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Biomass Estimate, Growth, Length and Age Distribution of the Northern Shrimp (*Pandalus borealis*)  
Stock on Flemish Cap (NAFO Division 3M) in June 2002

by

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### Abstract

A stratified random bottom trawl survey for shrimp on Flemish Cap conducted in the period 1997-2002 estimated stock biomass to 16000 t, 22000 t, 16500 t, 20000 t, 19000 t and 28000t, respectively. Average stock in numbers was about 3.99 billion, average density 0.68 g·m<sup>-2</sup> and average abundance 0.134 numbers·m<sup>-2</sup> for this period. Stock in numbers by length and age/maturity groups are calculated.

### Introduction

Previous results from the Faroese stratified random bottom trawl survey for northern shrimp on Flemish Cap are reported by Nicolajsen (1997, 1998, 1999, 2000, 2001).

### Materials and Methods

#### *Biomass estimate*

In June 2002 a total of 61 stations were selected in a stratified random trawl survey as shown in Fig. 1. The number of stations were allotted to the strata proportional to strata area. Stations were in the depth range 100-300 fathoms. Tow duration was 60 minutes and towing went on both in day and night time. As in the surveys in 1997-2001 the Faroese commercial shrimp trawler R/T Høgifossur (4400 HP) was used for the operation.

In 1997-2002 an Angmassalik II shrimp trawl with 40 mm mesh size in the codend and 22 mm bar spacing in the sorting grade was used. A single trawl was almost exclusively used except for a few stations in 1997 where a double trawl was used. In 1997-1999 the trawl had a circumference of 3000 50 mm mesh equivalent (50mm m.e.), which was 3600 50mm m.e. in 2000 and 3200 50mm m.e. in 2001 and 2002. Doorspread and towing speed was recorded for these trawl types and average values calculated for each type and arrangement.

For each station the density was calculated, Fig. 2. The catch data were standardized dividing the catches by area swept, i.e. length of tow times average width of the trawl. The length of tow was calculated by multiplying towing time with the average towing speed. The width of the trawl was calculated as the average distance between the doors as measured by Scanmar acoustic distance measuring device. The average density values were calculated for each stratum and multiplied by the strata area and summed for all strata to total biomass, Tab. 1.

### *Length distribution*

At each station a sample of about 200 specimens of shrimp were taken from the unsorted catch and analyzed onboard. The shrimps were measured to the nearest 0.5 mm using Vernier calipers and within length groups sorted by males and females (Rasmussen, 1953) and the females were further grouped into primiparous and multiparous (McCrary, 1971). The length distribution from each sample was raised to the total shrimp catch and divided by area swept for each station to get abundance per unit area (density) at length. Mean density at length was calculated for each strata and multiplied by strata area to get stock in numbers by strata before summing all strata by length and sex/maturity groups. Stock in weight was calculated using a weight-length curve for shrimp in Div. 3M for June 2002 (Nicolajsen, 2002).

### *Growth*

The mean length at age/maturity was estimated by visually identifying the modes of each age group in the length distribution of males, primiparous and multiparous females in the stock.

### *Age structure*

The length distributions of males, primiparous and multiparous females were separated into age groups using the MIX software by MacDonnald and Pitcher (1979). The mean length at age input was taken from the estimated growth curve. A so-called Solver function in the Excel spreadsheet software was used to make preliminary estimates of proportion of each age/maturity group while certain constraints were set on the value range of sigmas. The calculated proportions were used as input to the Mix software.

## **Results**

### *Biomass estimate*

The result of the total stock biomass calculations by the area swept method was 27 634 t with an unweighted average density of 0.948 g·m<sup>-2</sup> (Tab. 1). The stock in weight calculated for all strata was 28 088 t (Tab. 6). The discrepancy between the two estimates is 2%.

### *Length distribution*

The length distributions in stock by strata and its male, primiparous and multiparous female components as well as total stock are shown in Tabs. 2-5, respectively, and in Fig. 3. The stock weight at length in stock by strata and its male, primiparous and multiparous female components as well as total stock are shown in Tabs. 6-9, respectively, and in Fig. 4.

### *Growth*

The preliminary interpretation of mean lengths at age/maturity groups are show in Tab. 10. These means were used as input to the Mix software. The average length for each age group from Tab. 11 was used to estimate a von Bertalanffy growth curve, Fig. 5.

### *Age structure*

Proportion, average size and standard deviation of age/maturity groups from the Mix runs are shown in Tab. 11. Age distribution is shown in Tab. 12 and Fig. 6. Growth curve and relative size distribution of age/maturity groups is shown in Fig. 7. Stock in numbers in the period 1997-2002 are shown in Tab. 13 and plotted by year class in Fig. 8. A summary of stock parameters with C.V.% are shown in Tab. 14 and Fig. 9. Age structure in survey for 1997-2002 is shown in Fig. 10.

## **References**

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**Table 1** Area swept assessment of the Flemish Cap (NAFO Div. 3M) shrimp stock biomass for June 2002.

Strata No.	Average density t•km <sup>-2</sup>	Strata area km <sup>-2</sup>	Biomass t	No. of Stations
13	2.038	2572	5242	5
14	1.497	2401	3593	5
15	2.181	1629	3553	3
16	0.836	5574	4660	12
17	0.736	5402	3975	11
18	0.966	4116	3974	9
19	0.175	1715	300	4
20	0.369	1886	696	4
21	0.343	1629	559	3
22	0.098	943	92	2
23	0.771	1286	991	3
Total		29154	27634	61
Average	0.948			

