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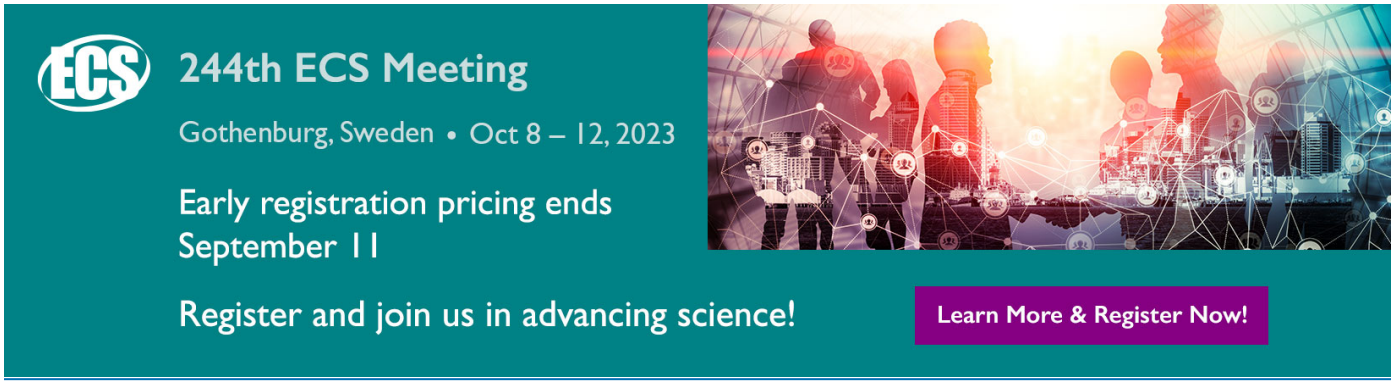

Fluctuation Effect of Dissolved of TAN (*Total Ammonia Nitrogen*) on Diatom Abundance in Intensive Shrimp Culture Ponds

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Abstract. TAN (Total Ammonia Nitrogen) is the accumulation of nutrient elements needed by plankton to grow in intensive shrimp farming ponds. The purpose of this study was to determine the relationship effect of TAN concentration fluctuations on diatom abundance in the intensive shrimp culture cycle. This research was conducted during one intensive shrimp culture cycle at PT. Menjangan Mas Nusantara, Pandeglang, with its research variables in the dominance percentage of plankton abundance and the level of TAN solubility in ponds. The results showed that during the shrimp culture period the abundance of plankton was dominated by predominant diatom, chlorophyceae, and chyanophyceae classes. The percentage of diatom dominance during cultivation has a graph similarity with the level dissolved of TAN fluctuation in the pond. The dissolved of TAN itself is described continue to increase with shrimp farming age. Statically, the relationship between the dissolved effect of TAN concentration on diatom abundance in ponds was modeled by the regression equation y = 2.210 + 32.411 (R^2= 0.88; α0.00). The conclusion obtained from the results of this study, the level of dominance by diatom abundance during shrimp culture period is strongly influenced by the fluctuation of TAN concentration as the main nutrient element in ponds with a significance level of 88%.

Keywords: diatom, intensive pond, plankton, shrimp culture, TAN

1. Introduction

Intensive aquaculture is a pattern of maintaining cultivated commodities with the use of high stocking densities. Intensive aquaculture is usually applied to shrimp commodities that are kept in the tropics [26] [27]. Intensive shrimp culture pattern that has a high stocking density will trigger an increase in excessive feed input following the growth rate of shrimp biomass that is kept [29]. The residual feed and feces resulting from shrimp metabolism will have an impact on the solubility of nitrogen in the waters [16] [18]. Indicators of increasing nitrogen waste load can be seen by monitoring fluctuations in the concentration of TAN (Total Ammonia Nitrogen) in the waters. TAN is the total accumulation of ammonia (NH_3) and ammonium (NH4+) compounds in the aquatic environment [22]. TAN is one of the nutrients that affect the level of abundance and dominance of plankton in intensive shrimp culture [9]. The presence of abundan plankton in aquatic ecosystems is an implication that in these the waters primary productivity level is quite high [34].

