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Growth and Reproduction in Northern Shrimp on Flemish Cap (Division 3M) and the Nose of the Bank (Division 3L) in September 1993–May 1994

by

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Introduction

A commercial shrimp fishery on Flemish Cap emerged around May 1993. Since Oct 1993 Faroese observers have been monitoring Faroese vessels both in the regular fishery and in an exploratory fishery for shrimps on the Nose of the Bank. Based on the material collected by these observers, this paper tries to estimate some population parameters related to growth and reproduction.

Material and method

The material was collected by Faroese observers on board Faroese shrimp vessels in the period Sep 1993 - May 1994. Some of these were engaged in an exploratory shrimp fishery in Div 3L. Two types of samples were taken: samples for length measurements which were worked on board and biological samples which were frozen to be worked later in laboratory. The number of specimens sampled is shown by area and month in Tab. 1 and the geographical distribution of the samples is presented in Figs. 1 and 2.

Samples for length measurements were taken from the unsorted catch. 314 samples with a total of 61981 specimens were measured. The oblique carapace length (OCL) of the shrimp was measured with Vernier calipers to the nearest 0.5 mm. The length distribution was standardize by multiplying the number of shrimp with total catch and divide by sample weight and divide by area swept. The area was calculated as average towing speed (2.75 nm/h) times duration of trawl on the bottom times the assumed effective trawl width (42 m). As the length samples were not weighted, the sample weight was calculated from the weight-length relationship mentioned below. Length samples were grouped into areas and months.

From 12 frozen samples taken back to the laboratory 2734 shrimps were investigated for sex and maturity, and 2771 were weighted individually. The sex and maturity stages were determined according to Rasmussen (1953) and Allen (1957) and condition of sternal spines in line with McCrary (1971). First the shrimps were group into males, intermediate and female, then females were characterized by the precence or absence of sternal spines, headroe and eggs with or without eyespots. In the modal analysis four groups were used: males, intermediate, females with or without sternal spines.

A whole shrimp weight - oblique carapace length relationship was calculated by fitting data to an allometric growth curve.

Growth

From the modes of the length distributions shown in Tabs. 2 and 3 and Figs. 3,4 and 5 a fair estimate of average size for each age group can be made for some month in

the sampling period. In this approach it has been done by eye. The precision will of course not be the same as in a statistical analysis. The results are presented in Table 4. A von Bertalanffy curve has been fitted. This was done with the use of a spreadsheet by watching the curve move instantly in relation to the data point while fiddling around with the growth parameters. The results are shown in Figure 6. It seems like the growth in Div 3M is some what faster than in Div 3L.

Data from Div 3M and 3L were pool together to estimate weight - length relationship. The result is presented in Tab. 5 and Fig. 7.

The reproductive cycle

From Tab. 3 and Fig. 5 it might be noted that the abundance of females with eggs decreases from Mar through May indicating the hatching period. In May all females have released their eggs. According to U. Skúladóttir (personal communication) the spawning period in Div 3M is in Aug so the incubation time is 9 months.

There is a drastic fall in the abundance of age group 5 from Mar to Apr (to about half the size in the start of the period). This might be due to migration of females to certain areas (possible shallower) to release their larvae.

References

Allen, J.A. 1959. On the biology of *Pandalus borealis* Krøyer, with reference to a population off the Northumberland coast. J. Mar. Biol. Assoc. U.K. 38: 189-220.

McCrary, J.A. 1971. Sternal spines as a characteristic for differentiating between females of some Pandalidae. J.Fish. Res. Board Can., 28: 98-100.

Rasmussen, B. 1953. On the geographical variation in growth and sexual development of the deep sea prawn (*Pandalus borealis* Kr.). Norweg. Fish. and Mar. Invest. Rep., 10 (3): 1-160.

Table 1 Number of specimens collected by Faroese observers group into areas and periods.

Northern shrimp, NAFO Div 3L and 3M, Sep 1993 - Mar 1994.

Investigation of sex, maturity. Number of observations.

Year	Month	3L	3M
1993	Sep		1219
	Oct		674
	Nov		372
Total			2265
1994	Mar	469	

Northern shrimp, NAFO Div 3L and 3M, Oct 1993 - May 1994.

Oblique carapace length measurements. Number of observations.

Year	Month	3L	3M	Total
1993	Oct	213	15931	16144
	Nov	0	3939	3939
Total		213	19870	20083
1994	Feb	172	3353	3525
	Mar	12805	7440	20245
	Apr	5008	4533	9541
	May	4213	4374	8587
Total		22198	19700	41898
Total		22411	39570	61981

Table 2 OCL distributions for different sex and maturity stages group by area and month. The three rightmost columns are summations used in the figures.

Div	Year Mon	Cpx mm	Male	Inter-mediate	Female +sternal spines	Female -sternal spines	Female +headroe +sternal spines	Female +headroe -sternal spines	Female with eggs -eyespots	Female with eggs +eyespots	Female +headroe +eggs +eyespots	FEMALE WITH STERNAL SPINES	FEMALE WITHOUT STERNAL SPINES	TOTAL
3M	1993 Sep	11.5	1											1
		12.0												
		12.5												
		13.0												
		13.5												
		14.0												
		14.5												
		15.0												
		15.5	4											4
		16.0	7											7
		16.5	12											12
		17.0	20											20
		17.5	30											30
		18.0	27											27
		18.5	19											19
		19.0	7											7
		19.5	8											8
		20.0	26											26
		20.5	52											52
		21.0	56	1					1				1	58
		21.5	61	1					2				2	64
		22.0	35						1				1	36
		22.5	27		1				5			1	5	33
		23.0	7	1					1				1	9
		23.5	14			2			4				6	20
		24.0	18						7				7	25
		24.5	25	2	3	2			22			3	24	54
		25.0	23	1		2		3	41				46	70
		25.5	11	1		1	1	4	91			1	96	109
		26.0	6	4	1		7	7	99			8	106	124
		26.5	6				4	11	113			4	124	134
		27.0					5	20	100			5	120	125
		27.5					5	10	71			5	81	86
		28.0						5	24				29	29
		28.5						4	15				19	19
		29.0						1	6				7	7
		29.5						2	1				3	3
		30.0							1				1	1
			502	11	5	7	22	67	605			27	679	1219

Div	Year Mon	Cpx mm	Male	Inter-mediate	Female +sternal spines	Female -sternal spines	Female +headroe +sternal spines	Female +headroe -sternal spines	Female with eggs -eyespots	Female with eggs +eyespots	Female +headroe +eggs +eyespots	FEMALE WITH STERNAL SPINES	FEMALE WITHOUT STERNAL SPINES	TOTAL
3M	1993 Oct	15.5	1											1
		16.0	5											5
		16.5	2											2
		17.0	15											15
		17.5	13											13
		18.0	13											13
		18.5	9											9
		19.0	3											3
		19.5	1											1
		20.0	5											5
		20.5	17											17
		21.0	29											29
		21.5	27						1				1	28
		22.0	19						1				1	20
		22.5	8											8
		23.0	3	2					2				2	7
		23.5	9						1				1	10
		24.0	18	1					3				3	22
		24.5	18						10				10	28
		25.0	19	1					20				20	40
		25.5	10						34				34	44
		26.0	13						43				43	56
		26.5	7	1		2			71				73	81
		27.0	2	1					94				94	97
		27.5	1						66				66	67
		28.0							32				32	32
		28.5							16				16	16
		29.0							3				3	3
		29.5							1				1	1
		30.0												
		30.5							1				1	1
			267	6		2			399				401	674

Table 2 OCL distributions for different sex and maturity stages group by area and month. The three rightmost columns are summations used in the figures. (Continued).

