

Reproductive Cycle of Marine Crab, *Portunus Sanguinolentus*



Zoology

KEYWORDS : Reproductive cycle, gonad index, carapace length, ovary, testis

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ABSTRACT

*Dahanu is the coastal area where fishes and crustaceans are exploited in large quantities. Fishery is the main source of livelihood for large section of economy under preivilged population of this coastal area. Decapod crustaceans like crab, prawn, lobster and some molluscs are commercially important as they are with high nutritional value. In the present investigation, the reproductive cycle of marine crab, *Portunus sanguinolentus* was studied by measuring percentage of different reproductive phases of male and female crab. The carapace length and gonad index was calculated. The colour of the gonad varies in different reproductive phases. The ovarian index is ranged between 0.80 ± 0.01 to 4.28 ± 0.02 . The testis index was ranged between 0.66 ± 0.02 to 3.74 ± 0.12*

INTRODUCTION

The role of fisheries in inceasing food supply, generating job opportunities, raising nutritional level and earning foreign exchange has been well recognized, with the fact that fishing is the principle source of livelihood for a large section of economically under preivilged population of the country, specially in the coastal area. The marine fish production in India has increased from only 0.53 million tonnes decreasing 1950-51 to nearly 3 million tonnes by 2004-05 (Shiani and Dave, 2006). The process of reproduction is essential for the continuation of life. If the individuals of a species forgot to reproduce the species becomes extinct (Mariakuttikan and Arumugam, 1997). The reproductive phenomemon can be examined in terms of molecular, cellular, physiological, neurohormonal and behavioural adaptations of individual to its environment. The knowledge gained by elucidating the proximate factors controlling reproduction can provide a better understanding of the evolution of life history and reproductive strategies in different environment. Studies on the annual reproductive cycle of crustaceans have been furnished by Chandran (1968), Lowerence and Giese (1969), Pillay and Nair (1971), Haley (1972), Ito (1976), Gangotri (1978), Farooqui (1980), Varadarajan and Subramoniam (1982), Joseph et al., (1985), Rao et. al (1986), Nagabhushanam et al., (1987), Vishwanathan, (1992), Khapate (1995), and Araki and Matsuura (1995). The annual reproductive cycle of crab is studied by many investigators (Rahman,1967; Subramonium,1977; Devi et al.,1990; Lavrich and Vinuesa,1993; Minagawa,1993; Koga, 1995; Lalitha et al.,1996; Paul et al.,1997; Gardner; 1995; Kumar and Ferguson, 2000; Garcia et al., 2001; Lardies and Castilla, 2001; Nakasone, 2001; Yamaguchi, 2001) . In crustaceans, the carapace length is another parameter to ascertain their reproductive maturity. Lavrich and Vinuesa (1993) remarked the relationship between gonad maturity and cephalothoracic length is false in southern king crab, *Paralomis granulosa*. The morphological maturity related to carapace length in male litodid crab, *Paralomis granulosa* and its reproductive phase was inferred by observing the size and carapace length (Hoggarth, 1993). The carapace length of ovigerous females of three land hermit crabs has been observed by Nakasone-Yukio (2001). Gonad index is a function of breeding cycle in marine and estuarine crustaceans. Giese (1959) formulated a corelationship between gonad maturity and body weight. The simultaneous observation of carapace length, gonad index and histological data leads to conclusions about breeding cycle. Yamaguchi Takao (2001) observed ovary indices and percentage of ovi-

gerous female in *Uca lactea*.

MATERIAL & METHODS

Marine crab, *Portunus sanguinolentus* were collected from Dahanu coast (Maharashtra) for the period of two years from January 2002 to December 2003. The total number of male and female were counted. The percentage of immature, maturing, matured male and females were calculated. The carapace length was measured with the help of scale nearest to millimetre in immature, maturing and matured crab. The wet weight of gonad was recorded and the gonad index of male and female was calculated by following formula (Giese, 1959) .

$$\text{Gonad index} = \frac{\text{Wet weight of the gonad}}{\text{Wet weight of the animal}} \times 100$$

RESULTS

The percentage of different phases of male and female crab is represented in fig 1 to 4. The increase in percentage of matured male and female crab was related to reproductive season. The maximum percentage of immature crab was observed in the month of January. The high percentage of immature male crab was 45 and 42 in January 2002 and 2003 respectively. The maximum matured male crabs were observed in the month of July and August. In July 2002 the percentage of mature male crab was 48 and 60 in July 2003. The highest percentage of matured male crab was 62 and 68 in August 2002 and 2003 respectively. Mature female crabs were recognizable by their bulging abdominal pleopods. When the egg extruded gots attached to them with the help of sticky substances and opening of spermathecae were clearly seen. The maximum percentage of matured female crab was observed in the month of June and July. The percentage of matured female was 58 and 56 in June 2002 and 2003. The highest percentage of matured female was 70 and 72 in August 2002 and 2003 respectively (Fig. 1 and 2). Maximum immature female crabs were observed in the month of January. The percentage of immature female in January 2002 was 52 and 56 in January 2003. The percentage of spent female crab was highest 54 and 59 in November 2002 and 2003. The carapace length of female crab was maximum in the month of August and September. The carapace length of female crab in September 2002 was 62 mm whereas 66 mm in the year 2003. The average length for female carapace ranged from 20 mm to 66 mm throughout two years. The highest carapace length of male crab was observed in the month of September 56 mm and 54 mm. The range for carapace length of male crab was 20 mm to 54 mm

