JOURNAL OF MODERN BIOTECHNOLOGY, VOL. 3, NO. 3, pp 30–34, May 2014

ISSN 2319–6645
JOURNAL OF MODERN BIOTECHNOLOGY

www.peer-reviewedjournals.com

Research Article

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

Jayaprakash Sivakumar[1*], Balu Nappinai[2], Jayapraksh Jayanthi[2] and Manikkavalli Gurunathan Ragunathan[2]

[1]PG and Research Department of Microbiology, Hindustan College of Arts and Science, Chennai – 603 103, Tamil Nadu, India.

[2]Department of Advanced Zoology and Biotechnology, Guru Nanak College, Chennai - 600 042, Tamil Nadu, India.

*Corresponding Author e-mail: sivamicro.hcas@gmail.com

Received 6 March 2014; Revised 27 March 2014; Accepted 15 April 2014

Abstract

Population density of *Emerita asiatica* in relation to oxygen demand in the Kovalam beach, East coast, Kanchipuram District of Tamil Nadu was studied. Specimens were collected once in a fort night from April 2013 to March 2014 by hand picking method in the intertidal region of Kovalam beach. The Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand 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 oxygen demand fluctuations; it can be concluded that oxygen demand fluctuations have influence on the population density of this species in Kovalam beach. Hence, the rather stable oxygen demand throughout the year and moderate changes in sea water may well be conducive to population density of *E. asiatica*.

***Keywords*:** *Emerita asiatica*, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, population density and sex-ratio.

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, Dexter (1992). 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, 1980) and *E. analoga* (Contreras *et al.*, 1999) or a continuous reproductive cycle like *E. portoricensis* (Goodbody, 1965), *E. holthuisi* (Ansell *et al*., 1972 a) and *E. asiatica* (Gunamalai and Subramoniam, 2002). In *E. brasiliensis*, a macroscale study showed a clear shift from continuous to seasonal reproduction from subtropical to temperate sandy beaches (Defeo and Cardoso, 2002).

Ansell *et al.,* (1972 b) 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. They also indicated that the period of growth to maturity would take about six to eight months. The sand crab is small in size, growing up to 35 mm long and 25 mm wide. It is grey or sand colored and does not have claws or spines. Like other crustaceans, they periodically molt, so the empty exoskeletons may be found on the shore. Males and females may look very similar at first glance, but there are some major differences. Females are larger with a carapace length of 14-35 mm, and the males reach 10-22 mm. If a female is carrying eggs, they will be found under the telson and will be a bright-orange mass. If a female is not carrying eggs, the pleopods to which she attaches eggs will be visible on the underside of the crab when the telson is lifted. There are three pairs of pleopods, and they resemble short threads (Knox and Boolotian, 1963).

Of recent times the study on this animal elsewhere is scanty. Due to huge variation in the high tide and low tide level in the sea shore, over exploitation by the fisherman and climate change, the population of the sand crab is totally decreased. Due to these reasons the marine ecosystem is facing a major change in its natural situation. From the survey of literature there is paucity in the study population dynamics 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 density of *E. asiatica* in the Kovalam beach.

MATERIALS AND METHODS

The present study was conducted in Kovalam beach 13º 06' N, 80º 24' E, located on the East Coast of Kanchipuram District, Tamil Nadu 35 km 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. 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.

Sea water samples were collected in polyethylene bottles. The analytical procedures for Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand were adopted from (APHA, 1995 and Trivedi and Goel, 1986) during the study period (April – 2013 to March – 2014).

RESULTS

The current investigation revealed some interesting facts. During the study period the highest dissolved oxygen 4.43 ± 0.280 mg/l was noticed in the month of January 2014. The lowest dissolved oxygen 2.41 ± 0.236 mg/l was obtained in the month of March 2014 (Figure 1 and Table 1). Maximum Biological oxygen demand 2.71 ± 0.232 mg/l was noticed during December 2013. Minimum 1.55 ± 0.180 mg/l was in the month of February 2014 (Figure 1 and Table 1). Highest Chemical oxygen demand 1.63 ± 0.181 mg/l was recorded in the month of May 2013. Whereas the lowest Chemical oxygen demand 1.07 ± 0.038 mg/l was observed in the month of August and December 2013 (Figure 1 and Table 1).

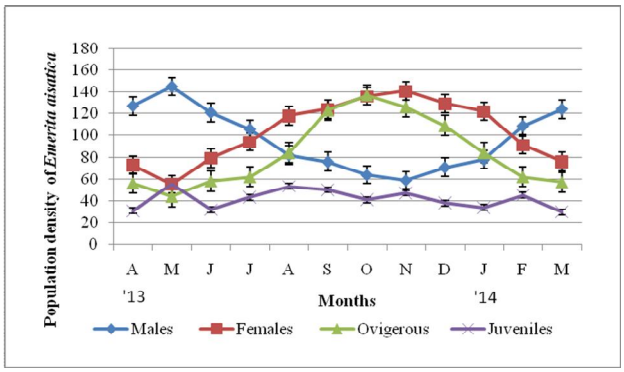

Figure 1: Total Levels of Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand in mg/l in the study area from April-2013 to March-2014

