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The Icelandic Shrimp Fishery (*Pandalus borealis* Kr.) at Flemish Cap in 1993-1998

by

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Abstract

Some 7 Icelandic vessels have been fishing for shrimp in the waters at the Flemish Cap in 1998 compared to 21 in 1997. In this paper there are logbook information on the Icelandic fishery for the years 1993 through 1998. The unstandardized catch rate has recently increased considerably or from 172 kg/hour in January-July 1997 to 279 kg in 1998 after a decline between 1995 and 1997

The observer samples have been pooled by months and depth. Age asessment has been carried out in 1997 and 1998 for the Icelandic data. An index of catch in numbers (no./hr) of males and females is shown to increase substantially in 1998 as compared to 1996 and 1997.

Introduction

The Spanish investigators (EU) have been measuring the biomass index of northern shrimp at the Flemish Cap since 1988 in their annual bottom trawl survey at Flemish cap. In 1993 the fishery was initiated by Canada, followed closely by Faroe Islands and Iceland.
The fishery was some 24-33 thousand tons in the years 1993-1995 to increase in 1996 to 48 thousand tons.

In this paper all the information from the Icelandic investigators is gathered. From the logbooks comes effort, catch and CPUE is calculated. From the biological samples taken by Icelandic observers comes various information on lenght and sex distribution of shrimp. From these the age asessments are carried out.

Materials and Methods

Icelandic observers sampled shrimp onboard all Icelandic vessels in the years 1996 and 1997 at the Flemish Cap. The shrimp was measured fresh to the nearest 0.5 mm using Vernier calipers. Observers then sorted each length class into males and females using the method of Rasmussen (1953) and the females further into primiparous and multiparous using the sternal spine criterion of McCrary (1971).

Age assessment was carried out using modal analysis (Macdonald and Pitcher, 1979) on the length distributions of males, primiparous and multiparous females respectively.

In order to get the number per hour of each age group, length/weight relationships were applied as calculated by Skúladóttir (1997) and Table 5. The length /weight relationsship of males and primaparous females was always the same. But for the multiparous females there were used the following relationsships: namely Sept-March for the winter months, April- June for that period and

July for the multiparous females of that month and finally the August relationsship for the multiparous females of August. Using length/weight relationships, mean length at age was turned into weight at age in each month. The sum of weight times proportion in each age and sex class was divided into the catch per month to get the total number of shrimp fished per month. Then the numbers of all the months January through July were summed and divided by the total number of hours fished from Table 1.

The logbook data include catch and effort. Not all skippers send in the logbooks, but information on landings can be obtained from the Fisheries Directorate in Iceland. Thus effort was raised by dividing the nominal catch of each month with the calculated CPUE from the logbooks in the years 1993-1996. In 1997 and the effort is first raised to the nominal effort by every half year.The overall CPUE of the January-July was then obtained by summing nominal catch of all months and corresponding effort. Nominal catch for the whole period was then divided by "nominal effort" to get the CPUE for the period January-July. When twin trawls were used the effort was always doubled for those but the catch was kept the same.

Catch and Effort data

In 1998 the fishery was carried out since February. The catch so far is 4285 tons (Table 1) as compared to some 4 thousand tons at the same time in 1997 (Skúladóttir, 1997). Iceland set a total allowable catch (TAC) for Icelandic vessels at 6 800 tons for the year 1998, the same as for 1997.

The distribution of effort is shown by months and years in Figure 1. Note the difference between the years 1997 and 1998 for the lack of tows in the south east area. Looking at tows by months the months of April and June of 1998 are different in that there are tows at shallow depths in the north east area. Figure 2 shows the proportion of catch taken by Iceland every year by the 4 sub areas. In 1993 the shrimp appears to have been caught in the same proportions in all areas except the south east (SE). In the years 1994 through 1997 the north west (NW) area seems to be the most important area. In 1998 the north east area (NE) becomes suddenly very important but south west area (SW) is hardly fished at all.

The mean CPUE for the year 1997 was the lowest ever for Iceland or 172 kg per trawling hour for the period January through July (Table 1). In 1998 the mean CPUE for the same period was much higher or 279 kg. The average size of gear used was 2932 in 1998, a little bigger than that used in 1995-1997 but similar to the sizes in the years 1993 and 1994. At the same time the use of twin trawls has increased in 1998 from about 60% in 1995-1997 to about 80% in 1998 (Table 2). As it is possible that doubling the effort for calculating the CPUE causes an underestimate of CPUE the rise of CPUE in 1998 was therefore perhabs an underestimate of the true CPUE as compared to the previous years.

Length frequencies and age groups

The proportions of sex groups by subareas is shown in Table 3. As usual most multiparous females occur in the south west in the period January to August. In the north east area there were few multiparous females in 1998, even fewer than in 1997 in the first part of the year. In the months September -December 1997, the situation was reversed as multiparous females became most numerous in the north east area. But then again the primiparous females had been most numerous in the first period of 1997 in the north east.

The length frequency distributions of Icelandic samples from 1997 and 1998 are shown in Figures 3-14. The highest peak in 1997 represents the 1993 year class of males (solid line). Primiparous is the dotted line and the broken line represents the multiparous females. In 1997 the the two yearolds appear first in July to increase gradually till November in 1997 (Fig. 3). In 1998 this 1994 year class has become the highest peak no three year old males. The primiparous peak appears to be bimodal and broad in most months of 1998 (Fig. 4). The differing height of peaks can be studied further in relation to depth and month. On the whole the 2 group seems to have a tendency to occur at less depth than other groups. Only once is there a hint of the one year olds at a size 9 mm

seen at depth below 300 fathoms in July 1997 (Fig. 8). The older animals have generally a tendecy to be more numerous at greater depths although there are sometimes exceptions from this, see e.g. the multiparous females in april 1998 which are most numerous at the depth 101-140 fm (Fig. 12).

The length frequency distributions were run through the modal analysis (Macdonald and Pitcher, 1979) in the three categories, namely, males, primiparous and multiparous females. The results, overall proportions of each sex group and mean weight at age from the age asessments are shown in Table 4. The mean weights at age as shown were calculated by using different length/weight relationships according to whether within the ovigerous period or not (Table 5). The male length/weight relationsship was used in all months for males and primiparous females. As multiparous females are sometimes ovigerous and sometimes not the length/weight relationships for these were found to fall into three categories. Firstly there is the onset of spawning, namely July where very few have spawned and secondly August where most have spawned. Then thirdly there is the ovigerous period where all the multiparous females are egg-bearing, namely September through March. The fourth is when all multiparous females have hatched and before spawning starts again, namely the period April through June.

Number per trawling hour of each age group should be proportional to the number in stock if the coverage of samples is sufficient and then again it also depends on whether CPUE in this case unstandardized CPUE for the period January-July is a reasonable indicator of stock size. The coverage of Icelandic samples in 1994 was poor and covered only the months June, July and August where some 2 thousand shrimp were measured (Skúladóttir, 1994). In 1996 and 1997 however there were over a million shrimp measured with good coverage both spatially and temporally (Skúladóttir, 1997) and in 1998 over 100 thousand were measured (Figs. 3 and 4). In 1998 the number of 3 year olds was at a high level and similar to the number of 3 year olds in 1996. The early sex change seen in 1995-1997 appears to take place a little bit later in 1998 as some males are changing sex at age 5 again as was the rule in 1993 and 1994. The no./hr. of 4 year olds seemed higher in 1998 than in 1997 and indeed 5 year olds were also quite numerous. The total number of females has doubled since 1996 and 1997, and the number of males per hour appears to have increased a great deal also since 1996 and 1997 (Table 6). But this also ties up with the great increase in CPUE.

By-catch

The by-catch was found to be mainly redfish or 0.6% of the shrimp catch in 1998 as compared to 1.4% in 1997 and 1.6% in 1996. Other species were wolffish 0.1% in 1998 as compared to 0.2% in 1997 and greenland halibut was 0.04% in 1998 as compared to 0.2% in 1997. No cod was detected and no american plaice (Skúladóttir, 1998).

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Table 1. Catch effort and CPUE of Icelandic vessels at the Flaemish Cap.

	January - July				August - December			
Year	Month	CPUE	Effort	Catch	Month	CPUE	Effort	Catch
1993					Aug	311	1363	424
					Sep	342	1064	364
					Oct	215	372	80
	June	374	1848	691	Nov	297	606	180
	Jul	324	1160	376	Dec	221	579	128
	Total	355	3008	1067	Total	295	3985	1176
1994	Jan	216	194	42	Aug	203	2025	411
	Feb	325	880	286	Sep	159	748	119
	Mar	281	719	202	Oct	125	632	79
	June	252	1698	428	Nov	113	230	26
	Jul	204	3461	706	Dec	75	13	1
	Total	239	6953	1664	Total	174	3648.5	636
1995	Jan							
	Feb	278.7	94	26.2	Aug	174.6	9283	1620.5
	Mar	246.8	1003	247.5	Sep	130.9	5605	733.7
	Apr	146.0	2155	314.7	Oct	162.4	3997	649.0
	May	257.8	3068	790.8	Nov	143.4	2022	289.9
	June	244.1	3993	974.6	Dec	175.9	1372	241.3
	Jul	245.8	7053	1733.7				
	Total	235.4	17366	4087.5	Total	158.6	22279	3534.4
1996	Jan	203.3	2016	409.9				
	Feb	243.6	1548	377.1	Aug	163.1	12700	2071.0
	Mar	255.8	4124	1055.0	Sep	167.6	9967	1670.0
	Apr	207.5	10251	2127.0	Oct	127.4	14674	1870.0
	May	185.7	12970	2409.0	Nov	134.1	5465	733.0
	June	199.8	19931	3982.0	Dec	158.4	3762	596.0
	Jul	177.0	21342	3777.0				
	Total	195.9	72182	14137	Total	149.0	46568	6940.0
1997	Jan	175.8	413	72.6				
	Feb	214.7	621	133.3	Aug	202.9	4332	879.0
	Apr	129.0	538	69.4	Sep	197.1	3569	703.6
	May	135.7	3892	528.2	Oct	216.3	2585	559.1
	June	162.1	5572	903.2	Nov	186.0	1075	200.0
	Jul	204.5	5935	1213.7	Dec	168.3	451	75.9
	Subtotal	172.1	16971	2920.4	Subtotal	201.3	12012	2417.6
	Total	172.1	20068	3453.3	Total	201.3	15053	3029.6
1998	Feb	206.7	312	64.5				
	March	197.3	851	167.9	Aug			612.8
	Apr	219.6	920	202.0				
	May	254.2	2900	737.2				
	June	332.2	3154	1047.8				
	Jul	328.5	983	322.9				
	Subtotal	278.8	9120	2542.3	Subtotal			
	Total	278.8	12411	3459.6	Total			612.8

Table 2. Landings and some averages calculated from the Icelandic logbooks.

