Identification, prevalence, and intensity of ectoparasite protozoa in white-leg shrimp *Litopenaeus vannamei* (Boone, 1931) at traditional and intensive shrimp ponds

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Abstrak

Penelitian ini menyelidiki prevalensi, keragaman, dan intensitas protozoa ektoparasit yang menginfeksi *Litopenaeus vannamei* di tambak udang tradisional dan intensif. Sebanyak 25 ekor udang dari masing-masing tipe tambak diperiksa untuk mengetahui keberadaan protozoa ektoparasit. Empat spesies parasit diidentifikasi di tambak tradisional: *Zoothamnium* sp., *Epistylis* sp., *Vorticella* sp., dan *Trichodina* sp. Sebaliknya, tiga spesies (*Zoothamnium* sp., *Epistylis* sp., dan *Vorticella* sp.) ditemukan di tambak intensif, dan *Trichodina* sp. tidak ditemukan pada tambak intensif. Prevalensi protozoa ektoparasit lebih tinggi di tambak intensif, dengan 88% udang terinfeksi, dibandingkan dengan 20% di tambak tradisional. Intensitas infeksi juga lebih tinggi di tambak intensif, dengan intensitas rata-rata 10,27 dikategorikan sedang, dibandingkan dengan intensitas 5,2 di tambak tradisional, yang dikategorikan rendah. Temuan ini menunjukkan bahwa kondisi budidaya intensif dapat berkontribusi terhadap peningkatan kerentanan terhadap infeksi ektoparasit pada udang. Studi ini menekankan pentingnya pemantauan dan pengelolaan infestasi parasit untuk mengurangi risiko kesehatan pada sistem budi daya udang.

Kata kunci: ektoparasit, *Litopenaeus vannamei*, protozoa, prevalensi, *Vorticella* sp.

Abstract

This study investigated the prevalence, diversity, and intensity of ectoparasitic protozoa infecting Litopenaeus vannamei in traditional and intensive shrimp ponds. A total of 25 shrimp from each pond type were examined for the presence of ectoparasitic protozoa. Four parasite species were identified in traditional ponds: Zoothamnium sp., Epistylis sp., Vorticella sp., and Trichodina sp. In contrast, three species (Zoothamnium sp., Epistylis sp., and Vorticella sp.) were found in intensive ponds, with Trichodina sp. absent in the latter. The prevalence of ectoparasitic protozoa was higher in intensive ponds, with 44% of shrimp infected, compared to 8% in traditional ponds. The intensity of infection was also higher in intensive ponds, with an average intensity of 10.27, categorized as medium, compared to an intensity of 5.2 in traditional ponds, categorized as low. These findings suggest that intensive farming conditions may contribute to increased susceptibility to ectoparasitic infections in shrimp. The study emphasizes the importance of monitoring and managing parasite infestations to reduce health risks in shrimp aquaculture systems.

Keywords: Ectoparasite, Litopenaeus vannamei, protozoa, prevalence, Vorticella sp.

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Introduction

White-leg shrimp (*Litopenaeus vannamei*) is a primary species in global aquaculture, prized for its rapid growth, resilience, and adaptability to various farming methods (Li *et al*., 2024). White-leg shrimp in many regions are cultivated using traditional and intensive pond systems. Intensive ponds, with controlled

environments and higher stocking densities, aim to maximize yield and productivity. In contrast, traditional ponds often rely on natural water exchange, with lower stocking densities and minimal external inputs. The use of traditional, semi-intensive to intensive farming systems in vannamei shrimp farming activities can cause a decrease in the quality of rearing water in ponds, which can lead to various diseases that cause enormous losses for vannamei shrimp farmers (Hamdillah *et al.*, 2023). Poor environmental conditions caused by high stocking densities and feed residues can increase water ammonia levels and accumulation of waste in cultivation ponds, making shrimp more susceptible to disease (Bintang *et al.*, 2022).

Protozoan ectoparasites are among the most common pathogens in shrimp aquaculture. The bottom of concrete and plastic pool walls is a potential place for ectoparasites to attach, especially in the protozoan group (Nurlatiffah & Ulkhaq, 2019). Species such as *Zoothamnium* sp., *Epistylis* sp., and *Vorticella* sp. are attached to the exoskeletons (Kakoolaki & Afsharnasab, 2016), body, gills, swimming leg, and walking leg of the shrimp (Hafidloh & Sari, 2019). Another protozoan ectoparasite that can infest aquatic organisms is the *Trichodina* sp. Infestation of these parasites causes irritation, tissue damage, and secondary infections. High parasitic loads can lead to impaired growth rates, increased susceptibility to other pathogens, and, in severe cases, mortality (Al Musaedi & Alsaady, 2022).

