



Fishery, biology and yield estimates of *Portunus sanguinolentus* off Chennai

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Received: 25 Jan 2011, Accepted: 15 Mar 2012, Published: 30 Apr 2012

Original Article

Abstract

The fishery and stock characteristics of the dominant species of crab, *Portunus sanguinolentus* was studied along the Chennai coast. The annual crab landings during the period 1998-2007 ranged from 236 t to 1,628 t with the catch rate fluctuating between 0.78 kg/h and 2.01 kg/h. The carapace width of *P. sanguinolentus* in the fishery was 41-165 mm for females and 41-155 mm for males. Females were dominant throughout the period of study, the overall sex ratio 1:1.41. Spawning was observed during October to April with peak spawning in December and January and peak recruitment in May, July and August. The estimated growth parameters are: females $L_{\infty} = 168.6$ mm, $K=1.3/\text{yr}^{-1}$; males $L_{\infty} = 161.9$ mm, $K=1.0/\text{yr}^{-1}$ and mortality parameters are: females $Z = 4.3$, $M = 1.2$, $F = 3.0$; males: $Z = 3.2$, $M = 1.1$, $F = 2.1$. Thomson and Bell yield prediction analysis gave the MSY as 536 t against the present annual average yield of 529 t that can be obtained by increasing the effort by 20% from the present level. As the increase in yield is marginal, it is suggested to maintain the effort at present level. Since crabs have high consumer demand and are an important ecological entity the resource needs proper management for its sustenance.

Keywords: *P. sanguinolentus*, Chennai, fishery, growth, mortality, yield estimates.

Introduction

Crabs are not a targeted resource in India, although they are available in the local and international markets. Crabs are an incidental catch in trawl and they are also caught in meager quantities by specialized gill nets, locally known as 'nandu valai' in the Chennai coast. The crab fishery off Chennai is supported by *Portunus sanguinolentus*, *Podophthalmus vigil*, *Portunus pelagicus*, *Charybdis lucifera* and *C. natator*, all members of Portunidae family. There are several reports on the fishery and dynamics of crabs from both west and east coasts of India ie, Rao *et al.*, 1973; Lalitha Devi, 1985; Telang and Tippeswamy, 1986; Sukumaran and Neelakantan, 1996 a, b, c, 1997 a, b, c; Dineshababu *et al.*, 2007; Jose and Menon, 2007 and Dineshababu, 2011. Besides, a general account of the crab fishery off Chennai was given by Subramaniam (1998) for the period 1985-95. There has been no published information on the stock characters of any species of crab from this coast so far. Hence it will be pertinent to describe the fishery of this important resource and also to study the growth and stock characters of the dominant species, *P. sanguinolentus* off Chennai.

Material and methods

Crab fishery for the period 1998-2007 was studied, based on the weekly trawl landings data collected from the Kasimedu

(Chennai) fisheries harbour. The catch and effort for each month was estimated by raising the daily landing to the number of fishing days in a month. The carapace width (between the tips of the largest lateral spines across the body) of a total of 312 males (44-152 mm CW) and 369 females (40-158 mm CW) was measured and individual weight was taken for estimating the carapace width-body weight relationship by the equation $W = aL^b$ (Le Cren, 1951), where 'W' is the weight in g, 'L' is the carapace width in mm and 'a' and 'b' are constants. Analysis of covariance was done to test variation between the regression co-efficient 'b' in both males and females (Snedecor and Cochran, 1967).

The crabs were sorted as per their stages of maturity into five classes namely immature, early maturing, late maturing, mature and spent. The mature females (n= 119) were used to estimate the size at maturity by the logistic curve method (King, 1995).

The carapace width of female and male crabs for the period 2004-2007 was arranged in 5 mm class intervals for growth studies and stock estimates. To get an estimate of asymptotic length (L_{∞}) and annual growth constant (K) of *P. sanguinolentus*, the CW frequency data was analysed by the Powell - Wetherall method (Wetherall *et al.*, 1987). The L_{∞} so obtained was re-estimated by using the data for gear selection by ELEFAN I module of FiSAT (Gayaniilo and Pauly, 1997). The length at age of males and females were established by von Bertalanffy growth formula. Pauly's empirical formula (Pauly, 1980) was used to determine natural mortality (M) and the linearised catch curve method (Pauly, 1983) for instantaneous total mortality (Z). The fishing mortality (F) was derived by subtracting M from Z. Exploitation ratio (E) was estimated by the formula F/Z . The total yield and biomass calculated by length based cohort analysis was used as input for the Thompson and Bell yield prediction model (1934).

