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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

by

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**Abstract**

A stratified random bottom trawl survey for shrimp on Flemish Cap conducted in the period 1997-2000 estimated stock biomass to 17000 t, 23500 t, 16500 t and 20500 t, respectively. Average stock in numbers was about 3.7 billion, average density  $0.64 \text{ g} \cdot \text{m}^{-2}$  and average abundance  $0.123 \text{ numbers} \cdot \text{m}^{-2}$  for this period. Stock in numbers by length and age/maturity groups are calculated.

**Materials and Methods**

*Biomass estimate*

In June 2000 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, 1998 and 1999 the Faroese commercial shrimp trawler R/T Høgfossur (4400 HP) was used for the operation. In 1997-1999 a single Angmassalik 3000 shrimp trawl with 40 mm mesh size in the codend and 22 mm bar spacing in the sorting grade was used. In 2000 the same type of trawl with a wider wingspread was used.

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 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 acoustic distance measuring device (Scanmar). The average density values were calculated for each strata and multiplied with 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 2000 (Nicolajsen, 2000).

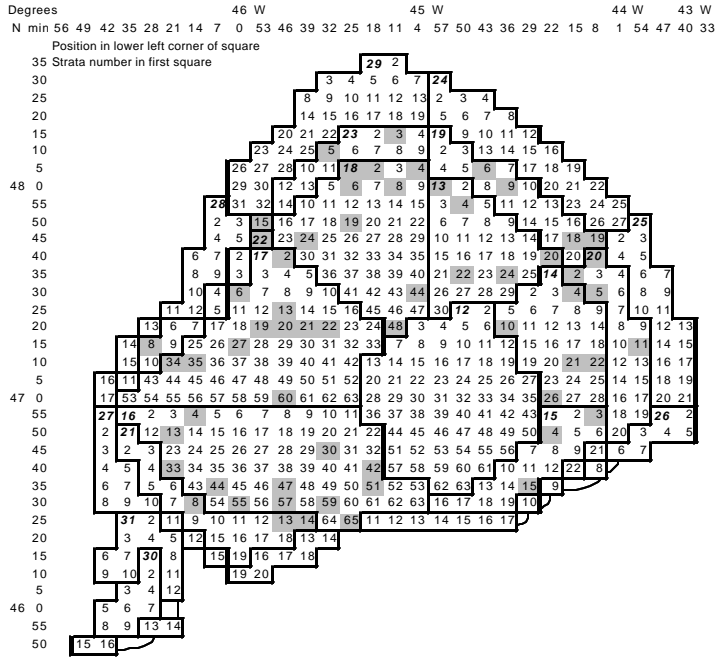


Fig. 1. Map of Flemish Cap (NAFO Div. 3M) showing strata with randomly selected stations (squares shaded) in the June 2000 survey. Each square area is 5 nm<sup>2</sup> by approx. 5 nm<sup>2</sup>.

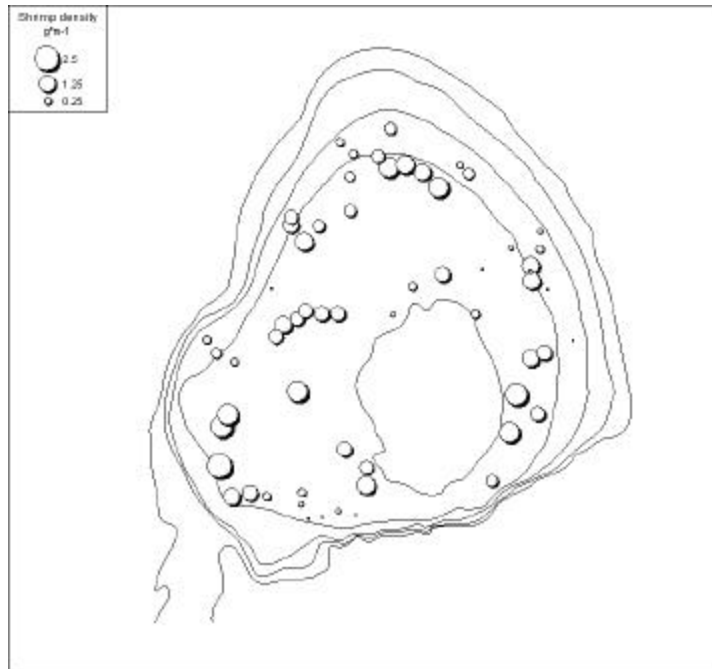


Fig. 2 Density of shrimp ( $\text{g} \cdot \text{m}^{-2}$ ) from survey on Flemish Cap (NAFO Div. 3M) in June 2000. Depth curves 200 m, 400 m, etc.

### *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 20 380 t with a weighted average density of 0.699 g· m<sup>-2</sup> (Tab. 1). The stock in weight calculated for all strata was 19 150 t (Tab. 6). The discrepancy between the two estimates is 6%.

