ECOLOGICAL CHARACTERISTICS AND PRESENCE OF HABs IN DRY SEASON AT ESTUARY OF TALLO MAKASSAR, SOUTH SULAWESI

Rahmadi Tambaru[a,*], Andi Iqbal Burhanuddin[a], Arniati Massinai[a], Muhammad Anshar Amran[a]
[a]FIKP Universitas Hasanuddin, Jl. P Kemerdekaan KM 10 Tamalanrea, Makassar, Indonesia

*Corresponding author (E-mail address): aditbr25@gmail.com

Abstract

Research on the ecological characteristics and presence of HABs in the dry season at the estuary of Tallo Makassar has been conducted from May to July 2020. Measurement of environmental parameters such as temperature, pH, salinity, current, and dissolved oxygen is carried out on three sampling points T1, T2, and T3. Similarly, water sampling to detect the presence of phytoplankton types. The measurement of other environmental parameters such as turbidity, nitrate, nitrite, ammonia, orthophosphate, and silicate is analyzed in a laboratory. Phytoplankton identification is also carried out in the laboratory. Characteristic analysis of ecology used PCA. To calculate the abundance of phytoplankton cells is used census method. The results showed that the ecological characteristics of Estuarial Tallo on T1 were characterized by dissolved oxygen, turbidity, and nutrients (nitrate, nitrite, ammonia, orthophosphate, and silicate). T2 is characterized by pH and temperature. The environmental characteristics in T3 are inverse to T1. HABs were detected in five species, namely *Ceratium furca, Ceratium fusus, Gonyaulax sp, Prorocentrum sp, dan Protoperidinium sp*. The percentage of non-HABs is higher when compared to HABs. The availability of orthophosphate influences the suitability of ecological factors with the development of Non-HABs. Otherwise, HABs are compatible with nitrate, nitrite, ammonia, and silicate.

Keywords: ecological characteristics, estuary, presence of HABs.

INTRODUCTION

An estuary is a coastal area that receives many organic and inorganic materials from human activities on land [1] [2]. The material is carried through the flow of the river [3] [4]. Its development impacts characteristic ecological changes [5] because the value of various environmental parameters is changing. This can lead to new events that are important to research.

Changes in nutrient concentrations (such as nitrates and phosphates) are examples of changes in ecological conditions in an estuary [6] [7]. The impact of this change is the unexpected development of some organisms. They can respond well to ecological changes and even support their growth. Types of organisms that existed before experience stagnant or undeveloped growth.

One of the organisms that are affected by changes in ecological characteristics is phytoplankton [8]. These organisms are classified as microorganisms so that they are grouped in the microalgae group. Its ability to respond to ecological changes is different for each type of phytoplankton [9] [10]. At certain times, some kinds are found in abundance. At other times it is quite another kind.

The least expected impact from changes in ecological characteristics is the development of dangerous microalgae types, which are often referred to as phytoplankton that cause HABs. An increase in excess nutrient concentrations can cause the bloom of HABs in water [11] [12]. The ecosystem becomes unstable when that happens. This can cause the life of other organisms to be disturbed. This situation often occurs along with the changing seasons.

This research has been carried out in Estuary Tallo Makassar, South Sulawesi, during the dry season to analyze the changes in ecological characteristics and the emergence of HABs in the estuary area. This water is one of the waters that receive a lot of organic and inorganic material from the land through river drains [13].

METHOD

The research was conducted from May to July 2020 (dry season) in the Tallo Estuary, Makassar City, South Sulawesi. These activities include taking water samples in the field, identifying phytoplankton samples, and analyzing water quality at the Chemical Oceanography Laboratory, Department of Marine Science, Faculty of Marine Sciences and Fisheries, Universitas Hasanuddin.

This research was conducted at three sampling points (T1, T2, and T3), with the assumption that the three have different nutrient concentrations and different values of several parameters such as salinity and turbidity. T1 is 500 m from the mouth of the Tallo river towards the sea, T2 is 1 km from T1, and T3 is 1 km from T2. Ecological parameters such as temperature, salinity, and currents were measured at each station. Simultaneously, water samples were taken to identify phytoplankton, including dangerous types (HABs) using the Uthermol method. A total of two liters of seawater samples were taken using a Kammerer water sampler, then put into a jerry can and brought to the laboratory. Part of the water sample is used for measurement of environmental parameters such as pH, turbidity, Nitrate (NO_3), Nitrite (NO_2^-), Ammonia (NH_4^+), Orthophosphate ($PO_4^{\equiv}$), Silicate (SiO_4^{-4}). The sampling time was 10.00-14.00 WITA [14]. The seawater sample is put into a cold box filled with ice.