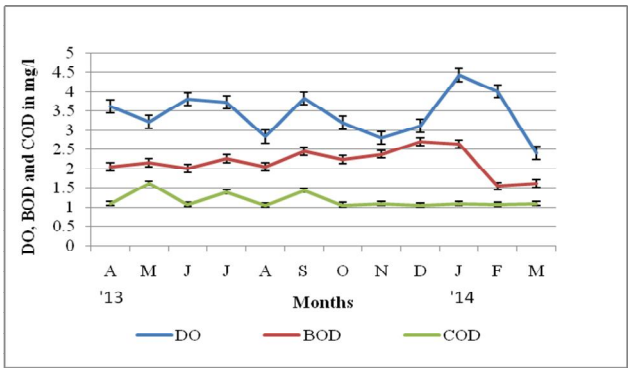

Figure 2: Population density of *Emerita asiatica* in the study area from April-2013 to March-2014

In the sea shore waters of the Kovalam, there is large seasonal variation in dissolved oxygen, biological oxygen demand and chemical oxygen demand, the mean monthly range of dissolved oxygen during the entire study was 3.42 mg/l (2.41 to 4.43 mg/l); biological oxygen demand 2.17 mg/l (1.55 to 2.71 mg/l) and chemical oxygen demand 1.19 mg/l (1.07 to 1.63 mg/l) respectively. 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 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 level of dissolved oxygen, Biological oxygen demand and Chemical oxygen demand 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)

Table 1: Total Levels of Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand in mg/l in the study area from April-2013 to March-2014

Months	**Dissolved Oxygen***	**BOD***	**COD***
April	3.62±0.232	2.05±0.224	1.12±0.103
May	3.22±0.266	2.16±0.303	1.63±0.181
June	3.81±0.311	2.02±0.157	1.09±0.036
July	3.72±0.268	2.26±0.228	1.41±0.176
August	2.84±0.306	2.05±0.158	1.07±0.038
September	3.83±0.261	2.45±0.174	1.45±0.194
October	3.21±0.347	2.24±0.144	1.08±0.037
November	2.81±0.268	2.38±0.225	1.12±0.103
December	3.12±0.245	2.71±0.232	1.07±0.038
January	4.43±0.280	2.65±0.174	1.11±0.104
February	4.02±0.014	1.55±0.180	1.09±0.045
March	2.41±0.236	1.62±0.232	1.12±0.103

Values are expressed as mean ± SEM *p < 0.001.

Table 2: Summarized population dynamics data of sand crabs in Kovalam beach from April-2013 to March-2014

Months	Males*	Females*	Ovigerous	Juveniles
April	127±1.44	73±1.030	54±0.444	34±0.628
May	145±1.01	55±0.831	38±1.387	47±0.496
June	121±0.27	79±1.030	57±1.030	39±0.608
July	106±1.29	94±0.521	67±1.030	34±0.628
August	82±0.902	118±0.98	93±0.628	45±0.566
Septembe	76±1.431	124±1.40	104±0.471	46±0.753
October	64±1.594	136±1.64	115±0.801	38±0.496
Novembe	59±1.777	141±0.60	122±0.496	42±0.753
Decembe	71±0.566	129±1.26	98±0.874	44±0.444
January	78±0.831	122±0.60	96±0.521	36±0.521
February	109±0.73	91±0.942	54±0.444	42±0.753
March	124±1.40	76±1.515	41±0.720	39±0.608
Total	1162	1238	939	486

Values are expressed as mean ± SEM *p < 0.001.

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 (Subramoniam, 1977, 1979). Dissolved oxygen (DO) is the measure of the amount of gaseous oxygen dissolved in an aqueous solution. It is one of the most important parameters in aquatic life as it is an absolute requirement for the metabolism of aerobic organisms and also influences inorganic chemical reactions (Cavallo *et al.*, 1999).

The oxygen dissolved in water is a very important parameter in water analysis as it serves as an indicator of the physical, chemical and biological activities of the water body. Two main sources of dissolved oxygen are diffusion of oxygen from the air and photosynthetic activity. Oxygen is considered to be the major limiting factor in water bodies with high concentration of organic materials (Vijayakumar *et al.*, 2000).

The present study on the Dissolved oxygen in the water of the study area showed higher values in the months from January and February 2014 (Fig. 1 and Table. 1). In this period more females and juveniles has been recorded thereby suggesting the enhanced rate of reproductive activity. The observed DO was above 4 mg/l which was also reported earlier in Arabian Sea (Raghunathan *et al.*, 2004) and in Gulf of Kacchchh (Desa *et al.*, 2005). The DO was lower during March 2014 and more males were recorded. With the DO level beyond 4 mg/l level the BOD and COD was minimum, which is reflected in the study. The inverse relationship between DO and BOD, and COD between BOD (Dey and Singh, 2003) are a natural process.

