ISSN2477-9458

# BOLETÍN DEL CENTRO DE INVESTIGACIONES BIOLÓGICAS

**Incidence of *Nematopsis* sp. (Proctista: Aplicomplexa) in *Penaeus vannamei* and its relationship with physicochemical parameters of watern.**
*Edison Pascal, Helimar Váquez, José Arcaya and Hennet Faría……* **80**

**Monitoreo de hongos anemófilos en el palacio de los deportes de combate, San Francisco, Zulia-Venezuela.**
*Andreína González, Laugeny Díaz, Elizabeth Ojeda y Ricardo Silva*. **97**

***COMUNICACIONES BREVES.***

**Primer registro de la almeja asiática invasora *Corbicula fluminea* (Muller; 1774) en la cuenca del río Carinicuao, Golfo de Cariaco, Venezuela.**
*Sinatra Salazar, Henry Salazar, Osmicar Vallenilla, Carol Lárez y Claudio Marchán……..* **115**

**Variación morfológica de *Basiliscus basiliscus* (Reptilia: Squamata: Corytophanidae).**
*Greimary Fuenmayor, Ángel Cardozo y Margareth Voelger……..* **123**

***NOTAS CIENTÍFICAS***

**Registro de *Corythaica carinata* Uhler, 1886 (Hemiptera: Tingidae) en el estado Zulia, Venezuela.**
*Alfredo Briceño-Santos……* **134**

**Geographical distribution note of the of *Paracymus* Thomson, 1867, from Venezuela (Coleoptera: Hidrophilidae: Hidrophilinae).**
*Mauricio García Ramírez and Nadiany Castillo Reyes……..* **139**

**Instrucciones a los autores**…….…...…… **149**

**Instructions for authors**…….…….…. **159**

**Vol. 59, N$^0$ 2, Pp. 80-168, Julio-Diciembre 2025**

UNA REVISTA INTERNACIONAL DE BIOLOGÍA PUBLICADA POR
LA UNIVERSIDAD DEL ZULIA, MARACAIBO, VENEZUELA

**Boletín del Centro de Investigaciones Biológicas**
Vol. 59. Nº 2, Julio-Diciembre 2025, Pp. 80-96
DOI: https://doi.org/10.5281/zenodo.19347930



# Incidence of *Nematopsis* sp. (Protoctista: Apicomplexa) in *Penaeus vannamei* and its relationship with physicochemical parameters of water

Edison Pascal[1]*, Helimar Vásquez[1, 2], José Arcaya[3] and Hennet Faría[4]

[1]Instituto Venezolano de Investigaciones Científicas (IVIC). ORCID ID: https://orcid.org/0000-0002-5108-1889
[2]Facultad de Ciencias Veterinarias, Universidad del Zulia (LUZ). ORCID ID: https://orcid.org/0000-0002-2505-7850
[3]Instituto de Investigaciones Clínicas "Américo Negrette" Facultad de Medicina, Universidad del Zulia (LUZ). ORCID ID: https://
[4] orcid.org/0000-0002-4111-4587
Liofilizados de Venezuela C. A. (LIVENCA). ORCID ID: https://orcid.org/0009-0003-3549-8371

edisonpascal@gmail.com/ epascal@ivic.gob.ve

## ABSTRACT

This study evaluated the incidence of parasitosis caused by *Nematopsis* sp. (Protoctista: Apicomplexa) in farmed shrimp (*Penaeus vannamei*) at a farm in the Falcón State, Venezuela, over four months (June–September). A total of 1000 specimens were sampled using a cast net, and microscopic counts of gregarines in the intestines were performed to estimate parasitic load. Concurrently, water physical parameters (pH, salinity, temperature, and transparency) were measured to analyze their relationship with parasitosis incidence. Results showed a significant progressive increase in incidence, from 39.52% in June to 143.52% in September, indicating a considerable rise in parasitosis levels. Monthly variations in physical parameters were observed, with decreases in pH, salinity, and transparency correlating with increased incidence. Correlation analyses revealed a strong negative association between pH and transparency with incidence ($r \approx -0.82$, $R^2 \approx 0.67$), and a moderate negative correlation with salinity ($r \approx -0.64$). Temperature had a lesser and non-significant influence ($r \approx -0.28$). These findings suggest that environmental factors, especially pH and transparency, play a crucial role in the parasitic dynamics of *Nematopsis* sp., affecting the health and productivity of *P. vannamei*. The study emphasizes the importance of continuous monitoring of physicochemical water parameters for sanitary control in aquaculture and recommends integrated strategies considering environmental conditions to prevent parasitic outbreaks.

