

POPULATION DYNAMIC OF ENDEAVOUR SHRIMP (*Metapenaeus elegans*) IN THE WATERS OF SOUTH COAST OF JAVA

Ali Suman¹⁾, Budi Iskandar Prisantoso¹⁾, and Gatut Bintoro²⁾

¹⁾ Research Center for Capture Fisheries, Ancol-Jakarta

²⁾ Politani Perikanan, Pangkep, Sulawesi Selatan

Received March 21-2005; Received in revised from Sept. 7-2005; Accepted Dec. 14-2005

ABSTRACT

Study on the population dynamic of endeavour shrimp (*M. elegans*) was conducted in the south coast of Java based on data collected during a period of November 2002 to October 2003. The purpose of the study is to identify biological and population parameters of the endeavour shrimp. Results shows that the size at first maturity of endeavor shrimp was 32.6 mm in carapace length. Sex ratio of males and females was 1.0:1.7. The chi square test indicated that comparison of male and female of the endeavour shrimp was significantly different. It means that there was imbalance in number between males and females. A number of 554 females were examined, resulting 60% were immature, and 40% were mature. The spawning season of endeavour shrimp in south coast of Java occurs throughout the year with two peaks, January (north west monsoon) and August (south east monsoon). The growth parameter of endeavour shrimp was 1.5 per year with maximum carapace length (L_{∞}) of 51.5 mm. Instantaneous total mortality (Z) and natural mortality (M) rates were 4.53 and 1.15 per year, respectively. While the respective fishing mortality (F) and exploitation rate (E) were 3.38 and 0.75 per year time respectively to maintain the sustainability of this shrimp fisheries resources. The exploitation rate of endeavour shrimp in south coast of Java was high. This suggests that fishing effort of the endeavour shrimp in that waters should be reduced.

KEYWORDS: shrimp, south coast of Java, population dynamic

INTRODUCTION

Endeavour shrimp (*M. elegans*) is one of penaeid shrimp species, dominantly caught in the waters of south coast of Java. Catch of endeavour shrimp may reach the third highest after others small size shrimp (*Parapenaeopsis stylifera*) and brown shrimp (*Metapenaeus ensis*) (Suman, 2004).

Exploitation of the endeavour shrimp in the water of south coast of Java has been carried out for years (Van Zalinge & Naamin, 1975) and become more intensive in the recent years due to an increase of local and or foreign market demand. If this situation continues to occur, sustainability of the shrimp stock would be disturbed in the future. Therefore comprehensive research is needed to reach rational utilization in order to maintain sustainability of the stock for prosperity purposes in the future (Naamin *et al.*, 1992).

This paper discussed population dynamic of the endeavour shrimp (*M. elegans*) in the south coast of Java. It hopes that the result can be used as basic and important information for other endeavour shrimp studies

and sustainable exploitation of the endeavour shrimp in the waters of the south coast of Java.

MATERIALS AND METHODS

Samples of the endeavour shrimp were taken from field research in south coast waters of Java (Figure 1) from November 2002 to October 2003. Biometric studies (carapace length, sex, and gonad maturity identifications) were done for 872 samples. Spearman & Karber method (Udupa, 1986) was applied to identify the size at first maturity with assumption that average size of first maturity occurs when 50% of the endeavour shrimp is already mature. Logarithmic size of the first sex mature (m) was calculated based on equation below:

$$m = xk + X/2 - (X \sum p_i)$$

where:

- m = logarithmic size of first sex mature
- xk = logarithmic size of mean value of 100% mature
- X = logarithmic different of mean value
- p_i = comparison of sex maturity of each length class

