

The Spawning and Fecundity of Norway Lobsters around the Scottish Coast

by

H.J. Thomas



Introduction

A preliminary report on the maturity stages of the ovaries of Norway lobsters taken from the Firth of Forth in September 1959 was given by Thomas, 1960. The present results are from investigations extending the work in the Forth and in other commercial Norway lobster fishing areas. The work is part of the investigations into the biology and fishery for this species, which has assumed considerable economic importance in Scotland, undertaken at the Marine Laboratory, Aberdeen.

The generous help of Mr. W.B. Hall in the statistical treatment of the fecundity determinations is gratefully acknowledged.

Material and Methods

During June-August 1961 the fishery research ship "Scotia", using an otter trawl with small mesh attachment, collected Norway lobsters from the Firth of Forth, Moray Firth, North Minch, South Minch and the Firth of Clyde, these being the major commercially exploited Norway lobster grounds in Scotland. In the Moray Firth sampling was undertaken on three occasions, during June, July and August respectively. Sampling in the other areas was confined to the middle of July.

Female Norway lobsters were measured, taking the carapace length in mm. A note was made of those individuals carrying spermatophores and a record as to the condition of the animal, soft-hard, berried/non-berried.

A note was made as to the colour and state of development of the eggs of females carrying spawn. In addition the ovaries were examined in the fresh condition and classified into five stages according to their appearance as follows:-

- 0 Ovary attenuated, smooth. Lateral wings drawn out in membranous points; soft, does not break easily. Right and left lobes separate easily. No eggs visible to naked eye. Colour translucent white.
- I Ovary filling out, still smooth with lateral wings appearing as flattened projections. Right and left lobes separate less easily than in stage 0 soft. Colour grey to pale yellow. Weight of individual eggs 0.14 mg.
- II Further expansion of ovary especially at anterior ends. Slight corrugations appearing. Eggs just visible to naked eye. Soft, colour yellowish. Weight of individual eggs 0.15-0.29 mg.
- III Expansion causing corrugations all over ovary. Decided lateral extension. Ovary firm and the two lobes do not separate easily. Colour pale green. Weight of individual eggs 0.30-0.54 mg.
- IV Ovary very swollen with anterior ends pushing forward and reaching to back of eye-socket. Ovary hard and does not break easily. Colour green. Weight of individual eggs 0.55-0.84 mg.
- V Anterior ends of ovary very swollen and fully expanded and turning inwards. Hard and brittle and difficult to remove without breaking. Colour dark green. Weight of individual eggs 0.85 mg.

In addition samples of mature females, from the above five areas, were preserved in 4% formalin. These, together with a sample collected off the east of Shetland, were used in fecundity determinations. The whole ovary was dissected out then weighed. Two portions, together representing between one-quarter and one-half of the whole ovary, were broken off and weighed. The eggs in these portions were then counted and from this a calculation made of the total number of eggs. About 20 egg counts of whole ovaries were made as a check on the validity of this method. After spawning the eggs become attached to the pleopods of the female. For comparison with egg counts of the ovary counts were also made of the spawn.

## Results

The stages of the development of the ovary in mature Norway lobsters - that is those carrying spermatophores - is shown for the Moray Firth during June, July and August in Table 1, page 4. In June 28% were in stage III. The corresponding percentage in July was 13% and in August 8% when the percentages in more advanced stages of development were correspondingly increased. This change reflects the development in the ovaries over the period. Of the females sampled during June, only 23% were at stage V of ovary development as opposed to 46 and 47% during July, August respectively. However, in August a proportion of early spawners will have become berried and have left the catchable stocks, consequently reducing the percentage of stage V. 90% of the mature females examined in June carried ovaries of stages III to V and, having regard to the rates of development of the ovary shown by the comparison of samples taken during June, July and August, it is reasonable to suppose that at least this percentage of females will spawn before the end of the following October, at which time females largely disappear from the catch. The evidence suggests that, in this area at least, mature female Norway lobsters spawn annually.

The stages of ovary development of mature female Norway lobsters from the Firth of Forth, the North Minch and the South Minch respectively during July 1961 are shown in Tables 2 and 4, page 5. Although the Firth of Forth shows the highest percentage of females in stage V of ovary development and correspondingly the lowest in stage III, the differences between the areas are not such as to suggest any material differences in the development and main spawning season. From all areas 69 females, carrying spermatophores, were in a soft condition. Of this total 33% were at ovary development stage II, 32% at stage III and 25% at stage IV. Since the female Norway lobster casts shortly after hatching of the eggs, it would appear that the early stages of ovary maturity from stage  $\bar{0}$  at the time of spawning to around stage III at the time of hatching, occur during the berried condition. The peak hatching period around Scotland is April/May (Thomas, 1954). This evidence confirms the conclusion that mature female Norway lobsters around Scotland spawn annually.

