



THE POPULATION DYNAMIC OF BANANA PRAWN (*Penaeus merguensis* de Man) IN TANAH LAUT WATERS, SOUTH KALIMANTAN

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ABSTRACT

Scientific advices on population dynamic of banana prawn (*P. merguensis* de Man) are required as an input to support an appropriate fisheries management. This study aims to identify the population parameters of the banana prawn in Tanah Laut waters. The study was conducted in Tanah Laut based on monthly enumeration data (January to November 2016). Results has been shown that the length size of carapace at first maturity of banana prawn was 43.39 mm. Sex ratio of males and females was 1 : 0.8. The chi square test indicated that comparison of male and female of the banana prawn was significantly different. It means that there was not balance in number between males and females. The spawning season of banana prawn in Tanah Laut waters happened throughout year and reached the peak on November (south-east monsoon). The growth parameter of banana prawn was 1.05/year with maximum carapace length (L_{∞}) of 55.0 mm. Instantaneous total mortality (Z) and natural mortality (M) were 6.05/year and 1.58/year, respectively. While fishing mortality (F) and exploitation rate (E) respectively were 4.47/year and 0.74/year respectively. The exploitation rate of banana prawn in Tanah Laut waters was high. Therefore, fishing effort of the banana prawn in that waters should be reduced to about 48 % for next coming year.

Keywords: Banana prawn; population dynamic; Tanah Laut; FMA 712

INTRODUCTION

Banana prawn (*P. merguensis* de Man) is one of penaeid shrimps which is dominantly caught in Tanah Laut waters. A mini trawl locally called "lampara dasar" is used to catch the prawn. The production of banana prawn is the third highest after others shrimps such as *Parapenaeopsis stylifera* and *Metapenaeus ensis* (Research Institute for Marine Fisheries, 2016). Exploitation of the banana prawn in Tanah Laut waters has taken place since long time ago (Naamin *et al.*, 1992) and become more intensive in the recent years due to the increasing of local and or foreign market demands. Disruption of banana prawn sustainability in Tanah Laut waters has been indicated by a decrease of stock abundance index (Research Institute for Marine Fisheries, 2016). If this situation continues to occur, sustainability of the shrimp stock will be disturbed in the future. Therefore, comprehensive research is needed to reach rational utilization in order to maintain sustainability of the stock for prosperity purpose in the future (Sparre & Venema, 1992).

This paper discussed population dynamic of the banana prawn (*P. merguensis*) in Tanah Laut waters.

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The results could be used as a reference in the future studies of banana prawn and to be basic information in management for sustainable fisheries of the banana prawn in Indonesian waters, especially in Tanah Laut waters.

MATERIALS AND METHODS

Samples of prawns specimen were taken during field research in Tanah Laut waters (Figure 1) from January 2016 to November 2016. Biometric study including carapace length, sex and gonad maturity stage was done on prawn sample about 1,674 individuals. According to Udupa (1986), Spearman & Karber's method is used to estimate the length size at first maturity with assumption that average size of first maturity occurs when 50 % of the banana prawn are mature. Logarithmic size of the first sex mature (m) was calculated based on equation below:

$$m = xk + X/2 - (\sum pi), \dots \dots \dots (1)$$

where:

- m : logarithmic size of first sex mature,
- xk : logarithmic size of mean value of 100 % mature,
- X : logarithmic different of mean value, and
- pi : comparison of sex maturity of each length class

