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POPULATION STRUCTURE AND BIOLOGY OF THE CRAB *DOTILLA SULCATA* FROM ELGHARQANA MANGROVE, SOUTH SINAI, RED SEA

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ABSTRACT

The population of the crab *Dotilla sulacta* of Elgharqana mangrove of South Sinai, Red Sea was studied by monthly sampling during low tide periods from February 2001 to January 2002. Crabs were collected by digging and seiving. Crabs were sexed, measured and berried females and moulting stage was recorded. A total of 1619 individual was obtained, of which 746 (46.1%) were males, 715 non-ovigerous females (44.2%), 106 (6.5%) ovigerous females and 52 (3.2%) juveniles. The overall sex ratio (M:F) was 1:1.1 and females outnumbered males during August-November The population shows sex differences in the size frequency distributions, with males reaching greater size than females. (3.5-12.1mm & 3.2-9.4mm carapace width respectively). Ovigerous females were observed during April-August and ranged in size between 4-9.2mm in carapace width. Juvenile recruitment to the population was discernible during July. Egg number increased with female size. Post-moult specimens were encountered during October-December. Linear models were observed in carapace width and length relationships for both sexes.

INTRODUCTION

The sand-bubbler crab *Dotilla* (family Ocypodidae) is a small species in size and one of the major tropical brachyurans occupying a variety of coastal biotopes, such as tidal flats, sandy shores and mangroves (Dray & Paula, 1998). This small crab sometimes forms extensive populations and thus plays an important role in the ecology of the infaunal community as a result of its burrowing and feeding activity at low tide (Bradshaw & Scoffin, 1999). These populations are responsible for a rapid turnover of the sediment and contribute significantly to the consumption of the available organic matter in the superficial layer of the sediment (Dray & Paula, 1998). On the other hand, the air that penetrates into the sediment as a result of their burrowing enhances oxidation in the anaerobic layers (Fishelson, 1983).

Dotilla sulcata (Forskål, 1775) is the only Red Sea representative of the subfamily Scopimerinae. This species inhabits the lower parts of the infratidal zone of the sandy beaches of the Red Sea forming large populations (Fishelson 1971, 1983). It has also been reported on the landward fringe of dry shores of the mangrove areas of Gulf of Aqaba (Por & Dor 1957). Elgharqana mangrove is one of the three mangrove thickets situated on the south-eastern tip of the Sinai Peninsula which comprise a part of the marine reserve area of Wadi Kid. They are considered the northernmost mangroves of the Red Sea and are reduced to the single bushy species of *Avicennia marina* (Dor, 1984). Five species of crabs have been reported to inhabit the intertidal areas of the mangroves of Sinai of which only *D. sulcata* inhabits the uppermost zone of the intertidal area of Elgharqana mangrove (Sallam, 1993).

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The population structure and ecology of *D. sulcata* have been studied in different parts of the Red Sea (Fishelson 1983) and in the Gulf of Oman (Clayton & El Kindi 1998). Although an abundant species, no attempt has been made to study its population in the mangrove areas of the Gulf of Aqaba. The main objective of this work, therefore, is to carry out a study on the population of the sand bubbler crab *Dotilla sulcata* inhabiting the mangrove area of Elgharqana, South Sinai as well as to investigate some aspects of its biology.

MATERIALS AND METHODS

Monthly random samples of *D. sulcata* were collected from the intertidal area of Elgharqana mangrove (Fig. 1) between February 2001 and January 2002. The area was visited at daytime low tide and the crabs were collected by digging at the positions of their obvious burrows by means of a large spade for a depth of 20cm, below which *Dotilla* does not burrow (Hartnoll 1973). Portions of sediment were placed in a metal sieve with 1.5mm square mesh and shaken gently. Crabs retained were removed and immediately preserved in 10% formalin. Sex was determined then crabs were measured for carapace width (CW) and length (CL) by means of a dissecting microscope fitted with an eye piece micrometer to the nearest 0.1mm (Fig.2). Moulting stage of each specimen was recorded. Unsexable individuals were classified as juveniles. For females, the presence or absence of extruded eggs was noted. Development of eggs was classed into four stages and eggs were counted.

