ISSN 2338-4344
eISSN 2686-200X

OPEN ACCESS

Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati (J-BEKH)

Volume 12, Issue 1, June 2025

Article History
Received: March 25, 2025
Accepted: May 23, 2025

Ectoparasites Identification on Spiny Lobster (*Panulirus homarus*) Cultivated Controlled Tanks and Floating Net Cages (KJA) at the Lampung Marine Aquaculture Center (BBPBL)

Identifikasi Ektoparasit Lobster Pasir (Panulirus homarus) pada Bak Terkendali dan Keramba Jaring Apung (KJA) di Balai Besar Perikanan Budidaya Laut (BBPBL) Lampung

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Abstrak

Ektoparasit dapat menginfeksi biota akuatik termasuk lobster pasir (*Panulirus homarus*) yang sering menyebabkan kegagalan budidaya lobster pasir seperti kematian, infeksi bakteri, dan penurunan kualitas budidaya. Salah satu kegagalan budidaya lobster pasir sering disebabkan karena gangguan ektoparasit. Pertumbuhan dan persebaran ektoparasit dipengaruhi oleh kondisi lingkungan. Penelitian ini bertujuan untuk mengidentifikasi jenis ektoparasit dan faktor- faktor yang mempengaruhi adanya ektoparasit pada lobster pasir serta menentukan intensitas dan dominansi ektoparasit lobster pasir. Penelitian dilakukan di keramba jaring apung (KJA) dan bak terkendali Balai Besar Perikanan Budidaya Laut (BBPBL) Lampung secara purposive random sampling sebanyak 18 ekor yang masing-masing diambil 9 ekor dari KJA dan bak terkendali. Tahapan penelitian meliputi pengambilan sampel lendir pada ekor dan kaki renang (pleopod), pemeriksaan ektoparasit secara mikroskopis, perhitungan intensitas dan dominasi ekoparasit, dan pengukuran parameter kualias air. Hasil penelitian diperoleh 3 jenis ektoparasit yang menyerang Lobster Pasir (*Panulirus homarus*) termasuk filum Protozoa dan kelas Ciliata yaitu *Vorticella* sp., *Zoothamnium* sp., dan *Epistylis* sp. Intensitas serangan ektoparasit *Vorticella* sp., sebanyak 11,5 individu/ekor. Domi nasi ektoparasit paling banyak adalah jenis *Vorticella* sp. sebesar 53,90%. Perbedaan jumlah ektoparasit pada bak terkendali dan keramba jaring apung dikarenakan perbedaan suhu dan ukuran wadah budidaya serta kedalaman yang mempengaruhi kualitas air.

Kata kunci: *bak terkendali, ektoparasit, keramba jaring apung, Panulirus homarus*

Abstract

Ectoparasites can infect aquatic biota, including spiny lobster (Panulirus homarus), which causes failure of spiny lobster cultivation, such as death, bacterial infection, and decreased cultivation quality. One of the failures of spiny lobster cultivation is often caused by ectoparasite disorders. Environmental conditions influence the growth and distribution of ectoparasites. This study aims to identify the types of ectoparasites and factors that influence the presence of ectoparasites in spiny lobsters and determine the intensity and dominance of spiny lobster ectoparasites. The study was conducted in floating net cages (KJA). It controlled Lampung Marine Aquaculture Center (BBPBL) tanks by purposive random sampling with 18 spiny lobsters, each taken from KJA and controlled tanks. The stages of the study included taking mucus samples on the tail and swimming legs (pleopods), microscopic examination of ectoparasites, calculating the intensity and dominance of ectoparasites, and measuring water quality parameters. The study results obtained three ectoparasites infecting the Spiny lobster, including the Protozoa phylum and the Ciliata class: Vorticella sp., Zoothamnium sp., *and Epistylis* sp. *The intensity of Vorticella sp. ectoparasite attacks was 11.5/lobster. The most dominant ectoparasite was the Vorticella sp. type at 53.90%. The difference in the number of ectoparasites in controlled tanks and floating net cages was due to differences in temperature, size of the cultivation container, and depth, which affected water quality.*