Div	Year Mon	Cpx mm	Male	Inter-mediate	Female +sternal spines	Female -sternal spines	Female +headroe +sternal spines	Female +headroe -sternal spines	Female with eggs -eyespots	Female with eggs +eyespots	Female +headroe +eggs +eyespots	FEMALE WITH STERNAL SPINES	FEMALE WITHOUT STERNAL SPINES	TOTAL
3M	1993 Nov	16.5	5											5
		17.0	9											9
		17.5	12											12
		18.0	15											15
		18.5	27											27
		19.0	15											15
		19.5	10											10
		20.0	3											3
		20.5	7											7
		21.0	5											5
		21.5	10		1							1		11
		22.0	12	3										15
		22.5	1	2										3
		23.0	5	3		1							1	9
		23.5	3	4	2					1		2	1	10
		24.0	2	1					1				1	4
		24.5	4	2	2				2			2	2	10
		25.0	4	2	3				16			3	16	25
		25.5	6		5				24			5	24	35
		26.0	3		2	1			18			2	19	24
		26.5	2	2	1				29			1	29	34
		27.0							26				26	26
		27.5							23				23	23
		28.0							23				23	23
		28.5							6				6	6
		29.0							5				5	5
		29.5							1				1	1
			160	19	16	2			174	1		16	177	372

Div	Year Mon	Cpx mm	Male	Inter-mediate	Female +sternal spines	Female -sternal spines	Female +headroe +sternal spines	Female +headroe -sternal spines	Female with eggs -eyespots	Female with eggs +eyespots	Female +headroe +eggs +eyespots	FEMALE WITH STERNAL SPINES	FEMALE WITHOUT STERNAL SPINES	TOTAL
3L	1994 Mar	12.5	1											1
		13.0												
		13.5												
		14.0	1											1
		14.5												
		15.0												
		15.5	1											1
		16.0												
		16.5	2											2
		17.0	4											4
		17.5	6											6
		18.0	3											3
		18.5	7											7
		19.0	2											2
		19.5	2											2
		20.0	18											18
		20.5	26											26
		21.0	20	1	1							1		22
		21.5	28	3	1							1		32
		22.0	23	1	3							3		27
		22.5	17	4	6				2			6	2	29
		23.0	16	10	21				6			21	6	53
		23.5												
		24.0	3	5	19				7			19	7	34
		24.5	1	4	14				5			14	5	24
		25.0			9	1			11			9	12	21
		25.5			10	2			15			10	17	27
		26.0			7	3			19			7	22	29
		26.5			3	2			17			3	19	22
		27.0			3	1			22			3	23	26
		27.5							18				18	18
		28.0			2				11			2	11	13
		28.5			1				9			1	9	10
		29.0							5				5	5
		29.5							4				4	4
		30.5												
			181	28	100	9			151			100	160	469

Table 3 OCL distribution for shrimp with and without eggs group by area and month. Unit: number per 1000 m^2.

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1993	10	3M	11.5	0.938		0.938
			12.0	0.717		0.717
			12.5	0.974		0.974
			13.0	0.867		0.867
			13.5	0.900		0.900
			14.0	0.311		0.311
			14.5	0.708		0.708
			15.0	0.865		0.865
			15.5	1.507		1.507
			16.0	1.416		1.416
			16.5	1.254		1.254
			17.0	2.257		2.257
			17.5	3.233		3.233
			18.0	3.413		3.413
			18.5	3.588		3.588
			19.0	2.790		2.790
			19.5	2.448	1.075	3.523
			20.0	2.403	2.702	5.105
			20.5	3.316	0.718	4.034
			21.0	6.847	1.109	7.956
			21.5	6.675	1.717	8.392
			22.0	7.994	1.346	9.340
			22.5	4.843	1.198	6.041
			23.0	3.982	1.276	5.258
			23.5	3.286	1.036	4.322
			24.0	5.201	1.323	6.524
			24.5	5.397	1.577	6.974
			25.0	5.911	2.887	8.798
			25.5	4.045	5.321	9.366
			26.0	3.817	11.536	15.353
			26.5	2.579	13.215	15.794
			27.0	1.739	15.083	16.822
			27.5	1.114	11.871	12.985
			28.0	0.947	8.869	9.816
			28.5	1.215	4.327	5.542
			29.0	0.844	2.537	3.381
			29.5		1.303	1.303
			30.0	0.718	1.242	1.960
			30.5	0.516	0.633	1.149
			31.0		0.779	0.779

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1993	11	3M	12.0	0.623		0.623
			12.5	0.186		0.186
			13.5	0.306		0.306
			15.0	0.393		0.393
			15.5	1.258		1.258
			16.0	0.685		0.685
			16.5	1.266		1.266
			17.0	1.161		1.161
			17.5	2.207		2.207
			18.0	2.965	0.306	3.271
			18.5	4.273		4.273
			19.0	3.334		3.334
			19.5	2.378		2.378
			20.0	1.315		1.315
			20.5	1.157		1.157
			21.0	1.959		1.959
			21.5	2.823	0.525	3.348
			22.0	3.336	1.151	4.487
			22.5	3.185	0.652	3.837
			23.0	2.616	0.835	3.451
			23.5	1.950	0.718	2.668
			24.0	1.824	0.843	2.667
			24.5	2.073	1.407	3.480
			25.0	1.678	2.497	4.175
			25.5	1.490	5.723	7.213
			26.0	1.197	10.033	11.230
			26.5	0.897	12.081	12.978
			27.0	0.695	12.208	12.903
			27.5	0.315	8.742	9.057
			28.0	0.426	5.499	5.925
			28.5		1.693	1.693
			29.0	0.992	1.072	2.064
			29.5		0.784	0.784
			30.0	0.284	0.341	0.625
			30.5		0.445	0.445