**Table 1.** Area swept assessment of the Flemish Cap (NAFO Div. 3M) shrimp stock biomass for June 2000.

Strata No.	Average density t•km <sup>-2</sup>	Strata area km <sup>2</sup>	Biomass t	No. of Stations
13	0.702	2572	1806	5
14	1.042	2401	2501	5
15	0.994	1629	1619	3
16	0.812	5574	4526	12
17	0.806	5402	4356	11
18	0.644	4116	2652	9
19	0.224	1715	384	4
20	0.359	1886	678	4
21	0.376	1629	613	3
22	0.608	943	573	2
23	0.522	1286	672	3
Total		29154	20380	61
Average	0.699			

### *Length distribution*

The length distributions in stock by strata and its males, 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 males, 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. 4.

### *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 1997-2000 are shown in Tab. 13 and plotted by year class in Fig. 8. A summary of stock parameters are shown in Tab. 14.

### **References**

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- Nicolajsen, Á. 1999. Biomass Estimate, Growth, Length and Age Distribution of the Northern Shrimp (*Pandalus borealis*) Stock on Flemish Cap (NAFO Div. 3M) in June 2000 and Faroese Shrimp catches 1996-1999. NAFO SC WP 99/114. 18 p.
- Nicolajsen, Á. 2000. Weight-length relationship of northern shrimp (*Pandalus borealis*) on Flemish Cap (Div. 3M) in June 2000. NAFO SC WP 00/52. 1p.
- 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 2. Stock in numbers (mill.) at length by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	2	0	0	1	0	0	0	0	0	0	0	3
9.5	1	0	0	0	0	0	0	0	0	0	0	1
10.0	1	0	0	0	0	0	0	0	0	0	0	1
10.5	1	0	0	1	1	0	0	0	0	0	0	3
11.0	0	1	0	0	0	0	0	0	0	0	0	1
11.5	0	0	0	1	0	0	0	0	0	0	0	1
12.0	0	0	0	1	0	1	0	0	0	0	0	1
12.5	0	0	0	0	1	1	0	0	0	0	0	2
13.0	2	0	0	2	0	0	0	0	0	0	0	5
13.5	1	1	0	6	0	1	0	0	0	0	0	8
14.0	4	3	0	5	1	1	0	0	0	0	0	15
14.5	1	2	0	10	1	1	0	0	0	0	0	15
15.0	5	6	0	9	2	2	0	0	0	0	0	24
15.5	3	3	4	16	6	1	0	0	0	0	0	33
16.0	6	12	4	39	10	3	0	0	0	0	0	76
16.5	11	17	6	55	25	8	0	0	0	0	0	124
17.0	18	38	20	93	47	13	0	1	1	0	0	232
17.5	29	48	22	73	65	24	0	0	0	0	0	262
18.0	50	51	52	84	63	33	0	2	1	0	0	335
18.5	36	46	31	70	51	29	0	2	0	0	0	266
19.0	39	42	33	78	51	31	0	5	1	0	0	280
19.5	24	20	23	81	43	36	1	4	1	0	0	234
20.0	34	25	29	88	59	42	1	8	2	0	0	288
20.5	30	27	22	64	50	38	2	6	3	1	0	243
21.0	25	37	16	59	48	42	2	7	4	1	1	241
21.5	21	20	18	43	38	29	1	4	4	1	1	180
22.0	16	24	13	30	32	21	1	6	5	1	1	150
22.5	12	21	9	32	34	18	1	4	3	2	1	137
23.0	14	21	11	28	31	24	2	6	2	1	2	142
23.5	10	14	8	25	28	18	1	5	9	2	2	122
24.0	6	9	6	21	34	23	3	3	7	3	3	118
24.5	3	8	3	18	20	12	3	8	5	4	5	90
25.0	3	8	2	12	29	10	5	6	6	6	9	97
25.5	1	5	1	8	14	5	5	5	5	8	9	65
26.0	2	4	1	7	8	5	5	3	7	7	11	59
26.5	0	1	0	3	3	4	3	2	3	5	7	32
27.0	0	3	0	2	5	2	2	3	3	7	7	34
27.5	0	0	0	0	5	1	1	2	1	5	3	18
28.0	0	0	0	0	4	1	1	1	1	2	2	13
28.5	0	0	0	0	1	0	1	1	1	1	2	6
29.0	0	0	0	0	0	1	0	0	0	1	1	4
29.5	0	0	0	0	0	0	0	0	0	1	0	2
30.0	0	0	0	0	0	0	0	0	0	0	0	2
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	414	519	336	1066	809	481	42	93	75	61	68	3964