The objective of this study is to assess and compare the intensity and prevalence of ectoparasitic protozoa in white-leg shrimp from traditional and intensive pond systems. This research aims to provide valuable insights into the relationship between farming practices and protozoan infestations, potentially guiding effective disease management strategies for sustainable shrimp aquaculture.

METHOD

This study was conducted from October until November 2024. Materials needed for research are shrimp that come from traditional and intensive shrimp ponds in Banyuwangi, East Java. Materials used for the parasite examination are oil immerse, aquades, labels, and samples of white-leg shrimp with an average length and weight of 4.23 cm and 9.10 gr. The equipment required for sampling the white-leg shrimp is an ice box. The tools for sampling the white-leg shrimp are a ruler, scissors, surgical tweezers, scalpel, scoop, glass object, glass cover, microtube, binocular microscope, trinocular microscope, and binoculars equipped with a lucida camera. This research used a survey method to gather facts from existing symptoms and provide a factual explanation of the social, economic, and political institutions (Apriyadi *et al*., 2023).

Sampling location is done at traditional ponds (Wonosari Beach) 8°14'35.8" S 114°23'01.3" E and intensive ponds (Mibama-Karangrejo) 8°13'42.9" S 114°23'05.9" E. The identification of parasites is based on specific organs associated with systematic determinants, such as the ectoparasites of shrimp. The researcher then scraped the tail, body surface, gills, walking, and swimming legs. The scraping results were observed under a microscope-type OLYMPUS CX23 with 40X, 100X, and 400X magnification. Identification of ectoparasites is based on identification keys Margolis & Kabata, 1989), Grabda (1991), & Gibson (2002). The prevalence values were calculated for each species of ectoparasites found in shrimps. Data analysis was conducted descriptively to identify and analyze the prevalence and intensity of ectoparasites.

Results And Discussion

Based on the results of parasite identification, *Litopenaeus vannamei* from traditional shrimp ponds were found to be infected by the following ectoparasitic protozoa: *Zoothamnium sp., Epistylis sp.,*

Vorticella sp., and *Trichodina sp.* Meanwhile, shrimp from intensive ponds were infected by *Zoothamnium sp.*, *Epistylis sp.*, and *Vorticella sp.* The absence of *Trichodina sp.* in intensive ponds suggests possible differences in environmental conditions or management practices influencing parasite prevalence and diversity. The prevalence of ectoparasitic protozoa in *Litopenaeus vannamei* was compared between traditional and intensive shrimp ponds. Of the 25 shrimp samples examined from traditional ponds for 2 months, 10 (40%) were infected with ectoparasitic protozoa. In contrast, a higher prevalence was observed in samples from intensive ponds, where 22 out of 25 shrimp (88%) were infected. These findings suggest that shrimp reared in intensive systems may be more susceptible to ectoparasitic protozoan infections than those in traditional systems. Table 1. Show the data of the intensity of ectoparasites in traditional shrimp ponds. And then, data on the prevalence calculation in traditional shrimp ponds can be seen in Table 2. *Zoothamnium*, a genus of peritrich ciliates, plays a significant role in shrimp aquaculture as a pathogen and a potential immunostimulant.

Table 1. Intensity of Ectoparasite Protozoa in *Litopenaeus Vannamei* in Traditional Pond Shrimp

Parasite Type	Number of Parasites	Number of Shrimp Examined	Number of Infested Shrimp	Prevalence	Category	Intensity	Category
Zoothamnium sp.	15	25	4	16%	Often	3.75	Low
Epistylis sp.	11		2	8%	Sometimes	5.5	Medium
Vorticella sp.	25		3	12%	Often	8.33	Medium
Trichodina sp.	1		1	4%	Sometimes	1.0	Low
Total	52	25	10	20%	Often	5.2	Medium

