

ANALYSIS OF PHYTOPLANKTON ABUNDANCE AS A POTENTIAL NATURAL FOOD SOURCE FOR CULTURED *PINCTADA MAXIMA* IN PEGAMETAN BAY, SUMBERKIMA

Analisis Kelimpahan Fitoplankton yang Berpotensi Menjadi Sumber Pakan Alami *Pinctada maxima* Budidaya di Teluk Pegametan, Sumberkima

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ABSTRACT

Phytoplankton are an essential component of aquatic ecosystems, serving as both primary producers and a natural food source for the pearl oyster (*Pinctada maxima*). Pegametan Bay, Sumberkima, is an aquaculture area utilized for pearl oyster cultivation; thus, information regarding phytoplankton abundance and composition is necessary to determine the potential availability of natural food in these waters. This study aims to identify and analyze phytoplankton abundance as a natural food source at the pearl oyster cultivation site in Pegametan Bay, Sumberkima. An explorative-descriptive method was employed, utilizing purposive sampling at four stations representing different water characteristics. Sampling was conducted once per week at each station for three consecutive weeks at a depth of 5 m, yielding a total of 12 water samples. This sampling design was used to describe spatial variation among stations and changes in the phytoplankton community throughout the observation period. Phytoplankton were then identified microscopically. The analysis included abundance, composition, diversity, evenness, and dominance indices, alongside the measurement of physico-chemical water parameters. The results showed that phytoplankton abundance ranged from 134.71 to 272.34 ind/L, with the highest abundance recorded at Station 3 (272.34 ind/L). The identified phytoplankton consisted of 56 species across six classes, with Bacillariophyceae being the dominant group (43 species). The diversity and evenness indices were classified as high, whereas the dominance index was low. This composition indicates that Pegametan Bay harbors a diverse phytoplankton community, demonstrating a strong potential to provide a natural food source for pearl oysters.

Keywords: Natural Food, Pearl oyster, Pegametan Bay, Phytoplankton.

ABSTRAK

Fitoplankton merupakan komponen penting dalam ekosistem perairan karena berperan sebagai produsen primer sekaligus sumber pakan alami bagi kerang mutiara (*Pinctada maxima*). Teluk Pegametan, Sumberkima merupakan salah satu kawasan budidaya yang dimanfaatkan untuk

pemeliharaan kerang mutiara, sehingga informasi mengenai kelimpahan dan komposisi fitoplankton diperlukan untuk mengetahui potensi ketersediaan pakan alami di perairan tersebut. Penelitian ini bertujuan untuk mengidentifikasi dan menganalisis kelimpahan fitoplankton sebagai sumber pakan alami pada lokasi budidaya kerang mutiara di Teluk Pegametan, Sumberkima. Penelitian menggunakan metode deskriptif eksploratif dengan penentuan stasiun secara *purposive* pada empat stasiun yang mewakili karakteristik perairan berbeda. Pengambilan sampel dilakukan satu kali pada setiap stasiun setiap minggu selama tiga minggu berturut-turut, pada kedalaman 5 m, sehingga diperoleh 12 sampel air secara keseluruhan. Desain pengambilan sampel tersebut digunakan untuk menggambarkan variasi spasial antar stasiun dan perubahan komunitas fitoplankton selama periode pengamatan. Fitoplankton diidentifikasi secara mikroskopis, kemudian dianalisis berdasarkan kelimpahan, komposisi, indeks keanekaragaman, kemerataan, dan dominansi, disertai pengukuran parameter fisika-kimia perairan. Hasil penelitian menunjukkan kelimpahan fitoplankton berkisar 134,71–272,34 ind/L, dengan kelimpahan tertinggi pada Stasiun 3 sebesar 272,34 ind/L. Fitoplankton yang teridentifikasi terdiri atas 56 spesies dari enam kelas, dengan Bacillariophyceae sebagai kelompok dominan sebanyak 43 spesies. Indeks keanekaragaman dan kemerataan tergolong tinggi, sedangkan dominansi tergolong rendah. Komposisi tersebut menunjukkan bahwa Teluk Pegametan memiliki komunitas fitoplankton yang beragam dan berpotensi menyediakan pakan alami bagi kerang mutiara.

