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The Icelandic Shrimp Fishery (*Pandalus borealis*) in the Denmark Strait in 1997-1998 and some Reflection on Age Groups in the Years 1991-1997.

by

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Abstract

In this paper there are logbook information on the Icelandic fishery for the years 1997-1998 as well as nominal catches. The nominal catch of 1998 was 1 400 tons as compared to 2 860 tons in 1997.

Age determination of the shrimp samples taken on the eastern side of the midline in were assessed by using modal analysis. The growth of males from the assumed age 3 to 6 is found to be on average 2.5-2.7 mm per year. The change of sex starts at the age of 5 but is estimated to take mostly place at age 6 so the the first spawning will take place at the age 5 for about 12% of the year-class and the rest of the year-class will spawn at the age of 6. The oldest shrimp detected were 8 years. The Icelandic samples from the northern area of the years 1987- 1998 were analysed with regard to size at sex change.

Introduction

In this paper there is an account of logbook information for the Icelandic fishery taking place on the eastern side of the midline between Greenland and Iceland. This information is presented here for the years 1997 and 1998 as well as the nominal catch.

The age of shrimp in Denmark Strait is assessed here in 1998 and the result of previous years sre presented. This is done here as before using the modal analysis. Moreover there have been questions on whether there is a difference in genetic makeup or physiology of the shrimp between the northern and southern areas. The northern shrimp in Denmark Strait and Icelandic waters has been studied as regards the physilogical differences like size at sex change (Skúladóttir, 1995, 1998). Rasmussen (1953) has indicated that size at sex change is related to the size of individuals rather than the age, but he considered that age at sex change had considerable geographic variation. Appollonio et.al. (1986) maintained that temperature plays a significant role in determining the age of sex change. Skúladóttir et al. also studied the variation in size at sex change for all shrimp grounds in Icelandic waters in the years 1988 and 1989 using the logistic curve to determine the length at which half of the shrimp had become mature females, termed L50.

In this paper the L50s of shrimp from the eastern part of the Denmark Strait are related except for the season 1987/88 where many smples were obtained from the Norwegian survey from the whole survey area lying north of 65°N.

Material and Methods

For most of the catch data there are logbook data which include catch and effort. Not all skippers send in the logbooks, but information on landings can be obtained elsewhere. Thus the equivalent to the nominal catch can be calculated for the effort. This is done by adding up all catch and effort by two periods of the year from the

logbooks and calculating the CPUE. Wherupon the nominal catch for the same period is divided by the CPUE to get the corrected effort. Twin trawls where treated by doubling the effort of twin trawls.

The measuring of the shrimp was carried out using sliding calipers and measuring the carapace from the eye socket to the hind end of the carapace middorsally to the nearest half mm. After this every specimen in a length class is gouped by sexual character as done by Rasmussen (1953) as well as detecting the presence or absence of sternal spines (McCrary 1971). The sex groups detected are 9. Later the 9 sex groups are combined and grouped together in the three main groups males, primiparous females (with sternal spines) and multiparous females (without sternal spines). In the group primiparous females there are also transitionals.

The age determination was carried out using the method of Macdonald and Pitcher (1979). For detecting the age groups, each of the three aforementioned length freqency distributions (lfd.) of males, primiparous females and multiparous females was run separately. It was tried first to asign many age-groups to the lfd. and then reduce the number to find the best fit. For the more difficult lfds a constraint had to be put on the coefficient of variation of the socalled sigma (standard deviation of the age-class) to be fixed at 0.045. Trial values for the mean length were used as starting values. Moreover when assessing the age of the multiparous females the sigmas were kept equal.

The method used to estimate the maturity ogive of mature females (without sternal spines was based on fitting of the sigmoid, so-called logistic curve first decribed by Pearl and Reed (1920). the equation used is:

$$y = 1/(1+e^{-(a+bx)})$$

Where x is the carapace length and y is the proportion of females without sternal spines against all individuals in that length class. From this the inflection point of the logistic curve was also calculated. The carapace length at the inflection point where 50% are mature females is called L50. When coefficient of variation was less than 0.6 the sample was not used.