during the year 2002 and 2003 (Fig. 7 and 8).

Fig. 1. Percentage of immature, maturing matured and spent females of *Portunus sanguinolentus* for the year 2002

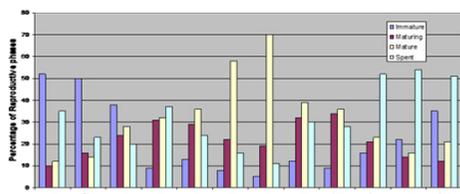


Fig. 2. Percentage of immature, maturing matured and spent females of *Portunus sanguinolentus* for the year 2003

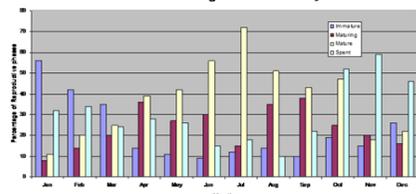


Fig. 2. Percentage of immature, maturing matured and spent females of *Portunus sanguinolentus* for the year 2003

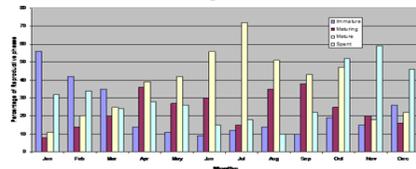


Fig. 3. Percentage of immature, maturing and matured male of *Portunus sanguinolentus* for the year 2002

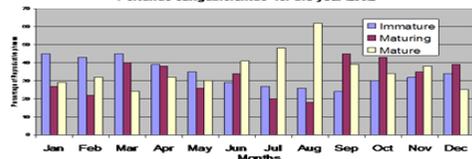


Fig. 4. Percentage of immature, maturing and matured male of *Portunus sanguinolentus* for the year 2003

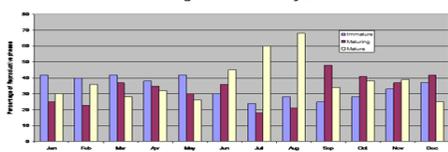
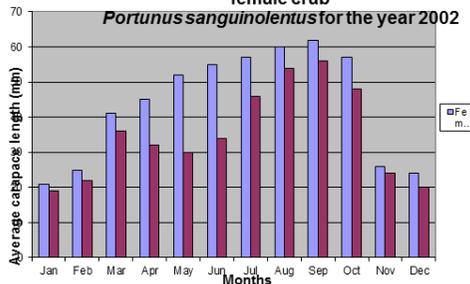


Fig. 5: Average carapace length of male and female crab *Portunus sanguinolentus* for the year 2002



In crab *Portunus sanguinolentus*, the gonad index values was high during the reproductive period. Gonad indices for female crab were maximum in the month of June and July. The ovarian index in the month of July 2002 was 4.17 ± 0.01 and 4.28 ± 0.02 in July 2003. The range of ovarian index was 0.86 ± 0.01 to 4.28 ± 0.02 , (Table 1 and 2). In male crab, the testis index was maximum in the month of August. The testis index in August 2002 was 3.74 ± 0.12 and 3.37 ± 0.01 in August 2003 (Table 3 and 4).

Table 1- Seasonal variation in the ovarian index and testis index of

Portunus sanguinolentus for the year 2002

Month	Ovarian index \pm S. D.	Testis index \pm S. D.
January	0.86 ± 0.01	0.73 ± 0.01
February	1.39 ± 0.01	0.91 ± 0.02
March	1.22 ± 0.09	1.06 ± 0.02
April	2.09 ± 0.01	1.14 ± 0.06
May	2.65 ± 0.02	1.90 ± 0.01
June	3.28 ± 0.07	2.27 ± 0.04
July	4.17 ± 0.01	2.87 ± 0.02
August	2.40 ± 0.02	3.74 ± 0.12
September	1.73 ± 0.01	1.49 ± 0.03
October	1.41 ± 0.03	0.72 ± 0.01
November	1.26 ± 0.01	0.95 ± 0.02
December	1.08 ± 0.02	0.83 ± 0.07