In intensive shrimp culture, there are several plankton communities that are desired to grow dominantly, such as Chlorophyceae, Rotifera, and Bacillariophyceae [8] [14] [33]. Bacillariophyceae or also known as diatoms, is one of the plankton commonly found in aquaculture waters [35]. Diatoms are a group of plankton that are desired to grow as live food for shrimp [19] [33]. Diatoms have natural essential elements such as protein, carbohydrates, fat, and DHA which are good for shrimp growth [12] [19]. In aquaculture ponds, diatoms tend to be cosmopolitan or sensitive to nutrient elements changes and water quality fluctuations in the aquatic environment [6] [8].

Thus, it can be hypothesized that one of the factors that affect the diatom abundance level in the pond ecosystem is the presence of a dynamic concentration of TAN solubility during the operational cycle of shrimp farming [2]. The TAN solubility in aquaculture waters is strongly influenced by fluctuations in water quality parameters other such as pH and temperature [36]. The TAN solubility concentrations in pond waters will continue to run dynamically, especially when the shrimp have reached harvest size [3]. Thus, the purpose of this study was to determine the relationship between fluctuations of the TAN concentration in the diatoms abundance on intensive shrimp culture cycle.

2. Materials and Methods

This research was carried out in the vannamei intensive shrimp culture pond, Menjangan Mas Nusantara Company, Pandeglang, in March-May 2019. The study was conducted on 4 operational aquaculture ponds measuring 3,200 m^2 with a stocking density of 110 fry/m^2. Parameters observed were indicators of plankton structure, abundance, and dominance, as well as TAN (Total Ammonia Nitrogen) parameters. Research data collection was carried out once a week at 09.00 during the shrimp culture cycle.

The plankton sample was taken as much as 500 ml with a water checker which was then compacted with a plankton net until 50 ml. Furthermore, the plankton samples were analyzed directly at the Water Quality Laboratory of Menjangan Mas Nusantara Company. Analysis of the identification and structure of the plankton abundance was carried out using a NEUBAUER© haemocytometer and an Olympus CX22 microscope based on the APHA method [1]. Furthermore, the abundance of plankton samples was calculated using the formula :

$$\Sigma cell/ml = N \times 10^{-1} / 1 \times 10^{4}\ cm^3$$

Note: *N* is the plankton counted number, 10^{-1} diluent factor, $1x10^{4}$ cm^3 is the volume size of haemocytometer box.

Meanwhile, to determine the percentage of plankton dominance index, calculations were made based on the Shannon-Wiener dominance index [5] [23] with using the formula:

$$D = (pi)^2$$
$$pi = ni/N$$

Note: *D* is the index of plankton dominance, *pi* is the proportion of the i-th plankton species, *ni* is the number of individual taxa to-i, and *N* is the total number of plankton individuals.

Meanwhile, for the analysis of TAN (Total Ammonia Nitrogen) concentration, it was carried out using the spectrophotometry method according to the guidelines of the APHA methods [1] at the Water Quality Laboratory of Menjangan Mas Nusantara Company. Next, to determine of the relationship between of fluctuations effect in TAN values on the diatom abundance, a simple linear regression analysis was performed with SPSS software Ver.16.

3. Results and Discussion

3.1. Plankton Community Structure

Based on the data results from identification of abundance and the calculation of the plankton dominance index. During the shrimp culture period phytoplankton from the classes Chlorophyceae, Chyanophyceae, and Bacillariophyceae (diatoms) were the plankton group that dominated the

ecological structure in shrimp ponds (Figure 1.). While other types of phytoplankton from the class Euglenophyceae, Raphidophyceae, Desmophyceae were identified but did not dominate in general. The high phytoplankton abundance because these organisms are the main base of food chain producers in waters [11]. The high dominance of phytoplankton in the classes Chlorophyceae, Chyanophyceae, and Bacillariophyceae (diatoms) is caused by the high ratio of nutrient load and physico-chemical dynamics in shrimp pond waters [33]. In addition, dynamic weather changes also affect the dominance of certain plankton type in the waters [32]. Plankton are aquatic microorganisms that are very sensitive to changes in ecological parameters on their environmental habitats [15].