**Table 2.** Stock in numbers (mill.) at length by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	1	0	0	0	0	0	1
9.5	1	0	0	0	0	1	0	0	0	0	0	2
10.0	3	0	0	0	1	3	0	0	0	0	0	8
10.5	4	0	0	0	1	2	0	0	0	0	0	8
11.0	0	0	0	0	2	2	0	0	0	0	0	3
11.5	0	0	0	0	1	2	0	0	0	0	0	3
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	1	0	0	0	1	2	0	0	0	0	0	5
13.5	5	0	0	1	3	4	0	0	0	0	0	12
14.0	17	0	3	1	9	1	0	0	0	0	0	31
14.5	9	6	12	4	11	7	0	0	0	0	0	49
15.0	25	20	9	4	12	23	0	0	0	0	0	93
15.5	20	17	12	8	13	24	0	0	0	0	0	94
16.0	32	16	6	10	26	23	0	0	0	0	0	114
16.5	46	9	11	22	37	31	0	0	0	0	0	156
17.0	54	34	48	41	49	50	0	0	0	0	0	275
17.5	123	79	86	42	65	65	0	0	0	0	0	461
18.0	153	106	127	63	64	92	0	0	0	0	0	606
18.5	157	106	178	52	73	115	0	0	0	0	0	683
19.0	146	120	110	66	64	93	2	1	0	0	3	606
19.5	110	73	124	54	43	73	1	1	0	0	5	483
20.0	49	35	40	45	29	45	2	1	0	0	2	250
20.5	38	23	15	43	26	19	1	2	1	0	3	170
21.0	20	12	14	39	20	19	1	0	1	0	3	129
21.5	13	13	12	35	27	23	1	2	1	0	4	132
22.0	14	17	15	45	29	17	1	2	1	0	4	145
22.5	15	10	9	48	28	17	1	3	1	0	6	137
23.0	28	23	11	48	33	22	1	4	2	0	7	179
23.5	32	17	11	50	34	23	1	6	1	0	10	185
24.0	26	27	18	41	33	26	2	12	3	0	11	200
24.5	17	18	4	34	25	18	2	14	8	0	10	149
25.0	16	11	0	17	15	16	4	12	7	1	9	107
25.5	7	6	0	13	13	7	3	10	7	1	8	75
26.0	8	2	3	7	7	7	3	5	7	1	4	55
26.5	2	1	0	5	4	5	3	2	7	1	2	30
27.0	1	1	0	2	4	1	2	1	4	1	1	18
27.5	0	0	0	2	2	2	1	1	3	1	0	11
28.0	3	0	0	0	3	0	1	0	1	1	0	9
28.5	0	0	0	0	1	0	1	0	1	0	0	4
29.0	0	0	0	0	1	0	0	0	0	0	0	2
29.5	0	0	0	0	0	0	0	0	0	0	0	1
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	1
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	1193	802	878	842	812	881	34	80	58	8	92	5681

**Table 3.** Stock in numbers (mill.) at length of males by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	1	0	0	0	0	0	1
9.5	1	0	0	0	0	1	0	0	0	0	0	2
10.0	3	0	0	0	1	3	0	0	0	0	0	8
10.5	4	0	0	0	1	2	0	0	0	0	0	8
11.0	0	0	0	0	2	2	0	0	0	0	0	3
11.5	0	0	0	0	1	2	0	0	0	0	0	3
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	1	0	0	0	1	2	0	0	0	0	0	5
13.5	5	0	0	1	3	3	0	0	0	0	0	12
14.0	17	0	3	1	9	1	0	0	0	0	0	31
14.5	9	6	12	4	11	7	0	0	0	0	0	49
15.0	25	20	9	4	12	23	0	0	0	0	0	93
15.5	20	17	12	7	13	24	0	0	0	0	0	93
16.0	32	16	6	10	25	23	0	0	0	0	0	113
16.5	46	9	11	22	37	31	0	0	0	0	0	156
17.0	54	34	48	41	48	50	0	0	0	0	0	274
17.5	123	79	86	41	65	65	0	0	0	0	0	460
18.0	151	106	127	63	64	92	0	0	0	0	0	603
18.5	157	106	178	51	71	115	0	0	0	0	0	679
19.0	145	120	107	65	64	92	2	1	0	0	3	598
19.5	100	67	122	52	38	69	1	1	0	0	5	455
20.0	41	27	40	39	23	41	2	1	0	0	2	216
20.5	29	8	5	33	15	12	1	2	1	0	3	108
21.0	8	6	3	23	6	10	1	0	1	0	2	60
21.5	4	2	0	12	5	9	0	1	1	0	3	39
22.0	1	3	3	9	5	3	0	1	1	0	3	30
22.5	0	1	0	6	5	4	0	1	1	0	5	23
23.0	4	1	0	4	3	2	0	1	1	0	6	22
23.5	0	1	0	2	4	1	0	0	1	0	4	14
24.0	1	1	0	0	1	1	0	1	0	0	4	10
24.5	0	0	0	0	1	0	0	1	0	0	1	4
25.0	0	0	0	0	0	0	0	0	0	0	1	1
25.5	0	0	0	0	0	0	0	0	0	0	0	1
26.0	0	0	0	0	0	0	0	0	0	0	0	0
26.5	0	0	0	0	0	0	0	0	0	0	0	0
27.0	0	0	0	0	0	0	0	0	0	0	0	0
27.5	0	0	0	0	0	0	0	0	0	0	0	0
28.0	0	0	0	0	0	0	0	0	0	0	0	0
28.5	0	0	0	0	0	0	0	0	0	0	0	0
29.0	0	0	0	0	0	0	0	0	0	0	0	0
29.5	0	0	0	0	0	0	0	0	0	0	0	0
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	0
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	979	632	774	491	536	688	10	12	10	1	43	4175

**Table 4.** Stock in numbers (mill.) at length of primiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0	0	0	0	0
10.0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
11.0	0	0	0	0	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0	0	0	0	0
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	0	0	0	0	0	0	0	0	0	0	0	0
13.5	0	0	0	0	0	0	0	0	0	0	0	0
14.0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
15.0	0	0	0	0	0	0	0	0	0	0	0	0
15.5	0	0	0	0	0	0	0	0	0	0	0	0
16.0	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0
17.0	0	0	0	0	0	0	0	0	0	0	0	0
17.5	0	0	0	0	0	0	0	0	0	0	0	0
18.0	0	0	0	0	0	0	0	0	0	0	0	1
18.5	0	0	0	0	2	1	0	0	0	0	0	3
19.0	2	0	3	1	1	1	0	0	0	0	0	7
19.5	9	5	0	2	5	4	0	0	0	0	0	24
20.0	8	6	1	4	5	3	0	0	0	0	0	28
20.5	10	14	9	7	10	7	0	0	0	0	0	57
21.0	12	6	11	14	11	8	0	0	0	0	0	62
21.5	7	11	12	17	20	12	0	1	0	0	1	79
22.0	10	12	11	25	16	12	0	1	0	0	0	88
22.5	11	9	7	25	13	11	0	2	0	0	1	80
23.0	20	15	10	23	14	13	1	3	0	0	1	100
23.5	24	13	9	25	12	12	1	5	0	0	5	107
24.0	14	16	11	19	17	14	2	10	1	0	6	110
24.5	12	13	2	11	7	7	2	12	4	0	8	77
25.0	12	6	0	4	3	7	3	10	3	0	5	54
25.5	2	3	0	5	3	3	2	8	2	0	4	32
26.0	5	1	0	1	0	0	2	5	1	0	2	18
26.5	0	0	0	0	1	0	1	1	0	0	1	6
27.0	0	0	0	0	0	0	1	0	0	0	0	2
27.5	0	0	0	0	0	0	0	0	0	0	0	0
28.0	0	0	0	0	0	0	0	0	0	0	0	0
28.5	0	0	0	0	0	0	0	0	0	0	0	0
29.0	0	0	0	0	0	0	0	0	0	0	0	0
29.5	0	0	0	0	0	0	0	0	0	0	0	0
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	0
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	159	130	85	185	141	116	15	58	11	1	36	937