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	2	3M	14.5	1.302		1.302
			15.0	1.544		1.544
			15.5	0.856		0.856
			16.0			
			16.5	2.604		2.604
			17.0	1.311		1.311
			17.5	1.232		1.232
			18.0	2.275		2.275
			18.5	5.908		5.908
			19.0	8.167		8.167
			19.5	11.377	1.302	12.679
			20.0	9.378		9.378
			20.5	6.902		6.902
			21.0	5.665		5.665
			21.5	2.723		2.723
			22.0	2.902	0.866	3.768
			22.5	3.327	0.207	3.534
			23.0	2.833	1.332	4.165
			23.5	2.825	0.103	2.928
			24.0	4.010	0.749	4.759
			24.5	4.740	1.670	6.410
			25.0	5.520	3.069	8.589
			25.5	4.746	5.162	9.908
			26.0	3.561	10.195	13.756
			26.5	3.086	16.478	19.564
			27.0	2.243	18.957	21.200
			27.5	2.464	18.022	20.486
			28.0	0.849	14.761	15.610
			28.5	1.062	6.821	7.883
			29.0	0.808	3.694	4.502
			29.5	0.831	1.330	2.161
			30.0		1.032	1.032
			30.5		0.993	0.993
			31.0		0.338	0.338

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	3	3M	13.0	0.656		0.656
			13.5	0.898		0.898
			14.0	1.112		1.112
			14.5	1.713		1.713
			15.0	1.859		1.859
			15.5	1.481		1.481
			16.0	1.413		1.413
			16.5	0.989		0.989
			17.0	0.923		0.923
			17.5	1.039		1.039
			18.0	2.401		2.401
			18.5	4.575		4.575
			19.0	8.641		8.641
			19.5	10.871		10.871
			20.0	11.715	1.455	13.170
			20.5	8.788		8.788
			21.0	5.000	0.973	5.973
			21.5	2.878	1.452	4.330
			22.0	2.088	1.141	3.229
			22.5	3.092	1.103	4.195
			23.0	4.159	1.153	5.312
			23.5	4.788	1.358	6.146
			24.0	6.234	1.265	7.499
			24.5	4.745	1.842	6.587
			25.0	4.003	2.230	6.233
			25.5	3.117	5.279	8.396
			26.0	2.291	9.503	11.794
			26.5	2.097	11.585	13.682
			27.0	2.503	11.726	14.229
			27.5	2.336	10.938	13.274
			28.0	1.364	6.709	8.073
			28.5	1.688	3.419	5.107
			29.0	1.120	2.510	3.630
			29.5	1.329	1.372	2.701
			30.0	0.836	1.300	2.136
			30.5		0.813	0.813
			31.0	0.711	1.774	2.485
			31.5		0.374	0.374
			32.0		0.438	0.438
			32.5		0.396	0.396

Table 3 OCL distribution for shrimp with and without eggs group by area and month. Unit: number per 1000 m^2. (Continued).

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	4	3M	12.5	0.427		0.427
			13.0			
			13.5	0.415		0.415
			14.0	0.347		0.347
			14.5	0.787		0.787
			15.0	0.959		0.959
			15.5	1.386		1.386
			16.0	2.104		2.104
			16.5	1.417		1.417
			17.0	2.062		2.062
			17.5	1.408		1.408
			18.0	0.672		0.672
			18.5	1.073		1.073
			19.0	2.600		2.600
			19.5	4.070		4.070
			20.0	9.069		9.069
			20.5	10.121		10.121
			21.0	9.526		9.526
			21.5	6.201		6.201
			22.0	3.166		3.166
			22.5	3.509		3.509
			23.0	4.268	0.427	4.695
			23.5	4.016	0.383	4.399
			24.0	4.255		4.255
			24.5	3.815	0.347	4.162
			25.0	3.520	0.422	3.942
			25.5	2.735	0.480	3.215
			26.0	2.909	1.024	3.933
			26.5	3.397	2.006	5.403
			27.0	3.851	2.164	6.015
			27.5	4.087	1.942	6.029
			28.0	3.283	1.403	4.686
			28.5	2.901	0.839	3.740
			29.0	2.254	0.605	2.859
			29.5	0.958	0.357	1.315
			30.0	0.569	0.330	0.899
			30.5	0.323	0.389	0.712
			31.0	0.278		0.278

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	5	3M	14.0	1.983		1.983
			14.5	4.688		4.688
			15.0	3.191		3.191
			15.5	10.414		10.414
			16.0	10.420		10.420
			16.5	9.652		9.652
			17.0	9.151		9.151
			17.5	4.944		4.944
			18.0	2.839		2.839
			18.5	4.385		4.385
			19.0	4.515		4.515
			19.5	8.932		8.932
			20.0	14.468		14.468
			20.5	19.153		19.153
			21.0	22.379		22.379
			21.5	15.764		15.764
			22.0	8.019		8.019
			22.5	4.586		4.586
			23.0	4.950		4.950
			23.5	6.409		6.409
			24.0	4.896		4.896
			24.5	6.382		6.382
			25.0	6.412		6.412
			25.5	4.903		4.903
			26.0	4.712		4.712
			26.5	6.501		6.501
			27.0	7.911		7.911
			27.5	9.246		9.246
			28.0	8.760		8.760
			28.5	5.770		5.770
			29.0	3.272		3.272
			29.5	1.591		1.591
			30.0	1.691		1.691
			30.5			
			31.0	0.405		0.405

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1993	10	3L	17.0	4.720		4.720
			17.5	7.080		7.080
			18.0			
			18.5	4.720		4.720
			19.0	4.720		4.720
			19.5	2.360		2.360
			20.0	21.241		21.241
			20.5	11.800		11.800
			21.0	47.202		47.202
			21.5	54.282	2.360	56.642
			22.0	80.243		80.243
			22.5	47.202		47.202
			23.0	14.161		14.161
			23.5	11.800		11.800
			24.0	21.241		21.241
			24.5	11.800	4.720	16.520
			25.0	21.241	2.360	23.601
			25.5	4.720	9.440	14.160
			26.0	7.080	18.881	25.961
			26.5	4.720	23.601	28.321
			27.0	4.720	16.521	21.241
			27.5	2.360	16.521	18.881
			28.0		16.521	16.521
			28.5		2.360	2.360

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	2	3L	19.0	2.377		2.377
			19.5	9.507		9.507
			20.0	7.130		7.130
			20.5			
			21.0	2.377		2.377
			21.5	7.130		7.130
			22.0	2.377		2.377
			22.5	2.377		2.377
			23.0	2.377		2.377
			23.5	4.753		4.753
			24.0	2.377		2.377
			24.5	26.143		26.143
			25.0	35.649		35.649
			25.5	26.143	4.753	30.896
			26.0	26.143	28.520	54.663
			26.5		42.779	42.779
			27.0	2.377	42.779	45.156
			27.5		42.779	42.779
			28.0		49.909	49.909
			28.5		21.390	21.390
			29.0		14.260	14.260
			29.5			
			30.0		2.377	2.377

