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Analysis of Fertility Rate and Water Quality in The Jeneberang River, Gowa Regency, Indonesia

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Abstract : This research aims to know fertility rate based on nitrogen, phosphate and eutrication content and water quality content along the Jeneberang River in Gowa Regency, Indonesia.

This research was conducted by taking samples at five observation stations in the waters of the Jeneberang River, Gowa Regency, Indonesia by measuring biological parameters, namely community structure and plankton abundance as the main parameter, while as a supporting parameter, the water quality parameters are physical and chemical parameters, namely temperature, pH, dissolved oxygen, nitrogen (N) and phosphate (PO₄). Data obtained from observations, presented in the form of tables and graphs and analyzed by descriptive analysis.

Keywords : Fertility, Water Quality, Jeneberang River, Plankton.

Introduction

Naturally, rivers can be polluted only on the surface of the water, on a large river with heavy water flows, a small amount of contamination material will undergo dilution so the pollution level is very low. This causes the consumption of dissolved oxygen needed by aquatic life and biodegradation will be updated quickly, but sometimes a river experiences heavy pollution so that the water contains contamination material one of which is phosphate¹¹. The Jeneberang River is one of the rivers located in Gowa Regency, Indonesia has a length of 75 km with a watershed area of 727 Km² and sourced from Mount Bawakaraeng at an elevation of +2,833.00 MSL10.

The potential for future Jeneberang river pollution is far greater compared to now, because the population of Gowa Regency increases every year, especially those in the outskirts of the Jeneberang river and residents living on the riverbank dispose of domestic (domestic) waste into the Jeneberang river. In addition there are mining industries, tofu factories, agriculture, and traditional markets along the Jeneberang River which will affect water quality¹⁷.

Water quality criteria, is it still feasible to use or not, in the sense that water quality is used to know whether the water is safe enough to be consumed or used for certain activities²³. River water quality is affected by the quality of water supplies originating from the catchment area while the quality of the water supply from

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the catchment area is related to human activities in it ²⁹. Changes in water quality conditions in river flow is the impact of waste from existing land use ²⁶. The rate of turbidity that occurs at the mouth of the river very high, thus causing the availability of nutrients that are spread unevenly and penetration of light entering the waters will reduce and greatly affect phytoplankton activity in photosynthesis ¹.

Changes in land use patterns into agricultural land, fields and settlements and increased industrial activity will have an impact on hydrological conditions in a watershed. In addition, various human activities in fulfilling their daily needs originating from industrial, household and agricultural activities will produce waste that contributes on decreasing river water quality ²⁴. Characteristics of waters from biological aspects, in this case the phytoplankton community is important to know as a basis in determining waters management ¹. Inside the river live various plankton which all have benefits. Plankton is a small organism whose life is carried away by the current and consists of creatures whose lives are animals (zooplankton) and as plants (phytoplankton).

This research aims to know fertility rate based on nitrogen, phosphate and eutrofication content and water quality content along the Jeneberang River in Gowa Regency, Indonesia.

Method

The study was conducted in May-July 2018 with sampling at five observation stations namely Station 1. the location is near the rice plant area near Malino (upstream river), Station 2, location around the Bili-bili Dam in Gowa Regency, Station 3 location of the twin bridges Sungguminasa in Gowa Regency, Station 4 location of the Jeneberang River Estuary and Station 5, location around Losasi Beach, Makassar City.

Sampling is done at 5 stations starting at 08.00-finish. This research was conducted by measuring biological parameters namely the identification and abundance of plankton as the main parameter, while as a supporting parameter is the water quality parameter in the form of physical and chemical parameters along the Jeneberang River to Losari Beach of Makassar namely temperature, pH, dissolved oxygen (DO), nitrogen (N) and phosphate (PO₄). Sampling is done horizontally. Plankton sampling was carried out twice during the research, while the measurement of water quality is done once a week for 5 times. Analysis of water samples done at Soil Laboratory and Marine Science Laboratory of Hasanuddin University. To identify plankton species using literature ⁹, plankton abundance is calculated based on APHA 3. Data obtained from observations, presented in the form of tables and graphs and analyzed by descriptive analysis.

