Diversity and Intensity of Protozoan Ectoparasites of Black Tiger Prawn (*Penaeus monodon* Fab.) from Segara Anakan, Cilacap, Central Java

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**Abstract.** Ectoparasites can infect tiger prawns (*Penaeus monodon* Fab.) in which their ectoparasite-host relationship may be influenced by environmental conditions such as temperature, geographical location, water depth, and anthropogenic disturbances. This study aimed to determine the intensity of ectoparasite infection and to measure the parasite diversity in tiger prawns. Samples were taken randomly from the Sleko fish market in South Cilacap. The results revealed that the highest ectoparasite intensity was *Zoothamnium* sp. (29.33 individuals per prawn), indicating a moderate attack rate. The lowest ectoparasite intensity was *Vorticella* sp. (6.27 individuals per prawn) suggesting low attack rate. The ectoparasite diversity on tiger prawns reached 1.00 implying a moderate level of diversity.

1. Introduction

Infection of ectoparasites may occur on marine organisms, such as black tiger prawn (*Penaeus monodon*). They may infect various life stages of the prawn, inhibiting their growth and development [1]. Ectoparasite infections may be affected by the environmental condition in which prawn and ectoparasites coexist. Parasite virulence against prawn resistance and prawn susceptibility may lead to parasite infection. Prawn mobility in its habitat may also enhance parasite exposure to it so that ectoparasites can infect a suitable host. Host-parasite population dynamics can be affected by ectoparasite occurrence, thus leading the parasite as a significant agent of natural selection [3]. Ectoparasite abundance and richness within the host population might form a basic pattern of parasite interaction.

Environmental condition, such as temperature, geographical location, water depth, and anthropogenic disturbances, may affect host-parasite relationship [21]. The sea water and river surrounding the industrial area in Cilacap may alter the physical condition of the water. The waste that enters the water banks and ends in the sea causes water quality degradation and chemical sediment deposit at the seabed [19]. These conditions disrupt the physical condition for prawn, enhance ectoparasite infection, hence lead to prawn population decline [1].

Previous research showed that prawns reared in culture were susceptible to ectoparasite infection [16]. However, there is no published research of ectoparasites on wild black tiger prawn thus information concerning its infection is unavailable. Data of parasite occurrence, such as diversity and intensity, is required to understand host-parasite ecology of the aquatic area [18]. Based on those
arguments, this research aimed to study the diversity and intensity of ectoparasites of caught wild Black Tiger Prawn (*Penaeus monodon* Fab.) from Kampung Laut waters, Cilacap.

2. **Methods**

The methods included sampling of wild prawn at Sleko fish market, ectoparasite observation, identification, and determination. This research used survey method and random sampling techniques. Total numbers of 20 caught prawns were obtained from the fishermen (10% x 10 kg caught prawn = 1 kg prawn sample). Samplings were done four times every five days in June 2017.

The ectoparasite intensity was calculated with Moller-Anders equation and the data were descriptively analyzed by comparing to the criteria of ectoparasite infection according to Williams and Williams [25]. Diversity index was determined with Shannon-Wiener equation [17] and diversity index was descriptively analyzed by comparing with standard index criteria.

3. **Results**

The results showed that not all of the 80 Black Tiger prawn samples were infected by ectoparasites. The observation resulted that only 54 of prawn samples were infected. There were three species of ectoparasites that infected the prawns, *Zoothamnium* sp., *Vorticella* sp. and *Epistylis* sp., that belong to phylum Protozoa (Figure 1).

![Figure 1](image.png)

**Figure 1.** Observed Ectoparasites on wild-caught Black Tiger Prawn from Sleko fish market, Cilacap Regency. a. *Zoothamnium* sp., b. *Vorticella* sp., c. *Epistylis* sp. (400 X).

Table 1 represents the total numbers of ectoparasites. Total of 734 ectoparasites were observed on pereopods of 41 prawn samples. The result of ectoparasite intensity calculations was shown in Table 2. *Zoothamnium* sp. had the highest ectoparasite intensity (29.33 ind/prawn) indicating moderate level of infection, while *Vorticella* sp. had the lowest intensity (6.27 ind/prawn) suggesting low level of infection. Diversity index showed the level of ectoparasite diversity in prawn population. The value on diversity index was calculated from the total number of ectoparasite found in prawns. The diversity of ectoparasite in black tiger prawn was moderate (value of 1.00).

| No | Ectoparasite Species | ∑ Ectoparasite | ∑ Prawn Infected | Intensity (Ind/prawn) |
|----|----------------------|---------------|-----------------|----------------------|
| 1  | *Zoothamnium* sp.    | 968           | 33              | 29.33                |
| 2  | *Vorticella* sp.     | 301           | 48              | 6.27                 |
| 3  | *Epistylis* sp.      | 638           | 35              | 18.23                |

4. **Discussion**

Ectoparasitic protozoans are easier to find on the surface of prawn body rather than other ectoparasites. This finding of ectoparasitic protozoans, *Epistylis* sp., *Vorticella* sp., and *Zoothamnium* sp., was similar to the ectoparasites infected Penaeid prawn [16].
The Zoothamnium sp. cell was inverted bell shape with stalk attached to the prawn body and formed a colony of 5 to 10 individuals. The colony was white with a round shape. The protozoan was mostly found in the pereopod area during observation. Previous research reported that Zoothamnium sp. had conically elongated to almost round shape with the size of 50-70 µm, had posterior stalk attached to a substrate, lived in a colony, with white coloration and attached to its host by myoneme [6].