**Keywords:** aquatic parasitosis, *Nematopsis* sp., *Penaeus vannamei*, physical parameters of water, ecoepidemiology.

**Incidencia de *Nematopsis* sp. (Protoctista: Apicomplexa) en *Penaeus vannamei* y su relación con parámetros físico-químicos del agua.**

**RESUMEN**

El presente estudio evaluó la incidencia de parasitosis causada por *Nematopsis* sp. (Protoctista: Apicomplexa) en camarones de cultivo (*Penaeus vannamei*) en una finca del Estado Falcón, Venezuela, durante cuatro meses (junio-septiembre). Se muestrearon 1000 ejemplares mediante atarraya, y se realizaron conteos microscópicos de gregarinas en intestinos para estimar la carga parasitaria. También se midieron parámetros físicos del agua (pH, salinidad, temperatura y transparencia) para analizar su relación con la incidencia parasitaria. Los resultados mostraron un aumento progresivo y significativo de la incidencia de la parasitosis, desde 39,52% en junio hasta 143,52% en septiembre. Los parámetros físicos variaron mensualmente, destacando disminuciones en pH, salinidad y transparencia correlacionadas con el incremento de la incidencia. Se demostró una alta asociación negativa entre pH y transparencia con la incidencia ($r \approx -0,82$, $R^2 \approx 0,67$), y una correlación moderada con salinidad ($r \approx -0,64$). La temperatura tuvo una influencia menor y no significativa ($r \approx -0,28$). Estos hallazgos sugieren que factores ambientales, en especial pH y transparencia, son determinantes en la dinámica parasitaria de *Nematopsis* sp., afectando la salud y productividad de *P. vannamei*. Este estudio resalta la importancia del monitoreo continuo de parámetros físico-químicos para el control sanitario en acuicultura y recomienda estrategias integrales que consideren las condiciones ambientales para prevenir brotes parasitarios.

**Palabras clave**: parasitosis acuática, *Nematopsis* sp., *Penaeus vannamei*, parámetros físicos del agua, ecoepidemiología.

**Recibido / Received**: 27-08-2025 ~ **Aceptado / Accepted**: 29-11-2025.

## INTRODUCTION

Shrimp farming is one of the fastest-growing aquaculture sectors globally, especially in regions such as Latin America, Asia and, more recently, Africa, contributing approximately 8% of total fish production (FAO 2020, López *et al*. 2022).

Within Latin America, countries such as Ecuador, México, and Brazil are leading this growth, positioning shrimp as a strategic product in the regional economy (Morales *et al*. 2011, Pascal *et al*. 2022). However, the success of this activity is threatened by various diseases affecting farmed shrimp, mainly those caused by viruses, bacteria, fungi, and parasites (García and Parrales 2019, Pascal *et al*. 2023).

Among the parasitic agents, protozoa play a crucial role, particularly the Gregarinae of the genus *Nematopsis* sp. (Protoctista: Apicomplexa), which mainly infect the digestive tract of *Penaeus vannamei* shrimp, a species widely used in commercial aquaculture due to its high resistance and adaptability (Pascal *et al*. 2023, Cabrera and Rubio 2012). Parasitosis by *Nematopsis* sp. not only affects shrimp health but can also negatively impact growth and production, which represents a challenge for sanitary management in shrimp farms (Flores *et al*. 2014, Pascal *et al*. 2022).

These Apicomplexans, previously mentioned, are endoparasitic protozoa that present acomplex life cycle and use arthropods, mollusks, or annelids as final or intermediate hosts. They obtain nutrients by osmosis within the host organism and have a well-defined body membrane. Their cytoplasm is divided into two regions: ectoplasm and endoplasm, with the ectoplasm containing myonemes that enable the parasite's sliding movements (Prado 1996). Based on morphology, sporozoites are classified into three groups: cephaline gregarines with three segments, acephaline gregarines with two segments, and paraophioidinids, which are elongated single cells with a centrally located nucleus in their adult form. The protomerite is the smaller anterior region, which, when located at the front, is called the epimerite; this structure can expand freely and functions as a mobile suction cup, allowing the parasite to adhere to the shrimp’s intestine by tactile contact (Pascal *et al*. 2024).

However, from an epidemiological point of view, it is important to study the different indicators of diseases in farmed shrimp populations, such as incidence (or incidence rate) whose fundamental characteristic is to identify the appearance of new cases within a population during a specific interval, so its calculation requires a continuous monitoring period. In relation to this concept, we have Prevalence, which quantifies the percentage of individuals who are affected by the disease at the instant in which the evaluation is performed within the population, so it is not considered a period of observation or monitoring (Fajardo-Gutiérrez 2017).

The objective of this research was to determine the incidence of *Nematopsis* sp. (Protoctista: Apicomplexa) in *Penaeus vannamei* cultured on a farm in Falcón State, Venezuela, and to analyze its relationship with the physicochemical water parameters (pH, salinity, temperature, and transparency). The goal was to understand how these environmental variables influence the parasitic dynamics and contribute to improved sanitary management in shrimp aquaculture.

## MATERIALS AND METHODS

Shrimp (*P. vannamei*) were collected during a period of four months (June–September 2023) on a farm located in the Mauroa municipality of Falcón State, near the town of Casigua, Venezuela, at coordinates 11°03′04″N 71°03′47″W. During this period, four sampling events were carried out, one per month, with a periodicity of approximately 30 days between each collection, coinciding with a fattening phase of the production cycle in which the stock consisted predominantly of adult shrimp suitable for harvest. This criterion ensured that the animals sampled were physiologically comparable and representative of market-size individuals under commercial farming conditions. The capture was performed using a two meter diameter cast net, sampling a total of 1000 specimens to ensure the representativeness and statistical robustness of the study, and the organisms obtained were transferred alive to the laboratory, where a clinical inspection was carried out for the observation of external pathological signs.

