PAPER NAME
Artikel EEET.pdf

AUTHOR
Tri Yusufi

WORD COUNT
4928 Words

CHARACTER COUNT
27101 Characters

PAGE COUNT
10 Pages

FILE SIZE
2.0MB

SUBMISSION DATE
Jun 22, 2024 12:45 PM GMT+7

REPORT DATE
Jun 22, 2024 12:46 PM GMT+7

2% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 2% Internet database
- 1% Publications database
- Crossref database
- Crossref Posted Content database

Excluded from Similarity Report

- Bibliographic material
- Quoted material
- Cited material
- Small Matches (Less then 10 words)
- Manually excluded sources

EEET ECOLOGICAL ENGINEERING & ENVIRONMENTAL TECHNOLOGY

Ecological Engineering & Environmental Technology 2024, 25(8), 47–56
https://doi.org/10.12912/27197050/189238
ISSN 2299–8993, License CC-BY 4.0

Received: 2024.05.12
Accepted: 2024.06.17
Published: 2024.07.01

Dynamic Modeling System of Cholorophyceae Abundance in Pen-Culture Ponds During the Dry Season

Tri Yusufi Mardiana[1], Heri Ariadi[1*], Farchan Mushaf Al Ramadhani[2], M. Bahrus Syakirin[1], Linayati Linayati[1]

[1] Department of Aquaculture, Faculty of Fisheries, University of Pekalongan, Sriwijaya Street No. 3, Pekalongan, Indonesia

[2] Department or Agrotechnology, Faculty of Agriculture, University of Pekalongan, Sriwijaya Street No. 3, Pekalongan, Indonesia

* Corresponding author's e-mail: ariadi_heri@yahoo.com

ABSTRACT

Chlorophyceae is a class of plankton commonly discovered in aquaculture ponds in tropical aquatic regions. Therefore, this study aimed to analyze the abundance levels of Chlorophyceae in pen-culture ponds during the dry season using a dynamic modeling system. The method adopted was a causal ex-post facto design, and the observed parameters were water quality and plankton abundance. The results showed the presence of various plankton classes such as Chrysophyceae, Chyanophyceae, Chlorophyceae, Dynophyceae, and Oligotrichea, as well as the discovery of 17 plankton genera. Water quality parameters identified Total Dissolved Solids (TDS) concentrations, dissolved oxygen levels, temperature, pH levels, and salinity ranging from 3.06–7.37 mg·L^{-1}, 4.39–6.30 mg·L^{-1}, 26.21–31.17 °C, 7.7–8.1, and 10–25 ppt, respectively. The average plankton dominance index (D') showed Chlorophyceae dominance at 4.55, followed by Chyanophyceae, Chrysophyceae, Dynophyceae, and Oligotrichea at 1.78, 0.08, 0.07, and 0.01, respectively, falling in the index category of $0.5 < D < 1$. Furthermore, the average plankton abundance dominance level (pi) signified Chlorophyceae dominance at 7.11E-01, followed by Chyanophyceae, Chrysophyceae, Dynophyceae, and Oligotrichea at 4.68E-01, 1.30E-01, 8.05E-02, and 3.96–02, respectively. This implied that in pen-culture water, Chlorophyceae significantly dominated over other classes. Dynamic modeling results showed the abundance of Chlorophyceae in ponds A, C, and D to be relatively uniform (± 5.00E-02 cell/ml) compared to pond B (± 0.10E-00 cell/ml). It was important to acknowledge that as Chlorophyceae dominance increased (0.10E-00–5.0E-02 cell/ml), the total plankton abundance in the water decreased contradictorily (0.01E-00–100E-04 cell/ml) due to over-dominance. On the basis of the modeling description, Chlorophyceae sustained for 20 weeks during the culture period, with optimal growth observed from the 1st to the 5th week. In conclusion, this plankton class experienced dynamic fluctuations during the pen-culture cultivation period, and the life cycle stability was dependent on water quality and temperature.

Keywords: dominance, nutrients, plankton, temperature, water quality.

INTRODUCTION

Chlorophyceae is a class of plankton commonly discovered in warm waters with high fertility levels (Fučíková et al., 2016). Furthermore, it is widely used as an alternative natural feed in aquaculture activities (Tulsankar et al., 2021). Plankton genera, such as *Chlorella sp., Scenedesmus sp., Tetraselmis sp.,* and *Dicthyospaerium sp.,* from Chlorophycae, are frequently used as natural feed (Soeprapto et al., 2023a). The nutritional content, such as protein at 13.75%, amino acids at 3.11%, and chlorophyll at 20.17% in this plankton class, is considered highly beneficial for supporting fish growth (Meril et al., 2022).

An innovative aquaculture practice widely developed in coastal areas is the pen-culture farming model. Pen culture includes cage farming methods that use natural water flow as the cultivation medium (Jiang et al., 2019). Furthermore, it is extensively developed due to the adaptive model, ease of construction, and cost-effectiveness of materials (Xie et al., 2022). Some commodities cultivated in pen-culture ponds include milkfish, saline tilapia, and snapper (Ariadi et al., 2022a).

A challenge faced in implementing pen-culture farming is the availability of natural feed support (Soares et al., 2004). In this farming method, reliance on artificial feed availability persists (Madusari et al., 2022), contributing to 70% of the total operational costs (Ariadi et al., 2023a). Therefore, efforts need to be made to develop the use of natural feed as an alternative in pen-culture farming activities (Linayati et al., 2024).

Chlorophyceae is one of the plankton classes expected to thrive in the pen-culture aquaculture ecosystem (Xie et al., 2022). This is in line with the types of pelagic fish commodities cultivated in the pen-culture system. The conducive conditions of warm waters and fertile coastal areas where the system is often situated promote the optimal growth of Chlorophyceae (Soeprapto et al., 2023a). Several genera, such as *Chlorella* sp., *Scenedesmus* sp, *Oocystis* sp., *Chodatela* sp., and *Gleocystis* sp. are also commonly discovered in brackish and marine aquatic ecosystems (Soeprapto et al., 2023b).

