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BREEDING SEASON AND BREEDING SIZE OF FEMALE *EMERITA PORTORICENSIS* SCHMITT (CRUSTACEA: ANOMURA) IN TRINIDAD, WEST INDIES

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Emerita portoricensis Schmitt is common on several of the beaches of Trinidad (Fig. 1). It is the small burrowing crustacean that Trinidadians know as sea armadillo, sea tatoo or sea cockroach, but which elsewhere is called mole crab or sand crab. However, since chitons, which are molluscs, are also called sea cockroach, any of the other common names is preferable to this. Chitons are sessile but **Emerita** is relatively active, moving with the tides so that it occupies the zone where the waves flow on to the beach. It spends most of its time buried in the wet sand but in feeding extends a pair of antennae above the sand as a wave begins to recede and traps on their feathery structure the microscopic particles in the water that form its diet.

Female **Emerita** carry their eggs on bristle-like abdominal appendages (pleopods) and since the eggs are usually bright orange they are easy to see, especially if the telson or last abdominal segment is pulled back from its normal position under the rest of the adbomen. It was the ease of observation of egg-bearing that suggested to me this study which had at first the simple objective of determining the breeding season. Later, a second objective was added as described below.

My methods were simple. I visited Maracas Bay every two or three weeks with the intention of catching and examining twenty adults. However, on many occasions the animals were difficult to find and I had to be satisfied with fewer. I simply walked extremely slowly along the beach looking for the animals' extended antennae and dug up those judged to be adult from the size of the antennae. Each individual was then examined for eggs and replaced. By moving in one direction the chance of catching the same individual more than once was minimized. These methods would not be used by a professional zoologist but they gave a clear-cut answer to any query nonetheless: **Emerita** breeds all the year round. The detailed results are shown in Table 1 where it can be seen that there was no occasion on which the beach was visited without finding ovigerous females.

TABLE I

The numbers of ovigerous females of E. portoricensis at Maracas Bay, 1971–1972.

Date	No. in Sample	No. Ovig.	% Ovig.
2 May '71	10	6	60
16 May '71	2	2	100
30 May '71	20	12	60
20 Jun '71	9	5	55
4 Jul '71	1	1	100
26 Sep '71	20	12	60
17 Oct '71	20	14	70
7 Nov '71	16	8	50
14 Nov '71	10	9	90
5 Dec '71	15	12	80
26 Dec '71	5	3	60
9 Jan '72	6	4	66
30 Jan '72	10	5	50
20 Feb '72	10	9	90
12 Mar '72	7	4	56
7 Apr '72	20	14	70
2 May '72	1	1	100
9 Jul '72	20	16	80
30 Jul '72	10	6	60
20 Aug '72	10	10	100
3 Sep '72	10	4	40

During the course of the study it became obvious that ovigerous females usually made up much more than half the number of individuals examined and that their size varied considerably. However, if each sample were made up of males and females of which only

some of the latter would be ovigerous, then one would expect fewer than 50% of each sample to be ovigerous. That this was not the case (Table 1) suggested that the mature males might be smaller than the mature females and that my method of capture might be selective for mature females. Thus, I decided to measure a sufficiently large sample of the animals to determine with some degree of reliability the maximum and minimum size of ovigerous females and the maximum size of males. This second study was done during a vacation at Mayaro in late August and early September, 1972. Females were distinguished from males by the presence of pleopods which are absent from the males.

On five days from 29th August to 2nd September all the **Emerita** visible on the beach during a 1–2 hr. period were collected for measurement. After measurement, all were returned to the same spot on the beach and after the first day no collecting was done within 50 m of this spot. Under a magnifying glass the carapace of each individual was spanned with a pair of dividers (Fig. 1) and the length then measured on a centimetre rule to the nearest half millimetre. Ovigerous females, non-ovigerous females and males were measured separately. The results for ovigerous females are shown in Fig. 1 as a histogram with a normal curve of the same mean and standard diviation fitted to it (cf Moroney, 1956).

Sixty ovigerous females were measured. The mean carapace length was 20.0 mm with a standard deviation of +2.0 mm. The smallest ovigerous female measured was 16.0 mm but Fig. 1 suggests that ovigerous females as small as 14.0 mm would occur at the rate of one in every five or six hundred. The largest measured was 25.5 mm but Fig. 1 suggests that 26.0 mm or 26.5 mm might be the upper limit.

Of the thirty eight non-ovigerous females measured the smallest was 11.0 mm and the largest 25.5 mm. As expected, the males were all small; of the nine found the smallest was 8.5 mm and the largest was 10.5 mm.