Table 3. Stock in numbers (mill.) at length of males by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	2	0	0	1	0	0	0	0	0	0	0	3
9.5	1	0	0	0	0	0	0	0	0	0	0	1
10.0	1	0	0	0	0	0	0	0	0	0	0	1
10.5	1	0	0	1	1	0	0	0	0	0	0	3
11.0	0	1	0	0	0	0	0	0	0	0	0	1
11.5	0	0	0	1	0	0	0	0	0	0	0	1
12.0	0	0	0	1	0	1	0	0	0	0	0	1
12.5	0	0	0	0	1	1	0	0	0	0	0	2
13.0	2	0	0	2	0	0	0	0	0	0	0	5
13.5	1	1	0	6	0	1	0	0	0	0	0	8
14.0	4	3	0	5	1	1	0	0	0	0	0	15
14.5	1	2	0	10	1	1	0	0	0	0	0	15
15.0	5	6	0	9	2	2	0	0	0	0	0	24
15.5	3	3	4	16	6	1	0	0	0	0	0	33
16.0	6	11	4	39	9	3	0	0	0	0	0	73
16.5	11	16	6	55	25	8	0	0	0	0	0	123
17.0	18	37	20	93	47	13	0	1	1	0	0	231
17.5	29	48	22	72	64	23	0	0	0	0	0	260
18.0	50	51	52	82	63	32	0	2	1	0	0	333
18.5	36	45	31	67	51	29	0	2	0	0	0	262
19.0	38	39	32	69	51	30	0	5	1	0	0	263
19.5	23	19	22	68	42	33	1	4	1	0	0	213
20.0	32	19	26	63	50	38	1	7	2	0	0	238
20.5	27	22	16	48	40	34	2	6	3	1	0	199
21.0	19	24	8	35	37	28	2	7	3	1	1	163
21.5	13	11	4	17	19	16	1	3	3	1	1	89
22.0	5	5	2	5	13	6	1	2	3	1	1	44
22.5	0	3	0	3	4	3	1	1	1	1	1	17
23.0	0	0	0	1	1	1	0	0	1	0	1	7
23.5	0	0	0	1	3	0	0	0	1	0	1	6
24.0	0	0	0	0	0	0	0	0	0	0	0	2
24.5	0	0	0	0	0	0	0	0	0	0	0	1
25.0	0	0	0	0	0	0	0	0	0	0	0	0
25.5	0	0	0	0	0	0	0	0	0	0	0	0
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	331	369	251	768	530	304	9	40	21	6	7	2635

Table 4. Stock in numbers (mill.) at length of primiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

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	1	0	0	0	0	0	0	1
18.0	0	0	0	1	0	0	0	0	0	0	0	1
18.5	0	0	0	3	0	0	0	0	0	0	0	4
19.0	1	3	1	10	1	1	0	0	0	0	0	17
19.5	1	0	1	14	2	3	0	0	0	0	0	21
20.0	2	5	3	25	9	3	0	1	0	0	0	48
20.5	1	5	6	13	7	4	0	0	0	0	0	37
21.0	5	13	8	19	8	12	0	1	1	0	0	66
21.5	7	8	13	15	14	11	0	1	1	0	0	71
22.0	8	15	11	15	16	13	0	2	2	0	0	83
22.5	10	15	7	16	19	11	1	4	2	1	1	87
23.0	8	16	8	10	16	16	1	5	1	1	0	84
23.5	6	9	3	8	15	9	1	3	6	1	1	62
24.0	4	4	3	11	19	13	2	2	4	2	2	66
24.5	1	2	1	9	12	6	2	2	3	2	4	46
25.0	2	5	1	8	12	5	3	2	4	4	7	53
25.5	1	3	0	1	4	2	3	2	3	5	7	31
26.0	0	2	0	1	3	2	2	1	4	5	7	28
26.5	0	0	0	0	1	1	2	1	0	4	4	13
27.0	0	0	0	0	0	0	1	1	1	3	3	9
27.5	0	0	0	0	1	0	0	0	0	3	1	5
28.0	0	0	0	0	0	0	0	0	0	0	0	1
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	59	106	67	179	161	112	19	28	33	34	38	835

Table 5. Stock in numbers (mill.) at length of multiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

