Analysis of the quality of the coastal substrate of Awarange Beach, Barru Regency, Indonesia

ABSTRACT

The study aims to determine the quality of the coastal substrate of Awarange Beach, Barru Regency, Indonesia. The research was conducted from July to August 2024 on the coast of Awarange Beach, SoppengRiaja District, Barru Regency, Indonesia. Soil sample analysis was carried out in the Chemistry and Water Laboratory of the Pangkep State Agricultural Polytechnic. This study uses a substrate quality survey method on the Awarange coast of Barru Regency. Determination of substrate quality refers to the chemical and physical properties of each location. Analisis data yang digunakandalampenelitianiniuntukmelihat pH, konsentrasinitrit (NO2), ammonia, nitrogen total dan teksturs ubstrat. Setelah mendapatkanhasilpengukuran, selanjutnyadilakukandengananalisisdeskriptif. The results of the study by measuring the quality of the substrate at three research locations, namely ST 1, La Sonrai recreation beach, Barru Regency; ST 2, which is the location around the Awarange shipyard, Barru Regency; and ST 3, which is the location near the Barru Regency Port, showed that the pH value, nitrogen, organic matter, ammonia (NH_3), and nitrite (NO_3) were all in good condition and were not classified as polluted. Furthermore, all research locations had a sandy substrate texture.

1. INTRODUCTION

Coastal areas are transitional areas between land and sea, with parts of the sea still influenced by land activities such as sedimentation and freshwater currents and parts of the sea influenced by marine activities such as tides, sea breezes, and salinity (Akbar &Pratiwi, 2023). These conditions cause coastal areas to experience pressure from various activities and phenomena on land and at sea (Pinto, 2015). Phenomena that occur on land include abrasion, flooding, and activities carried out by the community, namely the construction of settlements, deforestation for rice fields, construction of ponds, and so on, which ultimately have an impact on the coastal ecosystem. Likewise, phenomena at sea, such as sea tides, storm waves, and so on (Hastuti, 2012).

In general, coastal community activities include economic activities in the form of fisheries that utilize land, water, and open sea; tourism and recreation activities that utilize land, water, and underwater objects; marine transportation activities that utilize land and space allocation in the sea for shipping lanes, port pools and others; industrial activities that utilize land; mining activities that utilize land and sea; energy generation activities that use land and sea; maritime industry activities that utilize land and sea, settlements that utilize land for housing and public service facilities; and agricultural and forestry activities that utilize land (Pinto, 2015). Coastal damage is more influenced by natural and human factors (Gumilar, 2012).

The potential of natural resources in coastal areas must be supported by the management of the utilization of natural resources and environmental services in coastal areas, by conducting a comprehensive assessment of coastal areas and the natural resources and environmental services contained therein, determining the objectives and targets of utilization, and then planning and managing all utilization activities, in order to achieve optimal and sustainable development in a comprehensive and integrated manner

(Lubis, 2014). In addition, coastal and marine areas are also used for aquaculture (marine cultivation), recreation and tourism, agro-industry, transportation and ports, industrial development, settlements, and also as waste disposal sites (Lubis, 2014). Basically, the existence of industry can have positive and negative impacts on the development of the surrounding area (Rahayuningsih, 2017). Lack of coastal area management, inappropriate use of resources, lack of environmental standards, and lack of balance between tourism activities and physical space cause coastal damage due to tourism activities to worsen (Shafei& Mohamed, 2012).

Problems that threaten the sustainability of water resources are activities in the upstream areas of rivers, such as agriculture, plantations, industry, and settlements, that continuously have a significant impact on river ecosystems. Pollutants produced by each activity will be carried by river currents to the downstream areas, then accumulate in the estuary area so that the area around the estuary often contains quite high levels of pollutants (Prianto et al., 2010). Due to the pressure on water in coastal areas, it is possible that it will also have an impact on the substrate in coastal areas. Various efforts that are considered to be able to reduce the risk with various activities on the coast are planting mangroves. However, the utilization of mangroves that has occurred without paying attention to the composition of the vegetation must be restored through appropriate management methods, including selecting the right types of mangrove vegetation for the substrate, planting, conservation, and so on (Masruroh&Insafitri, 2020). According to Arief (2003), one of the supporting factors for maintaining high mangrove vegetation composition is mangrove substrate. Substrate is a place where mangrove roots can grow. Substrate is the main limiting factor for mangrove growth and distribution (Budiman, 1991).

Specifically for the Awarange coast, various activities have been carried out to support the community's economy, including coastal tourism, where there are tourism activities around the coast that also contains mangrove trees. According to Pinto (2015), tourism activities in coastal areas have the potential to be developed both in relation to natural and artificial tourism. Tourism and environmental activities are interrelated because they involve many tourism activities that will have an impact on the environment, economy, and physical and social aspects (Shafei& Mohamed, 2012). However, the coastal area is an area that is vulnerable to damage due to tourism activities. In addition, around it there is also a port called Awarange port where many ships sail and anchor. According to Lubis (2014), a port is a network system that is interconnected between one variable and another; increasing port activity will cause major changes in the port system, resulting in the need for port effectiveness and efficiency becoming increasingly urgent to be met immediately. Even around the harbor there has been a shipyard. These three factors are the basis for the need to conduct research on the condition of the basic substrate of the waters around the Awarange coast.

