Effect of temperature on the population of *Emerita asiatica* (H. Milne Edwards, 1837) in the Kovalam beach, East coast, Tamilnadu, India

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**ABSTRACT**

Effect of temperature on the population of sand crab, *Emerita asiatica* was studied. Specimens were collected once in a fortnight from April 2012 to March 2013 by hand picking method in the intertidal region of Kovalam beach. The temperatures of atmosphere, sea water and wet sand were recorded once in a fortnight. The population presented a smaller incidence of males in relation to females (54.79:45.21); however in September 2012 an inverse pattern occurred (29.50:70.50). Ovigerous females were present in all samples with greater frequencies in September and October 2012 where as the highest juveniles were present in May and August 2012.

**Introduction**

The sandy beach environment is not an easy place for organisms to live. Unlike the rocky intertidal ecosystem, there is no solid material on which to attach. Animals have to deal with crashing waves, changing tides, a beach that changes seasonally, and marine and terrestrial predators. The animals that live in this environment are buried in the sand. They all have adaptations that help them survive in the sandy beach ecosystem. It is in this environment that the sand crab can be found [1]. Sand crabs, including various species of *Emerita*, are typical burrowing forms found on exposed sandy beaches of temperate and tropical climates [2, 3]. *Emerita* species are highly adapted invertebrates to sandy-beach environments [2]; some show seasonal reproduction, such as *E. talpoida* [4] and *E. analoga* [5] or a continuous reproductive cycle like *E. portoricensis* [6], *E. holthuisi* [7] and *E. asiatica* [8]. In *E. brasiliensis*, a macroscale study showed a clear shift from continuous to seasonal reproduction from subtropical to temperate sandy beaches [9]. Ansell *et al.*, [10] studied the ecology of *E. holthuisi* along the Indian coast. They found that there were two main periods of recruitment to the beach population, one in the pre-monsoon months of February and March and one during the monsoon months. Comparative studies of population densities are made difficult by their habit of tidal migrations.

After the Tsunami there was no study about this animal in the Kovalam beach. Due to huge variation in the high tide and low tide level in the sea shore the population of the sand crab is totally decreased. While asking the fisherman community for the reason they said due to over exploitation and climate change it is going to extinct in this sea shore. Due to these reasons the marine ecosystem will face the major change in its natural condition.
From the survey of literature there is paucity in the population of the sand crab, *E. asiatica* for the past one decade. So in the present study, an attempt has been made to study the population of *E. asiatica*.

**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 K.M away from Chennai. In order to determine the population of *E. asiatica*, the sea shore was surveyed during the period of April 2012 to March 2013. Field work was conducted on each month once in a fortnight. A total of 24 surveys were carried out. Sand crabs were caught by hand. Collections were made during the day-time on the sandy beaches in and below the surf line. 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. The atmospheric temperature recorded in the current investigation has been collected from the Regional Meteorological Centre, Nungambakkam, Chennai - 06, during the study period (April – 2012 to March – 2013). The water from the surf region and wet sand temperature was measured by using a mercury thermometer with 0.1°C accuracy.

**Results**

The current investigation revealed some interesting facts. During the sampling year 2899 crabs were collected: 1315 males (54.79%); 1085 females (45.21%); 765 ovigerous females (31.87%) and 499 juveniles (17.21%). The greatest abundance of *E. asiatica* was observed during the summer, May 2012 (Table 1). Males were consistently more abundant than females. The highest abundance of males were recorded during May and June 2012 (Table 1). The maximum number of females were observed during September and October 2012 (Table 1). It indicates that the environmental parameters sustaining to increase the male 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 September and October 2012 (Table 1). The highest percentage of juveniles was recorded during summer, May and August 2012 (Table 1). During the study period the uppermost atmospheric temperature 40.1°C was noticed in the month of May 2012. The lowest atmospheric temperature 30.4°C was obtained in the month of December 2012 (Fig. 1 and Table 2). Maximum sea water temperature 34.5°C was noticed during June 2012. Minimum 25.5°C was in the month of December 2012 (Fig. 2 and Table 2). Highest wet sand temperature 35.2°C was recorded in the month of June 2012. Whereas the lowest wet sand temperature 26.5°C was observed in the month of December 2012 (Fig. 3 and Table 2).

![Fig. 1 Atmospheric temperature in centigrade of the study area from April 2012 – March 2013](image)

*Atmospheric temperature: Source Regional Meteorological Centre, Nungambakkam, Chennai.*
Fig. 2 Sea water temperature in centigrade of the study area from April 2012 – March 2013

Fig. 3 Wet sand temperature in centigrade of the study area from April 2012 – March 2013
Table 1: Summarized population dynamics data for sand crabs from Kovalam beach from April 2012 to March 2013. Mean ± SEM is given for each measure.

| Statistics        | Males         | Females        | Ovigerous | Juveniles     |
|-------------------|---------------|----------------|-----------|---------------|
| Mean              | 109.58±0.916  | 90.42±0.628    | 63.75±0.566 | 41.58±0.384   |
| Standard Error    | 7.78          | 7.78           | 7.30      | 2.51          |

Values are expressed as Mean ± SEM per year.

Table 2: Results of the ANOVA on the mean temperature of atmosphere, sea water and wet sand during the study period. Means linked by the lines differ significantly.

| Anova: Single Factor |
|----------------------|
| SUMMARY              |
| Groups               | Count | Sum  | Average | Variance |
| Atmospheric temperature in °C | 12    | 411.9| 34.325  | 10.4275  |
| Sea water temperature in °C | 12    | 357.2| 29.7667 | 6.758788 |
| Wet sand temperature in °C | 12    | 362.9| 30.2417 | 6.486288 |

Discussion

During the summer season (March – May) more number of males were found. The adult crab, Emerita asiatica undergoes continuous molting and reproduction throughout the year [12-14]. The crab mate usually spawns during the postmoult stage. Subsequently, it undergoes embryogenesis in the intermolt. Wu [15] have reported that the duration of embryonic development could be shortened by raising temperature in the range of 18-25°C. Water temperatures in estuaries and coastal waters along the north coast of South Africa range between 17-22°C in winter and 23-30°C in summer [16]. The egg incubation period of S. serrata exponentially decreased with increasing temperature [17]. In the sea shore waters of the Kovalam, there is large seasonal variation in sea water temperature; the mean monthly range during the entire study was 9 °C (25.5 to 34.5°C). The variation noted in population of E. asiatica showed there is a relationship to temperature fluctuations; it can be concluded that temperature fluctuations have influence on the population of this species in Kovalam beach. The shrimp Penaeus indicus and crabs Uca annulipes and Portunus pelagicus all have breeding peaks between October and January at Cochin [18-20], but on the East coast they have much more extended peak activities, including all the warmer months [21, 22]. Such intraspecific variability shows both how sensitive reproduction is to environmental conditions and how generally favorable the east coast is for year-round reproduction. Hence, the rather stable environmental temperature throughout the year and moderate changes in salinity may well be conducive to population of E. asiatica.

Conflict of interest statement

We declare that we have no conflict of interest.

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