Results and Discussion

Water fertility Rate

Total Nitrogen (ppm)

In nature, nitrogen is present both in air, sea and land. Besides that, nitrogen is a basic requirement for all organisms, because nitrogen is needed in synthesizing complex protein molecules and affect the growth and reproduction of these organisms. Some of these nitrogen sources include agricultural, chemical, textile, leather, food and forestry industries ²⁵.

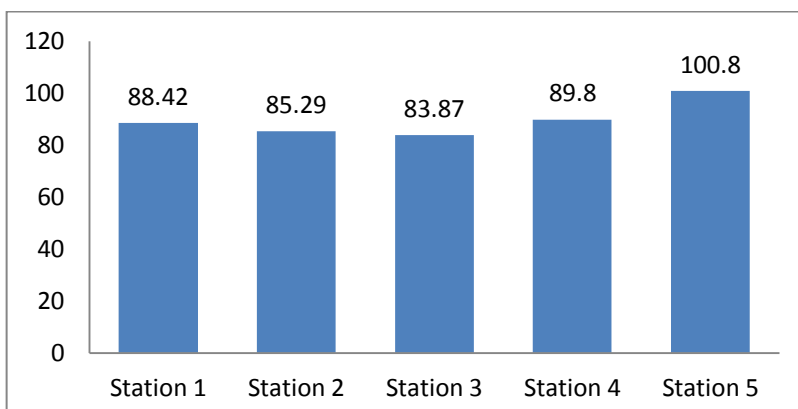


Figure 1. Water Nitrogen Content of Each Observation Station

In Figure 1 shows that the nitrogen content at 5 observation stations the highest is obtained at station 5 which is a station that is around Losari Beach Makassar, and the lowest nitrogen value is located at observation station 3 namely the location around the Sungguminasa Twin Bridge in Gowa Regency. High nitrogen content at station 5 presumably because station 5 has been connected directly to sea water at Losari Beach of Makassar. The concentration of nitrogen compounds contained in seawater varies, dependent from a distant nearby from sources of abundant nitrogen compounds²⁵.

Phosphate (ppm)

Phosphorus is an essential ingredient for higher plants and algae, thus greatly affecting the level of productivity of the waters. Phosphates are found in natural water or waste water as orthophosphate, polyphosphate and organic phosphate compounds. In the agricultural area orthophosphate comes from fertilizer which enter into rivers or lakes through drainage and rainwater flow¹¹.

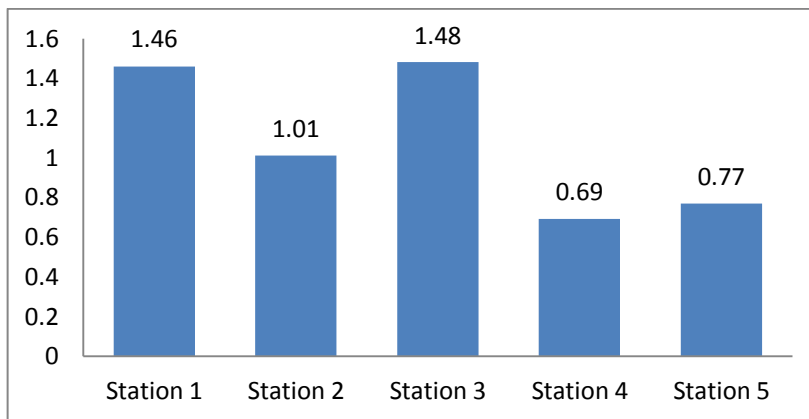


Figure 2. Phosphate content of water at each observation station

The results of the study (Figure 2) show the highest phosphate content obtained at station 3 which is the location around the Gowa Regency Twin Bridge of 1.48 ppm, followed by station 1 which is the location upstream of the Jeneberang River which is adjacent to agricultural land of 1.46 ppm, and the lowest is at station 4, which is adjacent to the river estuary by 1, 01 ppm. The high phosphate content at station 3 allegedly because there are many home industries in that location, while the high phosphate content at station 1 allegedly because the location is adjacent to agricultural land where excess fertilizer in agricultural paddy fields will flow to the Jeneberang river.