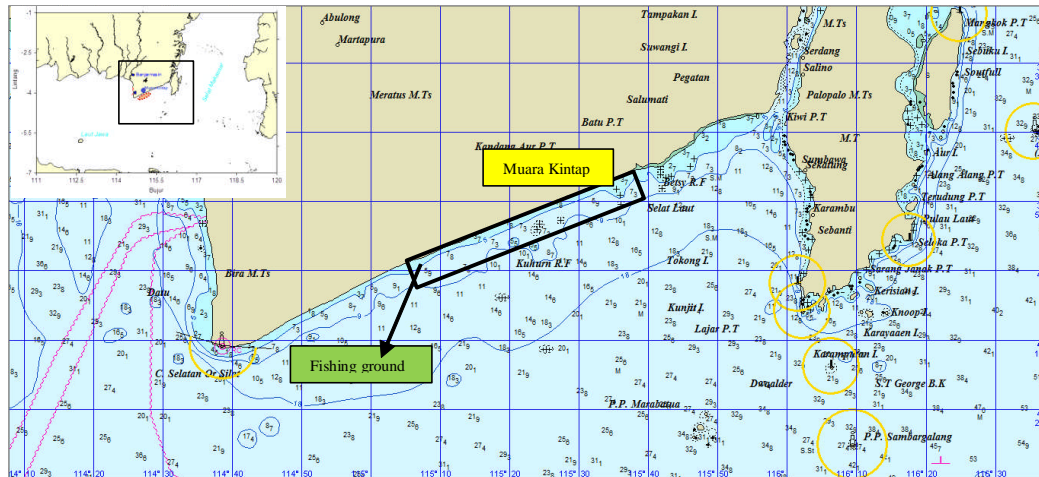


Figure 1. The fishing ground of banana prawn (*P. merguensis* de Man) in Tanah Laut waters, South Kalimantan.

In this classification, The Gonad Maturity Stage (GMS) I and II are classified as immature while GMS III, IV and V are mature. The GMS was morphologically identified based on sex maturity stage of the shrimp (Tuma, 1967 *vide* Naamin, 1984) namely: I = quiescent/undeveloped, II = developing, III = early maturity, IV = ripe, and V = spent. While chi square method was used to identify sex comparison (Sudjana, 1975).

Growth rate (K) and maximum carapace length (L_∞) were analyzed by tracing the modus of monthly carapace length distribution using ELEFAN program (Sparre & Venema, 1992, Gayanilo *et al.*, 1993). Basically, ELEFAN program is applied to interpret carapace length in time series data adjusted with von Bertalanffy growth curve. Growth pattern is indicated by curve which crosses highest number of modus (Sparre & Venema, 1992).

Total mortality (Z) was calculated from catch curve (Sparre & Venema, 1992, Gayanilo *et al.*, 1993) and natural mortality (M) was predicted using combination of Pauly empiric equation (Pauly, 1985) and fishing mortality rate (F) = Z – M, while exploitation rate (E) = F/Z (Sparre & Venema, 1992).

RESULTS AND DISCUSSION

Results

The Length size at First Maturity (L_m) and Sex Ratio

The length size at first maturity (L_m) of banana prawn in Tanah Laut waters was 43.39 mm in carapace length (Figure 2). The sex ratio tested by using the homogeneity test is not balance with the value 1.0 : 0.8 for male and female.

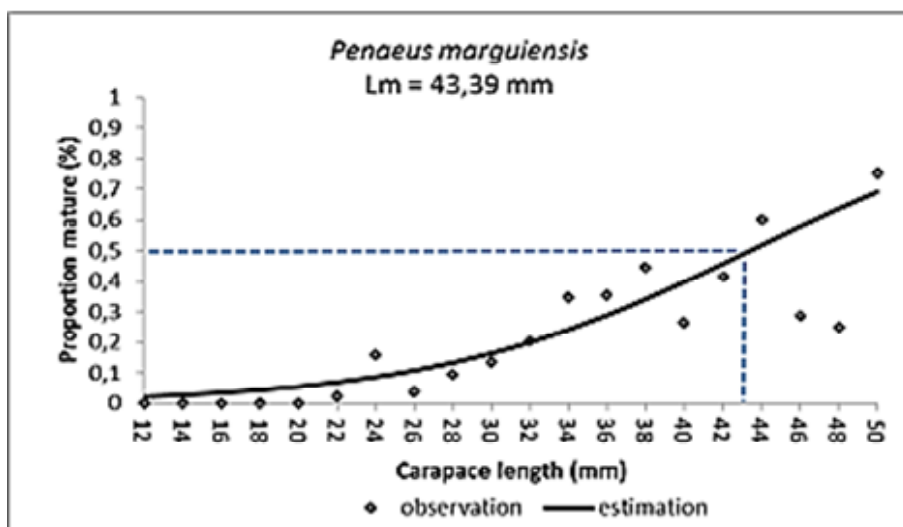


Figure 2. The carapace length size at first maturity of banana prawn (*P. merguensis*) in Tanah Laut waters, South Kalimantan.

Spawning Season

It seems that the highest number of mature female shrimp is taken place solely in November (Figure 3). This may indicate that the peaks of spawning seasons of banana prawn in Tanah Laut waters would be just one time in November.

Growth Parameter

Values recorded by identifying monthly carapace length frequency (Figure 4) were 1.5/year and 55.0

mm respectively for the growth rate (K) and maximum carapace length (L_{∞}).