Table 2 – Seasonal variation in the ovarian index and testis index of

Portunus sanguinolentus for the year 2003

Month	Ovarian index \pm S. D.	Testis index \pm S. D.
January	0.80 ± 0.03	0.66 ± 0.03
February	1.29 ± 0.01	0.85 ± 0.06
March	1.43 ± 0.01	1.03 ± 0.01
April	2.08 ± 0.02	1.10 ± 0.01
May	2.62 ± 0.05	1.47 ± 0.03
June	3.19 ± 0.02	2.06 ± 0.05
July	4.28 ± 0.02	2.72 ± 0.02
August	2.94 ± 0.02	3.37 ± 0.01
September	2.46 ± 0.01	1.58 ± 0.02
October	1.64 ± 0.01	0.66 ± 0.02
November	1.27 ± 0.20	0.84 ± 0.05
December	1.16 ± 0.04	0.70 ± 0.03

DISCUSSION

The marine crustaceans showed wide variety in their breeding period. Studies on reproductive cycle in crustaceans have been carried out by many workers. Gangotri et.al. (1978) reported the breeding period in *Barytelphusa guerinii* is from May to August. Gommell (1979) reported the ovaries showed a peak of activity during the month of

May to September and testicular activity recorded from April to September in *Paragrapsus laevis*. In *Potamon kooloense* the breeding activity is less in May-June (John and Khanna, 1982). Devi et.al. (1990) reported that *Ocypoda platytarsis* is an annual breeder, exhibiting its breeding activity from January to June with highest in May. Haddon and Wear (1993) investigated the annual reproductive cycle of the Newzealand paddle crab *Ovalipes catharus* and reported that three peaks of egg bearing females were found over each breeding season, the first during August the second through late November and early December and last during early January to early April. Lalitha et.al. (1996) reported that the crab *Uca annulipes* is a continuous breeder and breeding activity extends for several months in a year, the female have very prominent peaks between September and January. Pinho et al. (2001) studied annual reproductive cycle of deep water crab, *Chaceon affinis* and *Cancer bellianus* and observed ovigerous females only from October to March. The reproductive period of fiddler crab, *Uca lactea* started in early June and continued to the end of August (Yamguchi 2001). In successful breeding cycle the surrounding conditions i.e. ecological factor play an important role. The reproductive hormones play a key role in the reproduction. Hence, the balance of reproductive hormones and environmental factors together help in successful reproductive cycle of an animal. In present investigation, it was reported that in crab, *Portunus sanguinolentus* breeding season coincided monsoon season. During June to September, maximum number of ovigerous females were observed and it was revealed that this breeding peak is correlated with maximum development of gonad in crab. Similarly maximum number of males with full carapace growth were also observed in the month of June to September. This revealed that breeding cycle is correlated with maximum development of gonad in the crab. Occurrence of matured females during June to September, ultimately helped in successful breeding in these months. Similar reports have been cited in *Barytelphusa cunicularis* (Diwan, 1971) and *Barytelphusa guerini* (Kengar 1998). However in *Uca annulipes*, *Portunus pelagicus* and *Metapenaeus affinis* (Pillay and Nair 1971), in hermit crab *Clibanarium clibanarium* (Vardarajan and Subramoniam, 1980), rainy season hampered the breeding activity, these crustaceans showed reproductive activity in non-rainy season. The carapace Length considered as measure of sexual maturity in crustaceans. The carapace length of female of *Portunus sanguinolentus* were measured for two years. In *P. sanguinolentus* the maximum carapace length was 50-66 mm in the female observed in breeding season i.e. from May to September. The relationship between carapace length and maturity in crab has been carried out by the following workers. Buttler (1960) observed that male *Cancer magister* with carapace width of 10 cm and female with 11.5 cm were sexually matured. The crab *Barytelphusa cunicularis* entered into maturity after attaining the carapace length of 40 mm for male and 44 mm for female (Diwan 1971). Haley (1972) observed in *Ocypoda quadrata* the carapace length ranged between 25.0 to 34.9 mm. In hermit crab *Emerita asiatica* the carapace length ranged between 3.75 mm to 11.0 mm and 20 mm (Subramoniam, 1977). The freshwater crab, *Barytelphusa guerini* attained sexual maturity at a carapace length of about 45-60 mm (Gangotri et.al, 1978). Rahaman and Adiyodi (1980) established a positive relationship between body length and ovary in freshwater crab *Paratelphusa hydrodromous*. Yau (1992) reported that female crab, *Gaetice depressus* matured at the carapace width of 8.0 mm. Minagawa (1993) studied female puberty moult in red frog crab, *Ranina ranina* that occurred at 40-45 mm carapace length. Haddon and Wear (1993) investigated in the Newzealand paddle crab, *Ovalipes catharus* for average car-