The BOD was higher during December 2013, in this period more females were recorded followed by males and juveniles. The BOD was lower during February 2014, during this period more males were recorded followed by females and juveniles. It indicates the BOD has 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 oxygen demand fluctuations; it can be concluded that oxygen demand fluctuations have influence on the population of this species in Kovalam beach. Hence, the rather stable oxygen demand throughout the year and moderate changes in sea water may well be conducive to population density of *E. asiatica*.

REFERENCES

APHA-AWWA-WEF. 1998. Standard methods for the examination of water and waste water, 20th Edition, (American Public Health Association, Washington DC, USA).

Ansell, A.D., Sivadas, P., Narayanan, B., and Trevallion, A. 1972 a. The ecology of two sandy beaches in South west India. I. Seasonal changes in physical and chemical factor and the Macrofauna. *Mar. Biol.* **17** (4): 38-62.

Ansell, A.D., Sivadas, P., Narayanan, B., and Trevallion, A. 1972 b. The ecology of two sandy beaches in South west India. II. Notes on *Emerita holthuisi*. *Mar. Biol.* **17** (4): 311-317.

Cavallo, R. A. Rizzi, C. Vossa, T. and Stabili, L. 1999. Viable heterotrophic bacteria in water and sediment in 'Mar piccolo' of Taranto (Ionia Sea, Italy). *J. App. Microbiology.*, **86**: 906-916.

Contreras, H., Defeo, O. and Jaramillo, E. 1999. Life history of *Emerita analoga* (Stimpson) (Anomura, Hippidae) in a sandy beach of south central Chile. *Estuarine, Coastal and Shelf Science,* **48**: 101-112.

Defeo, O. and Cardoso, R. 2002. Macroecology of population dynamics and life history traits of the mole crab, *Emerita brasiliensis* in Atlantic sandy beaches of South America. *Marine Ecology Progress Series*, **239**: 169-179.

Defeo, O. and Cardoso, R. 2004. Latitudinal patterns in abundance and life history traits of the mole crab, *Emerita brasiliensis* on South America sandy beaches. *Diversity and Distributions,* **10**: 89-98.

Desa, E. Zingde, M. D. Vethamory, P. Babu, M.T. D'Sausa, S. N. and Verlecar, X.N. 2005. Dissolved oxygen – a target indicator in determining use of the Gulf of Kachchh waters, *Mar. Poll. Bull.,* **50** (1): 73-79.

Dexter D.M. 1992. Sandy beach community structure: the role of exposure and latitude. *J.Biogeogr* **19**:59–66.

Dey, S. and Singh, R. P. 2003. Comparison of chlorophyll distribution in the northeastern Arabian Sea and southern Bay of Bengal using IRS-P4 Ocean Color Monitor data, *Remote Sens. Environ.,* **85**: 424-428.

Diaz, H. 1980. The mole crab *Emerita talpoida* (Say): a case of changing life history pattern. *Ecological Monographs,* **50:** 437-456.

Goodbody, I. 1965. Continuous breeding in population of two tropical crustaceans, *Mysidium columbiae* (Zimmer) and *Emerita portoricensis* (Schmitt). *Ecology*, **46**: 195-197.

Gunamalai, V. and Subramoniam, T. 2002. Synchronisation of molting and oogenic cycles in a continuously breeding population of the sand crab *Emerita asiatica* on the Madras Coast, South India. *Journal of Crustacean Biology,* **22**: 398-410.

Knox, C. and Boolootian, R. A. 1963. Functional morphology of the external appendages of *Emerita analoga*. *Bull. S. Calif. Acad. Sci.,* **62**: 45-68.

Raghunathan, C., Sen Gupta, R., Wangikar, U. and Lakhmapurkar, J. 2004. A record of live corals along the Saurashtra Coast of Gujarat, Arabian Sea, *Curr. Sci.,* **87** (8): 1131-1138.

Sandoz, M. and Hopkins, S.H. 1944. Zoeal larvae of blue crab, *Callinectes sapidus* Rathbun. *Journ. Washington A cad. Sci.,* **34**: 132-133.

Subramoniam, T. 1977. Continuous breeding in the tropical anomuran crab, *Emerita asiatica* (Milne Edwards). *J. Exp. Mar. Biol. Ecol.* **65**:259-268.

Subramoniam, T. 1979. Some aspects of reproductive ecology of a mole crab, *Emerita asiatica* (Milne Edwards). *J. Exp. Mar. Bio. Ecol.* **65**:259-268.

Subramoniam,T. and Gunamalai,V. 2003. Breeding biology of the intertidal sand crab, *Emerita asiatica* (Decapoda: Anomura). *Advances in Marine Biology,* **46**: 91-182.

Trivedi, R. K. and Goel, P. K. 1986. Chemical and Biological Methods for water pollution studies, (Environment Pollution V C College of Science, Karad).

Vijayakumar, S. K. Rajesh, K. M. Mendon, R. and Hariharan, V. 2000. Seasonal distribution and behaviour of nutrients with reference to tidal rhythm in the Mulki estuary, Southwest Coast of India. *J. Mar. Biol., Assoc. India*., **42**: 21-31.