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Settlement Preference of the Lobster Larvae on the Different Shelter Materials in the Larvae Shelter Device (LSD)

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Abstract The lobster life phase is eggs, phyllosoma, puerulus, juvenile, and young lobster. The metamorphose coincides with its inshore movement and ends up into adult lobsters that inhabit the continental shelf area. The wild population of lobsters is determined by the survival rate of the puerulus. Fish larvae aggregating devices have been given significant results as a shelter or refuge area for several fish species. This device is then referred to as the Larva Shelter Device (LSD). The question is whether there is a preference for lobster larvae on attractor or shelter materials. The innovation of shelter materials in LSD is cement sack paper, waring nets and gunny sacks. The number of lobster larvae in different materials was analyzed. The research was carried out in February-May 2021 at Mutiara Beach Karanggongso of Prigi Bay, Tasikmadu, Watulimo, Trenggalek, East Java, Indonesia. The identification method of puerulus species is based on taxonomic and morphological characteristics. Initial identification is done by recording and photographing species, then adjusting to the experiences of fishermen compared to Jones and Dao 2010. The study found there were 3 types of puerulus species collected including puerulus of *Panulirus ornatus*, *P. homarus*, and *P. versicolor*. The highest species presentation in the three shelter materials was *P. homarus*. The data indicate that different shelter materials had no significant effect on the species composition of the spiny lobster puerulus.

Keywords Lobster, Prigi, Puerulus, Shelter, Refuge, Trenggalek, Lobster Shelter Device (LSD)

1. Introduction

Lobster (*Panulirus* sp.) is a species that belongs to the crustacean subphylum with spiny lobster type. The Indo-West Pacific region has 11 species of lobster from the genus *Panulirus* with 6 of them found in Indonesian waters. In Indonesia, 6 types of lobsters can be found from the Palinuridae family including Scalloped spiny lobster (*Panulirus homarus*), Ornate spiny lobster (*Panulirus ornatus*), Painted spiny lobster (*Panulirus versicolor*), Longlegged spiny lobster (*Panulirus longipes*), Pronghorn spiny lobster (*Panulirus penicillatus*), and Mud spiny lobster (*Panulirus polyphagus*). Those six lobster species can be found in the South Java waters. (*Panulirus homarus* and *P. penicillatus*) are the dominant lobster species in the South Java waters. Lobster (*Panulirus sp.*) has a local name as udang barong or udang karang [1–3].

The lobster life cycle after the eggs hatch consists of several phases, starting from the phyllosoma phase which moves planktonically or swims against the current so that in this phase, it struggles to reach offshore or shallow waters. Then it continues to puerulus phase whose movements are already nectonic or actively swimming,

which can be seen from moving towards the coast and settling in shallow coastal waters. In the next phase, the larvae (puerulus) will change their skin or moult to become juvenile which begins to look pigmented. The time spent from egg to juvenile ranges from 10-18 months [4,5].

Lobster (*Panulirus* sp.) is a species that has potential and economic value in Indonesia. The economic value is known from the high demand in the domestic and export markets [6]. The potential for puerulus of lobster that lives in the Indonesian seas is estimated to reach 20 billion fish each year. This number is estimated based on the adult phase when breeding female lobsters can lay up to 460,000 eggs. The social value of catching lobster pueruli has become the livelihood of small-scale fishers. Lobster particularly puerulus fishing can improve the welfare of coastal fishing households [7–9].

Lobsters have been utilized not only at the adult life phase but also at the early life stage or puerulus phase. Since national lobster production still depends on the wild stock, the puerulus utilization has become the potential pressure on the sustainability of the wild stock of lobster. The high economic value of lobster has merely come from the demand from the international market. The largest utilization is only through fishing or collecting from the wild as the cultivation is absent and still in research development. It has a major concern about the availability of lobsters in nature [10,11]. Therefore, in accordance with the regulations from FAO which were revealed to the Minister of Marine Affairs and Fisheries Regulation (PERMEN KP No. 17 of 2021) to create sustainable fishery activities, this research is related to the composition of the species to different shelter attractors materials or shelters. It is necessary to do to determine the wild lobster population enhancement as well as to support national lobster culture development program. Shelter attractors set in the larvae shelter device (LSD) that serve as a refuge for lobster larvae from natural mortality or low survival rate during their early life history can be considered in making a policy in the scope of the ecosystem approach to fisheries management. The study was aiming to find out the best material for larvae shelter device as a larvae refugia [12].

