

Reproductive cycle of the crab *Ocypoda macrocera* Milne Edwards (Crustacea: Brachyura) from Visakhapatnam coast*

C A NAGESWARA RAO**, K SHYAMA SUNDARI and
K HANUMANTHA RAO

Department of Zoology, Andhra University, Waltair 530 003, India

**Zoological Survey of India, Hillpatna, Berhampur 760 005, India

MS received 30 March 1985; revised 3 August 1985

Abstract. Reproductive cycle of the crab *Ocypoda macrocera* has been studied employing the gonad index method. Breeding period in this crab is found to be a prolonged one extending from March–September with small intermittent peaks and falls. Salinity is found to have a close relationship with the breeding cycle as lower salinities during October–January coincided with the absence of reproductive activity. Male crabs have not shown any clear picture in their gonad index in relation to breeding period and male gametes are found round the year.

Keywords. *Ocypoda macrocera*; reproductive cycle; gonad index; tropical marine invertebrates; salinity.

1. Introduction

Marine invertebrates are found to show different patterns in their reproductive behaviour and the reproductive biology of marine invertebrates have been studied extensively (Benett and Giese 1955; Farmanfarman *et al* 1958; Rahaman 1966, 1967; Knudsen 1964; Chandran 1968; Pillay and Nair 1971, 1973; Nagabushanam and Kulkarni 1977). The relation of gonad weight to the body weight as a factor in the determination of the breeding periodicities in the marine invertebrates has been well established and the reproductive cycles of crustaceans based on gonad index method was studied by several authors (Subrahmanyam 1963; Rahaman 1967; Pillay and Nair 1971; Diwan and Nagabushanam 1974). The gonad index method involves the determination of the ratio of gonad weight to body weight and it is evident that gonad index of animals with immature or spent gonads will be lesser while the gonad index of ripening and mature gonads will be high.

Various patterns and differences in the timing of the reproductive cycles among marine invertebrates from Indian coasts were reported and environmental factors were attributed as a major factor to them. As there are scanty reports on the reproductive biology of marine invertebrates from Visakhapatnam coast, the common shore crab *Ocypoda macrocera* has been taken for such study.

2. Materials and methods

Fortnightly samples of *O. macrocera* were collected from Lawson's Bay and palm beach localities of Visakhapatnam coast. Live crabs were brought to the laboratory

*Part of the Ph.D. thesis (CANR) approved by the Andhra University, Waltair.

and kept in glass jars containing sea water. At the initial stages of the study, samples of the crabs were dissected to ascertain average size range of the maturing forms; while collecting samples, care was taken to collect only the crabs within the size ranges of their sexual maturity and in intermoult stage.

In the laboratory, the specimens were thoroughly dried with filter paper to remove the outer water content. Size measurements viz. carapace length and width were taken and later the weight of each crab was made. The crabs were dissected out and the net weight of the gonads of all the crabs were taken separately. The gonad index was calculated as wet weight of gonad divided by wet weight of the animal and this fraction multiplied by 100. A minimum of 10 crabs for each sex were taken during every sampling and the mean values for each sampling period for both males and females were calculated. Thus the mean gonad index for all the months of a year was obtained. The sampling was taken from May 1981–August 1982 and during sampling at every time small pieces of both the gonads were fixed and later sectioned for histological observations.

3. Results and observations

The histological studies on the gonads revealed that female crabs measuring above 2.2 cm and male crabs of 2.1 cm carapace width are found to be mature. The carapace width range, range of gonad index and mean gonad indices of female and male crabs for all the months from June 81–May 82 are shown in tables 1 and 2. In the female crabs, during the period from October–January minimum gonad indices of 0.71, 0.45, 0.69 and 0.79 were recorded. Ovarian activity started in the month of February as indicated by the higher gonad index (1.32) and also high individual gonad index (1.77) in comparison to January. Increase in the gonad index continued and higher gonad

Table 1. *O. macrocera*—carapace width range, range and mean of gonad indices of female crabs for different months during 1981–82.

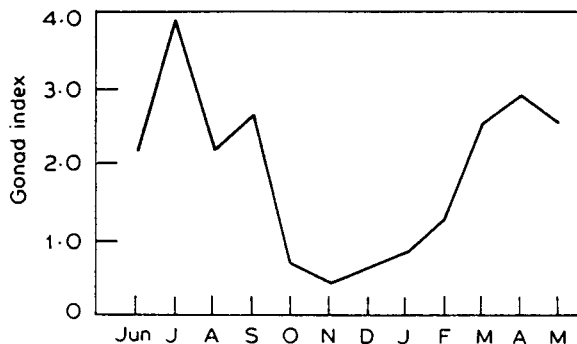
Year and month	Carapace width range Cm	Range of gonad index	Mean of gonad index
1981			
June	2.4–3.3	0.34–4.23	2.144 ± 0.906
July	2.2–2.6	0.66–8.02	3.945 ± 2.630
August	2.2–2.7	0.73–5.11	2.159 ± 1.795
September	2.3–2.9	0.40–9.80	2.659 ± 3.164
October	2.2–2.7	0.38–0.93	0.713 ± 0.262
November	2.5–3.0	0.15–0.62	0.456 ± 0.259
December	2.5–2.9	0.42–0.75	0.692 ± 0.139
1982			
January	2.4–3.0	0.25–0.92	0.794 ± 0.424
February	2.7–2.9	0.92–1.77	1.320 ± 0.411
March	2.5–3.0	0.56–10.96	2.557 ± 4.708
April	2.5–2.9	0.40–7.33	2.929 ± 2.146
May	2.4–3.1	1.10–10.42	2.586 ± 1.560