Catch and effort data

In 1998 the fishery was carried out in the period January through June. But most of the catch was taken in April and May. The total annual catch was only 1 403 tons in 1998 (table 1) as compared to 2 856 tons in 1997. The mean CPUE for the year 1995 was the highest ever for Iceland, namely 309 kgs per trawling hour. In 1996 and 1997 the mean CPUE was 240 and 238 kg/hour, which was also rather high. The CPUE was lower in 1998 i.e. 175 kg/hour. The average size of gear was about 3 400 meshes circumference of the belly in 1998, compared to 3 200 and 3 120 meshes in 1997 and 1996 resoectively. In most previous years the size was about 2 400 meshes, so there has been a substantial increase in the size of gear

Commercial Samples

The samples were obtained from shrimpers in 1997 and 1998. The proportion of males in 1996 was very high namely 70% as compared to 50% in 1997. The percentage of females was 30% in 1996 as compared to 50% in 1997 and 40% in 1998. As the Icelandic commercial samples have been quite few the last years it is not wise to draw any conclusions on the proportions of females in the catch.

Of the multiparous females 72% were carrying eggs in 1998, so there were 28% iof females in the resting phase. As pointed out before a proportion of the females will spawn every second year as hinted by the high percentage of mature females not carrying eggs. As a comparison in 1996 and 1997 the proportions not carrying eggs were 28% and 17% respectively. However only 6% of the females carrying eggs were green in head, i.e. preparing the next batch of eggs to be spawned in the following summer.

Estimation of Age

An attempt was made to determine the age of the shrimp in the Denmark Strait of the Icelandic samples in 1991, 1992, 1993 and 1994 (Skúladóttir 1994) and later in the 1995 and 1996 were assessed (Skúladóttir, 1996). Here again the samples of March through May (Table 2) were aged. The primaparous females seemed to have mostly a single peak with mean length at 27.7 mm. There was however a small peak of 23.8 mm CL. The multiparous females seemed to have two main modes and two small ones. All samples of the year 1998 were combined before the age assessment was carried out.

In table 4 are listed the mean lengths at age for the 3 sex groups for the years 1991-1998. For the males there appears to be great consistency between years in the mean lenghts at age. Four modes can usually be detected in the male lfd. and sometimes five. As the left hand side of the male lfd is usually very deficient as regards the socalled 2 year olds, their mean size is therefore badly determined and variable. At the age 3, 4 and 5, mean sizes of males are generally better estimated than in any other sex group. The 6 year old males in May 1991 were however unusually large but as the proportion was very low the mean size was not so well determined.

The primiparous females were usually biomodal except for May 1992 and 1995. The proportions of the 6 year olds changing sex as judged by the proportion of primiparous females against males plus primiparous females in the 6 group has been about 35% on the average in the years 1991 to 1997, but this could be an underestimate as more males may manage to change sex in time and still be able to spawn in August as females.

The multiparous females are a composite group and each year class is growing mostly when in the resting phase, i.e. when the females are not eggbearing (every second years) so there should be some slowing down of the growth as compared to that of the younger animals. The growth is thus 1.9 mm between ages 6 and 7 (table 4). The Mix can usually detect 3 age groups and occasionally there is the fourth year class, the young 5 year old multiparous females only representing a tiny proportion (below 2 % of all sex groups). The 6 year olds (mature females) also represent rather small percentages, namely between 3% and 19% of the overall proportion so their mean size may not always be very well determined.

When looking at the overall proportions these seem generally to be highest of 5, 6 and 7 year olds (Table 6).

Size at sex change, L50

In Table 7 are presented L50s as calculated per sample in the years 1987-1998. The Table is arranged in such a manner that all samples are within the same eggbearing period. This is neccessary as there might be a change in age at sex change between seasons. Moreover according to a previous study of data from the years 1985-1993 there was no appaerent seasonality in a change in L50 (Skuladottir, 1995). The averages of seasons are from 26.7 - 28.2. It is indeed variable how many samples are obtained in each season. The season 1987/88 is outstanding in having so many useable samples spreading over the whole shrimp area north of 65°N as about 16 samples were obtained from the Norwegian survey in September 1987. The range in L50 in 1987 ahows us that there is a considerable range in L50s between samples, namely ranging from 24.7 to 29.3, the average being of 28.2 mm CL. Low L50 values are also seen in 1990/91 where there were 3 samples with L50 less than 26 mm. The mean L50 of shrimp in waters north of Iceland is 24.3 mm (Skúladóttir, 1995). So there could have been an influx and mixing of some shrimp from the offshore Icelandic waters. Jonsdottir et al. (1998) using electrophoresis on allozymes have shown that samples obtained from the Icelandic offshore waters are not different genetically from the easternmost area of the Denmark Strait. But the samples obtained west for 28°W in the Denmark Strait show a genetical difference from the Icelandic offshore waters.

