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Ectoparasite analysis in vaname shrimp in Padang Pariaman, West Sumatra, Indonesia

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ABSTRACT

Ectoparasites pose a significant threat to the health and productivity of vaname shrimp (*Litopenaeus vannamei*) in aquaculture settings, particularly in tropical regions. This study aimed to assess the prevalence, intensity, and dominance of ectoparasites in vaname shrimp ponds in Padang Pariaman, West Sumatra. This study was conducted from March to May 2024 in vaname shrimp ponds in Padang Pariaman, West Sumatra. Sampling was carried out at five different pond stations, and water quality assessments were carried out. Ectoparasites were identified, and their prevalence, intensity, and dominance were measured. Station II had the highest prevalence (100%), intensity (69 ind/shrimp), and dominance of ectoparasites from all other observation stations. The dominant types of ectoparasites were *Epystylis* sp. (37.81%), *Zootamnium* sp. (18.65%), and *Vorticella* sp. (20.64%). Water quality at five Vaname shrimp pond stations showed significant variations, especially in pH, COD, and ammonia parameters, with some values exceeding the quality standard. Station V was identified as the most critical location with the highest COD (90.08 mg/l) and ammonia (0.188 mg/l) values and pH below the optimal threshold. It is important to implement better pond management strategies to improve shrimp health and productivity while minimizing the ectoparasites on aquaculture systems in tropical regions.

Introduction

Vaname shrimp (*Litopenaeus vannamei*) cultivation has emerged as one of the most significant and rapidly developing sectors in the fisheries industry in Indonesia. Particularly in the Padang Pariaman area of West Sumatra, this species has gained popularity among aquaculture farmers due to its favorable biological and economic characteristics. Vaname shrimp are renowned for their rapid growth rates, resilience to fluctuating environmental conditions, and substantial market demand (Pratiwi *et al.,* 2021). These attributes have positioned Vaname shrimp farming as a lucrative venture, contributing to the local and national economy by providing income for coastal communities and fostering economic development (Billah *et al.,* 2022).

However, the sustainability of this sector is increasingly threatened by health challenges in shrimp ponds, particularly ectoparasite infestations (Deriyanti *et al.,* 2021). Ectoparasites such as protozoa, monogeneans, and crustaceans can attach to the gills and exoskeleton of shrimp, disrupting physiological functions and compromising shrimp health (Brazenor *et al.*, 2020). These infestations are associated with reduced growth, increased mortality, and significant economic losses due to the costs of treatment and the decreased value of the product (Mahasri *et al.*, 2021; Gomila *et al.*, 2023).

While ectoparasite-related issues in Vaname shrimp have been studied in several regions of Indonesia, there is a clear lack of published data specific to Padang Pariaman district, despite its growing role in shrimp production. Most existing studies either focus on other shrimp species or are conducted at broader provincial levels, leaving a knowledge gap regarding localized infestation dynamics—particularly in terms of species composition, prevalence, and environmental correlations in West Sumatra (Juliana *et al.*, 2023).

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Furthermore, previous research has rarely integrated ectoparasite identification with environmental water quality analysis, even though this integration is essential for understanding the drivers of infestation and predicting outbreak risks. Therefore, this study is novel in its systematic assessment of ectoparasite diversity, prevalence, and infestation intensity in Vaname shrimp in Padang Pariaman. Identifying the dominant ectoparasite species, assessing infestation severity, and understanding their effects on shrimp health can inform targeted control measures. Such measures may include the use of environmentally friendly chemicals, biological control agents, or improved pond management practices to reduce parasite loads (Mahasri *et al*., 2021).

The findings of this study are expected to provide critical baseline data for the development of locally adapted health management strategies (Putra *et al*., 2021). These strategies may include targeted interventions such as improved biosecurity measures, optimized pond management, or environmentally responsible parasite control techniques (Hakalahti *et al*., 2008). In doing so, this research contributes not only to the scientific understanding of shrimp ectoparasitology in Indonesia but also to the practical sustainability of shrimp aquaculture in one of its emerging production hubs. Therefore, this study aimed to analyze the ectoparasites of Vaname shrimp in Padang Pariaman district, West Sumatra.

Materials and Methods

Location and time of research

This research was conducted from March to May 2024 at five different stations across the Padang Pariaman area, West Sumatra. The selection of these stations was based on the distribution of representative Vaname shrimp ponds and variations in environmental conditions that could potentially influence ectoparasite infestations. Data were collected through direct field observations and purposive sampling to ensure that the information obtained was both representative and accurate.