Subsequently, the intestines of each specimen were extracted for parasite evaluation. The quantification of the protozoan parasite *Nematopsis* sp. corresponded to counts under optical microscopy, using standardized methodology for gregarines in shrimp, based on the technique described by Lightner (1988) and Bucheli *et al*. (2008). The formula was applied:

$$Gr/Int=TGr\ x2.08$$

Where (Gr/Int) represents the estimated number of gregarines per intestine, (TGr) is the total gregarines counted in the microscopic sample and 2.08 is a correction factor that adjusts the count for the complete intestine estimate (Lightner 1988, Bucheli *et al*. 2008).

This procedure allowed accurate determination of the incidence and parasite load in shrimp, facilitating statistical analysis of the relationship between parasitosis and the physical parameters of the water, which were measured and analyzed in parallel.

**Evaluation of physical-chemical water parameters**

To evaluate the physical-chemical conditions of the water in the shrimp farm in Falcón State, the following parameters were measured monthly: pH, salinity, temperature, and transparency, taking as a basis a representative average of the entire farm.

The pH was determined using a portable multi-parameter digital meter (model HI98194, Hanna Instruments), which allows a direct and precise reading in the field with solid state sensors, previously calibrated with standard buffer solutions (pH 4,7 and 10) to guarantee accuracy (Mora-Faubla *et al.* 2025, Morales *et al*. 2011, Hanna Instruments 2023).

Salinity was measured using a portable conductivity meter, based on the evaluation of the electrical conductivity of water, indicating the concentration of dissolved salts. This technique is commonly recommended for aquaculture due to its speed and reliability (García and Parrales 2019, Mora-Faubla *et al.* 2025).

Temperature was recorded on site with a fast-response digital immersion thermometer, important in determining the optimal habitat for *P. vannamei* and in the development of its parasites (Mora-Faubla *et al*. 2025).

Transparency was assessed using a Secchi disk adapted for culture water, a parameter that influences habitat quality and microorganism proliferation (Bucheli *et al*. 2008, Hernández *et al*. 2021, Pascal *et al*. 2024).

Each parameter was measured at multiple sampling stations evenly distributed throughout the farm, with at least three replicate readings per station on each sampling date, matching the four monthly shrimp collection events conducted between June and September. In total, sixteen sets of physicochemical measurements were obtained (four sampling campaigns × four parameters), which were subsequently averaged to generate a representative monthly value for comparison with the incidence of parasitosis in the shrimp.

## RESULTS AND DISCUSSION

### Incidence

The increasing incidence observed in this study, from 39.52% in June to 143.52% in September, reveals a marked tendency of increase in the prevalence of parasitosis caused by *Nematopsis* sp. in *P. vannamei* in the shrimp farm of Falcón State. This increase may be related to seasonal and environmental factors (beginning of the rainy season, which persisted until the end of the sampling period), particularly the physicochemical conditions of the water, which affect parasite dynamics in aquaculture systems, with decreases in pH, reductions in transparency (i.e., increased turbidity), and low salinity being especially relevant, as they favor both the survival of the infective stages of *Nematopsis* sp. and the physiological susceptibility of shrimp to stress and infection (Pascal *et al.* 2024), Table 1.

**Table 1. Average values of parasites is incidence in the shrimp farm.**

| Month | Incidence |
|---|---|
| June | 39.52 |
| July | 95.68 |
| August | 133.12 |
| September | 143.52 |

Incidence values higher than 100%, as in August and September 2023, suggest a high level of infestation or a significant increase in the average parasite load per individual, which is epidemiologically relevant, since it may imply negative impacts on shrimp health and development, as reported in previous studies where *Nematopsis* infestations are associated with decreased weight and production (Hernández *et al*. 2021, Flores *et al*. 2014). These alarmingly high values in August and September 2023 can be attributed to the progression of the rainy season, during which increased freshwater input and runoff likely led to decreases in salinity, reductions in water

transparency (higher turbidity), and slight shifts in pH; together, these changes created environmental conditions that favored both the survival and transmission of *Nematopsis* sp. and increased the physiological stress and susceptibility of shrimp to infection.

Comparatively, research in the Latin American region has shown variable prevalences of parasitosis with *Nematopsis* sp (Figure 1) in farmed shrimp, usually lower, around 20-35% (Pascal *et al*. 2024, Morales *et al*. 2011). For example, a study conducted in the estate of Falcón reported a peak prevalence of 35.5% in September, considerably lower than the maximum detected in this research, which may be due to differences in methodology, culture density, environmental conditions or seasonality (Pascal *et al*. 2024).

