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POPULATION CHARACTERISTICS OF UDANG PENGKO MANTIS SHRIMP *LYSIOSQUILLA MACULATA* FABRICIUS ON A REEF FLAT IN PARI ISLAND*

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ABSTRACT

Population characteristic of the mantis shrimp *Lysiosquilla macullata* Fabricius, were monitored on a reef flat at the Pari Island coral ecosystem, Seribu Island Jakarta, from May 1985 to April 1987 (two years). The population density fluctuated from 50 individuals ha^{-1} to 475 individuals ha^{-1}. Small, medium and large individuals of Udang pengko were evenly spread over the reef flat area occupied by Udang pengko (*L. maculata*), there was no segregation by size. The occurrence of Udang pengko in terms of their distance from the reef edge, biomass and morphometrical characteristics was discussed. The statistical test for the differences between years showed the marked difference on their population density.

INTRODUCTION

MANTIS SHRIMPS are common on reef flat in Pari Island. The animal often occur in high densities (300 individuals ha^{-1}) and are important as a source of food. Mantis shrimp are burrowing shrimp and considered as scavengers. Despite their apparent importance there are few studies of the ecological aspect of those species in the reef flat of Pari Island. Sukardjo and Toro (1987), Toro and Sukardjo (1987). Toro and Sukardjo (1987) examined the distribution, abundance and reproductive success in the reef flat. The dominant crustacean fauna of reef flat is *Thalamita crenata* Latreille (Toro, 1979) and the only one species of mantis shrimp recorded in the reef flat is *Lysiosquilla maculata* Fabricius which extend from reef flat to reef edge. Few data are available on the population characteristics of this species in any area of its range.

The present paper is intended to provide preliminary information variation in such population characteristics as density, size frequency and biomass at a site in the reef flat area of Pari Island.

MATERIALS AND METHODS

A sampling station was established in the reef flat of the Pari Island (05° 50′ 60″ to 05° 52′ 25″ Longitude and 106° 34′ 30″ to 108° 38′ 20″ Latitude). The sample area (Fig. 1) is a sandy flat with a platform extending seaward at tidal level of mean high tide of 890.70 mm (± 60.70). Landward of the study area is sandy beach with scattered both *pescaprae* and Calophyllum formations, at approximately 1.5 metres high.

Tides are a mixture of semidiurnal and diurnal with a maximum range of 0 to 1.3 m ; levels are generally higher in dry season. The Pari Island site is exposed to small wave action from the Sunda Strait, though this is dampered some what by a subtidal reef in the frontal

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edge of the island. Wave action is greater in frontal edge than in the reef edge.

Samples were made on the reef flat at weekly intervals from May 1985 to April 1987. On each occasion transects were sampled, which were 20 m wide and divided into 10×10 m. The transect running from the beach upto the reef edge. To determine size-frequency and shore height characteristics all individuals of *Lysiosquilla maculata* in each quadrat were counted, measured to the nearest 0.1 mm in TL with caliper and weight by using 'Triple Beam Balance'.

Result

Density

The density of adult population of *Lyiosquilla maculata* differ clearly between 1985-1986 and 1986-1987 ($F_{1,22}=2.074$; $P < 0.05$) and the population was significantly larger in 1986-1987 ($F_{1,22}=16.3396$; $P < 0.01$) apparently due to a higher peak number of the year (Fig. 2).

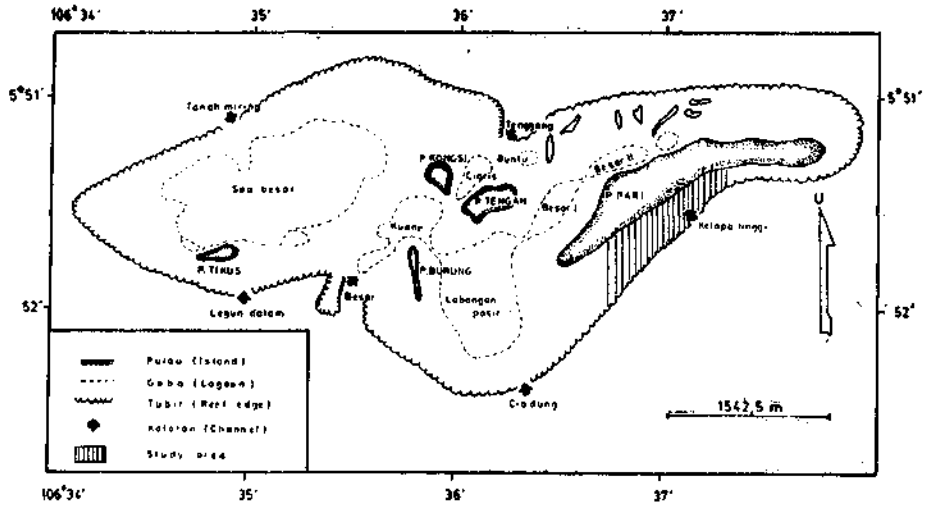

FIG. 1. The location of the study sites in the Pari Island.