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Table 1. The catch, effort and CPUE as reported by Icelandic logbooks. in the Denmark Strait in 1997 and 1998.

YEAR	MONTH	FROM LOGBOOKS CPUE kg/hr	EFFORT Tr. hours	CATCH Tonnes
1997	Jan	24	7	0.170
	Feb	245	785	192.541
	March	262	4278	1120.392
	April	286	2700	772.073
	May	134	1189	159.514
	June	25	8	0.200
logbooks	Σ Jan-June	251	8959	2244.690
Nominal catch	Σ Jan-June	251	10847	2717.797
1997	Oct	71	236	16.768
	Nov	8	7	0.058
	Dec	107	931	100.051
logbooks	Σ Oct-Dec	100	1174	116.877
Nominal catch	Σ Oct-Dec	100	1389	138.252
Nominal catch	ΣΣ 1997	238	12021	2856.049
1998	Jan	58	66	3.849
	Feb	182	314	57.208
	March	176	59	10.380
	April	218	3503	764.156
	May	130	3148	408.742
	June	130	24	3.127
logbooks	Σ Jan-June	175	7114	1247.462
Nominal catch	Σ Jan-June	175	7998	1402.519
1998	Sept	40	11	0.445
logbooks	Σ Sept	40	11	0.445
Nominal catch	Σ Sept	53	12	0.497
Nominal catch	ΣΣ 1998	175	8011	1403.016

Table 2. The length distribution by 3 major categories by months. The legend at the bottom of the table is the same as used before (Skúladóttir, 1995 a).

March 1997				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16	1			1
16.5				0
17	1			1
17.5	1			1
18	5			5
18.5	2			2
19	6			6
19.5	3			3
20	9			9
20.5	12			12
21	31			31
21.5	41		1	42
22	42	2		44
22.5	48		3	51
23	58		2	60
23.5	57	1	4	62
24	64	1	9	74
24.5	99	2	7	108
25	97	4	15	116
25.5	73	3	15	91
26	56	12	42	110
26.5	41	15	55	111
27	33	26	69	128
27.5	18	27	85	130
28	2	14	83	99
28.5	3	15	85	103
29	1	11	81	93
29.5	1	14	65	80
30		7	68	75
30.5		4	42	46
31		2	33	35
31.5			24	24
32		1	8	9
32.5			3	3
33			5	5
33.5			2	2
34			2	2
34.5				
35				
35.5				
Σ	805	161	808	1774
	ma	mi	mg	gm
Σ	805	16	4	141
mean CL	24.05	26.66	25.25	27.80
%	45.38	0.90	0.23	7.95
	ag	ga	ea	em
Σ	7	107	5	655
mean CL	27.07	29.67	27.50	28.14
%	0.39	6.03	0.28	36.92
	eg			
Σ	34			
mean CL	28.22			
%	1.92			

April 1997				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16	1			1
16.5				0
17	2			2
17.5				0
18				0
18.5	1			1
19				0
19.5	1			1
20	5			5
20.5	6			6
21	17		1	18
21.5	10			10
22	21	1		22
22.5	34	1		35
23	38	1	1	40
23.5	36			36
24	36	4	1	41
24.5	35	1	1	37
25	49	5	2	56
25.5	29	5	3	37
26	25	3	7	35
26.5	26	5	12	43
27	10	3	19	32
27.5	4	16	20	40
28	3	14	10	27
28.5	1	4	17	22
29		3	24	27
29.5		1	29	30
30		1	17	18
30.5			17	17
31			9	9
31.5			7	7
32			5	5
32.5			2	2
33			1	1
33.5			3	3
34				
34.5				
35				
35.5				
Σ	390	68	208	666
	ma	mi	mg	gm
Σ	390	10	1	57
mean CL	23.97	25.00	25.50	27.18
%	58.56	1.50	0.15	8.56
	ag	ga	ea	em
Σ	1	47	0	146
mean CL	26.50	29.81		28.50
%	0.15	7.06	0.00	21.92
	eg			
Σ	14			
mean CL	28.25			
%	2.10			