Kata Kunci: Fitoplankton, Kerang Mutiara, Pakan Alami, Teluk Pegametan.

INTRODUCTION

The cultivation of pearl oysters (*Pinctada maxima*) is a marine aquaculture activity of significant economic value with potential for development in Indonesia's coastal regions. Success in this cultivation depends not only on husbandry techniques but also on aquatic environmental conditions capable of providing natural food sources and supporting the biological processes of the cultured organisms. The availability of natural food is a crucial aspect because *P. maxima* is a filter feeder that obtains nutrients by filtering suspended particles from the water column. Consequently, the biological characteristics of the water—specifically the presence of phytoplankton—must be considered when managing cultivation sites.

Phytoplankton are autotrophic organisms that serve as primary producers in aquatic ecosystems. Their presence forms the foundation of the food web, as the organic matter produced through photosynthesis can be utilized by organisms at higher trophic levels. Primary productivity in a body of water is closely linked to phytoplankton abundance; thus, their presence serves as an indicator of the potential availability of natural food sources for aquatic organisms (Rahmah *et al.*, 2022). This makes monitoring phytoplankton abundance in *P. maxima* cultivation areas essential, particularly to determine whether the available phytoplankton community can meet the organisms' natural food requirements.

Sumberkima Village is a coastal area in Buleleng Regency where aquatic resources are utilized for aquaculture. The total area of cultivation ponds in Sumberkima Village reached 61 hectares in 2017, reflecting the high intensity of water area utilization for cultivation activities (BPP Gerokgak, 2017). In addition to pond-based farming, the coastal region of Gerokgak supports various other aquaculture activities, making aquatic environmental quality a critical factor in maintaining the sustainability of these operations (Amelia & Maharani, 2024). The intensity of coastal area utilization needs to be balanced with resource management that considers the equilibrium between ecological functions and community economic activities (Prasetya *et al.*, 2024). Aquaculture activities can introduce organic matter and nutrients into the aquatic environment through leftover feed, organism metabolic byproducts, and water exchange. Such inputs can influence the availability of nutrients required by phytoplankton,

thereby affecting aquatic productivity. Aquaculture activities in the Gerokgak region have the potential to exert environmental pressure if organic matter and nutrient inputs are unbalanced, particularly because increased nutrient levels can trigger eutrophication (Pebriani *et al.*, 2025). Therefore, the ecological condition of the Sumberkima coastal area requires periodic monitoring to understand the relationship between water utilization activities and changes in aquatic organism communities.

Sumberkima possesses significant coastal ecosystem diversity; thus, information regarding its aquatic biodiversity is crucial for supporting sustainable area management. Biodiversity monitoring serves to elucidate ecological changes resulting from the interaction between environmental factors and human activities (Prasetia *et al.*, 2025). Phytoplankton is a key biological component for characterizing these conditions, as its abundance and composition are heavily influenced by the aquatic environment. Variations in temperature, salinity, water clarity, and nutrient availability can affect phytoplankton growth and distribution (Ramadansur & Dinata, 2021). Physicochemical water characteristics are also linked to phytoplankton community structure, meaning that changes in environmental conditions can be reflected through shifts in abundance or species composition (Setyowardani *et al.*, 2021). The issue of phytoplankton availability warrants investigation because previous studies indicate that plankton abundance in Sumberkima waters is relatively lower than in several other locations around Gerokgak. This condition persists even though the water quality in Sumberkima—based on various environmental parameters—is superior to that of the comparison sites (Mustofa *et al.*, 2020). These findings demonstrate that water quality generally conducive to supporting aquatic life does not necessarily guarantee adequate phytoplankton availability as a natural food source. Variations in environmental characteristics across regions can also lead to differences in phytoplankton composition and abundance; therefore, the status of phytoplankton specifically within the *P. maxima* cultivation area in Pegametan Bay requires examination.

Phytoplankton composition also warrants attention, as increased abundance does not necessarily indicate water conditions favorable for aquaculture activities. Certain groups or species of phytoplankton have the potential to proliferate excessively and are associated with Harmful Algal Bloom (HAB) phenomena. The presence of phytoplankton species capable of causing HABs requires monitoring, as they can signal changes in ecological conditions and potentially disrupt aquaculture operations (Kusuma *et al.*, 2021). Consequently, identifying phytoplankton species in aquaculture areas is essential not only for assessing the availability of natural food but also for obtaining preliminary information on the presence of species that could cause ecological disturbances.