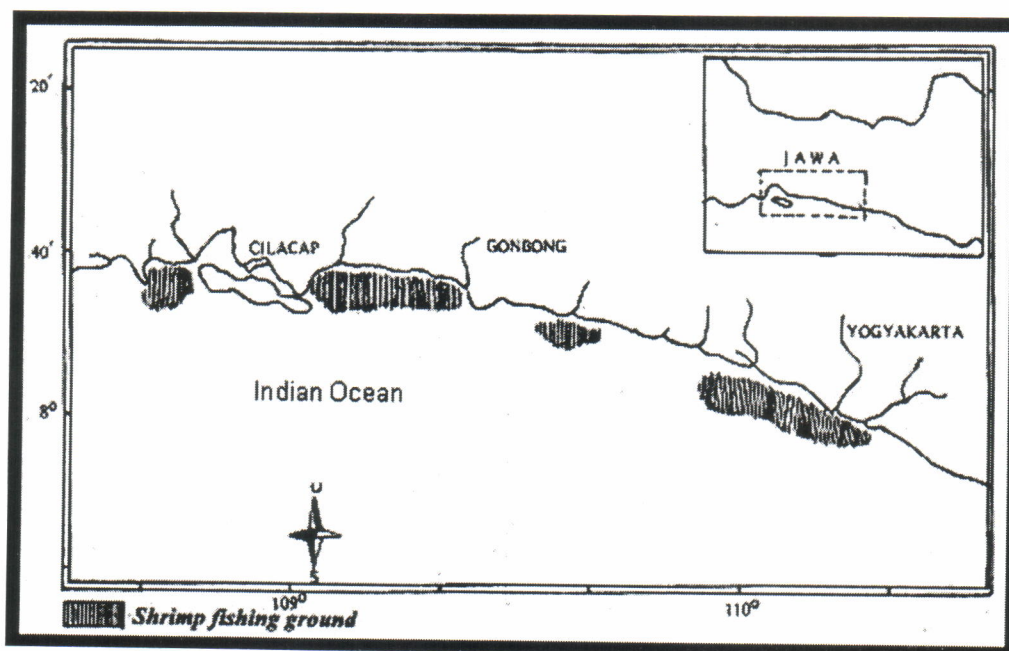


Figure 1. Shrimp fishing ground in the waters of south coast of Java.

In this classification, gonad maturity (stage) I and II are classified as immature while stage III, IV, and V are mature. The morphologically identified sex maturity stages of the shrimp (Tuma, 1967 in Naamin, 1984) are as follows I = quiescent or 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 analysed by tracing the modes of monthly carapace length distribution using ELEFAN program (Sparre & Venema, 1992; Gayanilo *et al.*, 1993). 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 empirical equation (Pauly, 1985) and fishing mortality rate (F)=Z-M, while exploitation rate (E)=F/Z (Sparre & Venema, 1992).

RESULTS AND DISCUSSIONS

Size at First Maturity

Shrimp age and size at first maturity are important for management purposes.

The size at first maturity of endeavour shrimp in the waters of south coast of Java was 32.6 mm in carapace length with confidence limits of 31.8 to 33.8 mm. Martosubroto (1978) reported that *M. ensis* in Tanjung Krawang waters reached first maturity when they grow to about 20 mm in carapace length. This difference in reaching first maturity might be influenced by the availability of food and environment condition such as temperature and salinity.

Maturity percentage frequencies distribution of the endeavour shrimp female can be seen in Table 1. Table 1 also illustrated that the longer the size of carapace length, the higher the maturity percentage of shrimp.

Table 1. Frequency distribution of mature female shrimp (*M. elegans*) in various size of carapace length in the waters of south coast of Java

Carapace length (mm)	Percentage (%)	Carapace length (mm)	Percentage (%)
24	3	36	60
26	18	38	76
28	22	40	78
30	37	42	88
32	41	44	100
34	51		

Sex Ratio

Data on sex and maturity of fish or shrimp stock are important as basic information for reproduction biology of the stock (Suhendrata & Merta, 1986). Homogeneity test informs that value of male and female was imbalance, it was also identified that sex ratio of the endeavour shrimp in south coast waters of Java was found to be 1.0:1.7. This ratio is significantly different with those reported in previous researchs (Suman *et al.*, 1987; Suman, 1991). That first authors found the value of 1.0:1.2 in Pangandaran waters, while the later found 1.0:2.5 in Kotabaru waters (South Kalimantan).

The measured carapace length of 318 male of endeavour shrimp ranged from 20 to 40 mm and of 554 female ranged from 20 to 44 mm. Suman *et al.* (1987) illustrated that in Pangandaran waters, range of carapace length of male endeavour shrimp was 12.2 to 24.3 mm and of female was 13.3 to 31.9 mm. Meanwhile in Kotabaru, South Kalimantan, it were found that carapace length of male and female endeavour shrimp ranged from 21.2 to 32.6 mm (Suman, 1991).

