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PLANKTON ABUNDANCE BETWEEN DRY AND RAINY SEASON IN TALLO FRESHWATER AND PANGKEP RIVER

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ABSTRACT

Plankton abundance is influenced by seasons, sea surface currents (SSC), nutrients and surface temperature (SST). Is a marine organism has a function to stabilize the surface temperature of the earth by regulating the concentration of Dimetyl sulfide (DMS) due to exposure to direct sunlight. There is the ability of the ocean to regulate warming and to regulate the distribution of water vapor in the atmosphere which is controlled by sea surface temperature. Sampling using the transeck system in September and January represents the rainy season and the dry season which is closest to the Tallo river estuary and the Pangkep river estuary represents the estuary region, towards the coast of the spermonde (Litoral) islands and far from the coast (offshore) from freshwater sources, but the relationship of nutrient entry into estuary areas by sea surface currents (SSC) is still poorly known. The dominant aspect of phytoplankton is determined by the amount of nutrients flowing (runoff) from land to estuary to spermonde waters.

Keywords: Estuary, Fitoplankton, Spermonde, Season, Runoff

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1. INTRODUCTION

Spermonde waters extend along the Makassar Strait to the western Sulawesi Sea. Spermonde waters have considerable fishery potential, especially small pelagic fish groups. The abundance of nutrients as a food source for surface marine ecosystems enriches the existing habitat around the waters of spermonde. Coastal ecosystems are dynamic ecosystems and have a variety of diverse habitats, on land and at sea, and interact with each other. Excessive enrichment of nutrients supports an increase in phytoplankton biomass in coastal ecosystems, generally expressed as high chlorophyll concentrations (Chl-a).

The cause of the increase in biomass received is the presence of anthropogenic eutrophication [1], a term that includes activities such as deforestation, agricultural extensification, industry, and urbanization, and waste water disposal [2]. River flow that carries organic material along the river flow will provide abundant nutrition for plankton throughout the season. Large river flow, Tallo river with Lat coordinates. 05^{o}05'.42 " N, Lng. 119^{o}26'34'E will contribute nutrients to the growth of biomass in the litoral region. The source of fresh water in the mouth of a large river, the Tallo river, but the relationship of the entry of nutrients into the estuary is still unknown. Spermonde waters are a litoral area marked by tides and tides filled with primary producers, both floating and rooted (seagrass beds and sea grasslands), which have limited location in Indonesia. Research on spatio-temporal dynamics of water fertility in the Spermonde Islands is important to study, because the Spermonde Islands receive a high anthropogenic burden due to increased nutrient supply from agricultural activities, aquaculture and waste disposal both domestic and industrial waste [3].

As the largest inter-continental crossing region, the rainy Pacific Ocean and the southern China Sea [4], Indonesia in this case the Spermonde Islands (Sangkarang) is one of the complex coral reefs located in the Makassar Strait which crosses from north-south, following the coastline South Sulawesi. The coral reef developed from Takalar Regency in the south to Pangkep regency in the north which has an area of around 40 - 50 km2 whose characteristics affect the entire coastal area [5]

Annual average surface cross flow (SSC) originates from the Pacific ocean to the Indian Ocean, as the explanation is shown in figure 1. Taking into account the characteristics of the mass of water, the dominant route through the Indonesian Sea is from the North Pacific via Mindanao, then through the Makassar Strait to the Banda Sea, and finally through the Timor Sea to the Indian Ocean upon drought [6].

Sea surface currents (SSC) have long been the focus of attention of researchers who are not only in view of local and regional perspectives but also globally. If seen locally, there is a relationship of major changes in the structure of water mass in the Indonesian sea, this is due to the entry of fresh water into the surface of the sea water from rivers originating from the island in its path, coupled with undercurrent friction, and mixing with strong tidal currents [7]. Regionally, it is important to understand how Indonesia's cross-flow with all its variability relates to the cross-flow system originating from the ocean currents in the rain Pacific to the Australian power rain. Globally, Indonesian cross flow (SSC) is believed to affect the climate of the entire archipelago in the archipelago (Indonesia) on a yearly and longer scale because the island stretching from Java to Timor is one of the stoppers of the global circulation system with all the variability that occurs .

The sea has a function to stabilize the surface temperature of the earth by regulating heating and distributing water vapor controlled by sea surface temperature [10]. There is the ability of the ocean to regulate warming and to regulate the distribution of water vapor in the atmosphere which is controlled by sea surface temperature [10].