Keywords: *controlled tanks, ectoparasites, floating net cages, Panulirus homarus*

How to Cite: Fatimatuzahra, I., Istiadi, K.A., Garbono, A. (2025). Ectoparasites Identification on Panulirus homarus Cultivated in Controlled Tanks and Floating Net Cages (KJA) at the Lampung Marine Aquaculture Center (BBPBL). *Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati (J-BEKH)*, 12(1), 119-131. https://doi.org/10.23960/jbekh.v9i1.411

INTRODUCTION

The most common fisheries cultivation system in Indonesia is lobster [1]. The five lobster species in Indonesia include Spiny lobster (*Panulirus homarus*), Pearl Lobster (*Panulirus ornatus*), Batik Lobster (*Panulirus longipes*), Bamboo Lobster (*Panulirus versicolor*), and Rock Lobster (*Panulirus penicillatus*) [2]. An interesting fishery commodity to cultivate due to high market demand is the Spiny lobster (*Panulirus homarus*) [3]. The price of Spiny lobster (*Panulirus homarus*) is relatively high in domestic and export markets, so domestic lobster cultivation needs to be increased to support the economy. [4].

The spiny lobster (*Panulirus homarus*) cultivation system can be carried out offshore using cages [5]. In some areas, such as the Center for Marine Aquaculture (BBPBL) Lampung, the cultivation of spiny lobsters (*Panulirus homarus*) is conducted using Floating Net Cages (KJA) and controlled tanks (fiberglass tanks and concrete tanks). Different depths in cultivation in Floating Net Cages (KJA) with controlled tanks might affect lobsters' survival rate and growth. Differences in the size of the cultivation container and the depth of the use of sinking cages with controlled tanks affect water quality. Tank leads to the accumulation of organic compounds at the bottom of the waters and can increase the risk of parasite attacks. One of the issues of Spiny lobster cultivation (*Panulirus homarus*) is usually caused by an ectoparasite. The types of ectoparasites typically found in the Crustacea group, including spiny lobsters, are the protozoa group: *Epistylis* sp., *Vorticella* sp., and *Zoothamnium* sp. [6], [7].

The growth and distribution of ectoparasites are influenced by environmental conditions, both biotic and abiotic factors. Indonesia is a tropical country with a climate that supports parasite development and its spread. Ectoparasites cause losses in Spiny lobster cultivation due to various diseases. Hence, effective and efficient disease control management is needed to reduce the impact of the disease. Appropriate and suitable cultivation methods are expected to optimize environmental conditions to reduce the risk of ectoparasite attacks and increase the results of Spiny lobster (*Panulirus homarus*) cultivation. Therefore, this study was conducted to determine the types of ectoparasites infecting Spiny lobster (*Panulirus homarus*) and to determine the intensity and dominance of ectoparasites and environmental factors that influence the presence of ectoparasites in Spiny lobster (*Panulirus homarus*).

METHODS

Materials

The tools used in this study were an object glass, dropper pipette, cover glass, microscope (Zeiss Primo Star) to observe parasite samples, scales to weigh lobsters, rulers to measure the body length of Spiny lobster, scalpel/spatula for taking Spiny lobster mucus, Petri dishes as sample containers, and scoop nets to take Spiny lobster samples. The materials used for this study were 2-year-old Spiny lobsters with an average size of 22 cm from Floating Net Cages (KJA) and controlled tanks, and NaCl as a physiological solution to keep the ectoparasite samples alive during observation.

Sampling

The sampling locations for ectoparasites of Spiny lobster include cultivation locations in Floating Net Cages (KJA) and controlled tanks at the Lampung Marine Aquaculture Center (BBPBL). Sampling of ectoparasites was carried out on the swimming legs (pleopods) and tail of the Spiny lobster. The tail is part of the external body organ with fine hair, making it easier for ectoparasites to attach [11]. Ectoparasites are also taken from swimming legs (pleopods) and walking legs (pereiopods) because these parts are often exposed and in direct contact with the bottom water environment, thus increasing the possibility of ectoparasite infection [12]. From the controlled tank and KJA, nine individuals were taken as samples with the inclusion criteria of 16-25 cm length and aged around 2 years. Spiny lobsters taken as samples are those that showed clinical symptoms such as lesions or wounds on the surface of the lobster's body that can be seen, changes in the color of the exoskeleton, and the presence of nodules or lumps on the body of the Spiny lobster. In this study, identification of ectoparasites refers to the identification guidebook entitled *Marine Fish and Crustacean Diseases in Indonesia.* [13].