The phosphate content in this research is greater than the research conducted by previous researchers who also conducted research on the Jeneberang River Estuary with the average concentration of phosphate content obtained ranged from 0.22 ppm to 0.26 ppm⁵. While in this research phosphate content found at the Jeneberang River Estuary (Station 4) an average of 0.69 ppm. Thus in a period of 8 years there has been an increase in the number of phosphate content in the Jeneberang River Estuary 3 times.

Based on water fertility criteria based on phosphate content it can be said that the waters around the mouth of the Jeneberang River has a very high fertility rate and phosphate content with such concentration suitable for marine tourism and the survival of marine life¹⁶. The value of 0.015 ppm phosphate is suitable for marine tourism and marine biota¹⁶.

Eutrophication

In Figure 3 shows the eutrophication value of the Jeneberang River during the research. Figure 3 also shows the highest eutrophication value at station 1 of 1471 mg/m³, and the lowest at station 4 is 878 mg/m³. The high value of water eutrophication at station 1 because the observation station is near to agricultural land that has a high fertility rate.

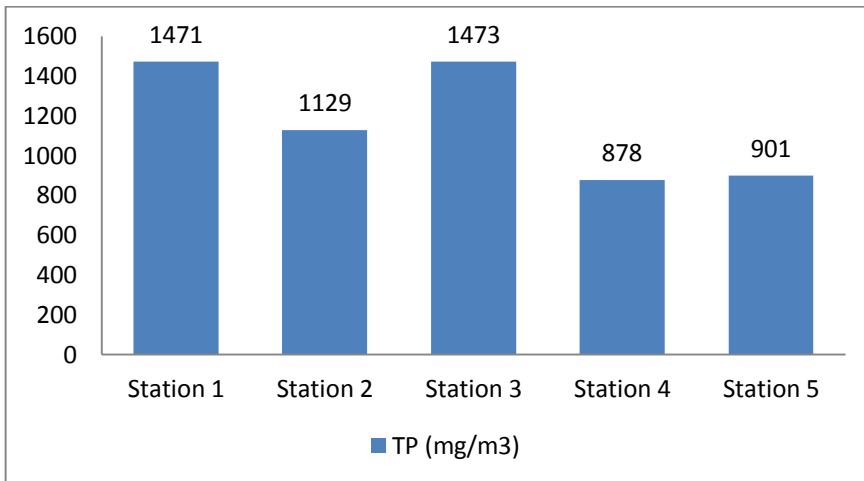


Figure 3. Value of Eutrophication of Water in Each Observation Station

Identification of Phytoplankton (cell / ml)

Characteristics of waters from biological aspects, in this case the phytoplankton community is important to know as a basis in determining water management because in the area there are many farms which uses river water as cultivation land ¹.

In Figure 4 shows that during research at station 1 The only known species of phytoplankton are species of *Rhizosolenia* sp., while the phytoplankton species *Leptocylindricus* sp. found on all observation stations but most are found at station 4, in *coscinodiscus* sp species also found on all stations with the highest number found at station 2, *Biddulphia* sp. species only found at station 1 and station 2 with the highest number at station 1, species *Peridinium* sp. only found on all station 2.

