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PHYTOPLANKTON COMMUNITY IN VANNAMEI SHRIMP (*Litopenaeus vannamei*) CULTIVATION IN INTENSIVE PONDS

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ABSTRACT

Optimal growth of shrimp and harvest in a pond is strongly influenced by water quality because this is a common thing but it cannot be denied that it is also an important thing. The combination of physicochemical parameters and biological indicators has become a classic way of studying water quality. Phytoplankton is a bioindicator that affects the productivity of vannamei shrimp in ponds. Currently, shrimp farming activities are intensive. This study was aimed to analyze the diversity and abundance of phytoplankton and water quality in vannamei shrimp ponds. The research objective was achieved by calculating the abundance, diversity index, evenness index, and plankton dominance index in ponds. The results of the study were that the phytoplankton of Chlorophyta with the highest total abundance in each pond was 18,400x10^3 individual/liter, 14,900x10^3 individual/liter, 16,620x10^3 individual/liter, and 6.410x10^3 individual/liter. The index of phytoplankton diversity at each location was 0.74, 0.73, 0.87, 0.74. Phytoplankton uniformity index at each location was 0.04, 0.04, 0.05, 0.05. Phytoplankton dominance index at each location was 0.60, 0.38, 0.56, 0.07. The abundance of phytoplankton is an obstacle to the success of vannamei shrimp aquaculture production.

Key words: abundance, diversity index, uniformity index, dominance index, aquaculture

مجتمع العوالق النباتية في استزراع الجمبري فانامي (*Litopenaeus vannamei*) في الأحواض المكثفة

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المستخلص

يتأثر النمو الأمثل للروبيان والحصاد في الأحواض بشدة بجودة المياه لأن هذا أمر شائع ولكن لا يمكن إنكار أنه أمر مهم أيضًا.أصبح الجمع بين المعلمات الفيزيائية والكيميائية والمؤشرات البيولوجية طريقة كلاسيكية لدراسة جودة المياه. العوالق النباتية هي مؤشر حيوي يؤثر على إنتاجية الجمبري في الأحواض. حاليا، أنشطة استزراع الجمبري مكثفة. هدفت هذه الدراسة إلى تحليل تنوع ووفرة العوالق النباتية ونوعية المياه في أحواض الجمبري في فانامي. تم تحقيق هدف البحث عن طريق حساب الوفرة، مؤشر التنوع، مؤشر التكافؤ، مؤشر هيمنة العوالق في الأحواض. أظهرت نتائج الدراسة أن العوالق النباتية لكلوروفيتا ذات أعلى وفرة إجمالية في كل حوض كانت 18.400×10^3 إند / لتر، 14.900×10^3 إندون/ لتر ، 16.620×10^3 إندون /لتر ، و 6.410×10^3 إندونيد / لتر .كان مؤشر تنوع كان مؤشر توحيد العوالق النباتية في كل موقع 0.04 ، 0.04 ، 0.05، 0.05. كان مؤشر هيمنة العوالق النباتية في كل موقع 0.60 ، 0.38 ، 0.56 ، 0.07. تشكل وفرة العوالق النباتية عقبة أمام نجاح إنتاج الاستزراع المائي للجمبري فنامي.

الكلمات المفتاحية: الوفرة، مؤشر التنوع، مؤشر التوحيد، مؤشر الهيمنة، تربية الأحياء المائية

