

Northwest Atlantic



Fisheries Organization

Serial No. N2960

NAFO SCR Doc. 97/103

SCIENTIFIC COUNCIL MEETING - NOVEMBER 1997

The Icelandic Shrimp Fishery (*Pandalus borealis* Kr.) in the Denmark Strait in 1996-1997
and Some Reflection on Age Groups in the Years 1991-1996

by

U. Skúladóttir

Marine Research Institute, Skúlagata 4
P. O. Box 1390, 121 Reykjavik, Iceland

Abstract

In this paper there are logbook information on the Icelandic fishery for the years 1995-1996 as well as nominal catches.

Age determination of the shrimp samples taken on the eastern side of the midline in 1995 were and 1996 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 18% of the year-class and the rest of the year-class will spawn at the age of 6 for the first time as the birthday is assumed to be the 1st of January. The oldest shrimp detected were 8 years. As the young shrimp are never found, the assumed age could well be a year older.

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 1996 and 1997 as well as the nominal catch.

There has been a growing need to assess the age of shrimp in Denmark Strait. This is now done as before using the modal analysis.

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. Whereupon the nominal catch for the same period is divided by the CPUE to get the corrected effort. Twin trawls were treated by doubling the effort of twin trawls.

The measuring of the shrimp is 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 grouped 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 frequency

distributions (lfd.) of males, primiparous females and multiparous females was run separately. It was tried first to assign many age-groups to the lfd. and then reduce the number to find the best fit. For the more difficult lfd. a constraint had to be put on the coefficient of variation of the so-called 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.

Catch and effort data

In 1996 the fishery was carried out in the period February through June with occasional tows taken in the autumn. But most of the catch was taken in March and April. The total annual catch was only 566 tons in 1996 (table 1) as compared to 2718 tons in 1997. The mean CPUE for the year 1995 was the highest ever for Iceland, namely 309 kgs per trawling hour. In 1996 the mean CPUE was 240 kg, which was also rather high. The CPUE was lower in 1997 i.e. 172 kg. It should be pointed out that twin trawls were more in use in 1997 than in 1996 where there was little usage of twin trawls. The average size of gear was about 3200 meshes circumference in 1997 as compared to 3120 meshes in 1996 (2400 meshes of most previous years).

Commercial Samples

The samples were obtained from shrimpers in 1996 and 1997. 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. 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 83% were carrying eggs in 1997, but 17% were not carrying eggs, and are considered to be in the resting phase. As pointed out before most 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 these proportions were 28% not carrying eggs.

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 primiparous 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 1997 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 1991-1997 now assuming the birthday to be the first of January. This is different from what was assumed before when the birthday was assumed to be first of June. Consequently all age groups are here a year younger than was stated in previous years. For the males there appears to be great consistency between years in the mean lengths 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 so-called 2 year olds, their mean size is therefore badly determined. 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 always seemed to be bimodal except for May 1992 and again in 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 is usually unable to pick up more than 3 age groups at a time except for 1994, 1996 og 1997 when there were 4 year classes. The youngest, i.e the 5 year old multiparous females only represent 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 proportions these seem generally to be highest of 5, 6 and 7 year olds (Table 6).

References

- Macdonald, P. D. M., and Y. J. Pitcher. 1979. Age-groups from size-frequency data: a versatile and efficient method of analyzing distribution mixtures. J. Fish. Res. Board Can., 36: 987-1011.
- McCrary, J. A. 1971. Sternal spines as characteristic for differentiating between females of some Pandalidae. J. Fish. Res. Board Can., 36: 987-1001.
- Rasmussen, B. 1953. On the geographical variation in growth and sexual development of the deep sea prawn (*Pandalus borealis* Kr.). FiskDir. Skr. Ser. Havunders. 10 (3) : 160 p.
- Skúladóttir, U. 1994. The Icelandic Shrimp fishery (*Pandalus borealis*) in the Denmark Strait in 1992- 1994, and a preliminary estimation of age. NAFO SCR Doc. 94/97. Serial No. N2486, 10 p.
1995. The Icelandic Shrimp fishery (*Pandalus borealis*) in the Denmark Strait in 1994- 1995, and some reflection on age groups in tha years 1991-1995. NAFO SCR Doc. 95/108. Serial No. N2647, 7 p.
1996. The Icelandic Shrimp fishery (*Pandalus borealis*) in the Denmark Strait in 1995- 1996, and some reflection on age groups in tha years 1991-1996. NAFO SCR Doc. 96/108. Serial No. N2805, 8 p.

Table 1. The catch, effort and CPUE as reported by Icelandic logbooks. in the Denmark Strait in 1996 and 1997.