The results of the identification of the plankton genus can be seen in Table 1. Based on the identification results plankton from the diatom, chyanophyta, chlorophyta, and dinoflagellate classes have the highest diversity of genera compared to others. This result has a strong correlation with the status of the plankton dominance percentage in that class (Figure 1.). Meanwhile, for zooplankton identified very minimum. This indicates that there is an effective grazing process in the pond ecosystem. Grazing is a process of low-level predation in the food chain model on aquatic ecosystems [31]. The existence of a grazing process and proportional water nutrient levels will greatly support the balance of aquatic biological ecosystems. The genus diversity and stability of the plankton biological community in intensive ponds tends to be relatively higher when compared to traditional ponds [30].

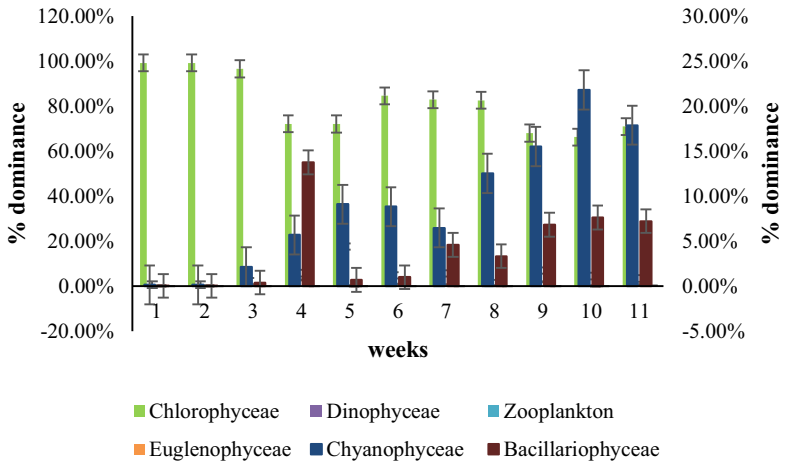

Figure 1. Plankton dominance percentage by class.

Table 1. The data results of plankton diversity by class and genus

Plankton	Class	Genus
Phytoplankton	Chlorophyceae	*Gleocystis sp., Westella sp., Chlamydomonas sp., Chlorella sp., Chodatella sp. Oocystis sp., Scenedesmus sp.,*
	Chyanophyceae	*Anabaena sp., Chroococcus sp., Merismopedia sp., Microcystis sp., Oschillatoria sp., Spirulina sp., Gomphosphaeria sp.*
	Bacillariophyceae	*Amphiphora sp., Skeletonema sp., Amphora sp., Cerataulina sp., Navicula sp., Chaetoceros sp., Coscinodiscus sp., Cyclotella sp., Pleurosigma sp., Streptotecha sp.*
	Raphidophyceae	*Gonyostomum sp.,*
	Dynophyceae	*Alexandrium sp., Chrysomonas sp., Peridinium sp., Gymnodinium sp., Noctiluca sp., Protoperidinium sp.*
	Desmophyceae	*Prorocentrum sp.,*
	Euglenophyceae	*Euglena sp.,*
Zooplankton	Centrohelea	*Acantocystis sp.*
	Actinochrysophyceae	*Actinophrys sp.*
	Tubulinea	*Amoeba sp.*
	Ciliata	*Euplotes sp.*
	Oligotrichea	*Strombidinopsis sp.*

3.2 Dynamics of TAN (Total Ammonia Nitrogen) Concentration in Ponds

The TAN concentration during shrimp culture period is dynamic fluctuating. TAN levels continued to increase with increasing shrimp culture periods, reaching the highest peak concentration at week 7 of culture period (Figure 2.). 80% of TAN sources in ponds come from uneaten feed [28]. TAN fluctuations in pond waters are strongly influenced by the acid-base degree of the waters [13]. Apart from feed waste, TAN itself also comes from fertilization activities [7] [10]. On average, TAN levels in research ponds are still below with TAN quality standard for shrimp farming, which is <0.1 mg/L [14]. The fluctuating of TAN solubility in ponds indicates that the nitrification cycle runs well during the shrimp culture period [24].