2. METHODS

2.1 Research Location

The research was conducted from July to August 2024 on the coast of Awarange Beach, SoppengRiaja District, Barru Regency, Indonesia. The sediment sampling process was carried out at 3 different locations. Location 1 (ST 1.) is the La Sonrai tourist spot, where there are also several mangrove trees around it; location 2 (ST 2) is a location located around the Awarange shipyard, and location 3 (ST 3.) is a location located around the Awarange

Port, where there are many ship loading and unloading activities, both government ships (Pelni) and private ships and fishermen. Analysis of soil samples was conducted in the Chemistry and Water laboratory of the Pangkep State Agricultural Polytechnic. This study used a substrate quality survey method on the Awarange coast of Barru Regency. Determination of substrate quality refers to the chemical and physical properties of each location.

2.2 Data Collection Methods

Soil sampling was conducted using systematic sampling techniques because the topography of the research location is flat (Suganda, 2006). Substrate sample analysis in the laboratory was conducted to determine pH, nitrogen, organic matter, NH_3, NO_2, and soil texture.

2.2.1. pH

Soil pH measurement was carried out by weighing 10 grams of soil sample, which was put into a shaker bottle. Then 50 ml of ion-free water was added to the bottle and then shaken with a shaker for 30 minutes, and then the soil suspension was measured with a pH meter that had been calibrated using a pH buffer solution of 7.0 and 4.0, and then the pH value was reported in 1 decimal (Prayitno et al., 2016).

2.2.2. Nitrogen

Total nitrogen content was measured using the indophenol method by titration (SNI 4146-2013). A sample of 10 g of pond bottom substrate, ±10 g of catalyst, and 35 ml of concentrated H_2SO_4 from each were put into a Kjeldahl flask. Then the heating process was carried out at a temperature of 400°C for 30 minutes. The solution was then cooled, and then 300 ml of distilled water was added. The cooling process was collected into 50 ml of H3BO3 solution and put into a 250 ml Erlenmeyer flask. After that, the distillate was titrated with 0.1 N H_2SO_4 solution using a mixture indicator until it turned violet. Furthermore, the total nitrogen content was calculated using the formula (Nadapdapa et al., 2020):

$$\text{Kadar nitrogen (\%)} = \frac{((a1 - a2) x n x 14)}{c} x100\%$$

Where :

a1 : is the average 0.1 N H_2SO_4 standard used in the sample titration (ml)
a2 : is the average 0.1 N H_2SO_4 standard used in the blank titration (ml)
n : is the normality of H_2SO_4 (g/L)
14 : is the atomic weight of Nitrogen

2.2.3. Total Organic Matter (BOT)

Total organic matter in water in this study was measured using the titrimetric method (SNI 06-6989.22-2004). A 100 ml water sample was put into a 250 ml Erlenmeyer flask, and then a few drops of KMnO4 were added until it turned slightly bluish. After that, 10 ml of 4N H2SO4 solution was added. Furthermore, the mixed solution was then heated using a hotplate until boiling, and then 10 ml of 0.01 N KMnO4 solution was added. The solution was then boiled for 10 minutes at a temperature of 105 °C, then 10 ml of 0.01 N oxalic acid solution $H_2C_2O_4$ was added and boiled again until the red color disappeared. The solution was then titrated with 0.01 N KMnO4 solution in a hot state until a pink color was formed (Rahman et al., 2022).

2.2.4. Ammonia (NH_3)

Ammonia measurement begins with the process of extracting ammonia from sediment samples. This process is carried out by taking a sediment sample of 2.5

grams, which is then added with 7.5 ml of 1M KCL solution. After that, the mixture is agitated using a vortex until homogeneous. Take 2 ml of the vortex results into a tube for centrifuge. Furthermore, the ammonia measurement process will be carried out on the suspension of the agitation results. The suspension (1 ml) was mixed with the reagent solution from the Salifert Ammonia Test Kit and waited for 2 minutes. Then, the absorbance value will be measured using a spectrophotometer using a light wavelength of 400 nm (Tinambunan et al., 2022).

2.2.5. Nitrate (NO_3)

Determination of nitrite levels was carried out using the spectrophotometer method (SNI 06-6989.9-2004). In an acidic environment (pH 22.5), nitrite will react with sulfanilamide (SA) and N-(1-naphthyl) ethylene diamine dihydrochloride (NED dihydrochloride) to form a purplish red azo compound that can be measured at a wavelength of 543 nm (Putri et al., 2019).

2.2.6. Substrate Texture

The method used to see the soil fraction is to provide a 100 mL beaker; soil samples are taken with a depth of 30 cm as needed, soil samples are put into the beaker, given enough water until it approaches the mouth of the bottle, and then homogenized. Placed on a flat place, after 1 minute, observations and measurements are made on the first layer (sand layer), and then the results of the observations are recorded. The sample is left for another 2 hours; after 2 hours, observations and measurements are made on the second layer (mud layer) and the third layer (clay layer). The results of the observations are then recorded, and the percentage of sand, mud, and clay fractions is calculated (Chrisyariati et al., 2914).