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	3	3L	10.0	0.443		0.443
			10.5			
			11.0			
			11.5	0.030		0.030
			12.0	0.030		0.030
			12.5	0.243		0.243
			13.0	0.152		0.152
			13.5	1.258		1.258
			14.0	0.601		0.601
			14.5	1.375		1.375
			15.0	1.102		1.102
			15.5	1.615		1.615
			16.0	2.498		2.498
			16.5	3.674		3.674
			17.0	5.980		5.980
			17.5	8.776		8.776
			18.0	8.663	0.030	8.693
			18.5	8.137		8.137
			19.0	6.983		6.983
			19.5	5.345		5.345
			20.0	6.688	1.021	7.709
			20.5	9.034		9.034
			21.0	13.151	2.698	15.849
			21.5	13.155	1.257	14.412
			22.0	13.326	1.898	15.224
			22.5	11.390	1.371	12.761
			23.0	10.227	1.607	11.834
			23.5	10.358	1.653	12.011
			24.0	10.241	2.400	12.641
			24.5	12.631	4.726	17.357
			25.0	7.685	6.220	13.905
			25.5	6.027	9.145	15.172
			26.0	5.147	8.842	13.989
			26.5	3.223	9.002	12.225
			27.0	2.268	7.640	9.908
			27.5	1.721	6.047	7.768
			28.0	0.929	4.666	5.595
			28.5	1.120	3.223	4.343
			29.0	0.279	1.440	1.719
			29.5		1.787	1.787
			30.0		1.144	1.144
			30.5		2.878	2.878
			31.0		0.735	0.735
			31.5		0.583	0.583
			32.0		0.742	0.742

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	4	3L	11.0	0.492		0.492
			11.5			
			12.0	0.384		0.384
			12.5	0.985		0.985
			13.0	1.101		1.101
			13.5	2.472		2.472
			14.0	1.368		1.368
			14.5	1.170		1.170
			15.0	1.101		1.101
			15.5	1.007		1.007
			16.0	1.904		1.904
			16.5	1.910		1.910
			17.0	2.343		2.343
			17.5	4.498		4.498
			18.0	4.458		4.458
			18.5	5.732		5.732
			19.0	5.926		5.926
			19.5	4.706		4.706
			20.0	3.990		3.990
			20.5	5.038	0.581	5.619
			21.0	6.049		6.049
			21.5	5.991		5.991
			22.0	5.793	0.257	6.050
			22.5	4.277	0.438	4.715
			23.0	4.538	0.473	5.011
			23.5	3.747	0.273	4.020
			24.0	4.724	0.646	5.370
			24.5	4.484	0.639	5.123
			25.0	3.437	0.742	4.179
			25.5	3.470	0.728	4.198
			26.0	2.299	0.697	2.996
			26.5	2.371	0.723	3.094
			27.0	1.534	1.023	2.557
			27.5	1.479	1.065	2.544
			28.0	0.738	1.106	1.844
			28.5	0.419	0.827	1.246
			29.0	0.388	0.507	0.895
			29.5	0.499		0.499
			30.0	0.490	0.453	0.943
			30.5	0.581		0.581
			31.0		0.453	0.453

Year	Month	Area	Cpx	Without eggs	With eggs	Total
1994	5	3L	12.0	1.676		1.676
			12.5	1.864		1.864
			13.0	1.633		1.633
			13.5	2.162		2.162
			14.0	1.897		1.897
			14.5	2.349		2.349
			15.0	3.140		3.140
			15.5	3.721		3.721
			16.0	3.614		3.614
			16.5	3.588		3.588
			17.0	5.026		5.026
			17.5	6.835		6.835
			18.0	10.269		10.269
			18.5	11.600		11.600
			19.0	13.432		13.432
			19.5	9.670		9.670
			20.0	9.516		9.516
			20.5	8.950		8.950
			21.0	10.807		10.807
			21.5	14.497		14.497
			22.0	12.626		12.626
			22.5	8.284		8.284
			23.0	6.962		6.962
			23.5	6.238		6.238
			24.0	6.233		6.233
			24.5	6.971		6.971
			25.0	7.170		7.170
			25.5	8.915		8.915
			26.0	7.737		7.737
			26.5	7.022		7.022
			27.0	3.909		3.909
			27.5	3.334		3.334
			28.0	2.291		2.291
			28.5	1.132		1.132
			29.0	0.752		0.752
			29.5	0.365		0.365
			30.0	1.431		1.431

Table 3 OCL distribution for shrimp with and without eggs group by area and month. Unit: number per 1000 m^2. (Continued).

Table 4 Average OCL in Div 3M and 3L for different months in the period Sep 1993 -May 1994.

Northern shrimp on Flemish Cap (Div 3M) and the Nose of the Bank (Div 3L)
Mean OCL (mm) estimated from length distributions.

NAFO Div	Age Group	1993 Sep	Oct	Nov	Dec	Jan	1994 Feb	Mar	Apr	May
3L	1							12.50	13.50	15.50
	2		17.50					18.00	18.75	18.75
	3		22.00				21.50	21.50	21.25	21.50
	4		24.50				25.00	24.50	24.25	25.50
	5		26.50				27.25	26.00	28.00	
3M	1							14.75	16.50	15.75
	2	17.75	18.50	18.50			19.50	19.75	20.50	20.75
	3	21.25	22.00	22.00			22.50	24.00	23.50	24.00
	4	24.75	25.00	24.50			25.00	27.00	27.25	27.50
	5	26.75	27.00	26.75			27.25			

Table 5 Input to regression: average OCL and average weight and their logs. Output from regression analysis.

Northern shrimp, NAFO Div 3M and 3L, Oct 1993 - Apr 1994.

Mean weight (gr) at cpx length (mm)

DATA:

QUALITY$	CPX	WEIGHT	N	CALWEIGHT	LNCPX	LNWEIGHT
-OK	11.5	0.79	1	0.8738	2.4423	-0.2357
-OK	12.5	3.18	1	1.1360	2.5257	1.1569
-OK	14.0	1.54	1	1.6229	2.6391	0.4318
-OK	15.5	2.18	6	2.2357	2.7408	0.7793
+OK	16.0	2.58	12	2.4706	2.7726	0.9478
+OK	16.5	2.85	21	2.7218	2.8034	1.0473
+OK	17.0	3.05	48	2.9900	2.8332	1.1151
+OK	17.5	3.34	61	3.2756	2.8622	1.2060
+OK	18.0	3.56	58	3.5793	2.8904	1.2698
+OK	18.5	3.81	62	3.9016	2.9178	1.3376
+OK	19.0	4.24	27	4.2433	2.9444	1.4446
+OK	19.5	4.48	21	4.6047	2.9704	1.4996
+OK	20.0	4.93	52	4.9867	2.9957	1.5953
+OK	20.5	5.34	102	5.3897	3.0204	1.6752
+OK	21.0	5.71	114	5.8144	3.0445	1.7422
+OK	21.5	6.02	135	6.2613	3.0681	1.7951
+OK	22.0	6.47	100	6.7311	3.0910	1.8672
+OK	22.5	6.97	75	7.2245	3.1135	1.9416
+OK	23.0	7.82	84	7.7419	3.1355	2.0567
+OK	23.5	7.91	40	8.2841	3.1570	2.0681
+OK	24.0	8.72	92	8.8516	3.1781	2.1656
+OK	24.5	9.27	126	9.4451	3.1987	2.2268
+OK	25.0	10.11	166	10.0652	3.2189	2.3135
+OK	25.5	10.99	224	10.7125	3.2387	2.3970
+OK	26.0	11.66	237	11.3876	3.2581	2.4562
+OK	26.5	12.33	275	12.0912	3.2771	2.5120
+OK	27.0	13.00	275	12.8239	3.2958	2.5649
+OK	27.5	13.75	194	13.5862	3.3142	2.6210
+OK	28.0	14.66	98	14.3790	3.3322	2.6851
+OK	28.5	15.39	52	15.2027	3.3499	2.7337
+OK	29.0	16.41	20	16.0581	3.3673	2.7979
-OK	29.5	16.91	9	16.9457	3.3844	2.8279
-OK	30.0	18.05	1	17.8663	3.4012	2.8931
-OK	30.5	17.93	2	18.8203	3.4177	2.8865

