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IDENTIFICATION AND PREVALENCE OF ECTOPARASITES IN BLUE SWIMMING CRAB (*Portunus pelagicus* Linnaeus, 1758) ON THE NORTH COAST OF JAVA

IDENTIFIKASI DAN PREVALENSI EKTOPARASIT PADA RAJUNGAN (*Portunus pelagicus* Linnaeus, 1758) DI PANTAI UTARA PULAU JAWA

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ABSTRACT

Besides overfishing, other factors that influence the decline in blue swimming crab (*Portunus pelagicus*) production are diseases caused by parasites. Poor environmental conditions could trigger parasite infestation on their host. This study aims to identify ectoparasites morphologically based on the research location and to analyze the prevalence of ectoparasites of the blue swimming crabs. Crab samples and data collection of aquatic environmental parameters were carried out at five locations in the northern part of Java Island, Indonesia: Pasuruan, Lamongan, Semarang, Cirebon, and Banten. The study was conducted from December 2021 to July 2023. Morphological identification of ectoparasites was carried out at the Biology Micro Laboratory I, Department of Aquatic Resources Management, IPB University. Interviews with fishermen were also conducted to ensure the crab catchment area around the research location. The number of blue swimming crabs obtained at each location varied, ranging from 25 to 35 individuals, consisting of large, medium, and small crabs. Based on the results of morphological identification, there were a total of five types of parasites found in all research locations, namely *Allokepon* sp., *Chelonibia testudinaria*, *Octolasmis angulata*, *Octolasmis warwickii*, and *Octolasmis* sp. The prevalence rate of crabs in each location was significantly different in five locations, namely Pasuruan, Lamongan, Semarang, Cirebon, and Banten, which were 80%, 74%, 80%, 12%, and 70%, respectively. The highest prevalence was in Pasuruan and Semarang. Factors affecting the prevalence rate of ectoparasites in blue swimming crabs included environmental quality such as temperature, salinity, pH, and dissolved oxygen (DO).

Keywords: environment, morphology, production

ABSTRAK

Beberapa faktor yang memengaruhi penurunan produksi rajungan (*Portunus pelagicus*) selain *overfishing* yaitu penyakit yang disebabkan parasit. Kondisi lingkungan yang buruk dapat memicu infestasi parasit pada inangnya. Penelitian ini bertujuan untuk mengidentifikasi ektoparasit secara morfologis berdasarkan lokasi penelitian serta menganalisis prevalensi ektoparasit pada rajungan. Pengumpulan sampel rajungan dan pengambilan data parameter lingkungan perairan dilakukan pada lima lokasi yang berada di bagian utara Pulau Jawa, Indonesia, yaitu Pasuruan, Lamongan, Semarang, Cirebon, dan Banten. Penelitian dilakukan pada bulan Desember 2021 hingga Juli 2023. Identifikasi ektoparasit secara morfologis dilakukan di Laboratorium Biologi Mikro I, Departemen Manajemen Sumberdaya Perairan, Institut Pertanian Bogor. Wawancara nelayan juga dilakukan untuk memastikan daerah tangkapan rajungan di sekitar lokasi penelitian. Jumlah rajungan yang didapatkan di setiap lokasi berbeda berkisar 25-35 individu terdiri atas rajungan berukuran besar, sedang, dan kecil. Berdasarkan hasil identifikasi morfologis terdapat total lima jenis parasit yang ditemukan di seluruh lokasi penelitian, yaitu *Allokepon* sp., *Chelonibia testudinaria*, *Octolasmis angulata*, *Octolasmis warwickii*, dan *Octolasmis* sp. Tingkat prevalensi kepiting di setiap lokasi berbeda secara signifikan pada lima lokasi yaitu Pasuruan, Lamongan, Semarang, Cirebon, dan Banten masing-masing adalah 80%; 74%; 80%; 12%; dan 70%. Prevalensi tertinggi pada lokasi penelitian Pasuruan dan Semarang. Faktor-faktor yang mempengaruhi tingkat prevalensi ektoparasit pada rajungan salah satunya adalah kualitas air yang meliputi suhu, salinitas, pH, dan *dissolved oxygen* (DO).