2. Materials and Methods

This research was conducted at Mutiara beach in the waters of Prigi Bay Karanggoso, Tasikmadu village, Watulimo sub-district, Trenggalek district, East Java by collecting data on the catch of lobster pueruli species in each treatment and interviews to determine the identification of lobster clear seed species. The treatment in this study used 3 types of shelter materials, namely cement paper, burlap/gunny sacks, and waring/monofilament (Figure 1). The data obtained were processed with Microsoft Excel and SPSS software to determine the difference in catches.

The identification method is carried out by recording and photographing species, then adjusting to the habits and experiences of fishermen in identifying lobster clear seed species. The reference used as a key to identify the characteristics is the book by Clive Jones entitled "Identification of tropical palinurid lobster puerulus and juveniles" [13,14]. The analysis used to test species composition between shelter materials were Chi-square, One Way ANOVA or Analysis of Variance is commonly referred to as the F test, and Tukey test for further analysis.

Figure 1. Types of shelter materials, left-right: cement paper, burlap/gunny sacks, and waring/monofilamennet

3. Result and Discussion

3.1. Puerulus Species Identification

The results of the identification of pueruli collected from Mutiara beach in the waters of Prigi Bay Karanggoso, Tasikmadu village, Watulimo sub-district, Trenggalek district as many as 4 species, namely *Panulirus ornatus*, *Panulirus homarus*, *Panulirus versicolor*, and *Panulirus polyphagus*.

The morphological characteristics of the puerulie species are as follows:

1. Lobster Mutiara (*Panulirus ornatus*)

The physical color is transparent, the eye color is brownish-black, and there is a bulge at the tip of the antenna that can light up. The antennas are characterized by having a black ring in the middle and the area after the ring and the tip before the protrusion is milky white (Figure 2).

Figure 2. Puerulus of Ornate spiny lobster (*Panulirus ornatus*)

2. Lobster Pasir (*Panulirus homarus*)

The physical color is transparent, the eye color is brownish-black. The antennas are transparent and characterized by having a black band in the middle (Figure 3).

Figure 3. Puerulus of Scallopped spiny lobster (*Panulirus homarus*)

3. Lobster Bambu (*Panulirus versicolor*)

The physical color is transparent, the eye color is brownish-black. The antennas are characterized by milky white color (Figure 4).

Figure 4. Puerulus of Painted spiny lobster (*Panulirus versicolor*)

4. Lobster Pakistan (*Panulirus polyphagus*)

The physical color is white, the eye color is black. The antennas are characterized by many red bands along with the antenna (Figure 5).

Figure 5. Puerulus of Mud spiny lobster (*Panulirus polyphagus*)

3.2. Puerulus Species Compositions on Each Shelter Materials

The graph of the percentage of catch of puerulus in each treatment of different shelter materials is as follows:

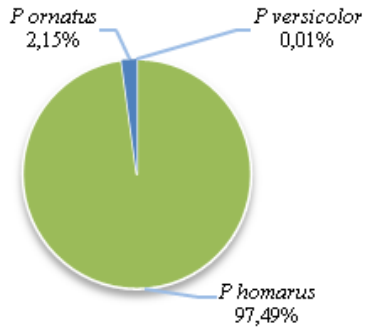

Figure 6. Proportion (percentage) of the number of individuals of puerulus species of Cement Paper Shelter

The results that nener nets with shelter attractors made of cement paper obtained the proportion of *P. ornatus* (lobster mutiara) of 2.15%, *P. homarus* (lobster pasir) of 97.49% and *P. versicolor* (lobster bambu) by 0.01% (Figure 6).