Data Analysis

Data analysis was conducted by calculating the intensity and dominance of ectoparasites infecting Spiny lobsters (*Panulirus homarus*). Intensity is the number of parasites found in individuals at a particular time compared to the total number of infected individuals. Ectoparasite intensity can be calculated using the formula [14]:

$$\text{Intensity} = \frac{\sum \text{Parasites found}}{\sum \text{infected lobster}}$$

The data obtained were calculated using the formula to determine dominance as follows [15]:

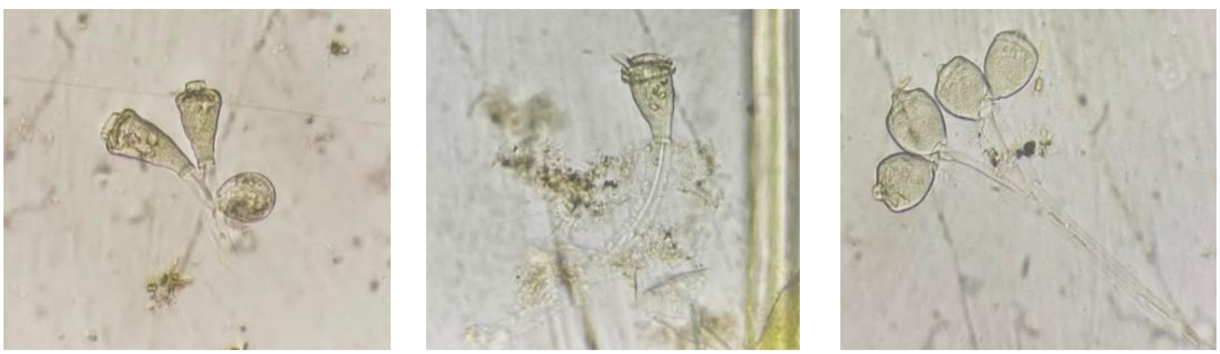
$$\text{Dominance} = \frac{\sum \text{parasites found per genus}}{\sum \text{Total parasites}}$$

Table 1. Parasite infection intensity criteria [16]

Intensity	Category
<1	Very low
1-5	Low
6-50	Moderate
51-100	Severe
>100	Very severe
>1000	Superinfection

RESULTS AND DISCUSSION

Ectoparasite observations on the Spiny lobster were conducted on the external organs of the Spiny lobster, tail, and swimming legs (pleopods). The locations for sampling ectoparasites of Spiny lobster included cultivation locations in Floating Net Cages (KJA) and the controlled tanks at the Lampung Marine Aquaculture Center (BBPBL). The types of ectoparasites obtained and infecting the Spiny lobster are shown in Table 2 and Figure 1.



(a) (b) (c)

Figure 1. Types of ectoparasites that infect spiny lobsters (*Panulirus homarus*) in BBPBL, (a) *Epistylis* sp., (b) *Vorticella* sp., (c) *Zoothamnium* sp., (100x magnification).