Data analysis was used in this study to see pH, nitrite concentration (NO_2), ammonia, total nitrogen, and substrate texture. After obtaining the measurement results, this analysis was carried out using Microsoft Excel 2013, and the data obtained were presented descriptively in the form of graphs, which were then analyzed as a basis for drawing conclusions.

3. RESULTS AND DISCUSSION

3.1. pH

Figure 1 shows that the lowest average substrate pH value is at location 3 (ST 3), which is the location around Awarange port with an average substrate pH value of 8.34, followed by location 2 (ST 2), which is the location around the shipyard, which is the average substrate pH value of 8.39, and the highest average substrate pH value is at location 1 (ST 1), which is the location that is the La Sonrai tourism recreation area with an average value of 8.61. All locations have an average substrate pH value between 8.34-8.61, which means that the substrate pH is in the basic category.

The high pH value of the substrate around the research location is thought to be caused by all locations having a substrate base in the form of coral. According to Chrisyariati et al. (2014), the degree of acidity (pH) of waters is greatly influenced by the decomposition of soil and the bottom of the waters as well as the condition of the surrounding environment. High pH levels can cause an increase in the concentration of toxic ammonia (Tinambunan et al., 2022). Furthermore, alkaline pH will reduce the solubility of micronutrients. P nutrients cannot be available to plants because of precipitation in solid carbonate. To reduce soil pH, sulfur can be used (Setyobudi, 1993).

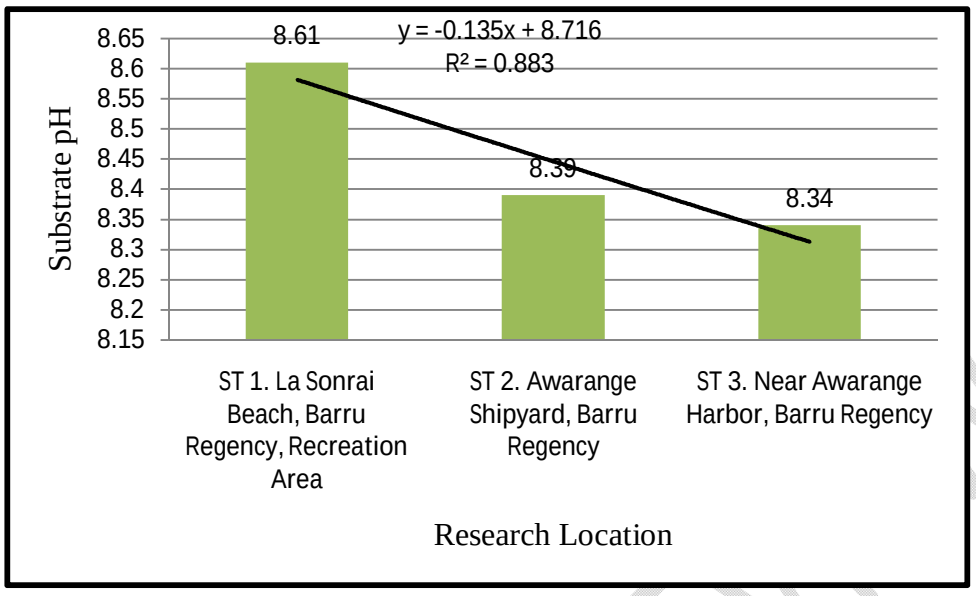

Figure 1. Substrate pH at the research location

3.2. **Nitrogen (%)**

Figure 2 shows that the nitrogen value in the substrate at the research location is in the range of 0.108-0.129, and the highest substrate nitrogen is at ST 2, namely 0.129, namely the substrate located around the Awarange shipyard, and the location with the lowest substrate nitrogen content is ST 3, namely the substrate located around the Awarange port in Barru Regency.