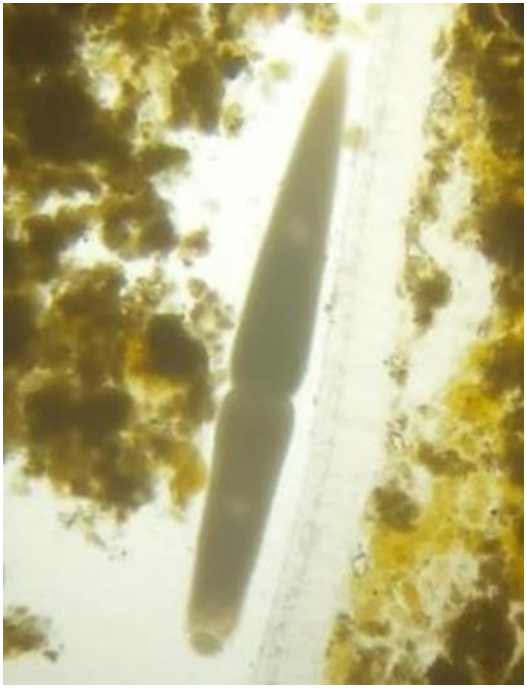

**Figure 1**: Trophozoite of the apicomplexan protozoan *Nematopsis* sp.

In this work, the relationship between prevalence and incidence of parasitosis caused by *Nematopsis* sp. in farmed shrimp can be understood considering that preva-

lence represents the proportion of infected animals at a given time, while incidence reflects the occurrence of new cases during a specific period (Fajardo-Gutiérrez 2017). Beyond this conceptual distinction, the concrete contribution of the present study lies in showing that the incidence values recorded between June and September increased sharply over time, reaching levels well above the prevalence figures previously reported for the same region, which indicates an active expansion of the infection rather than a stable endemic situation.

From an epidemiological perspective, this means that the parasite is not only present (prevalence), but is also spreading rapidly within the cultured population (high incidence), revealing periods of heightened transmission risk that coincide with specific environmental conditions, particularly those associated with the rainy season. Consequently, the findings of this study provide evidence that links temporal surges in incidence with changes in water physicochemical parameters, thereby fulfilling the objective of the research by identifying critical periods and environmental scenarios in which control and monitoring measures should be intensified to mitigate production losses and health impacts in *P. vannamei* farms (Fajardo-Gutiérrez 2017).

In this study, the very high incidence observed in August and September 2023 suggests that the population was undergoing an intense transmission phase of *Nematopsis* sp., likely driven by environmental changes associated with the rainy season (e. g., reduced salinity and transparency and slight shifts in pH) that both enhanced the survival and dissemination of infective stages and increased host susceptibility through physiological stress. Under these conditions, a large number of shrimp that were initially uninfected could have become newly infected in a short time window, producing incidence values that surpassed the typical prevalence ranges described in previous Latin American studies, without implying inconsistency but rather reflecting a dynamic, expanding epizootic process (Pascal *et al*. 2024).

This surprising pattern can be explained by the fact that incidence and prevalence capture different, but complementary, dimensions of the same epidemiological process. While prevalence indicates how many shrimps are infected at a given time, incidence reflects how many new infections are occurring over a defined period; therefore, during an active outbreak, incidence can transiently exceed the prevalence levels commonly reported in more stable, endemic situations (Fajardo-Gutiérrez 2017, Pascal *et al*. 2024).

This difference can be attributed to the fact that incidence accumulates the number of new cases overtime, reflecting the current dynamics of infection and possible rapid increase in the population of parasitized shrimp, while prevalence measures only the state of infection at a specific point, without considering the recent appearance of cases. Thus, the high incidence found in this investigation may indicate a rapid expansion or outbreak of parasitosis, resulting in a progressive increase in the proportion of affected shrimp, exceeding the static prevalence figures observed in previous studies. In addition, factors such as different methodologies, variations in culture densities, environmental conditions, and seasonality may influence these differences between the two epidemiological measures (Granados 1995).

The rapid rise in incidence may also reflect a synergistic effect between shrimp population density and physical water parameters, such as temperature and turbidity, which facilitate the proliferation of the apicomplexan protozoan and increase host susceptibility (Pascal *et al*. 2023, García and Parrales 2019). Studies have documented that high temperatures can favor the life cycle and multiplication of *Nematopsis* sp, thus increasing its incidence during warm months or with unfavorable environmental conditions (Flores *et al*. 2014).

From a sanitary and productive perspective, the high incidence recorded in August and September represents a challenge for disease management in aquaculture, since massive infestations can induce chronic stress, immune deterioration, and predisposition to secondary infections, affecting the productive and economic indices of the culture (Hernández *et al*. 2021, Pascal *et al*. 2022).

**Physicochemical parameters of water**

Environmental conditions recorded in June, with a pH of 7.9, salinity of 35, temperature of 28.2 °C, and transparency of 60 cm, depict a culture environment close to the optimal rearing range for *P. vannamei*, in which shrimp experience minimal physiological stress and maintain an effective immune competence. Under these circumstances, epithelial barrier integrity, osmoregulatory balance, and nonspecific immune responses are preserved, thereby reducing the likelihood of successful establishment and massive proliferation of *Nematopsis* sp. in the intestinal tract (FAO 2020, Mora-Faubla *et al*. 2025).