One of the functions of the sea which is the largest contributor to natural sulfur in the sulfur cycle in the atmosphere, and most of this sulfur is in the form of aerosol dimethylsulfide (DMS). DMS is a volatile organic compound produced by marine plankton. DMS in the atmosphere chemically oxidizes species which can eventually form condensates in the cloud core so that they can determine the impact of climate on an area of distribution [1]. DMS is produced from the enzymatic cleavage process of metabolite algae in the form of Dimethylsulfoniopropionate (DMSP). Some of the released DMS diffuses into the marine atmosphere where it is oxidized to sulfuric acid aerosols and forms the Nuclei Cloud Condensation (CCN) [11]. This aerosol CCN directly reflects sunlight and regulates the reflexity of sunlight against clouds, thus affecting the geothermal balance [12]. A rule of negative feedback on climate on earth has been proposed as an interaction between positive seasonal and solar radiation, DMS at sea level, and releasing DMS to the atmosphere [11], [12], [6]. However, the mechanism responsible for this seasonal pattern is not well known [11]. Recent research shows that the pattern of DMS formation by micro algae is caused by complex interactions between the formed DMS compounds, the onset of stress by microcellular, nutritional limitations, and exposure to solar UV radiation [11], [13].

DMS is believed to play a major role in maintaining the Earth's climate in stable climate conditions which are needed throughout life on earth. Researchers Charlson, Lovelock, Andreae and Warren first put forward this hypothesis so that it is known as the CLAW hypothesis [12], [14]. Increased concentrations of CO2 in the atmosphere will warm the planet as a result of the productivity of marine phytoplankton induction which results in greater carbon concentration from DMS.

The estuary region receives continuous nutritional input from fresh water sources from rivers flowing along estuary waters, but researchers are still less interested in how the biogeochemical cycles occur. To document the reduction of nutrients from the water column by phytoplankton, research was carried out on how to measure the distribution of sea surface currents (SSC), DMS, and phytoplankton across the salinity gradient of two estuaries: the Tallo river estuary and the Pangkep river estuary. Data processing research results in the form of diagrams to distinguish between changes conservatively and non-conservatively; namely the loss of nutrients from the water quickly in the form of an increase in phytoplankton populations in river mouths. At the Tallo estuary and the Pangkep river estuary, maximum turbidity is often observed as part of the Litoral region with a clearer maximum chlorophyll concentration.

Phytoplankton are able to photosynthesize and act as producers in the aquatic environment, while zooplankton act as the first consumers to connect phytoplankton as producers with organisms with higher trophic levels. The condition of a waters will also affect the pattern of distribution or distribution of phytoplankton both horizontally and vertically, so that it will affect the abundance of phytoplankton which in turn affects the value of primary productivity. Oceanographic parameters are one of the factors that greatly influence the variability of climate change, such as chlorophyll-a and sea surface temperature. Phytoplankton that are in the light layer (fotik) contain chlorophyll-a which is useful for photosynthesis. Chlorophyll-a is able to absorb blue and green light, so that the presence of phytoplankton can be detected based on the ability of the chlorophyll-a.

Spermonde waters have unique characteristics with changes in physical and chemical properties that are influenced by the movement of water masses from the Pacific Ocean and the Java Sea. The characteristics of the waters at sea differ according to the location of the waters with respect to land. Marine waters are based on water-forming material, namely type-1 and type-2. Type-1 waters are offshore waters with phytoplankton (chlorophyll-a) as the main component affecting the optical properties of seawater, while type-2 is a coastal area dominated by suspended material and organic material. Sea water into three classes based on water fertility, namely oligotrophic (open ocean), mesotrophic (intermediate), and eutrophic (coastal) [9], [15].

The aim of this research is to find out the impact of surface sea current (SSC) strength on the phytoplankton community structure in the spermonde area during the rainy season and dry season.

2. MATERIAL AND METHOD

Sample Collection and Screening

Samples were collected from ten locations (stations) in the estuary, shelf and open sea zones in the Indonesian spermonde stretch. This research was conducted in September 2017 as the dry season and January 2018 represented the rainy season. Analysis of phytoplankton samples at the Brackish Aquaculture Fisheries and Fisheries Counseling Research Center Laboratory (PPBAP) Maros and Oceanographic and Fisheries Faculties Laboratory of Hasanuddin University.

Vertical Phytoplankton Sampling Method

The study was conducted using the field survey method by taking phytoplankton and water samples based on the dry and rainy season conditions marked by high rainfall. Sampling was carried out in the morning at 9.00 Wita to 16.00 Wita.

Research Data Analysis

In this study, grouping of the phytoplankton community, data on chlorophyll-a concentration, sea surface temperature, surface current velocity and turbidity were carried out. The data is then averaged using Excel 2013 software and IBM 25 SPSS.

3. RESULT AND DISCUSSION

SSC and SST Against Chl-a.