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INTRODUCTION

In recent years, the shrimp (*Litopenaeus vannamei*) farming business along the North Coast of Java which has again shown its existence has also had an impact on the existence of shrimp farming in the South Coast of West Java, precisely in Pangandaran (19). The advantages possessed by Vannamei shrimp compared to tiger shrimp have sparked the passion for the cultivation of this fishery export commodity to develop rapidly. One of the potential areas to be used as aquaculture locations with the pond method is the coastal area of the southern part of Java Island. The area still has a large area to be developed also has good water quality so that it can be used as a solution to increase pond production. The recorded public use areas consist of a 479.66 Ha Pond Cultivation Fishery Zone located in Cijulang, Parigi, Sidamulih and Pangandaran Districts with a Fishing Zone covering an area of 22,778.66 Ha in all sub-districts (27). The diminishing existence of mangrove forests due to irresponsible transfer of land functions will have an impact on habitat destruction and ultimately have an impact on decreasing biodiversity in the aquaculture environment (32, 20, 21, 35) including declined diversity of phytoplankton (18). One of the organisms in the aquaculture environment is phytoplankton. The reduced diversity of phytoplankton will affect the yield of pond production, therefore phytoplankton is an important component in aquaculture ecosystems (44, 50). Phytoplankton is defined as an autotrophic microorganism because it can produce its energy source with the help of sunlight and has a passive movement because its life only floats in oceans, lakes, rivers, or other water bodies (57). The ability of phytoplankton to photosynthesize and produce oxygen from these activities to support the life of aquatic biota makes phytoplankton serve as an indicator of the primary productivity of waters (13). Photosynthetic activities in phytoplankton occur because in their bodies there are several kinds of chlorophyll such as chlorophyll a, b, and c. The presence of chlorophyll can be used as a measurement indicator of water fertility which is also influenced by seasons and water quality (54). Phytoplankton communities also have sensitive characteristics and differences in their tolerance to environmental changes so that they can be used as good indicators of environmental conditions and the health of pond waters (29, 16). In addition to playing an important role in the balance of aquaculture ecosystems, the diversity of phytoplankton also serves as natural food for commodities cultivated in ponds. The continuous succession of phytoplankton communities from dominant species occurs due to dynamic changes in growth factors such as light, temperature, and nutrient concentration (9). Previous studies have revealed that the initial phase of cultivation is usually dominated by diatoms and green algae. However, as the culture expanded, Cyanobacteria and Dinoflagellates also reproduced and gradually began to become dominant groups (10, 63). The presence of diatoms and green algae is highly desirable in aquaculture ponds because they have high nutritional value and contribute to water quality (48, 7) while the presence of Cyanobacteria and Dinoflagellates is highly undesirable because they contain low nutrients and have the ability to produce toxins (53, 41). Several studies have shown that the biomass or composition of the phytoplankton community influences the growth of Vibrio sp. (56). Vibrio sp. is one of the bacterial agents of Vibriosis disease that attacks shrimp culture (30). This Vibriosis disease can occur suddenly in shrimp ponds and the spread of infection occurs rapidly over several days or even up to two weeks (8). The results of this study prove that several types of phytoplankton such as diatoms and green algae can inhibit the growth and spread of Vibrio sp. Effectively (31). Thus, monitoring the phytoplankton community structure and the succession of dominant species is the key to managing the aquaculture system. The expansion of shrimp farming in Asia and America has raised concerns about the potential environmental impacts (43). Several negative effects were recorded in several locations, indicating that water quality has a close relationship with the development of fisheries, especially aquaculture, which is currently the focus of world attention (24). Optimal growth of shrimp and harvest in a pond is strongly influenced by water quality because this is a common thing but it cannot be denied that it is also an important thing (42). The combination of physicochemical parameters and biological indicators has become a classic way of studying water quality (22, 37). The addition of artificial feed, fertilizers, and other chemicals to stabilize the pond bottom in intensive pond cultivation makes accurate assessments using physicochemical parameters in ponds and the surrounding aquatic environment not optimal. In addition, it was also explained that there was a lack of information on the use of plankton communities as biological indicators to assess water quality in aquaculture systems, especially in shrimp ponds. The purpose of this research activity is to examine the relationship between pond productivity and phytoplankton diversity and to analyze water quality to support pond management. The main finding target of this research activity is to analyze the abundance and diversity of phytoplankton found in a pond. The analysis results obtained will be related to the level of shrimp production produced in an experimental pond.

MATERIAIS AND METHODS

Place and research time

This research was conducted for 8 months, from January-August 2020. The method used to determine the research point was based on the need for researchers to achieve certain goals and based on the results of the researcher's considerations so that the population in the area could be represented (Purposive Random Sampling). The number of samples taken was 4 points in January-July and 3 points in August so the total sample studied was 31 points. The locations used in this study were intensive ponds and traditional ponds with commodities in the form of shrimp that have had excellent harvest success within the last 5 harvest cycles. The first location was the location of intensive ponds at -7.676525o and the location of traditional ponds was at -7.680068o. The sampling locations came from different ponds around the coast of Pangandaran Beach. The ponds used in this cultivation area were intensive ponds and traditional ponds where intensive ponds use HDFE plastic as a base which aims to prevent the wide factor from entering into cultivation, while the natural soil base is used in traditional ponds. Nutrient intake for shrimp used in ponds in the research ponds comes from commercial feed.

Sampling procedure

Samples for phytoplankton and zooplankton calculations and primary productivity measurements were taken compositely from 4 different locations scattered around the coast of Pangandaran Beach. Sampling was conducted by taking water using a 30 L bucket and then filtering it using a 25µm plankton net. A total of 100 ml of water samples that will be used for the identification of phytoplankton and zooplankton are contained in bottles and 4 drops of formalin are added. The concentration of formalin used was 4%, and its function was to preserve the phytoplankton samples to be identified (51). The water sample that will be used to calculate the nitrate and phosphate values was taken as much as 600 ml from the surface of the water using a bottle. The bottle containing the sample water was put into the ice box, which aimed to maintain the durability of the sample.

