EGG LOSS DURING INCUBATION FROM OFFSHORE NORTHERN LOBSTERS (DECAPODA: HOMARIDAE)

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ABSTRACT

Egg loss during incubation from offshore northern lobsters, *Homarus americanus* Milne Edwards, was estimated by counting the eggs of 196 females. The lobsters were captured along the continental shelf off southern New England during October (eggs recently extruded), April, and June (eggs nearly ready to hatch). Egg loss during the period October to June averaged 36% for females of all sizes studied.

The exploitation of northern lobsters in the offshore canyons of the continental shelf is steadily increasing (Skud, 1969). Owing to this increased effort, the National Marine Fisheries Service (formerly the Bureau of Commercial Fisheries) has initiated a study of the biology and population dynamics of the stock. As accurate estimates of fecundity are useful for studying population dynamics, the present study was undertaken to determine the extent of egg loss from female *Homarus americanus* during embryonic development and the consequential magnitude of error in estimating fecundity if any loss occurs. Brunel (1962, 1963) has shown that female spider crabs, *Chionoectes opilio*, may lose over half their eggs during the incubation period. The present paper shows the extent of egg loss from the northern lobster and the difference in fecundity estimates depending on the time during the development period when the eggs are counted.

METHODS AND MATERIALS

The lobsters were captured with otter trawls during research and commercial cruises at Hudson, Veatch, Oceanographer, Lydonia, and Corsair Canyons. These canyons are located along the edge of the continental shelf, south and east of New England. The 196 female lobsters used in this study were divided into 5-mm groups according to carapace length. The mean number of eggs and the range for each 5-mm group are recorded in Table 1. Carapace length was measured from the posterior edge of an eye socket to the distal edge of the carapace.

The females were frozen at sea, later thawed in the laboratory and their eggs removed from the pleopods by stripping with small forceps. The eggs were hardened in Formalin for 24 hr, then soaked in fresh water before being dried in an oven at 150° C. Drying time lasted 1 to 2 hr depending on the size of the egg mass. After drying, the individual egg masses were rubbed over a 1-mm screen to break up any clusters and eliminate non-egg material, then counted with an electronic counter (Boyar and Clifford, 1967). Test runs with the counter produced a maximum error of ± 2%. The counts given represent numbers of viable eggs only (non-viable eggs are rarely observed in masses of developing eggs).

RESULTS AND DISCUSSION

A curvilinear relationship was apparent when the number of eggs was plotted on the corresponding carapace length. The same result was noted by Saila, Flowers, and Hughes (1969). In order to employ covariance analyses in this study, the data were transformed to natural logarithms. The lines presented in Figure 1 were plotted from the antilogarithms of the values calculated from the linear regression equations (Table 2).

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TABLE 1.—Month of capture, range and mean number of eggs for each 5-mm carapace length group for the 196 offshore female lobsters.

Carapace length groups (mm)	OCTOBER			APRIL			JUNE		
	Number of lobsters	Number of eggs		Number of lobsters	Number of eggs		Number of lobsters	Number of eggs	
		Mean	Range		Mean	Range		Mean	Range
80-84	3	10,449	8,286-11,357	1	9,212	--	1	7,890	--
85-89	10	14,341	8,707-17,428	2	10,518	9,010-12,027	2	7,920	6,400- 9,440
90-94	23	16,317	11,501-21,348	4	13,476	9,578-18,400	5	8,950	6,410- 12,240
95-99	15	19,440	14,425-25,454	3	15,973	12,140-19,310	3	9,887	8,270- 10,700
100-104	15	20,463	13,831-26,832	8	19,355	12,853-23,270	6	14,900	8,470- 17,940
105-109	1	24,896	--	4	19,212	16,161-22,853	4	19,692	10,160- 30,190
110-114	3	30,452	27,321-32,309	11	23,789	17,639-28,245	0	--	--
115-119	0	--	--	7	27,001	18,703-33,160	1	30,602	--
120-124	2	44,334	42,059-46,610	1	26,628	--	3	27,743	20,671- 31,789
125-129	2	51,184	50,008-52,361	5	35,757	18,821-40,159	1	42,743	--
130-134	0	--	--	5	32,796	25,180-41,636	4	40,728	33,238- 49,820
135-139	1	55,240	--	2	31,045	26,850-35,240	4	40,092	22,600- 52,956
140-144	0	--	--	2	51,002	48,526-53,478	4	45,506	32,770- 54,820
145-149	0	--	--	1	45,928	--	2	68,510	67,660- 69,360
150-154	0	--	--	0	--	--	5	52,457	44,463- 69,095
155-159	0	--	--	1	78,422	--	3	51,978	37,400- 66,551
160-164	0	--	--	1	66,210	--	3	64,673	56,302- 73,207
165-169	0	--	--	0	--	--	2	63,175	62,573- 63,777
170-174	0	--	--	1	70,178	--	3	71,831	60,866- 87,303
175-179	0	--	--	0	--	--	1	81,164	--
180-184	0	--	--	0	--	--	3	73,770	56,372-104,541
185-189	0	--	--	0	--	--	0	--	--
190-194	0	--	--	0	--	--	1	78,844	--
195-199	0	--	--	0	--	--	1	90,400	--

TABLE 2.—Raw sums, sums of squares, sums of cross products, and regression equations derived from transformed data on carapace lengths and numbers of eggs from 196 berried female lobsters captured during October, April, and June. ($X = \log_e$ carapace length, $Y = \log_e$ number of eggs.)

