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Maturation process and reproductive cycle in two marine crabs, *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) along the Karnataka coast

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ABSTRACT

In the development of ovary of *Portunus (Portunus) sanguinolentus* and *P. (P.) pelagicus*, six maturity stages have been recognised by gross examination, i.e., immature virgins, immature resting, early maturing, late maturing, mature and spent. By microscopical studies, nine arbitrary stages have been identifed in the maturation process of ovary. In the development of testis, three maturity stages have been discernible, i. e., immature, maturing and mature. The spawning season is exended from August to May in both the species with intensive activity during December-February in the former and during January-February and September in the latter species.

Introduction

The annual crab landings m India from the marine sector is around 25, 000 tonnes. The crab fishery is mainly supported by *Portunus (Portunus) sangumolentus* and *P. (P.) pelagicus* and these two species together contribute to about 90 % or the crab landings in the country.

Notwithstanding the commercial importance of *P. (P.) sanguinolentus* and *P. (P) pelagicus* in their distributional ranges, the information on the spawning biology of these crabs is rather fragmentary and limited to the works of Menon (1952), Prasad and Tampi (1953, 1954), Chhapgar (1956), George and Nayak (1961), Ryan (1967, 1967 a), Pillai and Nair (1970, 1971, 1971a, 1976)) gukumarane*aZ. (1986), Sumpton (1979) and Campbell and Fielder (1986) Mogt of thege studieg arg onJ briel accounts on some aspects of relative growth, sexual maturity, maturity stages, sex ratio, mating behaviour, fecundity and spawning from various regions. More recently, Sukumaran and Neelakantan (1996 and 1997) have dealt with relative growth, sex ratio, fecundity and reproductive potential in these two species from the Karnataka coast. The present study gives a fairly comprehensive account on the maturation process and reproductive cycle of P. *(P.) sanguinolentus* and P. *(P.) pelagicus*

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from the Karnataka coast on the central west coast of India.

Materials and methods

P. (P.) sanguinolentus and *P. (P.) pelagicus* caught by different gear were sampled from Mangalore, Malpe and Karwar, three important fish landing centres in Karnataka, on a regular basis and analysed for carapace width, sex and maturity conditions.

The gonadal developmental stages were ascertained by the following methods:

1. By gross examination of gonads.

2. By studying the ova diameter frequency distributions.

In the first method, developmental stages have been assigned based on oocyte size, colour or ovary size to determine the reproductive condition. The maturity in male crabs was determined based on the thickness and colour of vas deferens.

In the second method, the oocyte diameter measurements were taken from ovaries belonging to various developmental stages and oocyte size frequency polygons were constructed with a view to trace the development of ova from immature stage to mature condition. In order to bring out the natural sequence of maturity stages through which the ova pass before becoming fully mature, the ova diameter measurements taken from individual ovaries were classified according to the size - frequency distribution of ova and the position of the mode of the most mature groups of ova as suggested by Devaraj (1977).

The gonadosomatic index (GSI) which is useful in determining the reproductive cycle and for separating the spawning and non-spawning crabs was estimated monthwise by ascertaining the individual gonad weight in relation to body weight and found out the percentage.

Results and discussion

Maturation process in female

Structure of adult ovary : The ovary in both the species is paired and approximately H-shaped in form, lies dorsal to hepatopancreas and extend posteriorly upto the narrow abdomen along each side of the hind gut. Anterior to heart, the ovaries join at a commissure just posterior to the stomach, with lobes that extend anteriolaterally around the gastric region and into the cephalothorax on each side. Spermathecae, which arise from the mid lateral portion, extend ventrally to gonopores that open on the sixth thoracic somite.

Maturity stages of ovary (gross examination)

The following six stages of maturity have been recognised in the ovarian development in ***P.*** *(P.) sanguinolentus* and *P. (P) pelagicus.*

i) *Immature virgins (Stage I) :* The ovary is colourless, thread - like.

ii) *Immature resting I intermediate (Stage II)* : After ovulation, ovary return to immature stage before rematuration. The ovary in this stage is thick and translucent or yellow orange or brown orange or brown tan in colour. Crabs having broader abdominal flaps with immature ovary and measuring 100 mm carapace width and above are included in this stage.

iii) *Early maturing (Stage III)* : The ovary is slightly enlarged and char-

acterised by an ivory or yellow colour.

iv) *Late maturing (Stage TV) :* The ovary at this stage is swollen with pronounced lobulations often obscuring the antero-lateral portions of hepatopancreas. Colour varies from yellow to orange.

v) *Mature (Stage V)* : Mature ovaries are deep orange in colour and the greatly swollen anterior lobes completely obscure the underlying hepatopancreas and extend into the available space in the haemocoel.

vi) *Spent (Stage VI)* : The ovary is very flaccid and ivory or yellow orange or tan in colour.