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	1	0	0	0	0	0	0	0	1
15.5	0	0	0	0	0	0	0	0	0	0	0	0
16.0	0	1	1	0	1	0	0	0	0	0	0	3
16.5	0	1	0	0	0	0	0	0	0	0	0	1
17.0	0	0	0	0	0	0	0	0	0	0	0	0
17.5	0	0	0	1	0	1	0	0	0	0	0	2
18.0	0	0	0	1	0	0	0	0	0	0	0	1
18.5	0	0	0	1	0	0	0	0	0	0	0	1
19.0	0	0	0	0	0	0	0	0	0	0	0	0
19.5	0	0	0	0	0	0	0	0	0	0	0	0
20.0	1	1	0	1	0	1	0	0	0	0	0	3
20.5	1	0	0	3	2	0	0	0	0	0	0	7
21.0	1	0	0	6	3	2	0	0	0	0	0	11
21.5	0	0	1	11	5	3	0	0	0	0	0	20
22.0	3	4	0	9	3	2	0	1	0	0	0	23
22.5	1	3	1	12	11	4	0	0	0	0	0	33
23.0	6	4	2	17	14	7	0	1	0	0	0	51
23.5	4	5	4	16	10	9	0	2	2	1	0	53
24.0	3	5	3	10	15	10	1	1	3	0	0	51
24.5	2	6	2	9	8	7	1	5	2	1	1	43
25.0	0	3	1	5	17	5	1	5	3	1	2	43
25.5	1	2	1	6	10	4	1	2	2	2	2	34
26.0	2	2	1	6	5	3	3	2	3	2	4	31
26.5	0	1	0	3	3	3	1	1	2	1	3	19
27.0	0	3	0	2	5	2	2	2	2	4	4	25
27.5	0	0	0	0	4	1	1	1	1	2	2	13
28.0	0	0	0	0	4	1	1	1	1	2	2	12
28.5	0	0	0	0	1	0	1	1	1	1	2	5
29.0	0	0	0	0	0	1	0	0	0	1	1	4
29.5	0	0	0	0	0	0	0	0	0	1	0	2
30.0	0	0	0	0	0	0	0	0	0	0	0	1
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	25	44	18	119	119	65	13	26	22	21	23	495



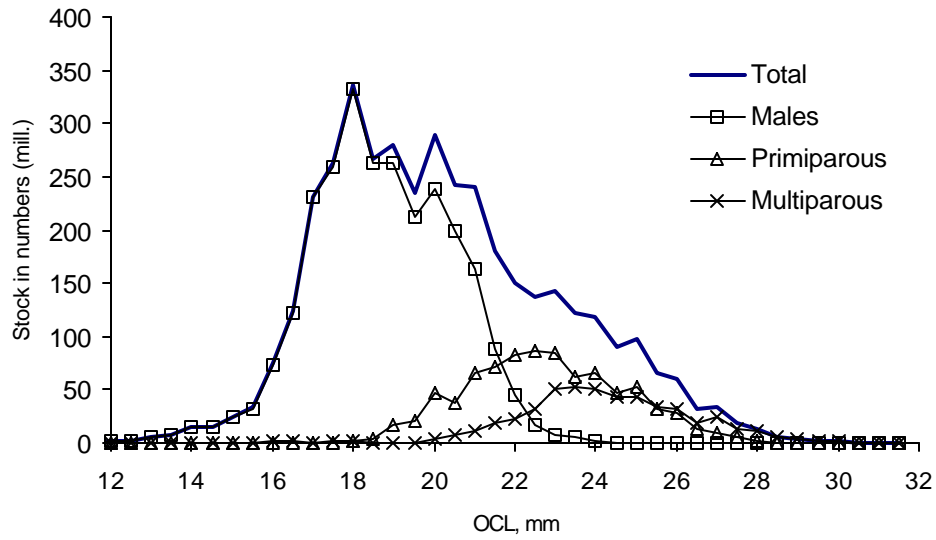


Figure 3. Length distribution in shrimp stock on Flemish Cap (NAFO Div. 3M) of total, males, primiparous and multiparous females from the June 2000 survey.

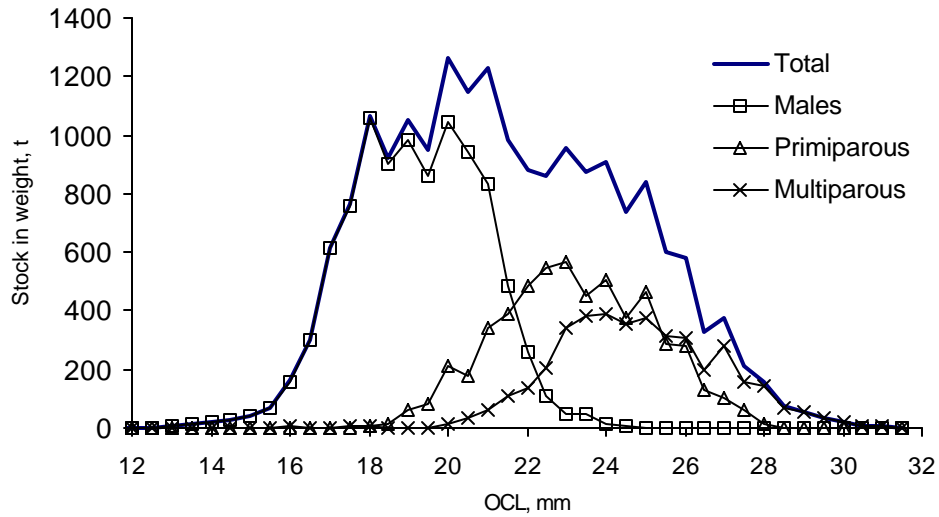


Figure 4. Stock weight (t) at length in shrimp stock on Flemish Cap (NAFO Div. 3M) of total, males, primiparous and multiparous females from the June 2000 survey.