Plankton Identification

Phytoplankton identification was conducted at the Laboratory of Fisheries and Marine Sciences Faculty, Jenderal Soedirman University. The bottle containing the sample water was shaken or stirred to even out the distribution of the phytoplankton and to facilitate identification activities, then a micropipette was used to take 1 ml of the water sample. The water sample was then dripped onto the Sedgewick Rafter for further observation under an Olympus microscope using a magnification of 10 x 10 (59). The method used in the observation of phytoplankton was a clean sweep method and 3 repetitions of observations using an Olympus microscope with a magnification of 10 x 10. Phytoplankton is identified at the species level which is referred to in the plankton identification book (60).

Data Collected

Phytoplankton Abundance

The abundance of phytoplankton was determined based on the sweep method conducted on a Sedgwick Rafter object glass. The abundance of phytoplankton has a quantitative unit which is expressed in the number of ind/ml (15). The formula for calculating the abundance of plankton as follow:

$N = n \, x \, \frac{Vr}{Vo} \, x \, \frac{1}{Vs}$

Where:

N = Abundance (ind/ml)

n = Number of observed individual (ind)

Vr = Filtered water volume

Vo = Sample volume on Sedgwick Rafter (ml)

Vr = Filtered water volume

Margalef Diversity Index

$DMg = \frac{S-1}{ln\, N}$

Where:

S = Total number of phytoplankton species

N = Total number of individual phytoplankton

Diversity Analysis

The species diversity index can be interpreted as a statement that mathematically describes the structure of life and can facilitate the analysis of information about the type and number of organisms. Phytoplankton diversity index can be calculated using the Shannon-Wiener index formulation (6) namely:

$H' = \sum_{i=1}^{S} pi \, ln \, pi$

Where:

H′ = Shannon-Wiener diversity index

Pi = ni/N

ni = Total individual number of each species / Number of individuals-i

N = Total number of individuals found

The determination of the group of biota community conditions based on the Shannon-Wiener diversity index (H′) (6) as follow:

H′ < 2,30 = Low Diversity

2,30 < H′ < 6,91= Medium Diversity

H′ > 6,91 = High Diversity

Uniformity Analysis

The distribution of the individual number in each organism can be determined by comparing the diversity index value with its maximum value. Phytoplankton and zooplankton uniformity index can be analyzed using the formula (39) namely:

$E = \frac{H'}{Hmaks}$

Where:

E = Eveness Index / Uniformity

H′ = Diversity Index

Hmaks = ln S

S = Total species

The Eveness index criteria according to (25) as follow:

E < 0,4 = Low category

0,4 < E < 0,6 = Medium category

E > 0,6 = High category

Based on this comparison, the value of E is between 0 to 1, the smaller the value of E obtained, the smaller the uniformity of a population, this means that the distribution of the number of individuals in each genus is not the same and there is a tendency that one genus dominates the population. The greater the value of E obtained, the population shows uniformity, namely the number of individuals of each genus can be said to be relatively the same or not much different (39, 6).

Dominance Analysis

The existence of the dominance of a species in a population type can be expressed by a dominance index. The dominance index can be calculated using the Simpson dominance index formula, which is as follows (39):

$C = \sum(\frac{ni}{N})^2$

Where:

C = Simpson dominance index

N = Total number of individuals

S = Number of species

ni = Number of individuals-i

The value of C ranges between 0 and 1, if the value of C is close to 0 then it means that almost no individual dominates, whereas if C is close to 1, it means that there are individuals who dominate the population (39, 6).

RESULTS AND DISCUSSION

Phytoplankton Abundance in Every Location

Phytoplankton sampling was conducted during the day around 09.00-15.00 WIB because at that time it was estimated how many phytoplankton were on the surface of the waters to conduct photosynthesis activities (38). The results of the identification of phytoplankton in 4 locations on the southern coast of Pangandaran found 9 classes of phytoplankton identified in this study. The types of phytoplankton identified were Chlorophyta, Cyanophyta, Chrysophyta, Diatom, Haptophyta, Ochrophyta, Dinoflagella, Euglenophyta, and Cilliata. The phytoplankton that dominates at each location observed is different. Chlorophyta is the most dominating group of phytoplankton in all observed locations.