Results suggest that Chlorophyceae tends to be cosmopolitan, signifying the substantial proliferation during the summer season (Rocha et al., 2024). This can serve as a basis for enhancing the optimization of the pen-culture farming cycle. As a result, this study aimed to analyze the abundance levels of Chlorophyceae in pen-culture ponds during the dry season using a dynamic modeling system. The objective was to predict the growth system of plankton class in pen-culture ponds during the dry season, facilitating the engineering of a more optimal farming cycle.

MATERIALS AND METHODS

This study was conducted in a milkfish aquaculture area using a pen-culture model along the coast of Pekalongan from February to March 2024 (Figure 1). The method adopted was the conceptual framework of causal ex-post facto design. Plankton sampling was performed at 4 different cultivation locations, determined based on the size and density of the stocked fish. The study parameters included water quality indicators, such as water pH were measured by using a Eutech pH-150 pH test, dissolved oxygen and temperature were measured by using a DO Meter YSI550i, salinity was measured by using an ATAGO Master 53A hand refractometer, and total dissolved solids were measured by using a Hanna Instruments Hi98301 TDS Tester, in addition to plankton parameters. Water quality and plankton parameters were sampled once a week at 10:00. Water quality were measured *in situ* and plankton

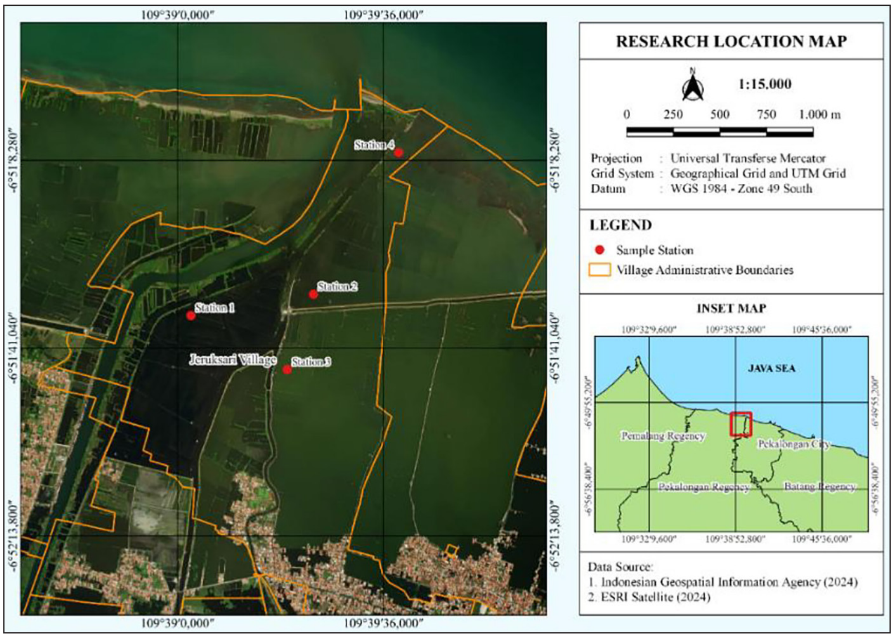

Figure 1. The study area location

parameters were analyzed *ex situ*. The observed plankton parameters included genus, abundance, and dominance. Water quality and plankton data were analyzed at the Biological Sciences Laboratory of Pekalongan University. Subsequently, genius identification and plankton abundance calculation were performed using a NEUBAUER© hemocytometer and Olympus CX23 microscope, adhering to APHA method guidelines (APHA, 2005). Plankton abundance was determined using the formula:

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

where: N – plankton counted in the hemocytometer; 10^{-1} – solvent factor; 1×10^{4} cm^3 – volume size of the hemocytometer box.

The Plankton dominance index was calculated using the following Shannon-Wiener index formula (Albarico et al., 2024):

$$D = (pi)^2 \quad (2)$$

$$pi = ni/N \quad (3)$$

where: D – plankton dominance index; pi – plankton species in the i proportion; ni – number of individual plankton taxa I; N – number of plankton individuals.

Water quality and plankton data were obtained according to the time and location of sample collection. The data from the research results were then processed mathematically and analyzed using dynamic modeling system analysis with Stella ver 9.02 software.

RESULTS AND DISCUSSION

Plankton profile

The Plankton profile observed at the study sites consisted of the classes Chrysophyceae, Chyanophyceae, Chlorophyceae, Dynophyceae, and Oligotrichea, as presented in Table 1. The abundance of classes in the plankton community was quite uniform, with more than 3 dominant classes present. Furthermore, the uniformity was due to similar ecological characteristics of the water (Xu et al., 2022). Chrysophyceae and Chyanophyceae had higher genus diversity (Meril et al., 2022). The genera discovered in Chrysophyceae include *Amphora spp., Cyclotella spp., Nitzia spp., Ampiphora spp., Chaetocheros spp., and Scenedesmus spp.,* while Chyanophyceae comprised of genera such as *Oscillatoria spp., Anabaena spp., Gomphosphaeria spp., Anabaenopsis spp.,* and *Microcystis spp.,* as detailed in Table 1. It was important to acknowledge that plankton classes were adaptive to changes in nutrient conditions in the water (Katayama et al., 2020).

Genus diversity levels were influenced by the dynamic N:P ratio of water (Ou et al., 2024). Additionally, several plankton genera from Chrysophyceae, Chyanophyceae, and Chlorophyceae are cosmopolitan in nature and can proliferate massively during certain seasons (Katayama et al., 2020). Brackish waters in estuarine areas were also often enriched with nutrients from runoff, fostering the dynamic existence of plankton (Ariadi et al., 2023b; Mardiana et al., 2023). This dynamic nature was quite relevant to the condition of the study site, situated in brackish water areas.