Table 2. Intensity of Ectoparasite in Intensive Pond Shrimp

Parasite Type	Number of Parasites	Number of Shrimp Examined	Number of Infested Shrimp	Prevalence	Category	Intensity	Category
Zoothamnium sp.	163	25	11	44%	General	14.82	Medium
Epistylis sp.	10		4	16%	Often	2.5	Low
Vorticella sp.	53		7	28%	Often	7.57	Medium
Total	226	25	22	88%	Usually	10.27	Medium

***Zoothamnium* sp.**

Zoothamnium, a genus of peritrich ciliates, plays a significant role in shrimp aquaculture. *Zoothamnium* sp. is a common ectoparasite found on the gills of white-leg shrimp (*Litopenaeus vannamei*), often leading to gill fouling and associated health issues. Infestation levels can vary, with higher densities observed in stagnant water conditions. *Zoothamnium* species exhibit diverse colony forms, such as umbellate colonies reaching up to 900 µm high and dichotomously branched stalks (Wu *et al*., 2020). The intensity in intensive ponds is lower at 3.75 (Low) compared to traditional ponds, which is 14.82 (Medium). *Zoothamnium* is found on the tail, swimming legs, and walking legs (Sarjito *et al*., 2016). The clinical symptoms of shrimp infected with *Zoothamnium* are that the body surface is covered with brown attached parasites, the digestive tract is empty, and the shrimp swims on the surface (Mahasri *et al*., 2018). *Zoothamnium* causes the disease zoothamniosis, which can cause death in secondary infection (Mukti, 2020). *Zoothamnium* is shown in Figure 1.

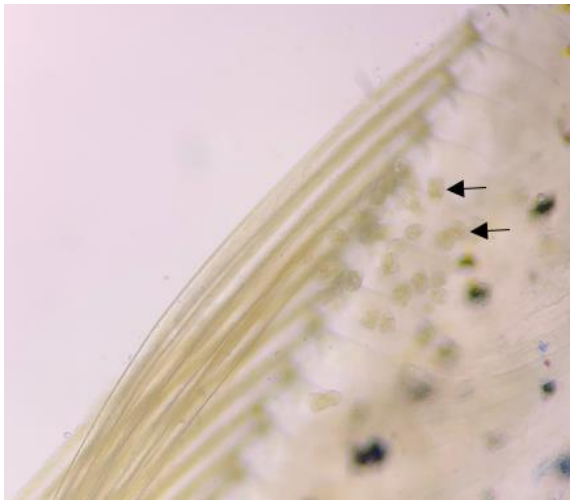

Figure 1. Ectoparasite *Zoothamnium* sp. which infested vaname shrimp under light microscopy OLYMPUS CX23 with 100x magnification (Source: Private Documentation)

***Epystilis* sp.**

Epistylis, a genus of sessile peritrich ciliates, is another significant ectoparasite affecting shrimp aquaculture. *Epistylis* sp. commonly colonizes the exoskeleton and gills of white-leg shrimp (*Litopenaeus vannamei*), potentially causing gill fouling, reduced respiration efficiency, and increased susceptibility to secondary infections (Puspitasari & Sari, 2020). Infestation levels often correlate with water quality, with higher densities typically observed in environments with poor sanitation or high organic matter. *Epistylis* species, such as *E. plicatilis*, form colonies of 30-50 individuals with a dichotomously branched, non-contractile stalk (Ummah *et al*., 2024). The predilection of this parasite is found on the tail, swimming legs, and walking legs (Muttaqin *et al*., 2018). Shrimp infected with *Epistylis* show clinical symptoms of slow movement, and the shrimp's body turns into a mossy brownish color (Kakoolaki *et al*., 2017). The intensity value of intensive ponds is higher at 5.5 (medium) than traditional ponds at 2.5 (low). *Epistylis* is shown in Figure 2.

