

POPULATION STRUCTURE OF TOPSHELLS
(*TROCHUS NILOTICUS*)
IN SAPARUA ISLAND, CENTRAL MOLUCCAS-
INDONESIA

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ABSTRACT

Lola snail (*Trochus niloticus*) is one of the largest sea snails that live in coral reefs at Indo Pacific region and Indonesia including Saparua Island, the province of Moluccas. In a few recent years, the exploitation of lola snails has been increasing, so that the population of lola snails in nature decreases. The yield of lola snail in Saparua Island and in the archipelagos of Banda from 1979 until 1992 showed a decrease from around 4 tons of dry shells to only around 0.25 tons. Furthermore, this research was aimed to estimate the size structure, age structure, and the sex ratio of lola snails population in Saparua Island, the regency of Central Moluccas. The sampling of lola snails used *transects strip method*. Each transect was 100 m long and 2 m wide, which were divided into 10 segments of 10 m x 2 m. Transect was laid perpendicular to the coast line started from the lowest fall of the tides to the coast. The Bhattacharya method was applied for data analysis. The frequency distribution of shell diameter revealed that lola snails in Saparua Island consisted of nine size classes and two different age classes, which indicated that the population of lola snails in Saparua Island had two periods of spawning. Finally, from this research it could be concluded that the sex ratio of lola snail was 1:1.

Key words: *Trochus niloticus*, population structure, Saparua Island

INTRODUCTION

Lola (*Trochus niloticus*) is a species of ocean snails that lives in coral reefs at Indo Pacific regions including the waters of East Indonesia territorial. In East Indonesia, this species is well known as *siput susu bundar* or lola. The shell of lola snails is used as material in Industry, especially for shirt button manufactures, jewelry and paint, while the meat is consumed by the local people as the source of protein. The spread of lola snail in Moluccas waters includes North Moluccas, Central Moluccas and South

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East Moluccas. In Central Moluccas, lola snails are found mostly in the western and southern part of Buru, the eastern part of Seram, Saparua and in the archipelago of Banda (Arifin 1993). In a few recent years, the world demand for lola snail shells is increasing. The global production of lola snail shells in 1990 was estimated around 4000 tons/year. From this amount, 70 % of it was derived from countries in Pacific region, while the rest came from South East Asia and Indonesia (Fao 1992). In 1998, world market demand for lola snail shells was estimated about 7000 tons/year valued around 50-60 million US\$ (Lawrence 1998; Winston & Grayson 1998). This situation caused the increase of lola snail exploitation which also caused a decrease of its population in nature.

The reduction of lola snails population due to continuous exploitation also occurred in some regions of Moluccas such in Saparua Islands, Central Moluccas Regency which were basically the producer of lola snail shells. In addition, the yield of lola snail in Saparua and in the archipelagos of Banda from 1979 until 1992 revealed a decrease from around 4 tons of dry shells to around 0.25 tons of dry shells (Arifin 1993; Braley 1993; Cesar 1996). Based on the issue above, this research was aimed to determine size structure, age structure, and sex ratio of lola snails in Saparua related to its potential for use and future management.

MATERIALS AND METHODS

This research was conducted from September until November 2003 in Saparua Island, Central Moluccas Regency, located at 03, 29° - 03, 80° South latitude and 128, 32° - 128, 43° East longitude with an area of 209 km².

Sampling

The sampling of lola snails was conducted in eastern and southern coasts of Saparua Island, specifically from six locations in the waters of some villages i.e. Booi, Haria, Ullath, Ouw, Itawaka and Nolloth (Figure 1).

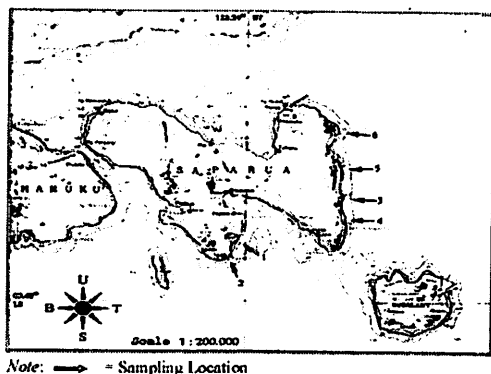


Figure 1 Lola snail (*Trochus niloticus*) sampling location in Saparua Islands, Central Moluccas
(1) Booi, (2) Haria, (3) Ullath, (4) Ouw, (5) Itawaka dan (6) Nolloth.