May 1997				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16				1
16.5				0
17				0
17.5				0
18				0
18.5				0
19	1			1
19.5				0
20	1			1
20.5				0
21	4			4
21.5	4			4
22	6			6
22.5	18			18
23	10			10
23.5	15		1	16
24	19		1	20
24.5	17		3	20
25	11		5	16
25.5	11	1	1	13
26	7		5	12
26.5	5	7	1	13
27	6	2	3	11
27.5	3	4	5	12
28	2	5	6	13
28.5		7	4	11
29		4	4	8
29.5		2	4	6
30			7	7
30.5			2	2
31		1	2	3
31.5			3	3
32			1	1
32.5				0
33				0
33.5				0
34				0
34.5				
35				
35.5				
Σ	140	33	58	232
	ma	mi	mg	gm
Σ	140	1	0	32
mean CL	24.08	26.50		27.94
%	60.61	0.43	0.00	13.85
	ag	ga	ea	em
Σ	4	17	0	32
mean CL	27.50	29.29		27.25
%	1.73	7.36	0.00	13.85
	eg			
Σ	5			
mean CL	28.40			
%	2.16			

ma: males
mi: transitionals
mg: females with sternal spines

gm: females with st. sp., green in head
ag: females without st. sp.
ga: females without st. sp., green in head

ea: eggbearing females, no eyes
em: eggbearing females, eyes
eg: eggbearing females, eyes, green in head

Table 2. continued.

desember 1997				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16				
16.5				
17				
17.5	3			3
18				0
18.5	1			1
19	2			2
19.5	3			3
20	1			1
20.5	1			1
21	3			3
21.5	3		1	4
22	7			7
22.5	11			11
23	15			15
23.5	28			28
24	27		1	28
24.5	30		1	31
25	24	1	1	26
25.5	24	3	1	28
26	23		4	27
26.5	17	3	8	28
27	11	2	7	20
27.5	9	1	11	21
28	2	3	12	17
28.5	3	4	19	26
29		1	24	25
29.5		2	26	28
30		1	23	24
30.5			18	18
31			21	21
31.5			9	9
32			9	9
32.5			3	3
33			4	4
33.5			2	2
34				0
34.5				0
35		1		1
35.5				
Σ	248	22	205	475
Σ	ma 248	mi 18	mg 1	gm 3
mean CL	24.47	27.69	35.50	26.67
%	52.21	3.79	0.21	0.63
Σ	ag 45	ga 37	ea 123	em 0
mean CL	29.46	29.66	29.30	0.00
%	9.47	7.79	25.89	0.00
Σ	eg 0			
mean CL	0.00			
%	0.00			

janúar 1998				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16				
16.5	1			1
17	1			1
17.5	5			5
18	8			8
18.5	8			8
19	7			7
19.5	8			8
20	10			10
20.5	14			14
21	8			8
21.5	8			8
22	6		1	7
22.5	12	1		13
23	14	1		15
23.5	9			9
24	15			15
24.5	7		2	9
25	14			14
25.5	9		1	10
26	5		4	9
26.5	5	2	3	10
27	3	4	5	12
27.5	3	2	7	12
28		1	9	10
28.5	1	3	8	12
29		1	12	13
29.5			10	10
30			8	8
30.5			6	6
31			6	6
31.5			4	4
32				0
32.5			1	1
33				0
33.5			2	2
34				
34.5				
35				
35.5				
Σ	181	15	89	285
Σ	ma 181	mi 11	mg 0	gm 4
mean CL	22.27	26.46	0.00	28.25
%	63.51	3.86	0.00	1.40
Σ	ag 5	ga 22	ea 48	em 14
mean CL	28.00	29.43	28.90	27.89
%	1.75	7.72	16.84	4.91
Σ	eg 0			
mean CL	0.00			
%	0.00			

