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PENGUKURAN PANJANG TUBUH CACING NIPAH PENDEK *Namalycastis abiuma* (POLYCHAETA: NEREDIDAE) DARI PERAIRAN MANGROVE SUNGAI KAPUAS KALIMANTAN BARAT

BODY LENGTH MEASUREMENT OF SHORT NYPA PALM WORM Namalycastis abiuma (POLYCHAETA: NEREIDIDAE) FROM MANGROVE ESTUARY OF KAPUAS RIVER IN WEST KALIMANTAN

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Abstrak

Cacing Nipah Pendek *Namalycastis abiuma* memiliki tubuh yang elastis dan mudah putus sehingga diperlukan pendekatan morfometri tubuh lain untuk menentukan panjang tubuh sesungguhnya. Tujuan penelitian ini untuk menentukan panjang tubuh total cacing nipah pendek dengan menggunakan bobot tubuh, jumlah total segmen berseta, panjang tiga segmen anterior pertama (L3) dan lebar segmen berseta atau setiger ke-10 (S-10). Spesimen yang digunakan dipilih hanya individu yang lengkap dan utuh. Pengukuran dilakukan dibawah mikroskop dengan lensa okular yang dilengkapi dengan mikrometer. Data dianalisis dengan analisis korelasi. Cacing yang digunakan sebanyak 258 individu yang terdiri atas 190 *immature*, 54 *submature* dan 14 *mature* dengan ukuran panjang tubuh rata-rata berturut-turut 108,62±34,80 mm, 172,27±42,78 mm dan 123,14±57,40 mm. Cacing betina ditemukan memiliki ukuran tubuh lebih besar dari jantan. Panjang tubuh *N. abiuma* dapat diduga dengan bobot tubuh, panjang L3 dan lebar S-10 dengan nilai koefisien korelasi (*r*) berturut-turut 0,82, 0,73 dan 0,78. Pendekatan morfometri dapat digunakan untuk menentukan ukuran tubuh *N. abiuma*.

Kata kunci: Morphometrics; Namalycastis; Nereididae; Polychaeta

Abstract

The short nypa palm worm Namalycastis abiuma has an elastic and fragile body. Therefore, an alternative approach of morphometrical techniques is needed to determine the total body length. This research aimed to estimate the total body length of the short nypa palm worm based on body weight, the total number of segments, the length of the first three anterior segment (L3) and the tenth setiger width (S10). Body measurement was done using stereomicroscope fitted with the micrometer. Correlation analysis was done to describe the relationship between the length of L3 and the width of S10. A total of 258 complete and whole specimens consisted of 190 immature, 54 submature, and 14 mature individuals. The average body length of immature individuals was 108.62±34.80 mm, 172.27±42.78 mm for sub mature individuals, and 123.14±57.40 mm for mature individuals. Based on sexual dimorphism, the female body size is larger than male. The body length of N. abiuma can be estimated by body weight, the length of L3, and the width of S10, with correlation coefficient (r) of 0.82, 0.73 and 0.78, respectively. Morphometry approach can be used to determine the body size of N. abiuma.

***Keywords**: ESBLs; Morphometrics; Namalycastis; Nereididae; Polychaeta*

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INTRODUCTION

Polychaeta exhibits intraspecific and interspecific morphological diversity. The intraspecies morphological variation can be found in both non-reproductive and reproductive phase individuals. In the *Nereididae* species, the reproductive phase maturation morphology was characterized by the morphological change of, two different body parts of heteronereid, called epitoke. In some *Nereididae* species, the reproductive phase is non-heteronereid, which is usually found in estuaries (Giangrande, 1997; Mouneyrac *et al*., 2010), e.g. *Nereis diversicolor* (Dales, 1950; Dales & Kennedy, 1954). In non-heteronereid species, the individual maturation is not characterized by the body parts modification, therefore the maturation steps should be identified by other character data.