Kata kunci: lingkungan, morfologis, produksi

INTRODUCTION

Blue swimming crab (*Portunus pelagicus*) is one of Indonesia's leading export commodities. Crab export demand from 2019 to 2021 tends to increase by 5% per year (KKP 2022), with the main export destination countries being the United States, China, and Japan (BPS 2022). In contrast to export demand, crab production in the last six years has tended to decrease by 1,800 kg per year. In 2022, crab production decreased by 0.40% (KKP 2022). Continuous blue swimming crab fishing can threaten the existence of its population in nature, so there is speculation that the longer the catch and the size of the blue swimming crab obtained will be smaller. Several factors that influence the decline in production besides overfishing are diseases caused by parasites. Parasites in the crab can be found in the tissue, gill chamber, and surface of the shell (Shields 1992). Parasites do not cause direct death to their hosts, but cause disorders such as respiratory disorders and slow growth. *Portunus pelagicus*, commonly known as the blue swimming crab, is a crustacean species exhibiting responsive capabilities to various environmental stimuli, both physiological and behavioral (Yusfiandayani dan Sobari 2011). This includes immunological and physiological reactions to parasitic infections, which activate defense mechanisms within the organism. Such responses play a crucial role in minimizing biotic stressors that may contribute to population decline, thereby supporting the sustainability of the species in its natural habitat.

Based on their presence, parasites are divided into two types: endoparasites and ectoparasites. Ectoparasites have faster colony development and have a direct impact on blue swimming crab production (Irvansyah *et al*. 2012). Parasites in an organism can also be used as a warning of environmental damage, thus creating a relationship between parasites in crabs and the condition of the aquatic environment. Ectoparasites that are usually found in crabs include *Chelonibia testudinaria* (Crustacea), *Dianajonesia tridens* (Crustacea), *Octolasmis angulata*, *O. lowei*, *O. warwicki* (Crustacea), *Ostrea puelchana* (Mollusca), and *Thompsonia* sp. (Crustacea) (Heirina 2021). Parasites in blue swimming crabs have different characteristics and impacts. Some types of parasites can also interfere with the molting process in crabs and inhibit movement (Yang *et al*. 2015).

The blue swimming crab is one of the fishery commodities with high economic value. Until now, crab production still depends on wild catches. The high demand for crabs has caused fishermen to use various methods to catch crabs and ignore the impact of overfishing. Another factor in the decline in crab production is the presence of parasitic diseases. Ectoparasites in large numbers in crabs can inhibit growth and cause death. Abnormal growth and death in crabs can affect overall production. Identification of ectoparasites based on parasite morphology is carried out as a basic step in managing the blue swimming crab resources. The prevalence rate of ectoparasites in the crabs has previously been studied by Heirina (2021) in three locations, namely Demak and Labuan Maringgai. This study was conducted to complement previous research by selecting five research locations that are centers of crab fishing in WPP NRI 712. The northern part of Java Island was chosen as a detailed research location, namely Pasuruan, Lamongan, Semarang, Cirebon, and Banten. This study was conducted as a basic step to find out the types of ectoparasites and factors that influence the prevalence rate of ectoparasites in blue swimming crabs. Thus, the purpose of this study is to identify factors that cause a decrease in crab production due to parasites.

METHODS

Time and location

The study was conducted from December 2021 to July 2023. The collection of blue swimming crab samples and data collection of aquatic environmental parameters were carried out at crab fishing centers in WPP NRI 712 (Java Sea), namely Pasuruan, Lamongan, Semarang, Cirebon, and Banten (Figure 1). Blue swimming crab sampling was carried out directly in the crab fishing area and assisted by local fishermen. The crab fishing area has the characteristics of a muddy sand base substrate. Blue swimming crab fishing at each location was carried out in the morning at 05.00 WIB. Morphological identification of ectoparasites was carried out at the Bio-Micro Laboratory I, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, IPB University.