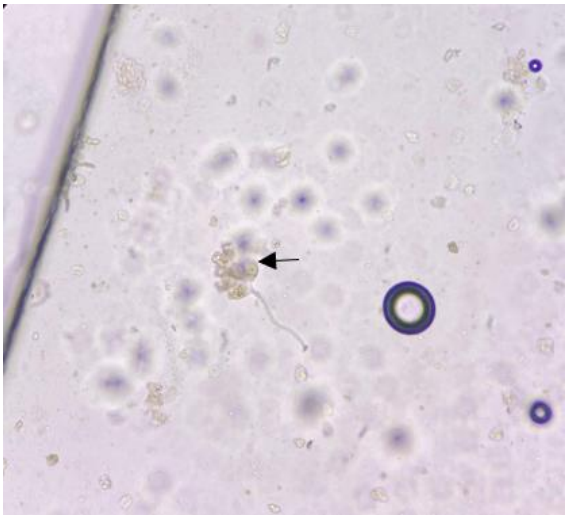

Figure 2. Ecroparasite *Epistylis* sp. which infested vaname shrimp under light microscopy OLYMPUS CX23 with 100x magnification (Source: Private Documentation)

***Vorticella* sp.**

Vorticella, a genus of bell-shaped peritrich ciliates, is a notable ectoparasite in shrimp aquaculture. *Vorticella* sp. can live in freshwater and marine waters (Abibulaeva & Dovgal, 2021). This protozoan parasite is generally found in conditions where the shrimp are stressed and affected by changes in water quality conditions. *Vorticella* sp. frequently attaches to the exoskeleton and gills of white-leg shrimp (*Litopenaeus vannamei*), leading to gill fouling and impaired respiratory function (Frischer *et al*., 2017). Infestations are often associated with elevated organic matter and stagnant water conditions. *Vorticella* species are characterized by their contractile stalks and solitary or clustered bell-shaped zooids, ranging from 50 to 200 μm in diameter (Liang *et al*., 2019). These ciliates use their ciliary movement to create water currents for feeding, but heavy infestations can disrupt shrimp health and growth (Li *et al*., 2019). *Vorticella* is depicted in Figure 3.

Figure 3. Ectoparasite *Vorticella* sp. which infested vaname shrimp under light microscopy OLYMPUS CX23 with 400x magnification (Source: Private Documentation)

***Trichodina* sp.**

Trichodina, a genus of mobile peritrich ciliates, is a well-known ectoparasite in shrimp aquaculture. *Trichodina* sp. commonly infests white-leg shrimp's gills, exoskeleton, and appendages (*Litopenaeus vannamei*) (Abd El-Lateif *et al.*, 2023). Infestation by *Trichodina* causes Trichodiniasis, often causing irritation, stress, and impaired physiological functions. *Trichodina* browses over gills and skin, damaging the host tissue and consuming the resulting dead tissues (Valladao *et al*., 2016). Parasites interfere with the nutrition of the host, cause metabolic disorders and digestive tract dysfunction, and damage the nervous system (Mishra *et al*., 2017). This parasite was only found in intensive pond shrimp with an intensity of 1.0 (low). These ciliates are typically associated with poor water quality and high stocking densities, which create favorable conditions for their proliferation (Decamp *et al*., 2007). *Trichodina* species are characterized by their disc-shaped bodies, measuring 30–70 μm in diameter, and a distinct adhesive disc equipped with rows of denticles used for attachment. Their rapid movement and capacity for reproduction make them a persistent challenge in aquaculture systems (Rahman *et al*., 2021). *Trichodina* can be shown in Figure 4.

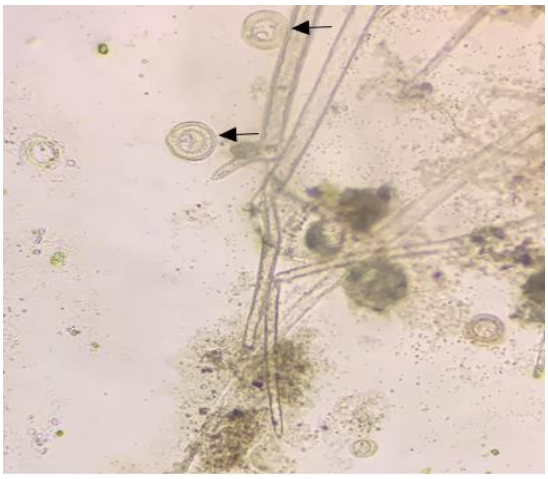

Figure 4. Ectoparasite *Trichodina* sp. which infested vaname shrimp under light microscopy OLYMPUS CX23 with 100x magnification (Source: Private Documentation)