Maturity stages in female (by microscopical studies)

On the basis of ova diameter - frequency analysis of P. *sanguinolentus* and *P. pelagicus* nine arbitrary stages were recognised and designated serially from A to I (Fig. 1). A brief description of the stages is given below.

Immature *:* Clusters of primary/ young oocytes present.

Stage A : Mode at 3.03 urn; no ova beyond 4.4 um.

Stage B : Mode at 3-4 um; no ova beyound 8.08 um.

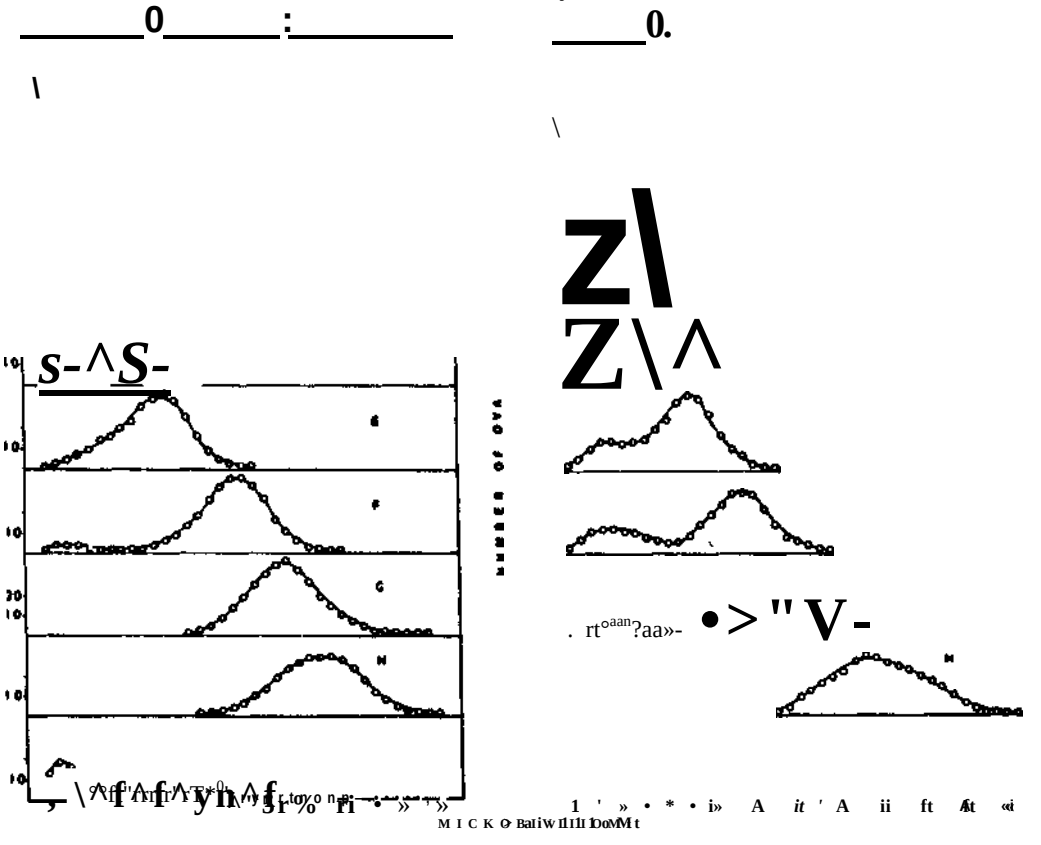

Fig. 1. Ova diameter frequency polygons showing the development of ova from immature to mature stage in *P. (P.) sanguinolentus* (S) and *P. (P.) pelagicus* (P). (For description of stages A - I, see the text).

Early maturing *:* Oocytes with clear nucleus and are in various stages of development.

Stage C : The mode of the most mature group of ova is 6.1 - 7.1 um; no ova beyond 11 um.

Stage D : The mode of the most mature group of ova is between 9.1-11.0 am and no ova beyond 18 urn. In *P. sanguinolentus,* another secondary mode at 5.05 um also noticed.

Late maturing*:* Many of the oocytes are in late phases of vitellogenesis and exhibit a granular texture due to the accumulation of yolk granules obscuring the nucleus completely.

Stage E : The mode of the most mature group of ova is between 13 and 15 urn. No ova beyond 23 um. A minor mode at 7 um seen in *P. pelagicus.*

Stage F : The mode of the most mature group of ova is between 18 and 22 urn and a mode between 5 and 7 um; no ova beyond 32 um.

Mature: Ovary is dominated by mature ova which are granular in apprearance as the oocytes are completely filled with yolk material.

Stage G : The mode of the most mature group of ova between 23 and 25 um and separated from the succeeding group of ova by a deep trough. The mode at 7 um showed no sign of development; no ova beyond 38 um.