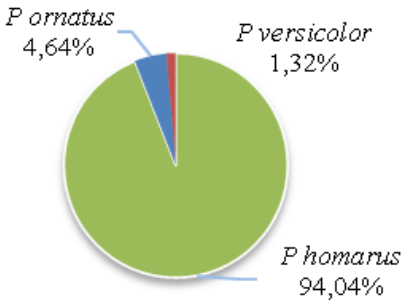

Figure 7. Proportion (percentage) of the number of individuals of puerulus species of Burlap Sack Shelter

Shelter attractors made from jute/burlap/guny sacks caught the proportion of *P. ornatus* (lobster mutiara) of 4.64%, *P. homarus* (lobster pasir) of 94.04% and *P. versicolor* (lobster bambu) by 1.32% (Figure 7).

Shelter made of waring got (*P. ornatus*) of 2.5%, (*P. homarus*) of 97.0 % and (*P. versicolor*) by 0.5% respectively (Figure 8).

The results of the proportions can be concluded descriptively that puerulus of *P. homarus* caught from Mutiara Beach has the highest value for any type of treatment of the three different shelter attractor materials. While the lowest proportion value is lobster bamboo (*P. versicolor*).

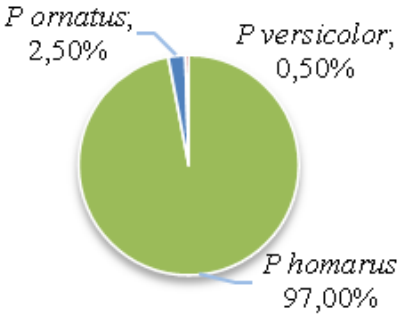

Figure 8. Proportion (percentage) of the number of individu of puerulus species of Waring or monofilament net Shelter

3.3. Puerulus Species Composition Analisis between Shelter Materials

The analysis of the composition of the lobster pueruli species using chi-square test aims to identify and prove the three treatments of shelter materials (cement paper, burlap sacks, and waring/monofilament) in a statistical approach whether there is a significant difference or not. The software used to perform this analysis was SPSS (Statistical Package for Social Science).

The results of the chi-square analysis in Table 1 can be seen in the Asymp value. Sig is 0.481, so because of the Asymp value. Sig 0.481 > 0.05, it can be concluded that accept H0 and reject H1. The conclusion is that the difference in shelter material has no significant effect on the composition of the number of individuals of each species caught.

Table 1. Chi-square test Effect of Shelter Attractor Material and Clear Lobster Seed Species

Shelter materials		Puerulus species		
		P ornatus	*P. homarus*	*P. versicolor*
Cement sack	*Observed*	6	272	1
	Expected	8	269	1
Guny sacki	*Observed*	7	143	2
	Expected	4	145	1
Waring/ monofilament	*Observed*	5	194	1
	Expected	5	193	1
Chi-square = 3.480, df = 4, *Asimp. Sig* = 0.481				

The results of this study are different from the results according to Priyambodo et al. [15], the type of shelter materials attractor and depth influence the number of lobsters pueruli species. The reason for the absence of differences is that the waters used as a place to test the treatment are homogeneous. This statement is reinforced by the results of research which, according to Erlania et al. [16], the highest distribution of pueruli was found in the characteristics of shallow waters, high turbidity levels and muddy sand bottoms. According to Mujiyanto et al. [17], the Karanggonggso location in Prigi Bay has a mixed type of bottom substrate which was about 50% of fine sand and muddy, the rest is a mixture of broken coral and shells. This opinion is in line with what happened to fishermen on Mutiara beach, where fishermen lobster pueruli in waters with mud-sand bottom substrate.

3.4. Statistical Analysis of Puerulus Species Composition on Each Shelter Materials

Data analysis with One Way ANOVA serves to see whether there are differences in the composition of the number of individuals of each species of puerulus in each shelter attractor. The software used to perform this analysis was SPSS.