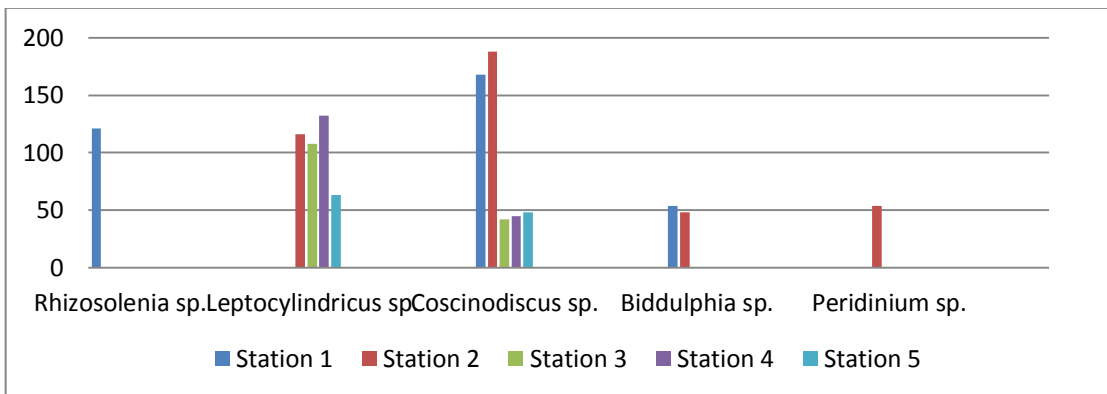


Figure 4. Phytoplankton species of each observation station

The results of research conducted by previous researchers who conducted the research in the coastal waters of the Madura Strait in Bangkalan Regency indicates that the water column is stirred due to sediment resuspension has a high turbidity value so there are limitations to the light in the water column in supporting the photosynthesis process and affect the distribution of phytoplankton in the waters column ¹.

Abundance of Phytoplankton

Certain composition and abundance of phytoplankton in a waters very important role as natural food on the tropical level above, also acts as a provider of oxygen in the waters. Factors that affect the abundance of phytoplankton is a low level of water brightness due to the high suspended material ¹. The abundance of phytoplankton during the research at 5 stations can be seen in Figure 5.

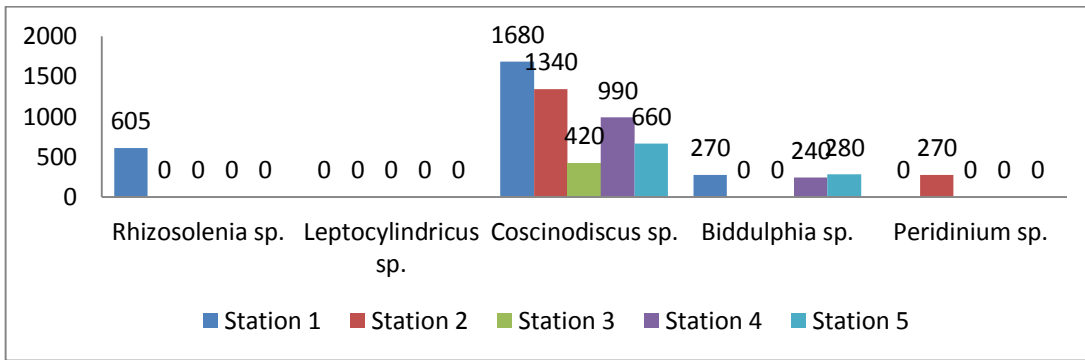


Figure 5. Phytoplankton species of each observation station

In Figure 5 shows that the abundance of phytoplankton species *Rhizosolenia* sp. amounting to 605 cel/ml and only found at station 1, *Leptocylindricus* sp. not found on all stations, species of *Coscinodiscus* sp. found at all stations but the highest abundance was found at station 1 of 1680 cel/ml, the highest *Biddulphia* sp. at station 5 is 280 cel/ml, species *Peridinium* sp. only found at station 2 with an abundance of 270 cel/ml.

Zooplankton identification

Given the important role of zooplankton in the waters, then the balance of the ecosystem in the waters needs to be maintained no exception to the waters of the Je'neberang river. One of the efforts made is to maintain the diversity of zooplankton ¹³.