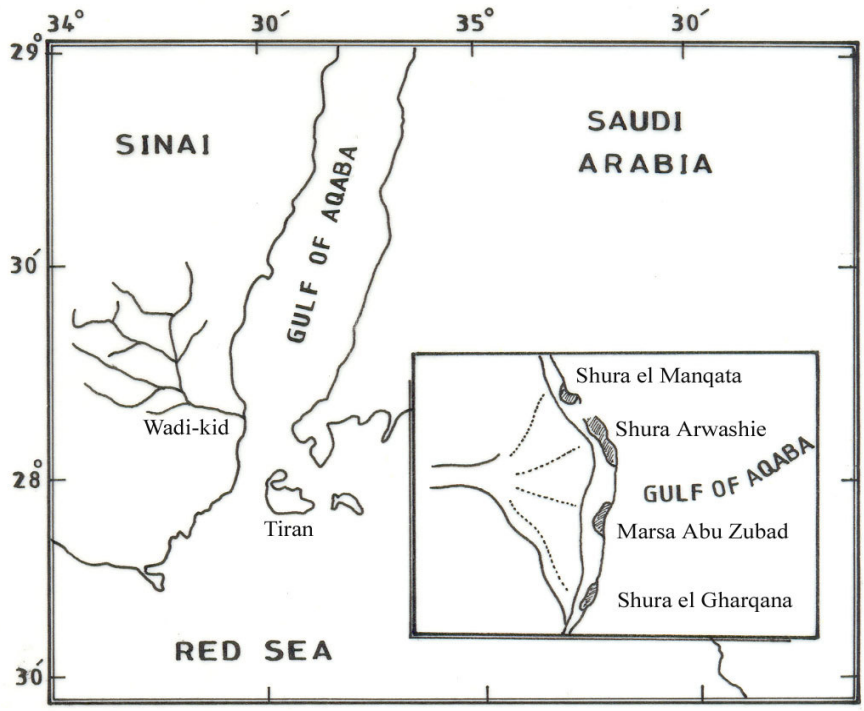

Fig.1. Map showing the locations of the study sites.

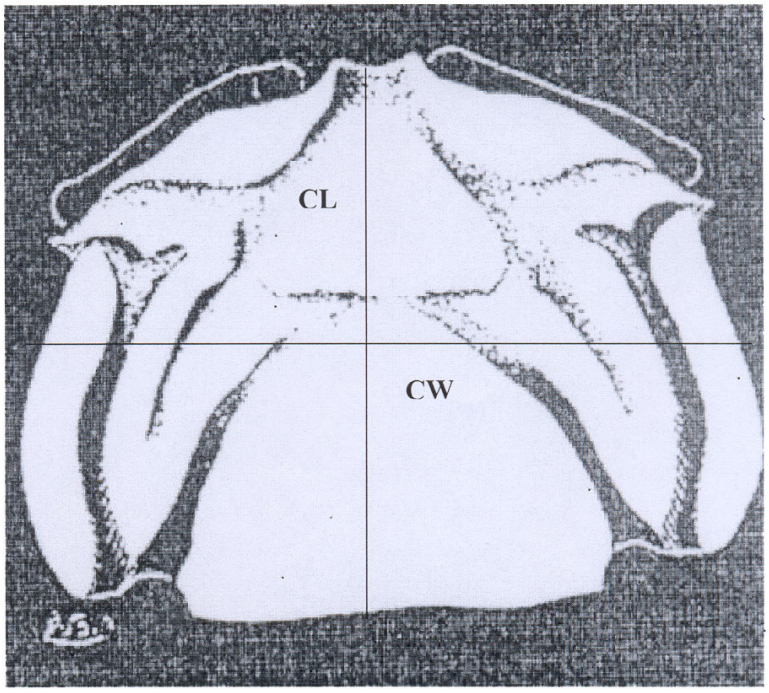

Fig.2. Carapace of *Dotilla sulcata* and locations of measured dimensions.

RESULTS

Population structure of *Dotilla sulcata*:

A total of 1619 *Dotilla sulcata* were obtained. These comprised 746 (46.1%) males, 715 non-ovigerous females (44.2%), 106 (6.5%) ovigerous females and 52 (3.2%) juveniles. Figure3 shows the pooled size frequency distributions of males, females and juveniles within 1mm carapace width class intervals. The size range was between 3.2-9.4 & 3.5-12.1mm CW for females and males respectively. Individuals ranging from 4.5-5.5mm & 5.5-6.5 CW represented the mode of the population for females and males respectively. A few males exceeded 9.5mm but no females. The average size of males, 6.35mm CW (n=746, SD=1.7) was larger to that of females at 4.81 mm CW (n=821, SD= 1.2).