Information regarding phytoplankton abundance and composition at aquaculture sites serves as a basis for evaluating water conditions and supporting environmental management tailored to the needs of the cultured organisms. Periodic phytoplankton monitoring helps track changes in water conditions and supports environmental management to maintain productivity (Wulandari *et al.*, 2016). However, comprehensive information regarding the abundance, composition, and specific types of phytoplankton serving as potential natural food sources for *P. maxima* at the aquaculture site in Pegametan Bay, Sumberkima, is currently lacking. This situation underscores the need for research to characterize the phytoplankton community at the site.

This study aims to determine the abundance levels and identify the composition and types of phytoplankton at the pearl oyster (*Pinctada maxima*) aquaculture site in Pegametan Bay, Sumberkima. The resulting information is expected to serve as baseline data for assessing the potential availability of phytoplankton as a natural food source, while also supporting the evaluation of water ecological conditions and the sustainable management of pearl oyster aquaculture.

RESEARCH METHODS

The study was conducted in January 2026 in Pegametan Bay, Sumberkima Village, Gerokgak District, Buleleng Regency, Bali. Sampling stations were selected using purposive sampling, taking into account differences in environmental characteristics and anthropogenic activities at each location. Sampling was carried out at four stations representing distinct locations: Station 1, situated near the shore or an estuary, represented waters potentially influenced by land-based activities; Station 2 was located in the middle of the bay, serving as a transition zone between the nearshore region and the aquaculture area; Station 3 was located within the pearl oyster floating net cage (KJA) area, representing waters directly influenced by aquaculture activities; and Station 4 was situated outside the bay, serving as a reference site for comparison with the other three stations. This station selection strategy aimed to characterize variations in water conditions and phytoplankton communities across locations subject to differing levels of anthropogenic influence. The coordinates for each station are presented in Table 1.

Table 1. Sampling Station Coordinates

Station	Coordinate	Location
1	8°08'16.0"S; 114°36'02.9"E	Near the beach/estuary
2	8°07'41.3"S; 114°35'58.2"E	Middle of the bay (transition zone)
3	8°07'18.5"S; 114°35'59.1"E	Pearl oyster floating net cage area
4	8°06'37.1"S; 114°35'53.6"E	Outside the bay

Phytoplankton identification was conducted *ex situ* at the Ganesha University of Education laboratory. The study employed a descriptive-exploratory method involving field surveys and laboratory analysis. This method was used to obtain an overview of the natural state of the phytoplankton community without the application of any experimental treatments. A similar descriptive-exploratory approach, utilizing field observations and laboratory identification, was also employed in the study by Yudasmara (2015).

The study population consisted of all phytoplankton naturally inhabiting Pegametan Bay, while the samples comprised phytoplankton collected at each designated station. Phytoplankton sampling was carried out once a week for three consecutive weeks between 10:00 and 12:00 WITA. Samples were collected at a depth of 5 m using a Nansen bottle, filtered through a plankton net, and preserved with 4% formalin.

Equipment used included a plankton net, sample bottles, a Nansen bottle, a thermometer, a pH meter, a DO meter, a refractometer, a Secchi disk, a float, a binocular microscope, a Sedgwick-Rafter Counting Cell (SRCC), cover slips, a dropper pipette, a hand counter, a graduated cylinder, label paper, writing instruments, a cooler box, identification manuals, and a camera. Research materials consisted of seawater samples, phytoplankton samples, 4% formalin, distilled water, ice cubes, and tissue paper.

Sampling was conducted at four stations selected via purposive sampling. Station 1 was chosen to represent the influence of land-based inputs and anthropogenic activities; Station 2 served as a transition zone; Station 3 was the primary pearl oyster cultivation site; and Station 4 served as a reference site located relatively far from human activity. At each sampling point within the stations, approximately 20 L of seawater was collected at a depth of 5 m using a Nansen bottle and subsequently filtered through a plankton net equipped with a 100 mL collection bottle. The use of a plankton net is a method for collecting plankton samples from the water (Hutabarat, 1986). The filtered samples were transferred to sample bottles, preserved with 4% formalin, labeled according to the sampling station, and stored in a cooler box. A 4%

formalin concentration was used to maintain sample integrity during storage, as plankton fixation can be effectively achieved using formalin concentrations of 2–5% (Wardana, 2003).