Research Method

The methods used in this research were direct observation and purposive sampling. Direct observations were conducted to identify and record the presence and intensity of ectoparasite infestation in Vaname shrimp at five different pond sites in the Padang Pariaman area, namely Station I, Station II, Station III, Station IV, and Station V. Purposive sampling was employed to ensure that the samples collected were representative and could provide a comprehensive overview of ectoparasite infestation at each research station.

The sampling procedure consisted of two main steps. First, pond selection: each station was chosen based on specific criteria such as pond size, cultivation techniques, and geographical location. The selected ponds included sufficient variation to represent general conditions in the region. Second, shrimp sampling: shrimp samples were collected randomly from various parts of the pond to avoid sampling bias. At each station, five shrimp samples were taken.

Parameters Observed

In this study, the parameters observed included identification of ectoparasite types, ectoparasite prevalence, ectoparasite intensity, ectoparasite dominance, and pond water quality.

Ectoparasite Identification

Identifying the types of ectoparasites is a crucial first step in diagnosing the health challenges faced by Vaname shrimp. Shrimp samples collected from each pond were examined in the laboratory using light microscopy at 100x and 400x magnification to detect and identify ectoparasites attached to the gills, appendages, and body surfaces. Wet mount preparations were made by placing gill and body tissue on glass slides with a drop of saline solution to preserve their natural morphology. Identification was carried out based on morphological characteristics such as body shape, attachment organs, and movement patterns. To ensure accurate classification, we referred to established taxonomic keys and reference literature, including Lom & Dyková (1992), Kabata (2003), and Rohde (2005), which are widely used in aquatic parasitology. The identification results were used to determine the dominant species at each sampling station and to analyze infestation patterns across the study sites (Juliana *et al*., 2023).

Prevalence of Ectoparasites

This prevalence data provides an idea of how widespread ectoparasite infestation occurs in the vaname shrimp population at each research station. Ectoparasite prevalence was calculated to determine the percentage of shrimp infested with ectoparasites in each pond using the following formula (Mahasri *et al.,* 2019):

$$Prevalence = \frac{number\ of\ shrimp\ infected\ with\ disease}{number\ of\ fish\ affected\ by\ the\ disease\ (tails)}\ X\ 100\%$$

Ectoparasite Intensity

This parameter is important for assessing the burden of ectoparasite infestation in vaname shrimp, which can affect shrimp health and growth. Ectoparasite intensity was measured to determine the average number of ectoparasites found in infested shrimp. Intensity is calculated using the following formula (Mahasri *et al.,* 2019):

$$\text{Intensity} = \frac{total\ number\ of\ infecting\ ectoparasites\ (ind)}{number\ of\ people\ affected\ by\ the\ disease\ (tails)}$$

Ectoparasite Dominance

This dominance data helps in understanding the dynamics of ectoparasite populations and the factors that influence the presence of certain ectoparasite species in shrimp ponds. Ectoparasite dominance was analyzed to determine the most dominant ectoparasite species in each pond. Dominance is calculated using the following formula (Mahasri *et al.,* 2021):

$$Dominance = \frac{the\ number\ of\ ectoparasites\ contaminating\ the\ sample}{total\ parasite\ contamination} X\ 100\%$$

Water quality

Pond water quality is observed to assess environmental conditions that can influence ectoparasite infestation. Water quality parameters measured include temperature, salinity, pH, dissolved oxygen, and nutrient content such as nitrate and phosphate. Measurements are carried out using standard measuring instruments in the field and laboratory. This water quality data is important for understanding the relationship between environmental conditions and levels of ectoparasite infestation.

Data Analysis

In this study, descriptive data analysis was used to provide an initial overview of the observed parameters, namely the types of ectoparasites, ectoparasite prevalence, ectoparasite intensity, ectoparasite dominance, and water quality. The data obtained from the research were processed using Microsoft Excel and analyzed descriptively.

Results

Based on the observations conducted at five different stations in the Padang Pariaman area, West Sumatra, the results for each Vaname shrimp sample are presented in Table 1. As shown in Table 1, five shrimp samples were collected at each station. The highest number of infected Vaname shrimp was found at Station II, where all five samples were infected with ectoparasites. At Stations I and V, four out of five shrimp samples were found to be infected. Meanwhile, the lowest numbers of infected Vaname shrimp were observed at Station III, with three infected samples, and at Station IV, with only two infected samples.