Size frequency distribution:

Monthly width frequency histograms using 1mm class intervals of carapace length were constructed for each sex of *Dotilla sulcata* (Fig.4 a,b). For both sexes, the population consisted predominantly of adult individuals, mostly exceeding 3.5mm CW during the period February – June. Recruitment to the population was only apparent during July, when the proportion of juveniles, ca 1.5-3.5mm CW exhibited a well pronounced peak. Following settlement, the recruits were observed to show progressive increase in size through the following months. As indicated by the sequence of size modes in the figures, the life span is

approximately 10 months for females and 12 for males.

Sex ratio:

This ratio fluctuated throughout the year (Fig.5), but females outnumbered males during August-November. Of the whole sample (1619 specimens), 821 were females (50.7%) and 746 were males (46.1%). The ratio was not significantly different (1.1:1 female: male) ($X^2 = 28.3$, $P>0.05$).

Incidence of ovigerous females:

Ovigerous females were observed between April-August with the maximum recorded in June (Fig.6). Females carried eggs at their first and second stages of development during April while eggs at their last stage of development occurred predominantly between June and August. Berried females ranged in size between 4.7-9.2 mm CW (Fig.7). The mean number of eggs incubated per ovigerous female was 361 ± 102.4 (range: 74-568, n = 106). There was a significant positive relationship between body size and the number of eggs extruded as shown by the regression equation: Log egg number = 0.9402 Log CW – 0.0671 (r^2 = 0.94) (Fig. 8).

The average size of ovigerous females (6.71± 0.96 mm CW, n= 106) was higher than that of non-ovigerous females (5.76 ± 1.1mm CW, n= 715).

Occurrence of moulted individuals:

Individuals of *D. sulcata* maintained their hard carapaces for most of the year (Fig.9). Recently-moulted specimens with soft shells were encountered from October- December, However, individuals in pre-moult condition were not detected in the sample.

Biometric relationships:

The relationships between carapace width and length of male and female *D. sulcata* are presented in Fig.10. Linear models were observed in the relationships indicating isometric growth. The two variables exhibited high correlations where the coefficients of determination (r^2) had values of more than 0.9. The regression equations are given as follows:

Males: Log CL = 0.9255 Log CW-0.0602 r^2= 0.95

Females: Log CL = 0.0890 Log CW - 0.0232 r^2= 0.91

DISCUSSION

The population of *Dotilla sulcata* in Elgharqana mangrove has a continuous presence all year round (Sallam 1993). The results on the sizes of the populations given by the present study were in accordance with those reported by Fishelson (1983) who stated that the maximal growth of *Dotilla* populations in the Red Sea is density related. Populations of the northern Red sea are comparatively larger than those of its south as a result of the usually more dense populations occurring in the south as well as the selective predation by animals feeding on those crabs. This is supported by the low maximum density of *Dotilla* (58 crab/m^2) reported by Sallam (1993) at the mangroves of the Gulf of Aqaba.

Males exceeded females in size and sex ratio was equivalent. These findings are consistent with those of *D. fenestrata* (Hartnoll 1973), *D. sulcata* (Clayton & Al-kindi 1998); *D. myctiroides* (Hails & Yaziz 1982), *Uca inversa* (Sallam 1993, Litulo 2005) and *Uca annulipes* (Litulo, 2005). However, the maximum size attained was above that found for *D. sulcata* population of the Gulf of Oman (Clayton & Al-Kindi 1993). While longevity was not addressed directly, the estimation given for the species under study fell within the range calculated for *D. sulacta* (Clayton & Al-Kindi 1998) and *D. myctiroides* (Hails & Yaziz 1982).

Females achieve sexual maturity between 4.5 and 5.5 mm in carapace width. Ovigerous females appeared between April-August with the maximum in June. In addition, recruitment to the population was recorded in July and moulting was discernible during autumn. These results suggest that breeding of *Dotilla sulcata* in Elgharqana occurs during spring and early summer and that

copulation takes place when females are hard-shelled. Warner (1977) reported that females become sexually receptive, when hard shelled, usually lay their eggs shortly after copulation and that mature females tend to moult in autumn, since moulting is inhibited by the cold in winter and by egg carrying during spring and summer. Other authors referred to the same breeding pattern for ocypodid crabs (Thurman 1985, Sallam, 1993 & Litulo 2005). Breeding during summer months is thought to be advantageous for *D. sulcata* of Elgharqana in order to ensure development of offspring before colder months.