Mortality Rate and Exploitation Rate

The value of total mortality (Z) represented by the value of slope (b) between $\ln N/t$ and relative age was 6.05/year (Figure 5). Meanwhile, the value of natural mortality (M) and fishing mortality (F) was 1.58/year and 4.47/year, respectively. Using exploitation rate equation ($E = F/Z$), the value of E was calculated about 0.74/year

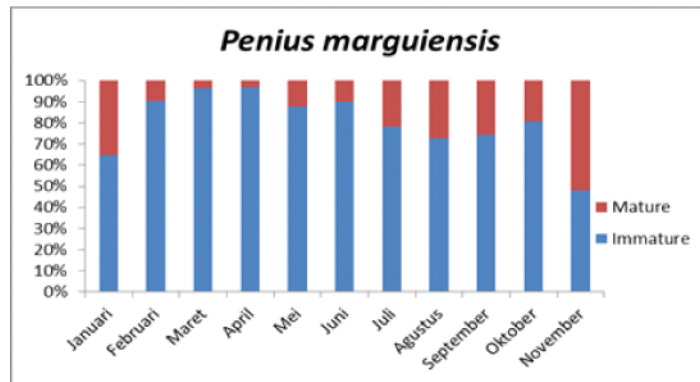


Figure 3. Frequency distribution of maturity stage of banana prawn (*Penaeus merguensis* de Man) in Tanah Laut waters, South Kalimantan.

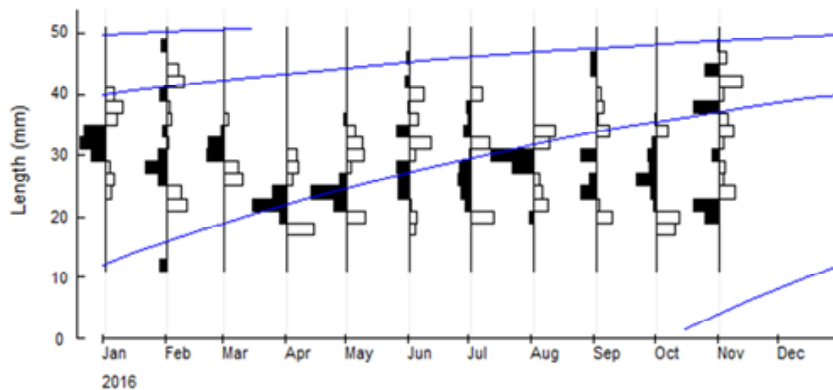


Figure 4. Carapace length distribution of banana prawn (*P. merguensis*) in Tanah Laut waters and growth curves fitted by ELEFAN.

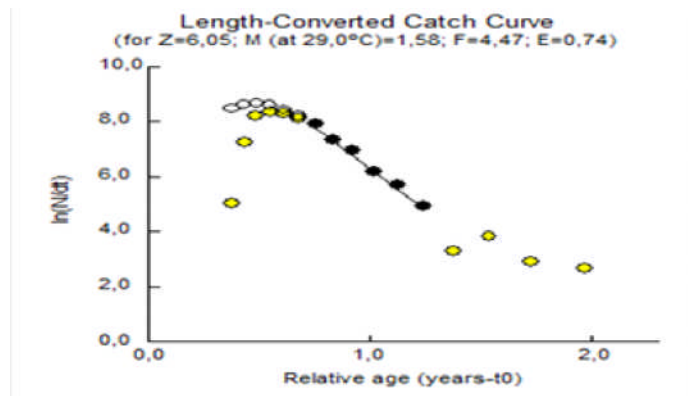


Figure 5. The value of total mortality (Z) of banana prawn (*P. merguensis*) in Tanah Laut waters, South Kalimantan.

Discussion

Shrimp age and size at first maturity are important for management purpose because exploitation has to let some stocks which have the same or bigger size when they reach maturity still alive (Sudjastani, 1974). The results analysis showed that the length size at first maturity (Lm) of banana prawn in Tanah

Laut waters was 43.39 mm in carapace length. Sumiono (1983) and the other researcher reported that banana prawn in several waters area reached first gonad maturity when they were 30 mm in carapace length (Table 1). In Table 1 it is seen that the differences in the value of length size at first maturity occurred in several waters.