3.4.1. Puerulus Species Composition on Cement Sack

Analysis of the treatment of cement paper shelter attractor material with One Way ANOVA test through SPSS software obtained the following results (Table 2).

The inductive statistics showed that there is a difference in the number of clear lobster seed catches in the shelter attractor made of cement paper (ANOVA, F=12.988, df=2, p<0.001) (Table 2), so further tests were carried out. The Tukey test was performed which looks more detail on the differences in species composition. The test found that *P. homarus* had significant differences compared to *P. ornatus* and *P. versicolor* (Table 3, Figure 1).

Table 2. One Way ANOVA of puerulus species on cement sack

Number of species	Sum of Squares	df	Mean Square	F	Sig.
Species	4,807.400	2	2,403.700	12.988	.000
Galat	4,996.900	27	185.070		
Total	9,804.300	29			

Table 3. Tukey test of puerulus species on cement sack Shelter.

Puerulus species	N	*Subset for alpha* = 0.05	
		1	2
P. versicolor	10	.1000	
P. ornatus	10	.6000	
P. homarus	10		27.2000

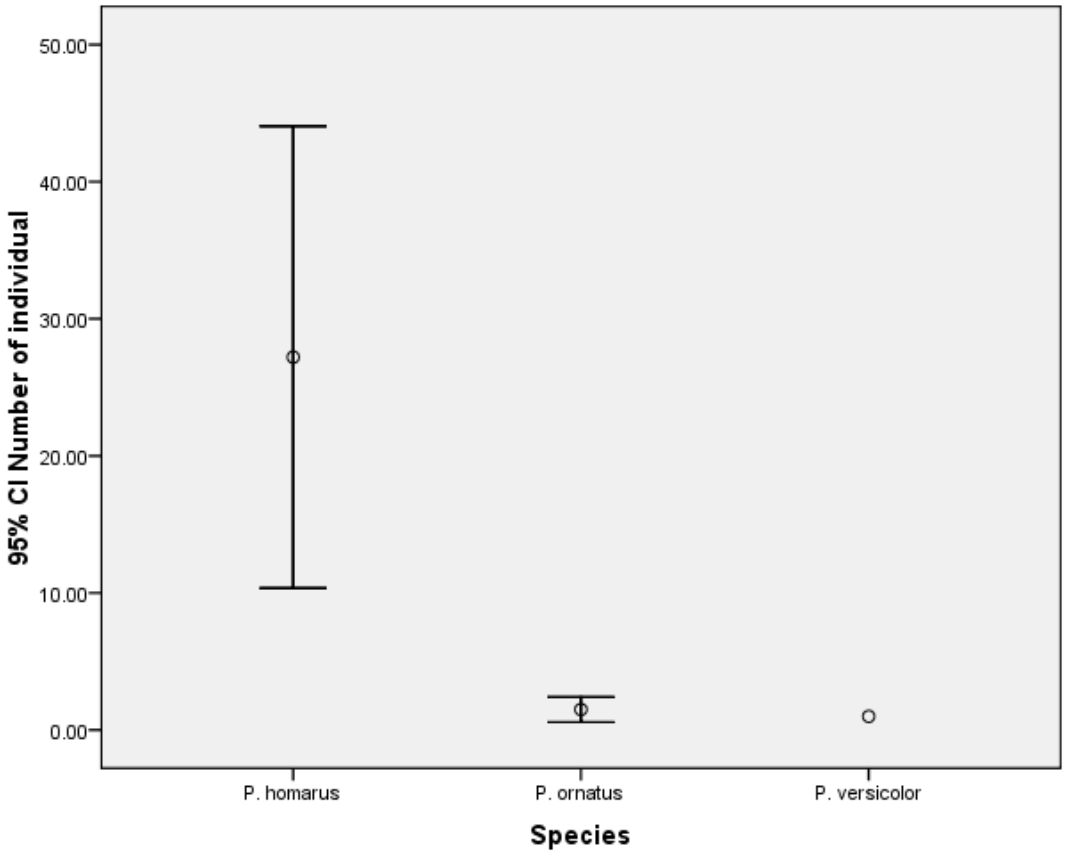

Figure 9. Puerulus species composition on cement sack shelter material

3.4.2. Puerulus Species Composition on Gunny Sack

One Way ANOVA on the number of each species collected from the gunny sack shelter materials are shown in Table 4.

