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# Study on Population Characteristics and Fishery of Western King Shrimp *Penaeus* (*Melicertus*) *latisulcatus* Kishinouye, 1896, along Thoothukudi coast, Southeast India

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**ABSTRACT**
Population characteristics and fishery of Western King Shrimp *Penaeus* (*Melicertus*) *latisulcatus* were studied along Thoothukudi coast for the period of two years from April 2006 and March 2008. Samples were collected from both mechanized and traditional vessels, to analyse various growth parameters and the status of fishery. Juveniles within the length range of 100 mm constituted more than 40% of the catch during the months of August, September, October and February. Year round poor catch rate revealed lesser catchability of this species to trawl particularly during day time. Year round spawning was recorded for this species with a peak during June and December. The values of '$L_\infty$' and 'K' were estimated as 233.80mm and 2.10 respectively. Seasonal variation was found to have definite impact on the growth characteristics of this species. Highφ' value revealed the conducive environmental conditions prevailing for the *P. latisulcatus.* The exploitation ratio (F/Z) was estimated as 0.21, which reveals further scope for the exploitation of this species particularly during night hours owing to its nocturnal feeding habit.

**Keywords:** Western King Shrimp, Growth parameters, Natural Mortality, Fishing Mortality, Exploitation ratio.

## 1. Introduction
Penaeid shrimps are distributed in tropical and sub - tropical zones of the coastal seas of the world. Besides the studies on biology, attempts have been made globally to study the population dynamics of shrimps which are considered to be the important resources under threat, either due to growth over fishing or recruitment over fishing. The FAO World Science Conference on biology and culture of shrimps and prawns held in Mexico during June 1967 made a spark among scientific community to think about stock depletion of coastal shrimp more seriously. The coastal shrimp resources are to be managed properly because, there are four stages of exploitation in the shrimp life history, they are, i) when the shrimp leave the nursery grounds and become accessible to artisanal fisheries, ii) when they reach the large bays where they are accessible to small trawlers, iii) during migration they are caught by fixed nets and iv) when they reach the sea and are caught by industrial trawlers[5]. In addition, penaeids also face the problem of stress from pollution and the damage and destruction of their habitats. These multifaceted problems made severe damage to shrimp stocks in the world waters. The Western King Shrimp *Penaeus latisulcatus* is one of the coastal shrimp species, having low catchability in tropical waters[12], forming minor fishery in India and Australian waters. This species and formally classified as *Penaeus latisulcatus*[11], has been subsequently reclassified by Perez Farfante and Kensley[13] raising the sub - genus *Melicertus* to generic rank *Melicertus latisulcatus*. Recently Flegel (2007)[4] revised the taxonomic name this species as *Penaeus* (*Melicertus*) *latisulcatus.* As any other penaeids, *P. latisulcatus* also grow fast in tropical climate and the growth was estimated in Kenyan water[1]. In India, only few studied were initiated on *P. latisulcatus.*

Length- frequency analysis of *P. latisulcatus* was made by Kathirvel and Selvaraj (1987)[10] in Chennai coast. They recorded a growth rate of 29-30 mm in one month. A note on the percentage composition and size frequency of *P. latisulcatus* along Thoothukudi coast has been recorded by Rajamani and Manickaraja (1991)[15]. This species was recorded from shrimp trawls at the depth ranging between 20-60 m. They recorded *P. latisulcatus* as third important species in terms of abundance, next to the *P. semisulcatus* and *P. indicus*. The South Australian shrimp fisheries mainly depend on *P. latisulcatus* which comprises 62% of the shark Bay shrimp catch, 46% for the Broom shrimp catch and 43% of the Exmouth Gulf shrimp catch[2]. The fishery characteristics were studied by Dixon *et al* (2012)[3] in Gulf St. Vincent of South Australia. In Australian waters *P. latisulcatus* is considered as one of the important commercial fishery as the market value of this species is high. There is great demand for this species in countries like Philippines, where it is sold on par with *P. japonicas* and *P. indicus*. The present study was carried out with the aim to study the growth characteristics and fishery potential of *P. latisulcatus* in Thoothukudi waters.