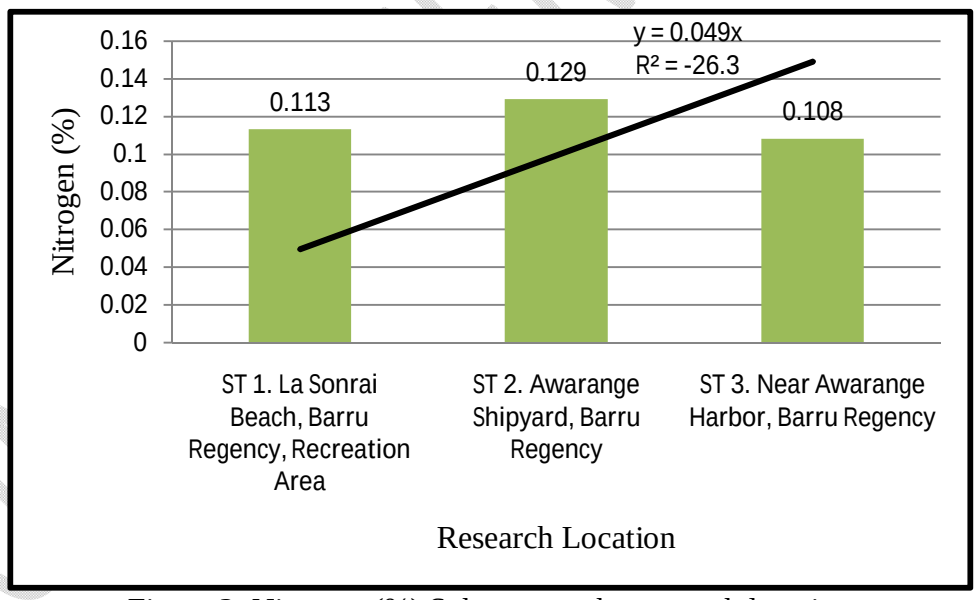

Figure 2. Nitrogen (%) Substrate at the research location

Another factor that causes low nitrogen content in the soil is the presence of excessive water in the soil so that nitrogen will undergo a denitrification process (Prayiko et al., 2016). Denitrification is the process of changing nitrate and nitrite into N_2 and N_2O gas, which will return to the atmosphere (Poerwowidodo, 1993). The low total N value in the soil, apart from the above factors, is also influenced by leaching that occurs in the soil. Bacteria play an active role in the process of breaking down organic materials such as carbon and nitrogen because these elements are a source

of energy and nutrients that are very much needed by bacteria in the formation of enzymes to carry out metabolism (Suprapto et al., 2017).

3.3. **Organic Materials (%)**

Organic matter is a material that stabilizes soil aggregates and is a source of plant nutrients, as well as a source of energy and food for soil microorganisms (Patti et al., 2013). Figure 3 shows that the organic matter content of the substrate at the research location is in the range of 0.39-1.04%, with the lowest organic matter content of the substrate at ST 2, namely the location around the Awarange shipyard, Barru Regency, namely 0.39, followed by ST 2, namely the location around the Awarange port, Barru Regency, namely 0.63, and the location with the highest organic matter content of the substrate is ST 1, namely the location on the beach of the La Sonrai recreation area, Barru Regency, namely 1.04%.

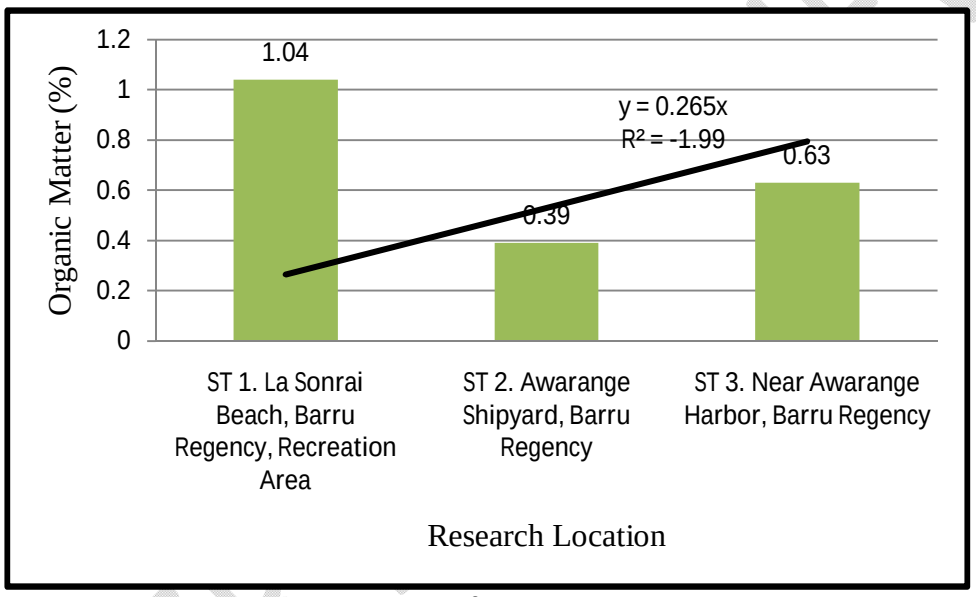

Figure 3. Organic Matter (%) of Substrate at the research location

Organic matter is a collection of various complex organic compounds that are undergoing or have undergone a decomposition process, either in the form of humus resulting from humification or inorganic compounds resulting from mineralization, including heterotrophic and autotrophic microbes that are involved and present in it (Hardjowigeno, 2003). Organic matter in sediment is composed of sedimentation results influenced by conditions during the sedimentation process. Conditions with the presence of oxygen will reduce the amount of organic compounds that precipitate due to further degradation of organic matter in the water column. The amount of organic matter that will be deposited is also closely related to primary productivity, waves, currents, and the presence of predators and decomposers (Killops and Killops, 1993). Organic matter is one indicator of the fertility of the aquatic environment. Organic matter in certain amounts is needed by waters, related to its function as a provider of nutrients for bacteria and phytoplankton in the waters (Marwan et al., 2015). The largest source of organic matter in the sea comes from land (Nybakken, 1992). The speed of bacteria in decomposing organic matter depends on the increase in organic matter levels in the substrate; the higher the organic matter available, the more the decomposition process will also increase (Nadapdapa et al.,

2020). Hanafiah&Kemas (2005) stated that increasing organic matter in the soil will also increase N in the soil.