The research trip was carried out in the dry season and the rainy season took two days with temperatures varying from 22°C to 30°C. The humidity in 10 stations ranges from 54% to 68% while the surface air pressure does not show significant changes ranging from 746 to 749 mmHg. In general the condition of in situ sea currents ranges from 5.92 to 8.12 cm / S at stations 1 to stations 5 and 7. And ranges from 7.05 to 10.04 cm/S at station 6 to station 10 with a temperature gradient that is measured (table 2). Specifically, water conditions from stations 2,3 and 6 have a slow internal temperature of 18°C at the surface with steep gradients to the bottom of the water matrix, while the water core is extracted from stations 4, 7 band 8 has temperatures above 16°C at the surface and temperature are weak or no gradient to the lower ward (Fig. 2).

Salinity profiles are generally homogeneous in all sampling stations, following a pattern shaped with two maximums; one near the surface and one at the bottom of the water (Fig. 2). Research on the spatial distribution and structure of the plankton community was carried out in the Spermonde waters area in South Sulawesi, Indonesia. In this study, from 10 observation stations, 38 genera of phytoplankton and 7 genus Zooplankton were found. The following is a graph of the composition of the type of plankton.

Composition of Phytoplankton Type

The composition of phytoplankton species found at the study site in the pangkep river estuary is 35 genera consisting of 5 classes classified into Chaetoceros sp. Class Rhizosolenia sp as many as 2957.23 genera, Rhizosolenia sp class as much as 249.57 genera, Oscillatoria sp class as much as 29.22 genus, Haptophyceae Class as much as 1 genus, and Prymnesiophyceae class as much as 1 genus. The most commonly found genus comes from the genus Nitzchia. While the least genus found is from the genus.

Based on Table 1, the average content of chlorophyll-a in the Tallo river mouth is 19.89 µg/L. The lowest concentration was found at Station 4 with a value of 0.65 µg / L and the highest concentration at Station IV with a value of 6.14 µg / m3. Judging from these values it can be said that the condition of the Tallo river estuary waters is still in normal condition (good). [19] provides criteria for estuary and estuary waters based on their chlorophyll content. For waters with chl-a content < 15 µg/m3 are categorized in good condition, 15 - 30 µg/m3 are in the moderate category and > 30 µg/m3 are categorized as poor.

The high content of chlorophyll-a phytoplankton in the Tallo river estuary waters does not always describe good conditions for these waters. Very high chlorophyll-a content indicates eutrophication or excessive nutrient enrichment. The effect of uncontrolled abundance of nitrate in ocean waters will be able to disrupt aquatic ecosystems namely the occurrence of eutrophication conditions [20].

Table 1. Characteristics of the spermonde Islan and their distance from major river mouth each season

Estuary	Major River	range (km)	Dry Season			Rainy Season		
			SSC ($cm.s^{-1}$)	SST (^oC)	Chl-a (ppm)	SSC ($cm.s^{-1}$)	SST (^oC)	Chl-a (ppm)
Muara S. Tallo	Makassar	0	5,92	32.85	3.0804	19,89	36	19.8934
Barranglompo		10,21	6,27	32.54	0.2429	0,15	32	0.1567
Bonetambung		16,66	6,68	31.55	0.0767	0,31	36	0.3101
Langkai		38,55	8,12	35.92	0.0646	0,02	36	0.0229
Lanjukkang		44,45	8,88	37.18	0.0006	0,21	37	0.2066
Muara S.Pangkep	Pangkep	0	7,05	33.87	0.7539	1,17	37	11.7354
Laiyya		11,1	7,76	33.56	0.3069	0,22	37	2.2352
Sarappokeke		31,12	8,56	33.33	0.2429	0,09	37	0.8773
Kondongbali		52,3	10,04	33	0.0767	0,20	38	1.9819
Kappoposang		64,32	10,41	32.52	0.0128	0,10	36	0.9384

While the high chlorophyll content at Station 4 is thought to be caused by the presence of nutrient supply from the land carried by the river flow and up to the river estuary which is located at station 4. While the distribution pattern as shown in Figure 2 shows the gradation of chl-a concentration values, namely high at coastal areas, especially river mouths and lower towards the open sea. The high concentration seen in the bay area is thought to be caused because in that area it is a place of accumulation of nutrients from the sugai rivers which empties into the bay.