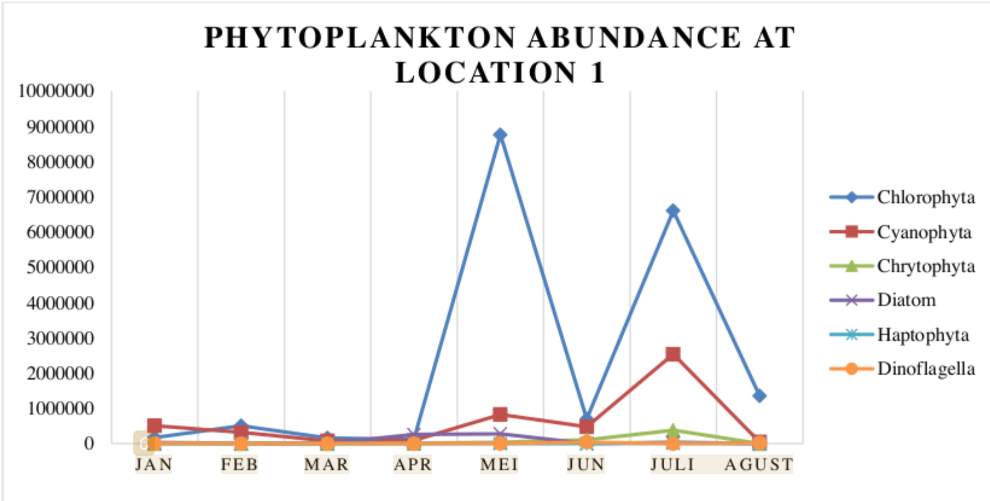

Figure 1. Phytoplankton abundance at location 1 of vannamei shrimp culture, L. *Vannamei*

The highest total abundance of phytoplankton at location 1 was obtained by Chlorophyta species, namely 18,400x10^3 ind/l, then followed by Cyanophyta 4,900x10^3 ind/l, then Diatom 622.5x10^3 ind/l. The abundance values of Chlorophyta every month starting from January to August were 170 x 10^3 ind/l, 510x10^3 ind/l, 160 x 10^3 ind/l, 120 x 10^3 ind.l, 8,770 x 10^3 ind/l, 700 x 10^3 ind/l, 6.610 x 10^3 in/l, 1,360 x 10^3 in/l. The abundance values of Cyanophyta each month starting from January to August were 510 x 10^3 ind/l, 320 x 10^3 ind/l, 80 x 10^3 ind/l, 90 x 10^3 ind.l, 830 x 10^3 ind/l, 480 x 10^3 ind/l, 2,540 x 10^3 ind/l, 50 x 10^3 in/l. Diatom abundance values every month starting from January to August were 30 x 10^3 ind/l, 10x10^3 ind/l, 0 x 10^3 ind/l, 260 x 10^3 ind.l, 280 x 10^3 ind/l, 2, 5 x 10^3 in/l, 40 x 10^3 in/l, 0 x 10^3 in/l.

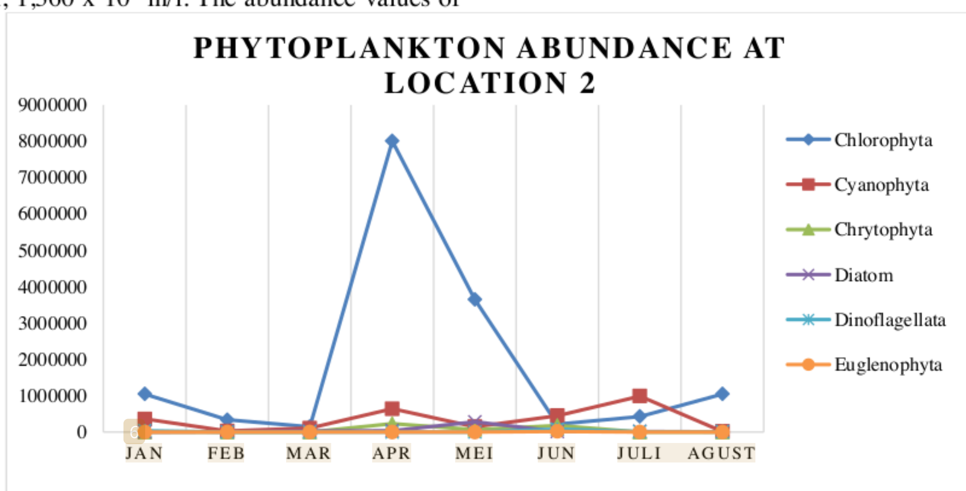

Figure 2. Phytoplankton abundance at location 2 of vannamei shrimp culture, L. *Vannamei*

The highest total abundance of phytoplankton at location 2 was obtained by the Chlorophyta species, namely 14.900x10^3 ind/l, then followed by Cyanophyta 2.750x10^3 ind/l, then Chrytophyta 480x10^3 ind/l. The abundance value of Chlorophyta every month starting from January to August were 1.050 x 10^3 ind/l, 340x10^3 ind/l, 150 x 10^3 ind/l, 8.010 x 10^3 ind.l, 3.650 x 10^3 ind/l, 220 x 10^3 ind/l, 430 x 10^3 ind/l, 1.050 x 10^3 ind/l. The abundance value of Cyanophyta every month starting from January to August were 360 x 10^3 ind/l, 30 x 10^3 ind/l, 110 x 10^3 ind/l, 640 x 10^3 ind.l, 150 x 10^3 ind/l, 450 x 10^3 ind/l, 990 x 10^3

ind/l, 20 x 10^3 ind/l. The abundance value of Chrysophyta every month starting from January to August were 0 x 10^3 ind/l, 0x10^3 ind/l, 0 x 10^3 ind/l, 230 x 10^3 ind.l, 70 x 10^3 ind/l, 180 x 10^3 ind/l, 0 x 10^3 ind/l, 0 x 10^3 ind/l.