The sample handling for phytoplankton cell count was carried out according to the deposition method developed by Uthermol [15]. As much as 1 ml of the sediment, then put into a Sedgwig Rafter Cell (SRC) with a scaled pipette to calculate the abundance of phytoplankton cells through the aid of a microscope. For calculating the abundance of phytoplankton cells using the sweeping method (census), they were then formulated based on guidelines of APHA [16].

Phytoplankton identification was carried out down to the species level using the plankton identification book from Tomas [17], Newell & Newell [18], Yamaji [19], dan Verlecar & Desai [20]. This was done descriptively to find out the number of species and the proportion of non-HABs and HABs phytoplankton. The PCA (Principal Component Analysis) is used [21] to analyze ecological characteristics. Analyzes were conducted based on research stations.

RESULT AND DISCUSSION

Ecological Characteristics

Environmental factors analyzed in explaining ecological characteristics are Temperature, Salinity, pH, DO (Dissolved oxygen), Current, Turbidity, Nitrate (NO_3), Nitrite (NO_2^-), Ammonia (NH_4^+), Orthophosphate ($PO_4^{\equiv}$), Silicate (SiO_4^{-4}), the abundance of Phytoplankton Non-HABs and HABs. From the results of the PCA analysis (Figure 1), the information given about the character of each station is centered on two main axes (F1 and F2). By explaining the two main axes, the environmental characteristics that affect each station can be explained by 72.98%. Missing information was only 27.02% of the total variance (Table 1).

Table 1. Eigenvalue F1 and F2 in PCA

	F1	F2
Eigenvalue	7.148	2.339
Variability (%)	54.988	17.996
Cumulative %	54.988	72.984

The ecological characteristics of the Tallo Estuary at each station, such as T1, are characterized by high nutrient levels (Nitrate, nitrite, ammonia, Orthophosphate dan silicate), DO (Dissolved oxygen) dan Turbidity. This is normal because the position of T1 is in front of the river mouth, which is thought to drain a lot of dissolved and suspended materials from the land, including the types of nutrients.

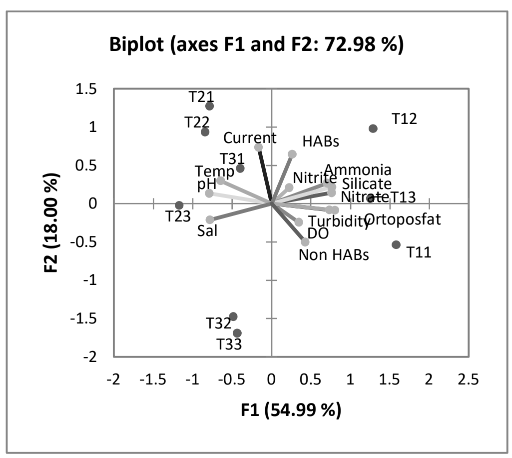

Figure 1. The results of the PCA analysis

The high concentration of nutrients causes the phytoplankton to be more active in photosynthesis; it impacts high dissolved oxygen. Another impact that can be seen from the T1 position is the high level of turbidity. Such conditions are inversely proportional to T3, which is located far from the river's mouth. The environmental characteristics in T2 are pH and temperature.

Detect the presence of HABs

The presence of phytoplankton, including changes in composition and abundance, is influenced by changes in a waters' ecological quality. This can cause species that were previously found sparingly at one time to become abundant at other times. A total of 26 species are scattered throughout the research stations (Table 2). All of these species are grouped into three classes, namely Bacillariophyceae (20 species), Cyanophyceae (1 species), and Dinophyceae (5 species).

Bacillariophyceae is a phytoplankton class with the largest number of species. This class in marine and estuary waters is indeed found to have a greater number of species than other classes. Several research results, such as those conducted by [22] in Estuaria Donan Cilacap of Central Java, [23] in the Mahakam Delta of South Kalimantan, [24] in Estuaria Vembrand India, also received similar results.

A total of 16 species were found at all stations (Table 2). These species are *Bacteriastrum sp, Cerataulina pelagica, Chaetoceros coarctatus, Chaetoceros curvisetus, Coscinodiscus sp, Leptocilindrycus sp, Nitzschia sp, Odontella sinensis, Pseudonitzschia sp, Rhizosolenia alata, Rhizosolenia setigera, Rhizosolenia stolterfothii, Thalassionema nitzschioides, Oscillatoria sp, Prorocentrum sp dan Protoperidinium sp*. The distribution of plankton species is generally even at all stations.

