Research Article

Population Density of *Emerita asiatica* (H. Milne Edwards, 1837) in Relation to Carbonates and Bicarbonates in the Kovalam Beach, East Coast, Kanchipuram District of Tamil Nadu, India

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Abstract

Population density of *Emerita asiatica* in relation to carbonates and bicarbonates in the Kovalam beach, East coast, Kanchipuram District of Tamil Nadu was studied. Specimens were collected once in a fortnight from April 2013 to March 2014 by hand picking method in the intertidal region of Kovalam beach. The total carbonates and total bicarbonates of sea water were recorded once in a fortnight. The population presented a smaller incidence of males in relation to females (48.66:51.34); however in May 2013 an inverse pattern occurred (73:27). Ovigerous females were present in all samples with greater frequencies in October and November 2013 where as the highest juveniles were present in May and September 2013. The variation noted in population of *E. asiatica* showed there is a relationship to carbonates and bicarbonates fluctuations; it can be concluded that carbonates and bicarbonates fluctuations have influence on the population density of this species in Kovalam beach. Hence, the rather stable carbonates and bicarbonates throughout the year and moderate changes in sea water may well be conducive to population density of *E. asiatica*.

Keywords: *Emerita asiatica*, carbonates, bicarbonates, population density, sex-ratio.

INTRODUCTION

The biology of species of the genus *Emerita*, characteristic swash-zone dwellers of exposed sandy beaches, has been thoroughly studied (Subramoniam, 1977b; Wenner, 1988; Lercari and Defeo, 1999; Jaramillo *et al.*, 2000). Sand crabs, including various species of *Emerita*, are typical burrowing forms found on exposed sandy beaches of temperate and tropical climates (Subramoniam and Gunamalai, 2003; Defeo and Cardoso, 2004). *Emerita* species are highly adapted invertebrates to sandy-beach environments (Subramoniam and Gunamalai, 2003); some show seasonal reproduction, such as *E. talpoida* (Diaz,
and E. analoga (Contreras et al., 1999) or a continuous reproductive cycle like E. portoricensis (Goodbody, 1965), E. holthuisi (Ansell et al., 1972) and E. asiatica (Gunalail and Subramoniam, 2002). In E. brasiliensis, a macro scale study showed a clear shift from continuous to seasonal reproduction from subtropical to temperate sandy beaches (Defeo and Cardoso, 2002). Investigations have believed that males and females are sexually distinct throughout their lives and that the mature females are larger than the mature males; this implies that males either grows more slowly than females or that female outlive males. Adult males can apparently be differentiated from adult females by their lack of pleopods (Knox and Boolootian, 1963). It should be noted, however, that the possession of pleopods is characteristic of all individuals in late zoeal stages and in the megalopa stage.

Emerita asiatica is the only mole crab inhabiting the sandy beaches of the Madras coast (Menon, 1933). Specimens are usually found buried in loose sand in the wave-washed portion of the beach. A brief account of the life history has been given by Menon (1933), with a short note on the occurrence of males (Menon, 1934). Subramoniam (1977a) has reported on the continuous breeding activity of this anomuran crab. However, only a little is known about its sexual biology. From the foregoing accounts and also on the literature survey there are scanty reports on the population density of the sand crab Emerita asiatica with relation to carbonates and bicarbonates and also there are no reports for the past one decade on their population in relation to severe climatic changes of the present day hence the present investigation has been undertaken to study the population density of E. asiatica in the Kovalam beach.

MATERIALS AND METHODS

The present study was conducted in Kovalam beach 13°06' N, 80° 24’ E, located on the East Coast of Kanchipuram District, Tamil Nadu 35 kms away from Chennai. In order to determine the population density of E. asiatica, the sea shore was surveyed during the period of April 2013 to March 2014. Field work was conducted on each month once in a fortnight. A total of 24 surveys were carried out. Collections were made during the day-time on the sandy beaches in and below the surf line. Sand crabs were caught by hand. More than hundred crabs were collected and brought to the laboratory with least disturbance in polythene bags containing wet sand. Four transects were fixed perpendicular to the coast, approximately 50 m apart. Collection points were situated along each of these transects at 10 m intervals from the upper high tide mark to the lower level of the surf zone. As Emerita asiatica has a patchy distribution, this collection strategy was followed to obtain a representative sample of the population on the whole beach. Ten equidistant sampling points were arranged along each transect. Three 1 m² replicates were taken in each of these transects and the animals collected from each replicate were transferred to the laboratory for sexing and measurement. In the laboratory, males were identified by the presence of genital papillae at the base of the coxae of the fifth thoracic leg. Females were identified by the presence of three pairs of pleopods, and they resemble short threads on the underside of the crab when the telson is lifted. Sea water samples were collected in polyethylene bottles. The analytical procedures for total carbonates and total bicarbonates were adopted from (Trivedi and Goel, 1986 and APHA, 1998) during the study period.

