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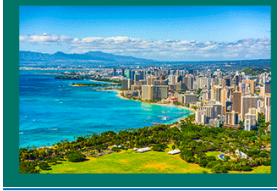

Investigation of condition factor of wild spiny lobster juvenile *Panulirus* spp. inhabit in Cilacap waters, Indonesia.

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Abstract. The aim of study is to analyze Length-Weight Correlation [LWC] and Condition Factor [CF] of wild spiny lobster juvenile *Panulirus* spp. (Decapoda: Palinuridae) inhabit in Cilacap waters. Juvenile of spiny lobsters are collected by dives and lighted attractor as juvenile trap from August to October 2018. The spiny lobster juvenile from study site is collected and accommodated in stereo foam box containing sea water and aerated. The juvenile is transported to laboratory and kept in 50x70x50 cm glass box containing sea water, aerated and identified. Total of 231 spiny lobster juveniles were collected and identified were found three species, namely *P. homarus* (213 individuals), *P. versicolor* (9 individuals) and *P, ornatus* (11 individuals). Minimum of CLand weight were found 3.2 mm and 0.01 g; and maximum were obtained 21 mm and 0.52 g. The LWC juvenile was found strong relation and were close to 1. The CF *Panulirus* spp. juvenile was obtained 0.009865 ± 0.00409 and the CF of *P. ornatus* was the highest value [0.011218 ± 0.00406] than other species. The habitat of Cilacap coastal waters demonstrated more support to the growth of *P. ornatus* than the growth of *P. homarus* and *P. versicolor*.

1. Introduction

Worldwide demand of marine resources for fish and shrimp, especially for spiny lobster become increase yearly. The impact of the condition has show high of exploitation, regarding the resources as unrestricted use and as consequent, the stock has decline. Some influence factors of the condition are impact to biology aspect of all spiny lobster life stage, in term such as population growth, length weigh relationships [LWR], condition factor [CF], mortality and environmental conditions. Responsibility of fisheries research is need to solve the above conditions to plan the fisheries management scientifically. In Indonesia, it is necessary to have preliminary scientific data regarding the minister's decree regarding the capture and export of lobster post larva.

Spiny lobster *Panulirus* spp. is a marine organism and has a complex life cycle [1]. Long distance of larvae distribution and oceanographic processes are influence the diversity of the species [2] and recruitment is done to catch the abundance of these species [3]. Another factors have impact to the lobster diversity is the influence of geographic and climate mechanisms [4] and the distance between the two species is related to the diversity [5]. The growth of spiny lobster has no significant impact on spatial variability but temporal aspect is opposite to the condition [6]. Life stage of spiny lobster for Pueruli and the abundance of the lobster in Mediterranean Sea was found on June-July, which the period of time of the settlement [7]. Post-larvae was found every month of the year and the peak of abundance fell on January-February. The minor peak comes on May and October [8].

Typically, morphology of spiny lobster species is distinguished as quite flat in the dorsal-ventral. The body has special color and segmented in to parts. The forward part of the tail becomes tubular. Each segment of the body is flexible [9].

Predation or lobster capture activities can break the body part, especially antenulae and periopod organ. Otherwise, during the next molting the broken organ will grow, however the new grown organ will be smaller than before [10]. The growing of lobster occur during molting stage [11]. Lobster growth stage starts from hatching of egg and earliest larval stage, furthermore, subsequently as mid larval, late larval, Puerulus settlement, juvenile, adult and barrier female stage. Spiny lobsters during larvae phase is inhabit in pelagic and oceanic area. After oceanic stage, the larvae actively swims towards the coast to settle in shallow waters and in fertile habitats after the final larval stage. Late-stage of phyllosoma larvae is collected in the northwestern Pacific from 7.4 to 27.7 mm of body length [12]. While in molt stage, the larval does not intake any nourishment until the first-stage of juvenile [13]. As benthic organism [14], another specification is nocturnal species behavior [15], [9], [16].

The main feed consuming on feeding behavior of scallop lobster is bivalve, crab, gastropod, barnacles; secondary food is algae, and incidental feed is *polychaete*, fish, echinoderms, *Ascidiacea*. Bivalves as nutrition source are supported of body weight of lobster [17], [18]. The complexity of habitat is correlate to spiny lobster density [19]. Growth rates due to spatial differences in processes is related to change population density and food resources [11]. The Southern Java waters is border by Indian ocean and as habitat of spiny lobsters. Fisherman catch the spiny lobster used lobster gill net at a depth of 5 -7 m [20]. Life, abundance and distribution of lobster are determined by the early stages of their life, namely the plankton stage when the first year of the life.