From an ecoepidemiological perspective, this "low disturbance environment" is reflected in the comparatively low incidence observed in June (39.52%), which is consistent with the absence of abrupt shifts in pH, salinity, or transparency that could promote explosive increases in parasite load. In shrimp aquaculture, departures toward more acidic pH values, reductions in salinity, and increases in turbidity (lower transparency) have been associated with imbalances in the microbiota, accumulation of organic matter, and enhanced survival of infective stages of protozoan parasites conditions (Table 2) that were not evident during this first month of sampling and that, therefore, provide a coherent explanation for the moderate level of parasitosis recorded at the beginning of the study (Bucheli *et al*. 2008).

**Table 2. Average of the physic chemical parameters of the water**

| Period | pH | Salinity (‰) | Temperature (Celsius) | Transparency (cm) |
|---|---|---|---|---|
| June | 7.9 | 35 | 28.2 | 60 |
| July | 7.6 | 36 | 28.5 | 60 |
| August | 7.1 | 34 | 28.0 | 65 |
| September | 7.5 | 29 | 28.2 | 50 |

In July, the water still exhibited values within the nominally acceptable range for *P. vannamei* (pH 7.6, salinity 36‰, temperature 28.5 °C, transparency 60 cm), yet the incidence of *Nematopsis* sp. almost doubled compared with June, reaching 95.68%. Rather than being explained solely by a "slightly higher temperature", this sharp increase is more consistent with a combination of cumulative exposure time and subtle but biologically relevant shifts in water quality that act synergistically on both the parasite and the host. From the host side, the transition from early to mid fattening implies higher biomass and stocking density, which elevates organic waste, favors microbial enrichment of the water column and pond bottom, and can impose chronic, sub lethal stress on shrimp, conditions known to compromise epithelial integrity and immune efficiency and there by facilitate intestinal colonization by apicomplexan parasites (Flores *et al*. 2014).

From the parasite side, a longer residence time of infective stages in a system that is progressively enriched with organic matter and biofilms increases the probability of contact between *Nematopsis* oocysts and susceptible hosts, amplifying transmission even when physicochemical parameters remain close to "optimal" thresholds. Moreover, the slight decline in pH relative to June and the higher salinity are consistent with a more stable marine environment that may prolong oocyst viability and enhance their capacity to persist in the water–sediment interface, where shrimp feed and interact intensively. Taken together, these ecological and physiological processes provide a robust explanation for the abrupt rise in incidence in July, indicating that the system was entering an epizootic phase driven not by a single parameter, but by the interaction between stocking conditions, progressive organic loading, and favorable micro environmental niches for parasite transmission (Mora-Faubla *et al*. 2025).

In August, pH dropped to 7.1, salinity dropped to 34 ppm, temperature dropped slightly to 28.0 °C, and transparency decreased to 55 cm. The drop in pH may indicate a slight increase in acidity, possibly associated with rainfall or accumulation of organic matter in the water that promotes processes of decomposition and acidification (García and Parrales 2019). This, together with the decrease in transparency, could favor environments more conducive to the development and transmission of *Nematopsis* sp. The incidence increased to 133.12%, marking a peak that reflects the influence of these conditions on parasitic growth.

Finally, in September, pH rose slightly to 7.5, salinity decreased markedly to 29 ppm, temperature remained at 28.2°C, and transparency dropped to 50 cm, the lowest value on record. Low salinity could reflect dilution by seasonal rains or significant freshwater input, which may affect shrimp osmoregulation and immune capacity, increasing their susceptibility to parasitic infections (Mora-Faubla *et al*. 2025, Morales *et al*. 2011). Reduced transparency may indicate increased turbidity or suspended matter, environments where parasites may be more successful in infecting their hosts (Pascal *et al*. 2024). The peak incidence of 143.52% in September coincides with these conditions, suggesting that the combination of unfavorable physical parameters may exacerbate health problems.

These results could confirm the sensitivity of *P. vannamei* culture to environmental variations, where parameters such as pH, salinity, and mainly transparency function as indirect indicators of habitat quality and parasitic risk (García

and Parrales 2019). On the other hand, stable temperatures but close to the upper limit favorable for shrimp seem to facilitate the proliferation of the protozoan, in agreement with reports of accelerated apicomplexan cycles in warm environments (Flores *et al.* 2014).

The analysis, together with the monthly incidences, could indicate that proper management of physical water parameters, maintaining conditions within the optimal values reported for *P. vannamei*, is fundamental for the epidemiological control of *Nematopsis* sp. and those deviations in pH, salinity, and transparency should be monitored to prevent parasitic outbreaks that affect aquaculture productivity.

