Abundance of Phytoplankton in Vannamei Shrimp (*Litopenaeus vannamei*) Farming Pond at the Center for Brackish Water Aquaculture Fisheries (BBPBAP) Jepara

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Abtract

Vannamei shrimp (Litopenaeus vannamei) is one of the commodities that is a priority in aquaculture development activities in Indonesia. The success of vannamei shrimp culture is influenced by various factors such as fry quality, feed quality, land carrying capacity, application of biosecurity and good water quality management. Water quality is closely related to the phytoplankton community contained in a waters. This study aims to analyze the abundance and dominance of plankton species found in pond waters. Monitoring the abundance of phytoplankton was carried out in 4 plots of vannamei shrimp aquaculture ponds at the Brackish Water Aquaculture Fisheries Center (BBPBAP) Jepara, namely plots A51, A51, A61 and A62. Identification and calculation of phytoplankton cells were carried out using a haemocytometer and Sedgwick. The results of the analysis showed that the highest abundance of phytoplankton was found in plots A61 at week 9 with a cell number of 36.73 x 106 cells/L, while plots A51, A52 and A62 decreased. Overall plot A62 had better water quality conditions when compared to plots A51, A52 and A61 indicated by the phytoplankton abundance value of 34.63 x 106 cells/L at week 9 and the dominance index of green algae, namely D > 0.5.

Keywords: *Vannamei shrimp, phytoplankton, green algae, abundance*

Introduction

Vannamei shrimp (*Litopenaeus vannamei*) is currently one of the most widely cultivated shrimp species in Indonesia besides tiger prawns (*Penaeus monodon*) either through semi-intensive or intensive cultivation technology. Vannamei shrimp farming is a promising business prospect for cultivators because of its high productivity. Some of the advantages possessed by vannamei shrimp include being able to be cultivated with a high stocking density, more resistant to disease, having a wide range of salinity tolerance, high survival rate and having a growth rate of 1-1.5 g/week (Supono, 2017; Suriawan. *et al*., 2019). These advantages make vannamei shrimp potential to be used as a priority commodity in aquaculture development plans in Indonesia. In addition, the price of vannamei shrimp in the market is quite competitive and the demand for the availability of vannamei shrimp also continues to increase both in the local market and on the export scale.

Success in vannamei shrimp culture is influenced by various factors such as fry quality, feed quality, good biosecurity implementation, feed management, and water quality management (Supono, 2017; Suryadi *et al*, 2021). The water quality of a pond is closely related to the health condition of the shrimp. Therefore, there is a need for intensive management and monitoring of water quality parameters so that shrimp are free from disease attacks and have a high survival rate at harvest. One of the parameters that can reflect pond water quality conditions is the presence of phytoplankton communities in the waters (Fuady *et al*., 2013; Renitasari & Musa, 2020). This is because phytoplankton are biota that are sensitive to changes in environmental conditions both in density and phytoplankton biomass (Joesidawati *et al*., 2019).

The high diversity of phytoplankton and the number of each species of phytoplankton can be used as indicators to determine the stability of the condition of a pond waters (Utojo, 2015). The presence of phytoplankton can also help meet the availability of dissolved oxygen in the waters through the process of photosynthesis. However, the high and uncontrolled growth rate of phytoplankton can trigger algae blooms. The occurrence of algal blooms will have an impact on decreasing water quality

and disrupting the stability of the pond ecosystem. Water parameters such as temperature, salinity, content of nitrite, nitrate, phosphate and organic matter affect the growth rate of plankton (Krisiyanto et al., 2013; Utojo 2015). Therefore, monitoring of the presence of phytoplankton communities in pond waters needs to be carried out so that water quality management can run well. This study aims to analyze the dynamics of the phytoplankton population as an indicator to describe the condition of the quality of pond waters at the Center for Brackish Water Aquaculture (BBPBAP) Jepara.

Methods

This research was conducted at the Center for Brackish Water Aquaculture (BBPBAP) Jepara., Central Java. In this study, monitoring of the phytoplankton population was carried out in 4 pond plots, namely plots A51, A52, A61 and A62. Observations of morphology and the number of phytoplankton cells contained in pond water samples were carried out using a Sedgwick haemocytometer and a microscope. Monitoring the phytoplankton population was carried out for 63 days with an observation time interval of once a week.