**Table 5.** Stock in numbers (mill.) at length of multiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0	0	0	0	0
10.0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
11.0	0	0	0	0	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0	0	0	0	0
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	0	0	0	0	0	0	0	0	0	0	0	0
13.5	0	0	0	0	0	1	0	0	0	0	0	1
14.0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
15.0	0	0	0	0	0	0	0	0	0	0	0	0
15.5	0	0	0	1	0	0	0	0	0	0	0	1
16.0	0	0	0	0	1	0	0	0	0	0	0	2
16.5	0	0	0	0	0	0	0	0	0	0	0	0
17.0	0	0	0	0	1	0	0	0	0	0	0	1
17.5	0	0	0	1	0	0	0	0	0	0	0	1
18.0	2	0	0	0	0	0	0	0	0	0	0	2
18.5	0	0	0	0	0	0	0	0	0	0	0	0
19.0	0	0	0	0	0	0	0	0	0	0	0	0
19.5	0	1	1	1	0	0	0	0	0	0	0	3
20.0	0	1	0	2	1	1	0	0	0	0	0	5
20.5	0	1	0	2	1	0	0	0	0	0	0	5
21.0	0	0	0	3	3	1	0	0	0	0	0	7
21.5	2	0	0	6	3	2	0	0	0	0	0	13
22.0	3	1	1	11	8	2	0	0	0	0	0	27
22.5	3	0	2	16	10	2	0	0	0	0	0	33
23.0	4	7	1	21	16	7	0	0	0	0	0	58
23.5	7	3	2	23	17	10	0	0	0	0	1	64
24.0	11	10	7	22	15	11	0	1	1	0	1	80
24.5	6	4	2	22	17	10	0	1	4	0	1	68
25.0	4	4	0	13	11	9	1	2	4	0	3	52
25.5	5	3	0	8	10	3	1	2	5	1	3	42
26.0	2	1	3	6	7	7	1	1	6	1	2	37
26.5	2	0	0	5	3	5	2	1	6	1	0	24
27.0	1	1	0	1	4	1	1	1	4	1	1	16
27.5	0	0	0	2	2	2	1	1	3	1	0	11
28.0	3	0	0	0	3	0	1	0	1	1	0	9
28.5	0	0	0	0	1	0	1	0	1	0	0	3
29.0	0	0	0	0	1	0	0	0	0	0	0	2
29.5	0	0	0	0	0	0	0	0	0	0	0	1
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	1
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	39	20	166	135	76	10	10	37	6	13	568

**Table 6.** Stock weight (t) at length by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	1	0	0	0	0	0	0	0	0	0	0	1
10.0	2	0	0	0	1	2	0	0	0	0	0	5
10.5	3	0	0	0	1	1	0	0	0	0	0	5
11.0	0	0	0	0	1	1	0	0	0	0	0	3
11.5	0	0	0	0	1	1	0	0	0	0	0	3
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	2	0	0	0	2	3	0	0	0	0	0	7
13.5	7	0	0	1	5	6	0	0	0	0	0	19
14.0	29	0	5	2	15	1	0	0	0	0	0	52
14.5	16	11	23	7	20	13	0	0	0	0	0	91
15.0	51	42	19	8	26	47	0	0	0	0	0	193
15.5	45	39	27	18	30	54	0	0	0	0	0	214
16.0	81	40	16	26	66	58	0	0	0	0	0	287
16.5	125	26	31	60	103	85	0	0	0	0	0	430
17.0	163	101	143	123	147	149	0	0	0	0	0	825
17.5	403	260	283	136	213	214	0	0	0	0	0	1509
18.0	544	379	452	225	227	328	1	0	0	0	1	2157
18.5	605	410	689	200	284	446	1	1	1	0	2	2637
19.0	612	502	462	276	269	390	7	3	1	0	12	2533
19.5	495	330	559	246	195	328	5	4	2	0	21	2184
20.0	240	168	197	220	143	220	10	7	2	0	8	1215
20.5	202	121	77	226	134	101	4	9	4	0	15	893
21.0	111	68	79	221	110	106	5	2	6	0	18	725
21.5	76	79	74	211	166	141	4	11	9	0	24	794
22.0	94	109	95	289	188	111	4	16	7	1	25	939
22.5	101	72	59	330	190	120	4	21	7	1	40	945
23.0	208	170	79	355	242	161	9	32	13	1	53	1323
23.5	251	133	90	390	265	179	11	45	10	1	78	1453
24.0	218	224	150	344	279	221	19	99	25	2	93	1675
24.5	155	157	32	300	221	156	20	122	69	3	93	1328
25.0	151	100	0	161	138	152	41	117	68	7	82	1015
25.5	70	58	3	128	134	67	34	104	70	9	77	753
26.0	83	22	33	75	78	75	36	58	71	9	43	582
26.5	18	8	0	57	44	61	29	21	74	9	18	339
27.0	9	16	0	22	51	15	20	10	49	12	12	216
27.5	0	0	0	20	25	27	18	9	33	11	2	144
28.0	36	0	0	1	37	7	11	4	14	7	5	122
28.5	0	0	0	6	8	3	9	0	17	5	4	52
29.0	0	0	0	7	11	0	3	0	5	4	0	30
29.5	0	0	0	0	0	8	0	0	5	4	0	16
30.0	0	0	0	0	0	0	0	0	5	1	0	6
30.5	0	0	0	0	7	0	0	0	0	2	0	10
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	1	0	1
Total	5204	3643	3675	4692	4077	4056	305	694	569	91	725	27732



