JoAS Volume 10 No. 2 October 2025
DOI: https://doi.org/10.20473/joas.v10i2.70465
pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Journal of Aquaculture Science

Pythoplankton and Zooplankton Composition in Vannamei Shrimp (*Litopenaeus vannamei)* Pond Ecosystems as Indicators of Water Stability

Atiek Pietoyo, Indra Kristiana*, Irvan Firman Syah, Hafidz Hakim, Wahyu Puji Astiyani

Aquaculture Study Program, Polytechnique of Marine and Fishery Pangandaran, Jl. Raya Babakan, Pangandaran 46396, Indonesia

Article info:

Submitted: March 3, 2025
Revised: May 29, 2025
Accepted: June 16, 2025
Publish: October 1, 2025

E-mail addresses:
*Corresponding author:
kristianaindra@gmail.com

ABSTRACT

Vannamei shrimp (*Litopenaeus vannamei*) is one of the leading commodities. Environmental factors are crucial to intensive vannamei shrimp production. Changes in the plankton's composition can show the ecosystem's balance. This research was carried out from March to June 2022 in intensive ponds in the Gending district, Probolinggo Regency, East Java. Sampling was carried out over seven weeks. The population was calculated using a haemocytometer. The species diversity was calculated using the Shannon-Wiener formula, and the uniformity index was calculated using the Odum formula. The abundance of zooplankton did not have a significant relationship with water quality parameters because each species was affected by different water quality parameters. The N/P ratio value does not directly impact the plankton population in this shrimp pond, where the results obtained from the pond waters have low diversity, which means that the waters have a low level of uniformity. There is no dominance of certain species.

Keywords: *Litopenaeus vannamei*, phytoplankton, water stability, zooplankton

INTRODUCTION

Litopenaeus vannamei is one of the leading commodities in shrimp cultivation. This originates from more than 20 °C sea temperature, from Northern Mexico to the Northern Peruvian coast (Kongchum *et al.*, 2022). In Indonesia, vannamei shrimp is a leading commodity and a major fisheries export. In 2022, the national production of vannamei shrimp in Indonesia reached 918,550 tons per year, while in 2023 production increased to 1,120,000 tons per year (Ministry of Maritime Affairs and Fisheries, 2024). The shrimp aquaculture sector has become a significant source of income for shrimp value chain actors worldwide, including both marginal and independent farmers. Whiteleg shrimp (Vanamei) are superior due to their greater resistance to disease and environmental fluctuations, high stocking densities, and shorter rearing times (Amelia *et al.*, 2021).

One of the crucial environmental factors for intensive vannamei shrimp growth is the presence of phytoplankton to support primary productivity and water quality. Systems prioritising phytoplankton balance exhibit a relationship between cultivated organisms and phytoplankton communities (Lukwambe *et al.*, 2019; Yang *et al.*, 2020). The composition of the phytoplankton community can affect the growth and survival of shrimp (Casé *et al.*, 2008). Unstable phytoplankton communities can increase the risk of shrimp (Lyu *et al.*, 2021). Plankton may be utilised as a natural feed source for prawn farming, which can help the industry grow, maximise the conversion

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

rate, and boost the effectiveness of artificial feed (Soeprapto *et al.*, 2023).

Changes in the quality of the pond environment may impact the balance of the pond ecosystem, as shown by changes in the composition of the plankton in the aquaculture environment. The foundation of this study is the significance of plankton function in the aquaculture pond. This study aims to analyze the plankton composition as an indicator of the stability of the ponds' aquatic ecosystem.

MATERIALS AND METHODS

Time and Place Research

This research was carried out between March and June 2022 in intensive shrimp ponds in the Gending district, Probolinggo Regency, East Java (Figure 1). Six shrimp ponds were observed. Each pond analyzed was circular, with a diameter of 30 m and an area of around 700 m^2. Sampling was carried out for seven weeks.