YEAR	MONTH	FROM LOGBOOKS		
		CPUE kg/hr	EFFORT Tr. hours	CATCH Tonnes
1996	February	198	1249	246.842
	March	229	359	82.316
	April	341	618	210.885
	May	59	12	0.712
logbooks	Σ Feb-May	242	2238	540.755
Nominal catch	Σ Feb-May	242	2297	555.011
1996	July	495	7	3.466
	August	164	14	2.300
	September	122	40	4.860
logbooks	Σ July-Sept	174	61	10.626
Nominal catch	Σ July-Sept			
Nominal catch	ΣΣ 1996	240	2358	565.637
1997	Janury	24	7	0.170
	February	248	802	198.966
	March	261	4290	1120.624
	April	285	2596	738.690
	May	135	1211	163.314
	June	557	83	46.236
logbooks	Σ Feb-June	252	8989	2268.000
Nominal catch	Σ Feb-June	252	9432	2379.670
1997	Sept	163	16	2.600
	Oct	28	70	1.961
logbooks	Σ July-Oct	53	86	4.561
Nominal catch	Σ July-Oct	53	6376	338.127
Nominal catch	ΣΣ 1997	172	15807	2717.797

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			
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	30			30
21.5	37			37
22	36	2		38
22.5	45		3	48
23	54		2	56
23.5	50	1	3	54
24	58	1	8	67
24.5	83	1	5	89
25	88	3	14	105
25.5	68	3	11	82
26	43	12	39	94
26.5	34	14	50	98
27	30	24	61	115
27.5	14	25	74	113
28	2	13	74	89
28.5	3	14	76	93
29	1	10	73	84
29.5	1	12	60	73
30		6	62	68
30.5		4	40	44
31		2	28	30
31.5			23	23
32		1	6	7
32.5			3	3
33			5	5
33.5			2	2
34			2	2
34.5				
35				
35.5				
Σ	717	148	724	1588
Σ	ma	mi	mg	gm
mean CL	717	14	4	130
%	23.98	26.93	25.25	27.78
%	45.12	0.88	0.25	8.18
Σ	ag	ga	ea	em
mean CL	7	90	5	599
%	27.07	29.69	27.50	28.20
%	0.44	5.66	0.31	37.70
Σ	eg			
mean CL	23			
%	28.04			
%	1.45			

April 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				0
18				0
18.5	1			1
19				0
19.5	1			1
20	4			4
20.5	5			5
21	13			13
21.5	9			9
22	17	1		18
22.5	29	1		30
23	30	1	1	32
23.5	27			27
24	23	3		26
24.5	23			23
25	34	2	1	37
25.5	24	3	2	29
26	14	3	4	21
26.5	18	3	7	28
27	7	2	10	19
27.5	3	12	15	30
28	1	11	7	19
28.5		3	9	12
29		2	21	23
29.5			22	22
30			9	9
30.5			10	10
31			6	6
31.5			5	5
32			3	3
32.5			2	2
33			1	1
33.5			3	3
34				0
34.5				
35				
35.5				
Σ	285	47	138	470
Σ	ma	mi	mg	gm
mean CL	285	8	1	38
%	23.82	24.81	25.50	27.24
%	60.64	1.70	0.21	8.09
Σ	ag	ga	ea	em
mean CL	1	33	0	94
%	26.50	30.02	0.00	28.69
%	0.21	7.02	0.00	20.00
Σ	eg			
mean CL	10			
%	28.10			
%	2.13			

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
Σ	ma	mi	mg	gm
mean CL	140	1	0	32
%	24.08	26.50	0.00	27.94
%	60.61	0.43	0.00	13.85
Σ	ag	ga	ea	em
mean CL	4	17	0	32
%	27.50	29.29	0.00	27.25
%	1.73	7.36	0.00	13.85
Σ	eg			
mean CL	5			
%	28.40			
%	2.16			

Table 3. The mean carapace length (CL), proportion (PR) and standard deviation (SD) for each age class from the Icelandic samples in the years 1996 and 1997 in the eastern part of the Denmark Strait area.

February-April 1996

Age	Males			Primip. females			Multip. females		
	CL	PR	SD	CL	PR	SD	CL	PR	SD
2	16.3	0.004	0.81						
3	19.4	0.0535	0.97						
4	21.9	0.2907	1.10						
5	24.5	0.3475	1.22	24.1	0.0083	1.21	24.0	0.0098	0.93
6				27.1	0.0867	1.36	27.2	0.1010	0.93
7							29.5	0.0814	0.93
8							31.3	0.0171	0.93

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

Table 4. Mean carapace length (mm) of northern shrimp as estimated from Icelandic samples in the Denmark Strait 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		
Mean	15.1	18.5	21.0	23.7	25.9		
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		
Mean				24.5	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
Mean				23.7	26.3	29.5	31.9

Table 5. Proportions by age groups of northern shrimp as estimated from Icelandic samples in the Denmark Strait in February-May in the years 1991-1997.