**Table 7.** Stock weight (t) at length of males by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	1	0	0	0	0	0	0	0	0	0	0	1
10.0	2	0	0	0	1	2	0	0	0	0	0	5
10.5	3	0	0	0	1	1	0	0	0	0	0	5
11.0	0	0	0	0	1	1	0	0	0	0	0	3
11.5	0	0	0	0	1	1	0	0	0	0	0	3
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	2	0	0	0	2	3	0	0	0	0	0	7
13.5	7	0	0	1	5	5	0	0	0	0	0	18
14.0	29	0	5	2	15	1	0	0	0	0	0	52
14.5	16	11	23	7	20	13	0	0	0	0	0	91
15.0	51	42	19	8	26	47	0	0	0	0	0	193
15.5	45	39	27	16	30	54	0	0	0	0	0	212
16.0	81	40	16	25	62	58	0	0	0	0	0	282
16.5	125	26	31	60	103	85	0	0	0	0	0	430
17.0	163	101	143	122	145	149	0	0	0	0	0	823
17.5	403	260	283	133	213	214	0	0	0	0	0	1506
18.0	538	379	451	224	227	326	1	0	0	0	1	2148
18.5	605	410	689	197	276	443	1	1	1	0	2	2624
19.0	606	502	449	271	266	386	7	3	1	0	12	2503
19.5	452	304	552	235	171	311	5	4	2	0	21	2058
20.0	199	130	193	191	112	201	10	7	2	0	8	1054
20.5	152	39	28	175	79	63	4	8	4	0	13	567
21.0	44	31	17	127	34	55	5	2	6	0	14	336
21.5	23	15	2	75	29	55	3	6	9	0	21	236
22.0	5	23	19	56	32	20	2	7	7	1	22	193
22.5	0	10	0	43	32	28	2	7	7	1	32	161
23.0	27	8	1	30	19	13	3	7	9	1	41	159
23.5	0	7	0	16	32	9	2	4	6	0	35	111
24.0	6	7	0	0	10	7	4	9	3	1	37	84
24.5	0	4	0	4	5	4	2	5	4	0	9	36
25.0	0	0	0	0	0	0	4	3	2	0	5	14
25.5	0	0	0	0	2	0	0	3	2	0	4	11
26.0	0	0	0	0	0	0	0	0	0	0	2	2
26.5	0	0	0	0	0	0	0	0	0	0	0	0
27.0	0	0	0	0	0	0	0	0	0	0	0	0
27.5	0	0	0	0	0	0	0	0	0	0	0	0
28.0	0	0	0	0	0	0	0	0	0	0	0	0
28.5	0	0	0	0	0	0	0	0	0	0	0	0
29.0	0	0	0	0	0	0	0	0	0	0	0	0
29.5	0	0	0	0	0	0	0	0	0	0	0	0
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	0
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	3584	2388	2947	2022	1952	2556	54	76	65	6	277	15929

**Table 8.** Stock weight (t) at length of primiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0	0	0	0	0
10.0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
11.0	0	0	0	0	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0	0	0	0	0
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	0	0	0	0	0	0	0	0	0	0	0	0
13.5	0	0	0	0	0	0	0	0	0	0	0	0
14.0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
15.0	0	0	0	0	0	0	0	0	0	0	0	0
15.5	0	0	0	0	0	0	0	0	0	0	0	0
16.0	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0
17.0	0	0	0	0	0	0	0	0	0	0	0	0
17.5	0	0	0	1	0	0	0	0	0	0	0	1
18.0	0	0	0	0	1	2	0	0	0	0	0	2
18.5	0	0	0	1	8	3	0	0	0	0	0	11
19.0	6	0	13	5	2	4	0	0	0	0	0	31
19.5	43	20	0	8	23	16	0	0	0	0	0	111
20.0	41	31	3	21	24	15	0	0	0	0	0	136
20.5	50	75	48	39	50	37	0	1	0	0	1	301
21.0	67	36	61	77	60	44	0	0	0	0	2	347
21.5	43	64	70	100	120	74	1	5	0	0	3	480
22.0	68	78	73	161	104	75	1	9	0	0	3	572
22.5	79	61	47	175	93	77	2	14	0	0	8	555
23.0	147	112	70	170	102	95	5	23	2	0	9	735
23.5	192	102	74	195	98	91	8	39	2	0	38	841
24.0	115	130	91	163	146	121	13	81	10	1	50	922
24.5	103	116	17	100	61	66	15	106	33	1	73	690
25.0	110	59	0	41	32	66	26	97	25	2	52	509
25.5	22	27	1	47	31	35	22	76	16	2	43	322
26.0	58	14	0	7	4	0	23	49	8	3	22	188
26.5	0	5	0	3	12	4	11	13	3	1	12	66
27.0	0	0	0	5	6	0	11	2	2	1	2	29
27.5	0	0	0	0	0	0	5	0	0	0	0	5
28.0	0	0	0	0	0	0	1	0	0	0	0	1
28.5	0	0	0	0	0	3	0	0	0	0	0	3
29.0	0	0	0	0	0	0	0	0	0	0	0	0
29.5	0	0	0	0	0	0	0	0	0	0	0	0
30.0	0	0	0	0	0	0	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	0
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0
Total	1145	931	569	1321	975	827	144	515	102	12	318	6859