Based on microscopic analysis, ectoparasites that infect Spiny lobster (*Panulirus homarus*) belong to the Protozoa phylum and the Ciliata class. The ectoparasites found are *Epistylis* sp., *Vorticella* sp., and *Zoothamnium* sp. Based on the literature, ectoparasites such as *Zoothamnium* sp., *Vorticella* sp., and *Epistylis* sp. are the Ciliata class that most often infect crustaceans [6], [7], [12], [17], [21], [22]. *Zoothamnium* sp. has a round shape and a branched stalk that can lengthen and shorten (Figure 1.c). *Zoothamnium* sp. has round zooids with cilia, is whitish, lives as colonies, has a branched contractile stalk, and is 50-70µm in size [23]. The ectoparasite *Epistylis* sp. in this observation is like *Zoothamnium* sp., which lives in colonies and has branched but non-contractile stalks and a flat, elongated zooid shape (Figure 1a). *Epistylis* sp. has flat, elongated zooids, transparent in color, branched stalks, non-contractile, living as colonies, measuring 45-49 µm, [20], [23]. *Vorticella* sp. found infecting Spiny lobster (*Panulirus homarus*) has a contractile and bell-shaped stalk, cilia, no branches, and lives solitary (Figure 1.b). *Vorticella* sp. has an inverted bell-shaped zooid with cilia and a flat, cylindrical stalk with a disc attached to the substrate [22], [24]. Data on the types and number of ectoparasites found in Spiny lobsters (*Panulirus homarus*) are shown in Table 2.

Table 2. Data on the types and number of ectoparasites identified in spiny lobster (*Panulirus homarus*) samples at BBPBL Lampung.

No	Species	Number of parasites in KJA	Number of parasites in Controlled Tanks
1	*Epistylis* sp	-	12
2	*Vorticella* sp	62	7
3	*Zoothamnium* sp	13	34
	Total	75	53

The type of ectoparasite found in Spiny lobster (*Panulirus homarus*) in KJA is *Vorticella* sp. (62 individuals), while seven are in the controlled tank. The ectoparasite *Epistylis* sp. is in the controlled tank (12 individuals). Meanwhile, *Epistylis* sp. was not found in the floating net cage (KJA). Thirty-four individuals of *Zoothamnium* sp. were found in the controlled tank, while in the KJA, only 13 individuals were found. Based on the results of observations, the ectoparasite types *Epistylis* sp. and *Zoothamnium* sp. were most commonly found in the controlled tank compared to the floating net cage (KJA). The ectoparasite, *Epistylis* sp., was not found in the floating net cage (KJA) because the water conditions had large waves. *Epistylis* sp. cannot survive because this type of ectoparasite does not have a contractile stalk, which makes it easier for the ectoparasite to move when environmental conditions are not optimal [17]. Differences in the size and depth of the cultivation containers and poor management of the place affect the distribution of ectoparasites. Floating Net Cages (KJA) are 4x4x4 m^3 in size, while controlled tanks consist of concrete tanks 3.4 m × 1.5 m × 0.66 m in size. The depth of the tanks correlates with the risk of parasites. Tanks that are too deep can cause the accumulation of organic compounds at the bottom of the water and increase the risk of parasites [18], [19]. Moreover, the water quality of controlled tanks is maintained; hence, the accumulation of organic compounds can be avoided, and the risk of parasites can be minimized. Ectoparasites in Floating Net Cages (KJA) and controlled tanks are related to maintenance and cleanliness factors. In controlled tanks, nets are cleaned and changed daily, while in KJA, the nets are cleaned and changed once a month. The cleaning period for the cultivation container is too long, lowering the water quality due to the large amount of dirt and leftover feed that accumulates. Providing too much feed causes leftover feed to sink and its organic compounds to accumulate in the water, leading to the growth of parasites [20]. The intensity and dominance of ectoparasites infecting Spiny lobster (*Panulirus homarus*) are shown in Table 3.

Table 3. Intensity and dominance of ectoparasites in spiny lobster (*Panulirus homarus*) samples at BBPBL Lampung

No	Genus	Infected lobster	Dominance	Intensity	Intensity
1	*Epistylis* sp	4	9,37%	3	Low
2	*Vorticella* sp	6	53,90%	11,5	Moderate
3	*Zoothamnium* sp	8	36,71%	5, 87	Moderate