Table 4. One Way ANOVA of puerulus species on guny sack

Species Number	Sum of Squares	df	Mean Square	F	Sig.
Species type	1,261.667	2	630.833	7.962	.002
Galat	2,139.300	27	79.233		
Total	3,400.967	29			

The test shows that there is a significant difference in the number of puerulus catches in the shelter attractor made of guny/burlap sack (ANOVA, F=7.962, df=2, $p<0.05$) (Table 4). the Tukey test found that *P. homarus* had significant differences compared to the *P. ornatus* and *P. versicolor* (Table 5, Figure 10).

Table 5. Tukey test of puerulus species on guny sack shelter

Puerulus Species	N	Subset for alpha = 0.05	
		1	2
P versicolor	10	.2000	
P ornatus	10	.7000	
P homarus	10		14.2000

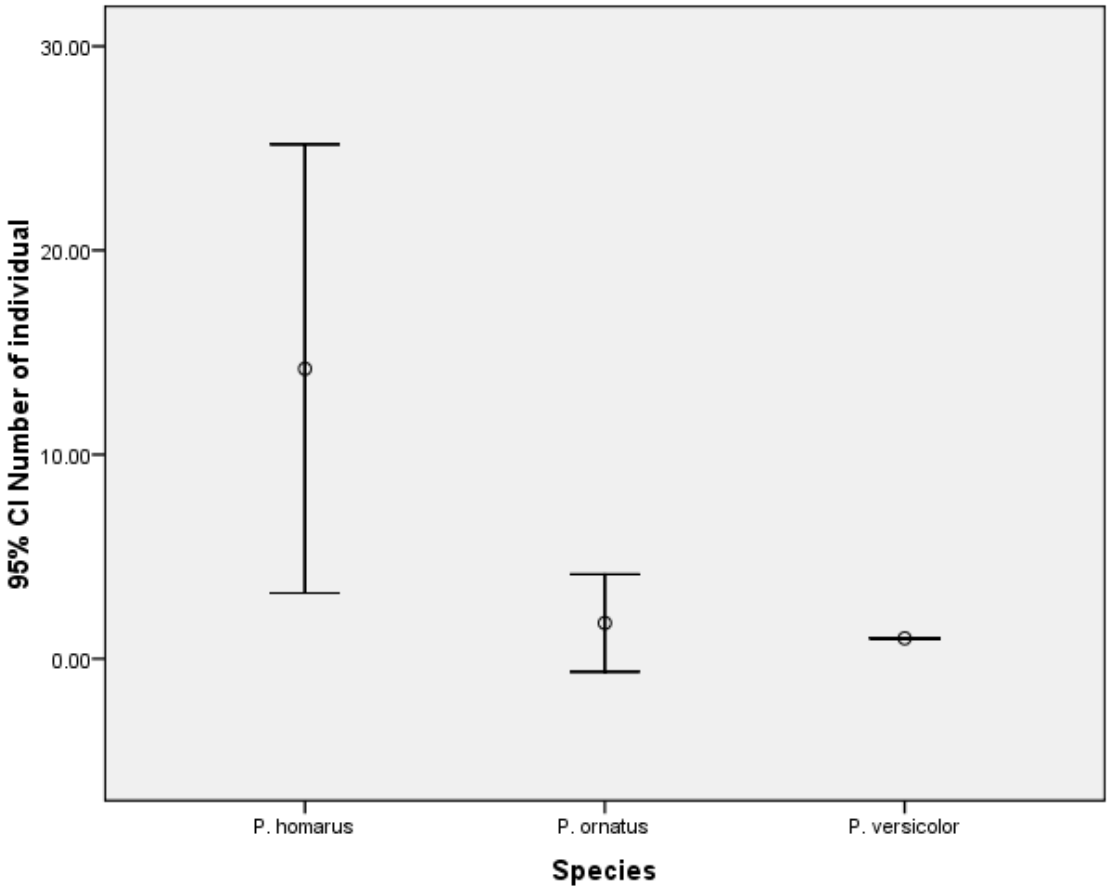

Figure 10. Puerulus species composition on guny sack shelter material

3.4.3. Puerulus Species Composition on Waring/Monofilament Net

Analysis of treatment of waring shelter materials with One Way ANOVA test through SPSS software got the following results.