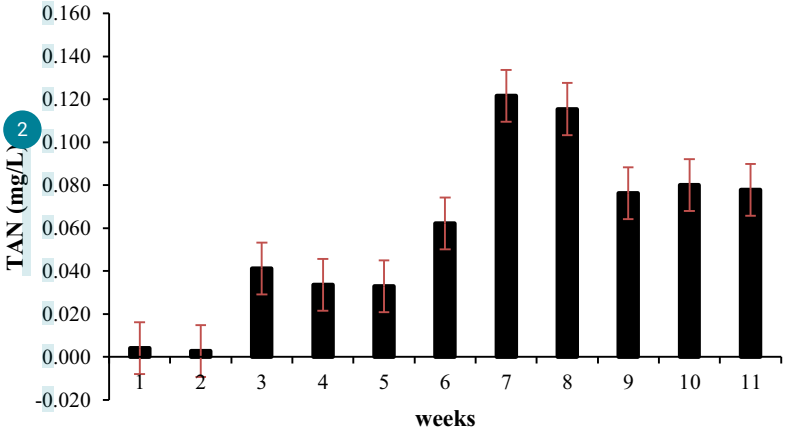

Figure 2. TAN (*Total Ammonia Nitrogen*) solubility concentration during shrimp culture

3.3 TAN Effect on Diatom Abundance

TAN levels in dynamic research ponds is very fluctuating (Figure 2.). If observed, the fluctuation is similar to percentage fluctuations of diatom plankton dominance during the shrimp culture period (Figure 1). Similar fluctuations were seen at weeks 5 to 11 (Figure 3.). This condition is because the majority of plankton from the diatom genus are cosmopolitan. The effect of TAN solubility concentration on diatoms abundance in ponds was modeled by the regression equation y= 2.210+32.411(R^2=0.88;α0.00), meaning that 88% of the diatoms abundance in ponds was strongly influenced by TAN. Also, for every 1 mg/L increase of TAN concentration there will be an increase in the abundance of diatoms by 2.2% of the total plankton population. Diatom plankton have a high survival tolerance to changes in environmental conditions [25]. In pond ecosystems, the plankton abundance will increase and fluctuate with increasing of shrimp culture periods [33].

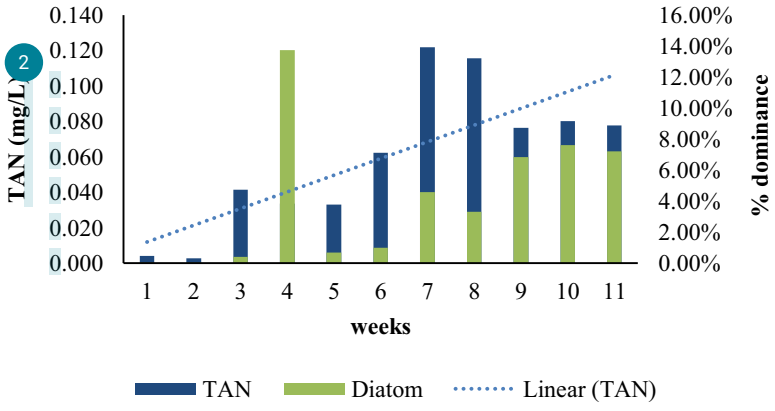

Figure 3. The relationship between effect of TAN (*Total Ammonia Nitrogen*) on diatom abundance

During the shrimp culture cycle plankton from the diatom, chlorophyceae, and chyanophyceae classes were dominant compared to other classes. Predominant plankton is a plankton genus that has a composition >10% of the total plankton composition in aquatic ecosystems [4]. The level of plankton dominance from the diatom, chlorophyceae, and chyanophyceae classes was followed by a higher diversity of genus structures from the three classes compared to other classes. This condition is triggered by the manipulation of plankton's environmental habitat [20].

In this study, diatoms, which belong to the predominant genus, are strongly influenced by the level of TAN solubility in ponds. TAN is a complex nutrient derived from waste from aquaculture ecosystems [10]. The TAN concentration itself will continue to increase and fluctuate when the shrimp culture period enters the age of >60 days [17]. In simpler terms, the diatom presence that are highly adaptive to dynamic of environmental fluctuations will last a long time because of the nitrogen compounds immobilization. Nitrogen compound are compounds whose immobilization is very strong due to the influence of other parameters [21].

4 Conclusion

Based on the results of the study, it was concluded that the level of dominance by diatom abundance during shrimp culture period is strongly influenced by fluctuation of TAN concentration as the main nutrient element in ponds with a significance level of 88%.

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