The results of observations of ectoparasites of Spiny lobster (*Panulirus homarus*) showed that there was a difference between the number of ectoparasites in Floating Net Cages (KJA) and controlled tanks (Table 3). Spiny lobster (*Panulirus homarus*) was most infected with *Zoothamnium* sp. (eight individuals), while *Epistylis* sp. and *Vorticella* sp. were four and six individuals, respectively. The highest intensity and dominance of ectoparasite infection was *Vorticella* sp., with as many as 53.90% and 11.5%, respectively, and was included in the moderate intensity category. The intensity and dominance of ectoparasite sp. were 36.71% and 5.87/lobster, respectively, and were categorized as moderate intensity. The intensity and dominance of sp. of 9.37% and 3/lobster were classified as low intensity. The high number of *Vorticell*a sp. in the waters is reinforced by the fact that Vorticella sp. is solitary. [6], [23], [25], [26]. The growth of solitary individuals will be faster than that of colonial individuals. The stalks of *Vorticella* sp. can shorten and roll up to support the movement [27]. This is what allows *Vorticella* sp. to live and survive in strong currents. The stalk of *Vorticella* sp. can shorten and roll up when stimulated by movement [27]. Vorticella sp. has a macronuclear contractile vacuole, a buccal cavity, and a stalk with a protective sheath [28]. The high growth rate of *Vorticella* sp., which divides every 6 hours, leads to higher infections.

Three types of ectoparasites found in this study, namely *Vorticella* sp., *Zoothamnium* sp., and *Epistylis* sp., are types of ectoparasites identified in spiny lobster (*Panulirus homarus*) samples at the BBPBL Lampung cultivation location, both in floating net cages (KJA) and controlled tanks. This shows that the three species are ectoparasites that were present and developing in the BBPBL Lampung waters when the study was conducted. This limited finding is based on the results of direct microscopic observations of 18 samples of external body mucus (tail and pleopod) showing clinical symptoms of infection. The identification method used is descriptive morphological, referring to the literature stating that *Vorticella* sp., *Zoothamnium* sp., and *Epistylis* sp. are common Ciliata groups that are often found in crustaceans [6], [7], [12], [16], [17], [18]. Thus, the absence of other types of ectoparasites in this study was not due to limited observations but because only these three types were found in spiny lobsters at the location and time of sampling at BBPBL Lampung.

Ectoparasites are taken from the tail and swimming legs of the Spiny lobster (*Panulirus homarus*). The tail is part of the external body organ of the Spiny lobster (*Panulirus homarus*), which has fine hair that is used to attach to the substrate [11]. Ectoparasites are also found on swimming legs (pleopods) and walking legs (pereiopods) because these parts are often exposed and in direct contact with the bottom water environment, thus increasing the possibility of ectoparasite infection [12]. Swimming legs (pleopods) can differentiate between male and female spiny lobsters [29]. In this observation, the sample used was the Spiny lobster (*Panulirus homarus*), measuring 16-25 cm and an age range of 2 years. Body size affects the number of ectoparasites on the host [20]. Large Spiny lobsters (*Panulirus homarus*) will have more parasites than smaller Spiny lobsters (*Panulirus homarus*); this is because the wider the body surface of the Spiny lobster (*Panulirus homarus*), the more areas can be colonized by ectoparasites. Other studies state that the presence of ectoparasites is not only caused by the body size and age of the host, but environmental factors that experience fluctuations also affect the presence of ectoparasites [30].

The results of water quality measurements are presented in Table 4. Based on the results of the study, it was found that the results of water quality measurements carried out in Floating Net Cages (KJA) and controlled tanks were included in the category of meeting the requirements for cultivation according to the Decree of the Minister of Environment Number 50 of 2004 concerning Sea Water Quality Standards for Marine Biota. Table 4 shows the results of water quality measurements carried out in Floating Net Cages (KJA) and controlled tanks included in the category of meeting the requirements for cultivation according to the Decree of the Minister of Environment Number 50 of 2004 concerning Sea Water Quality Standards for Marine Biota. The results show that the salinity, pH, DO (Dissolved oxygen), and temperature meet the requirements for cultivation. The water temperature in Floating Net Cages (KJA) and controlled tanks ranges from 28-30°C, which is good. Water salinity is 32 ppt; pH 7.8-7.9, and dissolved oxygen is >5. This shows that the water quality factor is good and suitable for cultivation [31], [32].