Table 1. The size at first maturity (Lm) of banana prawn (*P. merguensis* de Man) in several waters

Waters	Lm (CL-mm)	Source
Bintuni Bay	33.87	Sumiono (1983)
Kupang and Belu	41.80	Suman & Nugroho (1991)
Demak	39.77	Suman & Subani (1994)
Dolak	38.7	Hargiyatno <i>et al.</i> (2013)
Tarakan	33.8	Kembaren & Suman (2013)
North of Central Java	42.85	Tirtadanu <i>et al.</i> (2016)

This difference in reaching the length size at first maturity might be influenced by availability of food and environment condition such as temperature and salinity.

environment and recruitment pattern (Naamin, 1984). This result may propose the fishing close season of banana prawn in Tanah Laut Waters would be determined in November.

Data on sex and GMS of fish or shrimp stock are important and as basic information for reproduction biology of the stock (Suhendrata & Merta, 1986). Sex ratio for male and female of the banana prawn in Tanah Laut waters was 1 : 0.8 or imbalance. The imbalance of sex ratio indicates that the exploitation level of banana prawn in Tanah Laut waters was more intensive and this condition will disturb the recovery of banana prawn population (Naamin, 1984).

Value of K and Loo was greater than 1, indicating that the growth type of banana prawn in Tanah Laut waters is fast growth (Sparre & Venema, 1992). Therefore it must be taken care in planning the effort number to exploit the shrimp stock in these waters in order to obtain rational management of the stock. If the number of effort recommended is low, shrimp stock not captured would be useless or the number of natural mortality would be high because the growth type of the stock was fast growth and the shrimps have short life span. In contrast, if the effort is high, the stock might be disturbed, even jeopardized because there is no enough time for populations to renew their stock which led the decrease of recruitment number and amount of stock for next year.

The spawning season of banana prawn in Tanah Laut waters occurs all throughout the year with one peak, in November (south-east monsoon). This result is different to that reported by several authors for various locations. In Tanjung Krawang waters, peak of spawning season of banana prawn occurred in March and December (Martosubroto, 1978) while in North Coast of west Java waters, the peak of spawning seasons happened in March and April (Suman *et al.*, 1991). In Cilacap waters, peaks of spawning season are found in January and February (Khamdan, 2015). The difference in peak of spawning season of banana prawn in some waters area might be influenced by

Further analysis showed the total mortality (Z) of banana prawn in Tanah Laut waters was 6.05/year, natural mortality (M) was 1.58/year and fishing mortality (F) was 4.47/year. Saputra & Subiyakto (2007) and the other researcher reported that the mortality rate of banana prawn varied in several waters (Table 2).

Table 2. The mortality rate (per year) of banana prawn (*P. merguensis* de Man) in several waters

Waters	Z	M	F	Source
Segara Anakan	7.02	1.96	5.06	Saputra & Subiyakto (2007)
Kotabaru	4.52	1.96	2.56	Suman & Umar (2010)
Bone	7.86	1.90	5.96	Kembaren <i>et al.</i> (2012)
Tarakan	4.85	1.76	3.09	Kembaren & Suman (2013)
Sampit	5.70	1.93	3.77	Nurdin & Kembaren (2013)

It was presented that differences in value of shrimp mortality rates in several waters were caused by different level of effort number, predator and environment condition.

The exploitation rate (E) of banana prawn in Tanah Laut waters was high (E = 0,74). Based on Pauly criterion (Pauly *et al.*, 1984), it is concluded that over fishing of the banana prawn stock has occurred in Tanah Laut waters because rational fishing of fish or shrimp stock can be gained if values of E in that waters equals 0.5. If value of E is more than 0.5, the stock will be endangered thus effort has to be decreased in order to sustain the stock. The current result suggests that fishing effort of the banana prawn stock should be lowered until 48 % of the present status.

CONCLUSION AND RECOMMENDATION

The size at first maturity of Banana prawn (*P. merguensis*) of Tanah Laut waters reached their first sex maturity at carapace length size of 43.39 mm. Their sex ratio between male and female was not balance. The spawning season of the prawn occurred all the year with one peak in November. Banana prawn has very fast growth rate and its mortality is high. Therefore, to obtain rational management of the stock it must be taken care in planning the effort number allowed each year to exploitation the shrimp stock. Exploitation rate (E) of the banana prawn in the waters is found quite high with a value of 0,74/year. From this research, it suggests that that fishing effort should be reduced up to 48 % of present status in order to keep sustainability of the banana prawn stock. To support the proper and sustainable management of the banana prawn stock, comprehensive research in biology, economic, and social aspects would be necessary to do in the future.

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