MALES							
Year/"Agegroups"	2	3	4	5	6	7	8
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		
Mean	0.0095	0.0364	0.1658	0.2204	0.1338		
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		
Mean				0.0165	0.0731		
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
Mean				0.0145	0.0465	0.2512	0.0767

Table 6. Overall proportions by age of northern shrimp as estimated from Icelandic samples in the Denmark Strait.

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
Mean	0.0095	0.0364	0.1658	0.2408	0.2551	0.2417	0.0654

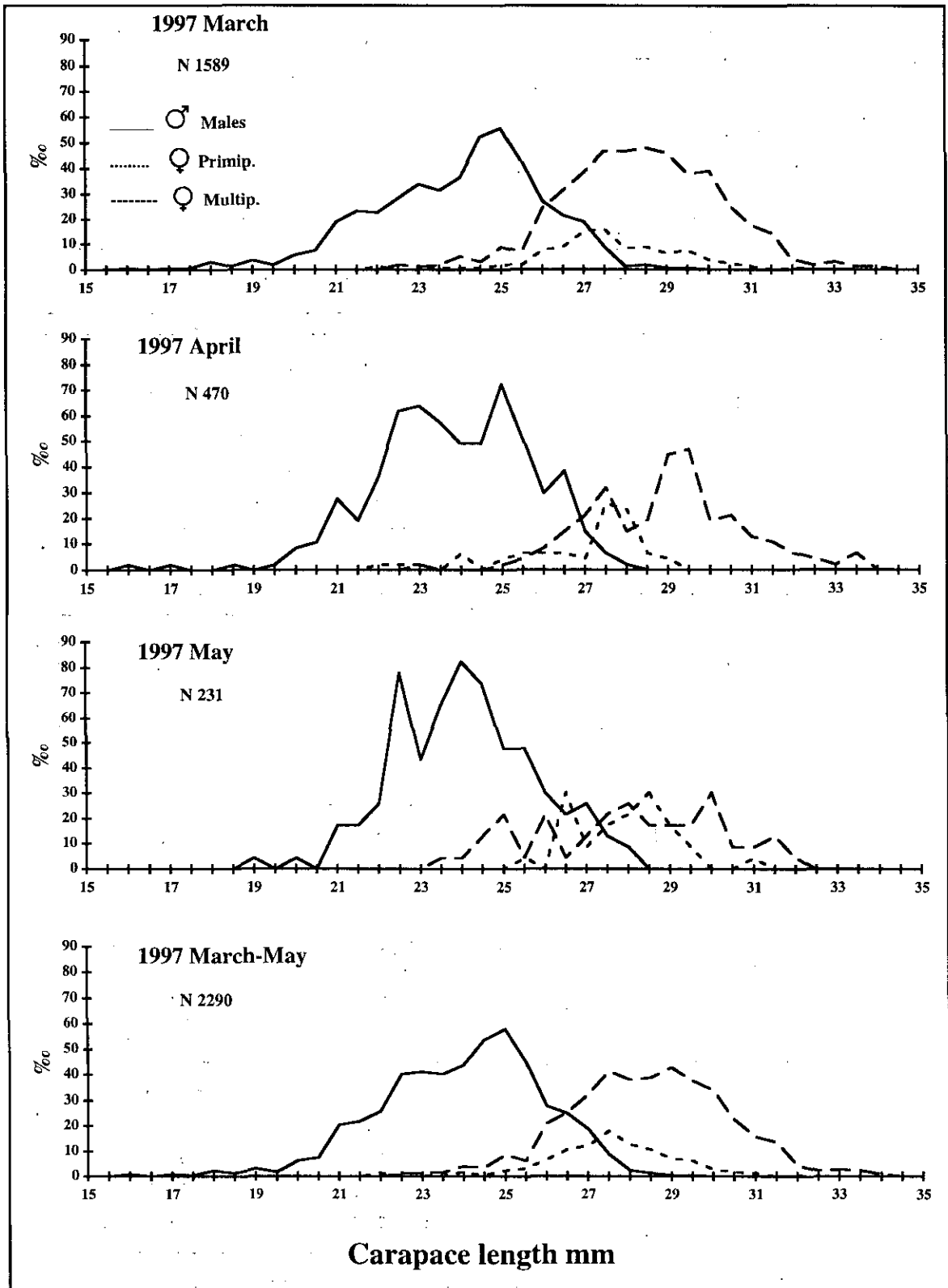


Fig 1. The Icelandic samples in 1997