in Calibration Parameters

The hydroacoustic data acquisition system (HYDAS) used to collect acoustic data for capelin surveys is calibrated at the beginning and end of each survey cruise. Calibration of the system is the responsibility of the Hydroacoustics Development Section, Science Branch at DFO's Northwest Atlantic Fisheries Center in St. John's, Nfld.. The calibration is done using a calibrated hydrophone positioned in a rigid frame on acoustic axis at a fixed distance from the HYDAS survey transducer face. Calculation of the system source level and receive sensitivity use the distance between the calibration hydrophone and the survey transducer face in accounting for spreading losses in acoustic signals during the calibration. The distance between the calibration hydrophone and the survey transducer was incorrectly measured with the result that the source level and receive sensitivity parameters were wrong. This error was discovered after the June NAFO meeting. Appendix A. lists both the original values used (May 1989 calibration) and the values corrected for the hydrophone distance error. The combined error in source level and receive sensitivity resulted in a change of -2.43 dB or a 42.9% reduction in the biomass estimate.

A small error was also made in the value for the beam pattern factor, the correct value is -29.42 instead of -29.7. This results in an additional change of -0.28 dB or a 3.5% reduction for a total reduction in the biomass estimate of 46.4% from 7,145,499 tons to 3,828,531 tons.

Survey Results

Revised Tables 1-4 are given below which use the correct biomass estimate of 3,828,531 tons. A revised appendix A. is also given showing both erroneous and corrected Division 3L calibration parameters.

Projections

Projections were performed using the same parameters as in June (Anon. 1989) and the revised estimates from the Canadian acoustic survey. Numbers of fish at age were taken from Table 3 and broken down into mature and immature components using the estimates of proportions mature from Table 4. The results of these calculations are found in Table 5. The spawning mortality, proportions mature, and mean weights-at-age are found in Table 6. The results of the projections are found in Table 5.

Discussion

The revised results from the May 1989 Canadian acoustic survey indicate that the 1987 year-class at age 2 is about 80% of the strength of the 1983 and 1986 year-classes and therefore would still be considered relatively strong. In contrast, results from a Soviet survey for 0-group capelin (Bakanev and Oganin 1988) indicated that the 1987 year-class was about 37% of the 1983 and about twice the strength of the 1986 year-class.

References

Anonymous 1989 Provisional report of Scientific Council June 1989 meeting. NAFO SCS Doc. 89/17, 147 p.

Bakanev, V.S. and L.A. Oganin 1988 Ichthyoplankton investigations for the capelin 1987 year-class strengths in NAFO Divisions 3KLNO. NAFO SCR Doc. 88/18, 11p.

Table 1. Acoustic survey results for 1989 NAFO Division 3L survey.

		Unit Statistics				
Strata	Biomass (b_h)	Sampled (n_h)	Total (N_h)	Area (km^2)	Biomass ($\bar{y}_h$)	Std. Deviation $\sigma(\bar{y}_h)$
A	623884	5	35	375.3	17825.2	12157
B	981117	5	30	379.0	32703.9	15569
C	1125332	5	30	429.1	37511.1	23700
D	508713	5	30	363.2	16957.1	11781
E	475284	5	30	322.1	15842.8	4602
F	114201	4	30	275.2	3806.7	1578
Total	3828531 ($\hat{y}_{st}$)	29	185 (N)		20694.8 ($\bar{y}_{st}$)	2269
St.Dev.	419676 $\sigma(\hat{y}_{st})$					$\sigma(\bar{y}_{st})$

Table 2. Densities and biomass (y_{hi}) for individual transects

Strata	Transect	Density(g/m^2)	Biomass(tons)
A	1	27.2	10219
	2	27.7	10396
	3	30.8	11574
	4	48.4	18161
	5	103.3	38776
B	1	124.0	47011
	2	114.1	43248
	3	104.3	39533
	4	63.6	24116
	5	25.4	9611
C	1	30.9	13259
	2	38.5	16507
	3	94.1	40374
	4	165.9	71171
	5	107.8	46244
D	1	74.8	27153
	2	61.3	22257
	3	74.1	26913
	4	11.0	3981
	5	12.3	4482
E	1	61.9	19922
	2	53.4	17207
	3	60.4	19458
	4	27.5	8851
	5	42.8	13776
F	1	18.0	4940
	2	18.2	5003
	3	5.9	1632
	4	13.3	3652

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
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	%	0.4	71.6	20.9	3.7	0.4		4
	L	69	114	153	187	186	125	
	%M	0.0	0.6	49.5	99.1	100.0	14.9	
B	%	0.1	82.8	16.7	0.3	0.1		7
	L	63	115	144	177	173	120	
	%M	0.0	0.5	18.8	92.7	100.0	3.9	
C	%	0.2	83.1	14.3	2.1	0.3		9
	L	76	115	147	183	191	121	
	%M	0.0	1.3	43.9	98.0	100.0	9.6	
D	%	1.1	46.0	46.7	5.7	0.5		7
	L	68	117	154	174	192	137	
	%M	0.0	4.9	69.6	94.9	90.1	40.6	
E	%	7.1	33.8	51.7	7.0	.5		7
	L	67	123	155	182	193	140	
	%M	0.0	11.7	73.9	98.7	97.6	49.5	
F	%	0.2	10.1	72.3	16.9	0.5		6
	L	70	131	163	180	194	163	
	%M	0.0	42.8	91.1	99.9	100.0	87.6	
Total	%	0.8	73.8	22.5	2.6	0.3		40
	L	68	115	151	181	189	125	
	%M	0.0	1.5	50.6	97.7	98.7	15.2	

Table 5. Capelin in Division 3L: projections of stock size for 1990

Numbers of fish (millions)

Age (yr)	June 1989 Mature	June 1989 Immature	June 1990
2	1900	312900	
3	47600	48600	232300
4	10900	100	44800
5	1400	-	1600
6			100

Biomass (tons) of mature fish 3,500,000

Table 6. Capelin in Division 3L - parameters used in the projections of stock size.

Age (yr)	Spawning mortaility	Proportion mature	Mean wt(g)
3	1.39	0.47	21.2
4	1.69	0.87	28.4
5	2.23	0.93	31.1
6	2.23	1.00	32.4

Appendix A.
Calibration Parameters

Parameter	Gadus 166 May 1989 Cal.	Corrected Cal.
Source level (dB)	123.27	124.33
Receive sensitivity (dB)	-74.71	-73.34
Fixed gain (dB)	5.86	5.86
Beam pattern (dB)	-29.70	-29.42
Target strength (dB)	-34	-34
Pulse length (millisecs)	0.6	0.6
Attenuation (dB/meter)	.0120	.0120