februar 1998				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16				
16.5				
17	1			1
17.5	2			2
18	6			6
18.5	11			11
19	14			14
19.5	14			14
20	22			22
20.5	17			17
21	15			15
21.5	14	1		15
22	21		1	22
22.5	20		1	21
23	17	1	1	19
23.5	22			22
24	32	2	1	35
24.5	28			28
25	30			30
25.5	16	1		17
26	20		3	23
26.5	14	5	14	33
27	10	6	12	28
27.5	8	3	14	25
28	6	4	18	28
28.5	1	5	17	23
29			15	15
29.5		2	17	19
30			15	15
30.5			12	12
31			10	10
31.5			5	5
32			4	4
32.5			2	2
33			2	2
33.5				0
34			1	1
34.5				
35				
35.5				
Σ	361	30	165	556
Σ	ma 361	mi 17	mg 1	gm 12
mean CL	23.04	26.71	25.50	27.42
%	64.93	3.06	0.18	2.16
Σ	ag 14	ga 24	ea 4	em 117
mean CL	28.50	29.44	27.25	28.72
%	2.52	4.32	0.72	21.04
Σ	eg 6			
mean CL	29.42			
%	1.08			

Table 2. Continued.

apríl 1998				
CL mm	Males	Primip. Females	Multip. Females	Σ
14	3			3
14.5				0
15				0
15.5	1			1
16	1			1
16.5	2			2
17				0
17.5	2			2
18	11			11
18.5	12			12
19	17			17
19.5	19			19
20	29			29
20.5	15			15
21	30		1	31
21.5	21			21
22	37			37
22.5	32	1		33
23	31	1	2	34
23.5	44	2	2	48
24	43	1	1	45
24.5	43	1	4	48
25	51		4	55
25.5	59	2	4	65
26	65	7	8	80
26.5	35	9	12	56
27	25	11	15	51
27.5	17	8	16	41
28	11	14	21	46
28.5	5	16	43	64
29	1	7	41	49
29.5		10	32	42
30	1	3	44	48
30.5		2	29	31
31			22	22
31.5			18	18
32			10	10
32.5			7	7
33			4	4
33.5			4	4
34			1	1
34.5			2	2
35				
35.5				
Σ	663	95	347	1105
Σ	ma 663	mi 5	mg 2	gm 88
mean CL	23.59	27.20	28.00	27.67
%	60.00	0.45	0.18	7.96
Σ	ag 6	ga 89	ea 17	em 206
mean CL	27.83	29.77	28.38	28.97
%	0.54	8.05	1.54	18.64
Σ	eg 29			
mean CL	29.60			
%	2.62			

maí 1998				
CL mm	Males	Primip. Females	Multip. Females	Σ
14				
14.5				
15				
15.5				
16	2			2
16.5				0
17	1			1
17.5	1			1
18				0
18.5	3			3
19	7			7
19.5	8			8
20	14			14
20.5	12			12
21	8			8
21.5	12			12
22	13	1		14
22.5	15			15
23	21	2	1	24
23.5	19	2	2	23
24	34	2	3	39
24.5	29			29
25	37	2	3	42
25.5	40	2	3	45
26	46	1	7	54
26.5	24	5	12	41
27	28	4	10	42
27.5	20	5	15	40
28	12	13	27	52
28.5	4	14	19	37
29		11	25	36
29.5		10	36	46
30			30	30
30.5		1	29	30
31		1	19	20
31.5			16	16
32			6	6
32.5			5	5
33			7	7
33.5			5	5
34			1	1
34.5				
35				
35.5				
Σ	410	76	281	767
Σ	ma 410	mi 2	mg 1	gm 73
mean CL	24.33	25.25	30.50	27.75
%	53.46	0.26	0.13	9.52
Σ	ag 4	ga 84	ea 0	em 188
mean CL	30.13	29.85	0.00	28.98
%	0.52	10.95	0.00	24.51
Σ	eg 5			
mean CL	29.90			
%	0.65			