3.4. **Ammonia (ppm)**

Ammonia (NH_3) is one of the inorganicnitrogens that is soluble in water (Connell and Miller, 1995). This compound comes from nitrogen, which becomes NH4 at low pH and is called ammonium. Ammonia in water comes from urine and feces, microbiological oxidation of organic substances, and from industrial wastewater and community activities (Putri et al., 2029). Ammonification is the process of forming ammonia from organic matter, which will then be converted into nitrate or nitrite through the nitrification process (Hastuti, 2011). Figure 4 shows that the ammonia (NH_3) content of the substrate at the research location is in the range of 0.0287-0.1005 ppm, with the lowest ammonia substrate content at ST 2, namely the location around the Awarange shipyard, Barru Regency, which is 0.0287 ppm, followed by ST 1, namely the location around the La Sonrai recreation beach, Barru Regency, which is 0.0329 ppm, and the location with the highest ammonia substrate content is ST 3, namely the location around the Awarange port, Barru Regency, which is 0.1005 ppm. Husnah (2010) found higher ammonia concentrations along the downstream Musi River, ranging from 0.63 to 3.09 ppm. It was further explained that the increase in ammonia concentration was caused by agricultural, plantation, industrial and residential activities around the area. The results of the study by Larasati et al. (2015) found that the concentration of ammonia in the Rupat Strait ranged from 0.092 to 0.724 ppm. According to Zhang et al. (2012), high concentrations of ammonia in waters can cause a decrease in dissolved oxygen, which can cause disruption of physiological and metabolic functions such as respiration.

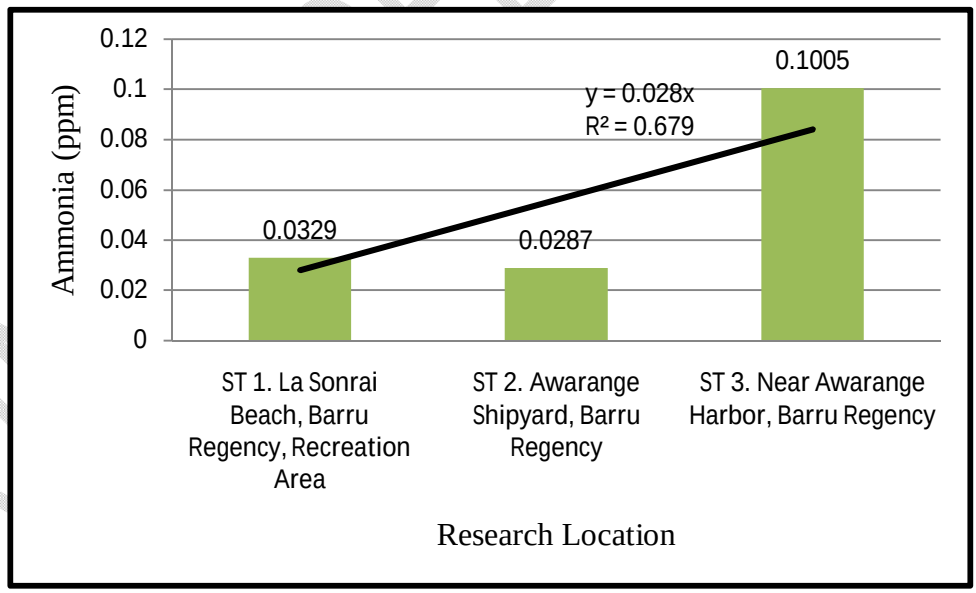

Figure 4. Ammonia (ppm) Substrate at the research location

When dissolved oxygen in the aquatic environment is low, ammonification will also slow down (Zhao et al., 2015). The ammonia content in mangrove sediments in TahuraNgurah Rai is known to be higher than the ammonia content in mangrove sediments in Perancak Bali (Susiana, 2015). The ammonia content in mangrove sediments in TahuraNgurah Rai is known to be higher than the ammonia content in

mangrove sediments in Perancak Bali (Susiana, 2015). The increasing levels of ammonia in the sea are related to the entry of organic matter that can be easily decomposed, both containing nitrogen and non-nitrogen elements (Tinambunan et al., 2022). In this ammonification process, organic matter will be converted into ammonia by a group of ammonifying bacteria (Iswantari et al., 2014).