**Influence of ecoepidemiological factors on the incidence of parasitosis**

The application of statistical correlation tests between physicochemical water parameters and the incidence of *Nematopsis* sp. in *P. vannamei* reveals results with important implications for sanitary and environmental management in culture systems. The correlation coefficients and linear models used allow the identification of patterns that relate environmental variables to parasite dynamics.

pH stood out as the key parameter with the strongest negative correlation with respect to parasitic incidence($r \approx -0.82$) and the highest coefficient of determination ($R^2 \approx 0.67$). This indicates that small variations in water pH are associated with large changes in the incidence of parasitism by the apicomplexan. A steep negative slope in the linear model suggests that as pH decreases, incidence increases significantly. This result is consistent with previous studies indicating that slightly acid-neutral conditions predispose to increased Apicomplexan protozoan development, affecting shrimp homeostasis and immune health (García and Parrales 2019). In addition, acidity can modify the microbiological composition and nutrient availability in the water, favoring favorable environments for the parasite (Morales *et al*. 2011, Figure2).

Water transparency also showed a strong negative correlation with incidence ($r \approx -0.82$), with a notably negative slope in linear models. Transparency acts as a proxy indicator of turbidity and suspended particulate matter, factors that influence parasite proliferation and transmission in aquatic systems (Pascal *et al.* 2024, Bucheli *et al*. 2008). A decrease in transparency (which implies higher turbidity) can facilitate contact between the host and the infective stages of the parasite, increasing parasite

incidence. Therefore, maintaining adequate levels of water clarity is critical to minimize sanitary risks.

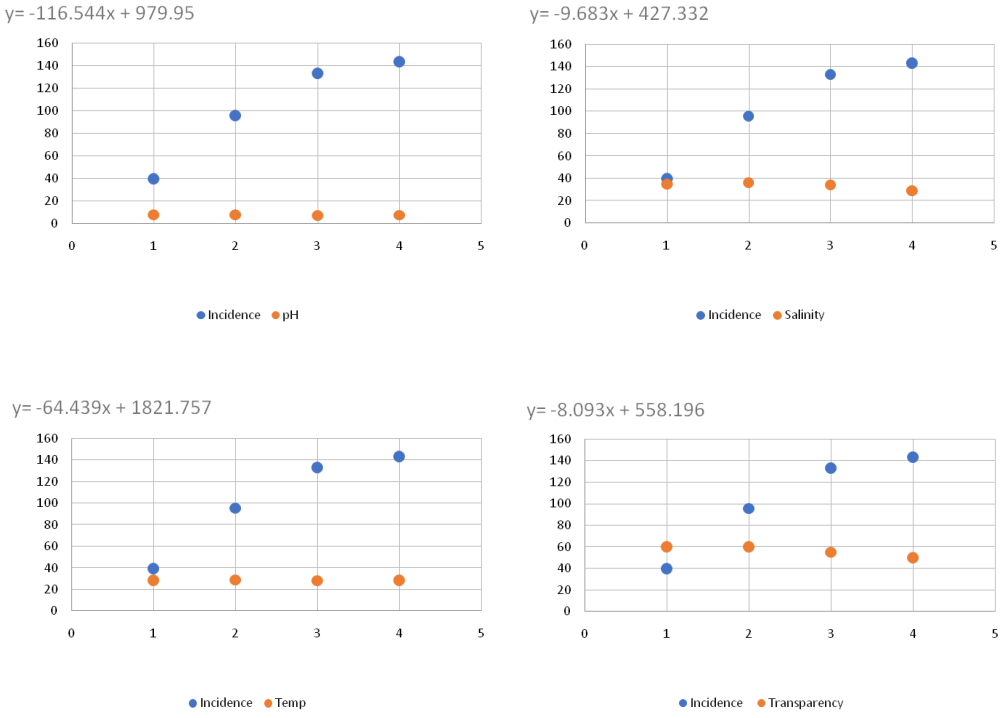


**Figure 2**: Scatter plots and regression models between physicochemical water parameters and the incidence of parasitosis by *Nematopsis* sp. in *P. vannamei*.

Salinity evidenced to be a secondary but relevant factor, with a moderate negative correlation (r ≈-0.64) and a negative slope. Decreased salinity is associated with an increase in parasitosis, which can be explained by the osmotic stress that shrimp suffer under low salinity conditions, weakening their immune defenses and facilitating infection (Morales *et al.* 2011, García and Parrales 2019). This is particularly relevant in areas where episodes of dilution by rainfall or freshwater inflows occur.

Finally, temperature showed a weak negative correlation (r ≈-0.28) and low $R^2$ value, indicating less direct influence on incidence variation in this particular study.

This observation partially differs from reports associating temperature increase with the acceleration of the Apicomplexan life cycle (Flores *et al*. 2014), which may be attributed to the relative thermal stability during the sampling period or to other environmental and biological factors having a greater weight in the specific context analyzed (Table 3).