Phytoplankton identification was conducted ex-situ at the Ganesha University of Education laboratory. Samples were first homogenized, after which a 1 mL aliquot was loaded into an SRCC. The preparations were examined using a binocular microscope at 100× magnification. Phytoplankton observation and counting were performed systematically across all 1,000 grids of the SRCC—comprising 20 rows and 50 columns—moving from one side to the other. All grids were examined without sub-sampling to ensure the count consistently covered the entire SRCC viewing area. Detected phytoplankton were counted, documented, and identified based on morphological characteristics, referencing the 3rd edition of *A Guide to the Marine Plankton of Southern California* (Perry, 2003).

Water quality parameters monitored included temperature, current velocity, transparency, salinity, pH, and dissolved oxygen (DO). Temperature was measured in-situ using a thermometer, while pH and DO were measured using pH and DO meters, respectively. Current velocity was measured using a float by calculating the distance traveled per unit of time using the equation:

$$v = \frac{s}{t}$$

Note: v = current velocity (m/s), s = distance traveled (m), and t = travel time (s).

Transparency is measured using a Secchi disk by recording the depth at which the disk disappears from view (d_1) and the depth at which it reappears (d_2), and is then calculated using the equation:

$$\text{Brightness} = \frac{d_1 + d_2}{2}$$

Salinity was measured using a refractometer on water samples collected from each station.

Data Analysis

Phytoplankton abundance was calculated based on the APHA (1992) method using the equation:

$$K = \frac{1}{V_d} \times \frac{L_{sr}}{L_a} \times \frac{V_t}{V_a} \times n$$

Note: K = phytoplankton abundance (ind./L), n = number of cells observed, V_d = volume of filtered water (± 20 L), L_{sr} = total area of the SRCC (1,000 mm²), L_a = area of observation (1,000 mm²), V_t = volume of filtered water (100 mL), and V_a = volume of sample observed on the SRCC (1 mL).

The phytoplankton community was analyzed based on the Shannon-Wiener diversity index (Fachrul, 2007), the evenness index, and Simpson's dominance index. The diversity index was calculated using the equation:

$$H' = - \sum_{i=1}^s p_i \ln p_i$$

with $p_i = n_i/N$, where n_i is the number of individuals of the i -th species and N is the total number of individuals. A value of $H' < 1$ indicates low diversity, $1 < H' < 3$ indicates moderate diversity, and $H' > 3$ indicates high diversity (Fachrul, 2007).

The evenness index is calculated using the equation:

$$E = \frac{H'}{H'_{\max}}$$

with $H'_{\max} = \ln S$. An E value < 0.4 indicates low evenness, $0.4 < E < 0.6$ indicates moderate evenness, and $0.6 < E < 1.0$ indicates high evenness (Odum, 1993 in Agus *et al.*, 2013).

The Simpson dominance index is calculated using the equation:

$$C = \sum \left(\frac{n_i}{N} \right)^2$$

C values of 0–0.5 indicate low dominance, 0.5–0.75 indicate moderate dominance, and 0.75–1 indicate high dominance (Ludwig & Reynolds, 1998 in Agus *et al.*, 2013). The results regarding abundance, species composition, community indices, and physicochemical parameters are subsequently presented descriptively using tables and narrative text to characterize the phytoplankton community conditions at each station.

RESULT

The results of the phytoplankton abundance calculations are presented in units of individuals per liter (ind/L) and shown in Table 2.