## 2. Materials and Methods

The present study was carried out for two years from April 2006 to March 2008 along Thoothukudi coast of Southern Tamil Nadu. The samples were collected from two different centres near Thoothukudi of Gulf of Mannar coast, one of the richest marine biospheres in the world. The first centre was Thoothukudi Fishing Harbour (Lat. 8°47'N and Long. 78°9.5E) where the mechanized boats with OAL ranging from 36' to 55' are being operated. The second centre was Threspuram, situated north of Fishing Harbour (Lat 8°48.9'N and long. 78°9.8'E) of Thoothukudi, where the traditional blank built boats of Thoothukudi origin called 'Vallam' are operated. Vallam are fitted with outboard motors are operating traditional mini trawls, locally called "Thallu vandi" very nearer to the coast all along Thoothukudi to capture shrimps.

Catch effort data were collected from two different gears namely demersal trawl and traditional mini trawl. The maturity stages of the shrimp were recorded for two years for female alone to find out spawning season. Five maturity stages were recognized in female adopting the method of Primavera (1985)[14]. Length - weight relationship was calculated by least square method, 'a' and 'b' values of the logarithmic form of cubic equation were estimated. Age and growth, mortality parameters and recruitment pattern were analyzed with FISAT Package developed by Gayanilo and Pauly (1996)[6]. The exploitation rate F/Z was used to predict the present level of exploitation.

## 3. Results and Discussion

*Penaeus latisulcatus* commonly called as Western king prawn (Vernacular name -'Poochie earl') was identified with taxonomic characters such as a adrostral crest and grove long, extending almost to posterior margin of carapace, Telson armed with three pairs of movable spines. Pleura of first five abdominal segments each with a short vertical red or brown stripe[9].

The length frequency distribution of *P. latisulcatus* caught along Thoothukudi coast is presented in the Fig. 1 the juveniles with the length up to 100 mm constituted above 40% of the catch during August, September, October and February. During the month of May the juvenile representation in the commercial catch was poor. Round the year spawning was observed for *P. latisulcatus* with two peak recruitments (Fig 2).

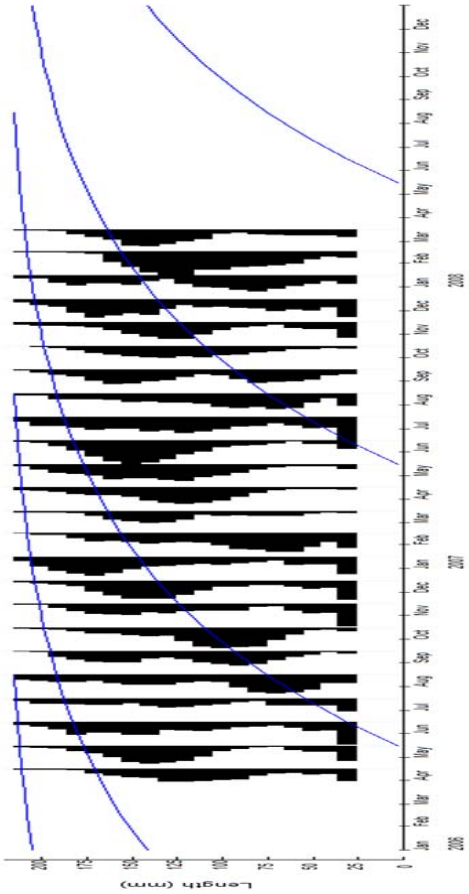

**Fig 1:** Length frequency distribution of *P. latisulcatus*

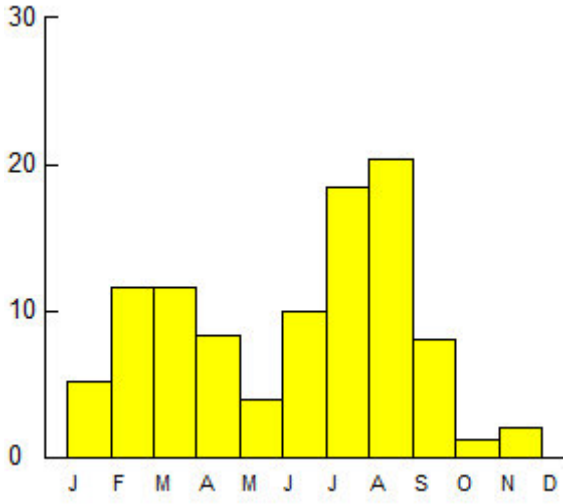


**Fig 2.** Recruitment pattern of *P. latisulcatus*

The catch and effort data of *P. latisulcatus* are presented in the Table 1. The catch and effort were combined for mechanized and motorized fishing vessels of Thoothukudi coast. The monthly average catch of this species along Thoothukudi coast was very low (1306.65 kg) and low catch was attributed due to less catchability of this species to trawling as this species is found to have nocturnal feeding habit and always found buried during day hours[12]. To maximize the catch of *P. latisulcatus*, it is advised to go for trawling at night hours. Even during night hours, the activity of *P. latisulcatus* has been reported to vary in accordance with moon phase and they spend minimum time for feeding[12]. Similar behaviour has been reported with *P. duodenum* and *P. plebejus*. The attachment of tickler chain in the foot rope of trawl net may give better catching rate of this species as the chain would disturb the bottom while trawling.