apace width of crab carrying eggs was 84.6 ± 9.65 mm and smaller female crab with 41-60 mm carapace width were found carrying eggs predominantly during January and February. Mcdintock et. al. (1993) investigated annual reproductive cycle of blue crabs and observed carapace width 80mm in adult crab and gonadal maturation occurring in summer. In Southern king crab, *Paralomis granulasa* carapace length at gonadal maturity in males 50.2 mm and in females 60.6 mm was reported by Lovrich et. al. (1993). Araki and Matsuura (1995) observed in freshwater crab, *Geotelphusa dehaani* sexual maturity attained when carapace length was about 18mm in male and 19 mm in female. Diesel and Horst (1995) in Jamaica montance crab, *Sesurma jarvisi* observed that the juvenile develop inside the snail shell, until they reached 8mm carapace width. Paul et. al, (1997) reported that in the snow crab, *Chionoecetes opilio*, the smallest ovigerous female was 34 mm carapace width and average carapace width of ovigerous female was 46 mm and carries 19000 eggs. A positive relationship was found between fecundity and carapace, with fecundity embryo mass weight while no significant relationship was found between fecundity and embryo size (Sigama, 1999). In arched box crab, *Calappa convexa* reproduction occurred throughout the year, with peak from April to August and female reached sexual maturity at 75 mm and carapace length 50mm (Ayon et. al, 2001) Garcia and Montelatto (2001) observed in *Paguristes erythropros* the minimum and maximum shield length was 1.7 and 11.8 mm for males 1.7 and 10.3 mm for non-ovigerous females and 3.2 and 7.8 mm for ovigerous females. In *Mitrax forceps* male and female crabs attained sexual maturity at a size of 7.15 and 11.20 mm carapace length respectively and size at maturity for 50% of the population was 19.20 and 16.24 mm carapace length for males and females (Hernandez et.al, 2001). Nakasone- Yukio (2001) observed that the carapace length of the smallest ovigerous female was 3.93 mm for *Coenobita rugosus*, 3.83 mm for *Coenobita purpureus* and 9.49 mm for *Coenobita cavipes*. In deepwater crab *Chaceon affinis* the carapace length at sexual maturity in female ranged between 83-97 mm (Pinho-Mario et. al, 2001). In crustacean different stages of ovarian maturation classified on the basis of colouration. In immature female of *P. sanguinolentus* ovary was white and translucent whereas in maturing it was yellowish and in matured crab the appearance of ovary was dark yellow or orange. In male *P. sanguinolentus*, there is no distinct colour change in the testis however, immature testis were transparent and mature testis are milky white. These colour clearly observed during reproductive phases of *P. sanguinolentus*. Similar reports are cited in other crabs (Farooqui, 1980 and Khapate, 1995). Gonadal index has been widely used as a measure to determine reproductive phase in many groups of crustaceans (Giese and Pearse, 1974). The relationship between gonad size, body weight and gonad development during a year has already been established in marine crustaceans by several investigators (Pillay and Nair, 1971; Sambasivarao, 1984; Rao et al., 1986). Rahaman (1967) suggested the maximum development of gonads are in November, January and June in *Portunus pelagicus*. In Japanese mitten crab, *Eriocheir japonicus* gonad maturation occurs after the puberty moult, taking approximately 4 months and the gonadosomatic index increased from below 1.0 to above 10.0 (Kabayashi et. al, 1995). Koga (1995) reported that in *Scorpinera globosa* gonadal index decreased with time in early to mid-reproductive seasons. In *Barytelphusa cunicularis* the maximum gonadal index was in January (Khapate 1995). Lalitha et. al (1996) reported that in female of *Uca annulipes* the mean gonad index reaches high value (8.32 ± 0.016) during September which down slightly in October and November and continues upto January when it reaches (7.85 ± 0.020)

whereas in male the lowest gonad index was in April (0.23 ± 0.016) and highest was in February (0.70 ± 0.16). In *P. sanguinolentus*, the gonad index of female crab was high in July and low in January whereas gonad index of male crab was more in August and it was low in October. The variation in the period of maximum gonad indices of the female crab in present study may be due to different hydrobiological conditions. This has been noted in a variety of crustaceans from west coast of India.

SUMMARY

The breeding cycle of marine crab *Portunus sanguinolentus* was studied for consecutive two years. i.e. January 2002 to December 2003. Various parameters such as percentage of immature, maturing and matured male and female, percentage of ovigerous females, carapace length for attainment of maturity, gonad index, were taken into consideration to conclude the reproductive activity. The female crab, *P. sanguinolentus* showed major reproductive activity during July to August. The higher percentage of ovigerous female crab (72%) found in the month of July. The maximum carapace length attained by the female crab was 66 mm and 56 mm by the male crab. The gonad index in female crab was highest 4.28 ± 0.02 and that of male crab was 3.74 ± 0.12. The knowledge of breeding cycle is beneficial for the aquaculturist interested in culturing the species. It also provide baseline data for management decision and culture of this species in the area.

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