Stage H: The mode of the most mature group of ova between 29 and 34 um. The minor mode at 7 um of stage G become insignificant; no ova beyond 47 um

Spent: Mature unspawned ova undergoing resorption are often present.

Stage I : No clear modes; no ova beyond 27 um.

Maturation process in male

Structure of adult testis (gross examination)

The male reproductive system consists of a pair of testes and vas deferens. The paired testes are slender, white convoluted tubes interconnected medially by a commissure. The vas deferens extends from the posterior end of testes and pass through the thoracic cavity and pereiopodal musculature of eighth thoracic segment where it ends in the penile papillae on the coxae of the fifth pereiopod.

The vas deferens is divided into four regions, the proximal vas deferens, mid vas deferens, distal vas deferens and ejaculatory duct. The proximal vas deferns is tightly coiled and dull-white in colour and lies anterior to the pericardial region. The milky white mid vas deferens is loosely coiled and constitute the largest part of the system. The distal vas deferens is transparent and highly convoluted partly extending into muscular ejaculatory duct.

Maturity statges of testis

In the present study, the following three stages have been recognised in the development of testis.

i) *Immature (Stage I)* : Testes and vasa deferentia not clearly differentiated; gonad small on either side of stomach; vasa deferentia are thin, translucent straight tubes; spermatozoa absent. Gonad of males measuring below 80 mm CW were in this stage of development.

ii) *Maturing (Stage II)* : Testes and vasa deferentia well developed. Testes

are large coiled tube spreading laterally and posteriorly in the stomach. Vasa deferentia opaque or white coiled mass, about 0.5 - 1.0 mm thick extending to both sides of heart. Spermatophores present.

iii) *Mature (Stage III)* : Testes showed further enlargement. Vasa deferentia are very much swollen, 2-3 mm thick and milky white mass extending to fill most body cavity. Spermatophores present.

Gonadosomatic index (GSI)

The GSI in females showed clear cyclic pattern with high values during January-February in *P. (P.) sanguinolentus* and during September and January-February in *P. (P.) pelagicus* (Figs. 2A and 2B) when the incidence of mature crabs were relatively high and low during the other months. Since the gonad index did not show any definite pattern in males (Figs. 2A and 2B), the breeding potential of male could be assessed only by the morphological condition of the gonad.

Spawning

It is seen that eventhough the spawning season is prolonged from November to May, peak activity was recorded during December-February in *P. (P.) sanguinolentus* as evident from high incidence of mature and spent crabs (Fig. 3A) along with maixmum values of ovigerous females during this period (Fig. 4A).

In the case of *P. (P.) pelagicus,* the spawning activity was pronounced during January-February and in September eventhough mature, spent or berried females were available practically in all the months from August -

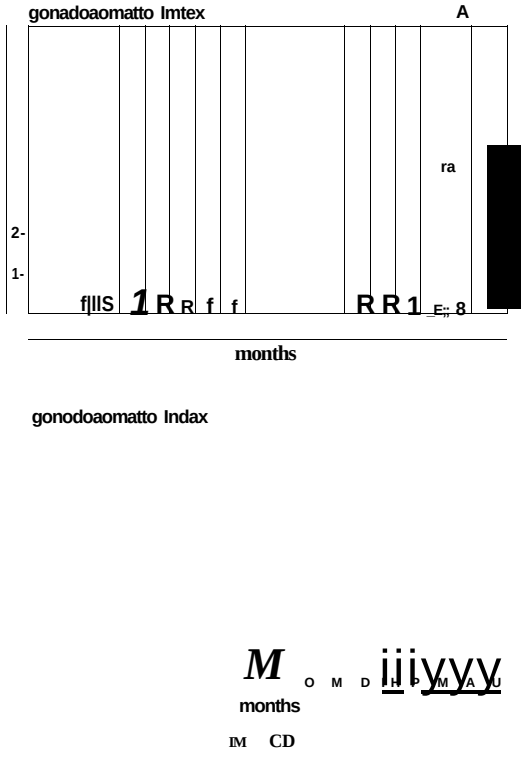

Fig. 2. A - Gonadosomatic index (GSI) for *P. (P.) sanguinolentus* during different months. B - Gonadosomatic index (GSI) for *P. (P.) pelagicus* during different months.

May (Figs. 3B and 4B) suggesting prolonged breeding in this species.

The occurrence of mature, spent and berried crabs of *P. (P.) sanguinolentus* and *P. (P.) pelagicus* in large numbers particularly during peak breeding season in the shrimp trawlers operating within 40 m depth tends to suggest that these crabs are breeding in the inshore waters itself.