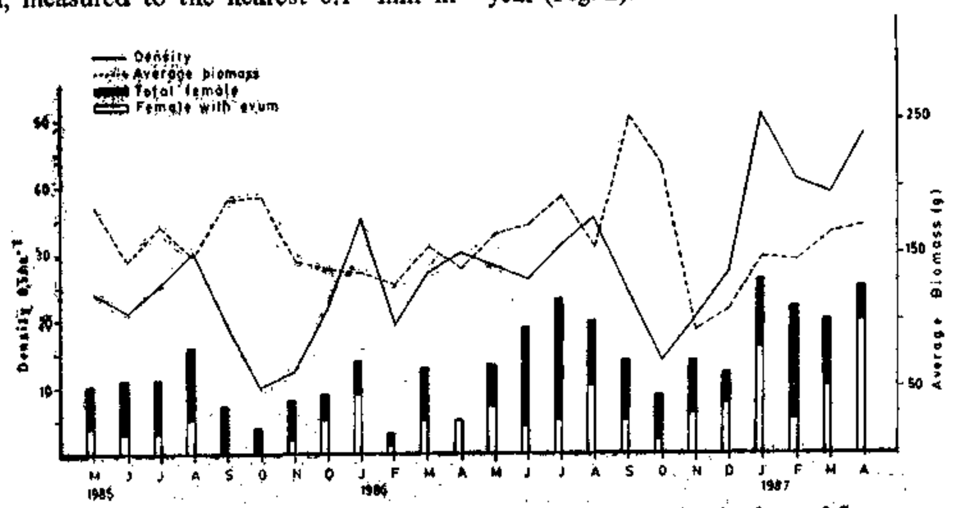

FIG. 2. Temporal pattern of Mantis shrimp *L. maculata* population in the reef flat area.

The highest densities were recorded at the high rainfall with 51 individuals 0.5 ha^{-1} in January 1987 (Fig. 2). Density remained high until April 1987 (48 individuals 0.05ha^{-1}), they declined sharply to 24 individuals 0.5 ha^{-1} in March.

Population density also varied significantly among sites (Fig. 3). Differences between sites were consistent from the two years of the study (Fig. 4). Pair density correlated significantly with total adult density for both years of the studies (1985-1986, r=0.684 ; 1986-1987, r=0.929 at $p < 0.01$). Consequently, sites ranked differently in terms of population density depending on the size range of individuals included in the censuses. *L. maculata* inhabited the reef flat from the edge to shore lines of the Pari Island. Figure 2 shows the changes in mean density of the population over two years sampled. During the period of two years, five typical fluctuations were noted in the population of *L. maculata* (Fig. 2) *viz.* from April 1986 to June 1986 the population decreased smoothly and then increased upto August 1986. From August 1986 to October 1986 the population decreased sharply and then increased again upto June 1987, then decreased upto March. This is an indication that the population consists of different age classes of the mantis shrimp.