The percentage of the catch of female Norway lobsters in the range of carapace length 16-35 mm, which are mature, as indicated by the presence of spermatophores, is shown in Table 5, page 6.

At about 23 mm carapace length 50% of female Norway lobsters are mature whilst virtually the whole population of 29 mm carapace length and over are mature. Of the smallest mature sizes, carapace length 22-24 mm, the majority of females carrying spermatophores were in stages IV or V of ovary development, Table 5. Of 43 individuals found not carrying spermatophores 37 were at maturity stage  $\bar{0}$ . The remainder were at ovary stage I. No individual up to 35 mm carapace length and not bearing spermatophores was found with an ovary in development stage more advanced than I. The data for the four areas shown in Table 5 are closely similar and suggest that these characteristics are uniform throughout the stocks around Scotland (excluding the Firth of Forth).

The relationship between carapace length and the number of eggs in the ovary of mature females is shown in Figure 1.

Table VI gives the regression equations for samples from individual areas. Further analyses of these samples showed that the slopes of these equations are not significantly different (i.e. on a logarithmic scale the five lines can be regarded as being parallel). This common slope is  $b = 2.350$ . The distances between the lines, however, are significantly different ( $P < 0.001$ ). Of the following areas those which are not significantly different from each other, are underlined.

Firth of Clyde The Minch E. Shetland Moray Firth Firth of Forth

Although apparently "undamaged" specimens only were used estimation of the number of eggs carried by Norway lobsters in spawn shows a somewhat lower average than the estimates based on the number of eggs in the ovaries. Most probably, this is due to eggs having been brushed off by the fishing operations since examination of the ovaries of newly spawned Norway lobsters indicates a complete extrusion of the eggs. Fecundity determinations based on counts of the number of eggs in the ovary would seem to be more reliable than egg counts of the spawn.

Table 6. The regression equations for the relationship between the number of eggs in the ovary and carapace length in mm for mature female Norway lobsters from stated areas in Scotland and overall

Firth of Forth	$F = 0.803 L^{2.267}$
Moray Firth	$F = 0.408 L^{2.450}$
Minch	$F = 0.808 L^{2.204}$
Firth of Clyde	$F = 0.353 L^{2.423}$
Shetland	$F = 0.128 L^{2.758}$
Overall	$F = 0.526 L^{2.350}$

Summary

Female Norway lobsters collected from the five major commercially exploited Norway lobster grounds around Scotland, during June-August, 1961, were examined for ovary condition. On the basis of the state of development of the eggs and the colour of the ovary, the latter was classified, according to its stage of development, into one of a series of five groups. Note was made as to the condition of the animal; soft/hard; berried/non-berries; with/without spermatophores.

Of the mature females (those carrying spermatophores) at least 90% were in an advanced stage of ovary development suggesting that at least this percentage were due to spawn before the end of the following October, at which time females largely disappear from the catch.

Of all mature females with soft shells, namely those recently cast, 53% were at ovary development stage II, 32% at ovary development stage III and 35% at ovary development stage IV. Since the female Norway lobster casts shortly after hatching of the eggs, it would appear that mature female Norway lobsters around Scotland spawn annually.

About 50% of female Norway lobsters of 23 mm carapace length were mature. Sizes at first maturity and the seasons of spawning and hatching were closely similar throughout the areas investigated.

Egg counts were made of ovaries from female Norway lobsters of various sizes and from the principal fishing areas around Scotland. The fecundity of the Norway lobsters from the various areas differed significantly. The lowest level of fecundity occurred on the south-west, the number of eggs increasing on the grounds to the north and east being highest in the Firth of Forth. Taking Scotland as a whole, the mature female Norway lobster of 35 mm carapace length produces on the average about 2,200 eggs annually.

References

- |              |      |  |
|--------------|------|--|
| Thomas, H.J. | 1960 | "Nephrops III. The biology of the Norway Lobster". Contribution no. 178 to ICES Shellfish Committee.   |
| Thomas, H.J. | 1954 | "Some observations on the distribution, biology and exploitation of the Norway lobster ( <u>Nephrops norvegicus</u> L.) in Scottish waters". Mar. Res. Scot., no. 1. |

Table 1. The percentage of total female Norway lobsters, carrying spermatophores, in stages 0 to V of ovary developments for each carapace length group (mm) and overall occurring in the Moray Firth - A during 20-30 June, B - 22-24 July and C - 16-18 August 1961 respectively.