Table 6. Stock weight (t) at length by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	1	0	0	0	0	0	0	0	0	0	0	1
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	1	0	0	1	1	0	0	0	0	0	0	2
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	1
12.0	0	0	0	0	0	0	0	0	0	0	0	1
12.5	0	0	0	0	1	1	0	0	0	0	0	2
13.0	2	0	0	3	0	0	0	0	0	0	0	6
13.5	2	1	0	7	0	1	0	0	0	0	0	11
14.0	7	4	0	7	1	2	0	0	0	0	0	22
14.5	2	3	0	16	1	1	0	0	0	0	0	24
15.0	10	12	0	17	3	3	0	0	0	0	0	44
15.5	6	7	8	31	13	2	0	0	0	0	0	66
16.0	13	27	10	87	23	7	0	0	1	0	0	167
16.5	28	42	16	132	62	19	0	1	0	0	0	300
17.0	48	100	54	248	126	35	0	3	2	0	0	617
17.5	85	140	65	214	188	70	0	1	0	0	0	764
18.0	159	162	164	266	199	104	1	7	2	0	0	1064
18.5	125	157	108	241	178	100	1	7	1	1	0	919
19.0	145	159	124	294	192	115	0	17	3	0	0	1049
19.5	99	79	92	330	176	147	3	17	4	0	1	949
20.0	151	110	127	387	258	184	3	33	8	2	1	1265
20.5	140	130	103	304	234	180	10	31	12	5	1	1149
21.0	127	189	81	300	242	211	9	37	19	6	7	1229
21.5	113	110	100	236	206	161	3	21	24	6	4	986
22.0	96	142	78	174	187	121	7	33	28	8	5	879
22.5	74	134	56	199	214	111	8	26	18	10	9	860
23.0	93	138	75	190	208	163	13	41	15	10	12	959
23.5	72	99	55	181	203	127	9	34	63	17	13	874
24.0	49	72	45	159	264	176	21	24	57	20	21	909
24.5	29	62	28	151	165	102	25	62	40	30	42	736
25.0	24	70	19	105	251	90	41	55	55	51	81	842
25.5	13	44	7	72	128	50	42	42	45	72	87	601
26.0	20	41	6	71	78	48	47	30	66	72	105	583
26.5	0	13	2	28	33	38	34	18	28	56	76	328
27.0	1	33	0	22	54	27	25	29	34	78	75	379
27.5	1	4	0	2	55	17	13	19	10	58	35	213
28.0	1	5	0	3	46	12	11	15	15	24	25	155
28.5	0	0	0	5	8	3	8	8	11	8	22	72
29.0	1	0	0	0	5	7	7	1	6	16	12	54
29.5	1	0	0	0	2	0	3	0	6	17	5	34
30.0	0	0	0	0	4	3	6	1	0	2	7	24
30.5	0	0	0	1	0	0	2	0	0	2	0	5
31.0	0	0	0	0	0	0	0	0	0	1	2	3
31.5	0	0	0	0	0	0	0	0	0	1	0	1
Total	1737	2291	1425	4485	4008	2440	354	615	575	573	646	19149

Table 7. Stock weight (t) at length of males by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

STRATA OCL, mm	13	14	15	16	17	18	19	20	21	22	23	Total
9.0	1	0	0	0	0	0	0	0	0	0	0	1
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	1	0	0	1	1	0	0	0	0	0	0	2
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	1
12.0	0	0	0	0	0	0	0	0	0	0	0	1
12.5	0	0	0	0	1	1	0	0	0	0	0	2
13.0	2	0	0	3	0	0	0	0	0	0	0	6
13.5	2	1	0	7	0	1	0	0	0	0	0	11
14.0	7	4	0	7	1	2	0	0	0	0	0	22
14.5	2	3	0	16	1	1	0	0	0	0	0	24
15.0	10	12	0	16	3	3	0	0	0	0	0	43
15.5	6	6	8	31	13	2	0	0	0	0	0	66
16.0	13	24	8	87	21	7	0	0	1	0	0	160
16.5	28	39	16	132	62	19	0	1	0	0	0	298
17.0	48	99	54	248	126	35	0	3	2	0	0	616
17.5	85	140	65	210	186	68	0	1	0	0	0	756
18.0	159	162	164	259	199	102	1	7	2	0	0	1055
18.5	125	156	108	230	176	99	1	7	1	1	0	905
19.0	141	147	119	258	189	112	0	17	3	0	0	986
19.5	94	78	89	275	170	135	3	15	4	0	1	864
20.0	141	83	116	275	218	166	3	30	8	2	1	1043
20.5	129	105	75	226	189	160	10	29	12	5	1	941
21.0	95	123	40	177	186	142	8	33	15	6	6	832
21.5	72	63	24	94	102	87	3	15	18	5	4	487
22.0	31	31	13	32	76	33	4	14	17	5	4	260
22.5	3	19	2	21	25	16	4	3	5	5	5	108
23.0	0	3	2	8	9	7	3	1	7	1	9	50
23.5	0	0	0	9	22	0	1	0	5	2	5	45
24.0	0	0	0	0	4	0	1	1	3	2	2	12
24.5	0	0	0	0	0	0	2	0	0	0	4	5
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	1	2
26.0	0	0	0	0	0	0	0	0	0	0	1	1
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	1194	1299	902	2624	1978	1201	46	178	104	34	45	9606