Results and discussion

On an average, 765.8 t of crabs were landed annually by trawlers during the study period when compared to 652.6 t as reported by Subramaniam (1998) for 1985-95. The fishing effort decreased gradually from 11,18,622 hours in 1998 to 4,88,464 hours in 2007. The catch per hour also showed wide variation, initially 1.11 kg in 1998 declining to 0.93 kg in the next year and then reaching 2.01 kg in 2000. From 2002 onwards the catch rate showed a declining trend (Fig. 1). The minimum catch rate was 0.78 kg/h, in 2001 and maximum of 2.01 kg/h was recorded in 2000. The dominant species was *Portunus sanguinolentus* forming 50.7%, followed by *Charybdis natator* (12.7%), *Podopthalmus vigil* (9.9%), *C. lucifera* (7.6%), *P. pelagicus* (6.8%), *C. cruciata* (3.8%) and minor quantities of *P. gladiator*, *P. argentatus* and *C. hoplites*.

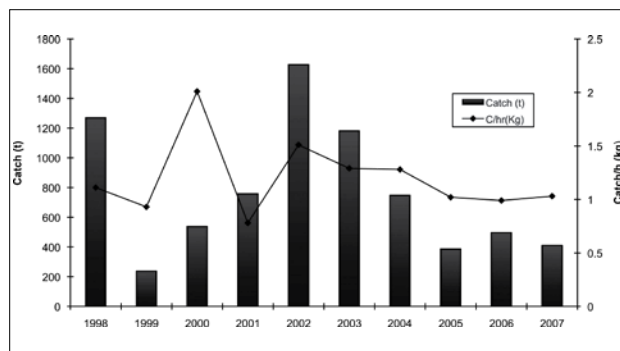


Fig. 1. Annual Catch (t) of crabs off Chennai during the period 1998-2007

Maturity and spawning: The females outnumbered males throughout the study period, overall male to female ratio being 1:1.41. The size at first maturity was estimated at 87 mm by the logistic curve method and this length is attained within the first year i.e., in 8 months (Fig. 2). Along the Calicut coast, Menon (1952) and Sarada (1998) reported the size at maturity of this species as 78 mm and 82 mm respectively. Lalitha Devi (1985) observed the size at maturity as 57 mm CW from Kakinada, whereas Sukumaran and Neelakantan (1997b) and Dineshbabu *et al.* (2007) observed the size at

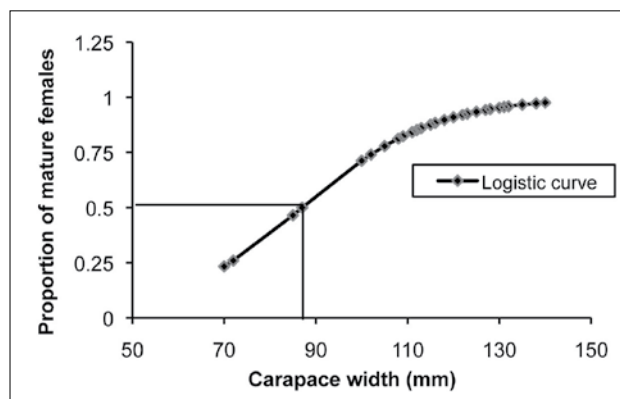


Fig. 2. Size at maturity (50%) of *P. sanguinolentus* female

maturity from Karnataka as 78 mm and 90 mm respectively. Size at maturity may vary depending on the geographical location and even within the same location (Berrill, 1982) depending on the pubertal moult. The spawning period of *P. sanguinolentus* was observed from October to April, with the peak spawning in December and January wherein higher numbers of mature and spent crabs were observed in the fishery. The juvenile recruitment to the fishery was during May to September, with the maximum occurring in May, July and August. The spawning and recruitment periods indicate prolonged breeding.

Carapace width-total weight relationship: Carapace width-body weight relationship was determined separately

for males and females. The equation in the form $W = aL^b$ for females is $0.00006489CL^{2.9473}$ ($r^2=0.852$) and for males $0.00005994L^{2.954}$ ($r^2=0.904$). Analysis of covariance showed that the slopes did not vary significantly at 5% level which agrees with the results of Lalitha Devi (1985), Sukumaran and Neelakantan (1997a) *et al.* (1997a) and Sarada (1998) for the species. Therefore a combined equation for both the sexes was made. The equation for the pooled data is $0.0000581L^{2.967}$ ($r^2=0.874$).