Water quality parameters

The water quality profile in the study area tends to be dynamically fluctuating during the fish farming period. Parameters such as total dissolved solids (TDS), dissolved oxygen, and temperature form oscillatory fluctuations, signifying high waste solubility and oxygen consumption levels in pen-culture ponds. TDS concentration, dissolved oxygen, and temperature ranged from 3.06 to 7.37 mg·L^{-1}, 4.39 to 6.30 mg·L^{-1}, and 26.21 to 31.17 °C, respectively, as presented in Figure 2. Increased waste load and oxygen consumption rates affected the dynamic of water quality and the productivity level of aquaculture in the farming ponds (Ariadi, 2023).

Table 1. Plankton profile in the pen culture pond during the research period

Class	Genus
Chrysophyceae	*Amphora* spp., *Cyclotella* spp., *Nitzia* spp., *Ampiphora* spp., *Chaetocheros* spp., *Scenedesmus* spp.
Chyanophyceae	*Oscillatoria* spp., *Anabaena* spp., *Gomphosphaeria* spp., *Anabaenopsis* spp., *Microcystis* spp.
Chlorophyceae	*Oocystis* spp., *Clamydomonas* spp., *Chlorella* spp.
Dynophyceae	*Peridinium* spp., *Gymnodinium* spp.
Oligotrichea	*Tintinopsis* spp.

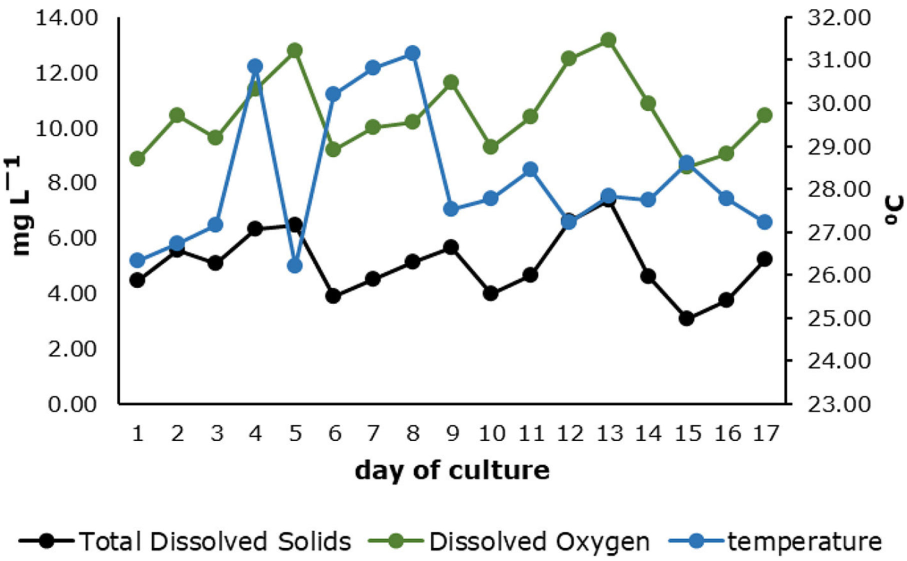

Figure 2. Fluctuations of total dissolved solids, dissolved oxygen and temperature parameters in the pen culture pond

The pH and salinity parameters were crucial factors to be considered in aquatic farming activities (Madusari et al., 2024). The concentrations of these parameters in pen-culture ponds showed fluctuating stability during the study period. The pH concentration and salinity ranged from 7.7 to 8.1 and 10 to 25 ppt, respectively, as presented in Figure 3. Furthermore, the stability in the parameters was attributed to the continuous natural circulation of the farming water medium. The intense circulation ensured that the water parameter conditions remained relatively stable (Mao and Xia, 2023). Salinity and pH levels influence the growth system of organisms and the biochemical cycles in aquatic ecosystems (Madusari et al., 2024). Classes such as Chrysophyceae and Chyanophyceae thrived optimally under neutral pH conditions and stable salinity levels (Fučíková et al., 2016). Fluctuations in pH and salinity concentrations were also influenced by the seasons and geographical conditions of the water (Wang et al, 2024). Extreme fluctuations affected the growth rate of organisms in aquaculture aquatic ecosystems (Linayati et al., 2024).

Plankton dominance index

Plankton dominance index in pond waters of the study site was described in Figure 4. It was