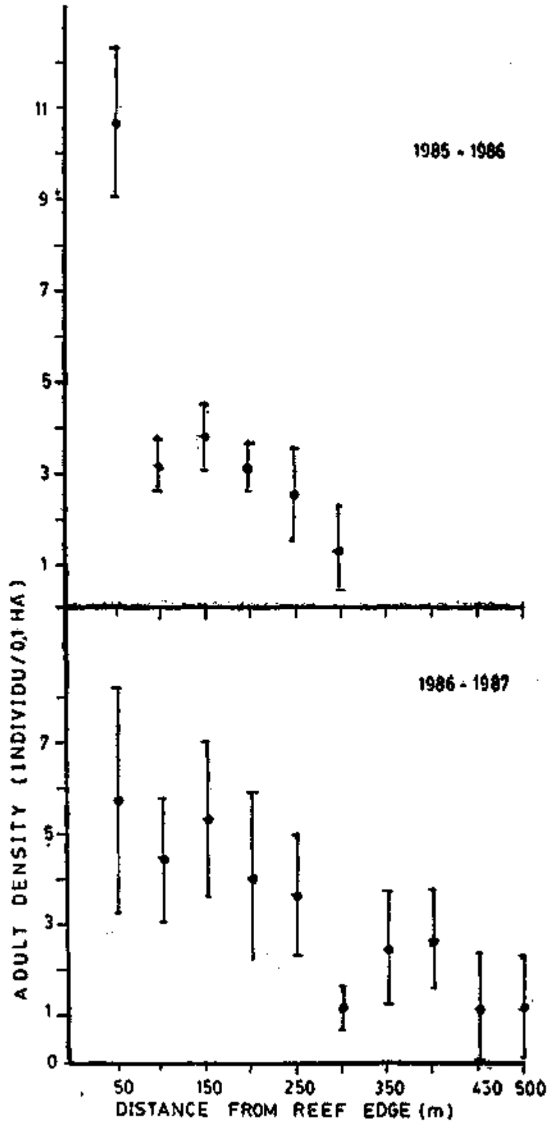

FIG. 3. Total adult density for 1985-1986 and 1986-1987 at the 10 study sites. Data are means ± SD. Locations are organized in terms of their distance to the reef edge.

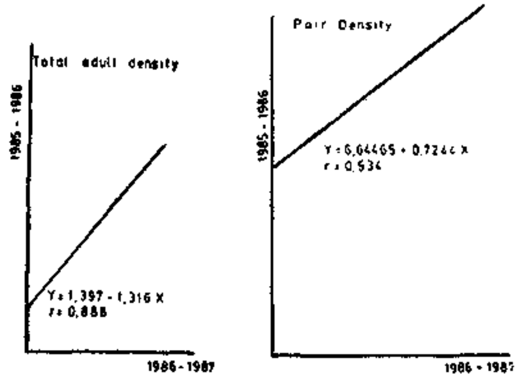

FIG. 4. Correlation between years for two mesures of population density at the 10 study sites.

The mean density was 5.8 to 10.6 individuals (0.1 ha^{-1}) in the location closed to the reef edge (50 m) (Fig. 3) and moved up steadily to 4.5 to 5.4 individuals (0.1 ha^{-1}) in location with 100 m-150 m from the reef edge. There was clear seasonal variation in the site locations occupied by the population. Areas of seagrass growth were avoided by *Lysiosquilla maculata*.

Figure 3 further suggests that average population density differs substantially between the reef edge ward and shore lines ward of the reef flat. A rank correlation between mean density and site distance from the reef edge is highly significant for both year of the study (1985-1986, r=0.850; 1986-1987, r=0.920; $P<0.01$).

Biomass and size frequency

Figure 6 plots the relationship between total length (X, mm) and weight (Y, g) on a Log/Log basis the equation is straight line of $Y = -3.992 + 2.606 X$ ($r = 0.930$). The means biomass of each month is shown in Fig. 2 and closely parallels density. Biomass was highest (mean=200.025 g) in the sample of September 1986 and remained high until October 1986 (190.388 g). In November 1986 biomass declined sharply to 954 g and then increased slightly to 169.79 g in April 1987.

Figure 7 shows the size frequency curves for 1985-1986 and 1986-1987 examined. Recruits to the population were first seen at a total length of 132.15 mm. Individuals smaller than 200.0 mm were present in all months except October (Fig. 7). The peak number of small individuals were recorded in January and February. Changes in the size frequency curves from May to November can be used to estimate growth of the adult. Their mean size (TL, mm) was 235.085 mm (± 37.178) in May, 198.017 mm (± 17.956) in November. The curve for May 1985 is distinctly bimodal, indicating that there are at least two, or three years classes in the population.

In contrast to the May 1985 graph, the plots for September 1986 upto November 1986 are single unimodal with large number of small individuals spread over the range of 170.00 mm to 190.00 mm (Fig. 7). This does not necessarily contradict the suggestion that *L. maculata* lives two years, but does suggest that 1985-1986 was a better year for recruitment and subsequent growth than 1986-1987.

When sampling began in May 1985, it was shown that *L. maculata* began to migrate coastal edge ward onto the reef edge ward. Based on two years study, the migrating individuals were 132.15 mm or longer. The population of *L. maculata* on the reef flat consists adult sizes only (Fig. 7). Adult size also varied significantly among site on the level of significant 1% (Fig. 5).