OUTPUT FROM SYSTAT:

DEP VAR:LNWEIGHT N: 27 MULTIPLE R: 0.999 SQUARED MULTIPLE R: 0.998
ADJUSTED SQUARED MULTIPLE R: .998 STANDARD ERROR OF ESTIMATE: 0.02592

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	-7.82192	0.08753	0.00000	.	-.89E+02	0.00000
LNCPX	3.14737	0.02821	0.99900	.100E+01	.11E+03	0.00000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	8.36687	1	8.36687	12449.21761	0.00000
RESIDUAL	0.01680	25	0.00067		

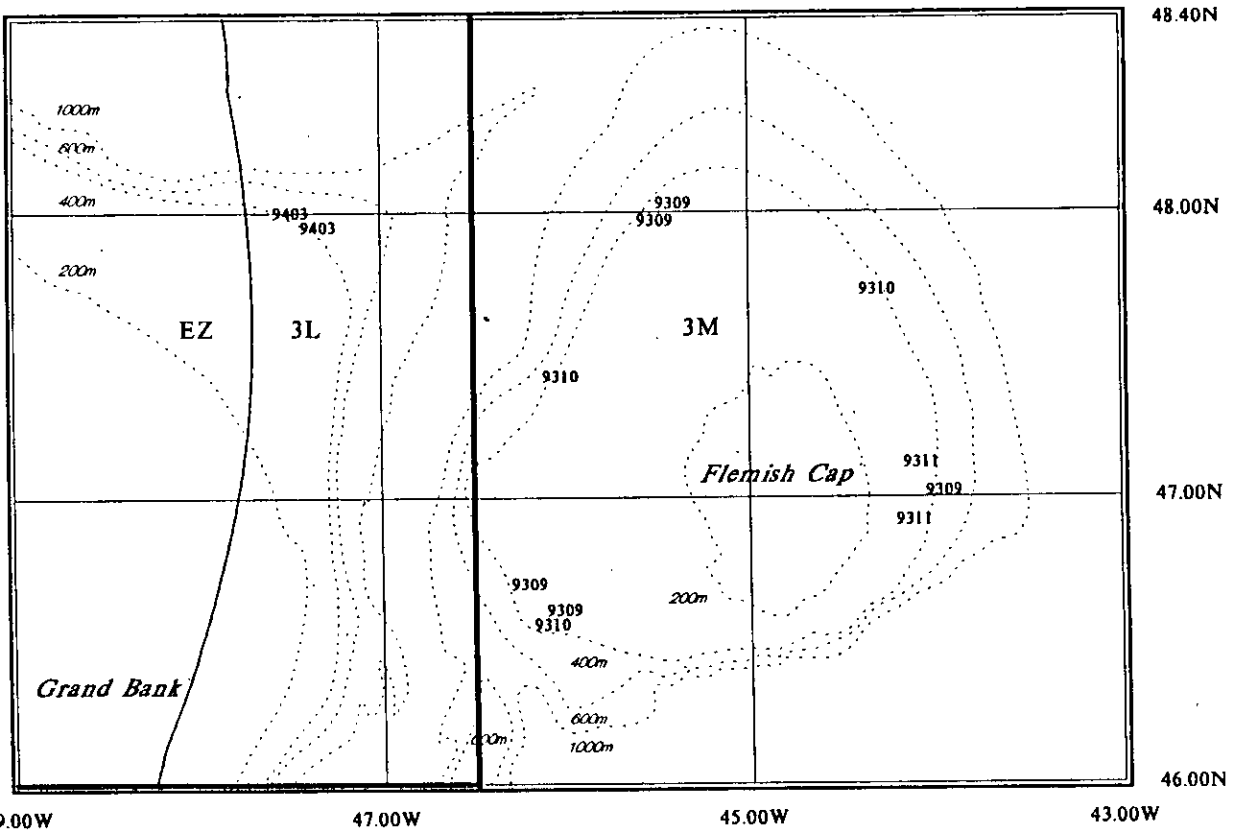


Figure 1 Geographical distribution of 12 biological samples taken in the period Sep 1993 -Mar 1994, indicated by year and month number.