**Table 1.** Average catch, effort and CPUE of *P. latisulcatus* in different months along Thoothukudi coast

| S. No | Month | Average No. of boats operated (Both Mechanized and Motorized) | Total boat days | Average weight of shrimp landed / boat CPUE (Kg) | Estimated total catch (Kg) |
|---|---|---|---|---|---|
| 1. | April | 25 | 510 | 0.1461 | 74.51 |
| 2. | May | 79 | 1180 | 0.1079 | 127.32 |
| 3. | June | 45 | 992 | 0.0776 | 76.98 |
| 4. | July | 54 | 1300 | 0.0693 | 90.09 |
| 5. | August | 52 | 785 | 0.1395 | 109.50 |
| 6. | September | 48 | 1192 | 0.2122 | 252.94 |
| 7. | October | 41 | 569 | 0.2073 | 117.95 |
| 8. | November | 15 | 29 | 0.1034 | 2.99 |
| 9. | December | 46 | 910 | 0.0834 | 75.89 |
| 10. | January | 39 | 819 | 0.1740 | 142.50 |
| 11. | February | 30 | 501 | 0.2844 | 142.48 |
| 12. | March | 38 | 727 | 0.1286 | 93.49 |
| **Total** | | 512 | 9514 | 1.7337 | 1306.64 |
| **Average** | | 43 | 793 | 0.144475 | 114.56 |

In the present study, occurrence of matured and spent animals of female *P. latisulcatus* recorded in the commercial catches of Thoothukudi coast, revealed year-round spawning (Table 2), with two peak (Fig. 2). Dixon *et al* (2010)[2] reported the peak spawning period for this species in November in South Australian waters. The length weight relationship for *P. latisulcatus* is presented in Table 3. The slope value (b) calculated for *P. latisulcatus* was more than three, indicating that the weight gain is higher in relation to growth in length.

**Table 2.** Percentage composition of female maturity stages of *P. latisulcatus*

| Sl. No. | Month | Percentage of female maturity stages | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| 1. | April | 13.06 | 22.54 | 28.29 | 18.53 | 17.58 |
| 2. | May | 16.36 | 17.93 | 22.93 | 29.81 | 12.97 |
| 3. | June | 8.17 | 22.40 | 22.40 | 30.03 | 17.00 |
| 4. | July | 14.92 | 16.20 | 16.20 | 17.70 | 35.13 |
| 5. | August | 21.43 | 19.28 | 15.28 | 21.88 | 22.13 |
| 6. | September | 31.69 | 16.34 | 17.14 | 26.69 | 9.74 |
| 7. | October | 23.11 | 15.13 | 15.90 | 22.64 | 8.22 |
| 8. | November | 27.26 | 28.03 | 20.91 | 22.98 | 0.82 |
| 9. | December | 17.46 | 10.10 | 16.23 | 31.01 | 26.20 |
| 10. | January | 11.55 | 13.86 | 18.56 | 19.44 | 36.59 |
| 11. | February | 30.17 | 17.85 | 18.16 | 18.87 | 14.95 |
| 12. | March | 29.46 | 20.52 | 24.61 | 15.52 | 9.89 |

I - Immature II - Early maturing III - Late maturing IV - Matured V - Spent

**Table 3.** Parabolic and logarithmic equations of length-weight relationship of *P. latisulcatus*

| Parabolic equation | Logarithmic equation |
|---|---|
| $W= 0.004179558\ L^{3.0034}$ | Log W = -2.3788+3.0034 Log L |

**Table 4.** Growth parameters of *P. latisulcatus*

| $L_\infty$ (mm) | K | $t_o$ (year) | C | wp | $t_s$ | φ' | M/K | $L_m/L_\infty$ |
|---|---|---|---|---|---|---|---|---|
| 233.8 | 2.10 | 0.180 | 0.33 | 0.91 | 0.41 | 5.09 | 1.48 | 0.61 |