Year	Nominal Catch Tons	Twin trawls % of catch	Trawl size No. of meshes	Unstandardized CPUE
1993	2 243	46.0	3 087	355
1994	2 300	56.2	2 975	239
1995	7 622	57.6	2 688	235
1996	21 077	57.8	2 805	196
1997	6 483	54.6	2 782	172
1998	4 072	78.1	2 932	279

Table 3. Percentage of sex groups by strata and months

NW stratum 1997			
Month	Males	Primip. females	Multip. females
Jan	53.98%	22.48%	23.53%
Feb	56.89%	18.68%	24.42%
Mars			
April	70.14%	19.57%	10.28%
May	56.10%	29.84%	14.05%
June	47.14%	35.35%	17.49%
July	72.27%	16.34%	11.38%
Aug	78.09%	2.05%	19.84%
Mean	62.09%	20.62%	17.28%

NE stratum 1997			
Month	Males	Primip. females	Multip. females
Jan	64.92%	12.04%	23.03%
Feb	51.98%	17.48%	30.53%
Mars			
April	66.02%	23.16%	10.80%
May	58.75%	31.16%	10.07%
June	48.17%	39.60%	12.22%
July	71.27%	22.02%	6.70%
Aug	80.22%	5.16%	14.60%
Mean	63.05%	21.52%	15.42%

SW stratum 1997			
Month	Males	Primip. females	Multip. females
Jan	43.21%	14.60%	42.17%
Feb	57.88%	21.64%	20.46%
Mars			
April	67.67%	21.21%	11.11%
May	68.47%	20.00%	11.52%
June	47.20%	30.35%	22.43%
July	72.97%	11.92%	15.10%
August	78.27%	1.16%	20.55%
Mean	62.24%	17.27%	20.48%

SE stratum 1997			
Month	Males	Primip. females	Multip. females
Jan			
Feb			
Mars			
April			
May			
June			
July	64.48%	27.38%	8.12%
August			
Mean	64.48%	27.38%	8.12%

Table 3 continued.

NW stratum 1997			
Month	Males	Primip. females	Multip. females
Sep	77.72%	0.82%	21.44%
Oct	70.93%	2.45%	26.60%
Nov	79.08%	7.29%	13.61%
Dec	51.77%	16.84%	31.38%
Mean	69.88%	6.85%	23.26%

NE stratum 1997			
Month	Males	Primip. females	Multip. females
Sep	75.24%	0.10%	24.64%
Oct	74.55%	26.10%	22.82%
Nov	61.66%	8.52%	29.80%
Dec	41.28%	15.36%	43.34%
Mean	63.18%	12.52%	30.15%

SW stratum 1997			
Month	Males	Primip. females	Multip. females
Sep	76.00%	0.08%	23.90%
Oct	67.19%	7.85%	24.94%
Nov			
Dec			
Mean	71.60%	3.97%	24.42%

SE stratum 1997			
Month	Males	Primip. females	Multip. females
Sep	81.92%	0.13%	17.94%
Oct	82.00%	0.13%	17.85%
Nov			
Dec			
Mean	81.96%	0.13%	17.90%

NW stratum 1998			
Month	Males	Primip. females	Multip. females
Jan			
Feb	58.16%	20.27%	21.55%
Mars	58.74%	20.24%	21.00%
April	53.88%	17.50%	28.61%
May	58.87%	20.12%	20.99%
June	47.36%	34.97%	17.67%
July	67.27%	22.92%	9.79%
Aug	86.25%	2.02%	11.72%
Mean	61.50%	19.72%	18.76%

NE stratum 1998			
Month	Males	Primip. females	Multip. females
Jan			
Feb	67.31%	19.27%	13.41%
March	65.76%	21.56%	12.66%
April	77.55%	17.97%	4.47%
May	60.77%	24.29%	14.92%
June	48.34%	39.01%	12.65%
July	60.70%	29.89%	9.40%
Aug			
Mean	63.41%	25.33%	11.25%

SW stratum 1998			
Month	Males	Primip. females	Multip. females
Jan			
Feb			
Mars	49.80%	20.18%	30.01%
April	37.42%	24.17%	38.40%
May	64.44%	24.47%	11.07%
June	61.19%	22.39%	16.41%
July	53.89%	32.59%	13.51%
August	79.71%	3.00%	17.28%
Mean	57.74%	21.13%	21.11%

SE stratum 1998			
Month	Males	Primip. females	Multip. females
Jan			
Feb			
Mars			
April			
May			
June			
July	49.93%	38.98%	11.08%
August			
Mean	49.93%	38.98%	11.08%

Table 4. Some results of the modal analysis by sex and presumed age groups in 1997 and 1998. Weight is calculated from length-weight relationsships shown in table 5.

January 1997

Age	3	4	4	4	5	6	7
Sex	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	18.65	21.90	23.35	22.87	25.73	27.89	29.40
Weight (g)	3.81	6.20	7.53	8.02	11.33	14.35	16.74
Per cent	4.95	40.72	15.96	1.10	29.42	4.51	3.34

February 1997

Age	3	4	4	4	5	6
Sex	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	18.43	22.11	23.72	21.94	25.70	28.60
Weight (g)	3.67	6.38	7.90	7.10	11.29	15.44
Per cent	21.42	34.49	18.95	1.12	19.65	4.37

April 1997

Age	3	4	4	4	5	6
Sex	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	18.55	21.89	23.47	23.99	25.85	28.18
Weight (g)	3.75	6.19	7.65	8.49	10.44	13.27
Per cent	50.66	18.11	20.73	3.15	5.45	1.66

May 1997

Age	2	3	4	4	4	5	6	7
Sex	Male	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	14.92	18.83	22.11	24.29	23.61	25.82	28.20	29.25
Weight (g)	1.93	3.92	6.38	8.49	8.12	10.41	13.30	14.72
Per cent	0.92	22.44	36.31	27.49	1.23	9.75	0.88	0.90

June 1997

Age	2	3	4	4	4	5	6
Sex	Male	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	15.72	19.36	22.54	24.57	23.83	25.80	28.81
Weight (g)	2.27	4.26	6.77	8.79	8.33	10.39	14.11
Per cent	0.08	16.30	31.11	35.64	1.29	13.69	1.84

July 1997

Age	2	3	4	4	4	5	6
Sex	Male	Male	Male	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	15.84	19.25	22.45	24.37	23.71	25.84	28.92
Weight (g)	2.32	4.19	6.69	8.58	8.20	10.54	14.64
Per cent	5.79	51.55	13.55	18.80	2.83	6.31	0.91

August 1997

Age	2	3	4	3	4	3	4	5
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	15.51	19.09	22.59	19.34	24.39	19.05	24.46	27.14
Weight (g)	2.18	4.09	6.82	4.25	8.60	4.39	9.55	13.20
Per cent	14.19	54.17	10.18	0.09	2.38	0.46	16.50	2.01

September 1997

Age	1	2	3	4	3	4	3	4	5
Sex	Male	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	10.44	16.03	19.34	22.64	19.84	24.73	19.94	24.58	27.54
Weight (g)	0.65	2.40	4.25	6.86	4.59	8.97	5.37	9.97	13.83
Per cent	0.04	11.47	45.33	20.28	0.09	0.30	0.55	20.32	1.65

October 1997

Age	1	2	3	4	3	4	3	4	5	6
Sex	Male	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	11.68	16.26	19.47	23.04	20.04	23.51	20.01	24.63	26.17	29.20
Weight (g)	0.92	2.51	4.34	7.23	4.74	7.69	5.43	9.97	11.91	16.41
Per cent	0.07	21.38	35.58	16.26	0.20	2.37	0.58	18.34	4.79	0.42

November 1997

Age	1	2	3	4	3	4	3	4	5	6
Sex	Male	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	11.92	16.49	19.90	23.47	21.34	23.99	19.74	24.91	27.63	29.68
Weight (g)	0.92	2.51	4.34	7.23	4.74	7.69	5.43	9.97	11.91	16.41
Per cent	0.42	18.55	40.88	5.28	3.76	4.52	0.43	25.20	0.70	0.23

Table 4 continued

December 1997

Age	2	3	4	3	4	4	5	6
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	17.47	20.54	23.69	21.81	24.07	24.92	27.62	29.72
Weight (g)	3.12	5.10	7.87	6.12	8.26	10.32	13.94	17.28
Per cent	4.56	41.54	3.04	4.03	12.44	24.94	8.94	0.51

February 1998

Age	2	3	4	4	5	4	5	6 and 7
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	14.11	17.34	20.27	22.05	24.68	19.50	24.99	29.12
Weight (g)	1.63	3.03	4.90	6.33	8.91	5.03	10.40	16.28
Per cent	0.88	34.13	26.58	16.82	3.08	0.60	16.70	1.22

March 1998

Age	2	3	4	4	5	4	5	6 and 7
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	13.55	17.88	20.89	22.23	25.33	18.93	25.12	28.20
Weight (g)	1.44	3.35	5.37	6.49	9.65	4.61	10.56	14.82
Per cent	1.72	39.14	18.28	18.24	2.19	0.49	16.96	2.99

April 1998

Age	2	3	4	4	5	4	5	6
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	13.20	18.29	21.03	21.88	25.05	19.34	24.53	26.87
Weight (g)	1.33	3.59	5.48	6.18	9.33	4.66	9.03	11.63
Per cent	6.00	49.25	3.95	17.73	0.33	0.75	17.29	4.69

May 1998

Age	2	3	4	4	5	4	5	6	7
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	14.09	18.57	21.03	23.25	25.87	18.61	23.92	26.02	29.39
Weight (g)	1.63	3.76	5.48	7.44	10.28	4.19	8.42	10.64	14.92
Per cent	1.97	32.53	24.82	17.92	2.81	0.34	5.23	14.00	0.39

June 1998

Age	2	3	4	4	5	4	5	6
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	14.37	18.88	21.14	23.30	26.12	19.69	24.45	26.42
Weight (g)	1.73	3.95	5.57	7.48	10.59	4.90	8.95	11.10
Per cent	5.55	32.87	22.05	22.71	1.89	0.39	8.76	5.78

July 1998

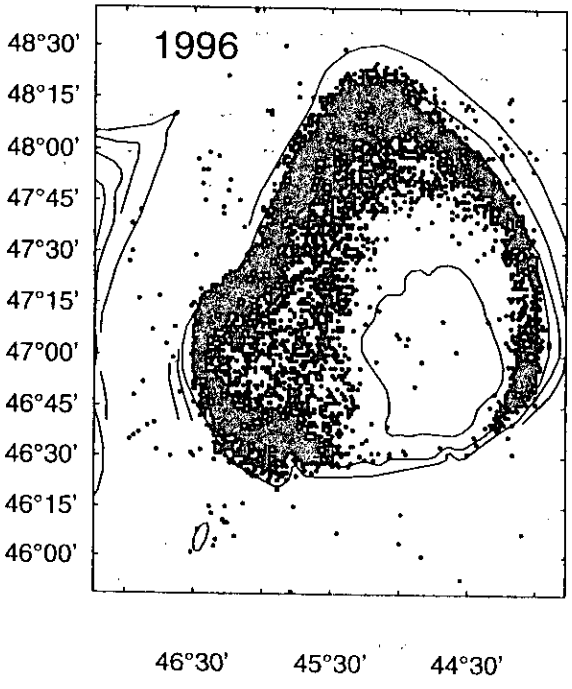
Age	2	3	4	4	5	3	4	5
Sex	Male	Male	Male	Primi. Fe.	Primi. Fe.	Multi. fe.	Multi. fe.	Multi. fe.
CL (mm)	15.02	19.09	21.37	23.50	25.90	18.61	22.67	25.50
Weight (g)	1.97	4.09	5.76	7.68	10.32	4.04	7.19	10.14
Per cent	6.88	37.89	19.23	21.77	4.14	0.40	0.96	8.73

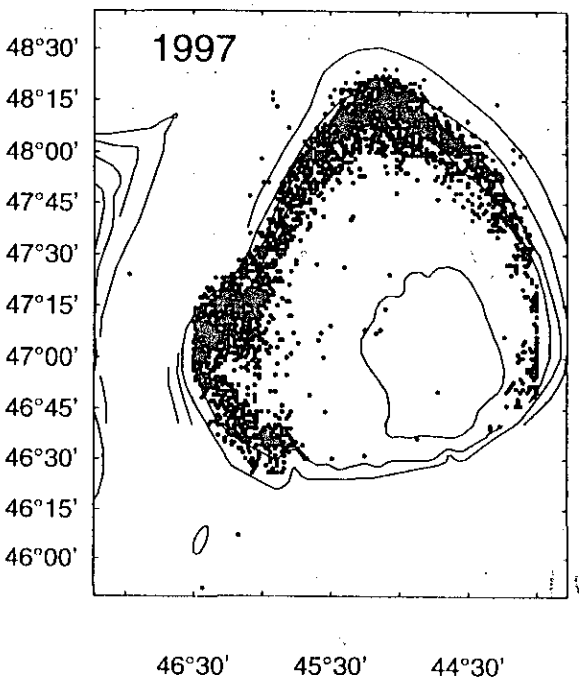
Table 5. Length-weight relationships for different sex groups of northern shrimp, where y is the weight and x is the carapace length.