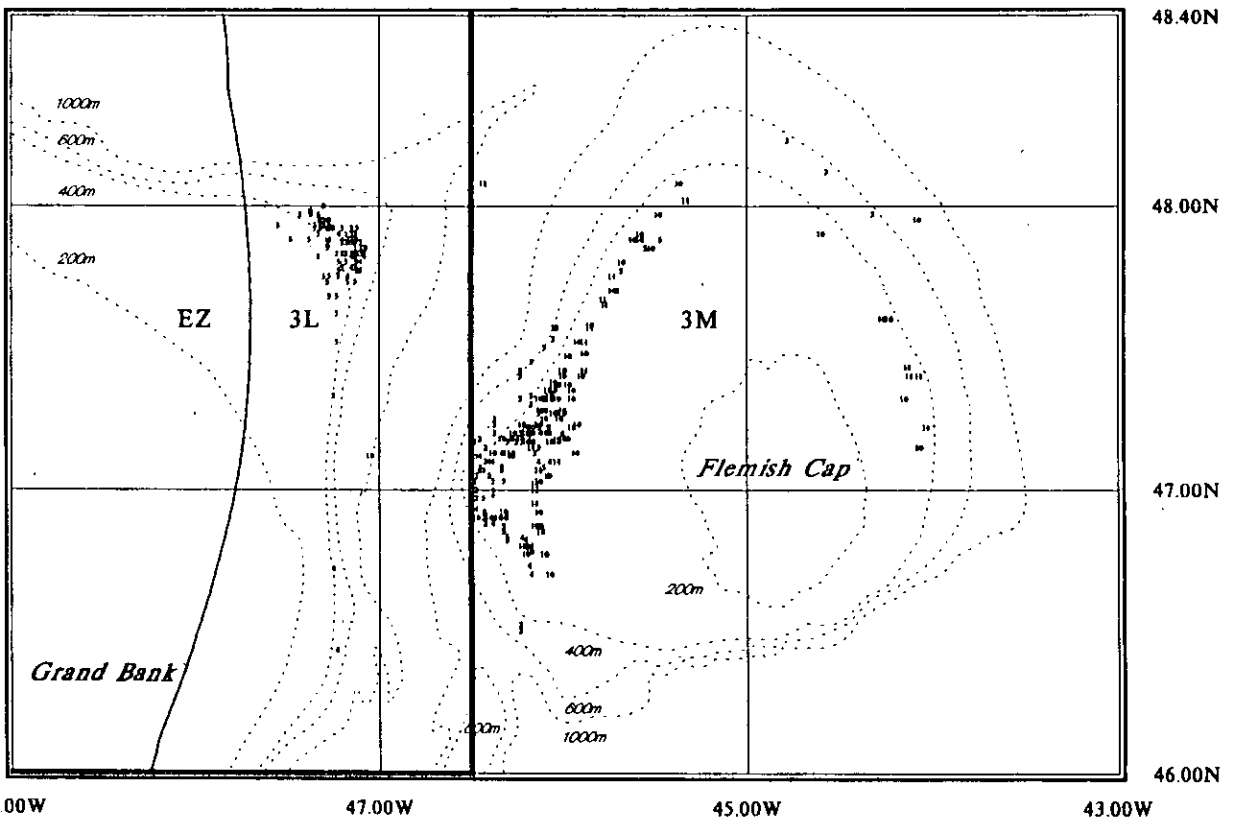


Figure 2 Geographical distribution of 314 OCL measurement samples taken in the period Oct 1993 - May 1994 indicated by month number.

Figure 3 OCL distribution of different sex and maturity groups in Div 3M Sep - Nov 1993 and Div 3L Mar 1994.

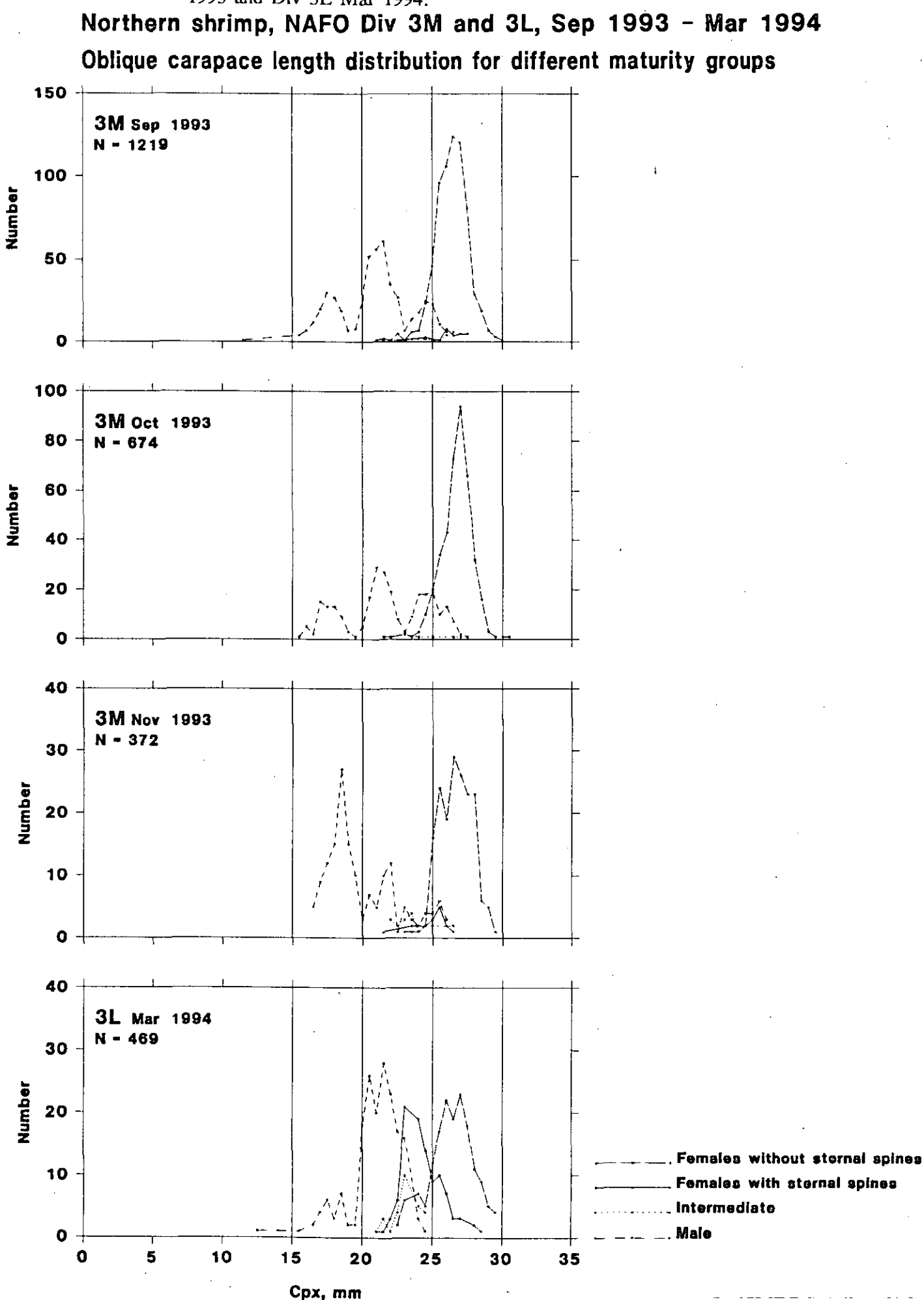


Figure 4 Standardized total OCL distribution in Div 3M and 3L in Oct 1993 - May 1994.