**Table 3. Correlation and linear models between physicochemical water parameters and the incidence of parasitosis by *Nematopsis* sp. in *Penaeus vannamei*.**

| Parameter | Coefficient r | $R^2$ | Slope | Significance (p) |
|---|---|---|---|---|
| **pH** | -0.82 | 0.67 | Negative | <0.05 |
| **Transparency** | -0.82 | 0.67 | Negative | <0.05 |
| **Salinity** | -0.64 | 0.41 | Negative | <0.05 |
| **Temperature** | -0.28 | 0.08 | Negative | >0.05 |

Taken together, these results reinforce the importance of rigorous monitoring and control of physical parameters such as pH, transparency, and salinity for sanitary management in *P. vannamei* cultures. The strong influence of pH and transparency on the incidence of parasitosis by *Nematopsis* sp. indicates that interventions aimed at maintaining these parameters within optimal ranges could be decisive in reducing the impact of these infections. In contrast, although temperature is a factor known to affect parasite biology, its effect was minor in this study, highlighting the need for a comprehensive approach that considers multiple environmental variables.

## CONCLUSIONS

The marked and sustained increase in *Nematopsis* sp. incidence observed in farmed *Penaeus vannamei* demonstrates that this parasite currently represents a significant sanitary constraint for shrimp production in Falcón State, with the potential to reduce growth performance, survival, and overall farm profitability if not actively managed. Building on these findings, the study provides epidemiological evidence that high incidence levels are closely linked to specific physicochemical water scenarios and to phases of the production cycle characterized by greater biomass and organic loading, thereby identifying critical periods during which monitoring and control measures should be intensified.

Consequently, the main contribution of this research is to move beyond merely describing the presence of *Nematopsis* sp. and to establish its behavior as an expanding epizootic process that can be anticipated and mitigated through environmental management, particularly by maintaining pH, salinity, and transparency within stable, near optimal ranges and by controlling stocking density and organic waste. These conclusions supply shrimp farmers and health managers with actionable criteria to design preventive strategies, refine biosecurity protocols, and prioritize surveillance during the rainy season and mid to late fattening stages, thus strengthening the resilience and sustainability of regional aquaculture systems.

The physicochemical parameters of the water evaluated (pH, transparency, salinity and temperature) showed significant monthly variations, with pH and transparency being the environmental factors that exhibited the highest negative correlation with the incidence of parasitosis ($r \approx -0.82$ in both cases). This indicates that small decreases in pH and water clarity are strongly associated with increases in *Nematopsis* sp. incidence, underscoring the importance of these parameters as critical indicators for sanitary monitoring.

Salinity exerted a moderate effect on parasite dynamics, with a significant negative correlation, suggesting that low salinity conditions could weaken the physiological resistance of shrimp and favor parasite proliferation. In contrast, temperature presented a weak and non-significant correlation, indicating that in this particular context, its influence was minor compared to other ecoepidemiological factors.

It is concluded that the routine monitoring and control of the physicochemical parameters of the water, particularly pH and transparency, constitute a fundamental strategy for the prevention and management of *Nematopsis* sp. parasitosis, helping to maintain optimal environmental conditions that minimize the risk of outbreaks and enhance the sustainability of shrimp farming.

## LITERATURE CITED

BUCHELI, M. S., R. A. LEÓN y I. R. CARRASCO. 2008. Análisis de la incidencia de gregarinas en cultivos comerciales de *Litopenaeus vannamei* y *L. stylirostris* en el sur del Caribe colombiano. https://repositorio.ufc.br/handle/riufc/ 53741

CABRERA, F. y M. RUBIO. 2012. Protozoarios epibiontes en el cultivo del camarón *Litopenaeus vannamei*. Revista Facultad de Ciencias Veterinarias 53(2): 100-106. http://ve.scielo.org/scielo.php?pid=S0258-65762012000200002&script=sciartte txtt=sci_

FAO. 2020. Acuicultura en América Latina: situación actual y perspectivas. Organización de las Naciones Unidas para la Alimentación y la Agricultura. https://www.fao.org/4/u1780s/U1780S04.htm

FAJARDO-GUTIÉRREZ, A. 2017. Medición en epidemiología: prevalencia, incidencia, riesgo, medidas de impacto. Revista Alergia México 64(1): 109-120. https://doi.org/10.29262/ ram.v64i1.252

FLORES, G., M. LÓPEZ AND R. MORALES. 2014. Impacto de la parasitosis por gregarinas (*Nematopsis* sp.) en el crecimiento del camarón blanco *Litopenaeus vannamei* de cultivo. Revista de Investigación Acuícola. 10(3): 45-53. https://raximhai. uaim.edu.mx/index.php/rx/article/view/713

GARCÍA, J. y S. PARRALES. 2019. Enfermedades parasitarias en camarones de cultivo: avances y retos. Acuicultura Latinoamericana 22(1): 15-29. https:// revistaespirales.consultorioampuero.com/index.php/es/article/view/379

GRANADOS, J. T. 1995. Medidas de prevalencia y relación incidencia-prevalencia. Med. Clin. (Barc.) 105: 216-218. https://www.academia.edu/download/36330523/ prevalencia.pdf

HANNA INSTRUMENTS. 2023. HI98194 Portable multiparameter meter: Technical specifications. https://www.hannainst.es