The species abundance in marine waters is more influenced by the abundance of the post larval stage [21]. Maximum abundance of shrimp species in high conditions is obtained at night and in mixed months with an additional factor of 4 times [22]. Recruitment of lobster as seabed species and playing a crucial potentially is influenced by the vary over time of body dimensions and nutritional condition of both settled pueruli larvae and first juveniles [13]. Nutritional value of wet spiny lobsters have investigated that protein content between 20.24-24.18 % [23]. Investigation focus to *Panulirus* juvenile that one of the most numerous native benthivorous organism and economically the adult of the species are high value. Abundant of the lobster juvenile became influence by highly of fishing pressure on adult of the species, the dynamic of water quality and the highly of lobster juvenile that catch by fisherman.

2. Materials and Methods

2.1. Study Area

The condition of eastern part of the Teluk Penyu of Cilacap waters is directly influence by oceanographic pattern of Indian Ocean, while the southern part waters is protected by Nusakambangan Island (Fig. 1). The coastline length of Teluk Penyu is approximately 40 km and bottom waters substrate are muddy sand and partly sand. The waters is fishing ground of spiny lobsters.

2.2. Source of data

Juvenile of spiny lobsters are collected by dives and lighted attractor as spiny lobster juvenile traps from August to October 2018 in Cilacap waters, Central Java, Indonesia. After the juveniles are collected, the juveniles are accommodated and aerated in stereo foam box containing sea water. The data are transported from study sites to Faculty of Fisheries and Marine Science Laboratory, Jenderal Soedirman University. In laboratory the juvenile are kept in aquarium 50x70x50 cm containing sea water and aerated, then identified base on [9].

2.3. Measurement and Analysis methods

The CL of lobster is measured using a vernier caliper to the nearest 0,5 mm and weighed (*w*) by digital scales to nearest 0.01 g. Condition Factor (CF) is calculated using the means CL and *w* are based on [24], [25] equation: $CF = W \times 100 / CL^{-3}$, Where W : mean weight (g) and CL : mean carapace length (mm). Those formulation is used to calculate individual of juvenile *Panulirus* species separately. The result is presented to an average ± standard deviation (sd). The data is analyzed statistically according to 5% level ($p < 0.05$) of significance.

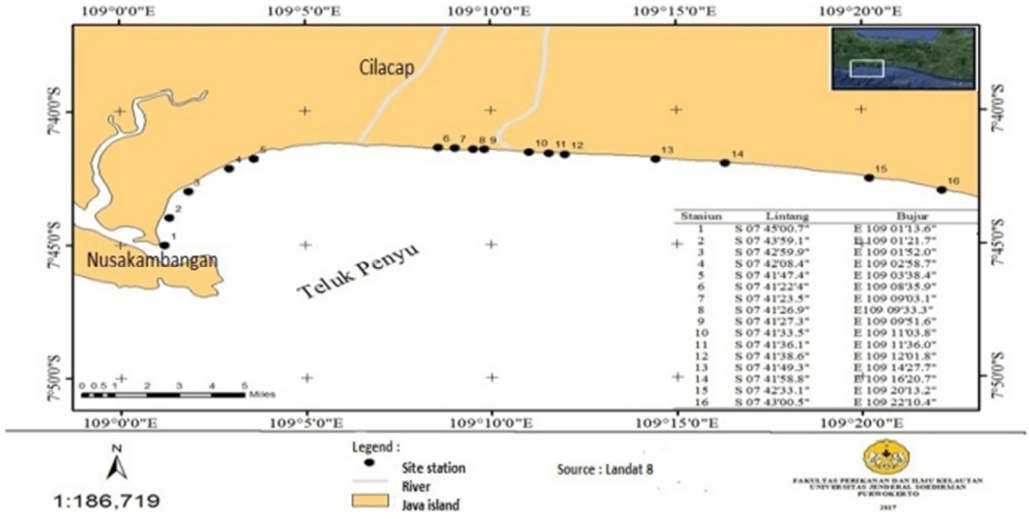

Figure 1. Site location of site study

3. Results and discussions

3.1. Bio-morphometric and relations

The waters of Cilacap are directly adjacent to the Indian Ocean with a semi-diurnal tidal type and the bottom sediment of the coastal waters is muddy sand due to the many river estuaries that supply mud [26]. Total of 231 spiny lobster juveniles were collected from the study site. Identification of spiny lobster juvenile was found three species, namely *P. homarus* (213 individuals), *P. versicolor* (9 individuals) and *P, ornatus* (11 individuals). Based on frequency distribution of the *Panulirus* spp. juvenile is found *P. homarus* as dominant species. [27] is found five species of aduld spiny lobster inhabit in southern Jawa waters, apart from the three lobsters mentioned above, namely *P. penicilatus* and *P. polyphagus*. Frequency distribution of CL of spiny lobster juvenile in Figure 1.