Body colour modification is another morphological variation found in non-reproductive individuals. This body colour modification can also be used to predict the maturation step. Nevertheless, the use of body colour modification also depends on the developmental phase and sex. According to Junardi *et al*. (2010), in *Namalycastis,* the colour variation was also found in non-reproductive individuals, which might bias the body colour changing observation during maturation.

Body size is an important parameter in reproductive strategy due to its implication on the other reproductive characteristics, such as maturation and fecundity. Therefore, the certain morphometrical method should be easily implemented as an alternative, especially in estimating the maturation size. Bias in the body size estimation in polychaetes species, which mostly perform elastic and fragile body characteristics, can be eliminated by adding the other body part measurements into the calculation.

Among *Namalycastis* collected from West Kalimantan, *N. abiuma* has more elastic and fragile body despite its wide distribution from tropical to subtropical regions in freshwater, estuaries, and full marine habitats (Glasby & Timm, 2008; Fu *et al.,* 2009). They are deposit-feeders inhabiting the sediment and ingested decaying wood and organic matter (Fu *et al.,* 2009). In West Kalimantan, this worm has economic value as fishing bait and is most often obtained from the mangrove estuary of the Kapuas River, which is (mostly) inhabited by Nypa palm vegetation. The worm is dioecious, with brown body colour on the dorsal side and pale white on the ventral side (Junardi, 2014a). The body size is shorter than another species found in the same habitat, i.e. *Namalycastis rhodochorde*. Therefore, it is also called short Nypa Palm worm. Some information about *N. abiuma* include its mitogenome (Lin *et al*., 2016), reproduction (Junardi, 2014a), ontogenesis (Junardi *et al.*, 2014b), and speciation (Magesh *et al.*, 2014).

Due to its economic value for fishing bait, body length estimation of polychaetes species with more fragile and easily-broken body such as *N. abiuma* is very useful in determining the reproductive phase, including maturation and fecundity, especially for aquaculture purposes. *N. abiuma* is a deposit feeder, however the mechanism of ingestion of decaying and rotten wood in *Nereididae* species is still unclear (Rasmussen, 1994). It was assumed that the species consumed rotting organic matter of the Nypa palm tree. On the other hand, the morphological characteristics of *Nereididae* species, especially the body length of *N. abiuma*, in a tropical area are not currently available. In this research, the total body length estimation of the short Nypa palm worm was described using body weight, segment number, the length of the first three anterior segments: prostomium, peristomium, and the first setiger (L3), and the tenth setiger width (S-10).

MATERIALS AND METHODS

Specimens of *N. abiuma* were collected from the estuary of Kapuas River in West Kalimantan Province of Indonesia (0,0°01'S-0,0°02'N and 109°11,10'-109°11',19' E), which was dominated by Nypa palm (*Nypa fruticans*). Random sampling was used to collect the specimens from the sediment around decaying branches of the Nypa palm trees from October, 2011 until September, 2012. Field specimens were transported in a sample container. The total number of 258 complete and whole specimens was collected for morphological measurements. Selected specimens were sorted based on sex and three developmental phases, namely immature, submature, and mature. Each developmental phase was determined based on gametogenesis step, following Junardi *et al*. (2010). Before measurement, samples were anaesthetized in 4% ethanol to avoid body elasticity.