**Table 5.** Mortality parameters of *P. latisulcatus*

| Natural mortality co-efficient (M) | Fishing mortality co-efficient (F) | Total instantaneous mortality co-efficient (Z) | Exploitation rate E = F/Z |
|---|---|---|---|
| 3.10 | 0.85 | 3.95 | 0.21 |

Asymptotic length ($L_\infty$) for *P. latisulcatus* was estimated as 233.80 mm. In the present study, *P. latisulcatus* showed higher 'K' value, (2.10) and relatively less life span of about 2 years (Fig. 3). The amplitude of growth oscillation (C) was found to high which may be attributed to variation in environmental temperature.

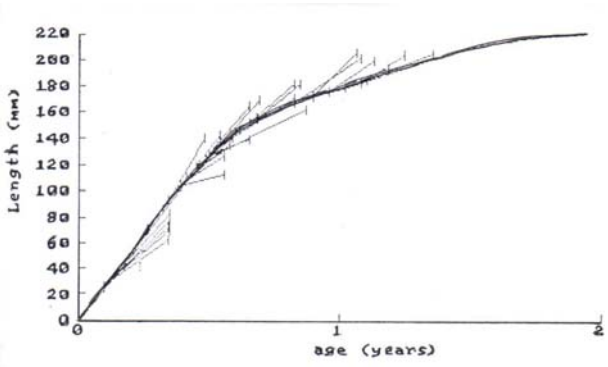


**Fig 3:** Growth curve of *P. latisulcatus*

In the present study the 'WP' was found to 0.91 which revealed that there is notable suppression in growth during the month of December due to relatively low temperature. Highφ' value (5.09) was recorded for *P. latisulcatus* revealed that Thoothukudi waters serve as conducive environment for the better growth. The relationship between the length at first maturity ($L_m$) and asymptotic length ($L_\infty$) of particular species shows the reproductive stress. Holt (1956)[8] has stated that $L_m/L_\infty$ ratio should be between maximal and minimal values of 0.3 and 0.9 respectively. In tropical waters the $L_m/L_\infty$ ratio falls closely to 0.58 for crustaceans. In the present study *P. latisulcatus* scored the $L_m/L_\infty$ value of 0.61. Thus, it could be inferred from the findings that the reproductive stress of *P. latisulcatus* is less. This phenomenon could also be correlated with higherφ' values.

The natural mortality co-efficient (M) and fishing mortality co-efficient (F) parameters estimated for *P. latisulcatus* were 3.10 and

0.85 respectively. Higher value of M reveal that this species died more in numbers naturally before they caught in fishing nets.

The Virtual population Analysis (VPA) graph of *P. latisulcatus* is presented in Fig 4. It could be observed from the VPA analysis, that *P. latisulcatus* was found to suffer due to growth overfishing inferring the susceptibility of juveniles to the trawls.

The present rate of exploitation (F/Z) of *P. latisulcatus* is 0.21, which is much lower than the exploitation ratio of 0.5% [7]. Hence this species is found to be under exploited and has further scope for increasing the effort.

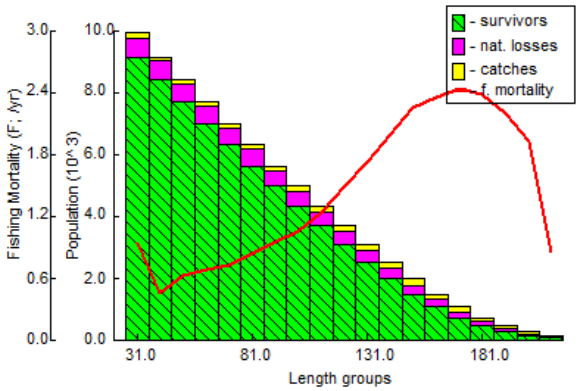


**Fig 4:** Virtual Population Analysis (VPA) of *P. latisulcatus* in Thoothukudi waters

## 4. Conclusion

Though the coastal fish stocks have been already over exploited due to indiscriminate trawling, there is further scope for exploiting this particular species. Though night time trawling may improve the catchability of this species, the other over exploited fish and shrimp stocks may be affected. A selective fishing method need to be evolved to capture *P. latisulcatus* without disturbing other coastal fish stocks.

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