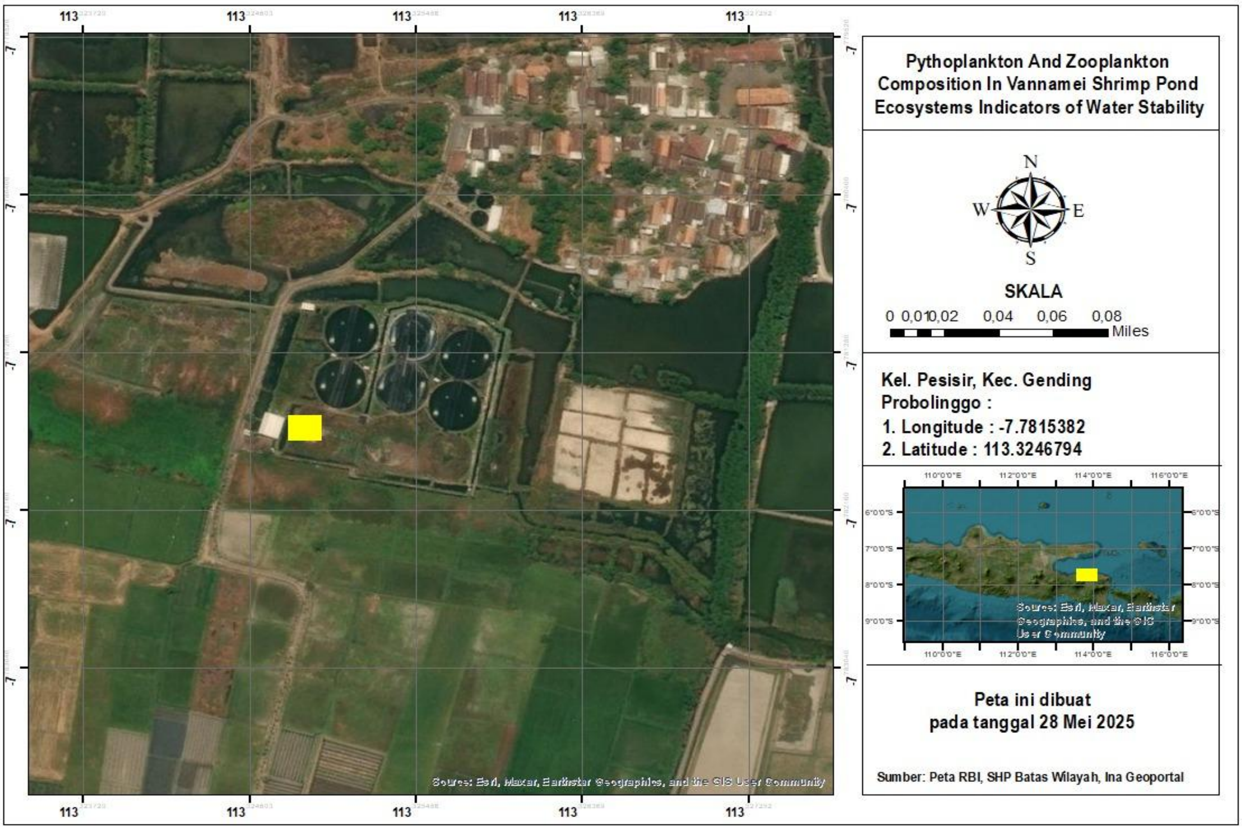

Figure 1. Vannamei Shrimp Ponds Location

Sampling Procedure

Sampling was conducted at a depth of 0.5 m using a 5-liter bucket at five replicate points. Samples were filtered using a 25-µm plankton net. Plankton samples were then transferred to 60 ml plastic bottles with the addition of 1% Lugol's solution and 2% formalin as a preservative. Samples were labeled and stored in a cooler for further testing in the laboratory. Under a microscope, qualitative and quantitative phytoplankton studies were conducted in the laboratory using the Utermöhl method. Sample composition was determined by identifying specific and infraspecific species.

Data Analysis

The data analysed includes abundance, diversity index, uniformity index, and dominance index.

A. Plankton Abundance

The abundance or population of plankton in this study was calculated using a haemocytometer. The sample was dropped with a pipette and observed with a magnification of 450×. The calculation result of the number of individuals in the grid was multiplied by 10^4. Determination of the abundance of phytoplankton species is calculated using the formula (Rasit *et al.*, 2016):

$$Vf = Lk \ x \ d$$

Vf: sample volume (ml)
Lk: square area (mm)
d: chamber depth of haemocytometer (mm)

$$\mathrm{Di} = \mathrm{ni}\left(\frac{\mathrm{Vs}}{\mathrm{Vc}}\right)\left(\frac{1}{A}\right)$$

Di: abundance of species I (individuals/L)
Ni: the number of individuals of species i
Vs: Total volume of all samples (ml);
Vc: calculated sample volume [(number of squares) × (Vf)] (ml)
A: volume of filtered water sample (L)

B. Diversity Index

The diversity index (H') was calculated using the Shannon-Wiener formula (Mason, 2002).

$$H' = -\Sigma \ (Pi) \ln (Pi)$$

$$i=1$$

H': Species diversity index
Pi: Proportion of types (ni/N)
ni: Number of individuals of type i
N: Total number of individuals

C. Uniformity index

The uniformity index calculation uses the formula Odum (1993) as follows:

$$E = \frac{H'}{\ln S}$$

E: Type uniformity index
H^1: Many types
S: Number of species in the community

D. Dominance index

The dominance index is analyzed using the following formula (Odum, 1994):

$$D = \Sigma[ni/N]^2$$

D: Simpson dominance index
ni: Number of individuals of type i
N: Total number of individuals

RESULTS AND DISCUSSION

The following is data from observations of plankton abundance in Table 1.

Table 1. Abundance of Phytoplankton and Zooplankton in Vannamei Shrimp Ponds Along with Percentages

Type of Plankton Based on Pigment	Genus	Population per week (individuals/L)						
		I	II	III	IV	V	VI	VII
Green Algae (Chlorophyta)	*Chlorella*	4.17×10^5	1.67×10^5	2.33×10^5	8.17×10^5	7.67×10^5	1.35×10^6	2.33×10^5
	Chlamydomonass	1.53×10^6	8.17×10^5	3.67×10^5	3.00×10^5	3.21×10^5	3.63×10^5	8.33×10^4
	Scenedesmus	4.17×10^3	8.33×10^3	1.67×10^4	4.17×10^4	1.67×10^4	7.08×10^4	6.25×10^4
	Oocystis	-	8.33×10^4	3.33×10^4	1.00×10^5	-	5.83×10^4	4.17×10^4
Total of Green Algae		**1.95×10^6 (90%)**	**1.08×10^6 (34%)**	**6.50×10^5 (24.2%)**	**1.26×10^6 (48.2%)**	**1.10×10^6 (30.7%)**	**1.84×10^6 (80.2%)**	**4.21×10^5 (71.6%)**