Jan.,Feb.,April, May 1998				
CL mm	Males	Primip. Females	Multip. Females	Σ
14	3			3
14.5				0
15				0
15.5	1			1
16	3			3
16.5	3			3
17	3			3
17.5	10			10
18	25			25
18.5	34			34
19	45			45
19.5	49			49
20	75			75
20.5	58			58
21	61		1	62
21.5	55	1		56
22	77	1	2	80
22.5	79	2	1	82
23	83	5	4	92
23.5	94	4	4	102
24	124	5	5	134
24.5	107	1	6	114
25	132	2	7	141
25.5	124	5	8	137
26	136	8	22	166
26.5	78	21	41	140
27	66	25	42	133
27.5	48	18	52	118
28	29	32	75	136
28.5	11	38	87	136
29	1	19	93	113
29.5		22	95	117
30	1	3	97	101
30.5		3	76	79
31		1	57	58
31.5			43	43
32			20	20
32.5			15	15
33			13	13
33.5			11	11
34			3	3
34.5			2	2
35				
35.5				
Σ	1615	216	882	2713
Σ	ma 1615	mi 35	mg 4	gm 177
mean CL	23.51	26.61	28.00	27.70
%	59.53	1.29	0.15	6.52
Σ	ag 29	ga 219	ea 69	em 525
mean CL	28.50	29.73	28.67	28.89
%	1.07	8.07	2.54	19.35
Σ	eg 40			
mean CL	29.61			
%	1.47			

Table 3. The mean carapace length (Cl), proportion (PR) and standard deviation (SD) for each age class from the Icelandic samples in the years 1997 and 1998 in the eastern part of the Denmark Strait ar

March-May 1997

Age	Males			Primip. females			Multip. females		
	CL	PR	SD	CL	PR	SD	CL	PR	SD
3	18.1	0.0076	0.81						
4	21.9	0.1145	0.98						
5	24.1	0.2011	1.08	23.8	0.0059	1.07	24.2	0.0152	1.18
6	25.6	0.1766	1.15	27.7	0.0922	1.25	27.4	0.1932	1.18
7							29.6	0.1845	1.18
8							32.3	0.0092	1.18

January-May 1998

Age	Males			Primip. females			Multip. females		
	CL	PR	SD	CL	PR	SD	CL	PR	SD
2	13.8	0.0015	0.62						
3	18.4	0.0374	0.83						
4	20.4	0.1110	0.92						
5	23.2	0.1752	1.04	23.3	0.0071	0.83	23.5	0.0075	1.06
6	25.8	0.2703	1.16	27.9	0.0725	1.18	27.2	0.0665	1.23
7							29.5	0.2192	1.33
8							31.7	0.0318	1.43

Table 4. Mean carapace length mm of northern shrimp in the area north of 65°N as esimated from Icelandic samples in the Denmark Stralt in February-May. The birthday here is 1st of January.

MALES							
Year/"Agegroups"	2	3	4	5	6	7	8
1991	15.0	18.5	21.0	24.0	27.0		
1992		18.0	21.1	23.8	25.6		
1993		17.8	20.1	22.7	25.1		
1994	14.0	18.1	20.3	23.0	25.6		
1995		19.7	21.0	24.0	26.2		
1996	16.3	19.4	21.9	24.5			
1997		18.1	21.9	24.1	25.6		
1998	13.8	18.4	20.4	23.2	25.8		
Mean	14.8	18.5	21.0	23.7	25.8		
Primiparous females							
1991				25.6	28.6		
1992				25.1	27.9		
1993				24.2	27.6		
1994				23.9	27.0		
1995					27.3		
1996				24.1	27.1		
1997				23.8	27.7		
1998				23.3	27.9		
Mean				24.3	27.6		
Multiparous females							
1991					26.1	30.2	32.0
1992					26.0	30.1	32.7
1993					25.2	29.7	
1994				22.9	26.3	28.8	31.4
1995					25.6	28.9	31.6
1996				24.0	27.2	29.5	31.3
1997				24.2	27.4	29.6	32.3
1998				23.5	27.2	29.5	31.7
Mean				23.7	26.4	29.5	31.9

Table 5. Proportions by age groups of northern shrimp as esimated from Icelandic samples in the Denmark Strait north of 65°N in February-May in the years 1991-1998.