Month	Sex group	No. of specimens	Equation	r squared
March-Dec	Male	953	ln y = 3.037*ln x - 7.549	0.939
March	multip. fem	51	ln y = 3.258*ln x - 8.166	0.86
April-June	multip. fem	127	ln y = 2.778*ln x - 6.689	0.919
July	multip. fem	122	ln y = 2.921*ln x - 7.144	0.941
August	multip. fem	66	ln y = 3.111*ln x - 7.689	0.897
September	multip. fem	97	ln y = 2.753*ln x - 6.565	0.921
October	multip. fem	114	ln y = 3.050*ln x - 7.458	0.899
November	multip. fem	147	ln y = 2.636*ln x - 6.083	0.846
December	multip. fem	133	ln y = 2.812*ln x - 6.745	0.863
Sept.-March	multip. fem	542	ln y = 2.929*ln x - 7.085	0.863

Table 6. No./hour of shrimp calculated from age asessments, nominal catch and effort for the period January-July of Icelandic samples.

		Males			∑ males	Females					∑ females
Years	Age groups	2	3	4		3	4	5	6	7	
1994	No./hr. (000)	8658	10118	2059	20835		125	3660	7720		11505
1996	No./hr. (000)	1310	15676		16986	1185	6209	1522	789		9705
1997	No./hr. (000)	362	6258	6348	12968		6811	2337	297	64	9509
1998	No./hr. (000)	2053	16514	9685	28252		9717	4971	3757	50	18495





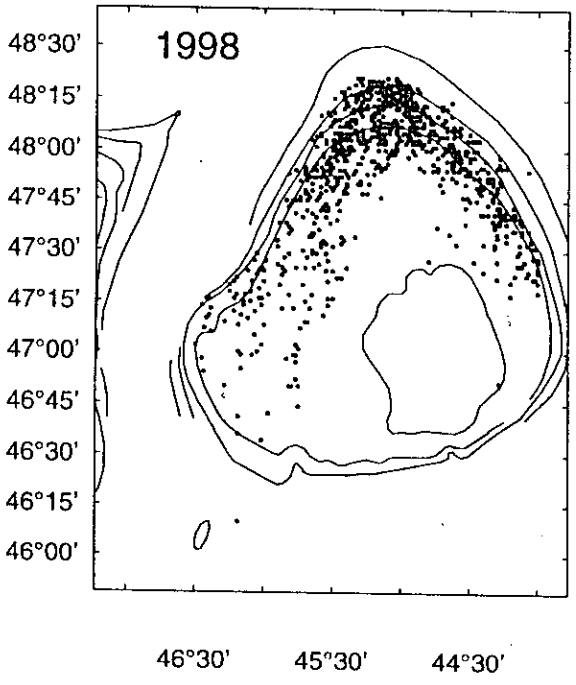
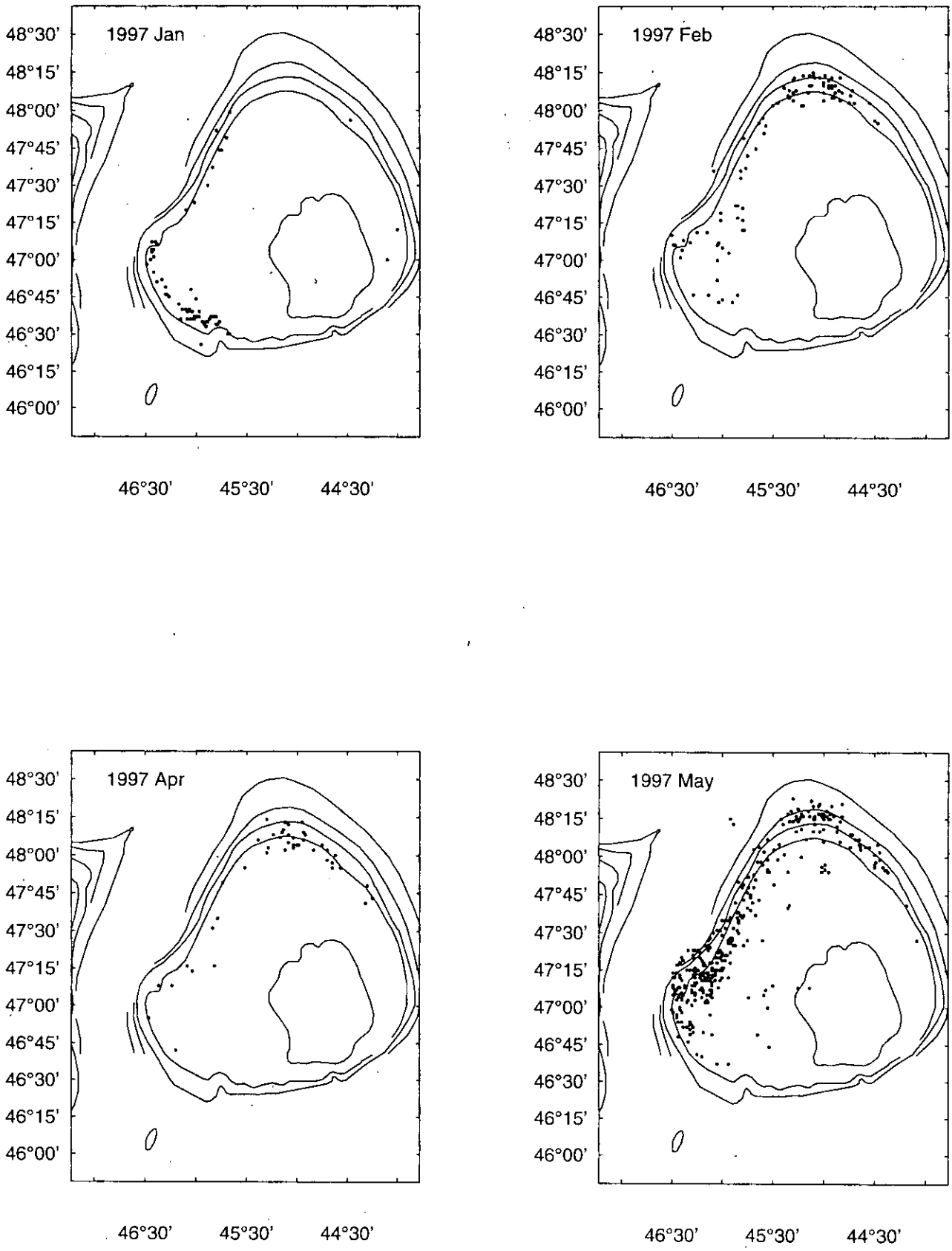


Fig. 1. Towing positions of the Icelandic fleet on Flemish Cap in 1996-1998.



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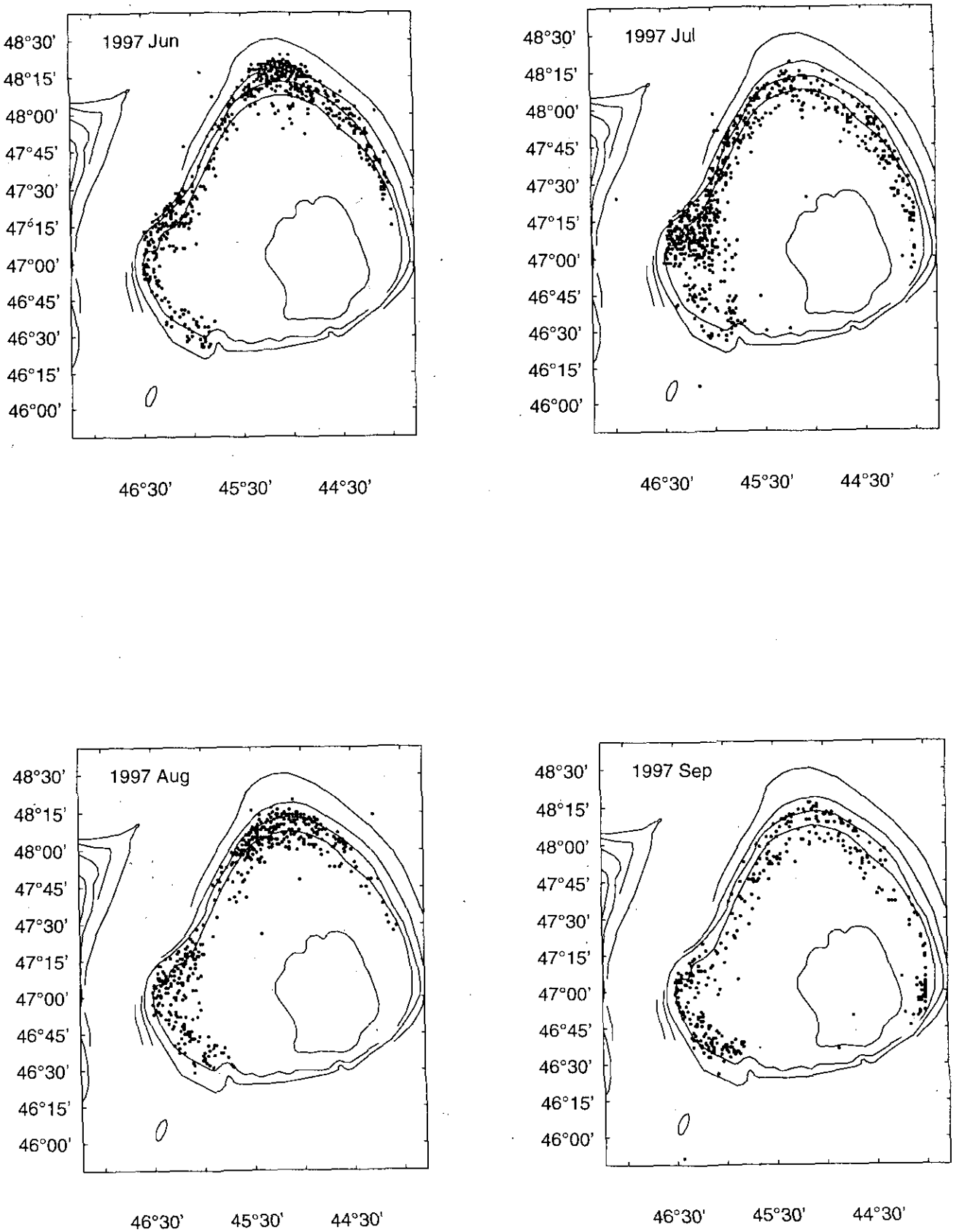

