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Influence of external factors on the breeding activity of a brachyuran crab, *Parasesarma plicatum* Latreille

E. Jasmine and A. Shyla Suganthi*

Department of Zoology, Holy Cross College (Autonomous), Nagercoil-629004, Kanyakumari District, Tamil Nadu, India.

*Correspondence e-mail: shylasuganthipadma@rediffmail.com

Abstract

This study evaluated the influence of external factors on the breeding activity of the crab, *Parasesarma plicatum*. Bimonthly collections were carried out from January 2010 to December 2010 in the estuarine mangrove region of Manakudy, Kanyakumari District, to analyze the effect of salinity, temperature and rainfall on the breeding activity of *P. plicatum*. Pearson's correlation analysis revealed that both salinity and temperature were positively (r = 0.9 and 0.86) correlated with the frequency of ovigerous females, while a negative correlation between the rainfall and percentage of ovigerous females (r = -0.88) was observed. These degrees of association allow to presume that the breeding activity of *P. plicatum* might have some variations over environmental factors such as salinity, rainfall and temperature.

Keywords

Parasesarma plicatum, temperature, salinity, rainfall, breeding, ovigerous

Introduction

Reproduction in brachyurans is extremely diversified (Hartnoll and Gould, 1988). In crustaceans breeding activity may follow a continuous (Sudha, 1983 and Negreiros-Fransozo *et al.,* 2002) or seasonal (Anilkumar, 1980 and Perez, 1990) pattern. The breeding activity in brachyuran crabs is generally associated with the variation in the extrinsic and intrinsic factors. The influence of these factors on the breeding activity can vary in different species inhabiting different ecological localities.

The extrinsic factors such as temperature, salinity and rainfall have been considered as important variables that trigger the reproductive mechanism (Vernberg and Vernberg 1988; Anger, 2003 and Cobo and Fransozo, 2003). Salinity and temperature can affect the development and survival of larvae and juvenile crabs. It also reduced reproductive success, individual growth, population growth and increased susceptibility to other pollutants or prey species (Minagawa, 1990 and Fleeger *et al.,* 2003).

The sesarmid crab, *Parasesarma plicatum* (Latreille) commonly inhabits the muddy substratum of estuarine and mangrove environments. They are called 'ecological engineers' (Jones *et al.,* 1994) which recycle the soil nutrients in the mangrove ecosystem. Though it is widely distributed among the tropical countries, the aspects on reproduction remains poorly understood. Hence, the present study provides information on the breeding cycle of *Parasesarma plicatum*, based on the monthly frequency of ovigerous females and further evaluates the association between the breeding intensity and the environmental parameters *viz*., temperature, salinity and rainfall.

Materials and Methods

Specimens of the mangrove crab, *Parasesarma plicatum* was collected from the Manakudy estuary of Kanyakumari District, Tamil Nadu, India, latitude

between 8º4'N and 8º21'N and longitude between 77º26'E and 77º30'E. Collections were made twice in a month by baiting or by hand picking during the year 2010. The frequency of reproductive females was determined on the basis of the appearance of berried females.

Water sample was collected from the site of collection and the salinity was estimated by silver nitrate method (Mohr, 1856). The monthly average values of temperature and rainfall were provided by the Regional Meteorological Centre, Chennai, Tamil Nadu. The association between ovigerous females and extrinsic factors was evaluated using Pearson's method (Zar, 1999).

Results

The survey during the year 2010 revealed that *Parasesarma plicalium* to be a continuous breeder. Though *P. plicatum* is a continuous breeder, the environmental variables were greatly affecting the breeding activity. The temperature was minimum (30.3°C) in December and maximum (33.6°C) in April. The rainfall ranged from 0 mm in February to 284.4 mm in November. High level of salinity was recorded (27 ppt) in the month of February and the level was as low as 5 ppt in the month of November (Table-1). The percentage of ovigerous females was 39% in the month of April and only 3% in the month of November. The discrepancy in the frequency of ovigerous females and salinity might be due to the heavy down pour (284.4 mm). The percentage of ovigerous females was positively correlated with temperature (r = 0.86) and salinity (r = 0.9) (P < 0.05) (Fig 1, 2). On the other hand there was a negative correlation between the ovigerous females and rainfall (r = -0.88) (Fig-3) and it was highly significant (p < 0.05).

Discussion

The variation in the monthly frequency of ovigerous females of *Parasesarma plicatium* during the year of 2010 indicated the crab to be a continuous breeder, irrespective of the season. Continuous reproductive pattern has also been reported in several other brachyurans of both tropical and sub tropical, which were exposed to narrow variation in the environmental factors throughout the year (Costa and Negreiros-Fransozo, 2003 and Lardies *et al.,* 2004).

Previous studies revealed that the frequency of ovigerous female was associated with different ecological niches (Anilkumar, 1980; Dube and Portelance, 1992; Leme, 2002 and Cobo and Fransozo, 2003). On the other hand, the environmental factors were not seemingly operative in the grapsidae crab, *Metapograpsus messor* (Sudha and Anilkumar, 1996). In the Norwuay lobster, *Nephrops norvegicus*, the influences from the local environment referred to as random factors were suggested to upset the breeding patterns (Sarada, 1991).