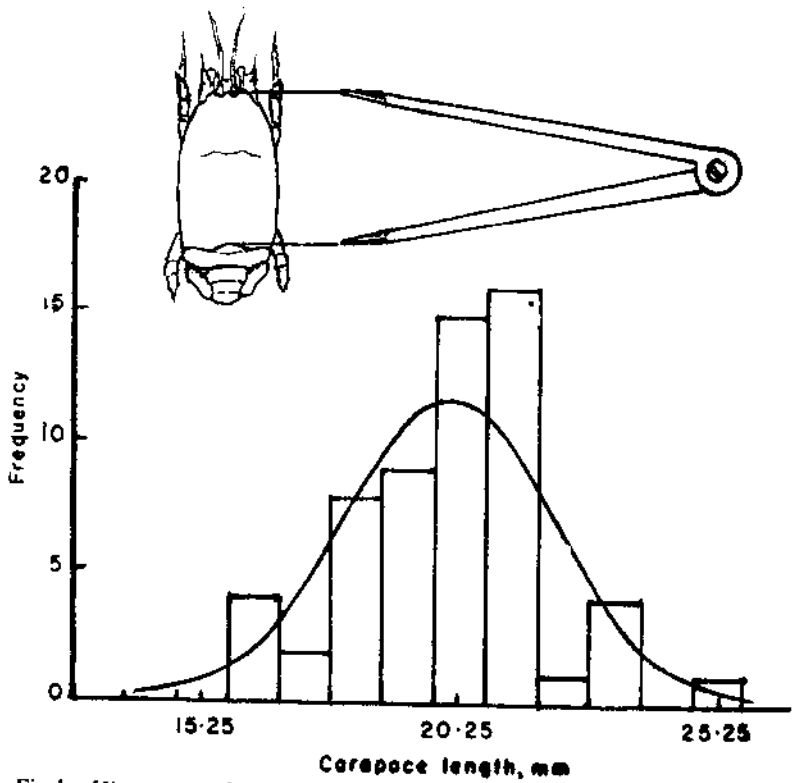

Fig 1: Histogram of carapace length for sixty ovigerous females with a normal curve of the same mean and standard deviation fitted to it.

Goodbody (1965) studied E. portoricensis in Jamaica for two years. Since he found young animals (smaller than 4 mm) and ovigerous females throughout both years, he concluded that E. portoricensis in Jamaica breeds all the year round. But in his population the largest specimen (out of 8805 measured) had a carapace length of only 17 mm (compared with my 25.5 mm) and the smallest ovigerous female was only 8 mm (compared with my 16.0 mm). His largest male was

8 mm whereas mine was 10.5 mm. Therefore, there is a remarkable difference in the average size of individuals in the two populations. There is a differnece, too. though not so striking in the average size of individuals on different beaches in Trinidad. Sixty ovigerous females from Maracas beach were measured for comparison with the Mayaro ones. Thirty-nine of them were collected between late August and early October 1974 and twenty-one were collected in small numbers during 1972 and 1973 and preserved in formalin. The mean carapace length was 17.5 mm with a standard deviation of 2.7 mm, the smallest was 13.0 mm and the largest 23.5 mm. The mean here is 2.5 mm less than that for the Mayaro population which is not statistically significant, but the fiugres show the trend well enough.

All the figures taken together show a decrease in average size with increase in latitude. Difference in nutrition could account for this trend. Mole crabs are dependent upon suspended matter in the water for their food and Trinidad's coastal waters which are influenced by the Orinoco river are noticeably less clear than Jamaica's, indicating a greater content of suspended matter. It is noticeable, too, that the water at Mayaro, which is more strongly influenced by the Orinoco is less clear than the water at Maracas. The hypothesis could be tested by measuring the amount of suspended matter in the water at different beaches and seeking a correlation with the average size of individual at the same beaches.

Differences in the minimum size of sexually mature females also occur in populations of **Emerita analoga**, a mole crab of the Pacific coast of America. In Chile at 33° 27' south latitude the smallest reproductive female out of 9996 measured was 16.4 mm in carapace length (Osorio et al 1970). Whereas at La Jolla in California at about 33° north latitude the smallest was 10 mm (Cox and Dudley, 1968). Here too, differences in nutrition could be important. The Humboldt current that washes the shores of Chile is well known to be rich in nutrients.

In Chile **E. analoga** breeds all the year round; at La Jolla in California ovigerous females were found only from February to September. However, MacGinitie (1938) has claimed that in California in some areas at least, "ovigerous individuals may be found throughtout the year". He also claimed that in general, "mating takes place in late spring and summer". If both of these claims were true the implications are either that the females can produce eggs in the absence of males or that there is some mechanism for the storage of sperm. However, sexually mature female **E. analoga** cultured in aquaria from

which males were excluded did not porduce eggs whereas those cultured with males did porduce eggs (Cox and Dudley, 1968). There is, therefore, reason to believe that female **E. analoga** neither store sperm nor produce eggs in the absence of males.

Although my observations establish only that ovigerous females occur the year round in Trinidad, without establishing that mating activity is year long, it seems unlikely that **E. portoricensis** would have developed a mechanism for storing sperm when **E. analoga** has not. Therefore, I conclude that mating activity is continuous throughout the year.

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