

PRELIMINARY RESULTS OF STUDIES ON FECUNDITY OF THE
SPINY LOBSTER, PANULIRUS MARGINATUS, IN THE
NORTHWESTERN HAWAIIAN ISLANDS

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ABSTRACT

Part of an investigation of the marine resources of the North-western Hawaiian Islands includes studies on the biology of the spiny lobster, Panulirus marginatus. This paper deals with the fecundity of P. marginatus collected from Necker Island and Maro Reef during 1978-79. Estimates of fecundity were made on 34 egg-bearing females. The number of eggs carried generally increased in relation to an increase in carapace length (CL). The smallest female (56.7 mm CL) in the sample carried an estimated 129,000 eggs. The largest female (104.6 mm CL) was found to have an estimated 454,000 eggs.

Northwestern Hawaiian Islands
Panulirus marginatus
fecundity

INTRODUCTION

The spiny lobster, Panulirus marginatus, which is endemic to the Hawaiian Archipelago and Johnston Atoll (Brock, 1973), is of great importance in the sport and commercial fisheries in the major Hawaiian Islands. Trapping surveys in the Northwestern Hawaiian Islands (NWHI) indicate that this species is taken at depths greater than 28 m (10 fathoms) (see paper by Uchida et al., part I).

One of the biological parameters of interest in the management of the resources is fecundity. Fecundity of P. marginatus caught off Oahu was previously estimated by Morris (1968) and by McGinnis (1972). However, no estimates have been made for P. marginatus caught in the NWHI; therefore, a study was initiated to determine their fecundity and also to examine whether significant differences occurred in fecundity among lobsters caught at different localities throughout the archipelago.

METHODS

The material used in this report was collected at Necker Island and Maro Reef during cruises of the NOAA ship Townsend Cromwell (TC-78-04 and TC-79-02) during October 20-27, 1978 and March 31-June 6, 1979. The lobsters were caught in the California two-chambered lobster pot (Uchida and Hida, 1977). The traps were baited and set in the late afternoon and picked up the next morning. Thirty-four egg-bearing or "berried" females were collected during these cruises.

The carapace length, defined as the distance along the mid-dorsal line from the transverse ridge between supraorbital spines to the posterior margin of the carapace, was measured to the nearest 0.1 mm. In the field, egg masses were collected by carefully stripping the setae of pleopods on which the egg masses were attached. The egg masses collected from each pleopod were then frozen separately for later examination in the laboratory.

In the laboratory, the egg masses from each pleopod were preserved in a solution of 4% formaldehyde and seawater and allowed to harden for about 30 days. Before processing the egg masses, they were blotted with paper towels for 15 minutes and weighed to the nearest 0.001 g. Total weight of the egg masses was derived by summing the weight of the egg mass on each pleopod. A sample of eggs weighing approximately 0.125 g was then taken from each pleopod to make up a sample of 1 g. All the eggs in this sample were counted. The total number of eggs carried was then calculated by simple proportion:

$$\frac{\text{Weight of sample}}{\text{No. of eggs in sample}} = \frac{\text{Total weight of eggs}}{\text{Total no. of eggs carried}} \quad (1)$$

RESULTS

Although the upper and lower size ranges of lobsters were inadequately represented in the sample, the results showed that the number of eggs carried by a female increases in relation to an increase in carapace length ($r = 0.810$; $df = 33$; $P < 0.01$) (Table 1). The relationship between the number of eggs carried and carapace length (Figure 1) is expressed by the equation:

$$Y = -226399 + 5541.3X^* \quad (2)$$

where X = carapace length in millimeters
Y = number of eggs carried

*Additional samples collected recently from females larger than 104.6 mm CL indicate that the relationship may be curvilinear.

TABLE 1. CARAPACE LENGTH AND THE ESTIMATED NUMBER OF EGGS CARRIED BY SPINY LOBSTER, PANULIRUS MARGINATUS, CAUGHT AT NECKER ISLAND AND MARO REEF

Carapace Length (mm)	Estimated No. of Eggs	Carapace Length (mm)	Estimated No. of Eggs
56.7	129,266	85.6	133,350
58.6	96,602	86.3	339,289
58.8	94,053	86.6	235,003
60.9	60,101	86.7	330,095
61.8	136,534	86.7	242,887
63.0	160,196	86.8	193,560
64.7	166,897	87.2	228,322
67.9	171,607	87.5	178,780
67.9	143,005	88.3	299,581
68.9	105,767	88.8	246,068
71.5	161,370	89.0	257,692
71.6	166,050	89.9	303,233
73.4	202,428	91.4	161,562
77.8	237,730	93.4	389,552
78.0	194,075	96.8	315,518
81.2	207,247	99.4	282,183
82.4	240,533	104.6	454,362