Continued on next page

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Type of Plankton Based on Pigment	Genus	Population per week (individuals/L)						
		I	II	III	IV	V	VI	VII
Blue Green Algae (Cyanophyta)	*Coelosphaerium*	3.33×10^4	1.67×10^4	-	-	-	-	5.83×10^4
	Anabaeopsis	-	-	-	-	-	4.17×10^3	-
	Microcystis	-	-	-	-	-	6.67×10^4	-
	Oscillatoria	4.17×10^3	3.75×10^4	5.42×10^4	1.25×10^4	5.83×10^4	5.00×10^4	3.33×10^4
Total of Blue Green Algae		**3.75×10^4 (1.7%)**	**5.42×10^4 (1.7%)**	**5.42×10^4 (2%)**	**1.25×10^4 (0.5%)**	**5.83×10^4 (1.6%)**	**1.21×10^5 (5.2%)**	**9.17×10^4 (15.6%)**
Diatom (Bacillariophyta)	*Amphora*	4.17×10^3	-	-	-	-	2.50×10^4	-
	Amphiprora	2.08×10^4	1.25×10^4	1.25×10^4	2.92×10^4	1.25×10^4	-	-
	Chaetoceros	1.04×10^5	1.67×10^4	2.08×10^4	1.67×10^4	1.67×10^4	-	-
	Coscinodiscus	-	-	-	1.67×10^4	-	-	-
	Cyclotella	-	1.67×10^4	8.75×10^4	2.88×10^5	9.00×10^5	1.21×10^5	5.00×10^4
	Cylindropyxis	-	-	-	-	3.00×10^5	1.50×10^5	
	Pleurosigma	-	-	-	-	-	-	8.33×10^3
	Navicula	-	-	-	-	-	-	
Total of Diatom		**1.29×10^5 (6%)**	**4.58×10^4 (1.3%)**	**1.21×10^5 (4.5%)**	**3.50×10^5 (13.4%)**	**1.23×10^6 (34.1%)**	**2.96×10^5 (12.9%)**	**5.83×10^4 (9.95%)**
Dinoflagelata (Phyrophyta)	*Prorocentrum*	1.25×10^4	-	-	-	-	-	-
	Chrysochromulina	-	-	-	-	-	2.08×10^4	-
	Protoperidium	-	-	-	-	4.17×10^3	-	-
	Gyrodinium	-	4.17×10^3	-	-	-	-	-
	Gymnodinium	-	3.83×10^5	6.67×10^4	2.46×10^5	2.17×10^5	8.33×10^3	4.17×10^3
Total of Dinoflagelata		**1.25×10^4 (0.6%)**	**3.88×10^5 (12.1%)**	**6.67×10^4 (2.5%)**	**2.46×10^5 (9.4%)**	**2.21×10^5 (6.1%)**	**2.92×10^4 (1.3%)**	**4.17×10^3 (0.72%)**
Golden Green Algae (Chrysophyta)	*Prymnesium*	1.25×10^4	1.57×10^6	1.75×10^6	7.00×10^5	-	-	1.25×10^4
	Cryptomonas		2.50×10^4	2.08×10^4	2.08×10^4	9.88×10^5	8.33×10^3	
Total of Golden Green Algae		**1.25×10^4 (0.5%)**	**1.59×10^6 (50.3%)**	**1.78×10^6 (66.2%)**	**7.21×10^5 (27.5%)**	**9.88×10^5 (27.5%)**	**8.33×10^3 (0.4%)**	**1.25×10^4 (2.13%)**
Abundance of phytoplankton		**2.15×10^6 (98.8%)**	**3.15×10^6 (99.4%)**	**2.67×10^6 (99.4%)**	**2.59×10^6 (99%)**	**3.60×10^6 (100%)**	**2.30×10^6 (100%)**	**5.88×10^5 (100%)**
Zooplankton	*Ciliata*	-	-	4.17×10^3	4.17×10^3	-	-	-
	Paramecium	4.17×10^3	-	-	-	-	-	-
	Acanthocystis	4.17×10^3	-	-	-	-	-	-
	Brachionus	8.33×10^3	4.17×10^3	-	8.33×10^3	-	-	-
	Vorticella	8.33×10^3	-	-	-	-	-	-
	Strombidinopsis	-	-	8.33×10^3	4.17×10^3	-	-	-
	Euplotes	-	8.33×10^3	-	4.17×10^3	-	-	
Abundance of zooplankton		**2.50×10^4 (1.2%)**	**1.25×10^4 (0.6%)**	**1.25×10^4 (0.6%)**	**2.08×10^4 (1%)**	**-**	**-**	**-**
Total of plankton		**2.17×10^6**	**3.17×10^6**	**2.68×10^6**	**2.61×10^6**	**3.60×10^6**	**2.30×10^6**	**5.88×10^5**

Total Abundance and Percentage Composition of Phytoplankton and Zooplankton

Table 1 shows phytoplankton and zooplankton abundance fluctuations during vannamei shrimp cultivation. The highest phytoplankton abundance was recorded in week 5 with 3.60×10^6 individuals/L, while the lowest was in week 7 with 5.88×10^5 individuals/L. The highest zooplankton abundance was recorded in week 1 at 2.50×10^4 individuals/L, and it was not detected from week 5 to week 7. The fluctuations in phytoplankton and zooplankton abundance during the observation period indicate mutually influencing ecological dynamics. According to Musa *et al.* (2023), zooplankton abundance influences phytoplankton abundance due to predation processes. When zooplankton are not detected, phytoplankton dominate the water.

Based on plankton abundance, the pond water is classified as mesotrophic. According to Vesensia *et al.* (2021), mesotrophic water is categorised as water with moderate fertility, with a phytoplankton abundance of 2,000–5,000 individuals/L and a zooplankton abundance of 1–500 individuals/L. This condition is suitable for the growth of vannamei shrimp because the nutrient content is optimal to support plankton growth as natural feed. The abundance and composition of plankton are significantly influenced by increased nutrient input during aquaculture activities. Uncontrolled nutrient increases can shift water bodies from mesotrophic to eutrophic conditions. Eutrophication in water bodies is highly dangerous as it can lead to low dissolved oxygen levels (Astuti et al., 2022). Nutrient input during aquaculture must be monitored and controlled to prevent water eutrophication.