Table 2. *O. macrocera*-carapace width range, range and mean of gonad indices of male crabs for different months during 1981-82.

Year and month	Carapace width range Cm	Range of gonad index	Mean of gonad index
1981			
June	2.3-2.8	0.63-1.28	0.836 ± 0.150
July	2.1-2.9	0.60-0.90	0.754 ± 0.120
August	2.2-2.8	0.678-0.976	0.818 ± 0.274
September	2.2-2.4	0.356-0.932	0.452 ± 0.258
October	2.2-2.4	0.550-0.836	0.660 ± 0.152
November	2.4-2.8	0.360-0.890	0.626 ± 0.212
December	2.4-2.9	0.260-0.754	0.444 ± 0.134
1982			
January	2.5-2.8	0.446-0.754	0.598 ± 0.154
February	2.5-2.9	0.794-1.156	0.842 ± 0.048
March	2.2-2.7	0.953-1.128	1.031 ± 0.089
April	2.6-2.7	0.473-0.752	0.615 ± 0.139
May	2.2-2.8	0.618-0.871	0.790 ± 0.116

index values are found up to September though maximum gonad index 3.94 was noted in July.

It is evident from the figure 1 that the gonad indices from March-September remained nearly at uniform level though minor peaks during April and July and slight falls in June and August were noted. The reproductive activity started in March and continued up to September as evident from the higher mean gonad indices (2.55, 2.65) and also higher individual gonad indices (10.96, 9.80) were found in March and September respectively. The sudden fall in the mean gonad index and also individual gonad index from October-January indicate the cessation of reproductive activity during this period. Histological observations of ovaries coincided with the above results showing developing oocytes during February-September and their absence from October-January.

**Figure 1.** Seasonal variation in the gonad index of female crab *O. macrocera* during 1981-1982.

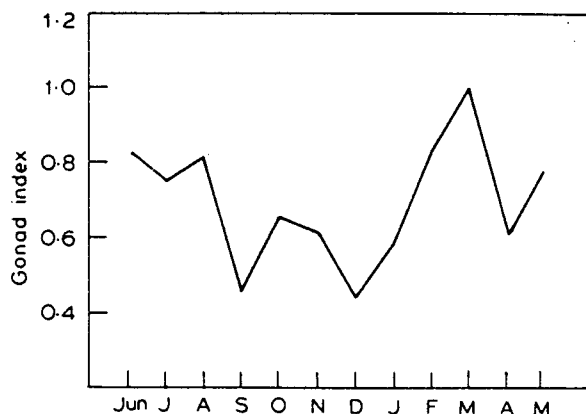


Figure 2. Seasonal variation in the gonad index of male crab *O. macrocera* during 1981-1982.

The gonad index values of the male crabs has not shown peaks or significant falls in its activity. It appears from the results shown in the table 2 and figure 2 that the gonad index of male crabs remained at nearly uniform level during most of the year except for a rise in March and fall in September and December. Maximum gonad index of 1.03 in March and minimum of 0.44 in December is noted. The results suggest more prolonged and frequent activity of the testis; During March not only maximum mean gonad index but also higher individual gonad index value was recorded, showing higher testicular activity at the beginning of breeding season. However histological observations of testis revealed the presence of developing male gametes even during minimum gonad index periods.

4. Discussion

The results clearly showed that the breeding period of *O. macrocera* is a prolonged one extending for about 7 months with higher activity during certain months. Female crabs have shown peak activity during April, July and September as evident from high gonad indices recorded (2.92, 3.94, 2.65). Though male crabs also have shown higher values of gonad indices during certain months of the active breeding period its value in assessing reproductive cycle is insignificant as testis is very minute in size; Rajabai Naidu (1955) reported female crabs of *O. macrocera* measuring 2.2 cm carapace width are mature, and could collect only one example of ovigerous crab during a period of 3 years in the month of August. In the present study also only 3 ovigerous crabs are collected in March. Therefore the data on the incidence of ovigerous females could not be combined with gonad index data in the study of the reproductive cycle for this crab.