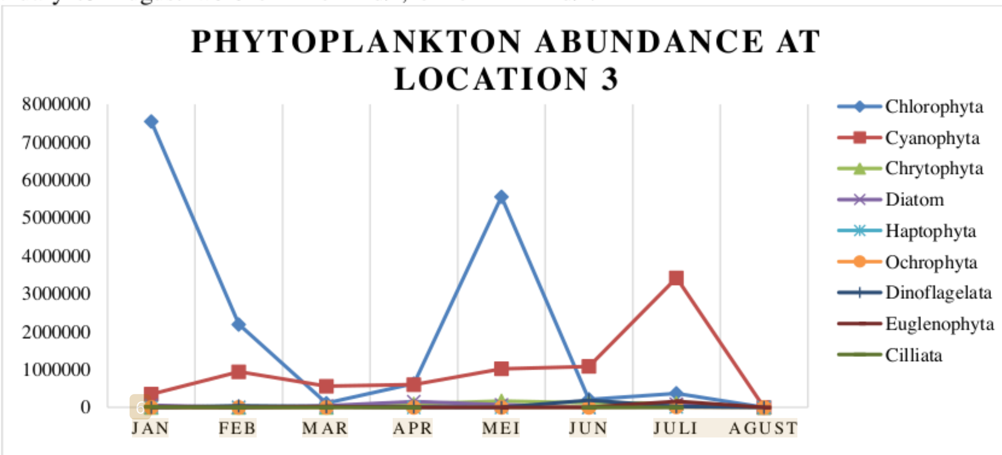

Figure 3. Phytoplankton abundance at location 3 vannamei shrimp culture, L. *Vannamei*

The highest total abundance of phytoplankton at location 3 was obtained by the Chlorophyta species, namely 16.620x10^3 ind/l, then followed by Cyanophyta 7.970x10^3 ind/l, then Chrytophyta 490x10^3 ind/l. The abundance value of Chlorophyta every month starting from January to August were 7.550 x 10^3 ind/l, 2.190x10^3 ind/l, 110 x 10^3 ind/l, 630 x 10^3 ind.l, 5.560 x 10^3 ind/l, 210 x 10^3 ind/l, 370 x 10^3 ind/l, 0 x 10^3 ind/l. The abundance value of Cyanophyta every month starting from January to August were 350 x 10^3 ind/l, 940 x 10^3 ind/l, 560 x 10^3 ind/l, 600 x 10^3 ind.l, 1.020 x 10^3 ind/l, 1.080 x 10^3 ind/l, 3.420 x 10^3 ind/l, 0 x 10^3 ind/l. The abundance value of Chrysophyta every month starting from January to August were 0 x 10^3 ind/l, 0x10^3 ind/l, 0 x 10^3 ind/l, 90 x 10^3 ind.l, 170 x 10^3 ind/l, 120 x 10^3 ind/l, 110 x 10^3 ind/l, 0 x 10^3 ind/l.

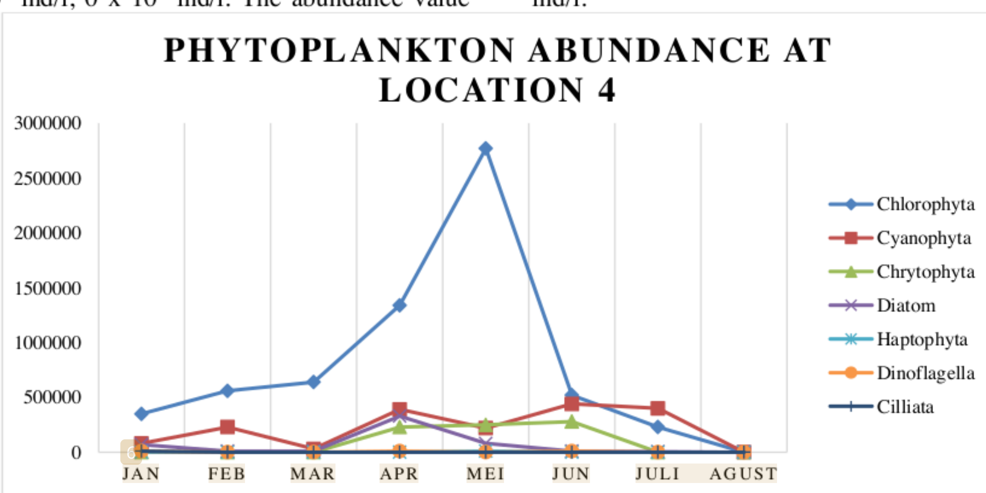

Figure 4. Phytoplankton abundance at location 4 vannamei shrimp culture, L. *Vannamei*