Phytoplankton composition was more dominant than zooplankton during observation (Table 1). The percentage composition of phytoplankton in week 1 was 98.8% and zooplankton 1.2%. This dominance increased to 100% in week 5 and remained stable until week 7. Higher phytoplankton levels indicate a more stable and productive ecosystem (Otero *et al.*, 2020). Ecosystem productivity is better and more stable when phytoplankton populations are more functionally diverse (Vallina *et al.*, 2017).

Plankton serve as bioindicators for assessing water quality. Changes in plankton composition and succession correlate with various water quality parameters (Sathishkumar *et al.*, 2021). Therefore, routine monitoring of plankton populations alongside water quality parameters is crucial. Sudden changes in plankton diversity can pose significant risks to the ecosystem and the health of the vannamei farming system. Drastic changes have the potential to affect shrimp physiology, causing cellular damage, disrupting respiratory function, and ultimately reducing performance and production levels (Lyu *et al.*, 2021; Li *et al.*, 2022). Therefore, implementing early detection strategies based on plankton monitoring is crucial to prevent water quality degradation and changes in the vannamei aquaculture ecosystem (Sathishkumar *et al.*, 2021).

Phytoplankton Abundance and Percentages Composition Based on Pigments

The percentage composition of phytoplankton is shown in Table 1. The composition of phytoplankton in vannamei shrimp culture varied throughout the observation period. The phytoplankton found consisted of different pigment-based groups such as Chlorophyta, Cyanophyta, Bacillariophyta, Phyrophyta, and Chrysophyta. According to Kristiana *et al.* (2024) four species of plankton were identified in the ponds used for vannamei shrimp cultivation: (50-71%) were green algae

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

(Chlorophyta); (16-32%) were blue green algae (Cyanophyta); (2-13%) were diatoms (Chrysophyta) and 1% were dinoflagellates (Phyrrophyta).

Green algae

The presence of green algae in vannamei shrimp farming waters is highly fluctuating, as shown in Table 1. It dominated at 90% in the first week, but decreased to 34% in the second week and 24.2% in the third week. The number increased again in the following weeks, reaching 80.2% in the sixth week. The observed green algae groups include: *Chlorella* and *Chlamydomonas* as the dominant species, followed by *Scenedesmus* and *Oocystis*. According to Samadan *et al.* (2020), *Chlamydomonas*, *Tetraselmis*, *Chlorella*, and *Oocystis* are the four Chlorophyta species commonly found in intensive vannamei shrimp farming ponds. *Chlorella* spp. is frequently found in intensive shrimp farming systems (Setyaningrum and Yuniartik, 2021), indicating that the water quality in such systems is nutrient-rich (Lyu *et al.*, 2021; Wafi and Ariadi, 2022). *Chlorella* is also tolerant to extreme weather changes and is unaffected by shrimp ponds' ecosystem dynamics (Liyana *et al.*, 2011). This plankton can also act as a competing microorganism for Vibrio spp (Ariadi *et al.*, 2022).

Blue Green Algae

Cyanophyta appeared in low proportions (0.5–2%) from the first to fifth weeks, but increased to 5.2% in the sixth week and peaked at 15.6% in the seventh week. The blue-green algae groups identified include: *Coelosphaerium* as the dominant species, *Anabaeopsis*, *Mycrocystis*, and *Oscillatoria*. Blue-green algae can disrupt shrimp farming productivity in excessive quantities because this group can produce toxins during blooms (Riandi *et al.*, 2021). To prevent blooms, water quality maintenance is necessary to suppress species' growth from the blue-green algae group.

Diatom

The diatom group showed fluctuations during the observation period. The peak abundance in week 5 reached 34.1% or 1,229,167 individuals/L. This figure continued to decline in weeks 6 to 7. This diatom group includes: *Amphora*, *Amphiprora*, *Chaetoceros*, *Coscinodiscus*, *Cyclotella*, *Cylindropyxis*, *Pleurosigma*, and *Navicula*. According to Supono and Hudaidah (2018), diatoms are a type of plankton that play a very positive role in vannamei shrimp farming. The species composition and abundance of diatoms can indicate aquaculture water quality (Tan *et al.*, 2013). Diatoms, particularly epipelic species like Pleurosigma, play a key role in sediment-water interactions by influencing organic matter dynamics, nitrate concentrations, and alkalinity (Foldi *et al.*, 2018).

Dinoflagellates

The presence of Dinoflagellata in vannamei shrimp ponds also fluctuates, with susceptibility levels ranging from 0.6% to 12.1% or densities ranging from 1.25×10^4 individuals/L to 3.88×10^5 individuals/L. The Dinoflagellata group includes: *Prorocentrum*, *Chrysochromulina*, *Protoperidium*, *Gyrodinium*, and *Gymnodinium*. A Dinoflagellata population explosion is harmful to vannamei shrimp. The toxins produced by the population explosion can inhibit growth due to anoxia, excessive mucus formation, or even death (Boyd, 2017). According to Adam *et al.* (2022), Dinoflagellata is the primary cause of White Faeces Disease outbreaks in vannamei shrimp ponds, alongside Vibrio.

Golden Green Algae

The abundance of golden green algae peaked at 66.2% in the third week. The Golden Green Algae group consists of *Prymnesium* and *Cryptomonas*. The presence of large amounts of *Prymnesium* indicates that the water is unhealthy. According to Boyd (2017), *Prymnesium* and *Crysochromulina* cause fish and shrimp mortality because they can produce the toxin prymnesin, which disrupts membrane permeability. This toxin can lyse red blood cells and cause neurotoxic effects.

Zooplankton Abundance and Percentage Composition

The Genus Brachionus, Strombidinopsis, and Euplotes dominate the abundant zooplankton. According to Wallace and Uyhelji (2009), *Brachionus* belongs to the phylum Rotifer, which lives in freshwater, brackish, and marine water. Rotifers can readily achieve population densities well over 1,000 individuals per litre due to their fast reproduction rates, and they can even occasionally take over zooplankton ecosystems.