Table 2. Phytoplankton Abundance

Station	Location	Week 1 (ind/L)	Week 2 (ind/L)	Week 3 (ind/L)	Average ± SD (ind/L)
1	Beach Estuary	118,58	151,12	134,43	134,71 ± 16,27
2	Middle of the Bay	177,72	208,01	190,46	192,06 ± 15,22
3	Floating Net Cage Area	254,70	291,49	270,83	272,34 ± 18,44
4	Outer Bay	147,44	178,57	161,03	162,35 ± 15,61

Descriptively, the highest mean abundance was found at Station 3 (Floating Net Cage Area), at 272.34 ± 18.44 ind/L, while the lowest abundance was observed at Station 1 (Coastal Estuary), at 134.71 ± 16.27 ind/L. Station 2 had a mean abundance of 192.06 ± 15.22 ind/L, whereas Station 4 recorded 162.35 ± 15.61 ind/L. Abundance values across all stations showed a relatively consistent pattern over the three-week observation period, with the highest values occurring in the second week at each station.

The distribution of individual counts by taxonomic class is presented in Table 3.

Table 3. Distribution of Phytoplankton Individual Counts by Taxonomic Class

Taxonomic Class	Station 1	Station 2	Station 3	Station 4	Total
Bacillariophyceae	1.073	1.737	2.441	1.507	6.758
Cyanophyceae	201	152	154	76	583
Dinoflagellata	59	66	116	60	301
Chlorophyceae	21	30	42	21	114
Euglenophyceae	36	54	72	42	204
Chrysophyceae	34	39	57	24	154
Total	1.303	1.784	2.642	1.527	7.256

The class Bacillariophyceae recorded the highest number of individuals across all stations, with a total of 6,758 individuals. The highest count for Bacillariophyceae was observed at Station 3 (2,441 individuals), while the lowest was at Station 1 (1,073 individuals). The class with the lowest number of individuals was Chlorophyceae, with a total of 114 individuals.

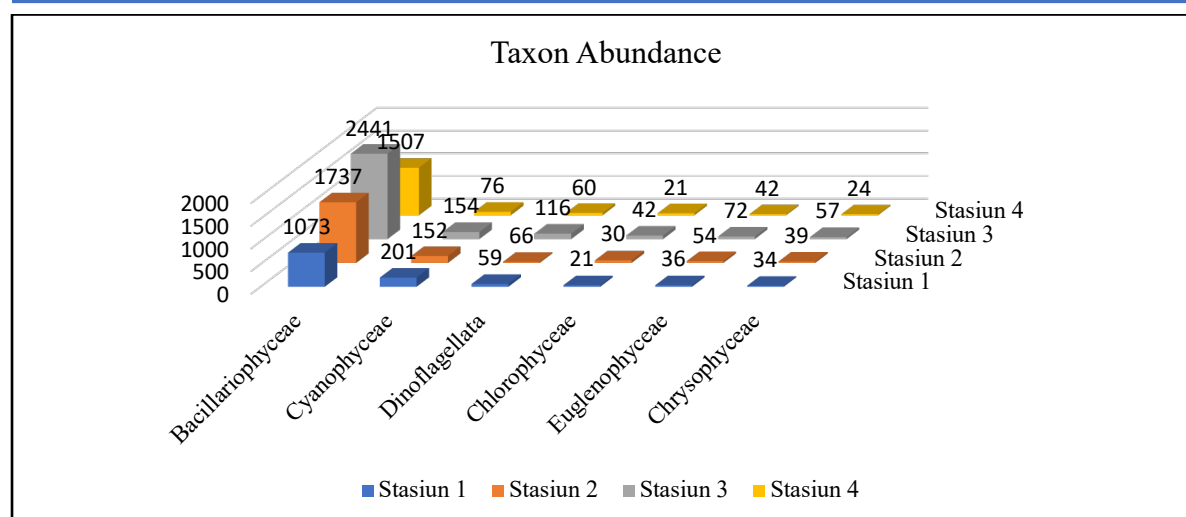


Figure 1. Graph of phytoplankton taxon abundance at each station

The phytoplankton diversity index was calculated using the Shannon-Wiener index (H'). The results of observations conducted over three weeks at four stations are presented in Table 4.

Table 4. Phytoplankton Diversity Index (H')

Station	Location	Week 1	Week 2	Week 3	Average
1	Beach Estuary	3,879	3,899	3,899	3,892
2	Middle of the Bay	3,856	3,870	3,868	3,865
3	Floating Net Cage Area	3,886	3,898	3,893	3,892
4	Outer Bay	3,727	3,765	3,751	3,747

Diversity index values ranged from 3.727 to 3.899 during the observation period. The highest average values were recorded at Station 1 and Station 3 (3.892 each), while the lowest average was at Station 4 (3.747). All H' values across the four stations over the three-week period exceeded 3.