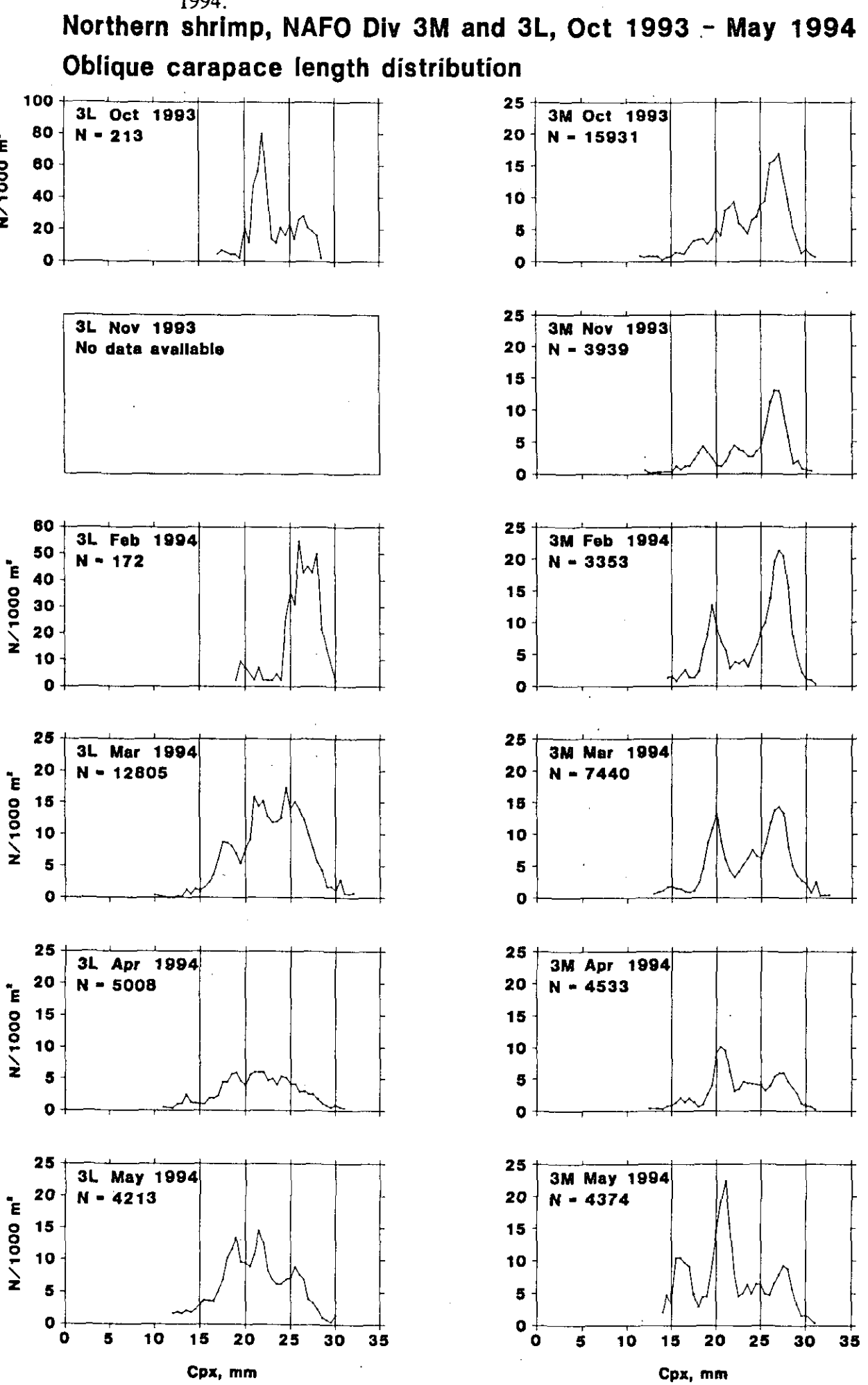
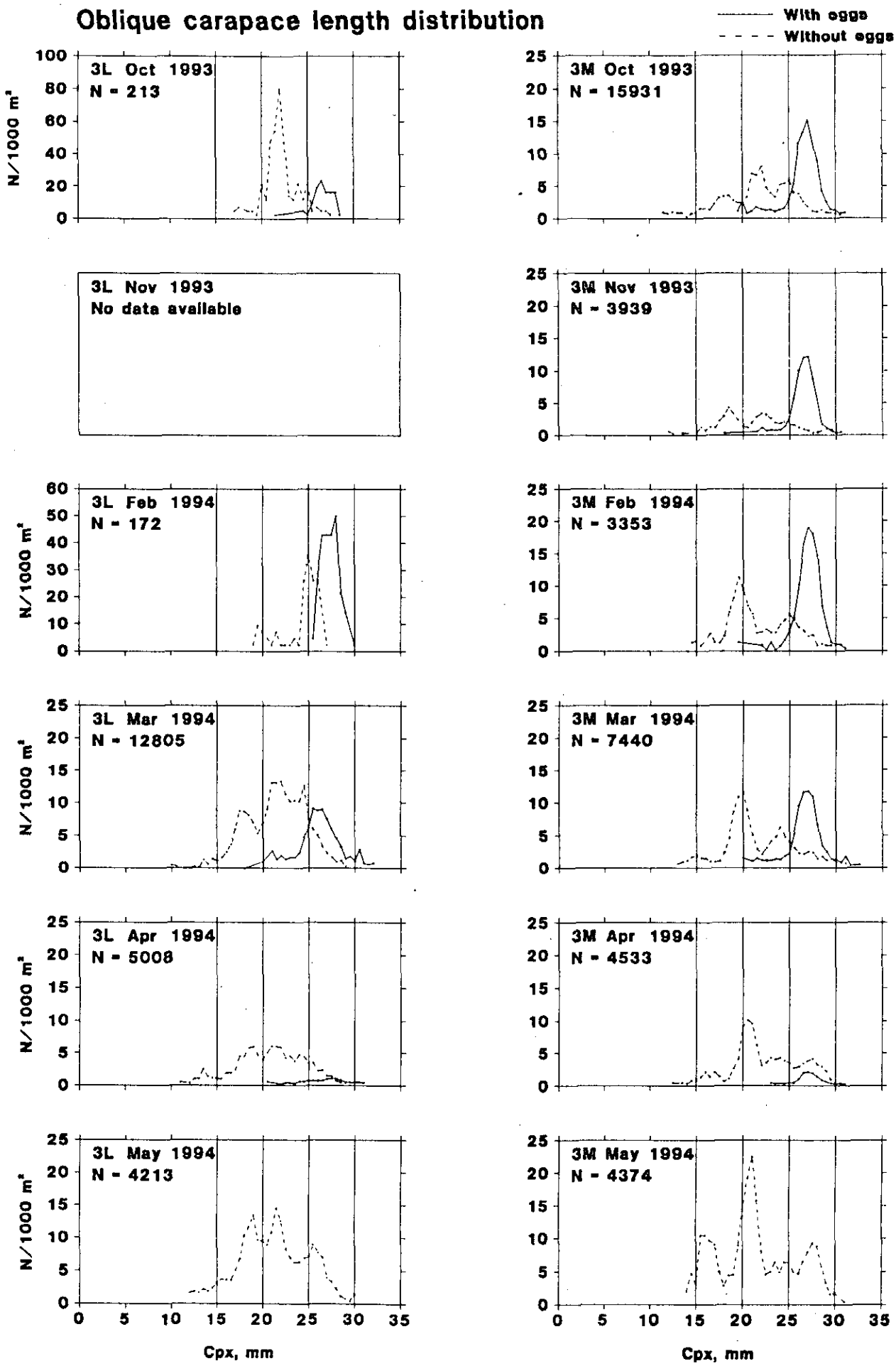


Figure 5 Standardized OCL distribution of shrimp with and without eggs in Div 3M and 3L in Oct 1993 - May 1994.