Table 8. Stock weight (t) at length of primiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

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	1	0	0	0	0	0	0	0	0	0	1
16.5	0	0	0	0	0	0	0	0	0	0	0	0
17.0	0	1	0	0	0	0	0	0	0	0	0	1
17.5	0	0	0	0	3	0	0	0	0	0	0	3
18.0	0	0	0	3	0	1	0	0	0	0	0	4
18.5	0	1	1	9	1	0	0	0	0	0	0	13
19.0	4	12	5	36	3	2	0	0	0	0	0	62
19.5	4	1	3	55	6	11	0	2	0	0	0	83
20.0	7	23	11	110	40	15	0	3	0	0	0	209
20.5	7	24	27	64	35	18	0	2	0	0	0	175
21.0	25	64	42	95	43	62	1	4	4	0	0	338
21.5	41	45	71	84	78	58	0	6	6	1	0	391
22.0	48	87	63	88	96	75	3	12	11	3	1	485
22.5	66	94	47	100	117	71	4	23	14	6	3	545
23.0	55	107	56	68	106	111	10	33	8	9	3	566
23.5	42	63	25	59	108	64	8	19	45	8	7	449
24.0	28	32	20	85	147	99	14	14	31	17	15	503
24.5	9	16	12	78	98	46	19	19	27	19	34	376
25.0	21	42	6	66	106	46	29	14	32	38	65	464
25.5	6	24	0	13	36	16	29	20	31	49	63	287
26.0	5	23	0	13	33	19	22	10	36	49	67	278
26.5	0	0	0	0	6	10	19	10	4	41	42	131
27.0	0	3	0	0	3	0	7	7	8	37	36	102
27.5	0	0	0	0	11	0	3	2	0	33	9	58
28.0	0	0	0	0	2	3	0	1	0	3	3	13
28.5	0	0	0	0	0	0	1	0	0	1	1	3
29.0	0	0	0	0	0	0	0	0	0	0	1	1
29.5	0	0	0	0	0	0	0	0	0	0	0	0
30.0	0	0	0	0	0	0	1	0	0	0	0	1
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	368	663	391	1024	1077	728	169	202	257	315	350	5542

Table 9. Stock weight (t) at length of multiparous by strata and total, Flemish Cap (NAFO Div. 3M) in June 2000.

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	1	0	0	0	0	0	0	0	1
15.5	0	1	0	0	0	0	0	0	0	0	0	1
16.0	0	2	2	0	2	0	0	0	0	0	0	6
16.5	0	3	0	0	0	0	0	0	0	0	0	3
17.0	0	0	0	0	0	0	0	0	0	0	0	0
17.5	0	0	0	3	0	2	0	0	0	0	0	5
18.0	0	0	0	4	0	1	0	0	0	0	0	4
18.5	0	0	0	2	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	0	0	0	0	1	0	0	0	0	0	1
20.0	3	5	0	2	0	3	0	0	0	0	0	13
20.5	4	1	1	15	10	2	0	0	0	0	0	34
21.0	7	1	0	29	14	8	0	0	0	0	0	58
21.5	0	2	5	58	27	16	0	0	0	0	0	107
22.0	17	25	2	54	15	13	0	7	0	0	0	133
22.5	5	22	7	78	72	23	0	0	0	0	0	207
23.0	38	29	16	114	93	46	0	8	0	0	0	343
23.5	30	35	30	113	73	63	1	14	13	7	1	380
24.0	21	41	25	74	113	77	6	10	23	0	3	392
24.5	19	46	17	73	67	56	5	43	12	11	5	355
25.0	3	28	13	39	145	44	12	41	23	13	16	376
25.5	8	19	7	59	92	34	13	22	14	23	23	313
26.0	15	18	6	58	45	29	25	19	30	24	36	304
26.5	0	13	2	28	28	28	15	8	24	15	34	197
27.0	1	29	0	22	50	27	19	23	26	41	39	277
27.5	1	4	0	2	44	17	10	16	10	25	26	155
28.0	1	5	0	3	44	9	11	14	15	20	21	142
28.5	0	0	0	5	8	3	7	8	11	7	21	69
29.0	1	0	0	0	5	7	7	1	6	16	11	54
29.5	1	0	0	0	2	0	3	0	6	17	5	34
30.0	0	0	0	0	4	3	4	1	0	2	7	23
30.5	0	0	0	1	0	0	2	0	0	2	0	5
31.0	0	0	0	0	0	0	0	0	0	1	2	3
31.5	0	0	0	0	0	0	0	0	0	1	0	1
Total	175	329	132	837	953	511	140	235	214	224	250	3999