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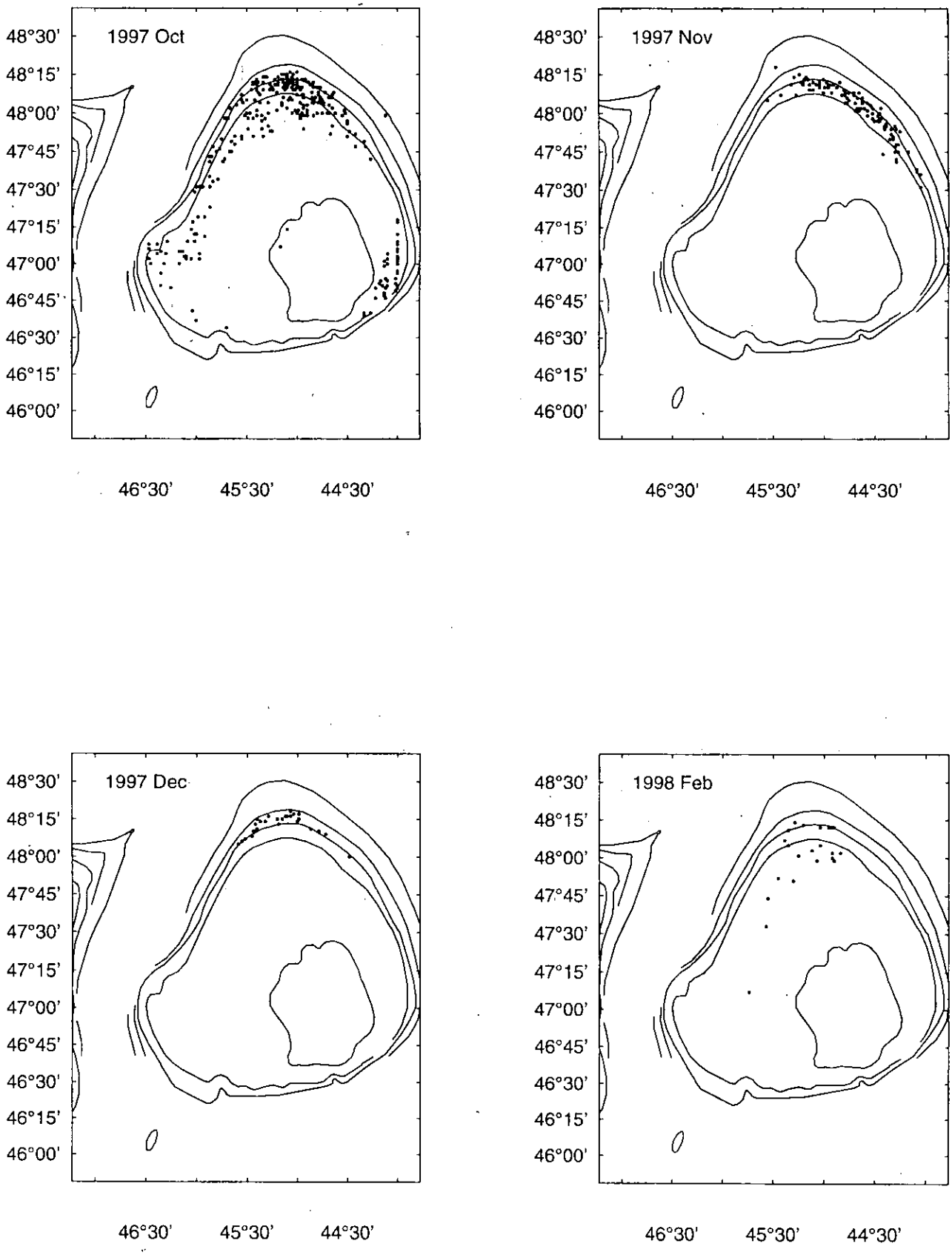

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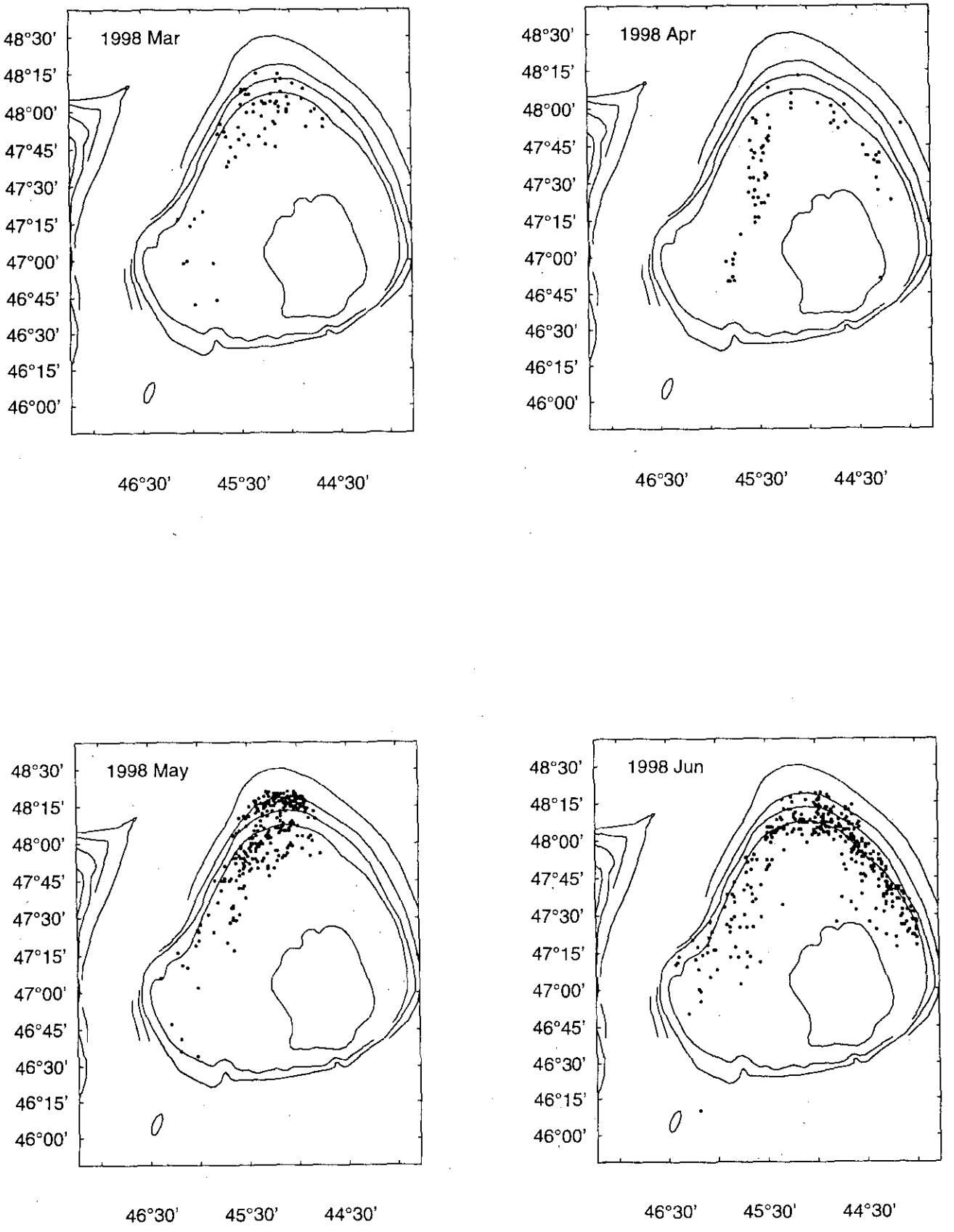

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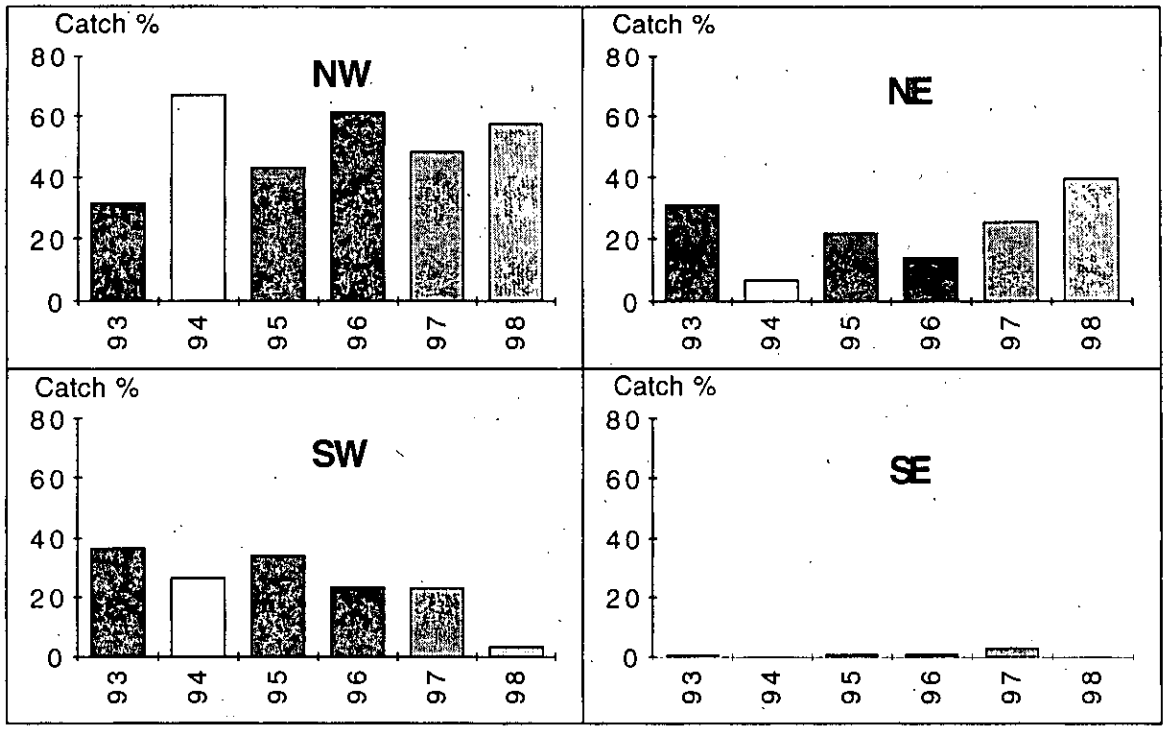

Fig. 2. The proportions of shrimp catch of Iceland at Flemish Cap by areas and years