3.5. Nitrite(ppm)

Nitrite (NO2) is an oxidized form of nitrogen with an oxidation number of +3 and is often found in wastewater treatment plants, river water, and drainage (Putri et al., 2019). Figure 5 shows that the nitrite (NO3) content at the research location is in the range of 0.0024-0.0029 ppm, with the lowest nitrite content at ST 1, namely the location around the La Sonrai recreation beach in Barru Regency, namely 0.0024 ppm, followed by location ST 3, namely the location around or near the Awarange port in Barru Regency, namely 0.0027, and the location with the highest nitrite content, namely ST 2, namely the location around the Awarange shipyard in Barru Regency, namely 0.0029 ppm. The Canadian Council of Ministers of the Environment (2008) states that natural waters generally contain nitrite of 0.001 ppm and should not exceed 0.06 ppm. Furthermore, Effendi (2003) states that in natural waters, nitrite is generally found in very small amounts due to its unstable nature due to the presence of oxygen.

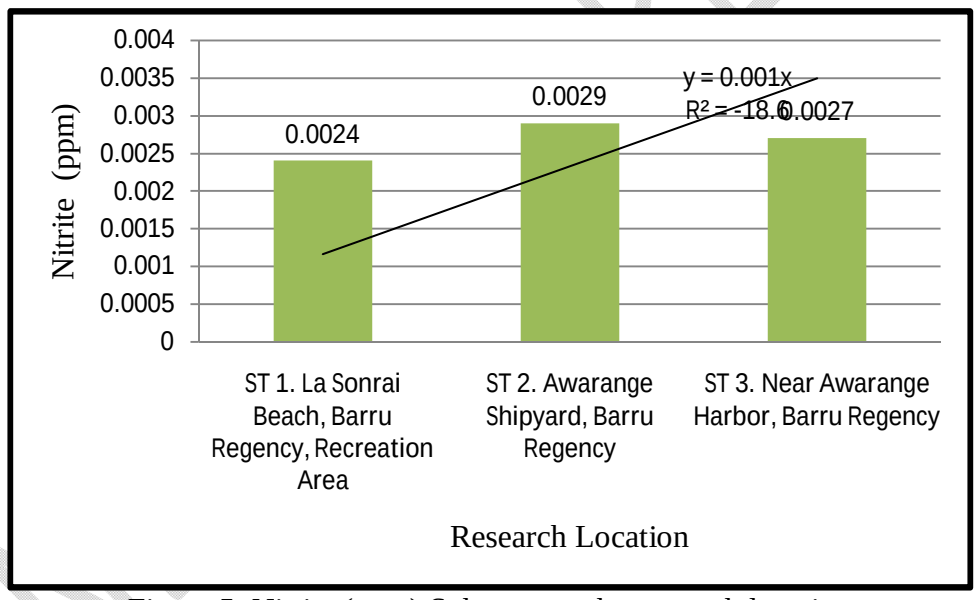

Figure 5. Nitrite (ppm) Substrate at the research location

As we know, nitrite is generally a transitional form between ammonia and nitrate and immediately changes into a more stable form, namely nitrate (Putri et al., 2019). However, nitrite is one of the key parameters in determining water quality because it is toxic when it reacts with hemoglobin in the blood, causing the blood to be unable to transport oxygen (Effendi, 2003). In the nitrification process and the ammonification process, it is very dependent on the presence of oxygen in the aquatic environment, because ammonification bacteria are aerobic bacteria that require oxygen to carry out their metabolic processes (Meirinawati, 2017). When oxygen in the environment is abundant, the ammonification and nitrification processes will also run smoothly (Iswantari et al., 2014). Because the high total bacteria indicate that there is a sufficient supply of

food (energy) and oxygen in the sediment (Tinambunan et al., 2022).

3.6. Substrate Texture

Table 1 shows that at the research locations, namely ST 1, La Sonrai recreation beach, Barru Regency; ST 2, Awarange shipyard, Barru Regency; and ST 3, near the Barru Regency Port, all locations have a sandy substrate texture. Sari et al. (2017) reported that the type of substrate found in river estuaries and rehabilitated mangroves was sandy substrate, while in natural mangroves it was muddy substrate. The three locations have a sandy texture, presumably because all locations face the open sea and are far from river mouths. According to Nybakken (1982), at river mouths with weak currents, the substrate type is mud and clay; if the current is strong, you will find a lot of sandy substrate because only large particles settle more quickly than smaller particles.

Table 1. Substrate texture at the research location

Substrate Sample	Substrate Texture
ST 1. La Sonrai Beach, Barru Regency, Recreation Area	Sandy
ST 2. Awarange Shipyard, Barru Regency	Sandy
ST 3. Near Awarange Harbor, Barru Regency	Sandy

Tipesubstrat pada suatupantaisangatmempengaruhipertumbuhan mangrove. Tipetanahjenis silt (debu) dan clay (liat) merupakanfaktorpenunjang proses regenerasidimanapartikelliat yang berupalumpurakanmenangkapbuahtumbuhan mangrove yang jatuhketikasudahmasak. Proses regenerasiinisangatmempengaruhikerapatan mangrove di suatu area. Sebaliknya pada pantaidengansubstratberpasirataupasirdengan campuranpecahankarang, kerapatanmangrovenyaakanrendahdikarenakanjenissubstrattersebuttidakmampumenangkap/menahanbuah mangrove yang jatuhsehingga proses regenerasitidakterjadi (Kordi, 2012).