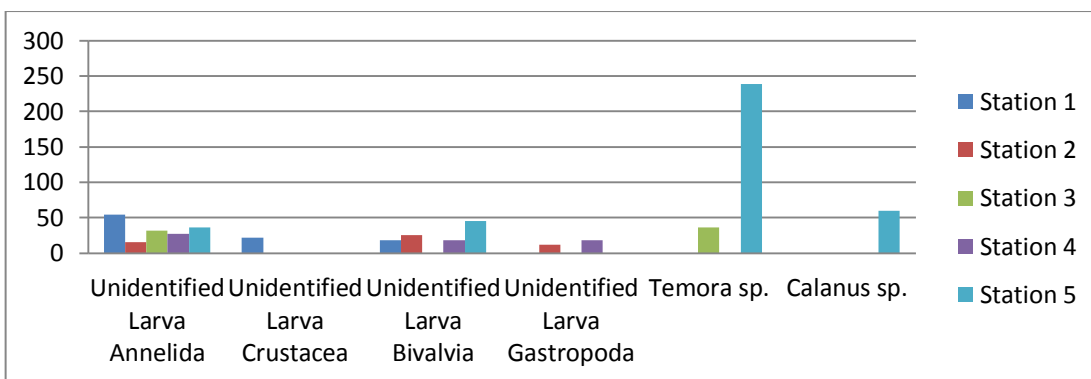


Figure 6. Zooplankton Species of Each Observation Station

Observations in this research showed that there were 6 zooplankton species found for all observation stations. Unidentified annelid larvae were found in all observation stations, Unidentified crustacean larvae were only found at station 1, Unidentified bivalve larvae were found in 4 observation stations namely stations 1, 2, 4 and 5, Unidentified gastropod larvae are only found in stations 2 and 4, *Temora* sp. Species. found in stations 3 and 5, as well as species of *Calanus* sp. only found at station 5.

Like the Je'neberang River whose land around the riverbank has been used for settlements and other activities namely agriculture, industry, offices and trade. Activities on the land generally emit waste and produce waste that is directly thrown into river waters so that the entry of pollutant sources causing a decrease in water quality. The level of waste pollution in the Je'neberang River is getting worse, and the use of water can directly affect the condition of human health and aquatic biota ¹³.

Zooplankton is heterotrophic, is a biota that is very important role in the food chain in an ecosystem. Zooplankton is the main key in energy transfer from major producers to consumers at the first level in ecological tropics. In addition, zooplankton is also useful in regenerating nitrogen in the oceans with its decomposition process making it useful for bacteria and the productivity of phytoplankton in the sea.. Another important role is to facilitate the absorption of carbon dioxide (CO₂) in the waters ¹³. Zooplankton plays a role in the distribution of CO₂ from the surface into sediments on the seabed ²¹.

Zooplankton abundance

Abundance and biomass or amount (weight of zooplankton is an important biological in the waters). This is closely related to daily changes and seasonal fluctuations where abundance and zooplankton distribution can also be used for secondary production estimates, so that the presence of zooplankton can be used as an indicator of waters productivity¹⁹.

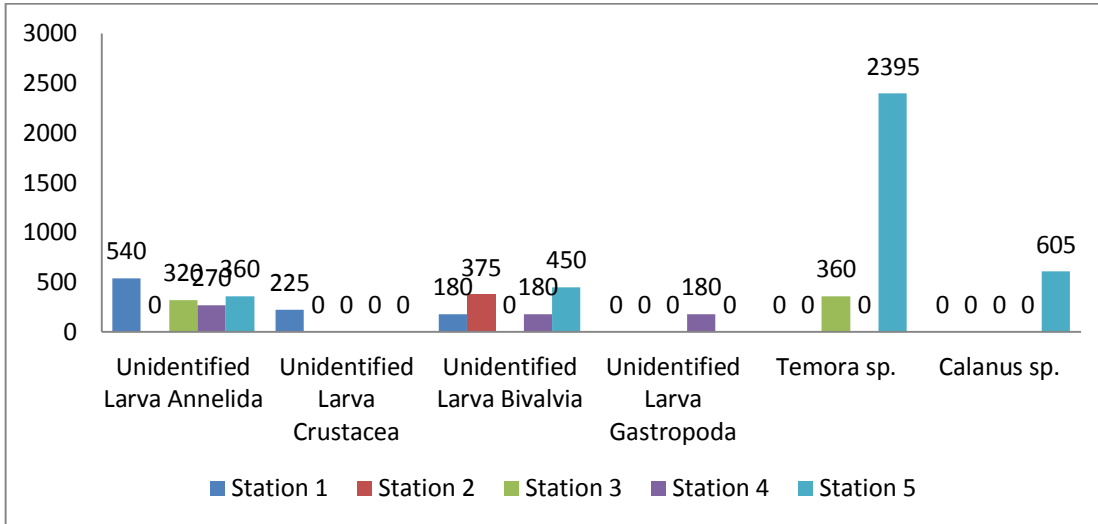


Figure 7. Zooplankton abundance of each observation station

The results showed that Unidentified annelid larvae and Unidentified bivalve larvae had the highest abundance at station 1, Unidentified bivalve larvae have the highest abundance at station 5, Unidentified gastropod larvae are found most abundantly at station 4, while *Temora* sp. and species *Calanus* sp. found most abundantly at station 5 (Figure 7). The high abundance of Unidentified bivalve larvae, *Temora* sp and *Calanus* sp. at station 5 it is suspected to be caused by station 5 is a location around Losari Beach which is a coastal location. The abundance of zooplankton follows the abundance of fithoplankton because fhytoplankton is the main food for zooplankton which is high enough to provide an opportunity for zooplankton to get enough food⁴.