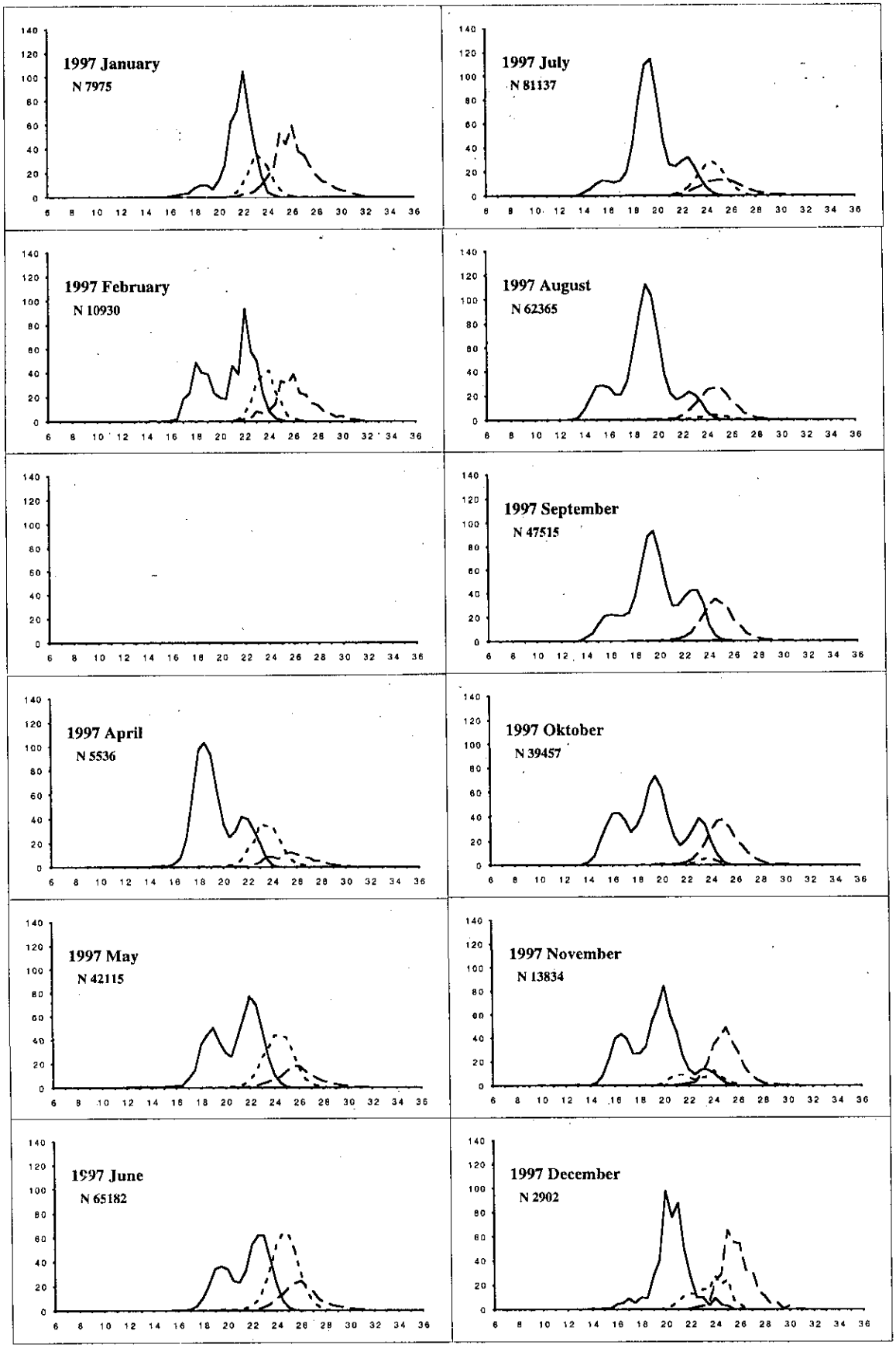

Fig. 3. The length frequency distribution of northern shrimp at Flemish Cap by months in 1997.

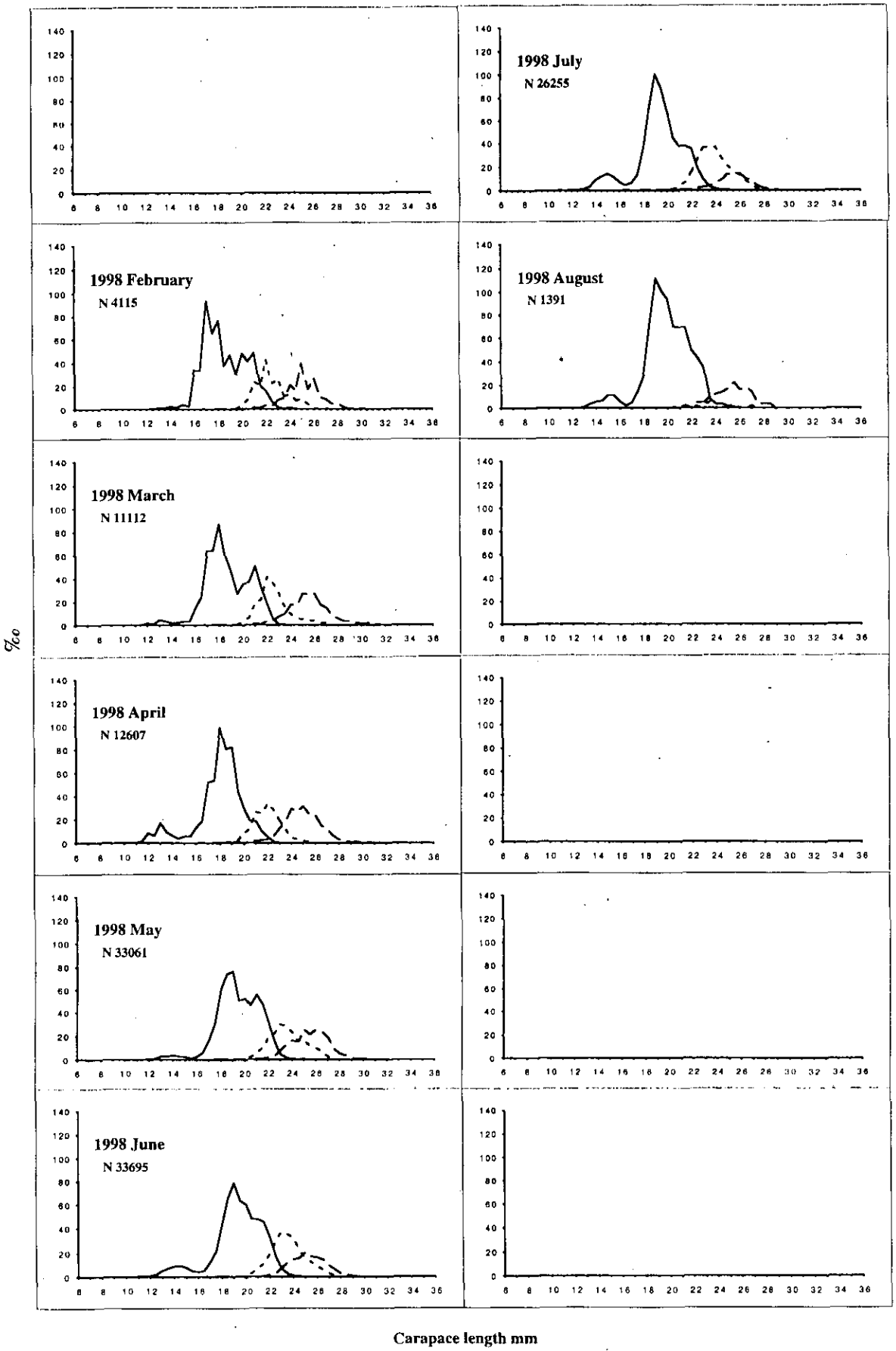

Fig. 4. The length frequency distribution of northern shrimp at Flemish Cap by months in 1998.

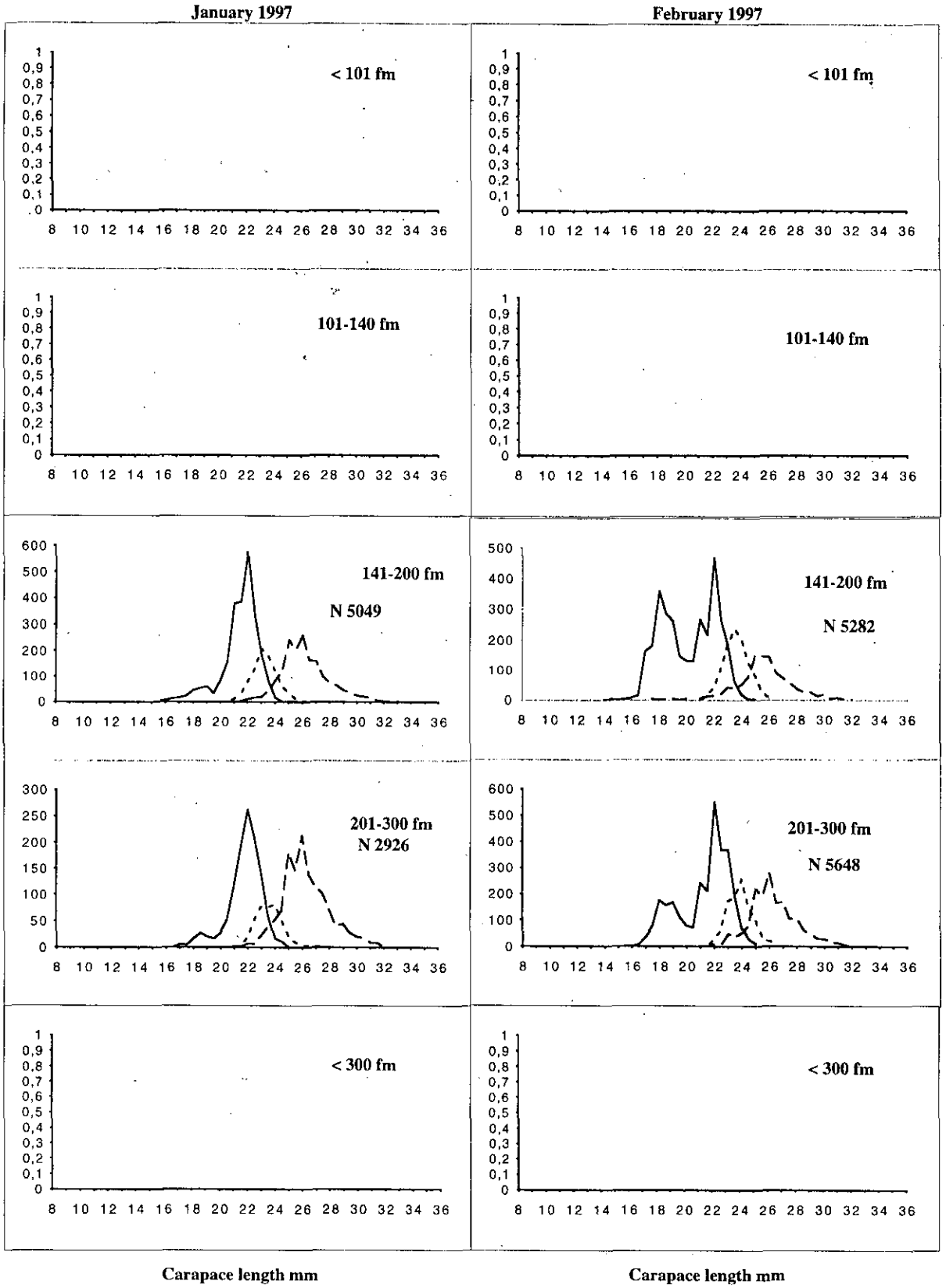

Fig. 5. The length frequency distribution of northern shrimp at Flemish Cap in January and February by depth in 1997.