Year/"Agegroups"	2	3	4	5	6	7	8
MALES							
1991	0.0195	0.0672	0.2789	0.2512	0.0389		
1992		0.0231	0.1589	0.2122	0.1709		
1993		0.0244	0.1450	0.2655	0.2215		
1994	0.0049	0.0513	0.1370	0.1917	0.1112		
1995		0.0275	0.0353	0.0733	0.0836		
1996	0.0040	0.0535	0.2907	0.3475			
1997		0.0076	0.1145	0.2011	0.1766		
1998	0.0015	0.0374	0.1110	0.1752	0.2702		
Mean	0.0075	0.0365	0.1589	0.2147	0.1533		
Primiparous females							
1991				0.0238	0.0902		
1992				0.0103	0.0603		
1993				0.0246	0.0638		
1994				0.0260	0.0620		
1995					0.0562		
1996				0.0083	0.0867		
1997				0.0059	0.0922		
1998				0.0071	0.0725		
Mean				0.0151	0.0730		
Multiparous females							
1991					0.0305	0.1732	0.0250
1992					0.0498	0.2821	0.0328
1993					0.0327	0.2225	
1994				0.0191	0.0383	0.2438	0.1149
1995					0.0264	0.5042	0.1936
1996				0.0098	0.1010	0.0814	0.0171
1997				0.0152	0.1932	0.1845	0.0092
1998				0.0075	0.0665	0.2193	0.0318
Mean				0.0129	0.0673	0.2389	0.0606

Table 6. Overall proportions by age of northerrn shrimp as estimated from Icelandic samples in the Denmark Strait in February-May.

Year/"Agegroups"	2	3	4	5	6	7	8
1991	0.0195	0.0672	0.2789	0.2750	0.1596	0.1732	0.0250
1992		0.0231	0.1589	0.2225	0.2810	0.2821	0.0328
1993		0.0244	0.1450	0.2901	0.3180	0.2225	
1994	0.0049	0.0513	0.1370	0.2368	0.2115	0.2438	0.1149
1995		0.0275	0.0353	0.0733	0.1661	0.5042	0.1936
1996	0.0040	0.0535	0.2907	0.3656	0.1877	0.0814	0.0171
1997		0.0076	0.1145	0.2222	0.4620	0.1845	0.0092
1998	0.0015	0.0374	0.1110	0.1898	0.4092	0.2192	0.0318
Mean	0.0075	0.0365	0.1589	0.2344	0.2744	0.2389	0.0606

Table 7 . Size of shrimp where 50% are mature females (L50) in the Denmark Strait north of 65° N from Icelandic shrimp samples. The season is from 1 June to 31 May in the latter year.

	Seasons										
	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98
L50 per sample	29.5	28.9	NA	26.2	27.3	27.5	27.5	26.5	28.5	27.0	27.0
	29.1	27.4		25.3	27.7	27.9	26.5	26.4	28.3	26.7	27.7
	28.2	28.8		26.5	28.1	27.6	26.7	27.3	26.8	28.2	27.1
	28.6			29.3	26.1	27.1	26.6	26.5	26.8	26.7	27.0
	29.0			27.4	27.9	26.6		26.5	27.1	27.3	27.0
	29.4			26.9		27.3		26.4	27.2	26.5	27.2
	28.9			25.4		27.2		27.2	26.1	27.3	28.7
	25.1			27.8				26.5	27.2	26.2	27.0
	28.0			27.4					27.7	27.4	27.7
	24.7			25.5					27.5	27.3	27.9
	27.6			28.1					27.2	27.4	27.5
	27.6			26.7					26.6	27.6	27.4
	28.0			27.0					27.4	26.7	28.3
	29.1			27.2					26.6	28.8	28.3
	28.4			29.7						28.0	28.2
	29.2			29.1						27.6	26.6
	29.3			27.7						26.2	28.1
	28.8			27.8						26.5	27.9
	27.6									26.7	28.4
	28.6									26.5	27.2
	28.4									27.1	26.5
	28.7									26.6	27.1
	28.0									26.7	
	28.6									27.3	
	27.0									26.7	
	28.6									27.3	
	28.9										
	28.8										
	29.3										
	28.0										
	29.3										
	28.2										
	27.4										
	27.1										
	27.3										
No. samples	35	3		18	5	7	4	8	14	26	22
Average	28.2	28.4		27.3	27.4	27.3	26.8	26.7	27.2	27.1	27.5
St. Dev.	1.1	0.8		1.3	0.8	0.4	0.5	0.4	0.7	0.6	0.6