The evenness index (E) was used to describe the distribution of individuals among phytoplankton species at each station. The calculated evenness index values are presented in Table 5.

Table 5. Phytoplankton Evenness Index (E)

Station	Location	Week 1	Week 2	Week 3	Average
1	Beach Estuary	0,964	0,969	0,969	0,967
2	Middle of the Bay	0,958	0,961	0,961	0,960
3	Floating Net Cage Area	0,965	0,968	0,967	0,967
4	Outer Bay	0,926	0,935	0,932	0,931

The evenness index values across all stations ranged from 0.926 to 0.969. The highest average evenness (E) values were observed at Station 1 and Station 3 (0.967), while the lowest average value was recorded at Station 4 (0.931). Throughout the three-week observation period, all E values fell within the 0.6–1.0 range.

Microscopic identification revealed the presence of 56 phytoplankton species belonging to six taxonomic classes: Bacillariophyceae, Cyanophyceae, Dinoflagellata, Chlorophyceae, Euglenophyceae, and Chrysophyceae. The species composition by taxonomic class comprised 43 species of Bacillariophyceae, 6 species of Cyanophyceae, 3 species of

Dinoflagellata, 2 species of Chlorophyceae, and one species each of Euglenophyceae and Chrysophyceae.

The class Bacillariophyceae represented the group with the highest species richness, comprising 43 species. Identified genera included *Skeletonema* sp., *Chaetoceros* sp., and *Navicula* sp. In addition to this group, species belonging to the Cyanophyceae, Dinoflagellata, Chlorophyceae, Euglenophyceae, and Chrysophyceae classes were also identified.

Identification results also indicated the presence of species categorized in this study as natural food sources, potentially harmful groups, or neutral groups. Species classified as potentially harmful included *Oscillatoria* sp., *Anabaena* sp., *Cylindrospermopsis* sp., and *Ceratium* sp., whereas *Scrippsiella* *precaria* and *Euglena* sp. were classified as neutral based on the study's classification criteria.

Simpson's dominance index (C) was calculated to determine the level of species dominance within the phytoplankton community. The results of the dominance index calculations at each station over a three-week period are presented in Table 6.

Table 6. Phytoplankton Dominance Index (C)

Station	Location	Week 1	Week 2	Week 3	Average
1	Beach Estuary	0,023	0,022	0,022	0,022
2	Middle of the Bay	0,023	0,022	0,022	0,023
3	Floating Net Cage Area	0,022	0,022	0,022	0,022
4	Outer Bay	0,028	0,026	0,027	0,027

Dominance index values ranged from 0.022 to 0.028. The highest mean value was recorded at Station 4 (0.027), while the lowest mean values were found at Stations 1 and 3 (0.022). All obtained dominance index values were below 0.5.

Physicochemical parameter measurements were conducted at four stations over a three-week period, yielding 12 data points. The parameters measured included temperature, current velocity, transparency, pH, dissolved oxygen (DO), and salinity. The water quality data presented in Table 7 represent the mean values of measurements taken over the three-week study period at each station. Descriptive statistics for each parameter are presented in Table 7.

Table 7. Descriptive Statistics of Physicochemical Water Parameters and Phytoplankton Abundance (N = 12)

Parameter	Unit	N	Minimum	Maximum	Average	SD
Water temperature	°C	12	28,60	30,10	29,25	0,44
Current velocity *	s/m	12	5,40	10,10	7,65	1,52
Brightness	m	12	1,90	10,80	7,11	3,31
pH	–	12	7,40	7,60	7,55	0,07
Dissolved oxygen (DO)	mg/L	12	5,80	7,70	6,74	0,67
Salinity	ppt	12	36,00	39,00	37,00	1,13

Water temperatures during the study ranged from 28.60–30.10°C, with an average of $29.25 \pm 0.44^\circ\text{C}$. Current speeds were recorded at 5.40–10.10 cm/s, with an average of 7.65 ± 1.52 cm/s. Water clarity ranged from 1.90–10.80 m, with an average of 7.11 ± 3.31 m. pH values ranged from 7.40–7.60, with an average of 7.55 ± 0.07 . Dissolved oxygen (DO) values ranged from 5.80–7.70 mg/L, with an average of 6.74 ± 0.67 mg/L, while salinity ranged from 36–39 ppt, with an average of 37.00 ± 1.13 ppt.