In Table 1, it can be seen that in the first week in the vannamei pond plots, there were four species of zooplankton: Acanthocyctis at 0.2%, Brachionus at 0.4%, Paramecium at 0.2%, and Vorticella at 0.4%. In the second week, there were two species: *Brachionus* and *Euplotes*. *Brachionus* decreased to 50% of the initial number, but Euplotes appeared at 8.33×10^3 individuals/L.

In the 3rd week, new species appeared, namely *Strombidinopsis* at 8.33×10^3 individuals/L and ciliates at 4.17×10^3 individuals/L. In the 4th week, *Brachionus* appeared again, 8.33×10^3 individuals/L; *Strombidinopsis* 4.17×10^3 individuals/L; *Euplotes* 4.17×10^3 individuals/L, and ciliate 4.17×10^3 individuals/L. The presence of zooplankton was not detected from the 5th week to the 7th week. According to Arafat *et al.* (2021), the biotic elements of the aquatic ecosystem are significantly impacted by the diversity and abundance of the zooplankton community. By consuming phytoplankton and other zooplankton and serving as a key player in energy transfer between fish and phytoplankton, zooplankton play an essential part in the aquatic food web.

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Diversity, Uniformity, and Dominance Index Value of Plankton

Figure 2 presents the diversity, uniformity, and dominance index values of plankton observed during the study.

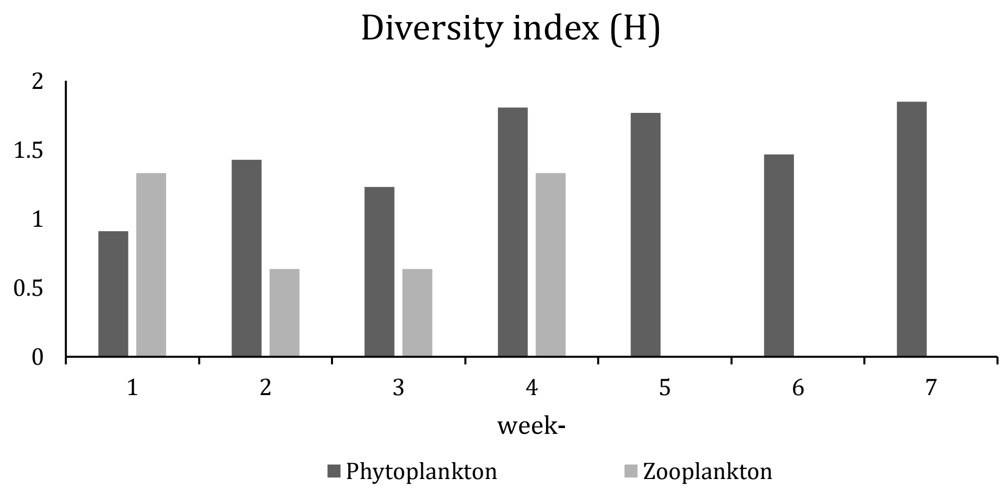

Figure 2. Diversity Index Value of Plankton

The diversity index of phytoplankton ranged from 0.91 to 1.85 (Figure 2), whereas zooplankton ranged from 0.64 to 1.33. In the 5th week to the 7th week, the presence of the zooplankton was not detected. The diversity index H < 2.3 is categorised as low biota community stability. According to Palupi *et al.* (2022), in intensive shrimp ponds, the diversity index is 1.95, whereas in traditional shrimp ponds it is 2.17. According to Lukwambe *et al.* (2019), probiotic supplementation had a major impact on algae growth. Probiotics supplements can reduce the development of Cyanobacteria species (*Oscillatoria* and *Anabaena*) and increase the growth of *Nannochloropsis*, *Chlorella* of Chlorophyta species, *Oocystis,* and *Navicula* of *Bacillariophyta* species.

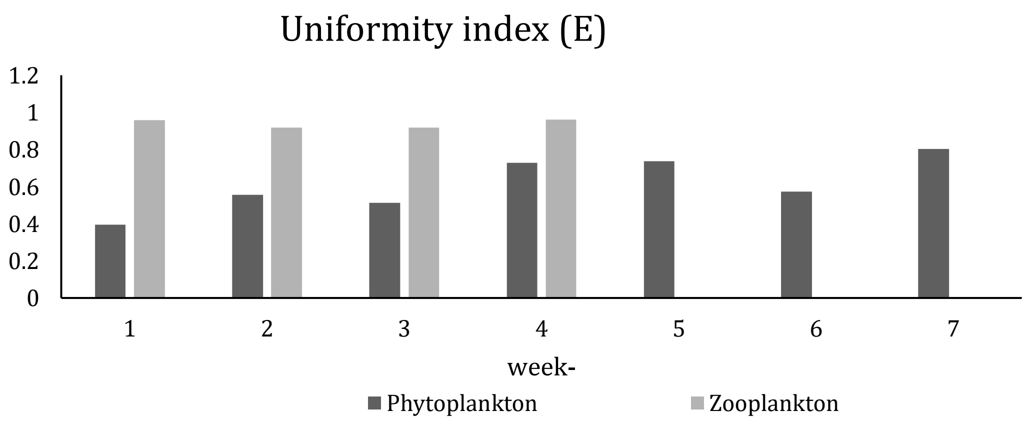

Figure 3. Uniformity Index Value of Plankton

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

The uniformity index of phytoplankton ranged from 0.39 to 0.80 (Figure 3), whereas zooplankton ranged from 0.92 to 0.96. According to Odum (1993) because there is no competition for food or space, populations are uniformly distributed when E > 0.5.