A	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No in sample	-	9	102	141	79	20	1	352
Maturity stage								
O		-	6	0.7	-	-		2
I		-	4	1	-	-		2
II		-	5	6	6	5		6
III		23	27	30	24	40	100	28
IV		44	30	45	41	40		39
V		33	27	16	29	15		23
B	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No in sample		14	172	422	213	57	5	883
Maturity stage								
O			0.6					+
I			5	2	4			3
II			5	8	14	16		9
III		14	9	15	13	9	20	13
IV		43	26	31	23	31	60	28
V		43	55	44	46	44	20	47
C	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No. in sample	0	2	20	35	19	0	0	76
Maturity stage								
O	-	50	-	-	-	-	-	1
I	-	50	5	3	-	-	-	4
II	-	-	5	6	16	-	-	8
III	-	-	5	8	10	-	-	8
IV	-	-	50	28	26	-	-	33
V	-	-	35	54	47	-	-	46

Table 2. The percentage of total female Norway lobsters, carrying spermatophores, in stages 0 to V of ovary development for each carapace length group (mm) and overall occurring in the Firth of Forth during 26-27 July, 1961.

	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No. in sample	-	-	12	34	89	60	8	203
Maturity stage								
0			-	-	-	-	-	-
I			-	-	-	-	-	-
II			-	-	6	5	12	6
III			-	6	10	8	12	8
IV			-	21	49	37	12	36
V			100	73	35	50	63	51

Table 3. The percentage of total female Norway lobsters, carrying spermatophores, in stage 0 to V of ovary development for each carapace length group (mm) and overall occurring in the North Minch during 19th July 1961.

	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No. in sample	-	6	90	94	8	-	-	198
Maturity stage								
0		-	3	-	-			2
I		-	1	-	-			+
II		-	-	1	-			+
III		-	8	9	25			9
IV		83	47	34	13			40
V		17	41	56	62			48

Table 4. The percentage of total female Norway lobsters, carrying spermatophores, in stages 0 to V of ovary development for each carapace length group (mm) and overall occurring in the South Minch during 16-17 July 1961.

	Carapace Length groups (mm)							Overall percentage
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
No. in sample		2	9	35	34	3	-	83
Maturity stage								
0		50	11	-	-	-		21
I		-	-	-	3	-		1
II		-	-	-	3	-		1
III		50	11	17	15	-		16
IV		-	67	29	38	-		35
V		-	11	54	41	100		45

Table 5. The percentage of the total number of female Norway lobsters in each 1 mm carapace length group, between 16-35 mm, carrying spermatophores and in stages O-V of ovary development from material collected during mid-July 1961 in stated fishing areas and overall.

		Carapace length mm																			
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
<u>Firth of Forth</u>							1				1	3	1	1	5	3	3	5	12	8	12
No. in sample																					
% with spermatophores							0				66	100	100	100	100	100	100	100	100	100	100
( O																					
% at ovary maturity stage	( I																				8
	( II																				
	( III															33					
	( IV																66	20	25	13	42
	( V									100	100	100	100	100	66	33	80	75	87	50	50
<u>Moray Firth</u>						1	2	3	3	13	20	29	31	43	51	89	79	89	98	71	66
No. in sample																					
% with spermatophores						0	0	33	66	85	95	96	97	100	100	99	100	100	100	100	100
( O											5	4									
% at ovary maturity stage	( I											7	6	1	3	2	3	1	6		
	( II										4	10	2	6	9	13	3	5	8	11	
	( III								18	5	11	10	12	6	15	9	20	12	21	7	
	( IV							50	45	5	18	30	35	27	33	37	22	25	31	32	
	( V				100			50	37	84	57	50	44	55	42	39	52	44	38	44	
<u>North Minch</u>									3	5	14	11	27	17	23	24	28	21	11	10	6
No. in sample																					
% with spermatophores									66	80	93	100	100	94	100	100	100	100	100	100	100
( O											8	9									
% at ovary maturity stage	( I										9	9									
	( II																				
	( III									8		7	6	13	8	18			10	16	
	( IV							50	100	61	36	52	50	35	37	39	29	36	20	16	
	( V							50		23	45	41	44	48	55	39	71	64	70	67	
<u>South Minch</u>				1		1	6	7	10	12	17	17	18	23	24	28	17	21	16	8	12
No. in sample																					
% with spermatophores			0	0	0	0	30	50	75	88	100	94	100	100	100	94	100	100	100	100	100
( O			0	0	0	0	50					6	4								
% at ovary maturity stage	( I		0	0	0	0															
	( II		0	0	0	0															
	( III		0	0	0	0		40	33	20	12	41	22	8	11	25	14	19	25	8	
	( IV		0	0	0	0	50	40	66	60	76	6	48	67	46	38	62	38	50	67	
	( V		0	0	0	0		20		20	12	47	26	25	43	31	24	38	25	25	
<u>Overall</u>				1		2	9	10	16	30	52	60	77	84	103	144	127	136	127	97	96
No. in sample																					
% with spermatophores			0	0	0	0	30	56	80	92	97	97	99	100	99	99	100	100	100	100	100
O			0	0	0	0	33				2	3	1	1	1						
I			0	0	0	0					5	5	4	3	1	2	1	2	1	4	
II			0	0	0	0					2	4	1	3	5	9	2	5	6	8	
III			0	0	0	0		22	21	10	9	16	13	8	13	13	15	12	19	7	
IV			0	0	0	0	33	44	63	38	38	41	41	37	36	38	29	30	30	36	
V			0	0	0	0	33	33	16	48	43	37	40	48	45	38	51	51	44	44	