Table 6. One Way ANOVA of puerulus species on waring/monofilament materials

Number Species	Sum of Squares	df	Mean Square	F	Sig.
Species type	2,432.867	2	1,216.433	7.465	.003
Galat	4,399.800	27	162.956		
Total	6,832.667	29			

Table 7. Tukey test of puerulus species on monofilament shelter

Puerulus Species	N	Subset for alpha = 0.05	
		1	2
P versicolor	10	.1000	
P ornatus	10	.5000	
P homarus	10		19.4000

The test shows that there is a significant difference in the number of puerulus catches in the shelter attractor made of waring/monofilament net (ANOVA, F=7.465, df=2, $p<0.05$) (Table 6). The Tukey test found that *P. homarus* had significant differences compared to *P. ornatus* and P. *versicolor* (Table 7, Figure 11).

The treatment of three different shelter materials (cement paper, gunny sacks, waring) revealed that the dominance of the puerulus species overall is scalloped spiny lobster (*Panulirus homarus*) followed by the other two species. The dominance of the clear seed species of sand lobster is reinforced by the opinion of Haryono et al. [18], in which the waters in the southern districts of Central Java are dominated by the scalloped spiny lobster. The results of this study are reinforced by the location of the installation of nener nets which are covered with mud which is the habitat of sand lobsters. This result is corroborated by Holthuis [19], in which the sand lobster is very fond of sand and mud habitats, hiding under rocks and areas close to river mouths. Shelter attractors were made of logs, waring nets, rice sacks and cement paper, the largest catch was obtained by clear seed species of sand lobster with shelter attractors made of cement paper which were operated at the bottom of the water. It was predicted that the dominant inhabitant of the South Java Sea and the Indian Ocean, in general, is *P. homarus* [2, 3].