The highest total abundance of phytoplankton at location 4 was obtained by the Chlorophyta species, namely 6.410x10^3 ind/l, then followed by Cyanophyta 1.790x10^3 ind/l, then Chrytophyta 760x10^3 ind/l. The abundance value of Chlorophyta every month starting from January to August were 350 x 10^3 ind/l, 560x10^3 ind/l, 640 x 10^3 ind/l, 1.340 x 10^3 ind.l, 2.770 x 10^3 ind/l, 520 x 10^3 ind/l, 230 x 10^3 ind/l, 0 x 10^3 ind/l. The abundance value of Cyanophyta every month starting from January to August were 80 x 10^3 ind/l, 230 x

10^3 ind/l, 30 x 10^3 ind/l, 390 x 10^3 ind.l, 220 x 10^3 ind/l, 440 x 10^3 ind/l, 400 x 10^3 ind/l, 0 x 10^3 ind/l. The abundance value of Chrysophyta every month starting from January to August were 0 x 10^3 ind/l, 0x10^3 ind/l, 0 x 10^3 ind/l, 230 x 10^3 ind.l, 250 x 10^3 ind/l, 280 x 10^3 ind/l, 0 x 10^3 ind/l, 0 x 10^3 ind/l.

Phytoplankton Diversity Index

Phytoplankton diversity index was calculated using the Shannon-Wiener index formulation. The results of the calculation of the phytoplankton diversity index from each location can be seen in Figure 5.

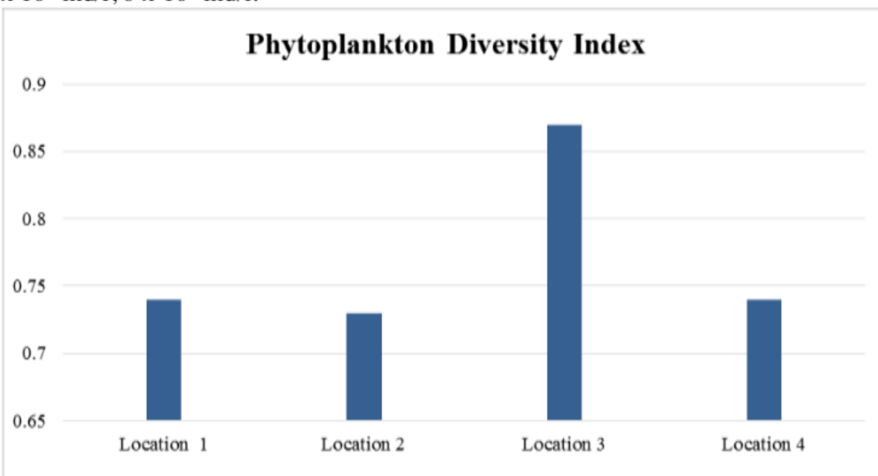

Figure 5. Phytoplankton diversity index in every location

Based on Figure 5. The highest phytoplankton diversity index was found at location 3, which was 0.87. The diversity index values for other locations are sorted from the highest, namely locations 1 and 4 which have the same diversity index value of 0.74. Location 2 has a diversity index value of 0.73

Phytoplankton Uniformity Index

The uniformity of phytoplankton found in 4 different locations in the southern coastal area of Pangandaran based on the calculation of the uniformity of phytoplankton samples taken can be seen in Figure 6 . Based on the results obtained in Figure 6. The highest phytoplankton uniformity index was found at locations 3 and 4 which have the same value of 0.05. The lowest phytoplankton uniformity index value was found at locations 1 and 2 with the same value of 0.04.