Analysis of Water Quality

Water is part of life on the surface of the earth, both groundwater and surface water. Water as material that is essential for life on earth is used for various life activities. Based on its designation, it is expected that the quality of water in the river is still within the limits of tolerance. Water quality criteria, is it still feasible to use or not, in the sense that water quality is used to find out whether the water is safe enough to be consumed or used for certain activities²³.

pH

The pH value is an important factor in the waters because the pH value in water will determine the nature of the water to be acidic or basic which will affect biological life in the water. Changes in acidity of water, both in the direction of alkalis and acids, will greatly disrupt the lives of fish and other aquatic animals. The degree of acidity is an important factor in the water treatment process for improving water quality¹⁵.

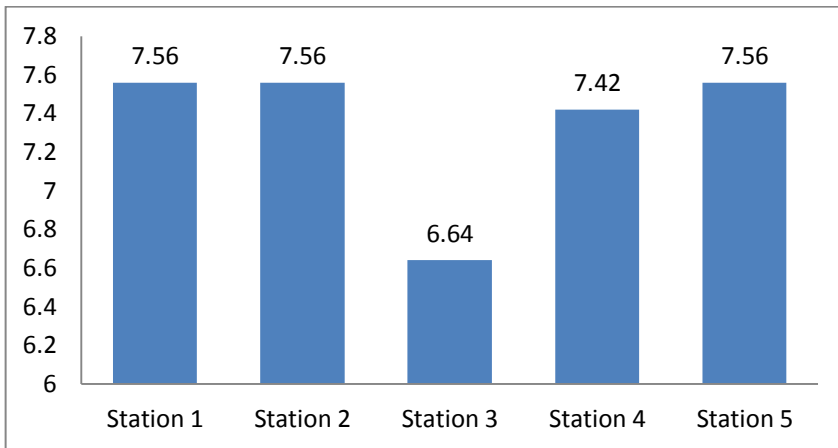


Figure 8. Water pH value of each observation station

Based on Figure 8 shows that the pH of the Jeneberang River water during the observation is in the range of 6.64 to 7.56, with the highest water pH at stations 1, 2 and 5, and the lowest pH at station 3 are 6.64. The pH range that is suitable for aquatic organisms is not the same depending on the type of organism⁸. Water pH that is suitable for the growth of aquatic organisms ranges from 6-9¹⁸. Most aquatic biota are sensitive to changes in pH and like pH around 7-7.5¹².

Thus it can be said that the pH value of water for the growth of organisms in the Jeneberang River is still feasible for the life of aquatic organisms. pH conditions can affect the level of toxicity of a chemical compound, aquatic biochemical processes, and metabolic processes of aquatic organisms. If the pH value of 6-6.5 will cause the diversity of plankton and animals microbenthos will decrease²⁷. Fish that live in waters with a high pH value (alkaline) have a higher ammonia content in the body compared to fish that live in neutral waters.

Dissolved Oxygen (ppm)

Oxygen content in waters is closely related to the presence of nitrogen in these waters. Nitrogen cycles that occur in a body of water sometimes consume the most dissolved oxygen compared to other biochemical reactions that occur in water⁶. Nitrogen affects the level of oxygen in the water, it can also be seen other water quality problems that occur.

This is shown in Figure 1 where the highest nitrogen content is obtained at station 5, while at station 5 the oxygen content is the lowest. In Figure 2 shows that the highest oxygen content occurs at station 4 are 7.56 ppm followed by station 2 are 7.36 ppm and the lowest at stations 1 and 5 at 5.72 ppm. The oxygen content in this study is greater than the results of research conducted by previous researchers who conducted research at the Porong River Estuary with dissolved oxygen values of 2.1-6.5 ppm¹. The life of fish and most other aquatic organisms can still live properly if the water dissolved oxygen content is greater than 3 ppm²⁸.