The number of incubated eggs for *D. sulcata* lies within the range of values given for other congeners. The relatively reduced fecundity of this species could be explained as an adaptation to its terrestrial habits. Thurman (1985) reported that both size and number of eggs produced appear to correspond to environmental conditions, and that the apparent expense in producing an egg brood in semi terrestrial species is not greater than that of other species which carry a large number of smaller eggs. Crane (1975) stated that semi- and fully terrestrial crabs smaller in body and clutch size. Consequently, there appears to some certainty that although low in number, a sufficient percentage of *D. sulacta* eggs will survive to reproduce as adults. This could be supported by the fact that it's the sole species inhabiting the study area and to the absence of other species competing over space and food resources (Sallam 1993).

The present results may suggest that *D. sulcata* follows a rapid breeding cycle accompanied by a rapid settlement in the study area which reflects marked ability to adapt to the surrounding environment.

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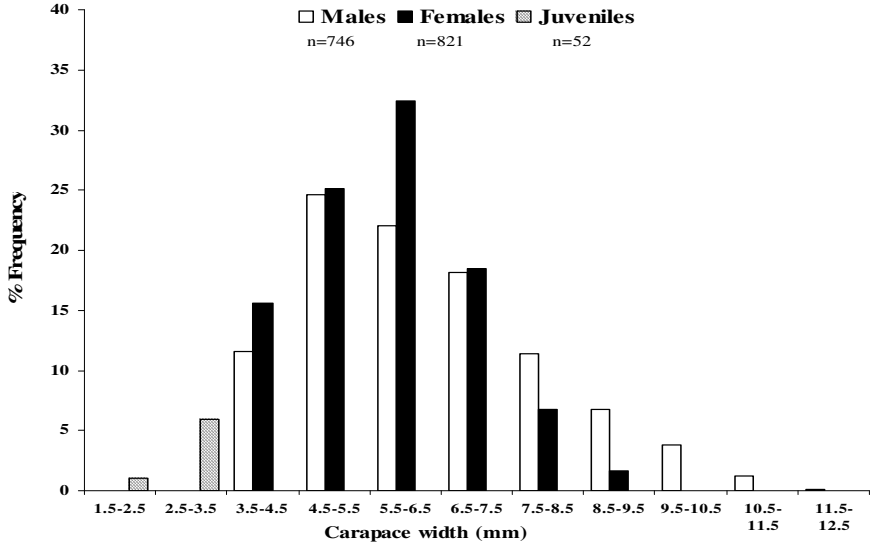

Fig.3. Size frequency distributions of males, females and juveniles.