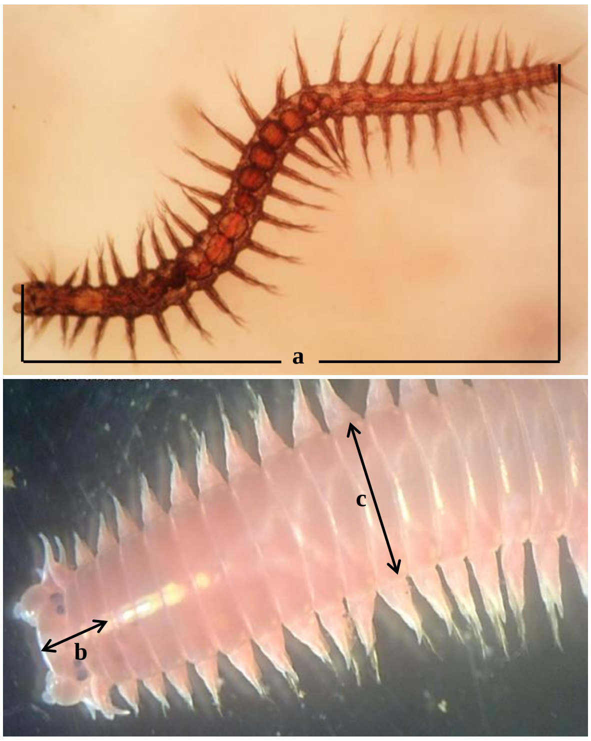

Figure 1. The body measurements of *Namalycastis abiuma*; (a) total body length, (b) length of the first three segment (L3), (c) width of tenth setiger (S10)

The measurement of body length and three most anterior part length (L3) and tenth cetiger width (S10) can be viewed in Figure 1. Body parts measurements were done under a stereo microscope equipped with a digital caliper (Mitutoyo Absolute) to the nearest 0.001mm. Other body parts were also measured as supporting data including total body length, body weight, and the number of body segments. Individual body weight was measured using an analytical scale (Ohaus PA 214) to the nearest 0.0001 gram. The counting of body segments and the posterior ends with very tight segments was done under a magnifying glass and a stereo microscope (Euromax). All morphological data were analyzed using a Kolmogorov-Smirnov normality test. Variance analysis was done with one way ANOVA to differentiate the body size, based on its developmental phases (immature, submature, and mature). Post Hoc and Least Significant Difference (LSD) Tests were done at α= 0.05%. The correlation between body length and other body size was done using correlation analysis. All data analysis was conducted by using SPSS v21.

RESULTS

The Nypa palm worm had reddish brown colour on the dorsal part and looked paler on the ventral part of the body. The body colour of mature individuals would change to dark red (female) and pale green on the ventral part of the body (male). The anterior part of the body had uniform width, meanwhile, the posterior part gradually tapered (Figure 2). The length measurement of the first three segments and the tenth setiger of the 258 specimens of *N.* abiuma in each developmental phase and sex are presented in Table 1. The average body length of immature individuals was 108.62±34.80 mm, 172.27±42.78 mm for submature individuals, and 123.14±57.40 mm for mature individuals. Mature males and females showed large eyes and epitokal setae were absent. Mature oocytes were spherical in shape, straw-colored, and 120-130µm in diameter.

The length of L3 between immature and mature individuals was different However, the length of L3 between submature and mature individuals was not different. Meanwhile, the width of S10 between immature and submature individuals was different. However, the width of S10 between immature and mature individuals was not different. Females had longer length of L3 and larger width of S10, than males. Both parameters showed significant differences. Moreover, there was a strong relationship between: (i) the total body length and (ii.a) the body weight, (ii.b) the length of L3, and (ii.c) the width of S10, which showed the coefficient of correlation (*r*) 0.82, 0.73, and 0.78, respectively.

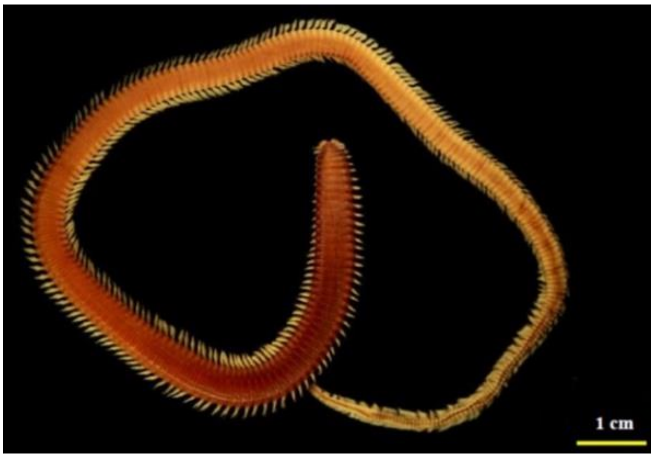

Figure 2. The whole body of *Namalycastis abiuma*

Table 1. The average (±SD) of body length, segment numbers, body weight, length of L3 and width of S10 among specimens of *N. abiuma* based on the developmental phase and sex