This data informs that range of carapace length of female was higher than that of male. This phenomenon might be influenced by difference in growth type of female and male. The growth of female was faster than male so that carapace length of female was always longer than male in the same age (Naamin, 1984).

Spawning Season

Spawning season of shrimp in a certain waters can be studied by identifying distribution of egg density or shrimp maturity in that waters (Martosubroto, 1978).

The observation shows that the number of immature and mature female endeavour shrimp were 331 (60%) and 223 (40%), respectively. It could be concluded that number of immature endeavour shrimp was higher than mature endeavour shrimp. It mean that on the biological aspects, status of the shrimp stock was likely in danger zone because fishing activity exploited more young shrimp than adult shrimp.

The distribution frequency of female endeavour shrimp in two maturity stages from November 2002 to October 2003 can be seen in Table 2.

Table 2 shows that the highest number of mature female shrimp occurred in January and August. It shows that peaks of spawning seasons of endeavour shrimp in the waters south coast of Java took place twice, in January and August. In Tanjung Krawang waters, peak of spawning season of endeavour shrimp occurred in March and December (Martosubroto, 1978) while in Kotabaru waters, South Kalimantan, peak of spawning season occurred happened in June only (Suman, 1991).

Table 2. Frequency distribution of gonad maturity of female endeavour shrimp in the waters of south coast of Java

Year	Month	Maturity stage (%)	
		Immature	Mature
2002	November	85	15
	December	53	47
2003	January	47	53
	February	94	6
	March	65	35
	April	65	35
	May	50	50
	June	70	30
	July	51	49
	August	44	56
	September	53	47
	October	55	45

Growth Parameter

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 modes (Sparre & Venema, 1992).

Values of growth rate (K) and maximum carapace length (L_{∞}) were recorded by identifying monthly the carapace length frequency (Figure 2). The value 1.5 per year and 51.5 mm, were respectively for K and L_{∞} .

Value of K and L was greater than 1, showing that growth type of endeavour shrimp in the south coast

waters of Java was fast growth (Sparre & Venema). Eventhough care must be taken into account when planning the amount of effort allowed to be applied each year for exploiting the shrimp stock in order to obtain rational management of the stock. If value of recommended effort was lower, uncapture shrimp stock would be useless or number of natural mortality would be high because the growth type of the stock was fast. It means that the stock had short life span. In contrast, if value of recommended effort was higher, the stock would be disturbed or even jeopardized because there was not enough time for population to grow the recruitment number and amount of next year stock will decrease.

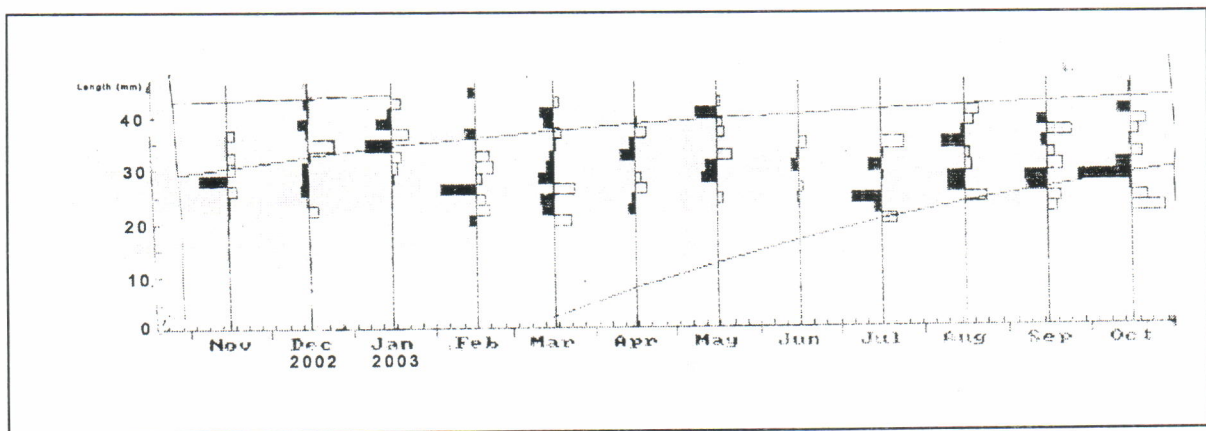


Figure 2. Carapace length distribution of endeavour shrimp (*M. elegans*) and growth curves fitted by ELEFAN.