Frequency distribution of lobster juvenile CL [Fig. 2], the dominant of interval class was shown 7-8 mm for *P. homarus*, *P. versicolor* in 8-9 mm and *P ornatus* in 4-5 mm. While the dominant interval class for *Panulirus spp.* juvenile was found in class interval 7-8 mm. The lobster life cycle during post larval stage has not color or transparent, after last molting becomes young juvenile. The juvenile is a young lobster that has gone through the coloring stage after the last molting. The final stage of molting with coloring conditions has been perfect as a young lobster and the morphology is same to an adult lobster. The young lobsters inhabit in coastal habitats as a nursery ground. Coastal fertility and abundant of food sources in coastal waters is strongly support to the growth of the young lobster. Coastal fertility associated with phyto-zooplankton abundance and Cilacap coastal waters as high abundance of Ichtyoplankton [28]. The regression correlation of spiny lobster juvenile. (Table 1).

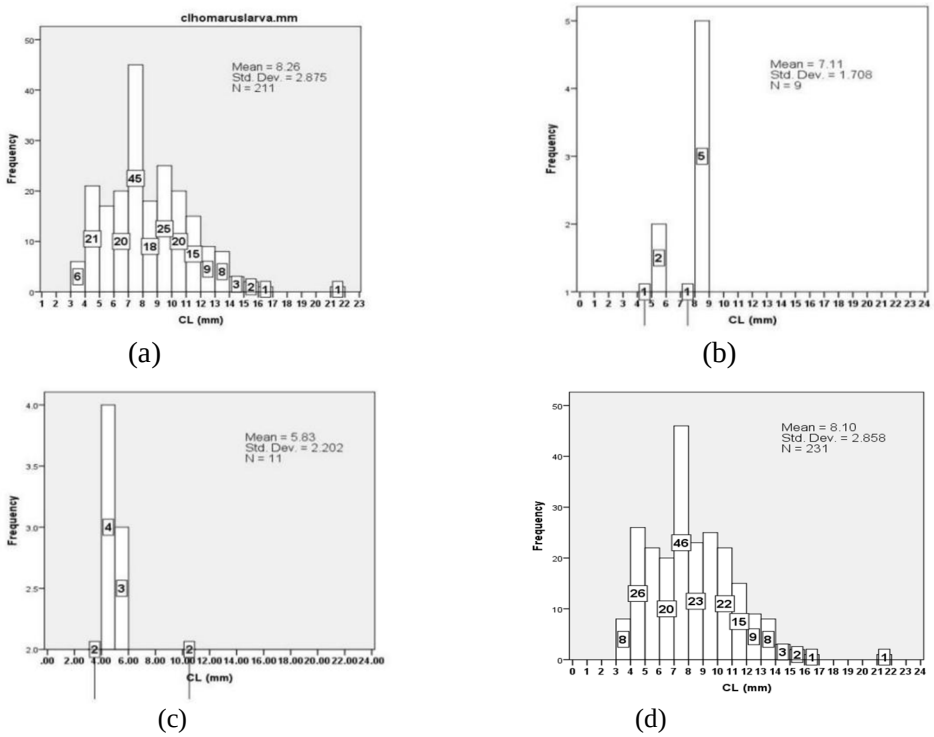

Figure 2. Frequency distribution of CL lobster juvenile of
(a) *P. homarus* (b) *P. versicolor* (c) *P. ornatus* and (d) *Panulirus* sp.

Table 1. Regression correlations of CL (mm) and *w* (g) *Panulirus* spp. juvenile.

Species	a [intercept]	b [slope]	r [correlation]	n	CL (mm)				w (g)			
					Min	Max	*sd*	Mean	Min	Max	*sd*	Mean
Panulirus spp.	- 0.082	0.173	0.889	231	3.2	21	2.858	8.1015	0.01	0.52	0.556	0.058
P. homarus	- 0.085	0.076	0.889	211	3.2	21	2.875	8.2623	0.01	0.52	0.057	0.060
P. versicolor	- 0.026	0.089	0.929	9	4.5	8.7	1.708	7.1111	0.01	0.06	0.016	0.047
P. ornatus	- 0.035	0.102	0.981	11	3.8	10.1	2.202	5.8273	0.01	0.07	0.023	0.024