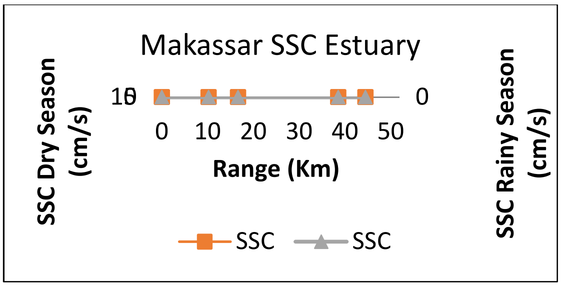

Figure 2. Surface SSC Kondition Pangkep and Tallo Estuary

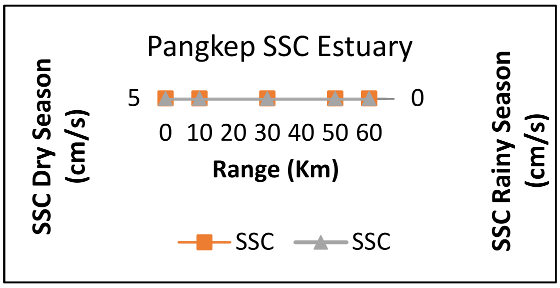

Figure 3. Surface SSC Kondition Pangkep and Tallo Estuary

According to the Makassar City Coastal and Sea Environment Profile report there are at least > 10 small rivers that flow into the Tallo river estuary.

The low current speed in the estuary spermonde is thought to cause nutrients to be easily accumulated and not transported to the high seas. The results of this study are also consistent with the results of research in Tallo Bay where the general pattern of chlorophyll-a phytoplankton, seston, and nutrient distribution shows that high values are almost always found in waters that are relatively close to river mouths, whereas in waters that have been some distance from river mouths the womb is getting lower, especially in the outer bay.

Table 1. shows the value of the uniformity index of phytoplankton in the rainy season obtained ranged from 0.0510 to 0.1786. The average diversity index is 1.06 with a standard deviation of 0.08. The largest diversity index was at station 11 and the smallest diversity index was at station 7. The index of phytoplankton uniformity obtained ranged from 0.37 to 0.41. The average diversity index is 0.40 with a standard deviation of 0.01. The largest diversity index was at station 13 and the smallest diversity index was at station 9.

The index of phytoplankton dominance obtained ranged from 0.08 to 0.17. The average dominance index is 0.11 with a standard deviation of 0.02. The dominance index is at station 7 and the smallest dominance index is at station 11.

Estuaries receive continuous nutritional input from their freshwater sources, but the fate of these inputs is less known. To document the removal of nutrients from the water column by phytoplankton, we measured the distribution of turbidity, nutrients, and phytoplankton across the salinity gradient of two estuaries: the Tallo river estuary, the Pangkep river estuary.

Mixed diagrams are used to distinguish between conservative and non-conservative behavior; that is, between the loss of the water column and export to estuary on the shelf. At the Tallo River Estuary and the Panggkep River Estuary, we often observe maximum turbidity in the oligohalin regions, maximum chlorophyll in waters that are clearer towards the sea than maximum turbidity, and zones of nutrient deficiencies at the highest salinity. At the mouth of the Tallo River, the mixing diagram is dominated by lateral waste input from the city of Makassar, and nutrient removal cannot be estimated.

The total reduction in N and P levels in the estuary of the Tallo and Pangkep rivers is estimated to be around ca. 5Oqb, except for the TP in the estuary of the Tallo river, which seems to be conservative. Phytoplankton accumulation is associated with removal of inorganic nutrients, indicating that absorption of phytoplankton is the main process responsible for removing nutrients. In the high salinity zone near and at the estuary, the nutritional restriction index suggests there are no restrictions on the Tallo river, little or no limits on the pagkep river, and extensive limits on the Tallo River estuary, especially for I '. Observations and information from this literature are summarized as a conceptual model of estuary's chemical and biological structure.

The diversity index values (H), uniformity (E) and dominance (C) of zooplankton are presented in T. The values of H, E, and C range between 1.55-2.02; 0.59-0.72; and 0.20-0.38. The highest diversity, uniformity, and dominance index values are in Groups I, II, and IV, respectively.

4. CONCLUSION

From this study it can be concluded that the composition of phytoplankton species in the estuary region consists of 5 divisions, namely Cyanophyta, Clorophyta, Desmidiacae, Xanthophyta and Pyrophyta. Based on salinity zoning the results obtained indicate that the Clorophyta division dominates the phytoplankton community in all zones. There is no difference in the composition of the phytoplankton division in estuary and middle waters, however the number of species tends to increase in the middle region. The results showed that the abundance of phytoplankton decreased with the decrease in salinity gradient. Based on the value of the Dominance Index it can be concluded that there are no dominant species in all sampling locations. In general it can be said that the Phytoplankton Diversity Index in the estuary region of the Tallo river is relatively high. Between Stations 1 and 2 have a somewhat similar level of structure compared to other stations.

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