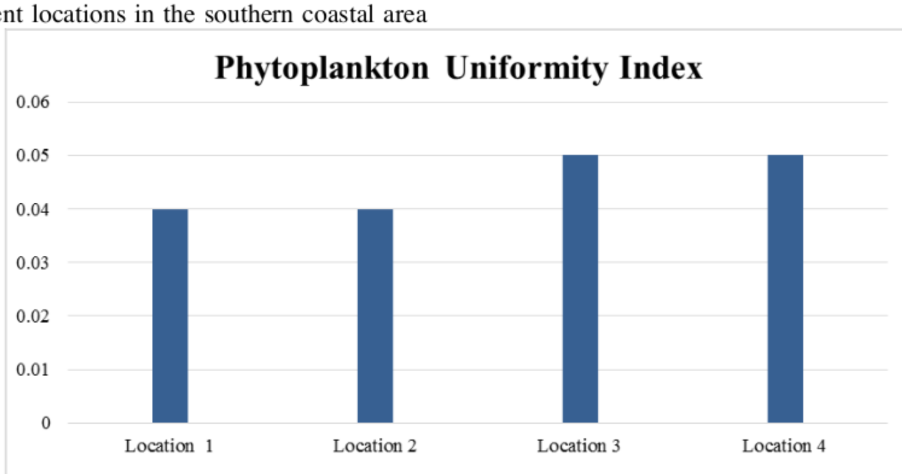

Figure 6. Phytoplankton uniformity index in every location

Phytoplankton Dominance Index: Phytoplankton dominance index was calculated using the Simpson dominance index formula. The results of the calculation of the phytoplankton dominance index from each location can be seen in Figure 7. The highest dominance index value in this study was at location 1, which was 0.60. The next highest dominance index was found at location 3, which was 0.56. Then followed by location 2 with a dominance index value of 0.38. The lowest dominance index value was obtained at location 4 with a value of 0.07