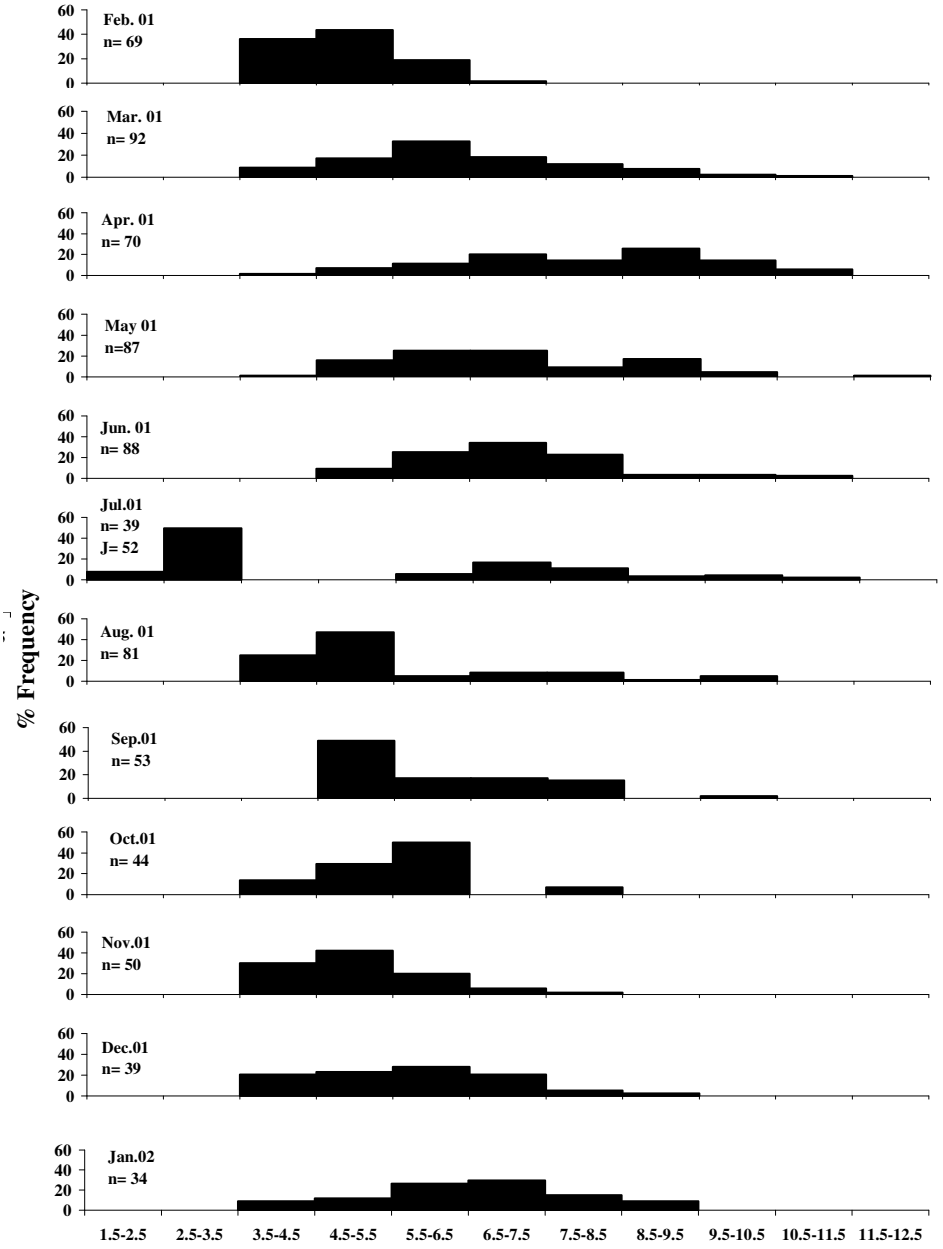

Fig.4a. Monthly size frequency histograms for males *D. sulcata.* n= number of individuals, J = juveniles.