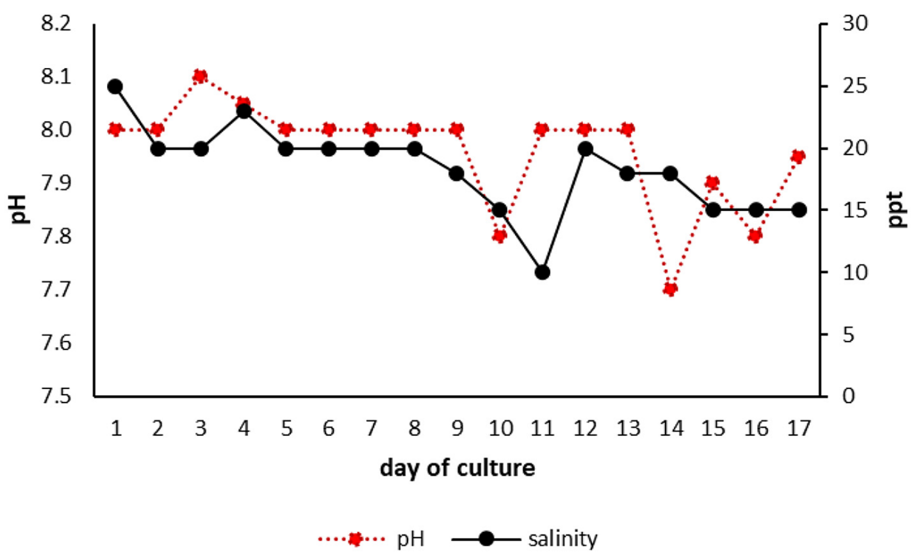

Figure 3. Fluctuations of salinity and pH parameters in pen culture ponds

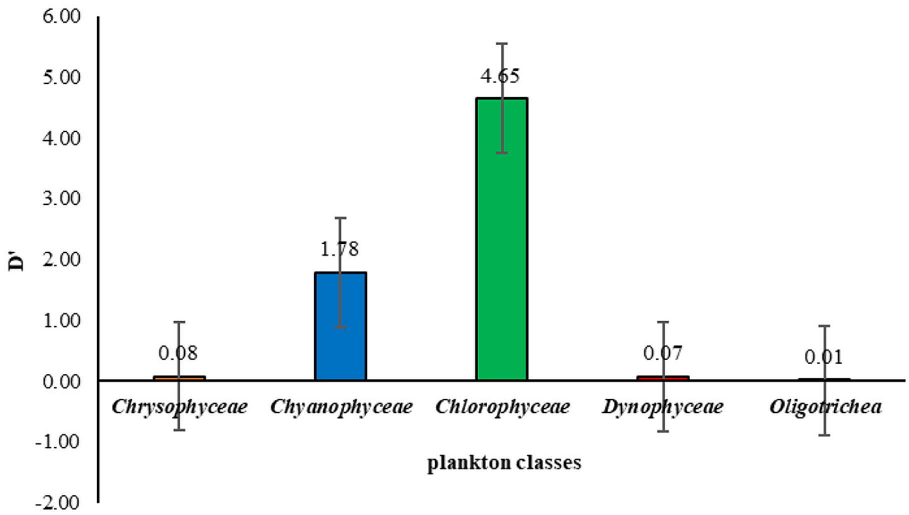

Figure 4. Plankton dominance index in pen culture ponds

predominantly led by Chlorophyceae with an average dominance index value (D') of 4.55, followed by Chyanophyceae, Chrysophyceae, Dynophyceae, and Oligotrichea at 1.78, 0.08, 0.07, and 0.01, respectively. On the basis of these values, Chlorophyceae and Chyanophyceae strongly dominated the waters, falling in the index category of 0.5 < D < 1. The high dominance was due to the location of aquaculture waters being in estuarine areas, which served as the final accumulation site for nutrients from downstream areas (Melki et al., 2024). Estuarine areas in low-lying regions had high fertility compared to other aquatic zones (Ariadi, 2023).

The high value of the plankton dominance index (D') correlated with the dominance level of plankton abundance (pi) described in Figure 5. According to the abundance values, Chlorophyceae and Chyanophyceae at 7.11E-01 and 4.68E-01, respectively, were highly dominant due to the presence of high nutrients in the aquatic ecosystem. These values were compared to Chrysophyceae, Dynophyceae, and Oligotrichea, at 1.30E-01, 8.05E-02, and 3.96–02. Some plankton genera of Chyanophyceae can synthesize nutrients intensively (Ariadi et al., 2022b). Additionally, Chlorophyceae was also a plankton class highly dominant in N:P > 1:20 conditions which facilitated vigorous growth (Lheureux et al., 2022).

Plankton in the aquatic locations was highly unbalanced due to the dominance of specific classes. The location of pen-culture ponds in estuarine areas significantly influenced the water quality profile during the fish farming period. Estuarine

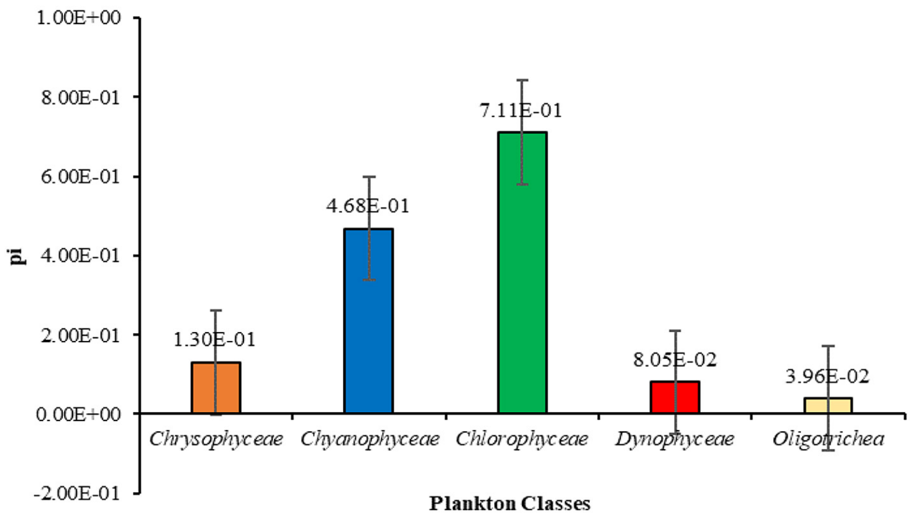

Figure 5. Level of plankton abundance in pen culture ponds

areas, characterized by brackish water ecology, were significantly dynamic due to the mixing processes of water from the sea and rivers (Ariadi et al., 2023b). The level of aquaculture intensification greatly affected the abundance of nutrients and plankton dominance (Mardiana et al., 2023). Pen-culture farming with high stocking densities required a large amount of feed input, leading to the water becoming eutrophic. Eutrophic waters were favored conditions for Chlorophyceae and Chyanophyceae to grow due to the high nutrient output (Katayama et al., 2020).

Plankton sampling during the summer season affected the discovery of Chlorophyceae and Chyanophyceae dominance (Albarico et al., 2024). Chlorophyceae was a cosmopolitan plankton, while Chyanophyceae was known for the ability to absorb nutrients massively (Soeprapto et al., 2023a). The substantial abundance of Chlorophyceae prompted further investigation, necessitating the use of a dynamic modeling system to comprehend the developmental trends during the summer period.

