Identification of Plankton Species and Environmental Parameters in Lhok Bubon Coastal Waters, Aceh Barat

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Abstract

Plankton plays a crucial role in aquatic ecosystems as primary producers and bioindicators of water quality. However, baseline information on plankton composition and environmental conditions in the coastal waters of Lhok Bubon, Aceh Barat, remains limited. This study aimed to identify plankton taxa and assess environmental parameters in the study area. Field sampling was conducted in October 2025 at three stations, with three replicates per station. Plankton samples were collected using a plankton net, preserved with Lugol's solution, and identified under a light microscope based on morphological characteristics. Water quality parameters, including temperature, pH, salinity, and dissolved oxygen (DO), were measured in situ. A total of 10 plankton taxa were identified, dominated by phytoplankton from the class Bacillariophyceae, followed by Cyanophyceae, zooplankton, and other microorganisms. The presence of diatoms such as *Aulacoseira granulata* and *Synedra ulna* indicates favorable conditions for primary productivity. Environmental parameters remained relatively stable, with temperature ranging from 31.4 to 32.9°C, salinity from 30 to 34 ppt, pH around 8.27, and DO averaging 11.45 mg/L, all within suitable ranges for aquatic life. The results indicate that Lhok Bubon coastal waters are in relatively good condition and capable of supporting plankton growth and ecological processes. However, the presence of cyanobacteria and organically associated microorganisms suggests the need for continuous monitoring to maintain environmental quality

1. Introduction

Coastal aquatic ecosystems are highly productive systems that play an essential role in maintaining environmental balance and supporting aquatic life. Water quality is a key factor determining ecosystem health, as changes in physical and chemical parameters can directly or indirectly affect aquatic organisms (Nair & Nayak, 2023). Both natural processes and anthropogenic activities, such as settlements, fisheries, and domestic waste discharge, are known to contribute to water quality degradation and disrupt ecosystem stability (Yusal & Hasyim, 2022).

Plankton is one of the biological components that is highly responsive to environmental changes in aquatic systems. These microscopic organisms drift in the water column and play a crucial role as primary producers (phytoplankton) and primary consumers (zooplankton) in aquatic food webs (Evita et al., 2021). In addition, plankton is widely used as a bioindicator due to its sensitivity to environmental changes, making it a reliable indicator of water quality conditions (Akbarurrasyid et al., 2023).

The distribution and occurrence of plankton are strongly influenced by environmental parameters such as temperature,

salinity, pH, and dissolved oxygen (DO). Variations in these parameters can affect plankton growth and presence in aquatic environments (Awwalia et al., 2025). Poor water quality may alter plankton composition and disrupt ecological functions in aquatic ecosystems (Shekina et al., 2024). Therefore, studies on plankton in relation to environmental parameters are essential for understanding the condition of aquatic ecosystems.

Lhok Bubon coastal waters, located in Samatiga District, Aceh Barat, have high biological resource potential but are also vulnerable to environmental pressures from human activities, including fisheries, tourism, and domestic waste disposal (Lubis et al., 2025). These activities may affect water quality and, consequently, the presence of aquatic organisms, including plankton. However, scientific information regarding plankton species in Lhok Bubon waters and their associated environmental parameters remains limited. Previous studies have largely focused on abundance, diversity, or statistical relationships between plankton and water quality in other locations (Mariyati et al., 2020; Pratiwi et al., 2024), while baseline data on plankton species identification in this area remain scarce. This limitation highlights a significant research gap that needs to be addressed to support ecological monitoring and sustainable coastal management. Therefore, this study aims to identify plankton species and to determine environmental parameters, including temperature, pH, salinity, and dissolved oxygen (DO), in the coastal waters of Lhok Bubon, Aceh Barat.

2. Methodology

2.1. Time, Place, and Materials

This study was conducted in the coastal waters of Lhok Bubon, Samatiga District, Aceh Barat, Indonesia, in October 2025. Field sampling was conducted at three observation stations representing different environmental conditions in the coastal area. Laboratory analysis for plankton identification and processing of water quality data was performed at the Laboratory of Aquatic Environmental Productivity, Universitas Teuku Umar (Figure 1).