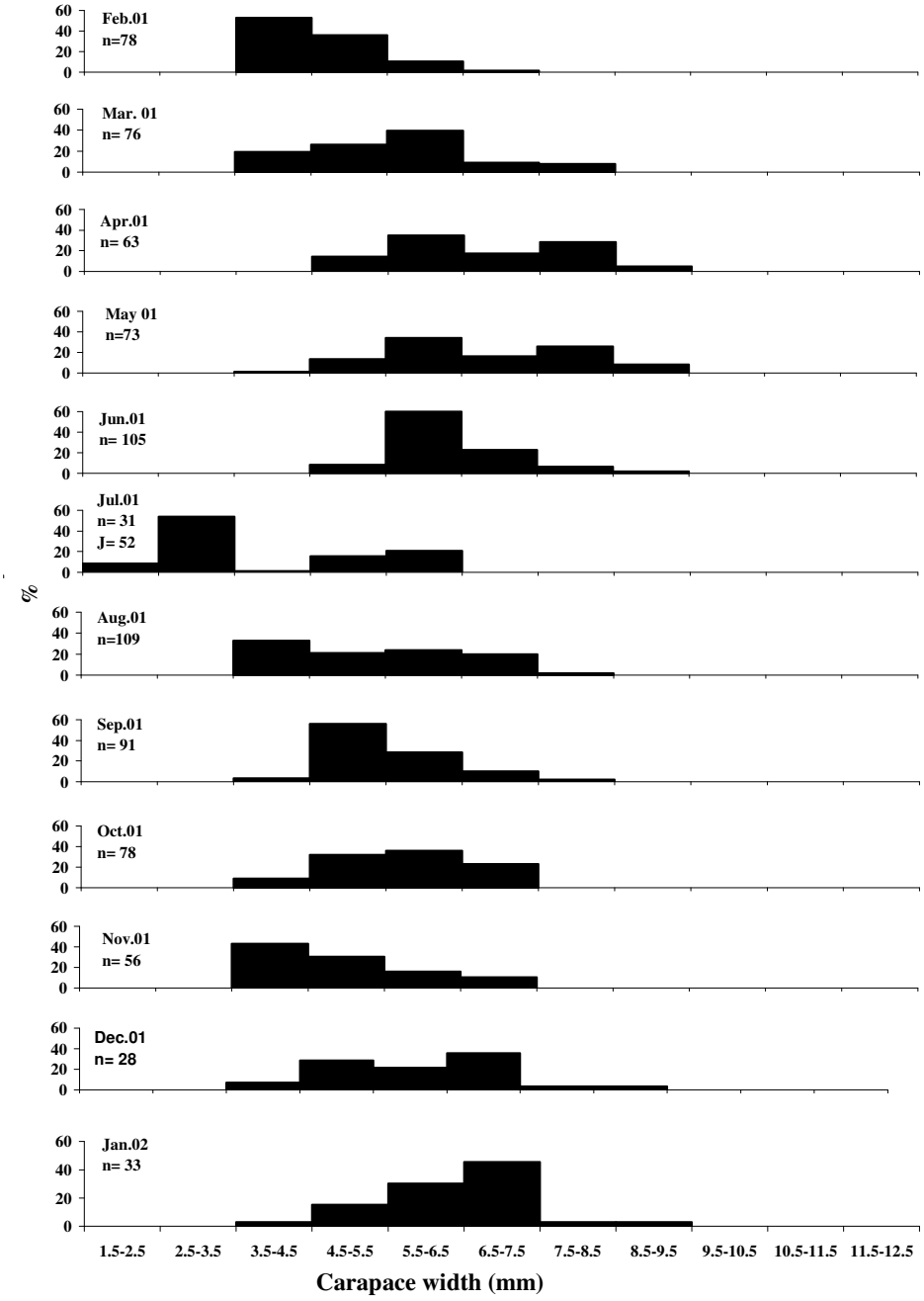

Fig.4b. Monthly size frequency histograms for females *D. sulcata.*
n= number of individuals, J = juveniles.

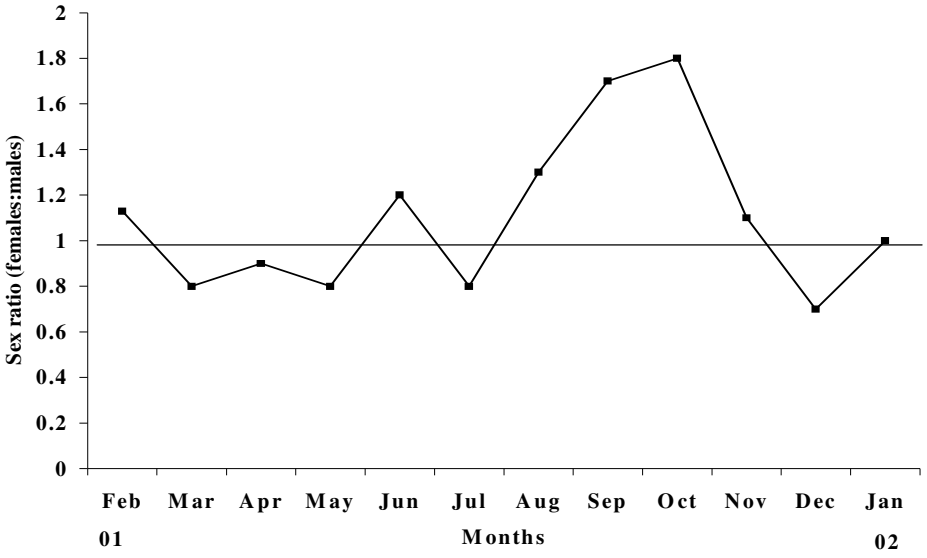

Fig.5. Monthly changes in the sex ratio. Straight line indicates ratio of 1:1 (females: males).