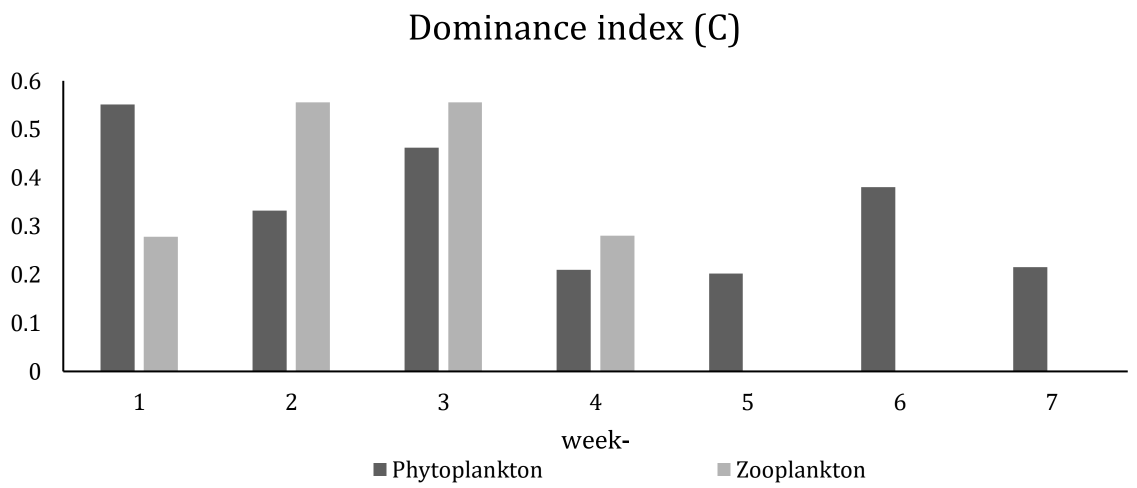

Figure 4. Dominance Index Value of Plankton

The dominance index of phytoplankton ranged from 0.21 to 0.55 (Figure 4), whereas that of zooplankton ranged from 0.27 to 0.55. This showed that there is no overwhelming phytoplankton or zooplankton in vannamei shrimp ponds. Odum (1993) said there are no dominating species when the value of C is near zero. However, a dominating species is present if the value of C is around 1. According to Palupi *et al.* (2022), the dominance index in intensive shrimp ponds is 0,18, while in traditional shrimp ponds it is 0.15.

Water quality parameters

Water quality test results are in Table 2.

Table 2. Value of Water Qualities

Water quality parameters	weeks						
	I	II	III	IV	V	VI	VII
pH	8.32	8.30	8.26	8.17	8.16	8.07	8.33
Salinity (ppt)	8.17	8.33	8.83	9.00	8.83	8.50	9.17
Total Alkalinity (ppm)	554.67	540.67	550.67	446.67	522.67	493.33	504.00
Phosphate (mg/l)	0.05	0.06	0.05	0.05	0.07	0.09	0.07
Total Nitrogen (mg/l)	1.19	2.02	1.60	1.85	1.29	1.20	3.34
N/P ratio	26	32	34	39	18	14	50

This vannamei shrimp pond has a water salinity of 8.17 – 9.17 ppt with a pH of 8.07 – 8.33 and total alkalinity between 446.67 – 554.67 ppm (Table 2). Total nitrogen values range from 1.19 to 3.34 mg/l, while phosphate values range from 0.05 to 0.09 mg/l. Nutrients needed for plankton growth in shrimp ponds include nitrogen and phosphorus availability. According to Nguyen and Harvey (1997) and Xu *et al.* (2010), nitrogen and phosphorus play a role in plankton growth. Nitrogen plays a direct role in synthesising protein biomolecules, the basic components of amino acids. Meanwhile, phosphorus is needed to form nucleic acids and store and transfer energy through ATP molecules (Yakoob *et al.*, 2021). Nutritional needs will differ for each species. Excess or deficiency will disrupt natural biochemical processes to trigger the development of certain species based on the availability of nutrients in the system. In ecosystem conditions, the availability of nitrogen nutrient content is higher than phosphorus, which will trigger the growth of certain species faster and more (such as algae) (Li *et al.*, 2020; Maberly *et al.*, 2022). Sommer *et al.* (2012) stated that the availability of excess phosphorus compared to nitrogen will also cause species that can fix nitrogen to become more numerous and grow faster (such as some *Cyanobacteria*).

The results of the calculation of the N/P ratio in shrimp pond waters range from 18:1 to 50:1. The ratio of nitrogen to phosphorus (N/P) requirements must be balanced, an ideal condition for stable plankton community growth. In general, the N/P ratio in shrimp ponds is 16:1, which is a classic ratio in natural aquatic ecosystems, where phytoplankton grow optimally in these conditions. However, according to Mustafa *et al.* (2024), the optimal ratio in shrimp ponds varies depending on the type of shrimp and ecosystem conditions. The specific value of the optimal N/P ratio in shrimp farming is not explicitly stated. An imbalance in this ratio can trigger changes in the structure of the plankton community, affect the dynamics of microorganisms, and potentially produce toxins or cause eutrophication (Elser *et al.*, 2020; Li *et al.*, 2020; Van Mooy *et al.*, 2021). In this shrimp pond, the N/P ratio value does not directly impact the plankton population. The results obtained from the pond waters have low diversity, which means that the waters have a low level of uniformity and no dominance of certain species.