4. CONCLUSION

Berdasarkanhasilpenelitiandenganmelakukanpengukurankualitassubstrat di tigalokasipenelitianyaitu ST 1. pantaitempatrekreasi La Sonrai KabupatenBarru, ST 2 yaituGalangankapalAwarangeKabupatenBarru dan ST 3. DekatPelabuhanKabupatenBarrumenunjukkannilai pH substratantara 8.34-8.61; Nitrogen (%) pada substrat di lokasipenelitianberada pada kisaran 0.108-0.129; kandunganbahan organic substrat di lokasipenelitianberada pada kisaran 0.39-1.04 %; kandungan ammonia (NH3) substrat di lokasipenelitianberada pada kisaran 0.0287-0.1005 ppm; kandungannitrit (NO3) di lokasipenelitianberada pada kisaran 0.0024-0.0029 ppm; semualokasipenelitianmemilikitekstursubstratyaituberpasir. Berdasarkanhasilpengukurankualitassusbtrat di lokasipenelitiandapatdinyatakanbahwakondisikualitassubstratmasihbaik dan belumberada pada kondisisubstrat yang tercemar.

REFERENCES

1. Akbar, A., & I. Pratiwi. 2023. The impact of environmental pollution in the coastal areas of Makassar due to community waste. Sensistek. 6(1): 75-78. **DOI:** https://doi.org/10.62012/sensistek.v6i1.24252
2. Arief, A. 2003. Mangrove Forest Functions and Benefits. Kanisius. Yogyakarta
3. Budiman, A. 1991. Study of Some Ecological Features of Indonesian Mangrove Molluscs. Dissertation.

Faculty of Postgraduate Studies. Universitas Indonesia.
4. Canadian Council of Ministers of the Environment (CCME). 2008. Canadian water quality guidelines. CCME. Ottawa. 1484 p.
5. Chrisyariati, I., B Hendrarto., &Suryanti. 2014. Total Nitrogen and Phosphate in Sediment of Different Mangrove Age in Brackishwater Pond Area atMangunharjo, Semarang. Diponegoro Journal of Maquares. Management of Aquatic Resources. 3(3): 65-72
6. Connel, D.W. dan G.J. Miller. 1995. Chemistry and ecotoxicology of pollution. UI Press. Jakarta. 520 hlm
7. Effendi, H. 2003. Water quality review for aquatic resources and environmental management. Kanisius.Yogyakarta. 258 hlm.
8. Gumilar, I. (2012). Coastal community participation in sustainable mangrove forest ecosystem management in Indramayu Regency. Journal of Akuatika, 3(2), 198-211.
9. Hanafiah, A., &Kemas. 2005. Soil Science Basics. PT Raja GrafindoPersada. Jakarta.
10. Hardjowigeno, S. 2003. Soil Science. AkademikaPresindo, Jakarta, 233 hlm
11. Hastuti P. Y. (2011). Nitrification and Denitrification in Ponds. Journal of Akuakultur Indonesia UniversitasPeranian Bogor, 10(1), 89-98
12. Hastuti. (2012). Coastal areas and phenomena that occur on the coast. Makassar: UniversitasHassanudin.
13. Husnah. 2010. Physicochemical dynamics of Musi River waters. In :Hartoto, D.I and N. N. Wiadnyana. Musi River Water Fisheries, South Sumatra. BRPPU. Ministry of Marine Affairs and Fisheries. Bee Publishing. Palembang. 264 hlm.
14. Iswantari, A., Wardiatno, Y., Pratiwi, N.T.M., &Rusmana, I. (2014). Benthic Flux and Potential Bacterial Activity Related to Nitrogen Cycle in Mangrove Waters Sediment of PulauDua, Banten. Indonesian Journal of Biology. 10(1), 109-117.
15. Killops, S.D., and V.J. Killops. 1993. Introduction To Organic Geochemistry. Logman Scientific Technical, Essex, 265 p.
16. Kordi, M.G.H. (2012). Mangrove Ecosystem: Potential, Function and Management. PT. RinekaCipta: Jakarta.
17. Larasati, C.E., M. Kawaroe& T. Prartono. 2015. Characteristics of diatoms in the Rupat Strait, Riau. *J. Marine Science.*20(4),223-232.http://dx.doi.org/10.14710/ik.ijms.20.4.223-232.
18. Lubis, Y.A. 2014. Study of Economic Activities of Coastal Communities in Ports. Journal of Government and Social Politics. 2(2), 133-140.
19. Marwan, A, H., Widyorini, N., &Nitisupardjo, M. (2015). Relationship between Total Bacteria and Total Organic Matter Content in Babon River Estuary, Semarang. Diponegoro Journal of Maquares, 4(3), 170-179
20. Masruroh, L., &Insafitri. 2020. The Influence of Substrate to Vegetation Density of Avicennia Marina in Gresik Regency. Juvenil. 1(2): 151-159. http://doi.org/10.21107/juvenil.v1i2.7569
21. Meirinawati, H. (2017). Nitrogen Transformation in the Ocean. Oseana, XLII(1), 36-46.
22. Nadapdapa, N.S., I.Y. Perwiraa., N.M. Ernawati. 2020. Analysis of Carbon, Nitrogen and Total Bacteria in the Bottom Substrate of Vannamei Shrimp Ponds (Litopenaeusvannamei) in the Mid-Planting Season in Sanggalangit