Growth and mortality parameters: The estimated asymptotic length was 161.8 for males and 168.6 for females by the Powell-Wetherall plot. The data was corrected for gear selection by using the probability of capture ($L_{50} = 83.8$ and $L_{75} = 93.3$ for females and $L_{50} = 79.5$ and $L_{75} = 85.3$ for

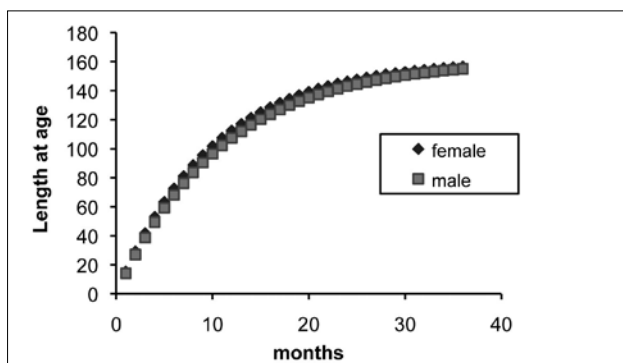


Fig. 3. von Bertalanffy growth curve of males and females *P. sanguinolentus*

males), the L_{∞} for males was 161.9 and for females 168.6 which are almost the same as estimated by the Powell-Wetherall plot. K was 1.3 /yr^{-1} for females and 1.0 /yr^{-1} for males. The females attained 112 mm in the first year, 146 mm in the second year and the males attained 107 mm and 143 mm in the first and second year (Fig. 3) after which the growth rate was slow (156 mm and 154 mm in females and males respectively in the third year). The length attained by female *P. sanguinolentus* from Calicut in the first year was reported to be 131 mm and male 136 mm (Sarada, 1998) which is higher than that obtained in the present study, whereas Sukumaran and Neelakantan (1997b) obtained almost similar results for female (112 mm in the first year and 155 mm in the second year), but for males the values were 124 mm in the first and 168 mm in the second year.

The instantaneous total mortality (Z) was estimated at 4.3 and 3.2 for females and males respectively and the natural mortality (M) was 1.2 for females and 1.1 for males. The fishing mortality (F) was 3.0 and 2.1 for females and males respectively. The exploitation rate ($E=F/Z$) is higher than 0.5 for both females (0.70) and males (0.67).

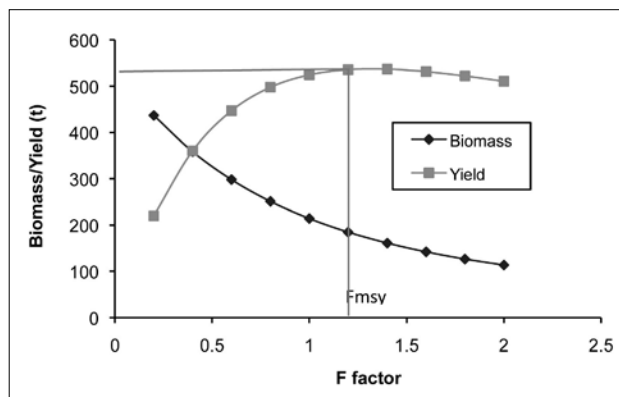


Fig. 4. Thompson and Bell plot for yield and biomass of *P. sanguinolentus*

Yield estimates: The L_{∞} and K estimated by ELEFAN for the pooled data were 168.5 mm and 1.3^{-1} respectively. The mortality parameters were $Z = 5.3$, $M = 1.2$ and $F = 4.0$. Using L_{∞} , K , M , 'a' 'b' and catch in numbers, the length based cohort analysis gave the standing stock as 256 t. The result of the analysis was used as input in the length based Thompson and Bell yield prediction model to derive the effort and yield relationship. The Maximum Sustainable Yield (MSY) was estimated as 536 t (Fig. 4) against the present annual average yield of 529 t, which can be achieved by increasing the effort by 20%. Since the increase in yield is only marginal (< 3%) this option, however do not appear as a feasible one. As the present annual yield is very close to MSY level, it is suggested to maintain the effort at present level (4,88,464 hours) to sustain the fishery of this valuable crustacean resource along this coast.

Acknowledgements

The authors place on record their sincere thanks to Dr. G. Syda Rao, Director, CMFRI and to Dr. E.V. Radhakrishnan, former Head of the Crustacean Fisheries Division for their encouragement and support. They also thank Dr. P.U. Zacharia, Head of Demersal Fisheries Division and Dr. A.P. Dineshababu, Scientist-In-Charge, CMFRI, Mangalore for their valuable suggestions.

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