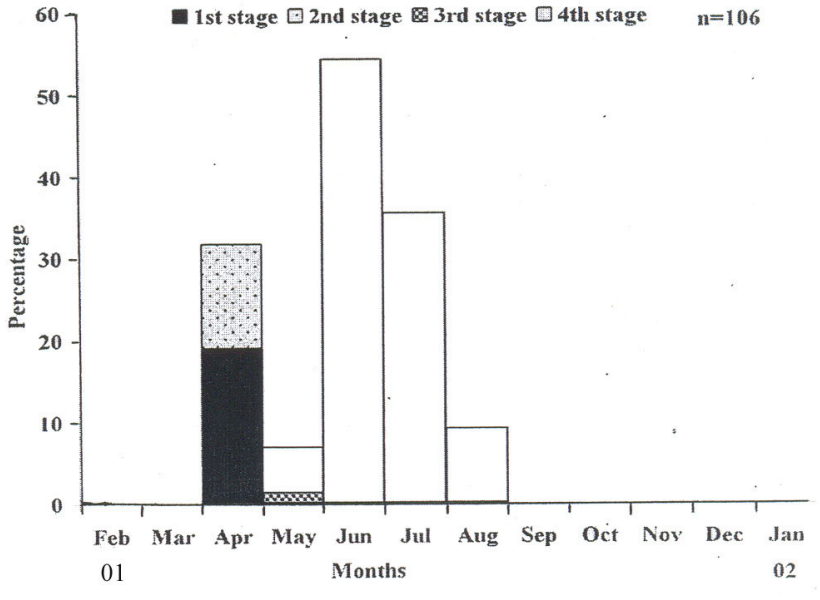

Fig.6. Percentage occurrence of ovigerous females with different egg stages. n = number of females.

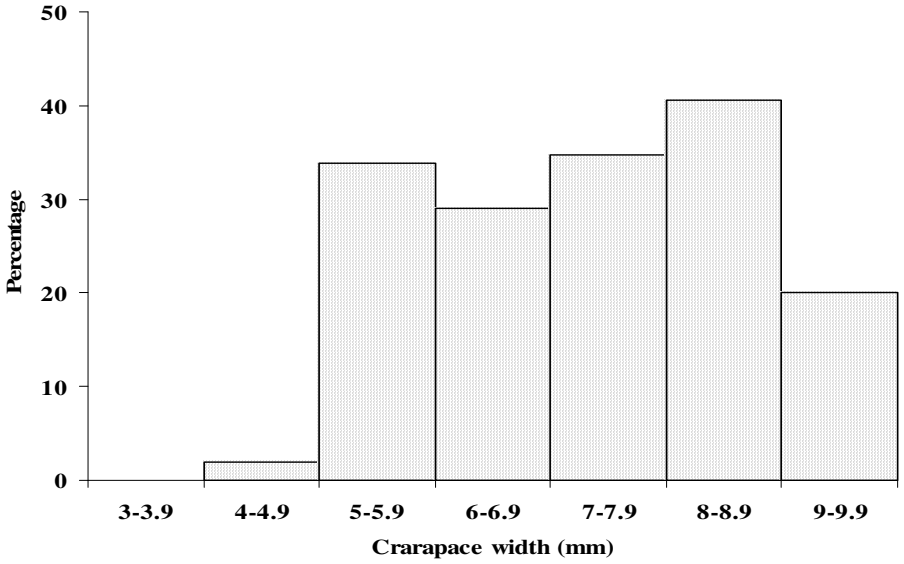

Fig.7. Percentage of ovigerous females in the different size classes at the breeding period (April-August).