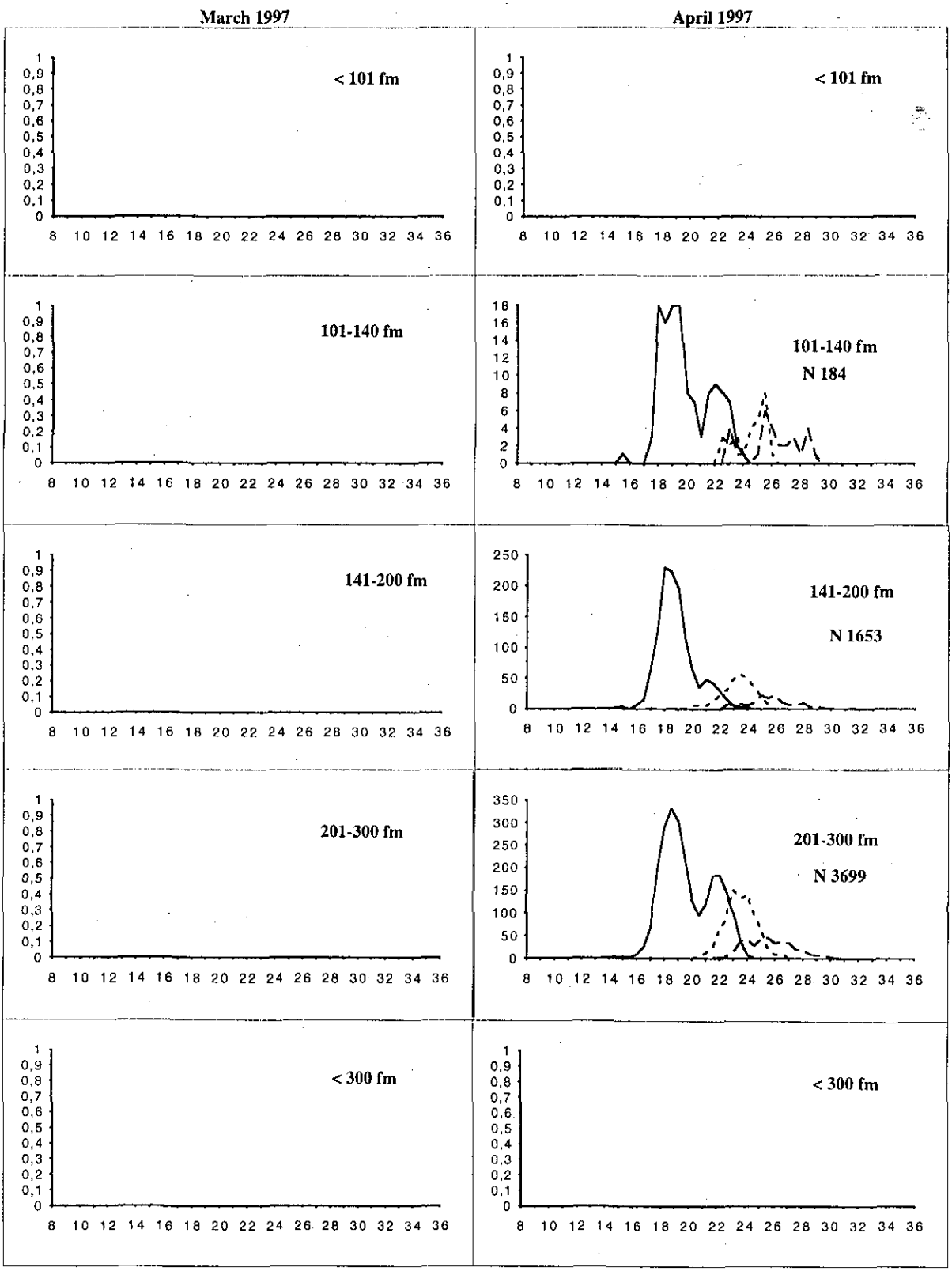

Fig. 6. The length frequency distribution of northern shrimp at Flemish Cap in April by depth in 1997. There was no fishery March.

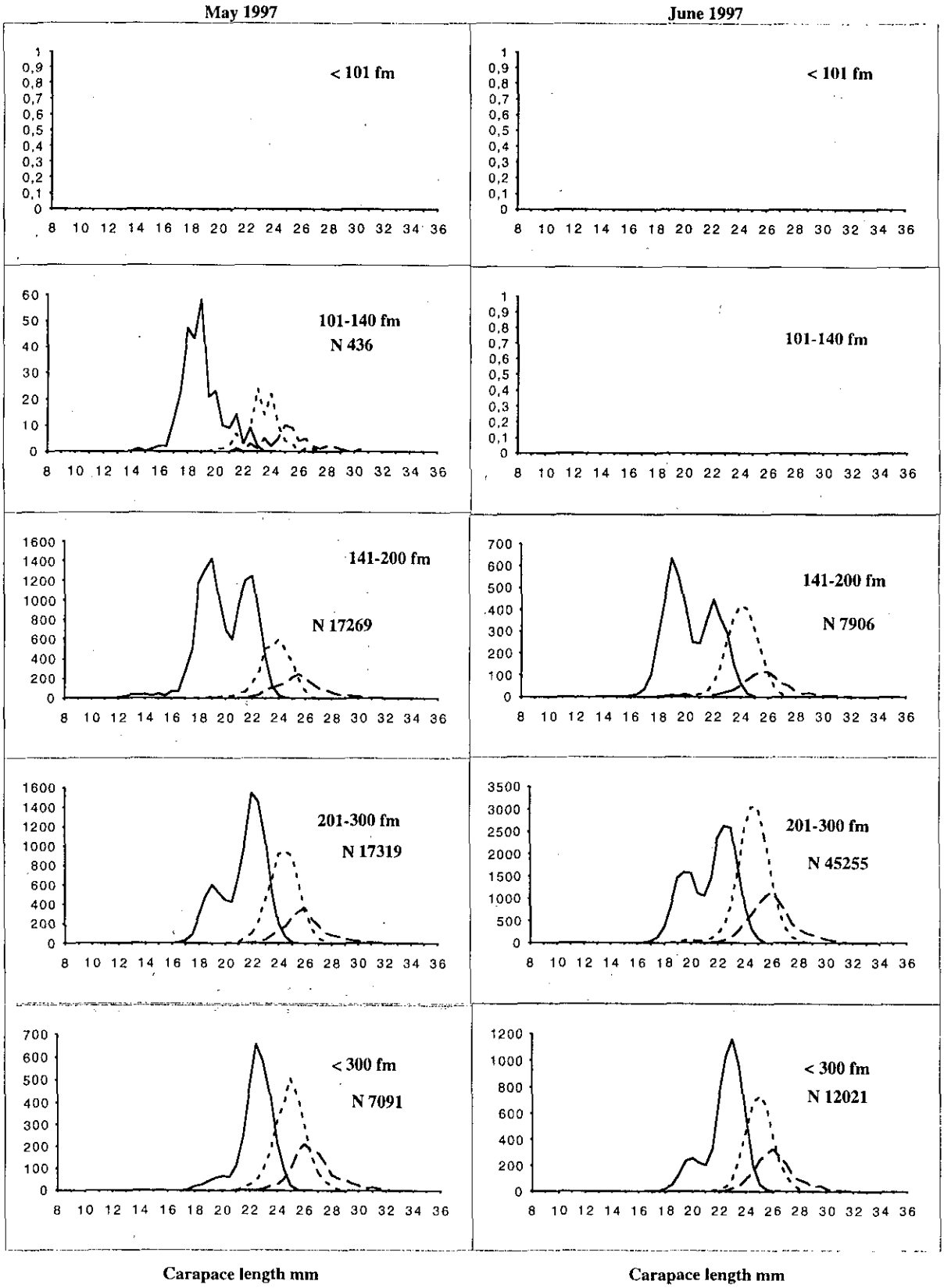

Fig. 7. The length frequency distribution of northern shrimp at Flemish Cap in May and June by depth in 1997.

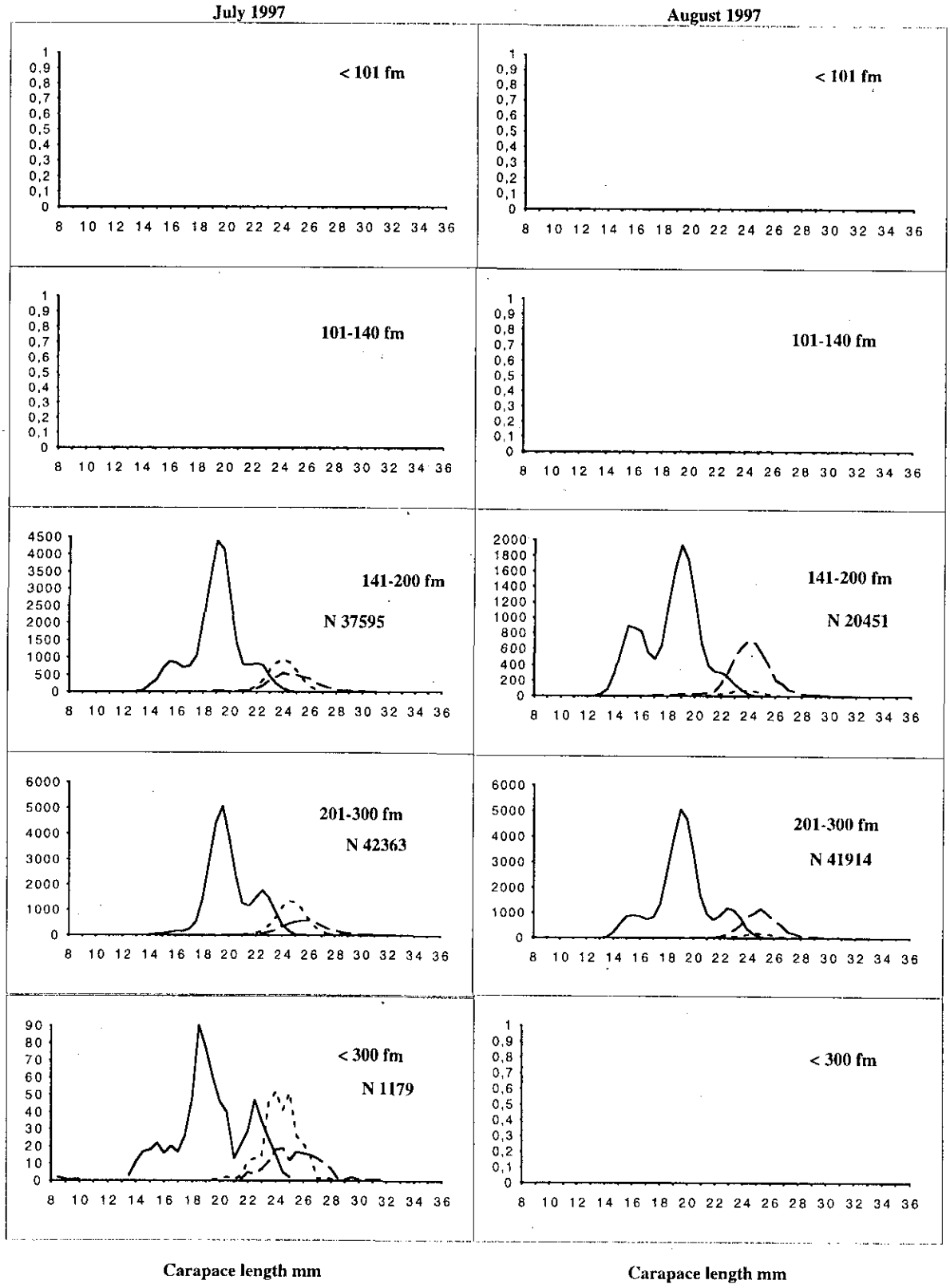

Fig. 8. The length frequency distribution of northern shrimp at Flemish Cap in July and August by depth in 1997.