2.2. Method

A field survey method was used to collect primary data, including plankton samples and water-quality parameters. Sampling was conducted at three stations, with three replicates per station. The selection of sampling stations was based on differences in environmental characteristics to represent the overall condition of the study area. Plankton sampling and preservation procedures followed standard methods for aquatic biological analysis (APHA, 2017), while identification was carried out based on morphological characteristics using plankton identification references (Newell & Newell, 1977).

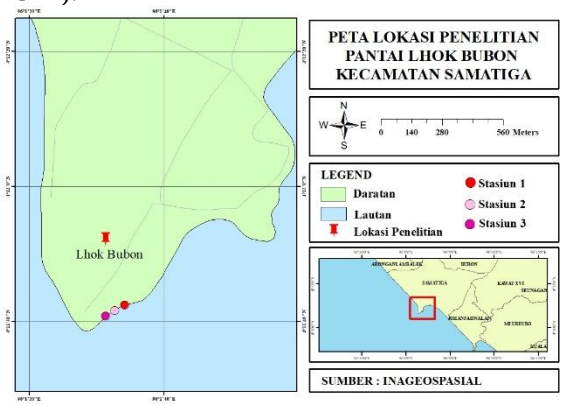

Figure 1. Research location

2.3. Procedures

Plankton Sampling

Water samples were collected from the surface layer using a bucket. At each sampling point, approximately 30–100 L of water was collected and filtered through a plankton net. The concentrated sample was then transferred into labeled sample bottles and preserved using Lugol's solution. Lugol is widely used as a preservative in plankton studies due to its effectiveness in preserving morphological structures (APHA, 2017).

Measurement of Water Quality Parameters

Water quality measurements were conducted directly in the field at each station. Temperature was measured with a digital thermometer, pH with a pH meter, salinity with a refractometer, and dissolved oxygen (DO) with a DO meter. Each parameter was measured three times at each station, and the values were recorded for further analysis.

Plankton Identification

Plankton identification was performed using a light microscope. A small volume of the preserved sample was placed on a glass slide and observed under a microscope. Observations were conducted using the field-of-view method

with multiple fields of view per sample to ensure representative identification. Morphological characteristics such as shape, size, and color were recorded, and identification was performed using standard plankton identification guides. Identification was performed using standard plankton identification guides (Newell & Newell, 1977).

Water Quality Data Processing

The measured water quality parameters (temperature, pH, salinity, and DO) from each station were averaged to represent the overall condition of the study area (Chidiac et al., 2023).

2.4. Data Analysis

Data analysis in this study was descriptive. Plankton data were presented in the form of identified taxa, while water quality data were analyzed by calculating mean values for each parameter across sampling stations. The results were then interpreted to describe the general condition of the aquatic environment in Lhok Bubon coastal waters.

3. Result and Discussion

Environmental Parameters

The results of water quality measurements in the coastal waters of Lhok Bubon are presented in Table 1. The observed parameters included temperature, pH, salinity, and dissolved oxygen (DO), which are essential indicators for evaluating the suitability of aquatic environments for plankton growth.

Overall, the measured environmental parameters indicated relatively stable and suitable conditions for aquatic organisms. The average water temperature ranged from 31.4 to 32.9°C, with a mean value of approximately 32.17°C. This temperature range is typical of tropical coastal waters and falls within the tolerance limits of most planktonic organisms. Temperature plays a crucial role in regulating metabolic activity and photosynthesis in phytoplankton, where increasing temperature within an optimal range can enhance biological processes (Handayani & Nuzapril, 2024).