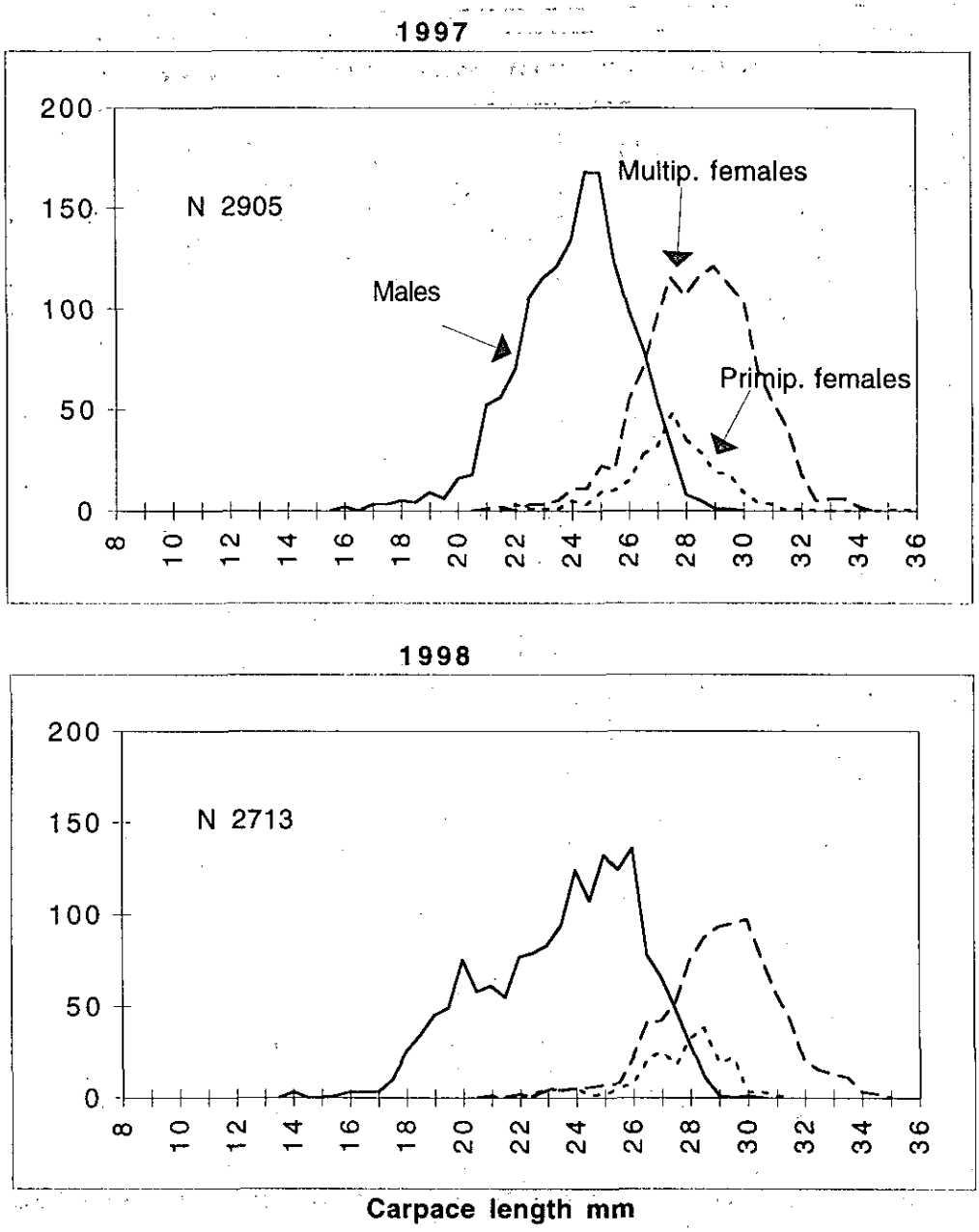

Fig. 1. The Icelandic samples in 1997 and 1998.