The sampling of lola snails was done at night by using *transects strip method* (Greenwood 1997). Nighttime sampling was preferred because lola snail is active at night. Therefore, by doing such sampling at that specified time, it was expected that the yield would be more maximum. Transect used in this sampling was 100 m long and 2 m wide. Besides, it was also divided into 10 segments of 10 m x 2 m. Three transects were put in each location perpendicular to the coast line started from the fall of the tides to the coast, by using a rope that was signed in each 10 m. The distance of each transect in each location was 100 m (Figure 2).

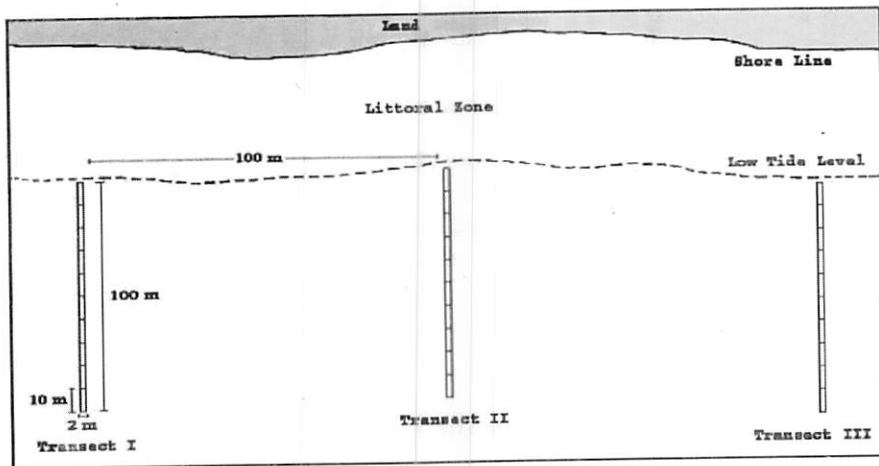


Figure 2 Transects strip method (Greenwood 1997) for lola sampling in Saparua Island, Central Moluccas.

The snails sampling was done by taking each lola snail found in each strip transects starting from the fall of the tides to the coast. It was done by applying two ways, diving and walking along transect. Hence, the diameter of each lola snail shell from the sampling was measured to determine size structure and age structure. In addition, 12 lola snails were taken randomly from each location to determine sex ratio. Those 12 lola snails had a diameter of more than 5 cm.

Size structure

Size structure was determined based on the basalt diameter of shell. The determination of size structure of lola snails was done by measuring basalt diameter of the shell of each snail that was sampled at each transects using a caliper with 0.05 mm accuracy. The diameter of each shell was measured based on the largest part of shell base starting from the tip of shell mouth (Figure 3). The data of shell diameter were grouped into some size classes by compiling a distribution table of size frequency and histogram graph of size frequency (Walpole 1995). The distribution of size class and

frequency distribution were also analyzed using Bhattacharya method in FiSAT II program (FAO-ICLARM Stock Assessment Tools) version 0.3.1 (Gayanilo *et al.*

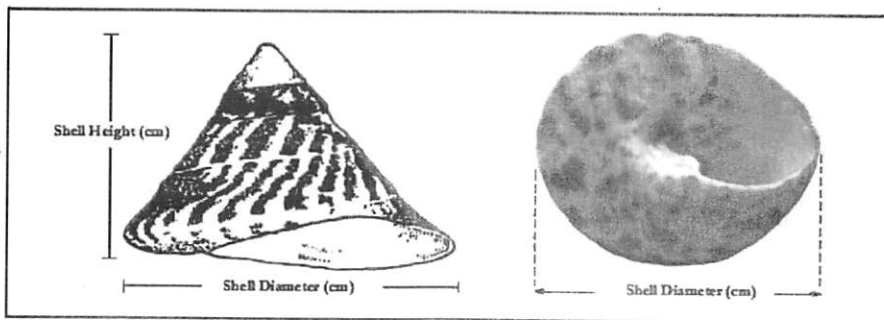


Figure 3. Lola (*Trochus niloticus*)

Age structure

The group of lola snail population according to age was based on the diameter of basal shell of each snail that was sampled. Age determination was done using Bhattacharya method in FiSAT II program (FAO-ICLARM Stock Assessment Tools) version 0.3.1. Bhattacharya method is a separation method of size frequency (shell diameter) into some normal curves distribution of normal frequency (modal progression analysis-MPA) (Sparre & Venema 1998; Gayanilo *et al.* 2002). The numbers of age group was based on the total normal curve distribution. The age of snails obtained was then used to estimate the total recruitment which occurred in population and reproduction potential of lola snails population.