RESULTS

The current investigation revealed some interesting facts. During the study period the highest total carbonates value (2.06 ± 0.223 g/l) was obtained in the month of December 2013 whereas the lowest (1.34 ± 0.153 g/l) was observed in the month of May 2013. The maximum total bicarbonates value (1.39 ± 0.178 g/l) and (1.39 ± 0.188 g/l) was obtained in the months of April and September 2013 respectively. Whereas the lowest total bicarbonates value (1.15 ± 0.136 g/l) was observed in the month of March 2014 (Figure 1 and Table 1). During the sampling year from April 2013 to March 2014 totally 2886 crabs were collected: 1162 males(40.26%); 1238 females (42.89%) among 1238 females 939 were ovigerous (75.84%) and 486
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juveniles (16.83%). The highest abundance of males were recorded during April and May 2013 (Fig. 2 and Table 2). The maximum number of females were observed during October and November 2013 (Figure 2 and Table 2). It indicates that the levels of salinity of the sea water sustaining to increase the female population. Ovigerous females were recorded over the entire study period. However, the greatest abundances (expressed as a percentage of the total population) were registered during October and November 2013 (Figure 2 and Table 2). The highest percentage of juveniles was recorded during May and September 2013 (Figure 2 and Table 2).

Figure 1: Level of Total Carbonates and Bicarbonates of the sea water in g/l of the study area from April-2013 to March-2014

Figure 2: Population density of *Emerita asiatica* in the study area from April-2013 to March-2014
The major carbon reservoir in the ocean is in the dissolved inorganic carbon (DIC), which is the total of aqueous CO₂, bicarbonate (HCO₃⁻) and carbonate (CO₃²⁻) ions. The pH of seawater is dependent on which of these species is the most predominant. The normal present day pH of seawater is more on the basic side between 7.9 and 9.0. At this pH the HCO₃⁻ ions predominate. Carbonate ion concentrations increase with increasing pH and when more CO₂ dissolves in seawater it becomes more acidic (Frank et al., 1964).

When CO₂ from the atmosphere reacts with seawater, it immediately forms carbonic acid (H₂CO₃), which is unstable. This further dissociates to form bicarbonate and carbonate ions. The bicarbonate and carbonate ions are responsible for the buffering capacity of seawater, i.e. seawater can resist drastic pH changes even after the addition of weak bases and acids. The carbonate ion can react with calcium ions (Ca), which are in excess in seawater, to form calcium carbonate (CaCO₃), the material out of which the shells of mussels, the skeleton of corals and the exoskeleton of some microalgae is made of. The consequent decrease in calcium carbonate saturation potentially threatens calcareous marine organisms (Feely et al., 2009).

Carbonates and bicarbonates have a high influence on the marine environment of the Bay of Bengal. During the present investigation the maximum total carbonates was recorded during December 2013 whereas the minimum was observed in the month of May 2013. The highest total bicarbonates was recorded in the months of April and September 2013 respectively. Whereas the lowest total bicarbonates was recorded in the month of March 2014. When the total carbonates level was high, the percentage of females was more. In December 2013, 64 % females, 36 % males, 76 % ovigerous females and 18 % juveniles were recorded. A reverse pattern occurred during the month of May 2013. In this period 73 % males, 27 % females, 69 % ovigerous females and 19 % juveniles were recorded. Among the females the percentage of ovigerous females was more. When the bicarbonates level was high,
the percentage of males was more. In April 2013, 64 % males, 36 % females, 74 % ovigerous females and 14 % juveniles were recorded. A reverse pattern occurred during the month of September 2013 even the bicarbonate level was high. In this period 38 % males, 62 % females, 84 % ovigerous females and 19 % juveniles were recorded. In the month of March 2014, 62 % males, 38 % females, 54 % ovigerous females and 16 % juveniles were recorded. Among the females the percentage of ovigerous females was more.

It is well known fact that the carbonates and bicarbonates variation in the Kovalam beach is under the human emissions of carbon dioxide level in sea water. In this present investigation the low carbonates and bicarbonates in the water of the study area during May 2013 and March 2014, the males were very large and they can tolerate only narrow range of carbonates and bicarbonates.

The present study on the carbonates and bicarbonates in the water of the study area showed higher values in the months of April, September and December 2013. In this period more males, females and juveniles has been recorded thereby suggesting the enhanced rate of reproductive activity. It indicates the carbonates and bicarbonates have created an impact on the population density of this species. The variation noted in population density of *E. asiatica* showed there is a relationship between carbonates and bicarbonates fluctuations; it can be concluded that carbonates and bicarbonates fluctuations have influence on the population of this species in Kovalam beach. Hence, the rather stable carbonates and bicarbonates throughout the year and moderate changes in sea water may well be conducive to population density of *E. asiatica*.

REFERENCES


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