Tabel 1. Water quality measurements in the coastal waters of Lhok Bubon

No	Parameters	Reply	St 1	St 2	St 3
1	pH	1	8,5	8,3	8,12
		2	8,12	8,10	8,2
		3	8,13	8,5	8,5
Average					8,27
2	Salinity (‰)	1	32	30	33
		2	39	32	34
		3	30	34	34
Average					31,9
3	Dissolved oxygen (DO) (mg/L)	1	10	10,2	11,1
		2	9,7	9,4	10,9
		3	18	9,4	14,8
Average					11,45
	temperature (°C)	1	31,4	32,2	32,3
		2	31,5	32,4	32,9
		3	31,5	32,8	32,6
Average					32,17

The pH values ranged from 8.1 to 8.5, with an average of 8.27, indicating slightly alkaline conditions. This range is considered optimal for marine organisms, particularly phytoplankton, which generally thrive in slightly alkaline environments. Stable pH conditions reflect a balance between photosynthesis and respiration in the aquatic ecosystem. Extreme pH conditions, either too acidic or too alkaline, may disrupt metabolic processes and limit plankton survival (Keil et al., 2021).

Salinity values ranged from 30 to 34 ppt, with an average of 31.9 ppt. This range falls within the normal salinity levels of tropical marine waters (30–35 ppt), suggesting minimal freshwater influence in the study area. Salinity is a key factor influencing plankton distribution, as it affects osmoregulation and physiological adaptation. Stable salinity conditions generally

support the presence of marine plankton species and contribute to ecological stability (Cahyani et al., 2023).

Dissolved oxygen (DO) concentrations ranged from 9.4 to 18 mg/L, with an average value of 11.45 mg/L. These values indicate well-oxygenated conditions, which are favorable for aquatic life. High DO levels in coastal waters are often associated with strong water mixing, wave action, and phytoplankton photosynthetic activity. Adequate oxygen availability is essential for respiration and metabolic processes of aquatic organisms (Nair & Nayak, 2023). Based on these observations, the environmental conditions in Lhok Bubon coastal waters are generally favorable for plankton development. The measured parameters fell within ranges commonly reported for healthy coastal ecosystems, suggesting that the aquatic environment can support biological productivity.

Plankton Identification

A total of 10 plankton taxa were identified in the coastal waters of Lhok Bubon, representing several taxonomic classes. The assemblage was dominated by members of the class Bacillariophyceae (diatoms), followed by Cyanophyceae, Zygnematophyceae, and a smaller proportion of zooplankton and other microorganisms. The dominance of diatoms suggests that the environmental conditions in the study area are suitable for primary productivity, as these organisms are commonly associated with nutrient-rich and well-oxygenated waters (Evita et al., 2021).

Table 2. Taxonomic composition of plankton in Lhok Bubon coastal waters

Class	Family	Genus	Species
Bacillariophyceae	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira granulata*
	Ulnariaceae	*Synedra*	*Synedra ulna*
	Fragilariaceae	*Fragilaria*	*Fragilaria sp.*
	Tabellariaceae	*Tabellaria*	*Tabellaria flocculosa*
Zygnematophyceae	Closteriaceae	*Closterium*	*Closterium sp.*
Cyanophyceae	Oscillatoriaceae	*Lyngbya*	*Lyngbya sp.*
	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria sp.*
Copepoda	Canthocamptidae	*Attheyella*	*Attheyella sp.*
Clitellata	Naididae	*Chaetogaster*	*Chaetogaster sp.*
Eurotiomycetes	Aspergillaceae	*Aspergillus*	*Aspergillus flavus*

The presence of diatoms, particularly *A.granulate* and *S.ulna*, indicates that the waters can support primary productivity under relatively stable environmental conditions. Diatoms are widely recognized as dominant phytoplankton in coastal ecosystems due to their adaptability to varying salinity and nutrient availability. The occurrence of these taxa in Lhok Bubon waters is likely associated with the observed salinity range (30–34 ppt) and high dissolved oxygen levels, which provide favorable conditions for photosynthetic activity and growth (Mariyati et al., 2020). These species are commonly found in well-mixed, nutrient-rich waters, suggesting that the study area supports a productive phytoplankton community.

In addition to diatoms, the presence of cyanobacteria, such as *Lyngbya* sp., reflects the ability of certain plankton groups to tolerate a wide range of environmental conditions. Cyanobacteria are known for their resilience and capacity to grow in nutrient-enriched environments. The relatively high temperature (~32°C) observed in this study may support their metabolic activity and growth. Although their presence contributes to primary productivity, it may also indicate the potential for nutrient enrichment, particularly if environmental conditions shift toward eutrophic states (Shekina et al., 2024).