Chlorophyceae abundance model and water temperature fluctuations

The relationship between Chlorophyceae abundance, temperature, and water quality parameters is described in Figure 6. On the basis of the modeling analysis results of four pen-culture ponds, this class experienced abundance fluctuations, forming an oscillatory graph. The fluctuations in abundance and water quality were contradictory. Poor water quality parameters impede Chlorophyceae abundance, leading to growth stagnation (Soeprapto et al., 2023a).

The abundance of Chlorophyceae in ponds A, C, and D was uniform (± 5.00E-02 cell/ml) compared to pond B (± 0.10E-00 cell/ml) (Figure 6). The anomaly in B was caused by the isolated position of the pond, leading to a lower plankton abundance level (0.10E-00–0.30E-00 cell/ml). The process of mixing and seawater intrusion significantly affected the growth system in aquaculture ponds (Liu et al., 2011). It is important to acknowledge that Chlorophyceae was highly dominant due to the dynamic influence of temperature in the pond water column (Vivier et al., 2019).

According to the modeling results, Chlorophyceae was subjected to a logarithmic growth phase from week 1 to 5 and became stationary by the seventh week. This suggested that the lifespan of plankton cells in pen-culture ponds was relatively long and affected by nutrient enrichment in the water (Meril et al., 2022). The continuously increasing temperature also signified the presence of intense biochemical processes in pond water (Fan et al., 2014).

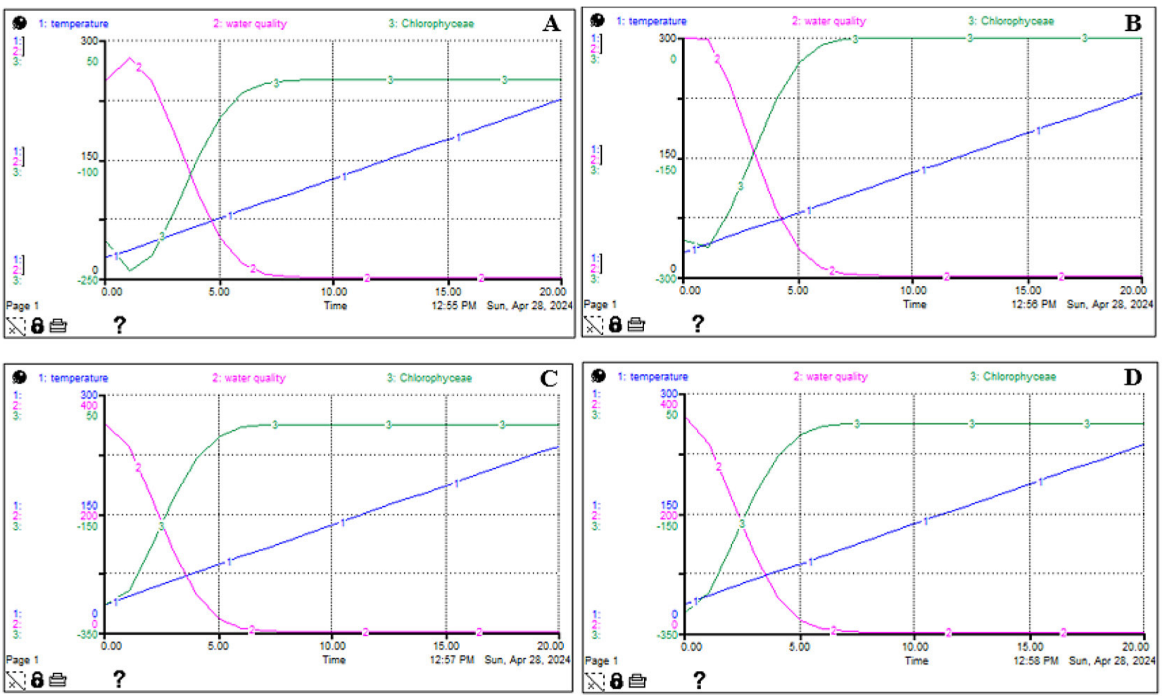

Figure 6. Results of dynamic modeling analysis of Chlorophyceae abundance levels and fluctuations in pond water temperature

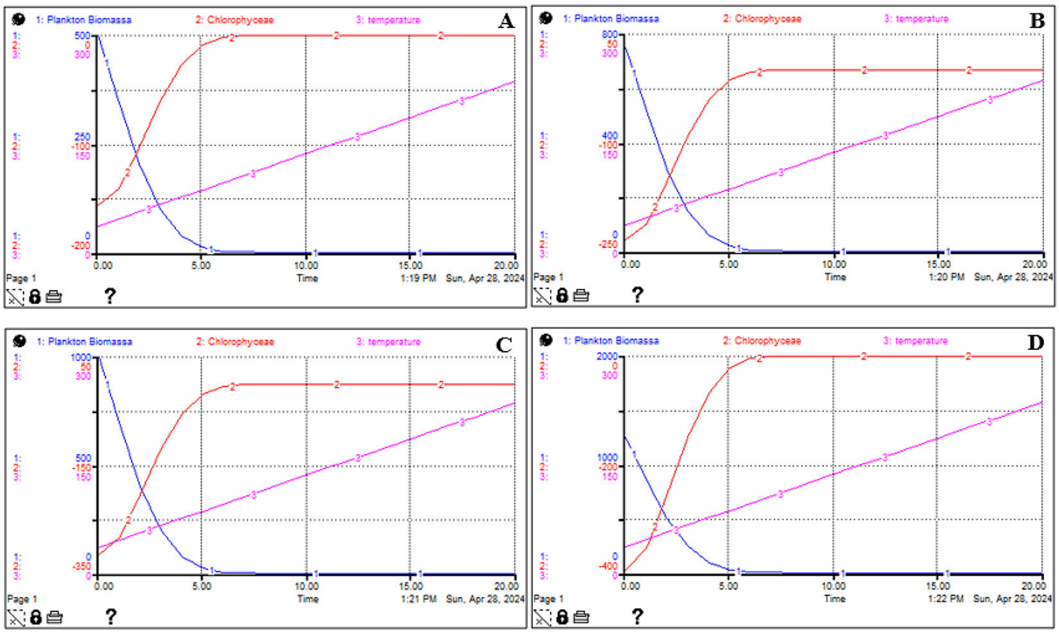

Figure 7. Results of dynamic modeling analysis of the relationship between the level of Chlorophyceae dominance and plankton abundance in pen culture ponds