Overall, the study results indicate that the phytoplankton community across the four stations comprised 56 species from six taxonomic classes. Mean abundance ranged from

134.71–272.34 ind/L, with the highest value observed at Station 3. Diversity index values ranged from 3.747–3.892; evenness index values from 0.931–0.967; and dominance index values from 0.022–0.027. Physicochemical parameters during the study showed temperatures of 28.60–30.10°C, current speeds of 5.40–10.10 cm/s, water clarity of 1.90–10.80 m, pH of 7.40–7.60, DO of 5.80–7.70 mg/L, and salinity of 36–39 ppt.

DISCUSSION

The study results indicate that phytoplankton abundance in Pegametan Bay ranged from 134.71 to 272.34 ind/L. The highest abundance was found at Station 3 (floating net cage area) at 272.34 ind/L, while the lowest was at Station 1 (coastal estuary) at 134.71 ind/L. This difference indicates spatial variation in the phytoplankton community. The high abundance in the floating net cage area is thought to be linked to nutrient availability resulting from aquaculture activities. Setiabudi *et al.* (2016) reported that mariculture activities in Pegametan Bay can increase nutrient inputs associated with plankton development. Hapsari *et al.* (2026) also found higher inorganic nutrient concentrations in the floating net cage zone of Sumberkima Bay compared to areas outside the aquaculture zone. However, this relationship cannot be considered causal, as nutrient concentrations were not directly measured in this study.

The phytoplankton community comprised 56 species across six classes, with Bacillariophyceae being the group with the highest number of individuals—totaling 6,758 cells and reaching 2,441 cells at Station 3. The high abundance of diatoms may be attributed to their ability to adapt to coastal water conditions and utilize nutrients. Although Bacillariophyceae was dominant at the class level, no single species was dominant; diversity indices across all stations exceeded 3, evenness was above 0.6, and dominance was below 0.5.

These conditions hold ecological significance for *Pinctada maxima*, which obtains food through a filtration mechanism. Huki *et al.* (2023) demonstrated that food particle selection in pearl oysters is related to particle size and the capacity of the filtration system to process them. Rango *et al.* (2023) also demonstrated that the filtration capacity of pearl oysters is linked to the size characteristics of available phytoplankton. The presence of *Skeletonema* sp., *Chaetoceros* sp., and *Navicula* sp. indicates the availability of diatom groups that can potentially serve as natural feed for *P. maxima*. This potential relates to the characteristics of phytoplankton as food particles available in the water column, capable of meeting the natural feed requirements of pearl oysters.

The abundance patterns observed in this study align with the findings of Sombak *et al.* (2025), who reported spatial variations in phytoplankton abundance within pearl oyster farming environments, with higher values tending to occur at sites associated with cultivation activities. Differences between studies may be attributed to water characteristics, sampling locations and depths, observation timing, analytical methods, and environmental conditions.

The presence of *Oscillatoria* sp., *Anabaena* sp., and *Ceratium* sp. warrants attention in the management of cultivation areas, as some members of these genera are associated with nutrient-enriched waters or have the potential to form Harmful Algal Blooms (HABs). However, their presence did not indicate an active HAB event, as the dominance index across all stations remained low. Periodic monitoring remains necessary to anticipate changes in phytoplankton composition and abundance resulting from shifting environmental conditions.

The phytoplankton composition in Pegametan Bay comprised 43 species of Bacillariophyceae, 6 species of Cyanophyceae, 3 species of Dinoflagellata, 2 species of Chlorophyceae, and 1 species each of Chrysophyceae and Euglenophyceae. The dominance of Bacillariophyceae may be linked to water conditions that favor phytoplankton growth; an average temperature of 29.25°C and a pH of 7.55 likely support the development of the

phytoplankton community. Djunaidi et al. (2024) stated that pH is one of the environmental factors influencing the growth and distribution of phytoplankton.