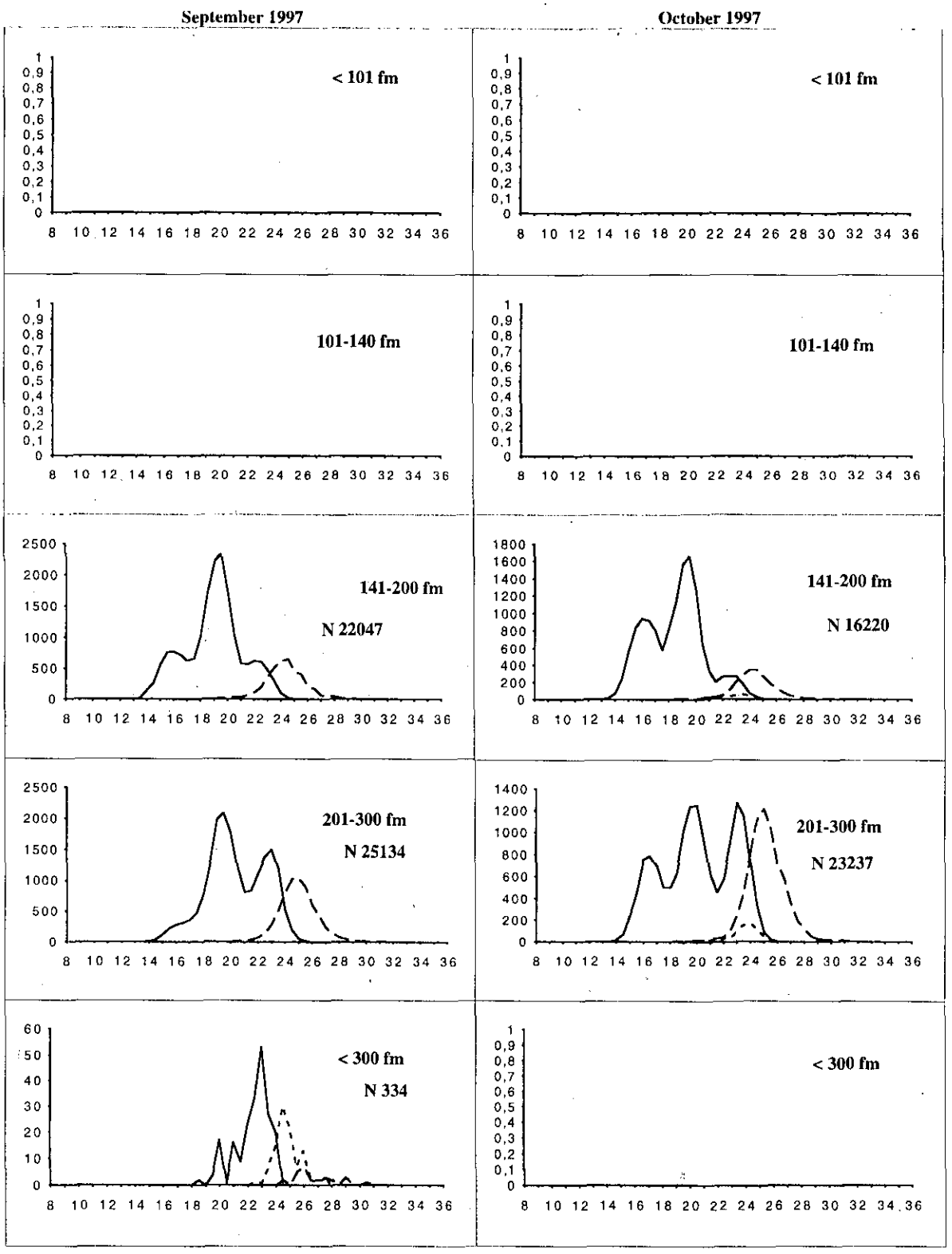

Fig. 9. The length frequency distribution of northern shrimp at Flemish Cap in September and October by depth in 1997.

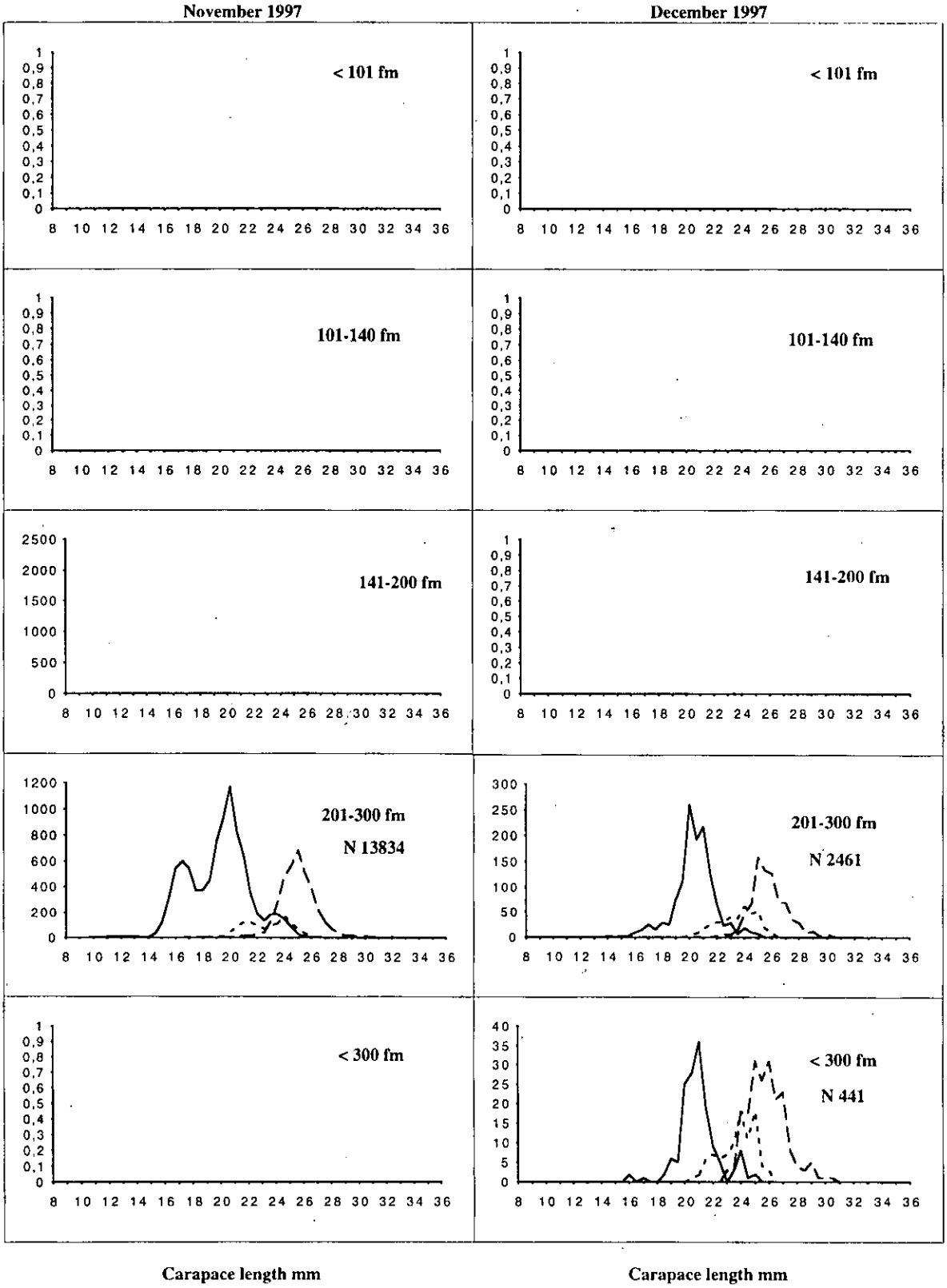

Fig. 10. The length frequency distribution of northern shrimp at Flemish Cap in November and December by depth in 1997.

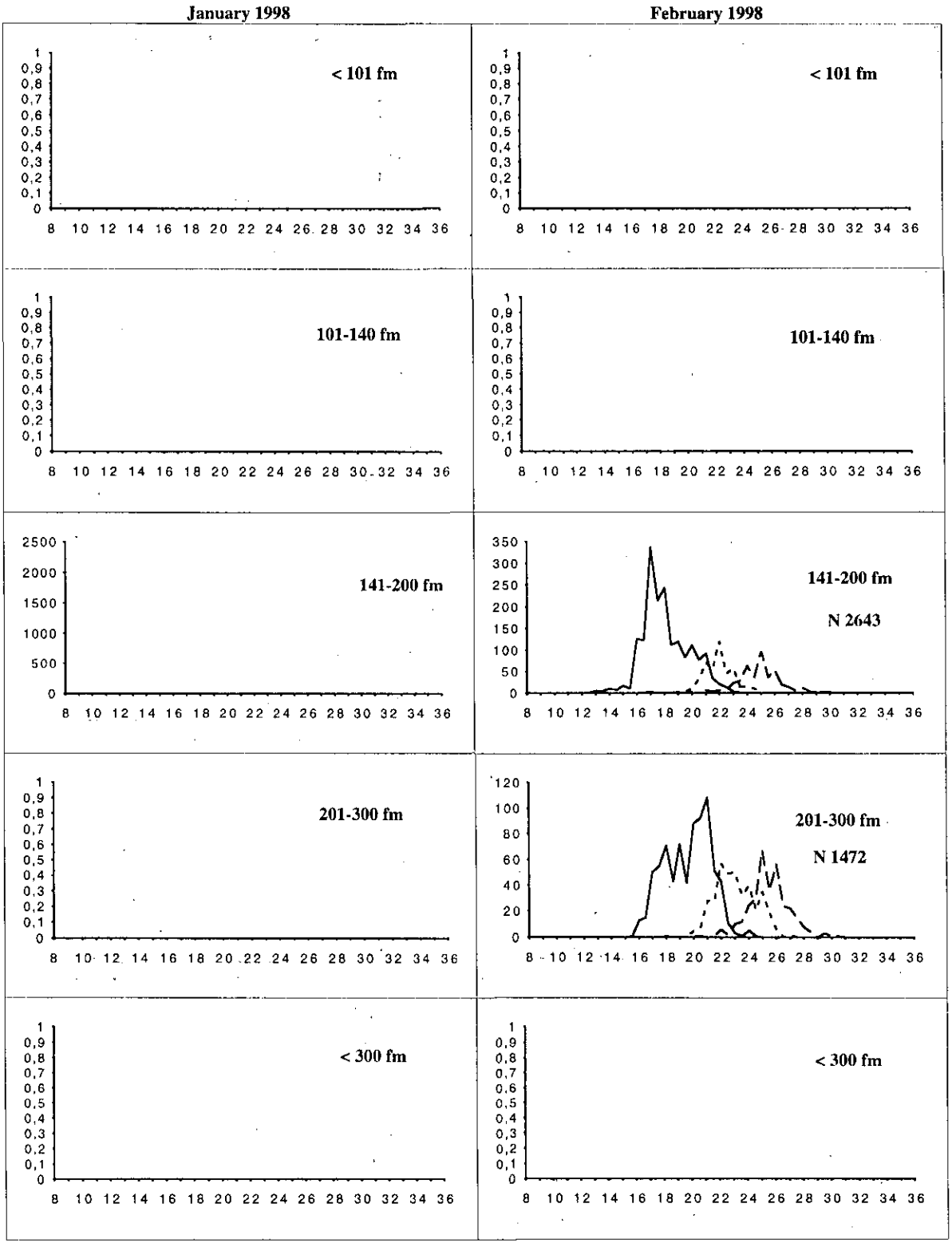

Fig. 11. The length frequency distribution of northern shrimp at Flemish Cap in February by depth in 1998. There was no fishery in January.