Parameters	Developmental phases			Sex		Correlation Coefficient (*r*)
	Immature (n=190)	*Submature* (n=54)	*Mature* (n=14)	Female (n=102)	Male (n=156)	
Body Length (mm)	108.62±34.80^{a}	172.27±42.78^{b}	123.14±57.40^{a,c}	130.91±51.03^{a}	117.39±41.78^{b}	-
Setiger Numbers	161.24±37.65^{a}	196.05±41.31^{b}	181.35±86.05^{a,c}	174.54±46.16^{a}	166.41±43.14^{a}	0.68
Body Weight (g)	0.59±0.56^{a}	1.75±1.18^{b}	1.28±1.25^{b,c}	1.04±1.06^{a}	0.76±0.78^{b}	0.82
Lengthof L3 (mm)	1.79±0.40^{a}	2.35±0.38^{b}	2.14±0.53^{b,c}	1.99±0.48^{a}	1.88±0.45^{b}	0.73
Width of S10 (mm)	2.82±0.68^{a}	3.93±0.81^{b}	3.18±1.08^{a,c}	3.23±0.93^{a}	2.96±0.80^{b}	0.78

Note: The number in the line followed by the same letter indicates that the parameter/the measurement is not significantly different at α= 0.05%

DISCUSSION

Polychaeta species ~~is~~ generally grow by increasing its body length and adding the number of body segments, which in turn will stop when entering the mature phase. Meanwhile, Polychaeta maturation will occur when the individual stops the growth of somatic cells and starts the development of gamete cells (Junardi, 2014a). In this research, females showed longer body size than males. while submature individuals showed longer body size than both immature and mature individuals. However, the body size of *N. abiuma* found in this research was different than the body size in the previous measurements conducted by Glasby (1999), collected from Tanga (Tanzania), Basrah (Iraq), Ao Yoan (Thailand), Cochinchine (Vietnam), and Santa Catarina (Brazil). The body size of *N. abiuma* collected from Tanga (Tanzania) was ranged from 19–33 mm, Basrah (Iraq) 80-85 mm, Ao Yoan (Thailand) 38 mm, Conchinchine (Vietnam) 335 mm, and Santa Catarina (Brazil) 45 mm. In addition, the body size of *N. abiuma* from Georgia (USA) was ranged from 50-100 mm (Rasmussen, 1994). The body weight trend was consistent with its body height, therefore, both were included in the same general parameter, named body size. It was indicated there were regional variations of body height in *N. abiuma* populations. The genetic factor, food availability, space, and oxygen level were also included as the determining factors in body length regional variation. Body size (body length and weight) was also influenced by the sediment quality, i.e. the existence of pollutant (Meador & Rice, 2001). The negative effect of the availability of pollutant in the habitat was also observed from the body size of the other worms. According to Mouneyrac *et al*. (2010), the body size of *Nereis diversicolor* from the polluted water sediment was smaller than the body size in the opposite condition.

The number of segment was also correlated to the body length and weight, in which the addition of segment number would be followed by the increasing body length and weight, however, the correlation was low (r <0.7). The adding of a new segment in the pygidium area might not give a contribution to the increasing body length. In *N. abiuma*, the length of L3 and the width of S10, between immature and submature individuals, were different. Meanwhile, the length of L3, between mature and submature individuals were not different, yet the width of S10 between both showed the difference. In this case, the body length stopped increasing when the individuals reached the submature phase. Therefore, both submature and mature individuals didn't significantly showed the difference of the length of L3. Meanwhile, the width of S10 continued to increase until the submature phase, but slightly shortened at the mature phase. Therefore, the submature individuals showed larger width of S10, than the mature individuals. It was assumed that the pressure of coelomic cavity to the dorsal and ventral part of the body happened during the gamete cells development of the maturation phase. It seemed that the enlargement of the coelom did not increase the total volume of the segment, including the size of the segment width in the mature individuals. It can be stated that the width of S10 continued to increase until the submature phase, however, it did not continue to grow until the mature phase. Mature individuals of *N. Abiuma* were also found with no modification of seta and parapodia (nonheteronereid). Therefore, the width of S10 would also tend to be the same, during submature and mature phases. Based on these two parameters, it can be concluded that in *N. abiuma* the total body length is not always consistent with the phase of individual development.