The prolonged breeding period from March-September is interspersed with minor peaks and falls. The fall of the gonad index values in June and August during the reproductive period is probably due to the occurrence of majority females which are in the process of recuperation of their gonads after the release of the first brood and some females with spent ovaries. Development of new brood within a period of 15-20 days after the first brood has been reported in *Uca annulipes* (Pillay and Nair 1973).

Differences in the breeding behaviour and reproductive seasons are reported in several crustaceans from Indian coasts. In *U. annulipes* the breeding period extending from July–April with 3 distinct periods of gonadal activity was reported (Pillay and Nair 1971). In *Portunus pelagicus* from Madras coast a continuous breeding activity was noticed from November–June (Rahaman 1967) while in the same crab from west coast of India, a lengthy extended breeding period from August–April was reported (Pillay and Nair 1971). In the crabs inhabiting intertidal sands and muddy estuarine breaches of west coast, breeding period extending from September–April and in the swimming crabs a continuous breeding activity round the year was noted (Pillay and Nair 1973). The breeding pattern of *O. macrocera* from Visakhapatnam coast resembles to some extent with those of other intertidal crabs, by its extended breeding activity with intermittent peaks.

The variations in breeding pattern in the tropical marine invertebrates has been attributed to changes in salinity and temperature. The coincidence of maximum breeding activity with higher salinity is reported in the pearl oyster *Margaritifera vulgaris* by Malps (1933). Similarly Panikkar and Aiyar (1939) and Pillay and Nair (1971) also indicated that the sudden changes to low salinities trigger off the reproductive activity in animals.

The breeding behaviour of *O. macrocera* agrees well with the earlier reports on the influence of salinity on reproductive cycle as periods of high salinities coincided with breeding activity and its absence during low salinities. Sunita Devi (1984) reported salinities of 33.63–35.97‰ from February–September and 23.02–29.97‰ from October–January in the near shore waters of Visakhapatnam during 1981–1982.

Acknowledgements

One of the authors (CANR) is grateful to the Council of Scientific and Industrial Research for the financial assistance and to Dr B K Tikader, Director, Zoological Survey of India, Calcutta for encouragement.

References

- Benett J and Glese A C 1955 The annual reproductive and nutritional cycles in two Western Sea urchins; *Biol. Bull. Wood's Hole*. **109** 226–237
- Chandran M R 1968 Studies on the marine Crab *Charybdis variegata*. I. Reproductive and nutritional cycle in relation to breeding periodicities *Proc. Indian Acad. Sci.* **B67** 215–223
- Diwan A D and Nagabushanam R 1974 Reproductive cycle and biochemical changes in the gonads of the Freshwater crab *Barytelphusa cunicularis* (Westwood 1836); *Indian J. Fish.* **21** 164–176
- Farmanfarmaian A, Giese A C, Boolootian R and Benett J 1958 Annual reproductive cycles in four species of West coast star fishes; *J. Exp. Zool.* **138** 355–367
- Knudsen J W 1964 Observations of the reproductive cycles and ecology of the common Brachyura and crabs like Anomura of Puget sound, Washington, *Pac. Sci.* **18** 3–33
- Malps A H 1933 Further observations on the age and growth rate of the Ceylon Pearloyster *Margaritifera vulgaris* with special reference to Oysters of Donan's Mutturarattu Paar. *Ceylon J. Sci.* **C5** 21–48
- Nagabushanam R and Kulkarni K M 1977 Reproductive biology of the sand crab *Emerita holthuisi*. *J. Mar. Biol. Assoc. India* **19** 50–57
- Panikkar N K and Aiyar R G 1939 Observations on breeding in brackish water animals of Madras; *Proc. Indian Acad. Sci.* **B9** 343–364

- Pillay K K and Nair N B 1971 The annual reproductive cycles of *Uca annulipes*, *Portunus Pelagicus* and *Metapenaeus affinis* (Decapoda: Crustacea) from the South West Coast of India; *Mar. Biol.* 11 152–166
- Pillay K K and Nair N B 1973 Observations on the breeding biology of the crabs from the South West coast of India; *J. Mar. Biol. Assoc. India* 15 754–770
- Rahaman A A 1966 Annual changes in the gonad and hepatic indices of the starfish, *Oreaster hedmanni* of the Madras coast. *Bull. Dept. Mar. Biol. Oceanogr. Univ. Kerala* 52 1–4
- Rahaman A A 1967 Reproductive and nutritional cycles of the Crab *Portunus pelagicus* (Linnaeus) (Decapoda: Brachyura) of the Madras coast; *Proc. Indian Acad. Sci.* B65 76–82
- Rajabai Naidu K G 1955 *Ecological studies of the Brachyura of the Waltair coast*, Ph.D. thesis, Andhra University, Waltair
- Subrahmanyam C B 1963 A note on the annual reproductive cycle of the Prawn *Penaeus indicus* of Madras coast; *Curr. Sci.* 32 165–166
- Sunita devi G 1984 *Studies on the water quality and crevice fauna of the intertidal single beach of Visakhapatnam coast*, Ph.D. thesis Andhra University, Waltair