CONCLUSION

Variations in plankton presence within vannamei shrimp ponds indicate shifts in the quality of the pond environment. The diversity index of phytoplankton is categorized as low biota community stability. The dominance index of phytoplankton ranged from 0.21 to 0.55, whereas that of zooplankton ranged from 0.27 to 0.55. This implies that there are no overwhelming species. The uniformity index of phytoplankton ranged from 0.39 to 0.80, whereas that of zooplankton ranged from 0.92 to 0.96. Based on the abundance of plankton, these vannamei ponds were stable. However, the N/P ratio calculation results showed a range that was too wide. This means that if the waters are not controlled properly, it will cause poisoning. In short, aquaculture waters in ecosystems such as this are categorised as water bodies with low stability, but are still suitable for vannamei shrimp farming.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of Pangandaran Maritime and Fisheries Polytechnic and pond cultivators in Probolinggo Regency, East Java Province.

AUTHORS' CONTRIBUTIONS

The following are the contributions made by each author: Data collection, the manuscript preparation, and graphics design were done by

AP, IK, IFS, HH. Data processing, manuscripts writing and proofreading are all done by AP and IK. Each author made a contribution to the final manuscript.

CONFLICT OF INTEREST

Every author affirms that they have no competing interests.

REFERENCES

Adam, M., Widiastuti, I. M., Yayan, A. Y., Insivitawati, E., Pakaya, R. F., Soegianto, A., & Khumaidi, A. (2022). Analysis of White Feces Disease (WFD) caused by Vibrio sp. and Dinoflagellata in Vannamei Shrimp (*Litopenaeus vannamei*) in Brackishwater Culture Pond. Scientific Journal of Fisheries & Marine, 14(1).

Amelia, F., Yustiati, A., & Andriani, Y. (2021). Review of shrimp (*Litopenaeus vannamei* (Boone, 1931)) farming in Indonesia: Management operating and development. World Scientific News, 158, 145-158.

Arafat, M. Y., Bakhtiyar, Y., Mir, Z. A., & Tak, H. I. (2021). Paradigm of Climate Change and its Influence on Zooplankton. Biosciences Biotechnology Research Asia, 18(2), 423–438.

Ariadi, H., Khristanto, A., Soeprapto, H., Kumalasari, D., & Sihombing, J. L. (2022). Plankton and its potential utilization for climate resilient fish culture. Aquaculture, Aquarium, Conservation & Legislation, 15(4), 2041-2051.

Boyd, C. E. (2017). General relationship between water quality and aquaculture performance in ponds. In Fish Diseases: Prevention and Control Strategies (pp. 147–166). Elsevier Inc.

Casé, M., Leça, E. E., Leitão, S. N., SantAnna, E. E., Schwamborn, R., & de Moraes Junior, A. T. (2008). Plankton community as an indicator of water quality in tropical shrimp culture ponds. Marine Pollution Bulletin, 56(7), 1343–1352.

Elser, J. J., Bracken, M. E. S., & Cleland, E. E. (2007). Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine, and terrestrial ecosystems. Ecology Letters, 10(12), 1135-1142.

Földi, A., Acs, E., Grigorszky, I., Ector, L., Wetzel, C. E., Varbiro, G., ... & Duleba, M. (2018). Unexpected consequences of bombing. Community level response of epiphytic diatoms to environmental stress in a saline bomb crater pond area. PLoS One, 13(10), e0205343.

Kongchum, P., Chimtong, S., Prapaiwong, N. (2022). Association Between Single Nucleotide Polymorphisms of nLvALF1 and PEN2-1 Genes and Resistance to Vibrio parahaemolyticus in The Pacific White Shrimp *Litopenaeus vannamei*. Aquac Fish, 7(4): 373-381.

Kristiana, I., Astiyani, W. P., Pietoyo, A., Maulidia, A. I., & Akbarurrasyid, M. (2024). Identifikasi Plankton pada Tambak Udang Vaname (Litopenaeus vannamei) di Teaching Factory Politeknik Kelautan dan Perikanan Pangandaran. Samakia: Jurnal Ilmu Perikanan, 15(1), 142-149.

Li, E., Wang, X., Chen, K., Xu, C., Qin, J. G., & Chen, L. (2022). Physiological changes of *Litopenaeus vannamei* under water quality stress and its relation to phytoplankton abundance. Aquaculture, 546, 737785.

Lukwambe, B., Nicholaus, R., Zhang, D., Yang, W., Zhu, J., & Zheng, Z. (2019). Successional Changes Of Microalgae Community In Response To Commercial Probiotics In The Intensive Shrimp (*Litopenaeus vannamei* Boone) Culture Systems. Aquaculture, 511, 5-11.

Lyu, T., Yang, W., Cai, H., Wang, J., Zheng, Z., & Zhu, J. (2021). Phytoplankton community dynamics as a metrics of shrimp healthy farming under intensive cultivation. Aquaculture Reports, 21, 100965.

Maberly, S. C., Van de Waal, D. B., & Raven, J. (2022). Phytoplankton growth and nutrients. In Reference Module in Earth Systems and Environmental Sciences (pp. 130-138). Elsevier Inc.

Mason, C.F. (2022). Biology of Fresh Water Pollution 4th ed. Pearson Education Ltd. London.682p.

Ministry of Maritime Affairs and Fisheries. (2024). Produksi Perikanan Budidaya Pembesaran https://portaldata.kkp.go.id/datainsight/produksi-ikan-budidaya

Musa, M., Thoyibah, A. A., Puspitaningtyas, D. A., Arsad, S., Mahmudi, M., Lusiana, E. D., Maftuch, M., & Huda, A. S. (2023). The Impact Of Water Quality On The Availability Of Phytoplankton and Growth of *Litopenaeus vannamei*. Journal of Water and Land Development, 56, 127–135.

Mustafa, A., Paena, M., Tarunamulia, T., Kamariah, K., Ratnawati, E., Athirah, A., ... & Albasri, H. (2024). Water quality changes in the coastal area of intensive whiteleg shrimp brackish water pond aquaculture. Journal of water and land development, 61 (IV–VI), 130–142.