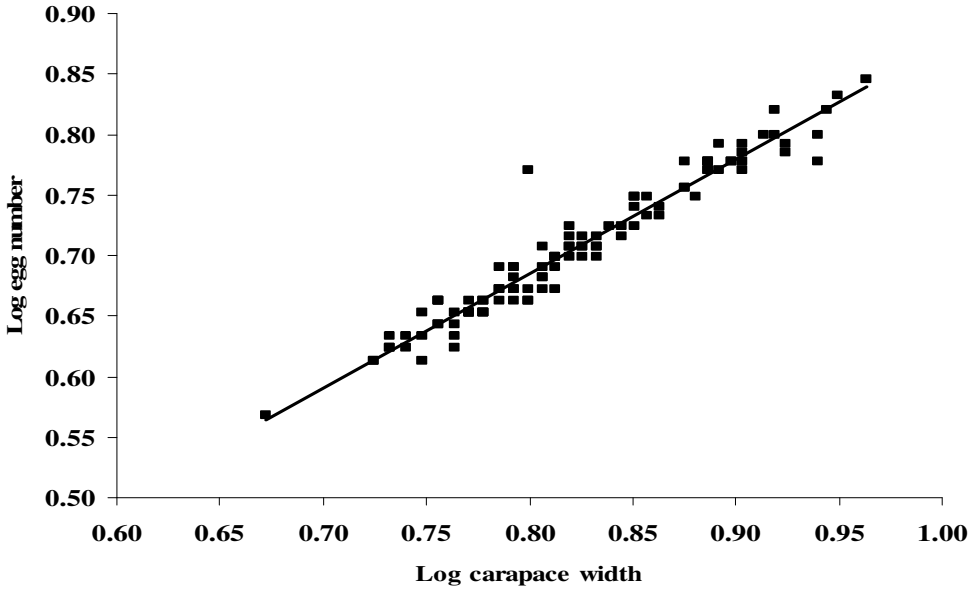

Fig.8. Relationship between female body size and number of incubated eggs.

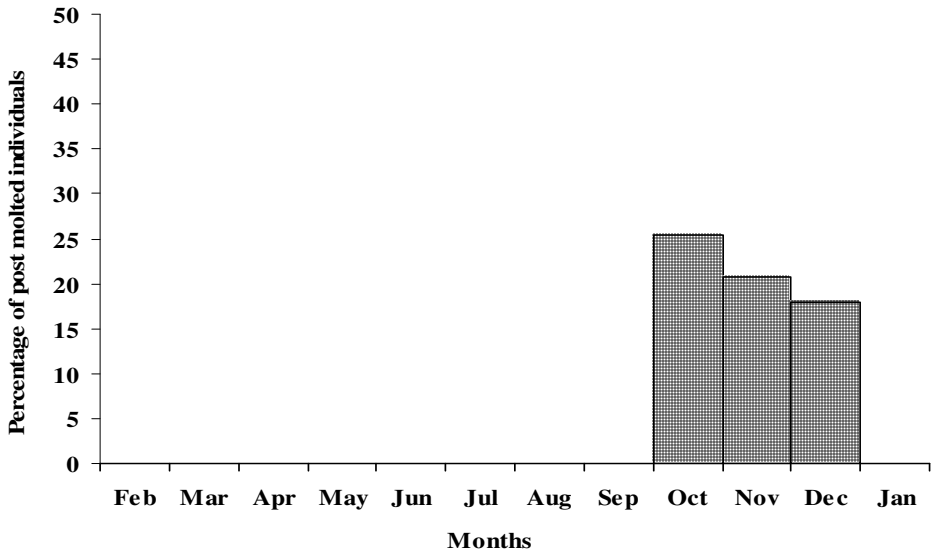

Fig.9. Percentage occurrence of postmolted individuals.

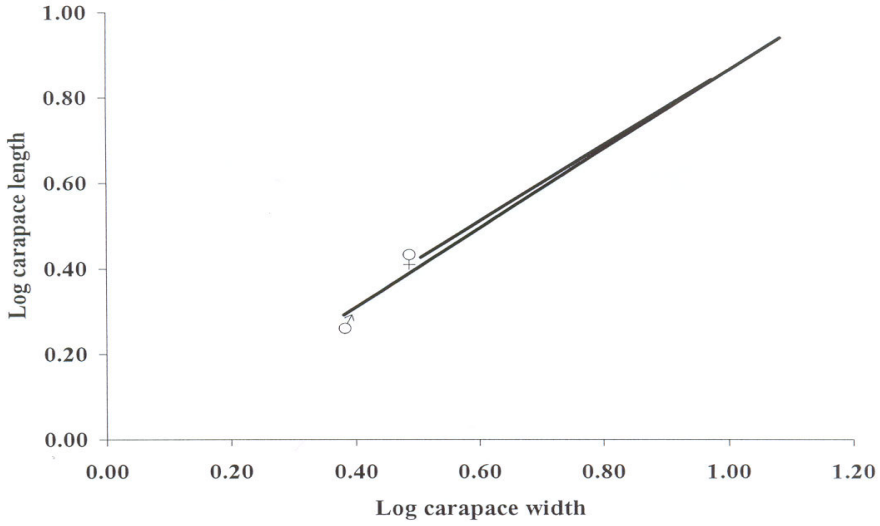

Fig. 10. Carapace width/carapace length relationships.

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