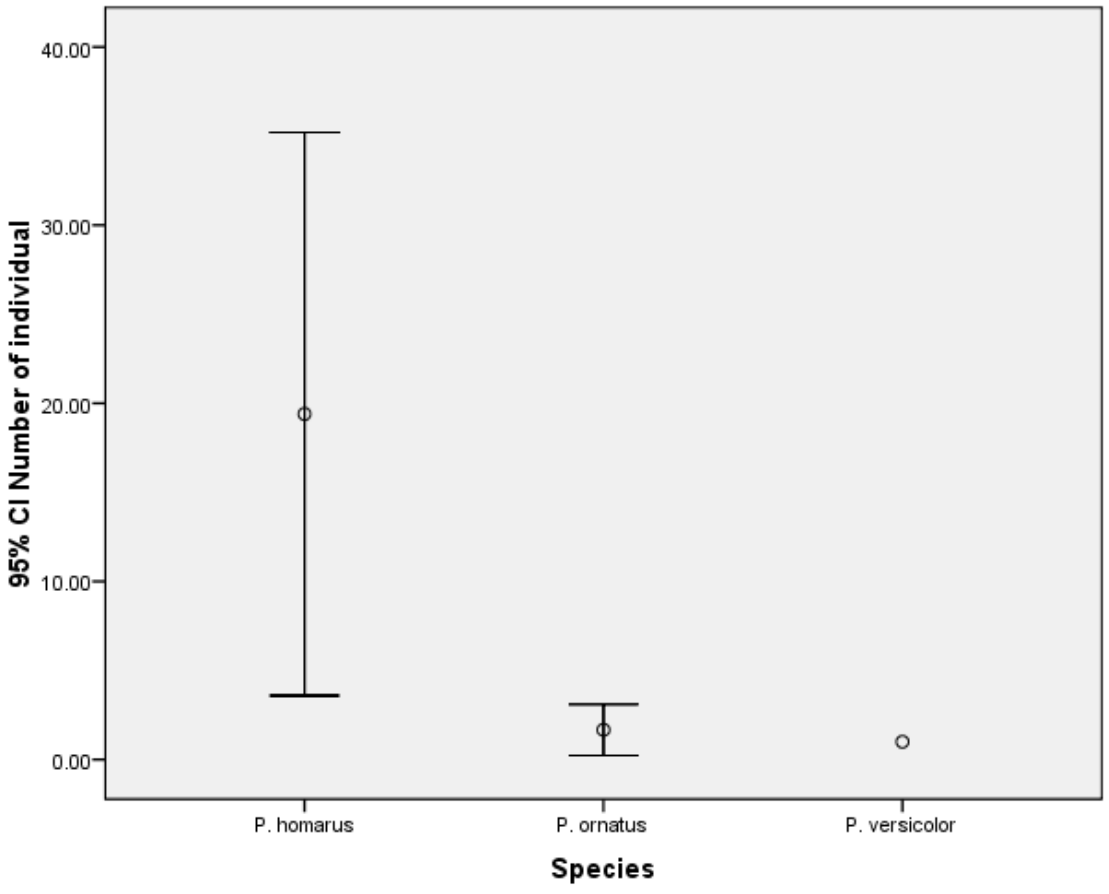

Figure 11. Puerulus species composition on monofilament shelter material

4. Conclusion

There were four species lobsters' pueruli found during the study. The species are *Panulirus ornatus*, *P. homarus*, *P. versicolor* and *P. polyphagus*. The most prominent feature is the pattern on the antenna. The ornate lobster puerulus (*P. ornatus*) has the characteristics of having a black ring, the antenna area after the ring to the tip before the head is milky white, and the tip of the antenna head can glow orange-black. The puerulus of scalloped spiny lobster (*P. homarus*) have a characteristic antenna with a black ring in the middle and a clear antenna at the tip. The painted spiny lobster (*P. versicolor*) has completely clear antennae. The puerulus of mud spiny lobster (*P. polyphagus*) have antenna that have many red rings arranged sequentially to the tip. Different types of shelter attractor materials (cement sack paper, burlap/guny sacks, and waring/monofilament) did not affect the species composition of lobster larvae. Overall *P. homarus* is the dominant inhabitant in those three different shelter materials followed by *P. versicolor* and *P. ornatus*. The need for further research on the effect of the combination of environmental factors and shelter attractor materials on the puerulus species composition.

REFERENCES

[1] A. Setyanto, N. Artini, R. & Eko, S. Yulianto. Distribution and Composition of Lobster Species Caught in Java Sea of East Java, Indonesia, Jurnal Perikanan Universitas Gadjah Mada, Vol.20, 49–55, 2018.

[2] A. Setyanto, S. Soemarno, D. G. R. Wiadnya, C. Nugroho. Biodiversity of Lobster (Panulirus) from Eastern Indian Ocean of Indonesia Waters, IOP Conference Series: Materials Science and Engineering, Vol.546, 1–8, 2019.

[3] A. Setyanto, D. G. R Wiadnya, C. Prayogo, R. J. West, M. Tsamenyi, S. Halimah, N. A. Rahman. Spiny lobsters species composition between North and South Sea of East Java, Indonesia, Copyright@ EM International, Vol.26, 2020.

[4] M. J. Kingsford, J. M. Leis, A. Shanks, K. C. Lindeman, S. G. Morgan, J. Pineda. Sensory environments, larval abilities and local self-recruitment, Bulletin of Marine Science, Vol.70, 309–340, 2002.

[5] J. Pineda, F. Porri, V. Starczak, J. Blythe. Causes of decoupling between larval supply and settlement and consequences for understanding recruitment and population connectivity, Journal of Experimental Marine Biology and Ecology, Vol.392, 9–21, 2010.