Chlorophyceae abundance model for plankton in pen-culture

The results of dynamic modeling of total plankton and Chlorophyceae abundance levels in pen-culture ponds are described in Figure 7. From the description of the four pen-culture ponds, the increase in the dominance of Chlorophyceae (0.10E-00–5.0E-02 cell/ml), led to a decrease in the abundance of total plankton in the water (0.01E-00–100E-04 cell/ml). This was due to the excessive dominance of the plankton class compared to others. Dynamic and nutrient-rich estuarine areas caused a drastic and stable increase in dominance (Ariadi et al., 2023b).

The dynamic of the pen-culture aquatic ecosystem and the location in the estuarine area greatly determined the system of microorganism development. Plankton were microorganisms highly sensitive to changes in aquatic environmental conditions (Ariadi et al., 2023b). The contradiction between Chlorophyceae abundance and total plankton abundance signified an unbalanced food chain cycle (Calbet et al., 2012). Massive Chlorophyceae dominance led to the scarcity of zooplankton species in the aquatic ecosystem of the pond (Rissik et al., 2009). This plankton class was cosmopolitan in the summer season (Kaur et al., 2021). Additionally, the long growth (stagnation) cycle of Chlorophyceae also triggers massive dominance.

The obtained results showed that Chlorophyceae was highly dominant in the water of pen-culture ponds. Dominance affected the existence of other plankton species and the total abundance (Trino and Rodriguez, 2002). The dynamic of water quality parameters and the increasing temperature significantly influenced the level of Chlorophyceae dominance (Fučíková et al., 2016). This plankton class was also highly adaptive to changes in nutrient abundance in aquatic ecosystems (Meril et al., 2022).

In terms of the development of natural feed in pen-culture pond waters, Chlorophyceae species were highly recommended due to excessively high dominance level. Milkfish had higher chances to consume Chlorophyceae because of suitability in consumption size (Nasmia et al., 2022). Chlorophyceae also offered a variety of nutrient content superior to several other plankton classes (Soeprapto et al., 2023a). Furthermore, the stability of the summer season and water temperature stagnation can be used as a reference for the pen-culture farming cycle calendar (McEwan et al., 2023). Stable temperatures prevented fish from becoming easily stressed, thereby enabling optimal growth (Assmy et al., 2023).

The diversity of plankton classes can also be an option for selecting the types of fish commodities cultivated in pen-culture waters. Some pelagic fish species such as tilapia, white snapper, and mullet have similar characteristics to milkfish and possess strong resistance in brackish waters (Shadrack et al., 2021). The presence of Chlorophyceae dominance also provides options for developing several cultivated commodities. The dominance level of this plankton class and the stability of water temperature in pen-culture waters are considered highly suitable for fish farming areas.

CONCLUSIONS

In conclusion, dynamic modeling system analysis showed that Chlorophyceae was subjected to dynamic fluctuations during the pen-culture farming period. Over the course of 20 weeks, the plankton class experienced a logarithmic growth system from the 1st to the 5th week, followed by growth stagnation. This implied that during the fish farming period, the presence of Chlorophyceae was constant and dependent on the water quality conditions of the pond as well as the temperature.