These results highlight the varying degrees of infestation among different parasite types, emphasizing the need for targeted management strategies in shrimp

aquaculture. An analysis of ectoparasitic protozoa infecting *Litopenaeus vannamei* was conducted on 25 shrimp in traditional ponds, identifying four main parasite types. *Zoothamnium* sp. was recorded in four shrimp with 15 parasites, resulting in an intensity of 3.75, categorized as low. *Epistylis* sp. was found in two shrimp with 11 total parasites, giving an intensity of 5.5, categorized as medium. *Vorticella* sp.: Detected in three shrimp, with a total of 25 parasites, resulting in an intensity of 8.33, categorized as medium. *Trichodina* sp.: Observed in one shrimp, with only one parasite, yielding an intensity of 1.0, categorized as low. 52 ectoparasites were identified in 10 infested shrimp, with an overall intensity of 5.2, categorized as medium.

The prevalence and intensity of ectoparasitic protozoa infecting *Litopenaeus vannamei* were analyzed across 25 examined shrimp in intensive shrimp ponds. The study identified three main parasite types with varying infestation.

Zoothamnium sp. was found in 11 infested shrimp, with 163 parasites detected. The intensity of infestation was 14.82, categorized as medium. *Epistylis* sp.: Detected in four shrimp, with 10 total parasites. The infestation intensity was 2.5, categorized as low. *Vorticella* sp.: Identified in seven shrimp, with 53 parasites, resulting in an intensity of 7.57, categorized as medium. 226 ectoparasites were recorded across 22 infested shrimp, with an average intensity of 10.27, categorized as medium. These findings highlight differences in parasite prevalence and intensity, underscoring the importance of monitoring and managing ectoparasitic protozoa in shrimp aquaculture.

The results showed that the number of parasites, prevalence, and intensity of parasites found in *Litopenaeus vannamei* shrimp from intensive ponds were more significant than those in traditional shrimp ponds. This is possible due to several factors, one of which is the cultivation density. Intensive ponds tend to have higher density than traditional ponds (Wahyudi *et al*., 2019). High density can increase the transmission level between *Litopenaeus vannamei* shrimp in ponds (Maimunah & Kilawati, 2015), so more parasites are found in *Litopenaeus vannamei* shrimp from intensive ponds. Marista and Mahasri (2023) added that high stocking density causes competition for space, resulting in direct contact between the shrimp bodies so that ectoparasite infestation can increase easily and quickly. In addition, based on the research results (Mahasri & Heryamin, 2016), 80.74% of shrimp are invested in ectoparasites, which is closely related to the increase in stocking density and the prevalence of ectoparasites. High stocking densities can cause a decrease in water quality, resulting in shrimp stress and susceptibility to ectoparasite infections such as *Zoothamnium*, *Vorticella*, and *Epistylis* (Pamenang *et al*., 2020).

The factor of high and low parasite prevalence rates is caused by the adaptability of the parasite to the host body so that it can live and develop based on favorable environmental quality (Giorgetti, 1989). Hendri *et al*. (2021) added that in addition to high density, the spread of disease can occur due to poor water quality. Changes in water quality fluctuations cause shrimp stress so that they are easily infested with ectoparasites due to weak immune conditions (Nur & Munir, 2022). Factors contributing to increased parasite growth include high shrimp seed stocking, overfeeding, and low oxygen levels. Overfeeding causes too much remaining feed left in the pond, so it can increase the content of organic matter (Rosnizar *et al*., 2018). Intensive shrimp farming with high productivity allows for a large amount of feeding. Following the statement of Rahayuni *et al*. (2022) that ponds containing excessive feed residues will increase the content of organic compounds that can reduce dissolved oxygen in *Litopenaeus vannamei* shrimp farming with intensive systems to spur the growth of parasites.

CONCLUSION

The results of this study reveal significant differences in the prevalence, diversity, and intensity of ectoparasitic protozoa between shrimp reared in traditional and intensive pond systems. *Zoothamnium* sp., *Epistylis* sp., and *Vorticella* sp. were the most prevalent parasites in both pond types, though *Trichodina* sp. was only found in traditional ponds. The higher prevalence and intensity of infections in intensive ponds suggest that environmental factors and management practices, such as water quality and stocking density, may influence parasite proliferation. These findings underline the need for more effective management strategies, including routine monitoring and improved pond management, to mitigate the impact of ectoparasitic protozoa on shrimp health. Reducing parasite burdens through targeted interventions can enhance shrimp welfare and improve aquaculture productivity.

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