Sex ratio

Determination of sex ratio was done by taking randomly 12 lola snails from each location with a minimum shell diameter size of 5 cm. Lola snails sex that was determined by gonad color could be only differentiated when the shell diameter has reached a minimum of 5 cm (Heslinga 1981; Pradina & Dwiono 1994). Sex determination was done by breaking the shell apex and examining the color of its gonad. The result showed that the gonad color of male lola snail was white to cream, while the ovary color of female lola snail was dark green (Moorhouse 1993; Rao 1937). Finally, sex ratio was obtained by comparing the sex of lola snails that were sampled. The sex ratio calculation used Chi-Square Goodness of Fit Test (Krebs 1989; Zar 1996).

RESULTS AND DISCUSSION

Size structure

The total lola snails collected in this research was 223 individuals with the smallest shell diameter of 2.32 cm, while the largest shell diameter was 9.68 cm. The grouping of lola snails was based on shell diameter as shown in size histogram (Figure 4). The class size histogram of lola snails shell indicated that lola snail population in Saparua could be grouped into nine size classes. From the distribution frequency application of shell diameter, it was obvious that most of lola snails collected in this research have a shell diameter around 2.79 cm to 7.84 cm. Snails with a shell diameter around 2.79 cm to 5.29 cm make up 68% of the total population. Snails with a shell diameter of 7.85 cm to 9.54 cm were only about 0.12 % of the total population.

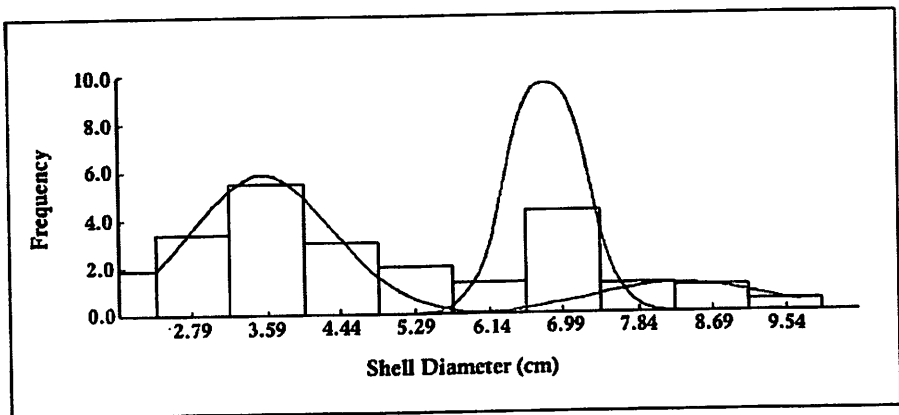


Figure 4 The distribution of size class and frequency distribution of lola snails (*Trochus niloticus*) population in Saparua Island based on Bhattacharya methods (FiSAT II)

Diameter frequency of lola snail shell based on sampling location indicated a variety of size group distribution.. Snails with a diameter between 8.69 cm to 9.54 cm were rare and even not found in Booi, Haria, Ullath, Ouw, and Itawaka. However, the type of such shell diameter was found in quite a number in Nolloth (Figure 5). Besides, the spread of class size diameter of snails also indicated that lola snails in Saparua were dominated by snails with shell diameter of less than 6.12 cm.