Results and Discussion

The types of phytoplankton found in plots A51, A52, A61 and A62 during 9 weeks of observation were phytoplankton from the Green algae, Blue Green Algae, diatoms and Euglenophyta groups. The identification results of the Green Algae group found two species of phytoplankton, namely *Chlamydocapsa* sp. and *Chlorella* sp.

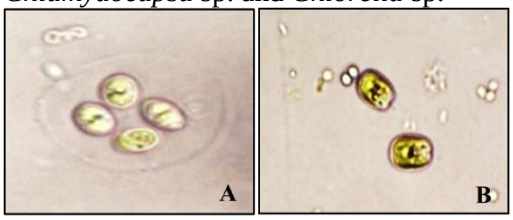

Image 1. Cell morphology of phytoplankton *Chlamydocapsa* sp. (A) and *Chlorella* sp. (B).

The identification of phytoplankton from the Blue Green Algae group was found by the species *Oscillatoria* sp., the diatom group, namely *Coscinodiscus* sp., and the Euglenophyta group, namely *Euglena* sp. (Image 2).

Image 2. Cell morphology of phytoplankton *Coscinodiscus* sp. (A), *Oscilatoria* sp. (B) and *Euglena* sp. (C)

The results of the analysis of water samples showed that there were fluctuations in the abundance of phytoplankton every week in all plots. During the 1st week, it was seen that the abundance of phytoplankton was still low at 319.87 cells/L in plot A51, A52 at 312.96 cells/L, A61 at 467.96 cells/L, and A62 at 136.942 cells/L. The highest abundance of phytoplankton was found in plots A61 at week 9 with a cell number of 36.73 x 106 cells/L, while plots A51, A52 and A62 decreased. The abundance of phytoplankton in plot A51 occurred at week 8 (35.17 x 106 cells/L), plots A52 and A62 at week 7 were 33.41 x 106 cells/L and 34.63 x 106 cells/L (Image 3).

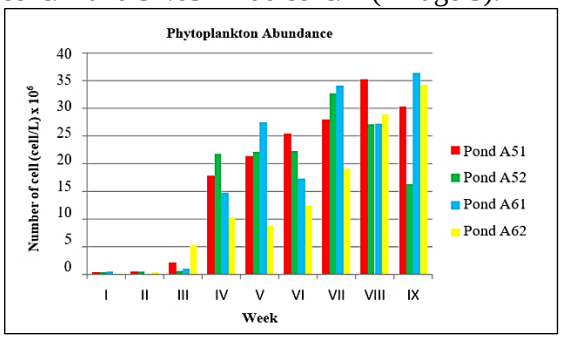

Image 3. The abundance of phytoplankton in the pond plots A51, A52, A61 and A62

The composition and abundance of phytoplankton will change at various levels in response to changes in environmental conditions, both physical, chemical and biological. The environmental conditions of pond waters that are fluctuating have an effect on changes in the diversity and abundance of phytoplankton. Good water quality management can increase nutrient uptake by phytoplankton. In ponds with intensive patterns, the phytoplankton community responds more quickly if there is an increase in nutrients such as organic matter, phosphate and nitrate than in traditional ponds (Utojo & Mustofa 2016).

In this study also performed the analysis of the dominance index (D). The dominance index value describes the presence or absence of a type of phytoplankton that

dominates the phytoplankton population in the waters (Rahmatullah *et al.*, 2016). Dominance index analysis showed that in all plots it was generally dominated by phytoplankton from the Green Algae group (Image 4,5,6, and 7).

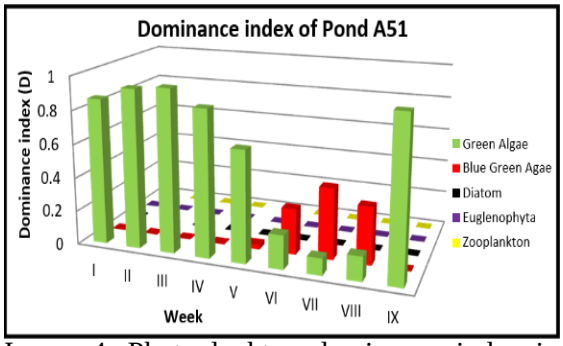

Image 4. Phytoplankton dominance index in plot A51

In the 1st and 2nd weeks, the dominance index value (D) of Green Algae in the A51, A52 and A61 plots was > 0.5, while in the A62 plots it occurred at 2, 8 and 9 weeks. The green algae group (class Chlorophyceae) is a type of phytoplankton that is expected to grow in pond waters. Green algae groups can increase the availability of dissolved oxygen in the waters and can be used as natural food for shrimp (Widigdo & Wardiatno, 2013).