The minimum size of CL and weight of first juveniles stage in coastal waters of Cilacap were found 3.2 mm and 0.01 g; and maximum 21 mm and 0.52 g. While, the average of CL and weight of each species for *P. homarus* were obtained 8.2623 ± 2.875 mm and 0.0602 ± 0.556 g; *P. versicolor* was earned 7.111 ± 1.708 mm and 0.0467 ± 0.016 g; *P. ornatus* was found 5.8274 ± 2.202 mm and 0.0241 ± 0.023 g; and *Panulirus* sp (mix) was got 8.1015 ± 2.858 mm and 0.576 ± 0.556 g. Linear regression equation of CL and weight of all juvenile species (mix) and each species of juvenile were obtained y = 0.173x – 0.082 for *Panulirus* species, y = 0.076x – 0.085 for *P. homarus*, y = 0.089x – 0.026 for *P. versicolor*, and y = 0.102x – 0.035 for *P. ornatus*. Intercept (a) and slope (b) as result of regression equation of CL and *w* were obtained correlations of each juvenile species and mix of spiny lobster juvenile. Both CL and *w* relations were shown a strong relation, correlation each equations was demonstrate close to one (1). Based on those correlations was shown the length and weight of the juvenile was influence each other. Meanwhile, [23] is found CL and TL ratio of adult spiny lobster between 0.36-0.45.

3.2. Condition Factor [CF]

The grow of marine organism is the sum of development of each body part, namely length and weight. The development of the body part is proportion of development of it and influenced by habitat dynamic, age and feed. Oceanography pattern of the spiny lobster habitat become limit factor to the survival of organism if the parameter condition unstable and change suddenly. The waters of the southern island of Java often occur when crude oil tanker and asphalt sinks, thus polluting coastal waters, which in turn greatly affects the survival of spiny lobsters, which are the basic organisms of the waters [29]. CF of organism is occurred by life stage. Generally, CF of juvenile stage with increasing of length is higher that old species. Indicator to know the fatness or well-being of a marine species is knew as condition factor [CF]. The ideal condition of an organism is attained if the increment of body length proportional to increment of body weight or the increment of weight is equal to cubic of body length (isometric growth) [30]. CF juvenile of *Panulirus* species as Table 2.

Table 2. Condition Factor of *Panulirus* spp juvenile.

	Condition Factor [CF]		
Species	Min	Max	Mean
Panulirus spp.	0.003987	0.030518	0.009865 ± 0.00409
P. homarus	0.003987	0.030518	0.009769 ± 0.00407
P. versicolor	0.007527	0.02	0.010658 ± 0.00458
P. ornatus	0.006794	0.018224	0.011218 ± 0.00406

The growth of early stages of spiny lobster life is influenced by the fertility of the waters, especially the availability of feed, abundant feed and ideal environmental parameters will greatly support juvenile growth. Tropical waters which low of waters parameter fluctuation is differ with sub tropical that have four climate system. Calderon [13] found variation of climate have impact to first juvenile of spiny lobster that W/CL index found higher than average in winter and spring. The health of lobster habitat is support to lobster health and fat. The growth of adult female is higher than the male for lobster inhabit in East Jawa waters [31]. Base on CF value, Rahman [32]. stated that West Southern Java waters habitat does not support to adult lobster growth. The lowest of CF in this research was obtained the 0.009769 ± 0.00407 for *P. homarus* species, which maximum of CF was show 0.030518 and minimum was 0.003987. The highest of CF was found for *P. ornatus* (0.011218 ± 0.00406). Ongkers [33] was got CF of *P. versicolor* inhabit in Ambon Bay waters for female higher than male. The condition factor for adult male lobsters inhabit in Yogyakarta and Pacitan waters is obtained between 0.658-0.658 or an average of 0.9 and females between 0.804-1.074 or an average of 1.003 [34]. Base on the condition, the Cilacap coastal waters habitat is less support to the growth of *P. homarus*, and base on the CF, it is indicate that the habitat of the Southern coast of Java waters was more support of the growth of *P. ornatus* spiny lobster juvenile. The condition is implies that *P. ornatus* is better than *P. homarus* and *P. versicolor*, that for the same length of those P. ornatus and another species *P. homarus* and *P. versicolor* juvenile, *P. ornatus* was heavier than the two species. Statistically [$p<0.05$] the CF of *Panulirus* spp (mix) was not found different to the CF of *P. homarus*.

4. Conclusion

Three species of spiny lobster juvenile inhabit in Cilacap coastal waters, namely *P. homarus*, *P. versicolor* and *P. ornatus*. The dominant of spiny lobster species juvenile inhabit in Cilacap coastal waters was *P. homarus* and the lowest number was *P. ornatus*. The relation of CL to *w* the juvenile is strong relation and the value close to 1. *P. ornatus* species as the lowest number but belong to highest value of CF. The condition is indicate the habitat of Cilacap coastal waters more support to the growth of *P. ornatus* than another species.

Acknowledgement
Thanks a lot to Prof. Soewarto as Head of Research Institute and Community Service-Jenderal Soedirman University for the support BLU 2018 Funding of the research.

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