The detection of zooplankton, including *Attheyella* sp., suggests the existence of trophic interactions within the aquatic ecosystem. As primary consumers, copepods rely on phytoplankton as their main food source (Vereshchaka, 2024). The coexistence of phytoplankton and zooplankton in this study indicates a functioning food web structure. This condition is supported by adequate dissolved oxygen levels, which are essential for respiration and metabolic processes of aquatic organisms (Evita et al., 2021).

Furthermore, the occurrence of *Aspergillus flavus* may be associated with the presence of organic matter in the aquatic environment. This microorganism is commonly found in environments with elevated organic content, suggesting that organic inputs either from natural processes or anthropogenic activities may be present in the study area (Josselin et al., 2021). However, its occurrence in limited abundance does not necessarily indicate severe pollution but rather reflects localized organic enrichment.

Overall, the identified plankton taxa and their ecological characteristics suggest that the coastal waters of Lhok Bubon are in relatively good condition and capable of supporting biological productivity. The combination of stable environmental parameters and the presence of both primary producers and consumers indicates a balanced aquatic ecosystem (Katkov et al., 2025). However, the presence of cyanobacteria and organically associated microorganisms underscores the importance of continuous monitoring to prevent potential environmental degradation.

Relationship between Plankton and Environmental Parameters

The composition of plankton identified in Lhok Bubon coastal waters reflects the influence of environmental conditions on the aquatic ecosystem. The relatively stable values of temperature, salinity, pH, and dissolved oxygen observed in this study provide favorable conditions for phytoplankton growth, particularly diatoms (Tripathy et al., 2024). These environmental conditions fall within the optimal range for plankton development, supporting the presence of taxa such as *A. granulata* and *S. ulna*, which are commonly associated with productive, well-oxygenated waters.

Temperature plays an important role in regulating metabolic processes and photosynthetic activity of phytoplankton (Fernández-González et al., 2022). The relatively high temperature recorded in this study (~32°C) is typical for tropical waters and may enhance phytoplankton growth, although extreme increases could potentially lead to shifts in community composition. Salinity values within the normal marine range (30–34 ppt) further support the presence of marine plankton, particularly diatoms, which are well adapted to stable salinity conditions (Cahyani et al., 2023).

Dissolved oxygen (DO) levels were relatively high, indicating well-oxygenated waters that support both phytoplankton and zooplankton. High DO concentrations are often associated with active photosynthesis and water mixing, which enhance oxygen availability in the water column (Xie et al., 2025). This condition supports the presence of zooplankton such as *Attheyella sp.*, which rely on sufficient oxygen and food availability for survival (Karpowicz et al., 2020).

The occurrence of cyanobacteria, such as *Lyngbya sp.*, may be related to nutrient availability in the water (Villalobos et al., 2025). While their presence contributes to primary productivity, it may also indicate the potential influence of nutrient inputs from surrounding activities. Similarly, the detection of *A.flavus* suggests the presence of organic matter, which may originate from natural processes or anthropogenic sources (Ouadhene et al., 2024). Overall, the relationship between plankton and environmental parameters in this study indicates that the coastal waters of Lhok Bubon are in relatively good condition and capable of supporting biological productivity. However, the presence of certain taxa associated with nutrient enrichment highlights the importance of continuous monitoring to maintain ecosystem stability.

4. Conclusion

This study identified 10 plankton taxa in the coastal waters of Lhok Bubon, Aceh Barat, including phytoplankton, zooplankton, and other microorganisms. The plankton community was dominated by diatoms (Bacillariophyceae), indicating favorable conditions for primary productivity. The measured environmental parameters, including temperature, pH, salinity, and dissolved oxygen, were within ranges suitable for aquatic life. These conditions support the growth and distribution of plankton in the study area. The presence of both phytoplankton and zooplankton suggests a functioning trophic structure within the ecosystem. Overall, the coastal waters of Lhok Bubon are relatively stable and capable of supporting biological productivity. However, the presence of cyanobacteria and organically associated microorganisms indicates the need for regular monitoring to prevent potential environmental degradation.

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