Table 10. Average OCL interpreted from size distribution.

Age	Males OCL, mm	Primiparous OCL, mm	Multiparous OCL, mm	Mean OCL, mm
0				
1	9.75			9.75
2	14.00			14.00
3	18.00			18.00
4	20.00	20.00		20.00
5		22.50	23.50	23.00
6		25.00	25.50	25.25
7		27.50	27.00	27.25
8			29.00	29.00
9			30.00	30.00

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

Sex and maturity group	Male		Primiparous		Multiparous		
	Age	Prop.	St.Dev	Prop.	St.Dev	Prop.	St.Dev
1		0.003	0.0011				
2		0.038	0.0049			0.017	0.006
3		0.531	0.0234				
4		0.427	0.0221	0.163	0.2146	0.060	0.065
5				0.502	0.4133	0.435	0.392
6				0.334	0.2293	0.487	0.358
		Mean	St.Dev	Mean	St.Dev	Mean	St.Dev
1		10.1	0.158				
2		14.7	0.115			16.8	0.4161
3		17.7	0.046				
4		20.2	0.069	20.2	0.8919	21.1	0.5739
5				22.3	0.3654	23.4	0.3147
6				24.7	0.8682	25.6	1.3175
		Sigma	St.Dev	Sigma	St.Dev	Sigma	St.Dev
1		0.45	0.1195				
2		0.66	0.0826			1.10	0.3531
3		0.80	0.0389				
4		0.91	0.0423	0.89	0.2786	0.63	0.3014
5				1.06	0.5762	1.05	0.4379
6				1.24	0.3049	1.68	0.4683

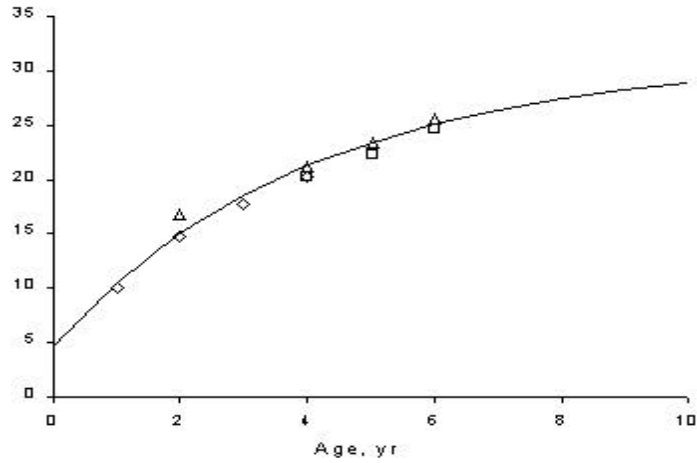


Figure 5. von Bertalanffy growth curve for shrimp on Flemish Cap (NAFO Div. 3M). Data points from calculation from Tab. 11.

Table 12. Stock in numbers (mill.) by age/maturity groups.

Age	Male	Primiparous	Multiparous	Total
1	9			9
2	100		9	108
3	1400			1400
4	1126	137	30	1293
5		419	215	635
6		279	241	520
Total	2635	835	495	3965

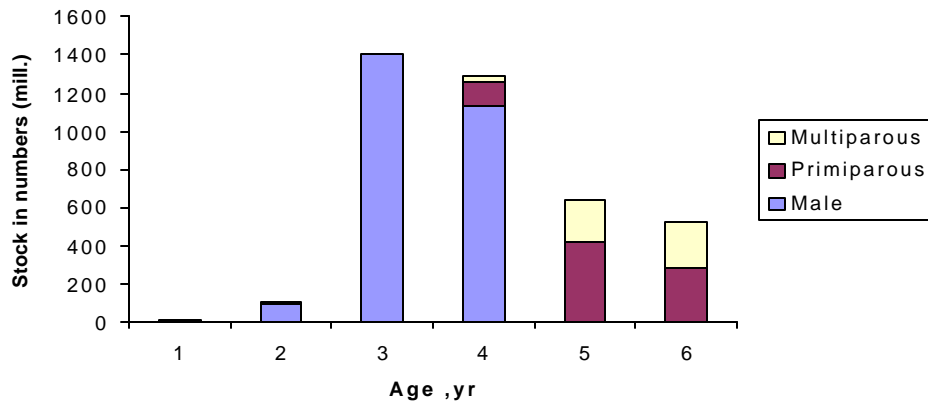


Figure 6. Stock in numbers at age/maturity. Data from Tab. 14.