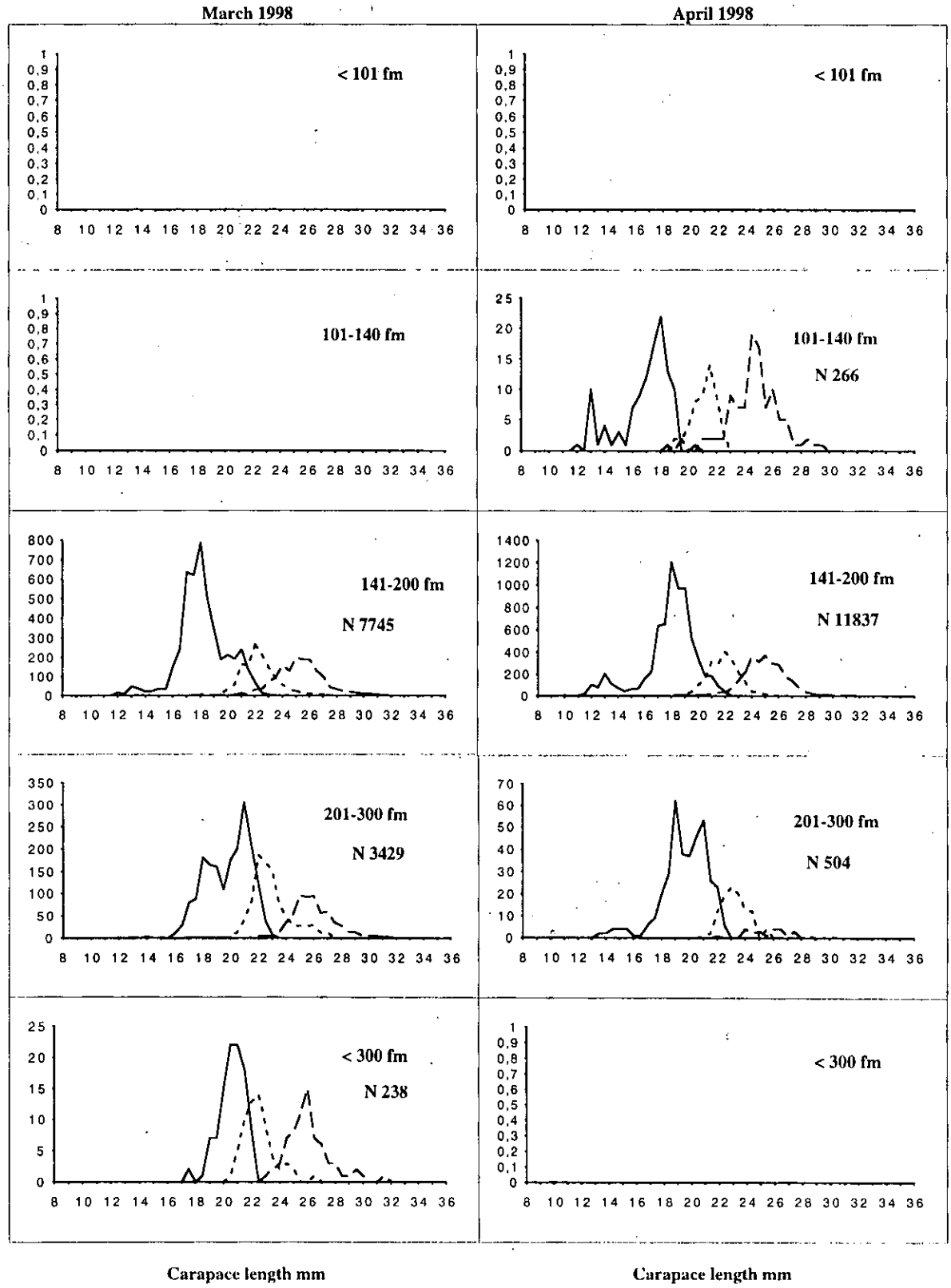

Fig. 12. The length frequency distribution of northern shrimp at Flemish Cap in March and April by depth in 1997.

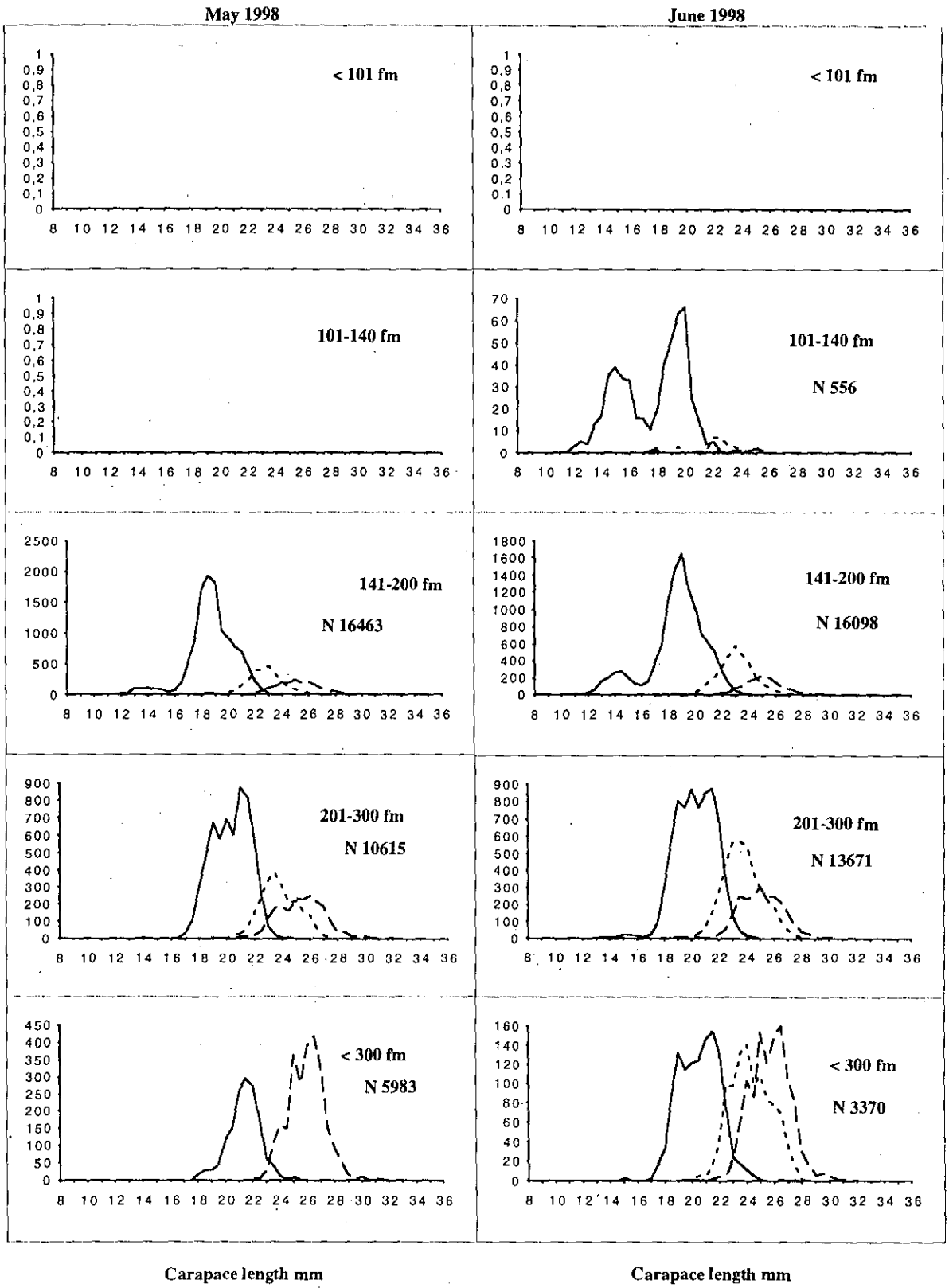

Fig. 13. The length frequency distribution of northern shrimp at Flemish Cap in May and June by depth in 1998.

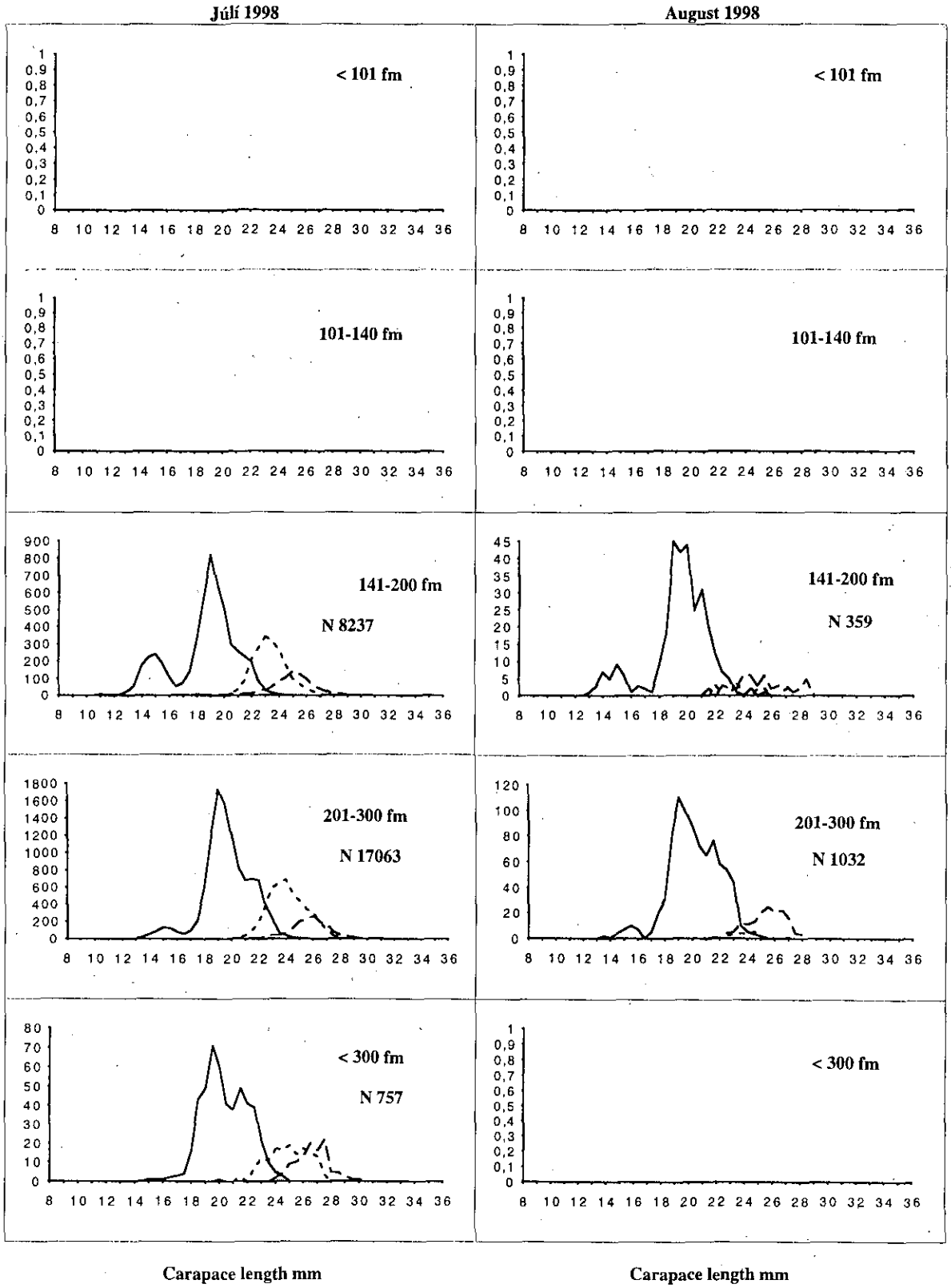

Fig. 14. The length frequency distribution of northern shrimp at Flemish Cap in July and August by depth in 1998.