Mortality Rate and Exploitation Rate

Value of total mortality (Z) represented by value of slope (b) between $\ln N/t$ and relative age (Figure 3) was 4.53 per year. Meanwhile value of natural mortality (M) and fishing mortality (F) were 1.15 per year and 3.38 year, respectively.

Pauly *et al.* (1984) reported that values of Z and F of Indian shrimp (*Metapenaeus affinis*) in Versoba waters, were 5.29 and 3.0 per year respectively. While values of Z and F of *Metapenaeus kutchensis* were 5.83 and 2.20 per year, respectively. It was also reported that the differences in value of shrimp mortality rates in several waters were caused by different level of effort, predator, and environmental conditions.

By using the exploitation rate equation $(E)=F/Z$, it obtained that the value E of endeavour shrimp in the waters of the south coast of Java was 0.75 per year. Based on Pauly criterion (Pauly *et al.*, 1984), it concludes that over fishing of the shrimp stock occurred in this location waters of Java, because rational the fishing of

fish or shrimp stock can be gained if the value E in that waters equals 0.5. If the value E is more than 0.5, the stock would endangered thus effort has to be decreased in order to sustain the stock. Phenomenon of the endeavour shrimp stock in the south coast waters of Java suggests that fishing effort of the endeavour shrimp stock should be deducted until 50% of the present status.

CONCLUSION AND RECOMMENDATION

1. The endeavour shrimp (*M. elegans*) reached at for maturity at the carapace length of 32.4 mm.
2. Sex ratio of male and female of endeavour shrimp (*M. elegans*) was 1.0:1.7. It called in imbalance condition.
3. Spawning season of endeavour shrimp (*M. elegans*) occurred throughout the year with two peaks in January (west monsoon) and August (east monsoon).

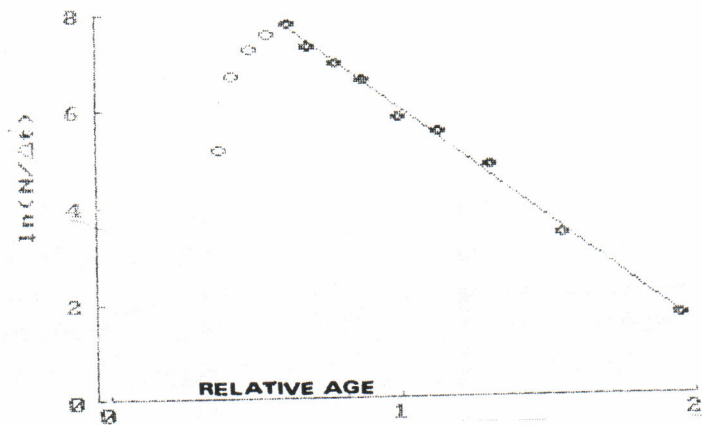


Figure 3. The value of total mortality (Z) of endeavour shrimp (*M. elegans*) in south coast waters of Java.

4. Values of growth rate (K) and maximum carapace length (L.) of endeavour shrimp (*M. elegans*) in the south coast waters of Java were 1.5 per year and 51.5 mm, respectively.
5. Values of total mortality (Z), natural mortality (M), and fishing mortality (F) of endeavour shrimp (*M. elegans*) were 4.53; 1.15; and 3.38 per year respectively.
6. Exploitation rate (E) of endeavour shrimp stock in south coast waters of Java was quite high; 0.75 per year.
7. In order to keep sustainability of endeavour shrimp stock, it suggests biologically that fishing effort should be deducted until 50% of present status.
8. In order to perform sustainability management of the endeavour shrimp (*M. elegans*) stock, comprehensive research in biology, economic, and social aspects are necessary to be conducted.

Acknowledgements:

This paper is the result of: The Research on Stock of Demersal Fish in Indian Ocean 2002-2003

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