HERNÁNDEZ, M., R. LÓPEZ, y F. MARTÍNEZ. 2021. Métodos prácticos para la medición de parámetros físicos en acuicultura. Revista de Tecnología Acuícola 14(2): 89-98. https://revistas.utm.edu.ec/index.php/aquatechnica/

LIGHTNER, D. V. 1988. A Handbook of normal penaeid shrimp histology. World Aquaculture Society. https://cesarom.files.wordpress.com/2013/08/bell-lightner _1988_handbook-of-shrimp-histology.pdf

LÓPEZ, V., S. HERNÁNDEZ, Y D. PÉREZ. 2022. Dinámica del cultivo de camarón en América Latina: cifras y proyecciones. Boletín Pesquero Latinoamericano 18(4): 32-42. http://dspace.unach.edu.ec/handle/51000/12334

MORA-FAUBLA, G. M., C. R. DELGADO-VILLAFUERTE, F. F. PEÑARRIETA-MACIA, y L. C. URDANIGO-MENDOZA. 2025. Producción de camarón blanco (*Litopenaeus vannamei*) y su impacto en los componentes fisicoquímicos del agua en el golfo de Guayaquil, Ecuador. MQR Investigar 9(2): e639. https://doi.org/10.56048/ MQR20225.9.2.2025.e639

MORALES, M. S., A. RUIZ, A. PEREIRA, V. SOLÍS y G. CONROY. 2011. Prevalencia de enfermedades de camarón blanco (*Litopenaeus vannamei*) cultivados en ocho regiones de Latinoamérica. Revista Científica. Facultad de Ciencias Veterinarias de la Universidad del Zulia 21(5): 434-446. https://www.redalyc.org/pdf/959/959 19362010.pdf

PASCAL, E., Y. ALVARADO y H. VÁSQUEZ. 2024. Prevalence of intestinal parasitosis caused by *Nematopsis* sp. (Protozoa: *Apicomplexa) in Litopenaeus vannamei* and its relationship with water turbidity, in a fattening farm. J. Mod. Agric. Biotechnol. 2024: 3: 7. DOI: 10.53964/jmab.2024007.

PASCAL, E., E. PORTILLO, A. MÉNDEZ y H. VÁSQUEZ. 2023. Relationship between infection caused by the apicomplex protozoan *Nematopsis* sp. and the weight of white shrimp *Litopenaeus vannamei* in a cultivation system. J. Biomed Res Environ Sci. Oct 13. 4(10): 1405-1411. Doi: 10.37871/jbres1810, https://www.jelsciences.com/ articles/ jbres1810.pdf

PASCAL, E., H. VÁSQUEZ, N. CASTILLO, Y. SANDREA y K. FERRER. 2022. Prevalencia de parasitosis en camarón blanco de cultivo (*Penaeus vannamei*) en dos fincas de la costa occidental del estado Falcón, Venezuela. Redieluz 12(2): 94 - 98. https://doi.org/10.5281/zenodo.7423301

PRADO, C. 1996. Diagnóstico, tratamiento y prevención de infestaciones por gregarinas en camarones *Penaeus vannamei* mediante dieta medicada. Degree thesis. ESPOL, Guayaquil, Ecuador. https://www.dspace.espol.edu.ec/handle/123456789/4

ISSN2477-9458

BOLETIN
DEL CENTRO DE INVESTIGACIONES BIOLÓGICAS
AN INTERNATIONAL JOURNAL OF BIOLOGY
PUBLISHED BY THE UNIVERSITY OF ZULIA, MARACAIBO, VENEZUELA
Vol. 59, No2, Pp. 80-168, July-December 2025.

**Incidencia de *Nematopsis* sp. (Proctista: Apicomplexa) en *Penaeus vannamei* y su relación con parámetros físico-químicos del agua.**
*Edison Pascal, Helimar Váquez, José Arcaya y Hennet Faría ….* **80**

**Monitoring anemophilous fungi at the Combat Sports Palace, San Francisco, Zulia, Venezuela.**
*Andreína González, Laugeny Díaz, Elizabeth Ojeda and Ricardo Silva...* **97**

***BRIEF COMMUNICATIONS.***

**First Record of the invasive asian clam *Corbicula fluminea* (Muller, 1774) in the Riber basin Carinicuao, Golf of Cariaco, Venezuela.**
*Sinatra Salazar, Henry Salazar, Osmicar Vallenilla, Carol Lárez and Claudio Marchán……..* **115**

**Morphological variation in *Basiliscus basiliscus* (Reptilia: Squamata: Corytophanidae).**
*Greimary Fuenmayor, Ángel Cardozo and Margareth Voelger…….* **123**

***SCIENTIFIC NOTES***

**Record of *Corythaica carinata* Uhler, 1886 (Hemiptera: Tingidae) in Zulia state, Venezuela.**
*Alfredo Briceño Santos……..* **134**

**Nota distributive geográfica de las especies de *Paracymus* Thomson, 1867, de Venezuela (Coleoptera: Hidrophilidae: Hidrophilinae).**
*Mauricio García Ramírez y Nadiany Castillo Reyes……..* **139**

**Instrucciones a los autores**…… **149**

**Instructions for authors**…….. **159**