**Table 9.** Stock weight (t) at length of multiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2002.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	0	0	0	0	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0	0	0	0	0
10.0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0
11.0	0	0	0	0	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0	0	0	0	0
12.0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0
13.0	0	0	0	0	0	0	0	0	0	0	0	0
13.5	0	0	0	0	0	1	0	0	0	0	0	1
14.0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0
15.0	0	0	0	0	0	0	0	0	0	0	0	0
15.5	0	0	0	2	0	0	0	0	0	0	0	2
16.0	0	0	0	1	4	0	0	0	0	0	0	4
16.5	0	0	0	0	0	0	0	0	0	0	0	0
17.0	0	0	0	1	2	0	0	0	0	0	0	3
17.5	0	0	0	2	0	0	0	0	0	0	0	2
18.0	6	0	1	0	0	0	0	0	0	0	0	7
18.5	0	0	0	1	0	0	0	0	0	0	0	2
19.0	0	0	0	0	0	0	0	0	0	0	0	0
19.5	0	5	7	2	1	0	0	0	0	0	0	15
20.0	0	7	0	8	6	4	0	0	0	0	0	25
20.5	0	6	0	12	5	1	0	0	0	0	0	24
21.0	0	0	0	17	16	6	0	0	0	0	3	42
21.5	10	0	2	36	17	13	0	0	0	0	0	79
22.0	21	8	4	72	52	15	1	0	0	0	0	174
22.5	22	2	12	112	66	16	0	0	0	0	0	229
23.0	33	50	8	155	120	53	1	2	3	0	3	428
23.5	59	25	16	178	134	79	1	3	2	0	5	501
24.0	96	87	59	181	123	93	2	9	12	1	6	669
24.5	52	38	16	196	155	86	3	10	33	2	12	603
25.0	41	41	0	120	106	86	10	17	41	4	25	492
25.5	48	31	1	81	101	33	12	25	52	7	30	421
26.0	25	7	33	69	74	75	13	8	63	6	19	392
26.5	18	3	0	53	32	56	18	7	71	7	6	273
27.0	9	16	0	17	45	15	9	8	47	11	10	186
27.5	0	0	0	20	25	27	13	9	33	11	2	139
28.0	36	0	0	1	37	7	10	4	14	7	5	121
28.5	0	0	0	6	8	0	9	0	17	5	4	49
29.0	0	0	0	7	11	0	3	0	5	4	0	30
29.5	0	0	0	0	0	8	0	0	5	4	0	16
30.0	0	0	0	0	0	0	0	0	5	1	0	6
30.5	0	0	0	0	7	0	0	0	0	2	0	10
31.0	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	1	0	1
Total	475	324	159	1350	1150	674	107	102	402	73	130	4944

**Table 10.** Average OCL interpreted from size distributions.

Age	Males OCL, mm	Primiparous OCL, mm	Multiparous OCL, mm	Mean OCL, mm
1	10.50			10.50
2	15.25			15.25
3	18.50	20.25	20.00	19.58
4	20.50	22.00	22.25	21.58
5	23.00	23.75	24.25	23.67
6		25.75	26.25	26.00
7			27.75	
8				
9				

**Table 11.** Results from the age separation for each sex/maturity group calculated with the Mix software.

Sex and maturity group	Male		Primiparous		Multiparous	
	Prop.	St.Dev	Prop.	St.Dev	Prop.	St.Dev
Age						
1	0.006	0.001				
2	0.100	0.012				
3	0.854	0.017				
4	0.014	0.028	0.274	0.032	0.042	0.013
5	0.026	0.025	0.726	0.032	0.574	0.056
6					0.377	0.089
7					0.0077	0.042
	Mean	St.Dev	Mean	St.Dev	Mean	St.Dev
1	10.5	0.133				
2	15.4	0.152				
3	18.5	0.028				
4	21.4	0.407	21.3	0.132	20.7	FIXED
5	22.7	1.107	23.9	0.067	23.6	FIXED
6					25.5	FIXED
7					27.3	FIXED
	Sigma	St.Dev	Sigma	St.Dev	Sigma	St.Dev
1	0.62	0.104				
2	0.94	0.085				
3	1.03	0.034				
4	0.60	0.561	1.06	0.056	0.98	0.267
5	1.04	0.410	1.18	0.033	1.10	0.095
6					1.47	0.264
7					2.24	5.151

**Table 12.** Stock in numbers (mill.) by age/maturity groups in Flemish Cap shrimp stock (NAFO DIV. 3M) in 2002.

Age	Male	Primiparous	Multiparous	Total
1	24			24
2	416			416
3	3566			3566
4	60	256	24	340
5	108	681	326	1115
6			214	214
7			4	4
Total	4175	937	568	5680

**Table 13.** Stock in numbers (mill.) in Flemish Cap shrimp stock (NAFO DIV. 3M) in the period 1997-2002.

Age	1997	1998	1999	2000	2001	2002	Average
1				9	15	24	16
2	855	210	214	108	1242	416	507
3	1568	1269	1289	1392	359	3566	1574
4	446	934	835	1285	1098	340	823
5	442	664	880	631	449	1115	697
6	89	570	200	517	677	214	378
7+		7	3			4	5
Total	3399	3654	3422	3942	3840	5680	3990

**Table 14.** Summary of survey stock assessment parameters for shrimp on Flemish Cap (NAFO 3M) in the period 1997-2002.

Year	Biomass t	Density g.m <sup>-2</sup>	Numbers (10 <sup>-6</sup> )	Average weight, g	Abundance numbers.m <sup>-2</sup>	Female biomass, t	C.V.%	Surveyed area, km <sup>2</sup>
1997	16102	0.50	3400	4.74	0.105	6417	111	32413
1998	21824	0.71	3654	5.97	0.119	11783	94	30612
1999	16486	0.57	3421	4.82	0.117	8621	75	29154
2000	20165	0.69	3941	5.12	0.135	9487	75	29154
2001	19036	0.65	3840	4.96	0.132	8930	58	29154
2002	27732	0.95	5681	4.88	0.195	11803	83	29154
Average	20224	0.68	3990	5.08	0.134	9507	83	29940