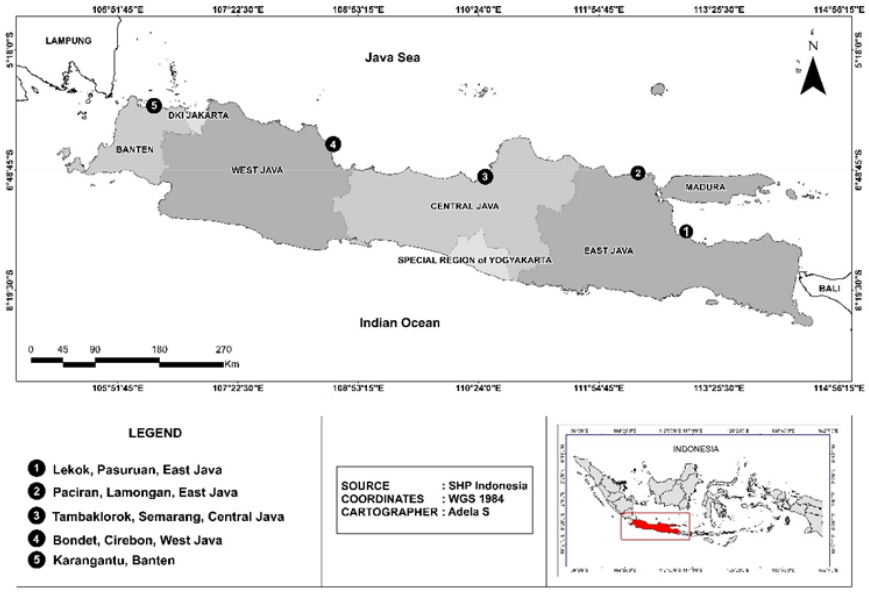

Figure 1. Location of research on identification and prevalence of ectoparasites in blue swimming crabs on the north coast of Java Island.

Sampling procedure

The tools used to catch blue swimming crabs were traps, gill nets, and lake nets (Husni *et al.* 2021). It is not uncommon to find fishing gear that is not environmentally friendly, such as dredges and mini-bottom trawls (Huda *et al.* 2021). The fishing gear used to obtain crab samples was traps. In addition, measurements of environmental parameters of waters and blue swimming crab habitat, such as temperature, salinity, pH, and dissolved oxygen (DO), were taken directly (in situ). The crabs caught were sampled to analyze their prevalence levels. Interviews with fishermen were conducted to ensure the crab fishing areas around the research location.

The number of blue swimming crabs obtained at each location varied between 25 and 35 individuals. The sampling was done randomly. Male and female crabs were separated to observe the difference in ectoparasite prevalence based on gender. Each crab was then measured for carapace width and weight. The blue swimming crabs that had been measured were then examined for carapace, claws, walking legs, swimming legs, and gills to obtain ectoparasites. Generally, ectoparasites in crab species were often found attached to the gills. Ectoparasites found during the study were barnacles and sea lice. The ectoparasite samples that had been taken were preserved using 96% alcohol to maintain the body structure of the ectoparasites. Ectoparasites in blue swimming crabs are generally small in size, so a stereo microscope was needed to observe ectoparasites. Ectoparasites were observed in the Bio-Micro Laboratory 1, IPB. Species of the genus *Octolasmis* were identified based on morphological characteristics such as overall shape, capitular and capitular plates, according to Jeffries *et al.* (2005), Chan *et al.* (2009), and Duan *et al.* (2008).

Data analysis

The prevalence of ectoparasites in blue swimming crabs was analyzed based on the calculation method of Bush *et al.* (1997). Ectoparasite analysis was carried out to calculate the level of occurrence and distribution of ectoparasites in the crabs. Prevalence is the number of hosts infected with one or more ectoparasites divided by the total number of hosts observed. Prevalence is expressed as a percentage when used descriptively. Prevalence analysis was carried out to classify hosts into two categories, namely infected and uninfected (Bush *et al.* 1997). The classification of parasite prevalence refers to Kabata (1985) (Table 1). The following is the formula for calculating the percentage of parasite infection prevalence (Kabata 1985):

$$Prevalence = \frac{\sum Blue\ swimming\ crab\ infected\ with\ parasites\ (ind)}{\sum Blue\ swimming\ crab\ observed\ (ind)} \times 100(\%)$$

Table 1. Classification of parasite prevalence (Kabata 1985).

No	Prevalence	Category	Note
1	100-99%	Always	Very severe infection
2	98-90%	Almost always	Severe infection
3	89-70%	Usually	Moderate infection
4	69-50%	Very often	Very frequent infection
5	49-30%	Generally	Common infection
6	29-10%	Often	Frequent infection
7	9-1%	Sometimes	Sometimes infection
8	<1-0.1%	Rarely	Rare infection
9	<0.1-0.01%	Very rarely	Very rare infection
10	<0.01%	Almost never	Never infection

RESULTS AND DISCUSSION

Morphological identification of ectoparasites

Morphological identification was carried out by comparing easily visible morphological characteristics. Based on the results of morphological identification, there were a total of five types of parasites found throughout the research location, namely *Octolasmis angulata*, *O. warwickii*, *Chelonibia testudinaria*, and *Allokepon* sp. (Figure 2). In addition to these four species, small black spots were found that were identified as cyprids of the genus *Octolasmis*. At that stage, *Octolasmis* could not be identified at the species level, so the *Octolasmis* sp. group was created.