In *N. rhodochorde*, the length of L3 at each phase was significantly different at each phase of development. However, only the width of S10 between immature and the other two phases that was different. Therefore, there was no significant difference between submature and mature individuals (Junardi, 2014a). Resource allocation between reproduction and growth is a simple model to determinate animal's growth, in which fecundity tends to increase in size. On the other hand, the allocated energy for the gamete cells development in a defined time scale depicts the reproductive efforts of the organism (Cassai & Prevedelli, 1998). Moreover, resource allocation is also affected by various ecological interactions, such as intraspecific and interspecific competition, predation, and parasitism (Kaitala, 1999). This research was a preliminary sudy to investigate: (i) the ecological data of *N. abiuna* in the research area, associated to their interactions with the habitats and Nypa palm trees, (ii) the effect of photoperiod and feed on growth and body size, and (iii) the biological data of *N. abiuna*, i.e.the age of spawning.

Based on sexual dimorphism, females had larger body size than males, which was also identified by the longer length of L3 and the wider width of S10. The longer body of females also indicated the higher number of total body segments. In addition, the larger width of S10 of females than males, was associated to the increasing coelomic capacity to accommodate larger oocytes than spermatozoa, including larger site for oocyte development. Sexual dimorphism of body size was also observed in other *Namalycastis* species, for example in *N. rhodochorde* (Junardi, 2014a). Females of *N. rhodochorde* were smaller than the males. The length of L3 of females was shorter than the males' length of L3, however, the width of S10 of both females and males was not different. It was indicated that the typical characteristic of sexual dimorphism in *Namalycastis* was species-specific.

In *N. abiuma*, the correlation analysis showed that the correlation value of the width of S10 gave a better estimation of the body length than the correlation value of the length of L3. According to Omena and Amaral (2001), the longitudinal muscles were stronger than the circular ones, therefore, more distortions occurred when the measurements were made. The measurement of the length of L3 was also influenced by the eversible pharynx. Moreover, using the length of L3 as the parameter to estimate the body size was better, than using the other parameters like body weight in observing *N. diversicolor* (Durou *et al.*, 2008). Therefore, the length of L3 was more useful to determine the growth and segment adding (Mouneyrac *et al.*, 2010).

Meanwhile, the width of the segment is not affected by the longitudinal muscle elasticity, therefore, the measured values tend to be stable. The significant correlation between the width of S10 and the body length was also observed in another Nereid worm species, i.e. *Laeonereis acuta* (Ieno *et al.*, 2000). It can be concluded that the width of S10 should be considered as a key parameter in estimating the total length of the body in the *Nereididae* family.

CONCLUSION AND SUGGESTION

The total body length of *Namalycastis abiuma* can be estimated by measuring the length of the first three body segments (L3) and the width of the tenth setiger (S10). Significant correlation values for estimating the total body length of *N. abiuma* were obtained; r= 0.73 for the length of L3 and *r*= 0.78 for the width of S10. Higher correlation values between the width of S10 and the total body length indicated that the width of S10 should be considered as a key parameter in estimating the total length of the body in ~~of~~ the *Nereididae* family. This preliminary research still needs to observe more aspects, such as the effect of sediment quality, photoperiod, and the interaction between the worm and the Nypa palm trees. This was a preliminary research therefore more aspects were needed to be observed such as the effect of sediment quality, photoperiod, and the interaction between the worm and the Nypa palm trees.

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