Month	N	ΣX	ΣX^2	ΣY	ΣY^2	ΣXY	Regression equation ($Y = a+bX$)
October	75	342.8625	1568.1306	737.7546	7267.0013	3375.0329	$\hat{Y} = -5.0202+3.2499(X)$
April	59	279.4272	1324.7648	595.6230	6026.4485	2824.7918	$\hat{Y} = -3.2280+2.8132(X)$
June	62	301.6997	1471.6059	640.9857	6666.0539	3130.1578	$\hat{Y} = -5.0231+3.1569(X)$

The regression lines were all significantly different ($P < 0.01$) in level (Y intercept) from each other. No significant difference was found in the slope of any of the lines, indicating egg loss is consistent between extrusion and hatching from females of all sizes. The average total loss from extrusion to hatching throughout the size range of the females studied was 36%, and the average loss during the last few months (April through June) was 13%.

The eggs obtained in October were all in prenaupliar condition (Templeman, 1940) and were judged to be no more than 4 weeks in age. Those eggs obtained in June were all within a month of hatching. Twenty-four berried females, caught in June, were kept in laboratory tanks where all egg hatching was completed by the middle of July. Eggs taken in April showed less development than those taken in June, and 12 females kept in the laboratory tanks from the April samples completed hatching by the first of July. Water temperatures in the laboratory during April and May were slightly higher than would be expected in the offshore waters for the same period.

The offshore waters where the lobsters are found undergo no great seasonal temperature fluctuations (Colton et al., 1968) typical of the coastal waters of New England. I have examined over 500 berried females from the offshore area and conclude that extrusion of eggs occurs in September and October, and that hatching occurs the following June or July. I have found no deviation from this pattern; however, slight

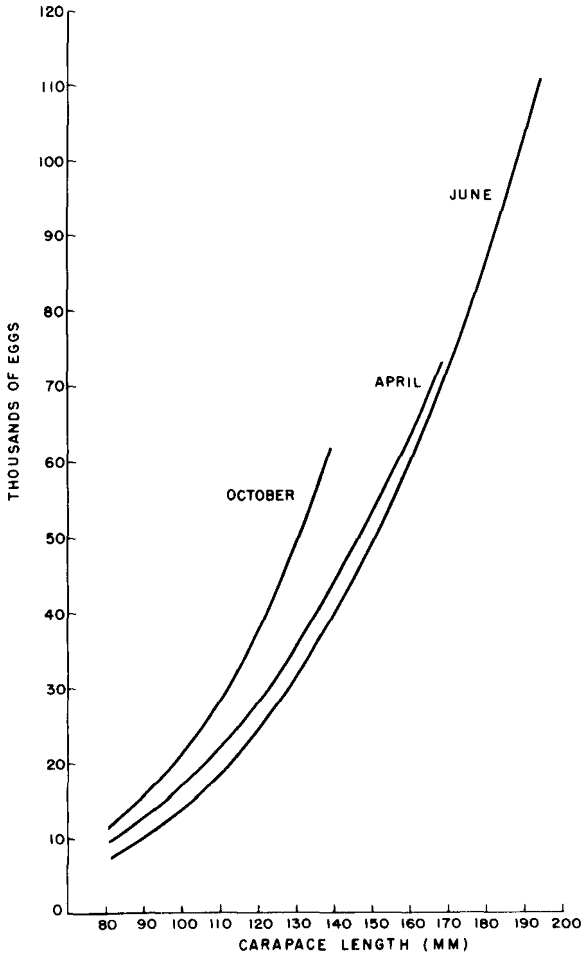

FIGURE 1.—Regression lines of egg counts versus carapace lengths for October, April, and June.

variation in the extent of development of eggs from one year to the next during the same month has been noted, and from canyon to canyon during the same year. These variations among years and areas are attributed to small differences in water temperature, while the consistent year to year reproductive periods are attributed to the relatively constant thermal environment.

While counts obtained from ovarian or newly extruded eggs testify to the reproductive potential of a female, counting eggs that are close to hatching give more reliable estimates of a female's potential contribution of larvae to the population.

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