Ectoparasites of the genus *Octolasmis* are also called stalked barnacles or pedunculate barnacles. *Octolasmis* are often found attached to the outer skeleton of shallow-water crustaceans, including blue swimming crabs. Jeffries *et al.* (1995) described the shelled barnacles of the genus *Octolasmis* into species, namely *O. angulata*, *O. cor*, *O. lowei*, *O. neptuni*, *O. triden*, and *O. Warwickii*. Two of them were found during the study, namely, *O. angulata* and *O. Warwickii* (Figure 2). Figure 2(e) was identified as the genus *Octolasmis* in the cyprid phase (Hoeg and Moller 2006).

In addition to stalked barnacles, during the study, shelled barnacles, *Chelonibia testudinaria* (Lim *et al.* 2021), were also found. Barnacles attach to all hard substrates, such as coral, mangrove trunks, rocks, and others. Barnacles can also attach to the outer skeleton of crustaceans or to the gill chamber of their hosts. This will interfere with the gas exchange process of their hosts (Hudson and Lester 1994). Other ectoparasites found during the study were a type of louse, namely *Allokepon* sp. (Hoeg *et al.* 2019). In full, the intensity of ectoparasites on blue swimming crabs observed at all research locations can be seen in Table 2.

The number of blue swimming crab samples obtained at each research location varied depending on the number of crabs caught by the fishing gear. The fishing gear used at each research location also varied. Crab fishermen at Pasuruan and Semarang used fishing gear in the form of dredges; in Lamongan, they used traps; while in Cirebon and Banten, they used gill nets. Based on Table 2, it was found that Pasuruan had the highest ectoparasite intensity in the *Octolasmis angulata*, with a total of 46,600. According to Yulanda *et al.* (2017), this number is included in the moderate classification. One of the behaviors of blue swimming crabs is to immerse themselves in the substrate, making crabs included in the group of demersal organisms. Demersal aquatic organisms have limited movement, so they respond slowly to environmental changes. According to Khan and Thulin (1991), organisms that have a slow response to environmental damage will cause chronic impacts on their bodies. These organisms will be more susceptible to diseases, including ectoparasites. The presence of ectoparasites in blue swimming crabs can cause respiratory disorders and slow growth (Hudson and Lester 1994). Crabs are often found in relatively shallow waters in warm waters. Blue swimming crabs are also often found in waters with sandy and muddy sand substrates around the coast (Manurung *et al.* 2024).