The ammonia measurements in controlled tanks showed that ammonia exceeded the quality standards. Meanwhile, the nitrite content in Floating Net Cages (KJA) and controlled tanks was also found to exceed the quality standards. The excess ammonia content in controlled tanks is due to the leftover feed piled up in the tank, thus increasing the organic matter content. The accumulation of leftover feed due to excessive feeding or overfeeding can affect the decline in water quality. Water quality parameters such as ammonium (NH), nitrite (NO_2), and nitrate (NO) tend to increase during overfeeding [33], [34]. *Vorticella* sp., *Zoothamnium* sp., and *Epistylis* sp. can live normally in good water quality, but these protozoa can increase their population in low water quality waters [35]. Low oxygen levels, high stocking densities, and. excessive feeding can increase organic matter content and trigger parasite growth [11]. Organic matter in the water is the result of leftover feed. During the observation of ectoparasites, a Spiny lobster (*Panulirus homarus*) was fed once a day in floating net cages (KJA), while in controlled tanks, feeding was done 3 times a day. The feed given was green mussels and small fish. If the organic matter content in the water is too high, it will affect the development process of ectoparasites, and endoparasites will increase in number [12]. Water conditions that contain a high amount of leftover feed cause the accumulation of organic materials, increasing ammonia levels and decreasing dissolved oxygen content in the water. The decreased dissolved oxygen content in the water causes ammonia to be more toxic [36].

Table 4. Water Quality Measurements in KJA and Controlled Tanks at BBPBL Lampung

System	Parameters					
	Salinity (ppt)	**Temperature (°C)**	**DO (mg/l)**	**pH**	**Ammonia (mg/L)**	**Nitrite (mg/L)**
Controlled Tanks	32	28,6	5,27	7,83	0,466	0,076
KJA	32	30,1	5,55	7,92	0,197	0,068
Standard	30- 34	28- 30	>5	7- 8,5	0,3	0,05

*DO: dissolved oxygen

Differences in water quality between controlled tanks and floating net cages (KJA) can affect the number of ectoparasites. Water quality in controlled tanks and floating net cages (KJA) is influenced by water depth. Spiny lobsters (*Panulirus homarus*) are often found in sandy coral habitats with a depth of around 1-5 meters. Spiny lobsters (*Panulirus homarus*) can also be found at depths of up to 90 meters. Floating net cages (KJA) at BBPBL have depths of 4 meters and 10 meters. Spiny lobster ectoparasites (Panulirus homarus) were sampled in KJA at a depth of 4 meters. The ideal water depth for floating net cages (KJA) ranges from 5 to 15 meters.

Meanwhile, in controlled tanks, the depth of the tank is around 66 cm. In controlled tanks with shallower depths, the risk of parasite attacks can be minimized, and environmental conditions can be better monitored. Water that is too deep can cause the accumulation of organic compounds at the bottom of the water and can increase the risk of parasites [34].

Ectoparasites do not cause direct death to the host because ectoparasites only use part of the host's body as a food source and as a habitat. The more abundant the parasites are on the host, the faster death will occur. Environmental conditions affect the existence of ectoparasites. Environmental conditions with unstable increases and decreases, especially temperature and cultivation containers containing leftover feed, will cause the accumulation of organic matter at the bottom of the water, and the DO (Dissolved Oxygen) content will be low [20].

CONCLUSION

In controlled tanks and floating net cages, three types of ectoparasites were found that infect Spiny lobster (*Panulirus homarus*): *Vorticella* sp., *Zoothamnium* sp., and *Epistylis* sp. belong to the Protozoa phylum and Ciliata class. Ectoparasites found in Spiny lobster (*Panulirus homarus*) are dominated by Vorticella sp., with a dominance value of 53.90%. The highest intensity of ectoparasite was *Vorticella* sp. (11.5/lobster) with medium intensity category, followed by *Epistylis* sp. (3/lobster) and *Zoothamnium* sp. (5.87/lobster), which are low-intensity categories. The distribution of ectoparasites is influenced by environmental factors such as water and feed quality, and susceptible host species. Ectoparasites emerge from an unbalanced interaction between host conditions, the environment, and pathogens.

CONFLICT OF INTEREST

I hereby declare that there is no conflict of interest in writing this scientific work.

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