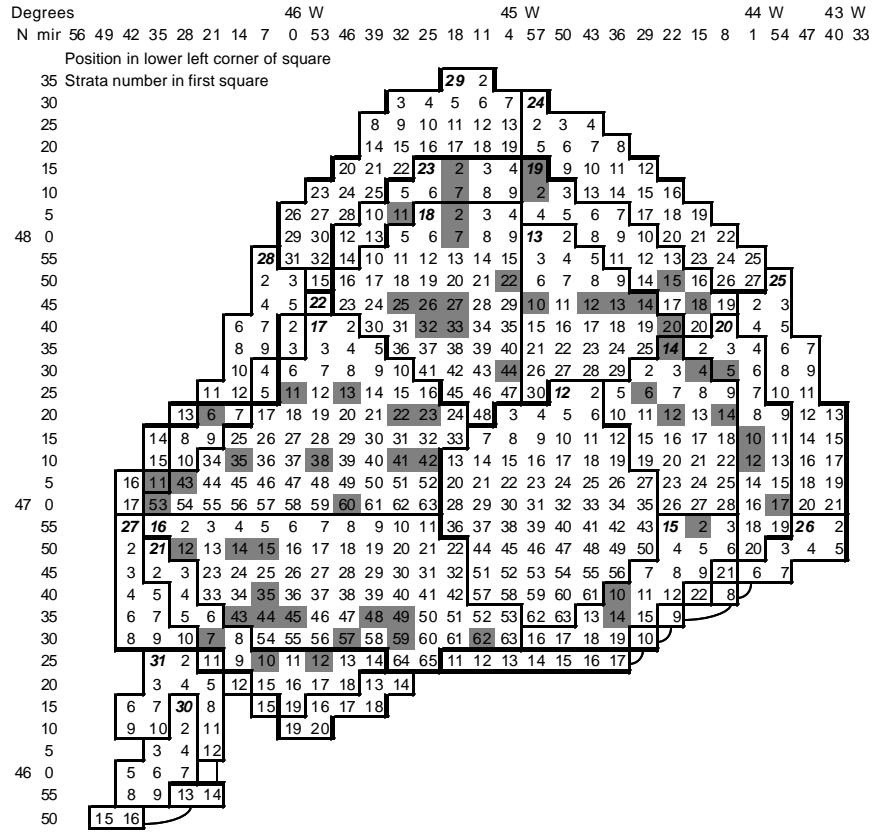
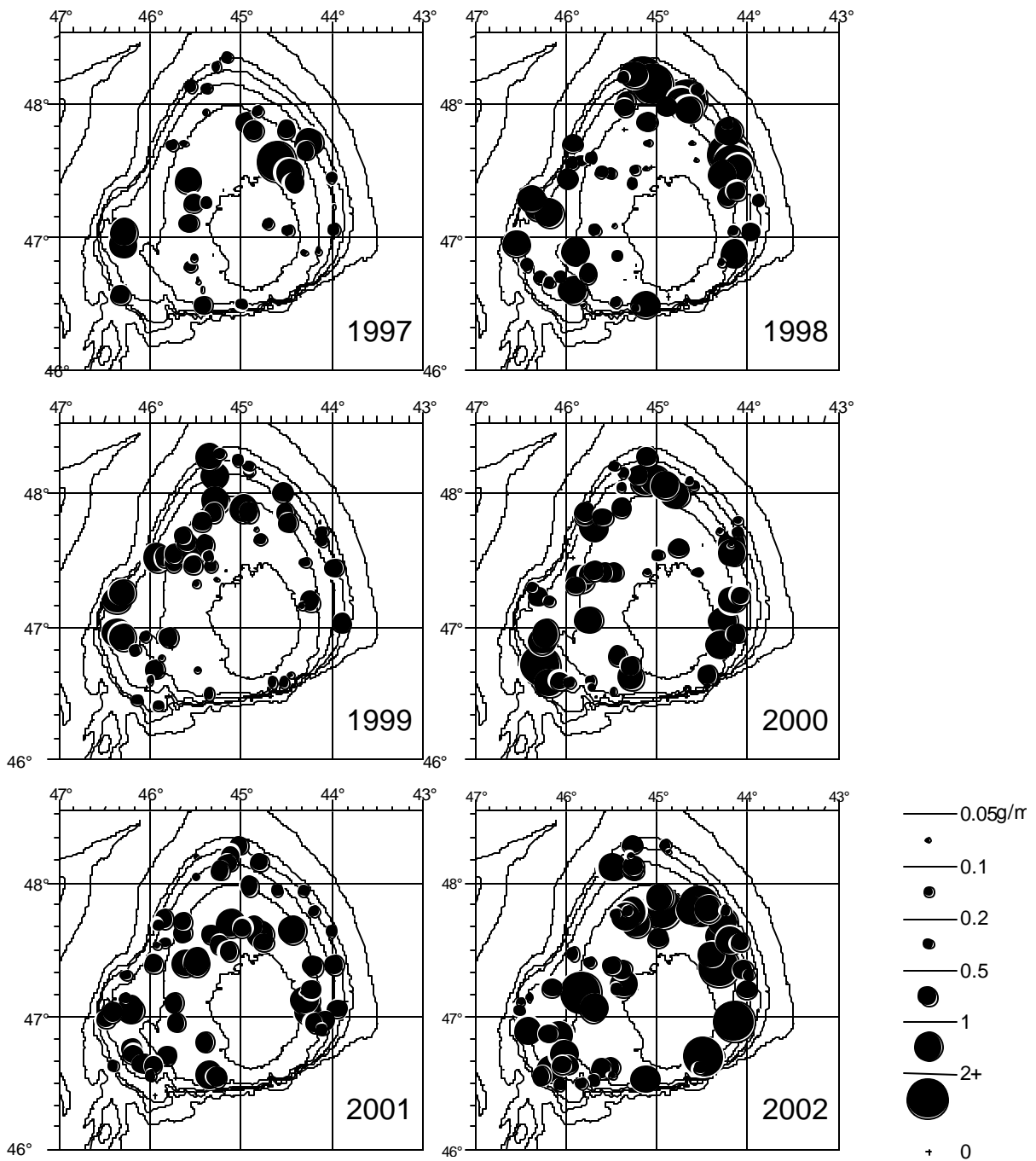
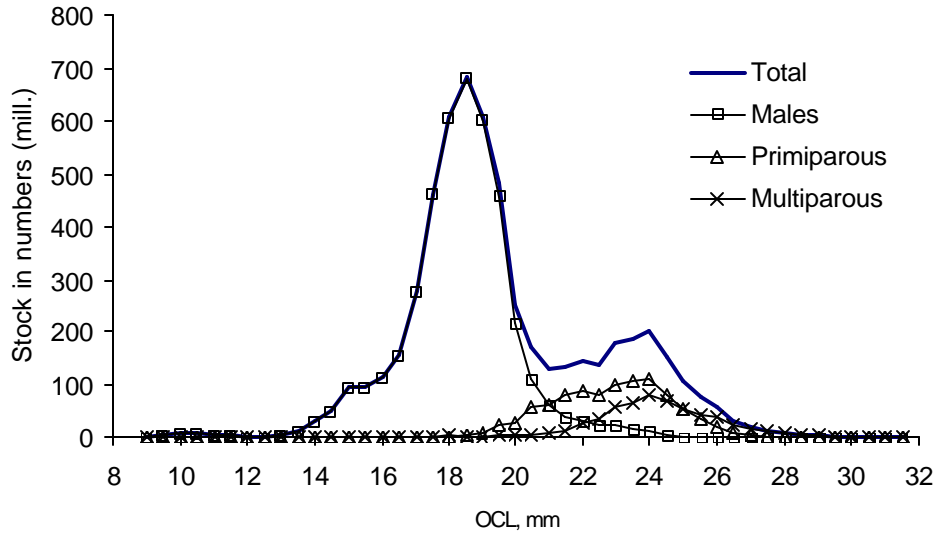