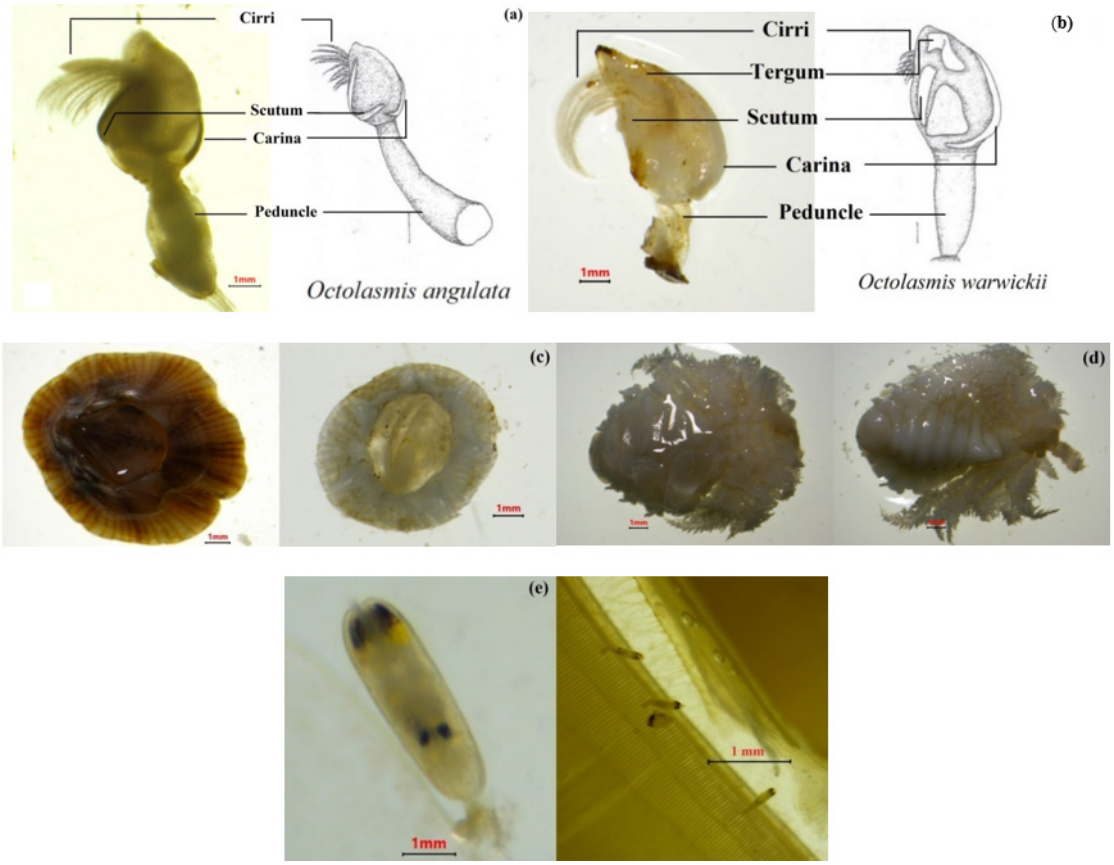

Figure 2. Ectoparasites on blue swimming crab (*Portunus pelagicus*): (a) *Octolasmis angulata*; (b) *Octolasmis warwickii*; (c) *Chelonibia testudinaria*; (d) *Allokepon* sp.; (e) *Octolasmis* sp.

Table 2. Intensity of blue swimming crab ectoparasites at the research location.

Sample	Blue Swimming Crab Ectoparasite Intensity at Sampling Locations (individuals)				
	Pasuruan	**Lamongan**	**Semarang**	**Cirebon**	**Banten**
Octolasmis angulata	46.6000	23.2222	12.9667	0.3846	19.4242
Octolasmis warwickii	1.8667	0.3333	1.6333	0.1154	2.5152
Octolasmis sp.	0.1333	3.5556	1.5333	0.1923	1.5758
Chelonibia testudinaria	0.1000	-	-	-	-
Allokepon sp.	0.0667	0.0370	-	-	-

Based on Table 3, the number of male blue swimming crabs caught in the five research locations ranged from 12 to 17 individuals per research location, with the maximum average carapace width and weight found in Lamongan, which was 105.00±8.36 mm and 75.28±15.88 grams. The number of female crabs caught ranged from 12 to 21 individuals per research location, with the maximum average carapace width and weight found in the Banten location, which was 108.11±16.62 mm and 88.42±39.83 grams. The results of the analysis and test (T-test; ANOVA) in Table 3 show that the prevalence rate of crabs based on gender and location was significantly different ($P < 0.005$). In summary, the results of the analysis of the prevalence rate of ectoparasites in blue swimming crab samples at each location are presented in Table 3. Based on the results of the analysis, it can be seen that the prevalence rate of female crabs is higher than that of male crabs. This is following Cruz *et al.* (2020), who found that female crabs are generally more susceptible to disease and parasites. The presence of parasites can also cause crabs to be unable to reproduce. Parasites in female blue swimming crabs can prevent the gonads to not developing, and in male blue swimming

crabs, they can cause feminization, making it difficult to identify the sex of the crab. Adult female crustaceans are more susceptible to parasites and diseases, especially during the spawning season (Messick 1998). Adult barnacles attach firmly to hard substrates that are permanent (Hudson and Lester 1994). The highest prevalence rates based on research locations were found in Pasuruan and Semarang, each at 80%. Heirina (2021) stated that environmental damage could increase the vulnerability of crabs to pathogens, including parasites, causing the prevalence percentage to be high.

Barnacles have a high reproductive rate because they are hermaphrodites. In the cyprid phase, barnacles do not require food. In addition, barnacles take a short time to metamorphose from the larval phase to the nauplii (Yap *et al.* 2015). This causes all types of barnacles to be adaptive and easy to find in shallow waters. *Allokepon* sp. was also found in small numbers but has a fairly large size in the gill chamber of the crab. Two locations where this species was found were Pasuruan and Lamongan. *Allokepon* sp. is an isopod that occupies the gill chamber. The size of this parasite is quite large, so it can cause gill deformities in the crab. Crabs infected with this parasite generally have a different upper carapace structure, namely swelling on the left or right side (Cruz *et al.* 2020).

