GENERAL DISCUSSION
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With an annual average production of 1,179 tonnes during 1983-93, crab landing in Karnataka formed around 5.1% of the all India crab landings. Although different types of gears are employed in crab fishery in the state, the bulk of the crab catch was obtained by trawls operated by mechanised fishing vessels. The important species contributing to the fishery were *P. sanguinolentus* and *P. pelagicus* and these two species together formed around 93% of the crab landing in the state. Although they are caught in varying quantities from September to May, the bulk of the catch was landed during January-February which coincided with the peak breeding activity of these crabs along this coast. Despite a steep rise in the trawl effort, there had been no proportional increase in crab landings which remained between 1000-2000 tonnes during the last few years.

Although advanced fishing countries of the world have adopted certain measures for the proper management of crab fisheries, no conservatory measure is observed or prevalent at present in India. Due to this, immature, moulting and berried crabs are fished indiscriminately. Consequently, often they are exploited at an age at which most of them might not have spawned even once. Since most of the gears employed (shrimp trawl, shore seine, minitrawl) are non-selective in nature, appreciable quantity of immature and juveniles are caught inadvertently and are unutilised. Present study has shown that juveniles (< 80 mm cw) of *P. sanguinolentus* formed around 58% of the crab catch in shrimp trawls and 82% in indigenous gears, whereas, in *P. pelagicus*, juveniles constituted upto 25% in trawls and 71% in indigenous gears. This large scale destruction of young crabs would obviously have adverse effect on the crab resources. This situation required to be remedied by educating the fishermen through audio-visual media such as, TV, radio, and news papers about the adverse effect of catching and destroying these
young ones on the crab stocks, and also by creating an awareness among them about the importance of releasing young crabs back to the sea or fattening them through short-term culture for the sustenance of these valuable resources. In addition, it is also required to enforce certain regulatory measures like fixing legal minimum size, protection of ovigerous females and soft-shelled crabs as practiced in several advanced fishing countries.

Despite their economic significance, the dynamics of the exploited population of these crabs remain poorly understood as there is no information on the mortality and stock assessment of brachyurans from India. In the present study, the status of the crab fishery is assessed based on the data emanating from the trawl fishery (for the period 1992-94) which accounts for more than 90% of the crab landing in the state.

*Portunus sanguinolentus* and *P. pelagicus* are marine species and support fishery of considerable magnitude in all maritime states of India. It is caught from the inshore and estuarine waters often in appreciable quantities. The breeding season is extending from August to May in both the species with peak activity during December-February in *P. sanguinolentus* and during January-February and September in *P. pelagicus*. The size at sexual maturity in female is at 92 mm in the former species and 99.0 mm in the latter, and in males, it is at 97 mm and 105 mm respectively. Sex ratio is nearly equal in both these crabs. The fecundity ranged from 0.044 to 1.19 million in *P. sanguinolentus* and from 0.56 to 1.07 million in *P. pelagicus*. The larval development takes place in the marine environment. The young crabs migrate to the inshore waters and often to estuaries. They grow relatively at a fast rate, and males and females attain a mean carapace width of 124.1 mm and 112.5 mm in *P. sanguinolentus* and 145.2 mm and 132.5 mm in *P. pelagicus* at the end of one year. The life span is around 2.5 years for both these species. The high fecundity, fast growth and multiple spawning help to maintain the resource.
For Karnataka waters, the annual average stock was estimated at 2,106 tonnes \((P.\ sanguinolentus = 1,272 \text{ tonnes} + P.\ pelagicus = 834 \text{ tonnes})\), whereas, the MSY was estimated at 1,343 tonnes \((P.\ sanguinolentus = 776 \text{ tonnes} + P.\ pelagicus = 567 \text{ tonnes})\) by the yield-per-recruit model of Beverton and Holt, which is very close to the annual average yield of 1,335 tonnes \((P.\ sanguinolentus = 771 \text{ tonnes} + P.\ pelagicus = 564 \text{ tonnes})\) obtained during 1991-93 period.

The optimum level of effort, \(f(\text{MSY})\), for these crabs was estimated at 1,190 tpd by yield-per-recruit model which is very close to the value obtained by the Fox model (1,120 tpd).

The present study indicate that the prevailing fishing intensity for males was more \((F = 2.6 \text{ or } E = 0.62 \text{ for } P.\ sanguinolentus, \text{ and } F = 3.9 \text{ or } E = 0.70 \text{ for } P.\ pelagicus)\), whereas, it was low for females \((F = 2.4 \text{ or } E = 0.62 \text{ for } P.\ sanguinolentus \text{ and } F = 3.23 \text{ or } E = 0.67 \text{ for } P.\ pelagicus)\). However, since the current yield of males and females of these two species are very close to MSY level, it will be advantageous if the effort is maintained at the current level itself to obtain biologically optimum yields.

Since the cod-end mesh of trawl is small \((28-35 \text{ mm})\), large quantities of juveniles of these crabs are retained by the trawl net. This is detrimental to the crab stocks and some management measures for the conservation of the resources are warranted. In the light of requirements for optimum fishing and also to increase the size at capture \((tc)\) by 20% (to by around 30%) to permit the young crabs to escape through the meshes of the trawl net and thereby enhance the yield subsequently, an increase in cod-end mesh size to 40 mm from 33 mm (mean) would seem to be a practical and ideal one. In addition, there is an urgent need to restrict the effort at the present level \((1,130 \text{ tpd or } 243 \times 10^3 \text{ bd})\) as a management strategy to prevent over exploitation of these valuable resources in the coastal waters of Karnataka. Eventhough, several methods of
management, such as, closed season, restricting the area of fishing etc. are available, mesh regulation along with certain amount of control of fishing intensity appears to be the most appropriate and suitable for the conservation and management of the marine crab resources of Karnataka.

Since crab meat is a delicacy in many parts of the world, it is exported alive, frozen and canned to several foreign countries. During 1993-94 alone, crabs worth Rs. 196.3 million (2,034 tonnes) were exported from India. Due to the ever-increasing demand for crabs for human consumption, there has been a recent upsurge of interest in the culture of crabs to augment the resources in several countries. These crabs can be bred in captivity as they can withstand wide environmental fluctuations (like salinity, temperature etc.) and offer little problem for artificial propagation. With multiple spawning, high fecundity and fast rate of growth, these portunids are suitable candidates for culture for augmenting the resources.