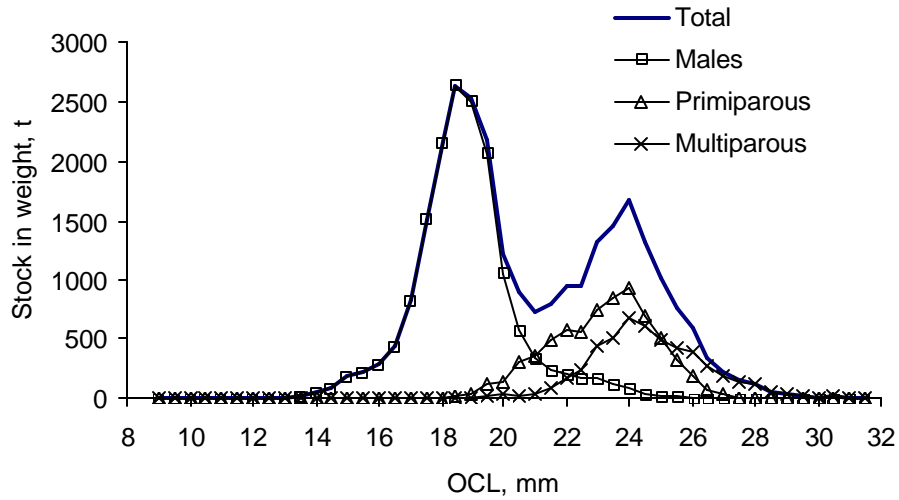
Figure 1. Map of Flemish Cap (NAFO Div. 3M) showing strata with randomly selected stations (squares shaded) in the June 2002.



**Figure 2.** Distribution of density of shrimp ( $\text{g} \cdot \text{m}^{-2}$ ) from surveys on Flemish Cap (NAFO Div. 3M) in 1997-2002.

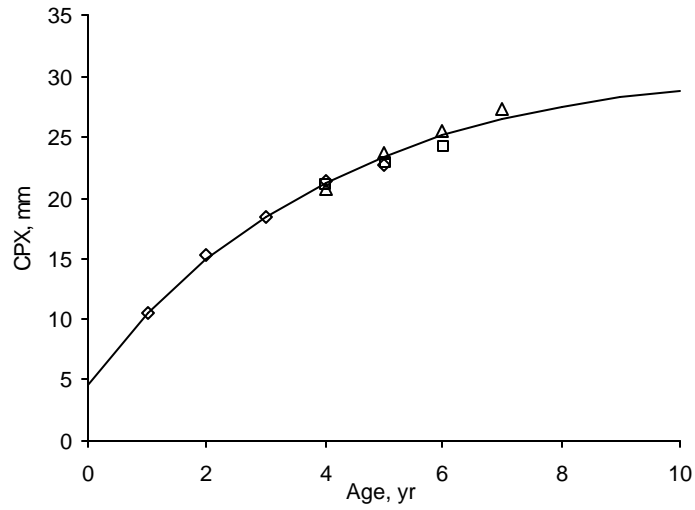


**Figure 3.** Length distribution in shrimp stock on Flemish Cap (NAFO Div. 3M) of total, males, primiparous and multiparous females from the June 2002 survey.

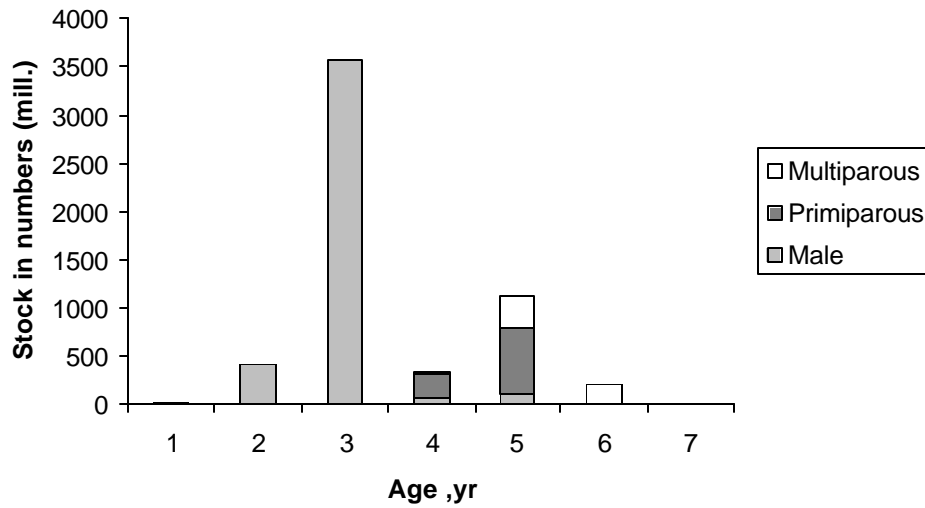


**Figure 4.** Stock weight (t) at length in shrimp stock on Flemish Cap (NAFO Div. 3M) of total, males, primiparous and multiparous females from the June 2002 survey.