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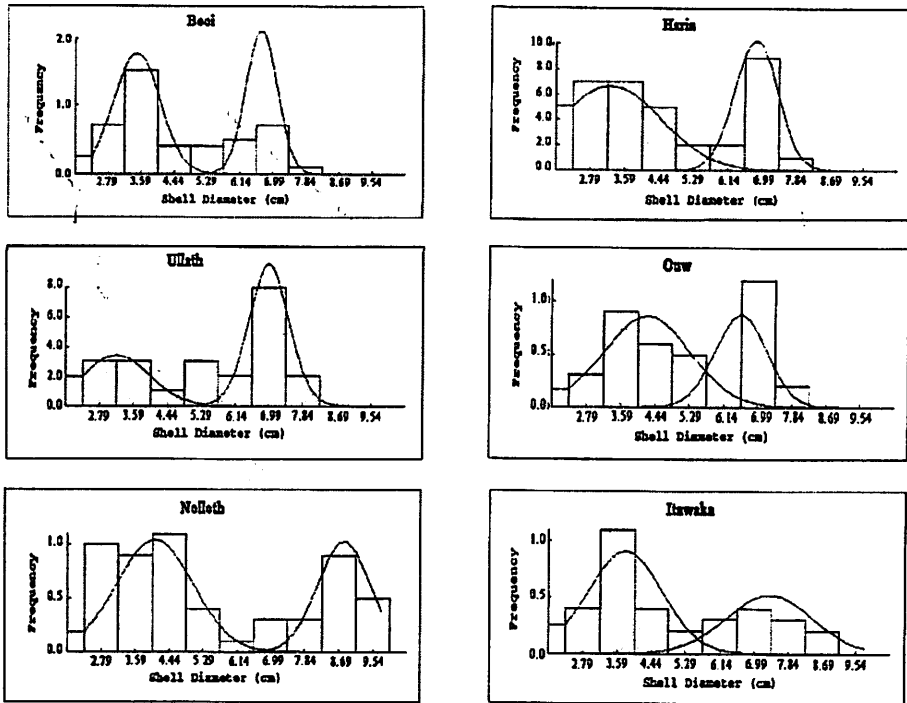


Figure 5. The distribution of size class and frequency distribution of lola snails (*Trochus niloticus*) population in sampling locations in Saparua Island based on Bhattacharya methods (FiSAT II)

In addition, a study conducted by Ponia *et al.* (1997) in Cook Island (Australia) and Trianni (2002) in Saipan Island (Pacific) showed that most of lola snails in both locations had a shell diameter range of 7 cm to 13 cm. However, according to Smith *et al.*, (2002), the population of lola snails in Cartier reef (Australia) consist of individuals that had more than 7 cm of its diameter. The existence of such lola snails with a shell diameter of more than 8.69 cm in Nolloth, was assumed as snails group that were not collected during the period of *Sasi* opening. Lola snails that were allowed to be collected during *sasi* opening were the snails with a shell diameter more rthan 6 cm (Arifin 1993; Braley 1993; Cesar 1996). However, from the six sampling locations, only Nolloth really followed the *sasi* rules for lola snails. As a result, lola snails with a shell diameter more than 8.69 cm were really rare or even not found in other locations, except in Nolloth.

Age structure

Age structure of lola snail was determined based on the total normal distribution curve formed from an analysis of frequency distribution toward shell diameter. The result of analysis revealed that lola snails population in Saparua consisted of two age classes (Figures 4 & 5; Tables 1 & 2). The total age classes of lola snails population

Table 1 The number of lola snails ages classes in Saparua Island based on Bhattacharya methods (FiSAT II)

Age Class	Population Size (<i>N</i>)	Separation Index (<i>SI</i>)
1	105	-
2	104	5,390
3	14	2,290

Table 2 The number of lola snails ages classes in sampling location in Saparua Island based on Bhattacharya methods (FiSAT II)

Location	Ages Class	Population Size (<i>N</i>)	Separation Index (<i>SI</i>)
Booi	1	26	-
	2	21	6,510
Haria	1	21	-
	2	14	4,020
Ullath	1	7	-
	2	12	5,800
Ouw	1	23	-
	2	14	2,730
Itawaka	1	21	-
	2	14	3,610
Nolloth	1	25	-
	2	17	5,910

The existence of such age group could also indicate that lola snails population in Saparua had two periods of spawning indicating that recruitment process occurred in that population. Generally, the recruitment in nature originated from the spawning process of individuals in that population (Krebs 1994). The results of some studies concerning lola snails showed a continuous spawning process of lola snails all year long, but there was a certain period when the climax of spawning process occurred (Rao 1937; Heslinga 1981; Hahn 1989; Pradina *et al.* 1996; Pradina *et al.* 1997).