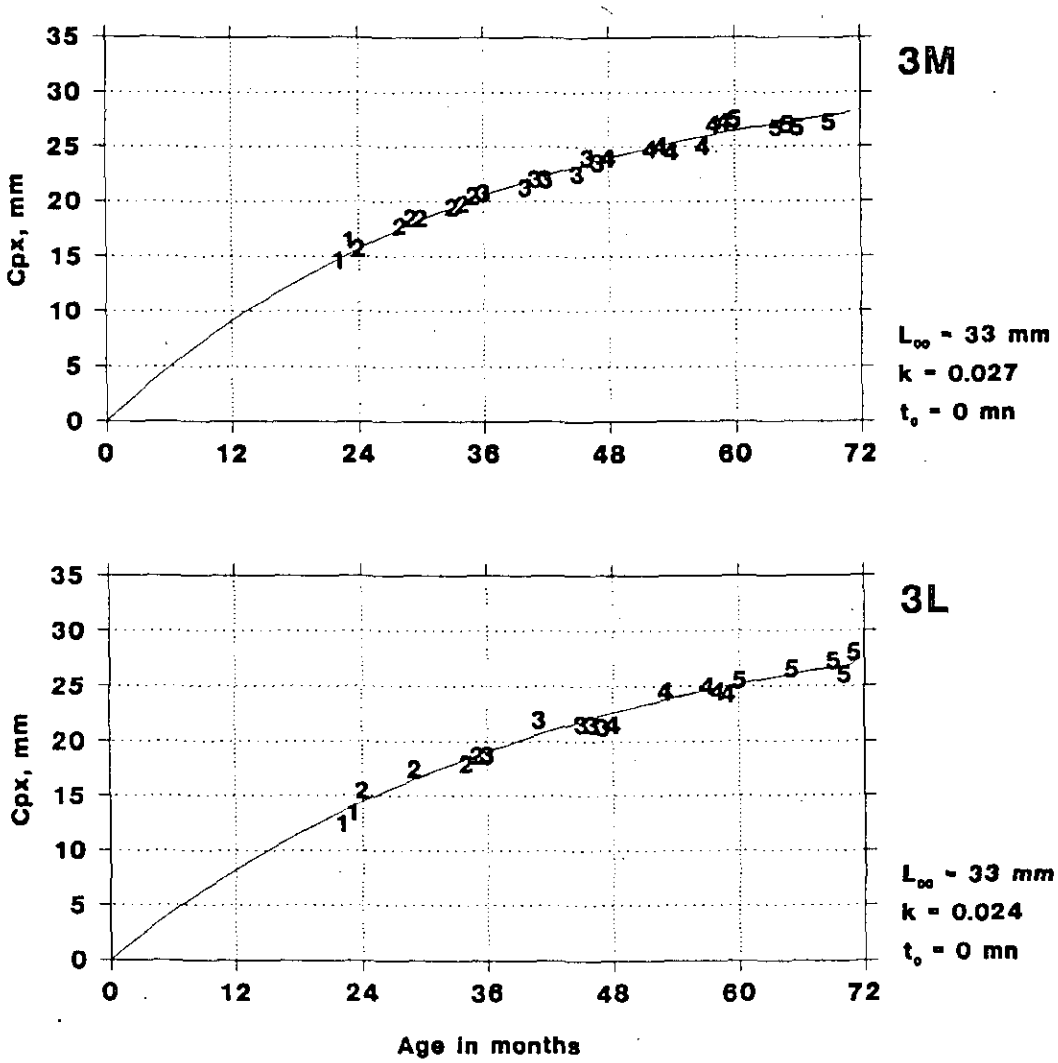


Figure 6 von Bertalanffy growth curves for Div 3M and 3L.

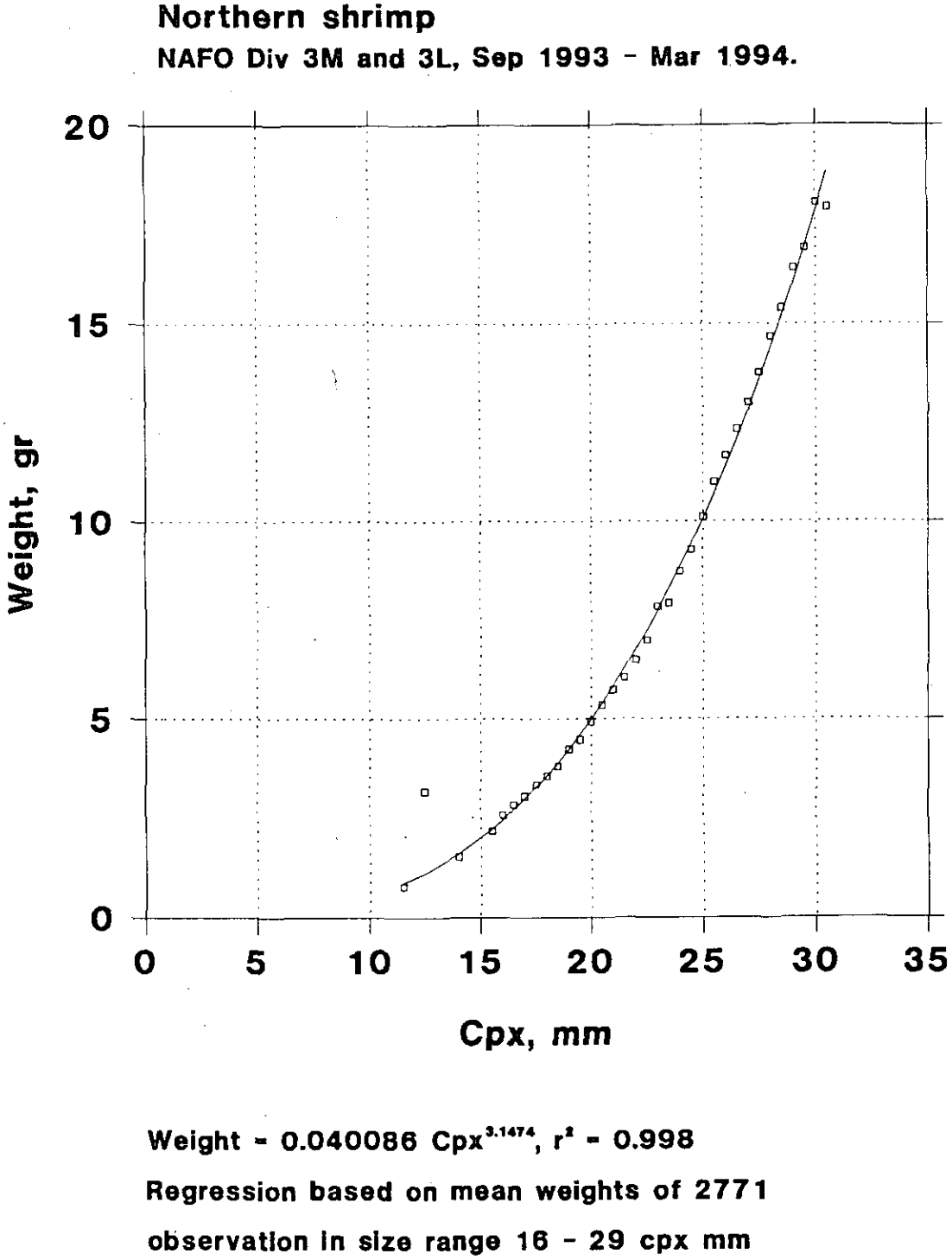


Figure 7 Whole shrimp weight - OCL relationship. Data for Div 3M and 3L are pooled together.