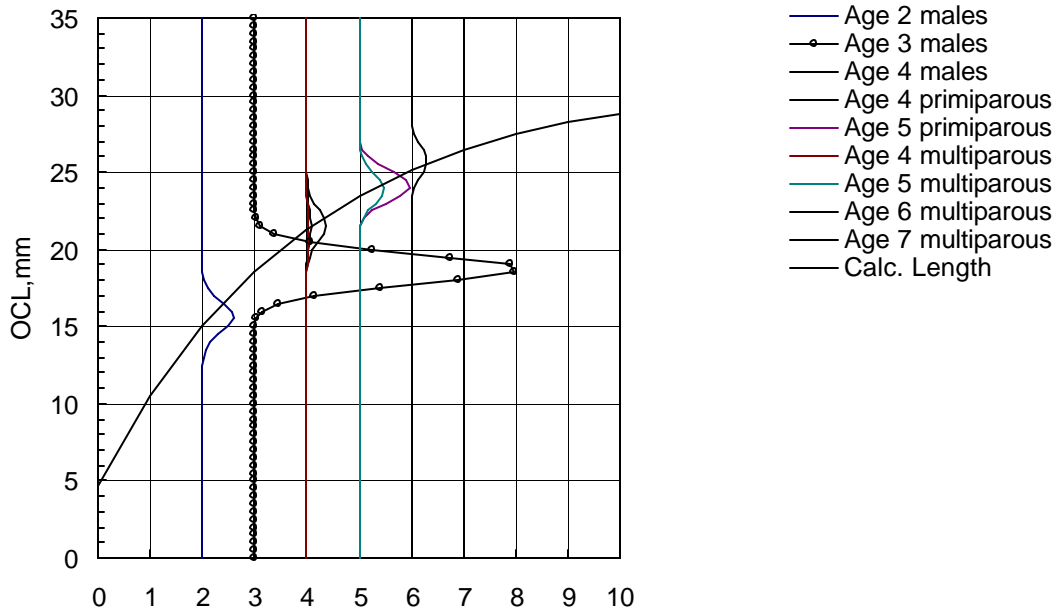




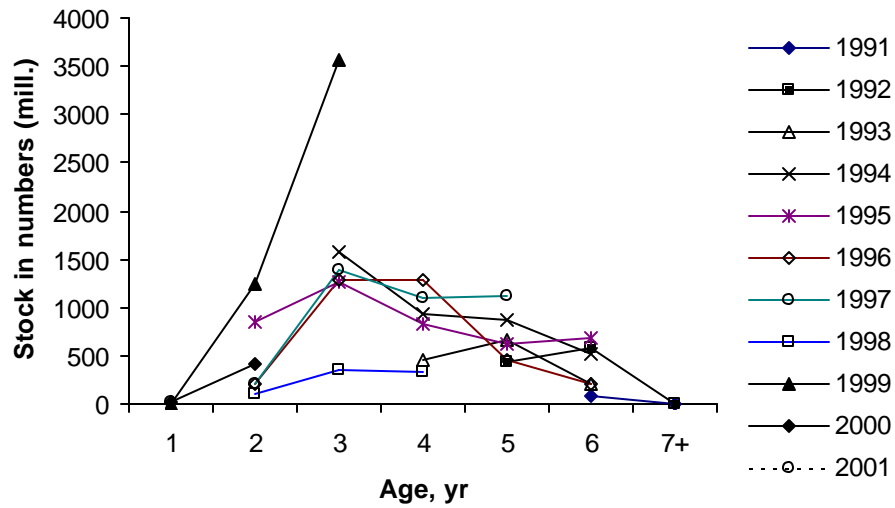
**Figure 5.** von Bertalanffy growth curve for shrimp on Flemish Cap (NAFO Div. 3M). Data points from Table 11.



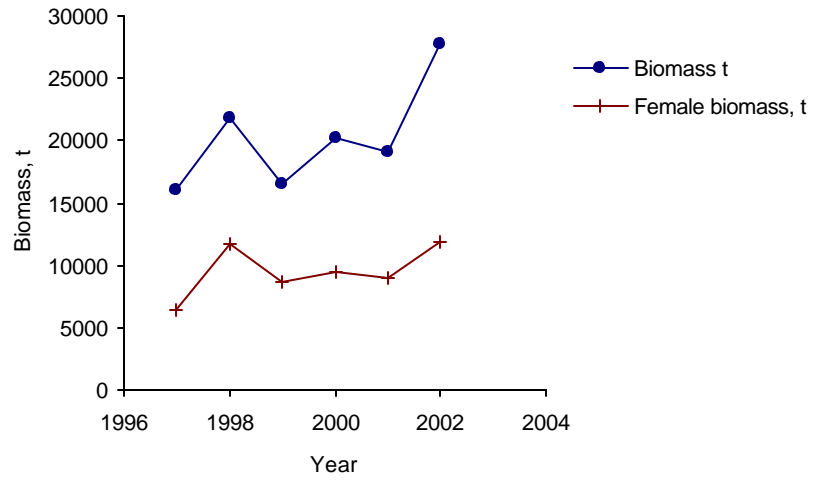
**Figure 6** Stock in numbers at age/maturity groups in Flemish Cap shrimp stock (NAFO DIV. 3M) in 2002. Data from Table 14.



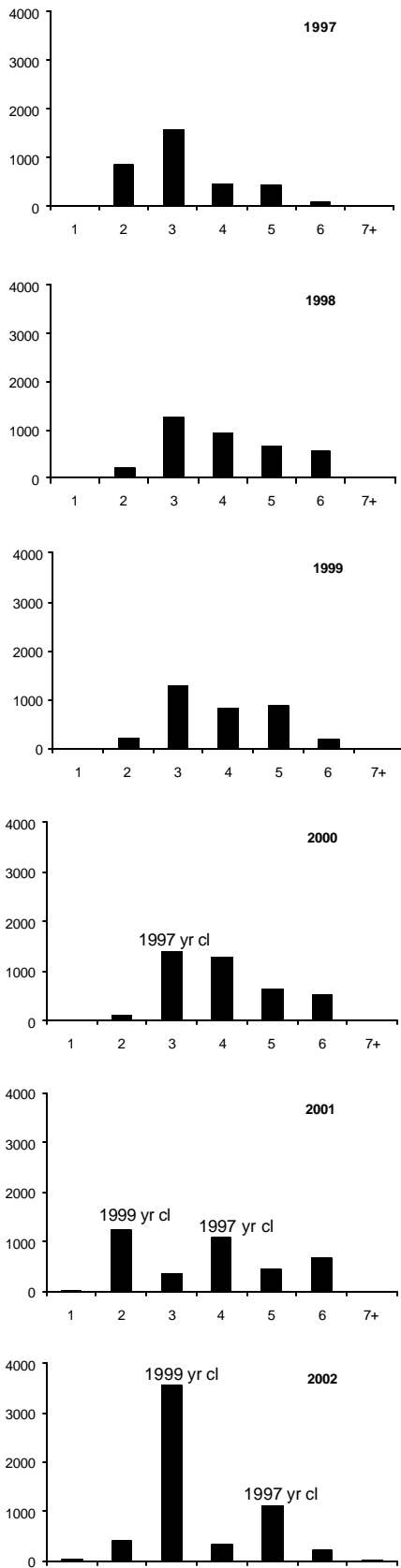
**Figure 7.** Growth curve and relative size distribution of age/maturity groups of shrimp on Flemish Cap (NAFO Div. 3M) from survey in June 2002.



**Figure 8.** Stock in numbers by year class in shrimp stock on Flemish Cap (NAFO Div. 3M) in the period 1997-2002.



**Figure 9** Total shrimp stock biomass and female stock biomass on Flemish Cap (NAFO Div. 3M) in the period 1997-2002.



**Figure 10** Age structure in survey for 1997-2002 for northern shrimp on Flemish Cap (NAFO Div. 3M). Units for x is age and for y is number of shrimps in millions.