Frequency histogram also showed that most of lola snails population in Saparua at the time of sampling composed of young group individuals which was marked by the shape of frequency distribution histogram of shell diameter that had a positive declivity to the left direction. The availability of young individuals in a large number

indirectly indicated that the accumulation process of new individuals into the group of reproductive individuals (recruitment) and that the spawning of lola snails population in Saparua has recently occurred. However, if lola snails population was grouped based on the reproduction capacity, lola snails population in Saparua during this research would tend to be dominated by the group of individuals that were not reproductive yet or the young group with a shell diameter less than 5 cm in average. The number of already reproducing mature individuals was related to the reproduction capacity of population members, and also sustainable stock supply of lola snails in Saparua.

Sex Ratio

The result of counting of lola snails sex ratio from the field data with application of Chi-Square Goodness of Fit Test showed that the sex ratio of male and female lola snails was 1:1 (Table 3). Test in each location, also showed the same ratio of 1:1 (Table 4). From table 4, it was obvious that based on the total lola snails of each sex of the population in Haria and Nolloth the number of female lola snails was higher than the number of male lola snails with the sex ratio of 1 : 2. However, based on the result of Chi-Square Goodness of Fit Test and the total lola snails of each sex, the male and female lola snails population in Saparua was in balance.

Table 3 The number of male and female of lola snails (*Trochus niloticus*) in Saparua Island

	Male (♂)	Female (♀)	N	$\chi^2_{0.05(1)}$	χ^2
Fi	32	40	72	3,841	0,888*
Fi	(36)=72 x 1/2	(36)			
$db = v = k - 1 = 2 - 1 = 1$					
* = $\chi^2_{Hit} > \chi^2_{Tabel (0,05(1))}$, accept H_0 = sex ratio is 1 : 1					

Table 4 The number of male and female of lola (*Trochus niloticus*) in sampling locations in Saparua Island

Location	Male (♂)	Female (♀)	N	$\chi^2_{0.05(1)}$	χ^2
Booi	7	5	12	3,841	0,333*
Haria	4	8	12	3,841	1,333*
Ullath	6	6	12	3,841	0,000*
Ouw	6	6	12	3,841	0,000*
Itawaka	5	7	12	3,841	0,333*
Nolloth	4	8	12	3,841	1,333*
$db = v = k - 1 = 2 - 1 = 1$					
* = $\chi^2_{Hit} > \chi^2_{Tabel (0,05(1))}$, accept H_0 = sex ratio is 1 : 1					

According to Moorhouse (1932) and Rao (1937), the ratio between male and female lola snails was in balance. Individual sex ratio in one population is related to the reproduction capacity of the individual of that population (Boughey 1973; Krebs 1994). If those individuals in one population have the same sex ratio, the opportunity for fertilization would be high in each location. As a result, it can support the sustainable use of lola snails as one of the species that has economic value.

CONCLUSIONS

The total number of lola snails collected from this research was 223 individuals with the smallest shell diameter of 2.32 cm, while the largest shell diameter was 9.68 cm. The class size histogram of lola snails shell indicated that lola snail population in Saparua could be grouped into nine size classes. From the distribution frequency application of shell diameter, it was obvious that most of lola snails collected in this research have shell diameter of around 2.79 cm to 7.84 cm based on the sampling location. The diameter frequency of lola snail shell indicated a variety of size distribution of size groups. Snails with a diameter between 8.69 cm to 9.54 cm were rare and even not found in Booi, Haria, Ullath, Ouw, and Itawaka. However, this shell diameter size was found in quite a number in Nolloth. The result of analysis revealed that lola snails population in Saparua consisted of two age classes. The existence of such age group also showed that lola snails population in Saparua had two periods of spawning indicated by recruitment process in the population. Frequency histogram also showed that most of lola snails population in Saparua at the time of sampling belonged to young group individuals. The availability of young individuals in a large number indirectly indicated that the accumulation process of a new individual into the group of reproductive individual (recruitment) and also the spawning of lola snails population in Saparua has recently occurred. Lola snails sex ratio from the field data showed that the sex ratio of male and female lola snails was 1:1. If those individuals in one population have the same sex ratio, the chance for fertilization would be high in each sampling location. As a result, the sustainable use of lola snails as one of the species of economic value could be maintained.

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