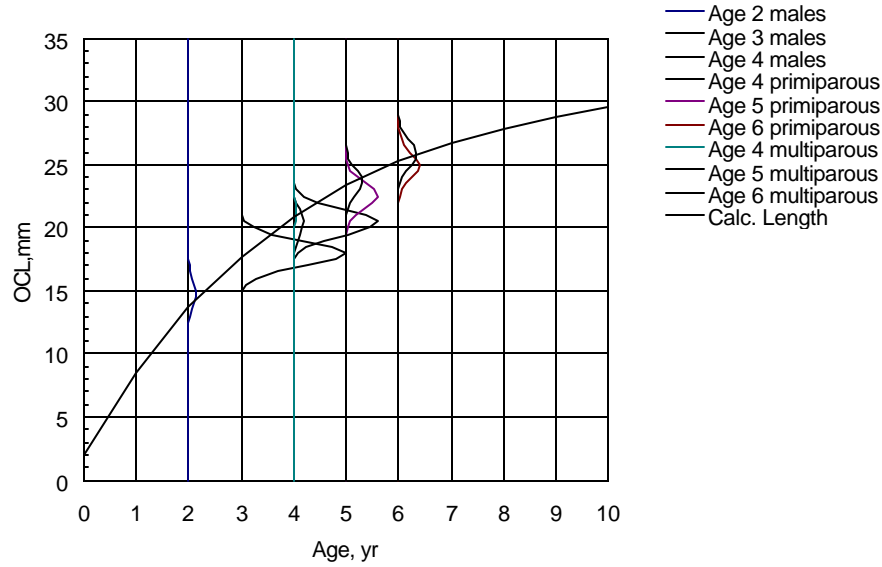


Figure 7. Growth curve and relative size distribution of age/maturity groups of shrimp on Flemish Cap (NAFO Div. 3M) from survey in June 2000.

Table 13. Stock in numbers (mill.) in Flemish Cap shrimp stock (NAFO DIV. 3M) in the period 1997-2000.

Age	1997	1998	1999	2000	Average
1				9	9
2	901	226	214	108	362
3	1653	1366	1288	1400	1427
4	470	1006	835	1293	901
5	466	715	880	635	674
6	94	614	200	520	357
7+		7	3		5
Total	3584	3934	3420	3965	3735



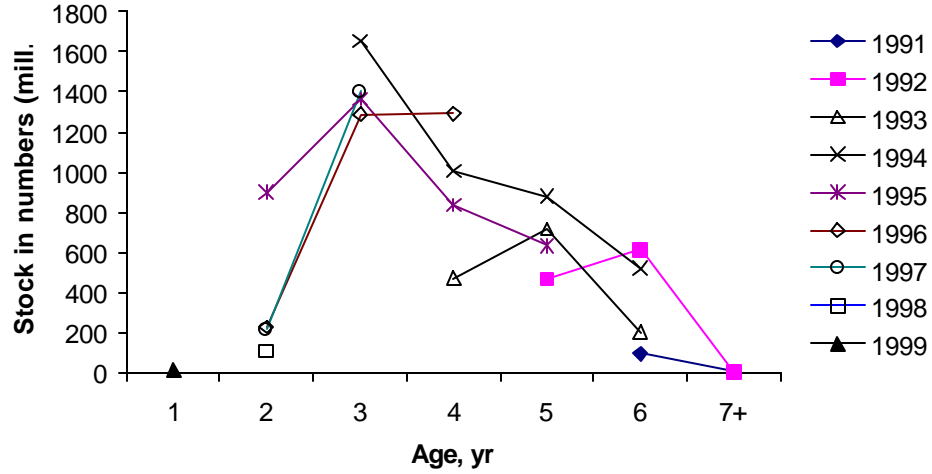


Figure 8. Stock in numbers by year class in shrimp stock on Flemish Cap (NAFO Div. 3M) in the period 1997-2000.

Table 14. Summary of survey stock assessment parameters for shrimp on Flemish Cap (NAFO 3M) in the period 1997-2000.

Year	Biomass t	Density g.m- 2	Numbers (10-6)	Average weight, g	Abundance numbers.m-2	Surveyed area, km2
1997	16978	0.52	3585	4.74	0.111	32413
1998	23495	0.77	3934	5.97	0.129	30612
1999	16477	0.57	3419	4.82	0.117	29154
2000	20280	0.70	3964	5.14	0.136	29154
Average	19333	0.64	3726	5.17	0.123	30333