[6] E. H. Petersen, C. M. Jones, B. Priyambodo. Bioeconomics of Spiny Lobster Farming in Indonesia, Asian Journal of Agriculture and Development, Vol.10, 25–39, 2013.

[7] N. Caputi, M. Feng, A. Denham, L. Simon de, J. Penn, D. Slawinski, A. Pearce, J. How. Optimizing an oceanographic-larval model for assessment of the puerulus settlement of the western rock lobster, Panulirus cygnus, in Western Australia, Bulletin of Marine Science, Vol.94, 775–800, 2018.

[8] I. Plaut. Sexual maturity, reproductive season and fecundity of the spiny lobster Panulirus penicillatus from the Gulf of Eilat (Aqaba), Red Sea, Marine and Freshwater Research, Vol.44, 527–535, 1993.

[9] R. Mohan. Size structure and reproductive variation of the spiny lobster Panulirus homarus over a relatively small geographic range along the Dhofar coast in the Sultanate of Oman, Mar. Freshwater Res, Vol.48, 1085–1091, 1997.

[10] C. M. Jones. Progress and obstacles in establishing rock lobster aquaculture in Indonesia, Bulletin of Marine Science, ISSN 0007-4977, Vol. 94, Nº. 3, 2018, Págs. 1223-1233, Vol.94, 1223–1233, 2018. https://dialnet.unirioja.es/servlet/articulo?codigo=6586732&info=resumen&idioma=ENG (accessed December 27, 2021).

[11] N. Tran, U.-P. Rodriguez, C. Y. Chan, M. J. Phillips, V. Mohan, P. John, G. Henriksson, S. Koeshendrajana, S. Suri, S. Hall. Indonesian aquaculture futures: An analysis of fish supply and demand in Indonesia to 2030 and role of aquaculture using the AsiaFish model ☆, Marine Policy, Vol.79, 25–32, 2017.

[12] R. Siow, A. H. Nurridan, R. Hadil, R. Richard. The establishment of fisheries refugia as a new approach to sustainable management of fisheries in Malaysian waters, IOP Conference Series: Earth and Environmental Science, Vol.414, 012023, 2020.

[13] C. Jones, H. Dao., Identification of tropical palinurid lobster pueruli and juveniles, 2010.

[14] H. Matsuda, M. Sakai, T. Yanagimoto, S. Chow. Morphological differences among phyllosoma larvae of the pronghorn spiny lobster, *Panulirus penicillatus*, from the western, central, and eastern areas of the Pacific Ocean, Crustacean Research, Vol.48, 105–118, 2019.

[15] B. Priyambodo, C. Jones, J. Sammut. The effect of trap type and water depth on puerulus settlement in the spiny lobster aquaculture industry in Indonesia, Aquaculture, Vol.442, 132–137, 2015.

[16] E. Erlania, N. Radiarta, K. Sugama, P. Dinamika kelimpahan benih lobster (panulirus spp.) di perairan teluk gerupuk, nusa tenggara barat: tantangan pengembangan teknologi budidaya lobster, Jurnal Riset Akuakultur, Vol.9, 475–486, 2014.

[17] Mujiyanto, Riswanto, D. Wijaya. Similaritas Biota Penempel pada Substrat Terumbu Buatan Lobster di Teluk Prigi Jawa Timur dan Pangandaran Jawa Barat, in: Rehabilitasi Ekosistem Terumbu Karang untuk Keberlanjutan Sumber Daya Perikanan (pp. 203-220). AMAFRAD Press. Ris. Dan Sumber Daya Mns. Kelaut. Dan Perikanan, 2018.

[18] F. E. D. Haryono, S. Hutabarat, J. Hutabarat, A. Ambariyanto. Comparation of spiny lobster (Panulirus sp.) populations from bantul and cilacap, Central Java, Indonesia, Jurnal Teknologi, Vol.78, 51–54, 2016.

[19] L. B. Holthuis. FAO species catalogue: Marine lobsters of the world, FAO Fisheries Synopsis, Vol.13, 151, 1991.