A total of five HABs species are found at all stations, namely *Ceratium furca, Ceratium fusus, Gonyaulax sp, Prorocentrum sp, dan Protoperidinium sp* (Table 2). These species belong to the Dynophycea class group, containing toxic metabolites. If it grows well, it is feared that it can have a detrimental impact on other organisms such as shellfish and fish. This can cause poisoning and even death if humans eat it.

Table 2. The presence of phytoplankton types by Sampling point

Species Name	Station		
	M 1	**M 2**	**M 3**
Bacillariophyceae			
Bacteriastrum sp.	+	+	+
Cerataulina pelagica	+	+	+
Chaetoceros coarctatus	+	+	+
Chaetoceros curvisetus	+	+	+
Chaetoceros didymus	+		+
Coscinodiscus sp.	+	+	+
Lauderia anullata	+		
Leptocilindrycus sp.	+	+	+
Licmophora sp.	+		
Nitzschia sp.	+	+	+
Odontella mobiliensis	+		+
Odontella sinensis	+	+	+
Pleurosigmasp.	+		+
pseudonitzschia sp.	+	+	+
Rhizosolenia alata	+	+	+
Rhizosolenia castracanei	+		+
Rhizosolenia imbricate	+		+
Rhizosolenia setigera	+	+	+
Rhizosolenia stolterfothii	+	+	+
Thalassionema nitzschioides	+	+	+
Cyanophyceae			
Oscillatoria sp	+	+	+
Dinophyceae			
Ceratium furca	+		
Ceratium fusus			+
Gonyaulax sp		+	+
Prorocentrum sp	+	+	+
Protoperidinium sp	+	+	+

Info : + (present)

The comparison of the percentage of non-HABs and HABs phytoplankton can be seen in Figure 2. The percentage of non-HABs phytoplankton is greater than the HABs at each station. T1 has 98% to 2%, T2 is 97% to 3%, and T3 is 99% to 1%.

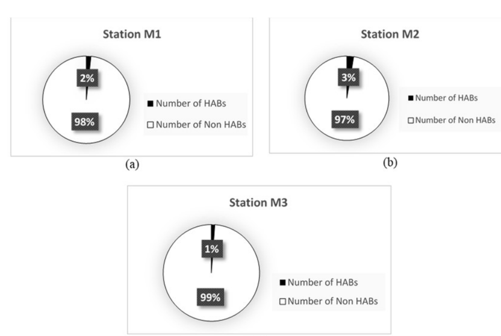

Figure 2. Comparison of the percentage of non-HABs and HABs phytoplankton at each station

The comparison of the three stations is in stark contrast. This means that non-HABs phytoplankton is more developed; their suitability with ecological factors is better. These factors are considered to have not changed much and are still in normal conditions.

Suitability of environmental factors with the presence of Habs and Non-HAbs

In Figure 1, Habs and Non-HAbs are abundant in T1 when compared to T2 and T3. In T1 also found high turbidity and nitrate (NO_3), nitrite (NO_2^-), ammonia (NH_4^+), orthophosphate ($PO_4^{\equiv}$), silicate (SiO_4^{-4}). As previously explained, the position of T1 is right in front of the river mouth. Based on that position, T1 certainly contains many dissolved and suspended materials originating from the mainland.

The high concentration of nutrients in T1 causes phytoplankton to be more active in photosynthesis; it impacts high dissolved oxygen. Another impact that can be seen from the T1 position is that the turbidity is found to be high.

In general, the development of Phytoplankton Non-HABs is more influenced by orthophosphate; on the other hand, HABs corresponds to nitrate, nitrite, ammonia, and silicate.

CONCLUSION

Based on the results of research on the ecological characteristics and presence of hazardous phytoplankton in the dry season in the Estuary Tallo Makassar, South Sulawesi, it can be concluded that the ecological characteristics of the Tallo Estuary in T1 are characterized by high marine oxygen, turbidity, and nutrients (nitrate, nitrite, ammonia, orthophosphate dan silicate, T2 is characterized by high pH and temperature values, and the environmental characteristic in T3 are inverse to T1. Five phytoplankton HABs were detected, namely *Ceratium furca, Ceratium fusus, Gonyaulax sp, Prorocentrum sp, dan Protoperidinium sp*. The percentage of non-HABs is much higher when compared to HABs. The availability of orthophosphate more influences the suitability of ecological factors with the development of non-HABs; on the other hand, HABs are compatible with nitrate, nitrite, ammonia, and silicate.

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