DISCUSSION

During the period of this study, the *L. maculata* population increased in density by 14.55%. The survey from May 1987 to August 1987 (4 months) showed that the population had increased to 21.95% of its initial level.

During this period from September 1986 to November 1986 (Fig. 7) the population of mantis shrimp was classified mostly in small size (Fig. 7). It can be assumed hypothetically that the most dramatic migration of *L. maculata* had occurred and possibly corresponded to moulting season. *Lysiosquilla maculata* is benthic organism and lives on the reef flat where the population is frequently covered by waters eliminating the possibility of migration during high tide. Two years field observation in the reef flat, the most predatory *Portunus pelagicus* is present in the study area in small number. This suggests that possibility of animal predation can be discounted as a major source of the mortality. The period from September 1986 to November 1986 was considered as the starting point of the rainy season. This could have caused the environment in the reef flat support the abundance of *Portunus pelagicus*. However, the mortality of *L. maculata* was concentrated amongst the largest individuals of the population suggesting that post reproduction mortality in the primary cause.

The size frequency graphs changed markedly between May to April (Fig. 7). Individuals with total length less than 250 mm occurred as typical element of the population (Fig. 5).

The Total Length frequency distribution of the mantis shrimp *L. maculata* consecutively taken are considerably complex. The difference of length-weight relation between both sexes is too slight to warrant it. Accordingly the relationship was treated on the basis of material combined both sexes (Fig. 6). Computing the data for 1985, 1986 and 1987 (Table 1), it is worth noting herewith that the constant b is as seen above, having values more than 2. Thus the cube law may be applied too in this animal as is the case with most fishes.

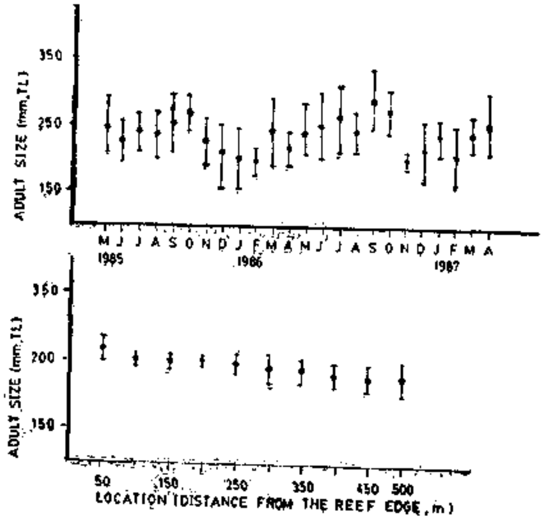

FIG. 5. Size (Total length, mm) of adult *L. maculata* at the study reef flat ($\bar{x} \pm$ SE). Heterogenity among sites and months are significant at P 0.01.

Density increased starting from August as recruits entered the population, but declined steadily in January (Fig. 2) as may of the small individual died (Fig. 7).

Figure 3 shown that recruitment in 1985-1986 was largely failure especially in the area of 300 m to 500 m from the reef edge, the causes of which are not known. Recruitment was better in 1986-1987 as shown in the increasing density per 0.5 ha starting from January 1987 to April 1987 (Fig. 2). Thus there are sub-

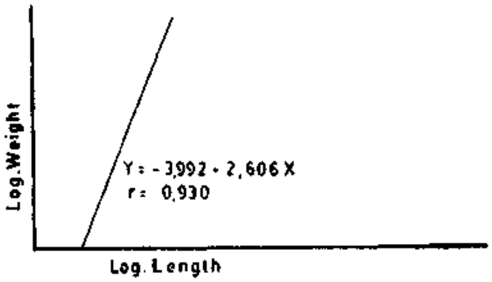

FIG. 6. Log/Log of total length (mm) versus wet weight of *L. malculata* collected at reef flat of Pari Island, Northwest Jakarta.

stantial year to year variations in the population density of *L. maculata* which can be as high as at least an order of magnitude. It was originally expected that the recruits to be at the site with 250 m to 500 m from the reef edge (Fig. 5). There was an initial tendency for small individual (less than 200 mm) to be at those site, but this concentration was rapidly dissipated as indicated by the lower density per 0.1 ha (Fig. 3) and was statistically significants.