Data on environmental parameters of the waters at the five research locations are presented in Table 4. Based on Table 4, the temperature is in accordance with the optimum temperature for the survival of blue swimming crabs, namely, 28-30°C (Juwana 2002). Salinity is closely related to the distribution and migration patterns of barnacle ectoparasites. Waters with high salinity are more likely to be found with ectoparasites, especially the genus *Octolasmis*. *Octolasmis* has an optimal habitat range similar to that of the crabs. Before *Octolasmis* attaches to a hard substrate, including crab shells, *Octolasmis* also has a planktonic cyprid phase (Suherman 2022). In addition, water temperature also has a major influence on the distribution of the planktonic phase of *Octolasmis*. Temperature affects the metabolic processes in the body of *Octolasmis*.

Table 3. Prevalence levels of male and female blue swimming crab ectoparasites.

Location	Sex	N (ind.)	L average (mm)	W average (g)	Prevalence (%)	
Pasuruan	Male	17	94.16 ± 17.95	78.12 ± 36.52	64.71	80
	Female	13	95.98 ± 43.18	69.19 ± 15.39	100	
Lamongan	Male	12	105.00 ± 8.36	75.28 ± 15.88	50	74
	Female	15	104.16 ± 10.14	71.37 ± 25.51	93.33	
Semarang	Male	15	101.80 ± 11.83	76.13 ± 26.59	73.33	80
	Female	15	101.22 ± 20.91	71.88 ± 22.75	86.67	
Cirebon	Male	14	99.13 ± 21.32	74.66 ± 32.29	7.14	12
	Female	12	100.95 ± 14.18	73.89 ± 27.72	16.67	
Banten	Male	12	101.10 ± 10.96	63.02 ± 17.86	50	70
	Female	21	108.11 ± 16.62	88.42 ± 39.83	80.95	

Note: N = Number, L = Carapace width, W = Weight

Table 4. Results of measuring environmental parameters at the research location.

Parameter	Locations				
	Pasuruan	Lamongan	Semarang	Cirebon	Banten
Temperature (°C)	29.7	29.8	29.5	28	27.8
Salinity (ppt)	34	35	34	28	31
pH	8.2	8.4	8.4	7.5	7.6
DO (mg/L)	5.4-5.8	5.7-6.7	5.1-5.7	5.7-7.3	5.5-5.9

The results of salinity parameter measurements at the Pasuruan, Lamongan, and Semarang were above the optimum temperature for blue swimming crabs, which was 28-32 ppt (Tanti and Sulwartiwi 2010). Temperature and salinity are important factors that affect aquatic organisms, including ectoparasites. Changes to these two factors can affect eating habits, reproduction, metabolism, and the life cycle of *Octolasmis* (Indarto *et al.* 2021). The results of pH parameter measurements at the five research locations were within the optimum range of 7-8.5 (Syahidah *et al.* 2003). Meanwhile, the results of DO parameter measurements at Pasuruan and Semarang were lower than in other locations. However, the results of DO measurements at the five locations based on KEPMENLH Number 51 of 2004 concerning Sea Water Quality Standards for marine biota were above 5 mg/L. The lowest prevalence rate was in Cirebon. All water quality parameters in Cirebon waters were in optimum condition. This location experiences little environmental pressure, causing blue swimming crabs to be less susceptible to disease, including parasites. A study revealed the interaction of pollution with organisms that have parasites. Pollution can significantly increase the number of ectoparasites in aquatic organisms. Parasites in aquatic biota are indicators of environmental pollution (Khan and Thulin 1991). Parasites are also one of the factors in the variation in the size of crabs (Afifah 2017). The prevalence rate of the Cirebon research location was the lowest among other locations. The results of the environmental parameter analysis at the research location were in the good range, but the Cirebon research location was the optimal habitat for the crabs. In addition, when taking visual crab samples, the Cirebon location was near a mangrove forest, which allowed for good water environmental quality for crab habitat.

CONCLUSION

Ectoparasites in blue swimming crabs from the north coast of Java Island consist of four species, namely *Octolasmis angulata*, *Octolasmis warwickii*, *Chelonibia testudinaria*, *Allokepon* sp. The prevalence rate of the crabs based on gender and research location is significantly different. The highest prevalence of blue swimming crab ectoparasites was found in Pasuruan and Semarang, with moderate to severe infection classification. Temperature and salinity are the main factors that influence the presence of ectoparasites in crabs.

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