In plots A51 and A52, it was found that the dominance of phytoplankton species in the blue green algae group was found at weeks 6 to 8 (plots A51) and weeks 5 to 8 (plots A52) (Image 4 and 5). However, the dominance index value of the blue green algae phytoplankton group is <0.5.

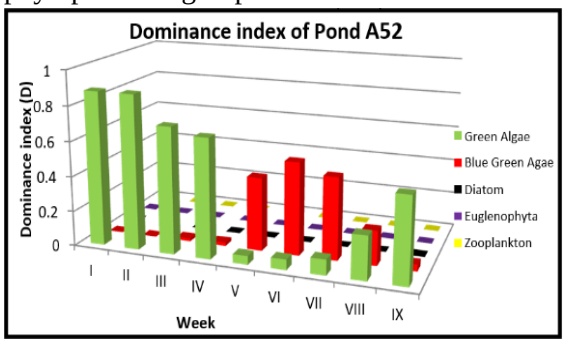

Image 5. Phytoplankton dominance index in plot A52

The value of D < 0.5 can mean that a species has low dominance (Odum, 1994). Krebs (1978) also stated that a dominance index value close to 1 indicates a high dominance of a species, while an index value close to 0 indicates low dominance or no species dominates in a population.

The group of blue green algae (class Cyanophyceae) is a type of phytoplankton that is not expected to exist in the waters because it can produce toxins that are harmful to shrimp. The type of blue green algae identified in the pond is *Oscillatoria* sp. The high abundance of phytoplankton class Cyanophyceae can occur because the ratio of N:P in pond waters is low (Widigdo & Wardiatno, 2013). Under these conditions, the value of the N:P ratio must be increased so that other types of phytoplankton can grow in the waters.

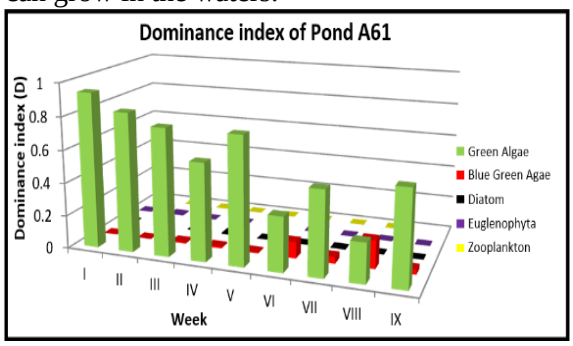

Image 6. Phytoplankton dominance index in plot A61

In contrast to the other three ponds, the dominance of phytoplankton green algae tends to increase along with the length of time for rearing vannamei shrimp in plot A62. The highest dominance index value for the green algae group was found at week 9 with a D value > 0.5 (Image 7).

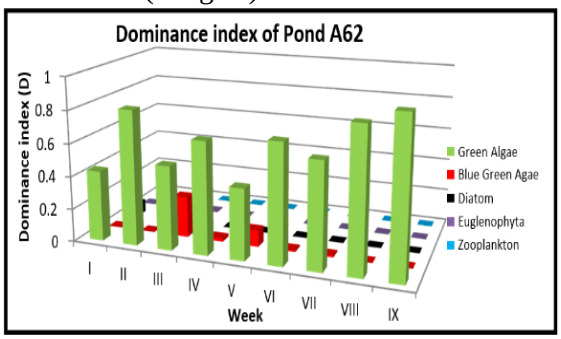

Image 7. Phytoplankton dominance index in plot A62

Pond waters that are dominated by green algae will tend to be green. The pond plots dominated by the green algae group were reported to have higher productivity values when compared to the pond plots dominated by the diatom group (Arifin et al., 2018). This can provide an illustration that the four pond

plots have good water quality conditions until the 9th week (63 days), especially the A62 plot.

Conclusion

A62 pond plots are described as having the best water quality conditions based on the phytoplankton abundance value of 34.63 x 106 cells/L and the green algae phytoplankton dominance index, D > 0.5 at week 9. The types of green algae identified from pond water samples in plots A51, A52, A61 and A62 were *Chlamydocapsa* sp. and *Chlorella* sp.

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