Village, Buleleng, Bali. Current Trends in Aquatic Science. III(1), 97-105.
23. Nybakken, J.W. 1982. Marine Biology an Ecological Approach. Translated by H.M. Eidman, Koesoebiono et al,.Gramedia, Jakarta
24. Nybakken, J. W. 1992. Marine Biology: An Ecological Approach. GramediaPustaka Utama, Jakarta, 549p.
25. Patti, P.S., E.Kaya& Ch. Silahooy. 2013. Analysis of Soil Nitrogen Status in Relation to N Absorption by Paddy Plants in Waimital Village, Kairatu District, West Seram Regency. Agrologia 2(1): 51-58
26. Pinto, Z. 2015. Study of Coastal Community Behavior that Causes Environmental Damage (Case Study in Kuwaru Beach, Poncosari Village, Srandakan District, Bantul Regency, DIY Province). Journal of Regions and Environment. 3(3), 163-174. http://dx.doi.org/10.14710/jwl.3.3.163-174
27. Poerwowidodo. 1993. Soil Fertility Study. Bandung: Angkasa.
28. Prayitno, S., M. Mandala., J. Sudibya. 2016. Soil Quality on land affected by sea water Overflow for Crops Cultivation (A Case Study in Kepanjen Village , District of Gumukmas, Jember Regency. BerkalaIlmiah PERTANIAN.
29. Prianto, E., Husnah, & S. Aprianti. 2010. Physical and chemical characteristics of water and zooplankton community structure in the Banyuasin River Estuary, South Sumatra. Bawal. 3(3):149-157. http://dx.doi.org/10.15578/bawal.3.3.2010.149-157.
30. Putri, W.A.E., A.I.S. Purwiyanto., Fauziyah., F. Agustriani& Y. Suteja. 2019. Condition of Nitrate, Nitrite, Ammonia, Phosphate, and Bod of Banyuasin River Estuary, South Sumatera. Journal of Tropical Marine Science and Technology. 11(1): 65-74. DOI: http://dx.doi.org/10.29244/jitkt.v11i1.18861
31. Rahayuningsih, Y. (2017). The Impact of the Cement Industry on the Livelihood System of Bayah Fishermen. KP Socio-Economic Journal, 12(2), 213–223.
32. Rahman, A.A., I.Y Perwira., & I.W.D. Kartika. 2022. Total Organic Matter (TOM) Content and Turbidity in Water in the DAM Estuary, Badung, Bali. Current Trends in Aquatic Science. V(2): 142-147
33. Sari, A.N., Kardhinata, E.H., & A. Hanifah, M.Z.N. (2017). Substrate Analysis in the Nipah Village Ecosystem of Sei Nagalawan Village, Serdang Bedagai, North Sumatra. Journal of Environmental, Industrial, and Health Biology. 3(2), 163-173.
34. Setyobudi B. 1993. Soil Chemistry and Plant Nutrients. Faculty of Agriculture. University of Jember.
35. Shafei, F., & Mohamed, B. (2012). Tourism and the enviornment: Issues of concern and sustainability of Southern Part of the Caspian Sea Coastal Areas. Journal of Sustainable Development, 5(3), 2-15. doi:10.5539/jsd.v5n3p2.
36. Suganda. 2006. Physical Properties of Soil and Methods of Analysis. Bogor :AgroInovasi.
37. Suprapto, N., Chang, T. S., & Ku, C. H. (2017). Conception of learning physics and self-efficacy among Indonesian university students. Journal of Baltic Science Education, 16(1), 7-19
38. Susiana. (2015). Water quality analysis of mangrove ecosystem in Perancak estuary, Bali. Agrikan: Journal of Fisheries Agribusiness. 8(1), 42-49.
39. Tinambunan, H.S., I.Y. Perwira ., & N.M. Ernawati. 2022. Total Number of Bacteria and Nitrogen Nutrients in

Mangrove Sediments of Ngurah Rai Grand Forest Park (TAHURA), Bali. Current Trends in Aquatic Science. V(1): 18-24.

40. Zhang, J.Y., W.M. Ni., Y.M. Zhu, and Y.D. Pan. 2012. Effects of different nitrogen species on sensitivity and photosynthetic of three common freshwater diatoms. *Aquat Ecol.*, 47:25-35. http://dx.doi.org/10.1007/s10452.012.9422.z.
41. Zhao, X., Wei, Z., Zhao, Y., Xi, B., Wang, X., Zhao, T., Zhang, X., & Wei, Y. 2015. Environmental factors influencing the distribution of ammonifying and denitrifying bacteria and water qualities in 10 lakes and reservoirs of the Northeast, China. Microbisal Biotechnology, 8(3), 541–548