TABLE 1. *Length (X=L, mm)—weight (Y=W, g) relationship of mantis shrimp* Lysiosquilla maculata *population with reef flat habitat*

Period	Equation	Log. Equation
May—December 1985	.. Y=—3.709+2.484 X r=0.921	$W=10^{-4}$ 1.953 $L^{2.4843}$ r=0.921
January—December 1986	.. Y=—4.057+2.629 X r=0.942	$W=10^{-5}$8.766 $L^{2.6297}$ r=0.942
January—April 1987	.. Y=—3.610+2.444 X r=0.985	$W=10^{-4}$ 2.453 $L^{2.4186}$ r=0.985

The more important small scale determinant of distribution within the reef flat area inhabited by *L. maculata* was the presence of seagrass. *L. maculata* were concentrated in the sandy habitat during the season and were inactive. They were scattered during rainy season and were actively moving to locations which constantly wetted by tides. The type of rocky as areas of refuge for *L. maculata* during the dry season might be a factor setting an upper limit on the population for as was shown in August (Fig. 2). Of which intra-specific composition was probably important in this study.

Because of the decline in the population in the period of second transition monsoon (September, October and November) (Fig. 2, Fig. 7) no attempt was made to estimate somatic production. The mean biomass of *L. maculata* at Pari Island was ranging from 95.40 g to 200.025 g. This must be regarded as preliminary as it would very considerably depending on the population level. Of which it is reasonable that Production (P) : Biomass (B) ratios of *L. maculata* should be investigated during 1985-1987 for measuring the present status of the population.

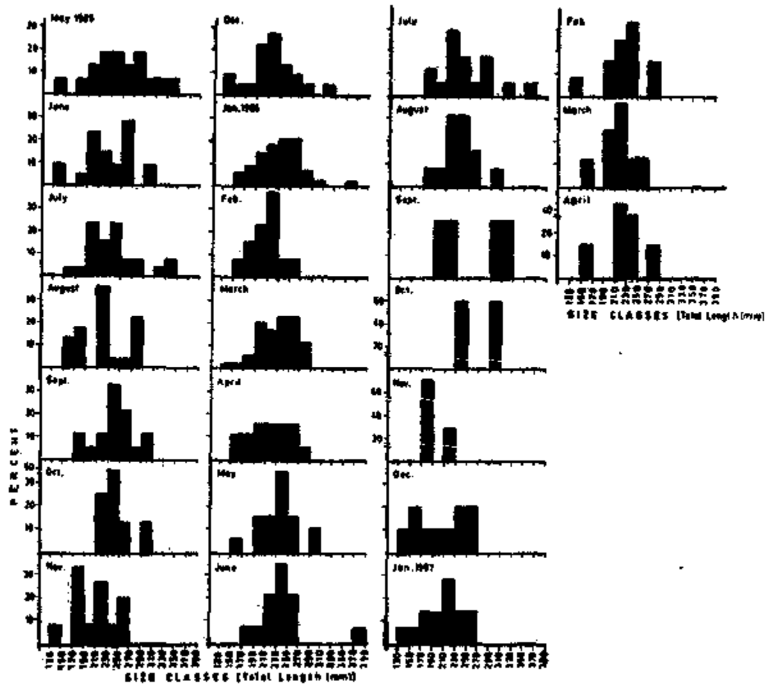

FIG. 7. Size frequency of *L. maculata* collected at reef flat, Pari Island from May 1985 to April 1987.

Furthermore, data of the females (Fig. 2) suggest that spawn production as a significant component of secondary productivity in *Lysiosquilla maculata* and may substantially exceed somantic production.

REFERENCES

SUKARDJO, SUKRISTIJONO AND A. V. TORO 1987. Aspek ekologi Udang pengko *Lysiosquilla maculata* Fabricius di rataan terumbu karang gugus Pulau Pari : 1. Telaah unsur Nitrogen dan Fosfat di substratnya. Paper presented at Seminar Laut Nasional, Jakarta, 27-30 Juli 1987.

TORO, V. 1979. Some notes on the crustacean fauna in mangrove area of Pari Island group, Seribu Island, Jakarta. *Prosiding Seminar Ekosistem Hutan Mangrove, Jakarta*, 27 *Februari* — 1 *Maret* 1978, Halaman : 114-119.

TORO, A. V. AND SUKRISTIJONO SUKARDJO 1987. Aspek ekologi udang pengko, *Lysiosquilla maculata* Fabricius di rataan terumbu karang gugus Pulau Pari : 2. Distribusi, kelimpahan, dan dewasa bertelur. Paper presented at the Seminar Pembangunan : Air, ikan, dan parawisata in Bandung, Indonesia, 10-12 September, 1987.