Current velocity plays a role in phytoplankton distribution through water mass movement and nutrient dispersal. Current conditions at the study site facilitate the dispersal of phytoplankton between locations; however, their influence on the dominance of Bacillariophyceae cannot be separated from other environmental factors.

The dominance of Bacillariophyceae is significant for pearl oyster farming areas, as diatom groups such as *Skeletonema* sp., *Chaetoceros* sp., and *Navicula* sp. have the potential to serve as natural food sources. Huki et al. (2023) explain that particle size is a crucial factor in pearl oyster food selection. Thus, the high species richness of Bacillariophyceae indicates the presence of phytoplankton components relevant as natural food sources.

These findings align with Mustofa et al. (2020), who demonstrated that the coastal waters of Sumberkima possess conditions favorable for aquaculture activities. A similar pattern of diatom dominance in pearl oyster farming environments was also observed by Sombak et al. (2025), suggesting that Bacillariophyceae constitute a key group within the phytoplankton communities of bivalve farming ecosystems.

The presence of Cyanophyceae and Dinoflagellata in lower numbers still warrants attention, as some members of these groups can be associated with nutrient enrichment and the potential formation of Harmful Algal Blooms (HABs). However, the low dominance values indicate that no single species is proliferating excessively. Therefore, the presence of *Oscillatoria* sp., *Anabaena* sp., and *Ceratium* sp. is best viewed as a community component requiring monitoring rather than as evidence of an active HAB event.

Ecologically, the observed phytoplankton composition includes groups capable of meeting the natural food requirements of *P. maxima*. Bacillariophyceae emerged as the dominant group, comprising 43 species and a total of 6,758 cells. Huki et al. (2023) demonstrated that food particle utilization by pearl oysters is influenced by particle size, while Rango et al. (2023) linked filtration processes to phytoplankton size characteristics. The presence of *Skeletonema* sp., *Chaetoceros* sp., and *Navicula* sp. ...indicating the potential availability of suitable natural food for **P. maxima**. However, this study did not measure consumption, filtration efficiency, growth, or survival of the shellfish; therefore, the relationship cannot be characterized as a direct causal link.

Community structure metrics—diversity >3 , evenness >0.6 , and dominance <0.5 —indicate a diverse community not reliant on a single species. These conditions support the availability of a more diverse range of natural food sources for *P. maxima*. Differences in abundance across locations indicate that natural food availability is not entirely uniform, with the highest values observed in the floating net cage (KJA) area. This pattern is consistent with findings by Setiabudi et al. (2016) regarding the link between mariculture activities and increased nutrient and plankton levels in Pegametan Bay. Hapsari et al. (2026) also reported relatively higher inorganic nutrient levels in the cultivation zone of Sumberkima Bay.

The increased phytoplankton abundance in the KJA area requires a balanced perspective; while nutrient enrichment can boost productivity, excessive input also has the potential to alter community structure. Sombak et al. (2025) demonstrated that phytoplankton distribution in pearl oyster cultivation environments can vary spatially, highlighting the need for periodic monitoring.

Overall, Pegametan Bay hosts a diverse phytoplankton community, with the highest abundance found in the KJA area and Bacillariophyceae serving as the dominant group. The presence of various diatom species indicates the potential availability of natural food for *P. maxima*, while low dominance values suggest that no single species dominates the community. The relationship between phytoplankton and the survival of the shellfish in this study is best understood in terms of ecological potential; therefore, demonstrating a direct effect on the

growth and survival of *P. maxima* requires further research that simultaneously measures phytoplankton consumption, feed biomass, growth, physiological condition, and survival.

CONCLUSION

Phytoplankton abundance in the waters of the pearl oyster (*Pinctada maxima*) cultivation site in Pegametan Bay, Sumberkima, ranged from 134.71 to 272.34 individuals/L. The highest abundance was recorded at Station 3, with a mean of 272.34 individuals/L. Community structure analysis revealed high diversity and evenness alongside low dominance, indicating a diverse phytoplankton community not dominated by any single species.

The identified phytoplankton comprised 56 species across six classes, with Bacillariophyceae being the most abundant group, represented by 43 species. The presence of these phytoplankton groups—particularly the Bacillariophyceae—indicates a potential supply of natural food capable of supporting the pearl oyster cultivation environment in Pegametan Bay.

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