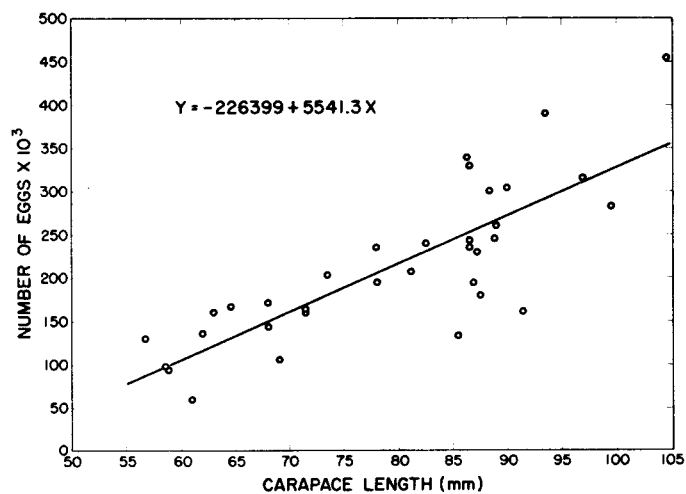


Figure 1. Relationship between the number of eggs carried and carapace length in the spiny lobster, Panulirus marginatus

DISCUSSION AND CONCLUSION

To determine whether the estimates obtained from this study differed from those provided by other investigators, comparisons were made for certain sizes for which estimates were available either in tabular form (Morris, 1968) or graphic form (McGinnis, 1972) (Table 2).

TABLE 2. CARAPACE LENGTH AND THE NUMBER OF EGGS CARRIED BY FEMALE PANULIRUS MARGINATUS AT OAHU, NECKER ISLAND, AND MARO REEF

Carapace Length (mm)	Estimated Number of Eggs Carried		
	Oahu*	Oahu ⁺	Necker Island and Maro Reef [§]
54	--	--	72,831
69	134,000	--	155,951
70	--	140,000	161,492
80	--	210,000	216,905
81	261,000	--	222,446
83	228,000	--	233,529
87	271,000	--	255,694
89	280,000	--	266,777
90	--	280,000	272,318
93	328,000	--	288,942
95	263,000	--	300,024
98	--	--	316,648
100	--	410,000	327,731
101	440,000	--	333,272
101	431,000	--	333,272
101	467,000	--	333,272
102	--	--	338,814
102	--	--	338,814
105	495,000	--	355,438
110	--	575,000	--
111	--	--	--

*Data from Morris (1968).

+Data from McGinnis (1972).

§Data from this study and estimated by the regression equation.

Comparison of data from Morris (1968) with those obtained from this study showed rather good agreement at the lower size range. Morris estimated that a female of 83.0 mm CL caught off Oahu carried 228,000 eggs compared to an estimated 233,529 eggs carried by a female of similar size caught in the NWHI. At a larger size of 101 mm CL, however, the discrepancy was larger; this study estimated 333,272 eggs whereas Morris estimated from 431,000 to 467,000 eggs.

The egg counts for P. marginatus were also similar at the lower size range to counts obtained by McGinnis (1972) for specimens also caught around Oahu. For example, McGinnis found that P. marginatus of 70 mm CL produced about 140,000 eggs. In comparison, a 70-mm CL female in this

study was estimated to carry 161,492 eggs. At larger sizes, however, the counts by McGinnis on Oahu lobsters were higher. His data showed that a 90-mm CL female carried about 280,000 eggs, whereas the equation calculated for this study predicts that at 90 mm CL, the number of eggs carried by a female is 272,318.

The estimates of the number of eggs carried obviously vary with the accuracy and precision of the sampling, weighing, and counting. Kensler (1967) found that the number of eggs in a gram sample can vary from 6,453 to 8,341 for Jasus verreauxi. Morgan (1972) reported that fecundity can be calculated with some degree of accuracy by basing egg counts on individual females and by not averaging counts based on several specimens of different sizes.

Apparently, P. marginatus is less fecund than other members of the genus. Berry (1971) showed that a 70 mm CL P. homarus of South African waters carried 309,907 eggs. Ino (1950) estimated that a 71 mm CL P. japonicus carried 524,000 eggs. Berry (1973) reported that a female Palinurus delagoae carried far fewer eggs for its size than any of the other members of Palinuridae. Apparently, the smaller number of eggs carried by the females of this species is associated with the comparatively large egg size. Berry added that like many other deepwater crustaceans, P. delagoae produces relatively few large eggs which have a prolonged incubation period. The extended incubation produces larvae which when hatched are in an advanced stage of development. Egg size, then, appears to be an important consideration when studying fecundity.

FUTURE RESEARCH NEEDS

Additional samples, particularly in the lower size ranges below 60 mm CL and in the upper size ranges beyond 90 mm CL, are needed to extend the range and improve the estimates already obtained. As more data are accumulated, comparisons will be possible to determine variations in fecundity estimates among the islands and banks sampled.

SUMMARY

Egg counts were made on 34 female Panulirus marginatus caught at Necker Island and Maro Reef. The smallest female (56.7 mm CL) carried an estimated 129,000 eggs whereas the largest female in the sample (104.6 mm CL) carried an estimated 454,000 eggs. The study also showed that the number of eggs carried increases relative to an increase in CL. A comparison of estimates of the number of eggs carried by female spiny lobsters caught off Oahu shows relatively good agreement with those obtained for the females caught at Necker Island and Maro Reef.

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