REFERENCES

1. Albarico, F.P.J.B., Lim, Y.C., Chen, C.W., Chen, C.F., Wang, M.H., Dong, C.D. 2024. Linking seasonal plankton succession and cellular trace metal dynamics in marine assemblages. Science of The Total Environment, 907, 167805. https://doi.org/10.1016/j.scitotenv.2023.167805
2. American Public Health Association (APHA). 2005. Standartd Methods for the Examination of Water and Wastewater. 16th edition. APHA, Washington D.C.
3. Ariadi, H. 2023. Dinamika wilayah pesisir. UB Press, Malang.
4. Ariadi, H., Soeprapto, H., Sihombing, J.L., Khairina, W. 2022a. Analisa model causal loop pemanfaatan keramba budidaya ikan adaptif dan potensi pengembangannya. Jurnal Perikanan, 12(4), 504–512. https://doi.org/10.29303/jp.v12i4.343
5. Ariadi, H., Soeprapto, H., Sihombing, J.L., Khairina, W., Khristanto, A. 2023a. Strategi pengembangan budidaya ikan pada keramba adaptif di wilayah pesisir: Studi kasus di Kota Pekalongan. Buletin Ilmiah Marina Sosial Ekonomi Kelautan Dan Perikanan, 9(1), 27–35. https://doi.org/10.15578/marina.v9i1.11643
6. Ariadi, H., Syakirin, M.B., Hidayati, S., Madusari, B.D., Soeprapto, H. 2022b. Fluctuation effect of dissolved of TAN (Total Ammonia Nitrogen) on diatom abundance in intensive shrimp culture ponds. IOP Conference Series: Earth and Environmental Science, 1118, 1–7. https://doi.org/10.1088/1755-1315/1118/1/012001
7. Ariadi, H., Syakirin, M.B., Mardiana, T.Y., Soeprapto, H., Linayati, Madusari, B.D. 2023b. Kelimpahan plankton Prorocentrum sp. pada tambak intensif udang vaname (Litopenaeus vannamei). Agromix, 14(2), 215–220. https://doi.org/10.35891/agx.v14i2.3668
8. Assmy, P., Kvernvik, A.C., Hop, H., Hoppe, C.J.M., Chierici, M., David, D., Duarte, P., Fransson, A., García, L.M., Patula, W., Kwasniewski, S., Maturilli, M., Pavlova, O., Tatarek, A., Wiktor, J.M., Wold, A., Wolf, K.K.E., Bailey, A. 2023. Seasonal plankton dynamics in Kongsfjorden during two years of contrasting environmental conditions. Progress in Oceanography, 213, 1–24. https://doi.org/10.1016/j.pocean.2023.102996
9. Calbet, A., Martínez, R.A., Isari, S., Zervoudaki, S., Nejstgaard, J.C., Pitta, P., Sazhin, A.F., Sousoni, D., Gomes, A., Berger, S.A., Tsagaraki, T.M., Ptacnik, R. 2012. Effects of light availability on mixotrophy and microzooplankton grazing in an oligotrophic plankton food web: Evidences from a mesocosm study in Eastern Mediterranean waters. Journal of Experimental Marine Biology and Ecology, 424–425, 66–77. https://doi.org/10.1016/j.jembe.2012.05.005
10. Fan, L., Chen, J., Liu, Q., Wu, W., Meng, S., Song, C., Qu, J., Xu, P. 2014. Exploration of three heterotrophic nitrifying strains from a tilapia pond for their characteristics of inorganic nitrogen use and application in aquaculture water. Journal of Bioscience and Bioengineering, 1–7. https://doi.org/10.1016/j.jbiosc.2014.09.006
11. Fučíková, K., Lewis, L.A., Lewis, P.O. 2016. Comparative analyses of chloroplast genome data representing nine green algae in Sphaeropleales (Chlorophyceae, Chlorophyta). Data in Brief, 7, 558–570. https://doi.org/10.1016/j.dib.2016.03.014
12. Jiang, Z., Wang, C., Zhou, L., Xiong, W., Liu, C. 2019. Impacts of pen culture on alpha and beta diversity of fish communities in a large floodplain lake along the Yangtze River. Fisheries Research, 210, 41–49. https://doi.org/10.1016/j.fishres.2018.10.007
13. Katayama, T., Nagao, N., Kasan, N.A., Khatoon, H., Rahman, N.A., Takahashi, K., Furuya, K., Yamada, Y., Wahid, M.E.A., Jusoh, M. 2020. Bioprospecting of indigenous marine microalgae with ammonium tolerance from aquaculture ponds for microalgae cultivation with ammonium-rich wastewaters. Journal of Biotechnology, 323, 113–120. https://doi.org/10.1016/j.jbiotec.2020.08.001
14. Kaur, R.P., Sharma, A., Sharma, A.K., Sahu, G.P. 2021. Chaos control of chaotic plankton dynamics in the presence of additional food, seasonality, and time delay. Chaos, Solitons & Fractals, 153(1), 111521. https://doi.org/10.1016/j.chaos.2021.111521