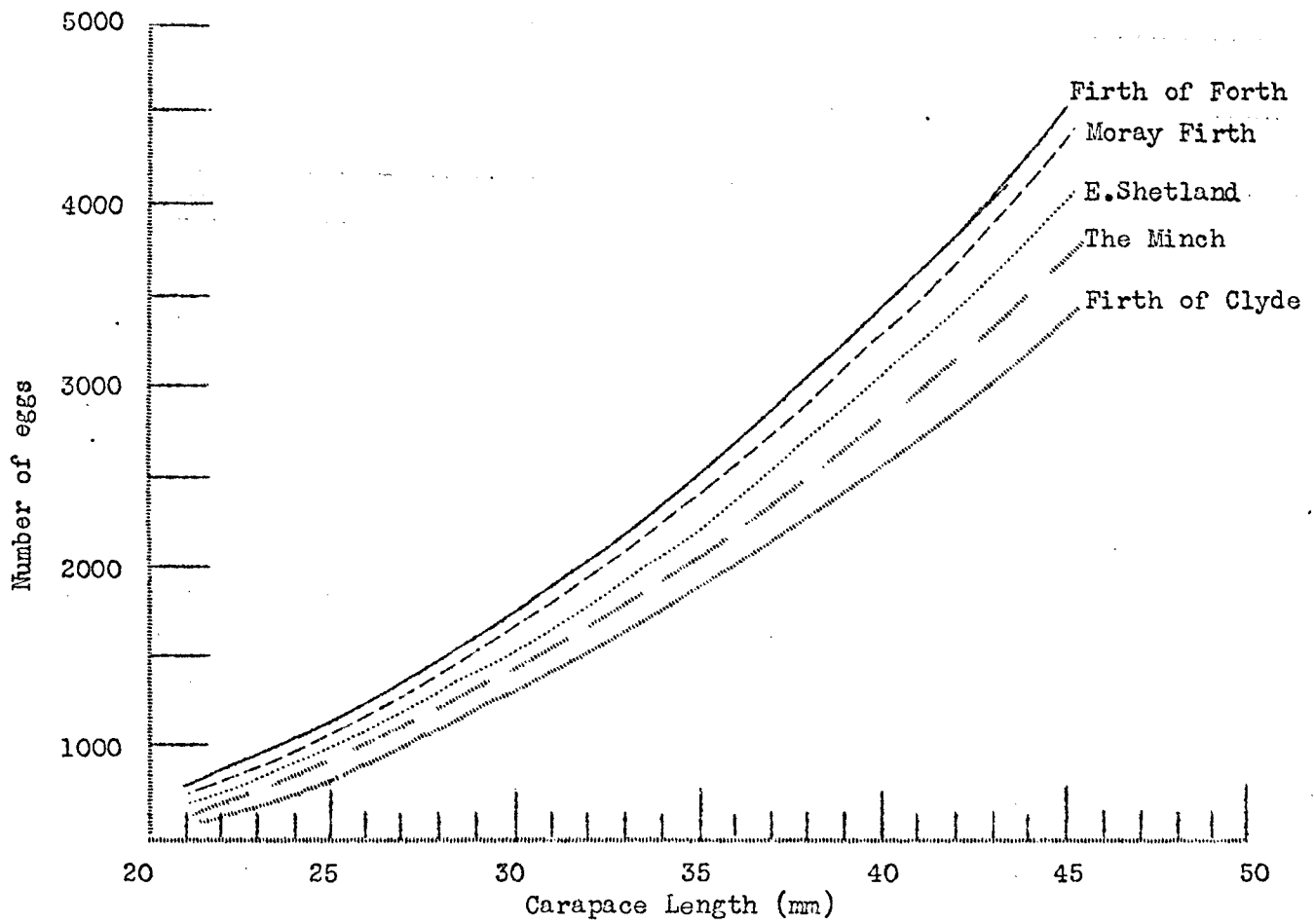


Figure 1. The relationship between carapace length and number of eggs in the ovaries of mature female Norway lobsters, shown for stated areas in Scotland.