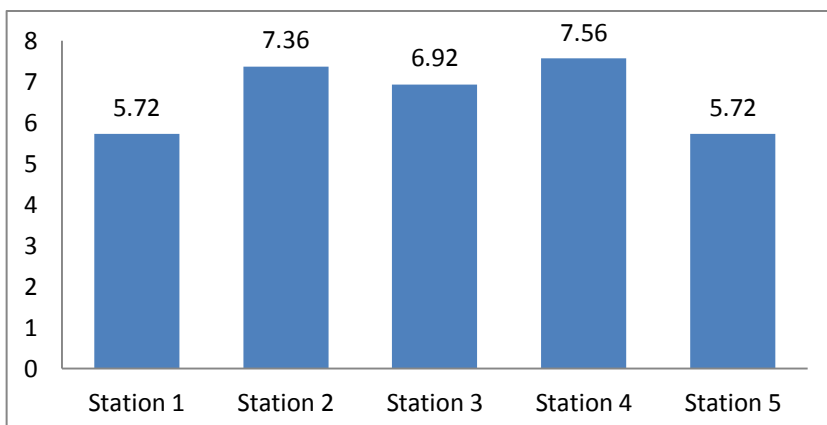


Figure 9. Dissolved Oxygen Value of Each Observation Station

Dissolved Oxygen (DO) in water is needed to support the life of organisms in it ²². The main source of Dissolved Oxygen is photosynthesis, besides that the characteristics of the river also affect the presence of Dissolved Oxygen ². The relatively flat river characteristics show a relatively calm flow pattern and no turbulence will reduce the process of reaerating air into water reduced so that the process of diffusion of oxygen into river water was not optimal ¹⁴.

Temperature (°C)

Temperature affects chemical and biological reactions that occur in water ²². In Figure 10 shows that the water temperature on the Jeneberang River during the research is in the range of 28.6-29.2°C, with the highest average temperature at station 1 and station 5 each at 29.2°C. The results of this study are still lower than the results of research conducted by previous researchers who conducted research at the Porong River Estuary where temperatures were obtained from 29-32°C ¹. In addition, the temperature of river water is a limiting factor for aquatic organisms ⁸. For aquaculture for fish life in tropical waters, optimal temperatures are needed ranging from 28 - 32°C ¹⁵.

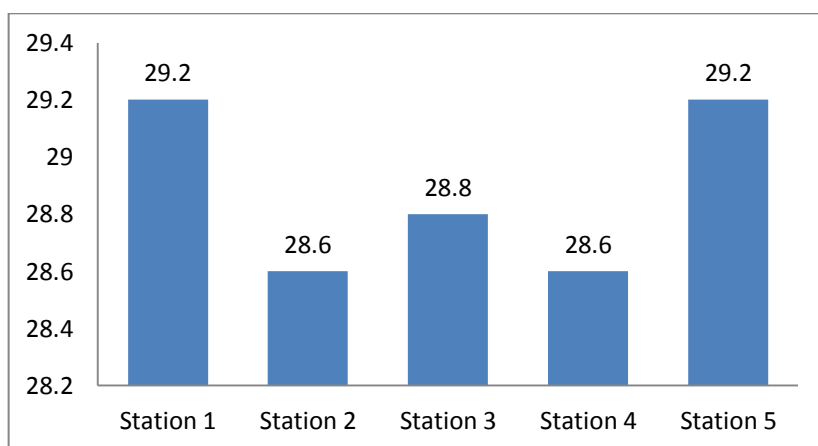


Figure 10. Value of Water Temperature of Each Observation Station

Conclusion

Based on the level of fertility, the Jeneberang River, Gowa Regency, Indonesia including fertile which has high phosphate, nitrogen and eutrophication. Water nitrogen content is in the range of 83.87-100.8 ppm, phosphate water content 0.69-1.48 ppm, and eutrophication between 878-1473 mg/m³. Phytoplankton and zooplankton are quite available and abundant at almost every observation station. The results of observations of water quality indicate that the pH of water is quite high ranging from 6.64 to 7.56, Dissolved oxygen is very good in the range of 5.72-7.56 ppm and the water temperature is in the range of 28.6-29°C which means it is quite good.

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