Table 1. Number of infected white shrimp from 5 observation stations

Sampling Station	∑ Observed Vaname Shrimp (ind)	∑ Infected Vaname Shrimp (ind)
Station I	5	4
Station II	5	5
Station III	5	3
Station IV	5	2
Station V	5	4

Based on the calculation results of the prevalence value of Vaname shrimp ectoparasite from five different station points in the Padang Pariaman area, West Sumatra, it can be seen in Table 2.

Table 2. Prevalence of Vaname shrimp ectoparasites from 5 observation stations.

Sampling Station	Prevalence Rate (%)	Prevalence Category (Indahsari, and Ulkhaq, 2019)
Station I	80	Moderate Infection
Station II	100	Infection Always
Station III	60	Frequent Infections
Station IV	20	Common Infections
Station V	40	Frequent Infections

Based on Table 2, the prevalence percentages of Vaname shrimp ectoparasites at different stations show that the highest prevalence, classified as always infected, was found at Station II (100%). At Station I, the prevalence was classified as moderate infection with a percentage of 80%. Stations III and V were classified as frequent infection, with prevalence rates of 60% and 40%, respectively. Meanwhile, Station IV had the lowest prevalence, classified as common infection, with a percentage of 20%. The results of the intensity calculations for Vaname shrimp ectoparasites at the five stations are presented in Table 3.

Table 3. Ectoparasite intensity of vaname shrimp from 5 observation stations

Sampling Station	Intensity level	Intensity category (Mahasri *et al*., 2023)
Station I	21	Currently
Station II	69	Critical
Station III	2.7	Low
Station IV	2.5	Low
Station V	2.0	Low

Based on the calculation of ectoparasite intensity values presented in Table 3, the highest intensity was recorded at Station II, with a value of 69, classified as a severe intensity category. At Station I, the intensity value was 21, falling into the moderate category. Meanwhile, Stations III, IV, and V had intensity values of 7, 2.5, and 2.0, respectively, all of which are classified as low intensity categories.

As shown in Table 4, the same four types of ectoparasites were found at Stations I and II, namely *Epistylis* sp., *Zoothamnium* sp., and *Vorticella* sp. At Station I, the numbers found were 59, 22, and 3, with dominance percentages of 14.67%, 5.47%, and 0.74%, respectively. At Station II, the corresponding numbers were 152, 75, and 83, with dominance percentages of 37.81%, 18.65%, and 20.64%. At Station III, only two parasite types were found: *Zoothamnium* sp. (6) and *Vorticella* sp. (402), with dominance percentages of 0.49% and 1.49%, respectively. Meanwhile, at Station IV, two types of ectoparasites were identified, namely *Ichthyobodo* sp. (2) and *Epistylis* sp. (3), with dominance percentages of 40% and 60%. At Station V, only one type of parasite was found, with a value of 8 and a dominance percentage of 100%.
The results of calculating the percentage value of the level of ectoparasite dominance at five different station points are presented in Table 4.

Table 4. Level of dominance of vaname shrimp ectoparasites from 5 observation stations

Station	Type of ectoparasite	∑ ectoparasite	Level of ectoparasite dominance (%)
I	*Epystylis* sp	59	14.22
	Zootamnium sp	22	5.30
	Vorticella sp	3	0.72
	Ichtyobodo sp	0	0.00
II	*Epystylis* sp	152	36.63
	Zootamnium sp	75	18.07
	Vorticella sp	83	20.00
	Ichtyobodo sp	0	0.00
III	*Epystylis* sp	2	0.48
	Zootamnium sp	0	0.00
	Vorticella sp	6	1.45
	Ichtyobodo sp	0	0.00
IV	*Epystylis* sp	3	0.72
	Zootamnium sp	0	0.00
	Vorticella sp	0	0.00
	Ichtyobodo sp	2	0.48
V	*Epystylis* sp	8	1.93
	Zootamnium sp	0	0.00
	Vorticella sp	0	0.00
	Ichtyobodo sp	0	0.00
	Total	415	100

The results of observations of water quality in vaname shrimp ponds at 5 different stations in the Padang Pariaman area, West Sumatra are seen in Table 5.