The Vorticella sp. had a yellowish inverted bell shape cell and moveable stalk. It was a solitary ectoparasite. This finding is coincidence with a reported observation of Vorticella sp., which also mentioned the species to have contracted cell, macronucleus, adoral membrane, and long stalk [20]. The moveable stalk that shortens and coils allows this ectoparasite to move around [2]. Vorticella sp. was mostly found at pleopod during observation.

Epistylis sp. showed the shape of an inverted bell. The differences with Zoothamnium sp. was that it had an elongated rather than round shape. Epistylis sp. had white transparent coloration and formed many colonies. These characters were similar to the previously reported morphological observation of Epistylis sp. which had elongated, inverted bell shape with transparent coloration, flagellum, macronucleus, infundibulum, contracted cell and formed a colony of 2 to 5 individuals [20]. Similar with Zoothamnium sp., Epistylis sp. was mostly found at the pereopod area.

The ectoparasitic protozoans of each body part were counted to detect their infection intensity. Pereopods and pleopods were susceptible to ectoparasite infection. Pereopods are mostly motile, thus enhance the probability of direct contact among prawns in their habitat of the sea bed. These conditions increase the ectoparasite virulence through pereopods and pleopods. Ectoparasites usually inhabit the most active parts of the body because of high oxygen rate, as in fish operculum or pectoral fins. The highest ectoparasite infections were concentrated on pereopods. The pereopod and pleopod mobilities on the substrate are most likely to contribute to the high intensity on both areas [16]. Direct contact of pereopods and pleopods with the muddy substrate at the base of water causes the highest infection rate on those areas [26]. Those factors initiate the attachment and rapid distribution of parasitic organisms at the water base, thus leading to higher intensity of protozoan ectoparasite.

The ectoparasite intensity showed the degree of ectoparasite infection on prawn. Ectoparasite infections are common in prawn culture with poor water quality. Moreover, ectoparasites can reproduce in a short amount of time and well adapted to a new environment. The ability of ectoparasite in overcoming prawn’s immunity might increase the intensity of parasite infection. The ectoparasite survival rate on prawns is caused by the parasite adaptation ability in a new environment and prawns low response against ectoparasite occurrence [23].

Intensity value can be affected by the prawn maturity. The bigger and heavier the host, the higher the level of parasite infection [15] in [23]. There is also a different number of ectoparasite that infects adult and juvenile host [9]. There are many cases indicate that infection level has fluctuated with age [4]. The similar phenomena also occur in Kaureling fish (Tor tambra) in which the endo and ectoparasite prevalence and infection are higher in adult fish [13] [14].

The moderate infection level of Zoothamnium sp. enables high parasite distribution in prawn and high rate of ectoparasite productivity. Ectoparasitic protozoans are common in prawns including Black Tiger prawn, and Penaeid prawns, such as “udang pisang” (Penaeus sp.) and vannamei prawn (Litopenaeus vannami). The ectoparasite infected “udang pisang” and vannamei prawn are the member of Ciliata [16]. Several species of Ciliata includes Zoothamnium sp., Vorticella sp., and Epistylis sp. to which the former is identified as ectoparasite in black tiger prawn [27].

Zoothamnium sp. is ectoparasite with the highest intensity because of its ability to adapt to a new environment and its rapid reproduction. Moreover, it can infect all stages of prawns, from eggs, larva, juvenile to adult, in water with low dissolved oxygen [12]. The species infected prawns body surface, pereopods, pleopods, rostrum, and gills, and causes respiration difficulty, low mobility and foraging of the prawns.

This result indicated that only few ectoparasites found in prawn thus suggested low diversity. The ectoparasite richness that infected prawn influenced the index value. More species leads to higher
diversity although its value also depends on the individual number of each species [24]. Prawns diversity index is determined by ectoparasite richness and its abundance in prawn [10].

The decline in prawn physiology causes susceptibility against infection. Prawn samples had lived in open water near an industrial area whose waste most likely degraded the physical water condition. This water condition, as the prawn habitat, has weakened their immunity and leads to ectoparasite infection [5].

The diversity of ectoparasite in cultivation was lower than that in open water. It showed value of 0.79 in polyculture ponds, which indicated low diversity [5]. It possibly due to less availability of intermediate hosts to support the ectoparasite life cycle. The diversity of ectoparasite was lower in cultivation than in open water since the parasites in cultivation often had direct life cycle [11], probably because the required intermediate or final host for a normal life cycle was not available.

5. Conclusion

In conclusion, Zoothamnium sp. and Epistylis sp. showed a moderate level of intensity, and Vorticella sp. showed a low level of intensity. The ectoparasites on Black Tiger prawn in Kampung Laut, Cilacap Regency showed a moderate level of diversity.

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