Under low temperatures the degree of maturation of oocytes and ovarian growth was low in intertidal crabs (Christy, 2003) *Uca lactea* (Yamaguchi, 2001) and *Petrolistes laevigatus* (Lardies *et al.,* 2004). In the present study the breeding activity of *P. plicatum* was high at high temperature. The peak of ovigerous females was high during the summer months, was also reported previously (Cobo and Fransozo, 2003; Litulo, 2005 and Efrizal *et al.,* 2006). According to Adiyodi and Adiyodi (1970) and Wear (1974), temperature acted as a

Table-1. Effect of external factors on the breeding activity of the brachyuran crab *P. plicatum*

Months (2010)	Ovigerous females (%)	Salinity (ppt)	Temperature (°C)	Rainfall (mm)
January	20	18	30.8	54.9
February	31	27	31.9	0
March	34	25	33.1	0.3
April	39	23	33.6	7.3
May	37	20	32.8	62.2
June	18	15	30.5	93.1
July	23	17	31.2	42.7
August	35	24	32	10
September	28	22	31.9	8.3
October	18	10	31	150
November	3	5	30.9	284.4
December	9	7	30.3	245.1

Fig-1 Shows the correlation coefficient (r) of ovigerous females (%) and temperature (°C)

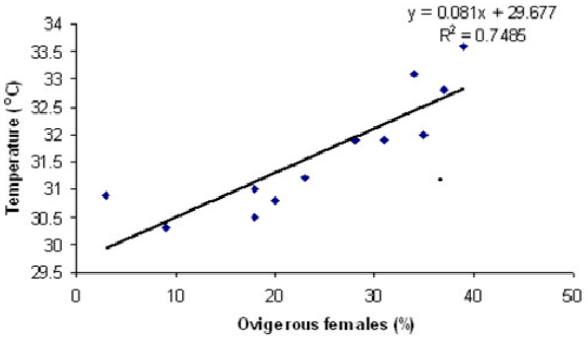


Fig-2 Shows the correlation coefficient (r) of ovigerous females (%) and salinity (ppt)

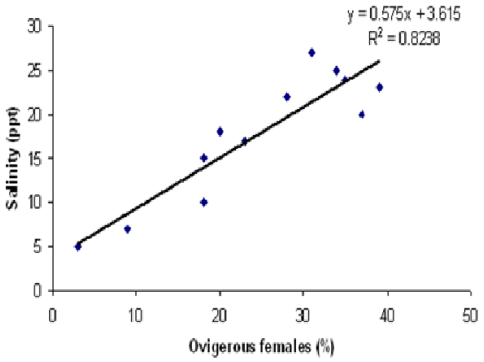
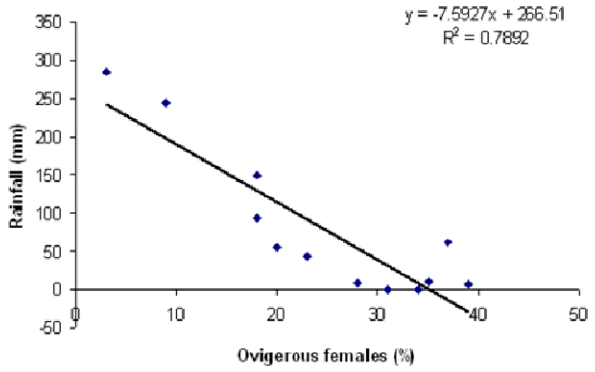


Fig-3 Shows the correlation coefficient (r) of ovigerous females (%) and rainfall (mm)



catalytic agent and accelerated the physiologic mechanisms that were probably associated with the development of gonadal tissues of the animals. In *Pachygrapsus marmoratus,* normal vitellogenesis commenced during short-day and low-temperature conditions, and became intense when photoperiod and temperature attained maximum values in other crabs, such as *Scylla serrata* (Nagabhushanam and Farooqui, 1982) and *Goniopsis cruentata* (Cobo and Fransozo, 2003).

Available literature revealed that high light intensity induced hyperactivity of the neurosecretary cells of the eyestalk of the crab. Presumably, the physiological effects of hyperactivity of cells of eyestalk were responsible for the general increase in DNA and RNA synthesis coupled with increased protein contents in the ovary that accelerated the oogonial proliferation, and early protein yolk synthesis in the oocyte. Besides protein and RNA increases, carbohydrate as well as lipid substances also showed elevated levels under increased light intensities (Adiyodi and Subramoniam, 1983 and Nadarajalingam and Subramoniam, 1987**)**.

Under very low salinity (5ppt), the breeding activity (3 to 9%) of the candidate crab, *P. plicatum* was greatly reduced during the months of November and December. It could be supposed that the heavy downpour brought down the salinity of the water, which in turn reduced the incidence of breeding activity of the females. Kannupandi *et al. (*1997) reported that rainfall elicited an osmotic stress in decapod crustaceans, because most of the energy went to the maintenance of the body. Reduced reproductive activity at very low salinities was also reported in *Chasmagnathus granulata* (Gimenez, 2003) and gravid females of *Menippe adina* and *M. mercenaria* (Brown and Bert, 1993). The reproductive cycle was much more delayed in *Philyra corallicola* (Kannupandi *et al.,* 2005) due to low and high salinities which caused imbalance in the osmo-regulatory mechanism (Perumal and Subramanian, 1985).

To conclude, the breeding activity of *P. plicatum* was higher at high temperature and salinity. High temperature and salinity induced gonadal development. The optimum salinity for high reproduction was 10 - 27 ppt, and beyond the level of 5 ppt the reproductive capacity of the crab would be greatly affected.

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