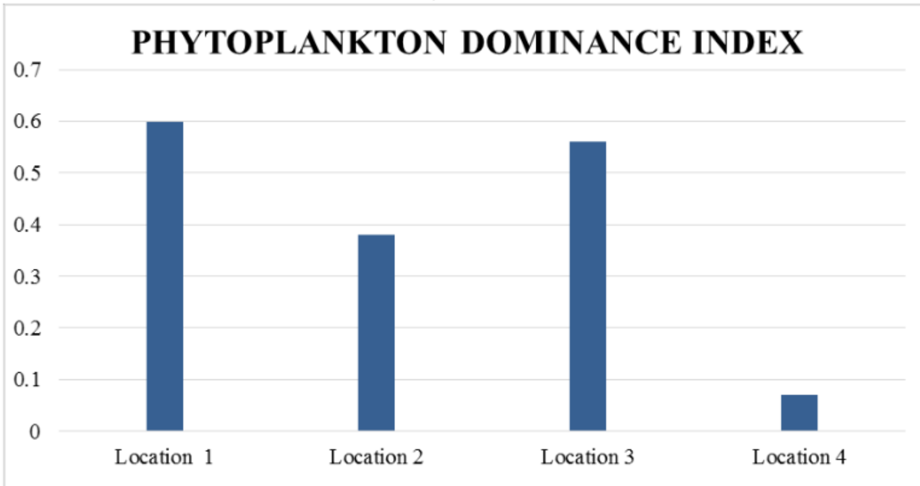

Figure 7. Phytoplankton dominance index in every location

The abundance of phytoplankton formed in pond waters is not only influenced by chemical and physical factors of the observed water quality, nutrients (3) but the impact generated from aquatic waste around the cultivation site also affects the state of the nutrient content contained in these waters (2, 14). According to Samocha & Lawrence (49), Pond effluent greatly affects the water quality index, especially in ponds located near disposal areas . The existence of a phytoplankton community in water is influenced by the contribution made by a species in these waters because phytoplankton will continue to grow according to external stimuli such as light, temperature, and the concentration of nutrients contained in the aquatic environment (62). Phytoplankton which had the highest abundance and dominated at all observed locations was Chlorophyta with a total abundance index value of each location were 18,400x10^3 ind/l, 14,900x10^3 ind/l, 16,620x10^3 ind/l, and 6.410x10^3 ind/l. This is in accordance with the results of a study (23) who conducted research by testing the abundance of phytoplankton in vannamei shrimp farming ponds located in Alasbulu Village, Wongsorejo District, Banyuwangi, East Java. The results of this study indicate that Chlorophyta is a type of phytoplankton that has the highest abundance index value. The same opinion is also given (1, 4) that the composition of the Chlorophyta phytoplankton community in ponds dominates most tropical water bodies. Increased temperature, sunlight, and tropholytic activity due to low water levels and frequent movement of water from deep, nutrient-rich sediments to the tropholytic zone can increase the abundance of phytoplankton during the dry season. The dominance of Chlorophyta that occurs in ponds in the dry season is related to the intensity of sunlight and large water catchment areas that irrigate phosphate-rich agricultural land (58, 26). Chlorophyta have flexibility in physiology and behavior that can tolerate environmental changes better than other species (52). The study of the abundance of phytoplankton in ponds is also in accordance with the findings of Uttah *et al*., (58) that phytoplankton biomass increases with increasing transparency and this is often associated with the dry season, while high turbidity that often occurs in the rainy season results in a reduction in biomass. Chlorophyta are unicellular planktonic algae that are very well adapted to live in brackish and marine waters by covering a wide variety of forms, ranging from unicellular to multicellular and complex algae that are commonly found in marine and terrestrial habitats (28). Chlorophyta live in cold waters and have low salinity (55). Judging from their habitat, Chlorophyta is very possible to breed well in the waters of vannamei shrimp ponds. Increasing the abundance of Chlorophyta in shrimp culture waters provides benefits because this type of phytoplankton is a good source of food for shrimp (34, 17). Aquatic ecology with supportive conditions is needed to produce quality aquatic production. Therefore, water quality factors and phytoplankton diversity are important things to study (45). The biotic and abiotic factors of pond waters greatly affect the formation of the diversity of phytoplankton in them, this also affects the aquaculture ecosystem and the health of the cultivated shrimp commodities (61). The diversity of phytoplankton at the four locations observed was 0.74, 0.73, 0.87, and 0.74 and this indicates that the diversity index value belongs to a low scale. According to Basmi (6), diversity index values below 2.30 are considered low or small. According to Ni *et al.,* (36), the diversity of phytoplankton obtained in research ponds was included in the low category with a value of 1.93-2.49. The diversity of phytoplankton in a culture media can be done by managing cultivation activities properly, especially in feeding shrimp so that waste disposal in aquaculture ponds can be controlled. This is explained in a study De *et al*., (11) regarding shrimp feeding with the addition of a mixture of fish waste hydrolyzate proven to increase the abundance and diversity of phytoplankton in pond waters marked by the growth of Isochrysis galbana which is one of the beneficial algae for shrimp farming activities. Further research conducted by Lukwambe *et al*., (33) explained that the provision of probiotics in cultivation activities is one of the factors that affect the rate of algae growth. The probiotics given can increase the growth of algae types Nannochloropsis and Chlorella from Chlorophyta as well as Oocystics and Navicula from Bacillariophyta. In addition, the administration of probiotics can also reduce the growth rate of algae of Oscillatoria and Anabaena species of Cyanobacteria species. The highest phytoplankton uniformity index was found at locations 3 and 4 with the same value of 0.05, while locations 1 and 2 had a uniformity index of 0.04. This shows that the uniformity index obtained at each location is included in the medium category referring to the uniformity index criteria according to Krebs (25), namely the uniformity index value of 0.4 < E < 0.6 is included in the medium category. This is different from the research conducted Rahmah *et al.,* (47), research conducted on the waters of Vannamei shrimp ponds in Manyar District, Gresik Regency, showed that the uniformity index value ranged from 0.242-0.216 so it was classified into the low category. The smaller the value of E obtained, the smaller the uniformity in a population, meaning that the distribution of the number of individuals in each genus is not the same and there is a tendency that a dominates genus the population. Conversely, the greater the value of E obtained, then a population shows uniformity, namely the number of individuals of each genus can be said to be relatively the same or not much different and there is no dominant genera in a population (6). The location used in this study uses a mill as an oxygen supply as well as to help the spread of phytoplankton. Sufficient light intensity and water currents at each depth during observations caused the distribution of individual phytoplankton to be evenly distributed. This is further explained by Rahayu *et al.,* (46) that the uniformity of phytoplankton is caused by the wind which causes the accumulation of species in one place. Phytoplankton dominance index value was included in the low category at location 2 and location 4 with values of 0.38 and 0.07. While the value of the phytoplankton dominance index was included in the moderate category at location 1 and location 3 with values of 0.60 and 0.56. This is in accordance with what has been stated Odum (39), that if the C value is close to 0 then no species dominates in a water, but if the C value is close to 1 then there are species that dominate in the waters. The dominance index in a water is related to the diversity index, which means that the more species you get, it really depends on the total value of different individuals or species. The existence of a high survival rate in aquaculture waters is influenced by the high dominance and diversity index values obtained. In this case, the indicator of water fertility is influenced by phytoplankton, because ecologically, phytoplankton has an important function as the main producer. The more diverse types of phytoplankton in aquaculture waters can indicate the level of water stability. The stable water conditions will support the primary productivity of a shrimp culture and growth (12).

CONCLUSION

Chlorophyta had the highest abundance of phytoplankton at the 4 research sites with a total abundance in each pond were 18,400x10^3 ind/l, 14,900x10^3 ind/l, 16,620x10^3 ind/l, and 6,410x10^3 ind/l. The index of phytoplankton diversity at each location was 0.74, 0.73, 0.87, 0.74. Phytoplankton uniformity index at each location was 0.04, 0.04, 0.05, 0.05. Phytoplankton dominance index at each location was 0.60, 0.38, 0.56, 0.07. The abundance of phytoplankton found at the site can increase aquaculture production because phytoplankton are the main producers and indicators of the quality of a water.

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