Nguyen, R. T., & Harvey, H. R. (1997). Protein and amino acid cycling during phytoplankton decomposition in oxic and anoxic waters. Organic Geochemistry, 27(3-4), 115-128

Odum, E. P. (1993). Dasar-Dasar Ekologi. Diterjemahkan dari Fundamental of Ecology oleh: Tjahjono Samingan. Edisi ketiga. Yogyakarta. Gadjah Mada University Press

Otero, J., Álvarez-Salgado, X. A., & Bode, A. (2020). Phytoplankton Diversity Effect on Ecosystem Functioning in a Coastal Upwelling System. Frontiers in Marine Science, 7, 592255

Palupi, M., Fitriadi, R., Wijaya, R., Raharjo, P., & Nurwahyuni, R. (2022). Diversity of Phytoplankton in The Whiteleg (*Litopenaeus vannamei*) Shrimp Ponds in The South Coastal area of Pangandaran, Indonesia. Biodiversitas, 23(1), 118–124.

Rasit, A., M.I. Rosyidi, R. & Winarsa. 2016. Struktur Komunitas Fitoplankton Pada Zona Litoral Ranu Pakis. Berkala Sainstek, IV(1), 5-9.

Riandi, M. I., Susilo, R. J. K., Sani, M. D., Maharani, A. Y., Soegianto, A. G. O. E. S., Putranto, T. W., & Wiradana, P. A. (2021). Surveillance of Vibrio And Blue-Green Algae in Intensive System of Pacific White Shrimp (*Litopenaeus vannamei*) in Situbondo Regency, East Java, Indonesia. *Poll Res*, 40(2), 611-616.

Samadan, M.G, Supyan S, Andriani R, Juharni J. (2020). Kelimpahan Plankton pada Budidaya Udang Vannamei (*Litopenaeus vannamei*) dengan Kepadatan Berbeda di Tambak Lahan Pasir. Jurnal Ilmu Kelautan Kepulauan, 3,222-229.

Sathishkumar, R. S., Sundaramanickam, A., Sahu, G., Mohanty, A. K., Ramesh, T., & Khan, S. A. (2021). Intense bloom of the diatom *Hemidiscus hardmanianus* (Greville) in relation to water quality and plankton communities in Tuticorin coast, Gulf of Mannar, India. Marine Pollution Bulletin, 163, 111757.

Setyaningrum, E. W., & Yuniartik, M. (2021). Comparison of Plankton Abundance, Water Conditions, Performance of Vaname Shrimp (*Litopenaeus Vannamei*) Growth in Intensive and Extensive Cultivation Systems in Banyuwangi Regency Waters. Journal of Aquaculture Science, 6(1IS), 15–27.

Soeprapto, H., Ariadi, H., & Badrudin, U. (2023). The dynamics of Chlorella spp. abundance and its relationship with water quality parameters in intensive shrimp ponds. Biodiversitas Journal of Biological Diversity, 24(5).

Sommer, U., Adrian, R., De Senerpont Domis, L., Elser, J. J., Gaedke, U., Ibelings, B., & Winder, M. (2012). Beyond the Plankton Ecology Group (PEG) model: mechanisms driving plankton succession. *Annual review of ecology, evolution, and* systematics, 43(1), 429-448

Supono, S., & Hudaidah, S. (2018). The diversity of epipelic diatoms as an indicator of shrimp pond environmental quality in Lampung Province, Indonesia. Biodiversitas Journal of Biological Diversity, 19(4), 1220-1226.

Tan, X., Sheldon, F., Bunn, S. E., & Zhang, Q. (2013). Using diatom indices for water quality assessment in a subtropical river, China. Environmental Science and Pollution Research, 20, 4164-4175.

Vallina, S. M., Cermeno, P., Dutkiewicz, S., Loreau, M., & Montoya, J. M. (2017). Phytoplankton functional diversity increases ecosystem productivity and stability. Ecological Modelling, 361, 184-196.

Van Mooy, B. A. S., Hmelo, L. R., Sofen, L. E., Campagna, S. R., May, A. L., Dyhrman, S. T. (2012). Quorum sensing control of phosphorus acquisition in *Trichodesmium consortia*. *ISMEJ*.6, 422-429.

Vesensia, O., Arthana, I. W., & Dewi, A. P. W. K. (2021). Abundance of plankton in the waters of Geger Beach, Badung Regency, Bali. Advances in Tropical Biodiversity and Environmental Sciences, 5, 103-108.

Wafi, A., dan Ariadi, H. (2022). Estimasi Daya Listrik untuk Produksi Oksigen oleh Kincir Air Selama Periode "*Blind Feeding*" Budidaya Udang Vannamei (*Litopenaeus vannamei*). Indonesian J Fish Sci Techno, 18(1), 19-35.

Wallace, R. L., & H. A. Uyhelji. (2016). Rotifera. Reference Module in Earth Systems and Environmental Sciences.

Xu, H., Paerl, H. W., Qin, B., Zhu, G., & Gaoa, G. (2010). Nitrogen and phosphorus inputs control phytoplankton growth in eutrophic Lake Taihu, China. Limnology and oceanography, 55(1), 420-432.

Yaakob, M. A., Mohamed, R. M. S. R., Al-Gheethi, A., Aswathnarayana Gokare, R., & Ambati, R. R. (2021). Influence of nitrogen and phosphorus on microalgal growth, biomass, lipid, and fatty acid production: an overview. Individuals, 10(2), 393.

Yang, W., Zhu, J., Zheng, C., Lukwambe, B., Nicholaus, R., Lu, K., & Zheng, Z. (2020). Succession of phytoplankton community during intensive shrimp (*Litopenaeus vannamei*) cultivation and its effects on cultivation systems. Aquaculture, 520, 734733.