15. Lheureux, A., David, V., Del Amo, Y., Soudant, D., Auby, I., Ganthy, F., Blanchet, H., Cordier, M.A., Costes, L., Ferreira, S., Mornet, L., Nowaczyk, A., Parra, M., D'Amico, F., Gouriou, L., Meteigner, C., Oger-Jeanneret, H., Rigouin, L., Rumebe, M., Tournaire M.P., Trut, F., Trut, G., Savoye, N. 2022. Bi-decadal changes in nutrient concentrations and ratios in marine coastal ecosystems: The case of the Arcachon bay, France. Progress in Oceanography, 201, 102740. https://doi.org/10.1016/j.pocean.2022.102740
16. Linayati, L., Nhi, N.H.Y., Ariadi, H., Mardiana, T.Y., Fahrurrozi, A., Syakirin, M.B. 2024. Relationship between abundance of Clamydomonas spp and Chlorella spp on clinical performance of red tilapia Oreochromis niloticus in silvofishery ponds. Croatian Journal of Fisheries, 82, 33–42. https://doi.org/10.2478/cjf-2024-0004
17. Liu, X., Wu, Q., Chen, Y., Dokulil, M.T. 2011. Imbalance of plankton community metabolism in eutrophic Lake Taihu, China. Journal of Great Lakes Research, 37(4), 650–655. https://doi.org/10.1016/j.jglr.2011.09.005
18. Madusari, B.D., Ariadi, H., Mardhiyana, D. 2022. Analisis strategi pengembangan budidaya ikan pada daerah terdampak banjir rob di Pesisir Utara Pekalongan. AKULTURASI: Jurnal Ilmiah Agrobisnis Perikanan, 10(2), 503–511. https://doi.org/10.35800/akulturasi.v10i2.43417
19. Madusari, B.D., Ariadi, H., Mardhiyana, D. 2024. Dynamic modelling analysis on the effectiveness of coastal land resources for aquaculture activities utilization. Journal of Natural Resources and Environmental Management, 14(1), 174–180. https://doi.org/10.29244/jpsl.14.1.174
20. Mao, M., and Xia, M. 2023. Seasonal dynamics of water circulation and exchange flows in a shallow lagoon-inlet-coastal ocean system. Ocean Modelling, 186, 102276. https://doi.org/10.1016/j.ocemod.2023.102276
21. Mardiana, T.Y., Ariadi, H., Linayati, L., Wijianto, W., Fahrurrozi, A., Maghfiroh, M. 2023. Estimation of carrying capacity for floating net cage cultivation activities in Pekalongan coastal waters. Jurnal Perikanan Universitas Gadjah Mada, 25(1), 19–24. https://doi.org/10.22146/jfs.80968
22. McEwan, N., Pawlowicz, R., Pakhomov, E., Maldonado, M.T. 2023. Seasonality of modelled planktonic food web structure in the Strait of Georgia, Canada. Ecological Modelling, 482, 110402. https://doi.org/10.1016/j.ecolmodel.2023.110402
23. Melki, S., Dakhli, S., Hechmi, S., Gueddari, M. 2024. River nutrient inflows and coastal ecosystem health in Northeast Tunisia's Kelibia Mediterranean Region. Regional Studies in Marine Science, 71, 103410. https://doi.org/10.1016/j.rsma.2024.103410
24. Meril, D., Piliyan, R., Perumal, S., Sundarraj, D.K., Binesh, A. 2022. Efficacy of alginate immobilized microalgae in the bioremediation of shrimp aquaculture wastewater. Process Biochemistry, 122, 196–202. https://doi.org/10.1016/j.procbio.2022.08.030
25. Nasmia, Natsir, S., Rusaini, Tahya, A.M., Nilawati, J., Ismail, S.N. 2022. Utilization of Caulerpa sp. as a feed ingredient for growth and survival of whiteleg shrimp and Chanos chanos in polyculture. Egyptian Journal of Aquatic Research, 48(2), 175–180. https://doi.org/10.1016/j.ejar.2022.01.005
26. Ou, L.J., Wang, Z., Ding, G.M., Han, F.X., Cen, J.Y., Dai, X.F., Li, K.Q., Lu, S.H. 2024. Organic nutrient availability and extracellular enzyme activities influence harmful algal bloom proliferation in a coastal aquaculture area. Aquaculture, 582, 740530. https://doi.org/10.1016/j.aquaculture.2023.740530
27. Rissik, D., Shon, E.H., Newell, B., Baird, M.E., Suthers, I.M. 2009. Plankton dynamics due to rainfall, eutrophication, dilution, grazing and assimilation in an urbanized coastal lagoon. Estuarine, Coastal and Shelf Science, 84(1), 99–107. https://doi.org/10.1016/j.ecss.2009.06.009
28. Rocha, G.S., Lopes, L.F.P., Melao, M.G.G. 2024. Phosphorus limitation combined with aluminum triggers synergistic responses on the freshwater microalgae Raphidocelis subcapitata (Chlorophyceae). Chemosphere, 352, 1–9. https://doi.org/10.1016/j.chemosphere.2024.141320
29. Shadrack, R.S., Gereva, S., Pickering, T., Ferreira, M. 2021. Seasonality, abundance and spawning season of milkfish Chanos chanos (Forsskål, 1775) at Teouma Bay, Vanuatu. Marine Policy, 130, 1–8. https://doi.org/10.1016/j.marpol.2021.104587
30. Soares, R., Peixoto, S., Bemvenuti, C., Wasielesky, W., D'Incao, F., Murcia, N., Suita, S. 2004. Composition and abundance of invertebrate benthic fauna in Farfantepenaeus paulensis culture pens (Patos Lagoon estuary, Southern Brazil). Aquaculture, 239, 199–215. https://doi.org/10.1016/j.aquaculture.2004.05.041
31. Soeprapto, H., Ariadi, H., Badrudin, U. 2023a. The dynamics of Chlorella spp. abundance and its relationship with water quality parameters in intensive shrimp ponds. Biodiversitas, 24(5), 2919–2926. https://doi.org/10.13057/biodiv/d240547
32. Soeprapto, H., Ariadi, H., Badrudin, U., Soedibya, T.P.H. 2023b. The abundance of Microcystis sp. on intensive shrimp ponds. DEPIK: Jurnal Ilmu-Ilmu Perairan, Pesisir Dan Perikanan, 12(1), 105–110. https://doi.org/10.13170/depik.12.1.30433
33. Trino, A.T., and Rodriguez, E.M. 2002. Pen culture of mud crab Scylla serrata in tidal flats reforested with mangrove trees. Aquaculture, 211, 125–134.
34. Tulsankar, S.S., Cole, A.J., Gagnon, M.M., Fotedar, R. 2021. Temporal variations and pond age effect on

plankton communities in semi-intensive freshwater marron (Cherax cainii, Austin and Ryan, 2002) earthen aquaculture ponds in Western Australia. Saudi Journal of Biological Sciences, 28(2), 1392–1400. https://doi.org/10.1016/j.sjbs.2020.11.075

35. Vivier, B., David, F., Marchand, C., Thanh-Nho, N., Meziane, T. 2019. Fatty acids, C and N dynamics and stable isotope ratios during experimental degradation of shrimp pond effluents in mangrove water. Marine Environmental Research, 150, 1–8. https://doi.org/10.1016/j.marenvres.2019.104751
36. Xie, C., Dai, B., Wu, J., Liu, Y., Jiang, Z. 2022. Initial recovery of fish faunas following the implementation of pen-culture and fishing bans in floodplain lakes along the Yangtze River. Journal of Environmental Management, 319, 115743. https://doi.org/10.1016/j.jenvman.2022.115743
37. Xu, H., Zhao, D., Zeng, J., Mao, Z., Gu, X., Wu, Q.L. 2022. Evaluating the effects of aquaculture on the freshwater lake from the perspective of plankton communities: The diversity, co-occurrence patterns and their underlying mechanisms. Environmental Pollution, 309, 119741. https://doi.org/10.1016/j.envpol.2022.119741

2% Overall Similarity

Top sources found in the following databases:

- 2% Internet database
- 1% Publications database
- Crossref database
- Crossref Posted Content database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Omar Benamari, Amina Labhar, Naoufal Ahidar, Amin Salhi, Mhamed A... Crossref	<1%
2	smujo.id Internet	<1%
3	repository.unikal.ac.id Internet	<1%
4	www2.mdpi.com Internet	<1%

Excluded from Similarity Report

- Bibliographic material
- Cited material
- Manually excluded sources
- Quoted material
- Small Matches (Less then 10 words)

EXCLUDED SOURCES

ecoeet.com Internet	13%