Ovigerous females

The ovigerous females of *P. (P.) sanguinolentus* started appearing in the fishery in December and steadily increased its abundance, attaining higher

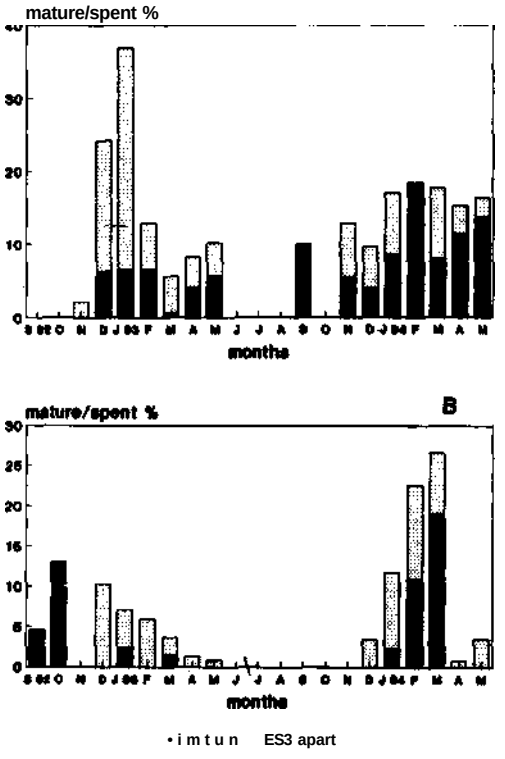

Fig. 3. A - Monthwise distribution of mature and spent stages of P. *(P.) sanguinolentus* females. B - Monthwise distribution of mature and spent stages of P. *(P.) pelagicus* females (data for Mangalore, Malpe and Karwar pooled.)

values in December, January or February in the trawl catches during 1992-'93 and 1993-'94 seasons (Fig. 4A). In the following months, the proportion of ovigerous females was relatively low. It was found that berried crabs of this species occurred in the catches in all the months in various proportions except June when there was no catch.

In *P. (P.) pelagicus,* berried crabs started appearing in the catch in August, steadily increased in January-February in the trawl catches during 1992-'93 and 1993-'94 seasons and marginally reduced in March. There were only few crabs in berried state in April, May and August. In July, no berried crabs were taken in any gear. In September and October, the incidence of ovigerous females was observed to be high (Fig. 4B).

The present study showed that the breeding activity in *P. (P.) sanguinolentus and P. (P.) pelagicus* was much reduced in the coastal waters during the peak monsoon months possibly due to the low saline conditions prevailing in the nearshore waters during that period.

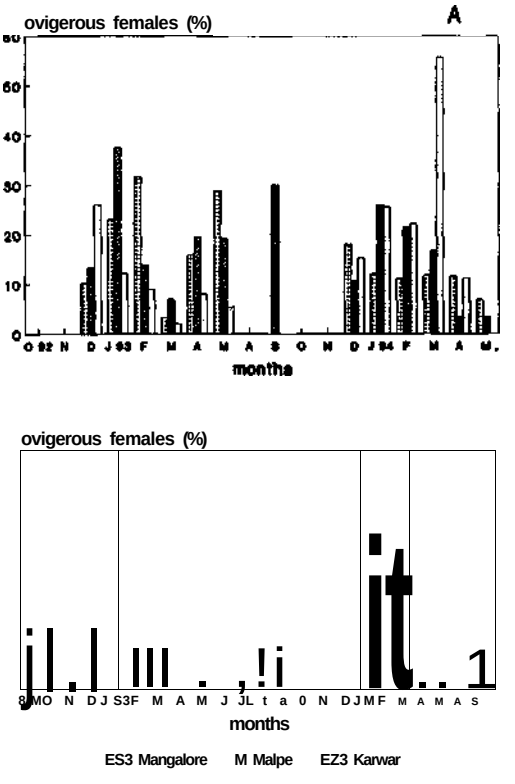

Fig. 4. A - Monthwise distribution of ovigerous females of *P. (P.)sanguinolentus* at Mangalore, Malpe and Karwar. B - Monthwise distribution of ovigerous females of *P. (P.) pelagicus* at Mangalore, Malpe and Karwar.

The recruitment of younger juveniles during October-April (November-April in *P. (P.) pelagicus)* suggests peak spawning activity during August-February in these marine portunids, although the incidence of ovigerous and mature/spent females indicated peak activity only during December-February in *P. (P.) sanguinolentus* and in September-October and January-February in *P. (P.) pelagicus.* It is possible that the adult population which has moved into deeper waters during monsoon months due to low saline conditions prevailing in the nearshore waters, may be breeding in the deeper waters during monsoon months (August-September), where the hydrological conditions may be more favourable resulting in recruitment of younger juveniles into the fishery in October/November period. The high incidence of ovigerous and mature/spent females of *P. pelagicus* in the samples obtained in September is also in conformity with this view.

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