Table 5. Water quality values for each vaname shrimp pond observation station

Analysis parameters	Unit	Sampling station					Quality standards
		Station I	Station II	Station III	Station IV	Station V	
Physical							
Color	-	Light green	Dark green	Chocolate	Light green	Dark green	-
Temperature	° C	30.4	29.2	28.5	28.8	29	28-33
Chemical							
pH	-	7.11	6.9	7.5	7.1	6.97	7.5-8.5
Salinity	‰	20.1	17.5	19.3	20.3	16	15-35
DO	mg/l	4.86	4.1	5,11	4.9	4.8	4-6
BOD	mg/l	2.05	2.71	2.14	4.15	6.9	<25
COD	mg/l	26.48	37.5	38.95	73.54	90.08	<40
Ammonia	mg/l	0.095	0.162	0.133	0.152	0.188	<0.1

Based on Table 5, which presents the physical water quality parameters, each pond station exhibited different water colors and temperatures that were classified as normal according to water quality standards. Shrimp ponds with light green water were found at Stations I and IV, while dark green water was observed at Stations II and V. Brown water was recorded at Station III. Meanwhile, the chemical parameters were generally within the tolerance limits of water quality standards, although several parameters exceeded the recommended values.

Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan
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Discussion

The observed variation in ectoparasite prevalence and intensity across the stations suggests a strong influence of environmental quality and pond management practices on parasite dynamics. Station II, which recorded 100% prevalence and a high intensity value (69), exemplifies conditions that are highly conducive to parasite proliferation. High ammonia levels (0.162 mg/L), low pH (6.9), and dark green water color indicate organic pollution and possible algal blooms, both of which are known to increase parasite transmission by weakening host immunity (Salwany *et al*., 2018; Mustafa *et al*., 2022). Similar trends were reported by Rahman *et al.* (2020) in Bangladesh, where elevated nutrient loads and poor water circulation significantly contributed to ectoparasite outbreaks in shrimp farms.

The correlation between poor water quality and higher ectoparasite infection is consistent with the findings of Mairawita *et al.* (2025), who reported that monogenean and protozoan parasites thrive in ponds with unstable dissolved oxygen levels and high stocking densities. At Station II, these stressors likely compromised shrimp health, making them more susceptible to infestation. The high abundance of dominant species such as *Epistylis* and *Vorticella* further suggests that these protozoans are opportunistic under degraded environmental conditions, as also noted by Lom & Dyková (1992).

In contrast, Stations III and IV showed lower infection rates and intensities, which can be attributed to more stable environmental parameters and possibly better natural biological control. At these stations, dissolved oxygen (DO) and pH levels were more optimal, and ammonia concentrations were within safe limits. These findings are consistent with those of Mizuno *et al.* (2019), who reported that ponds with regular water exchange and controlled feed input had significantly lower parasite loads.

Interestingly, although Station III had brown water and the highest COD and BOD levels, ectoparasite dominance was relatively low. This may reflect a different micro-ecological structure or the presence of antagonistic microbial communities that suppress parasite reproduction, as suggested by Parades *et al.* (2021). Alternatively, it could indicate that while pollution is present, other limiting factors—such as temperature or the lack of suitable attachment surfaces—may reduce parasite colonization.

The sharp dominance of a single ectoparasite species at Station V (100%) indicates a lack of biodiversity, which may facilitate species monopolization. According to Hillebrand *et al.* (2008), lower parasite diversity under stressful conditions often leads to dominance by a few highly adaptive species.

The spatial variation in ectoparasite infections observed in this study underscores the complex interactions between water quality, shrimp density, and pond ecology. These findings support the broader conclusion of Leigh *et al.* (2020) that localized pond conditions must be carefully managed to prevent parasitic outbreaks. Comparisons with studies from other regions affirm that improving environmental parameters—especially ammonia levels, pH stability, and organic load—is a universal strategy for managing shrimp health.

Conclusion

This study revealed significant variation in the levels of ectoparasite infestation, with Station II exhibiting the highest prevalence (100%) and intensity (69). Stations I, III, IV, and V showed lower levels of infestation: Station I had moderate prevalence (80%) and intensity (21), while Stations III, IV, and V demonstrated relatively low ectoparasite intensities, indicating more stable environmental conditions. The dominant ectoparasites identified included *Epistylis* sp., *Zoothamnium* sp., *Vorticella* sp., and *Ichthyobodo* sp. These findings highlight the need for regular water quality monitoring, stock density control, and proper pond management to minimize ectoparasite infestations and improve shrimp health.

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