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Annelid Biodiversity in Dead Corals Against Pollution in Tarahan Island

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ABSTRACT

Tarahan Island is one of the small islands located in the waters of Banten Bay, Banten Province. This study aims to determine the cryptic organisms found on dead corals and determine the level of seawater pollution with TSS, BOD, COD parameters used as variables for assessing the status of water pollution in Tarahan Island, Banten. The method used in this research is using Purposive Sampling location determination. Data collection was carried out on March 26, 2025 to May 15, 2025 on Tarahan Island. Based on the results of the study found 42 individuals of the phylum Annelida. The most common species found was Alitta Succinea. The results of TSS research showed an average concentration of 377.77778 mg/L and BOD had an average concentration of 0.616667 mg/L.

INTRODUCTION

Tarahan Island is one of the small islands located in the waters of Banten Bay, Banten Province. The island is ecologically important because it is located in a coastal area rich in biodiversity, including seagrass beds, coral reefs, and cryptic biota that live in dead coral structures. The ecosystem around Tarahan Island supports important ecological functions such as fish spawning habitat, abrasion resistance, and natural filters for pollutants. Tarahan Island, located in Serang, Banten, is a coastal area adjacent to a fairly active industrial area. Coastal areas often face significant environmental pressures due to human activities.

The presence of several factories and industrial activities around the coast raises concerns about the potential for water pollution that can disrupt the balance of marine ecosystems. In addition, human activities are also one of the causes of pollution. Various types of waste and pollutants, including metals, can be found in coastal waters (El-Sharkawy et al., 2025). These industrial wastes can contain harmful substances such as mercury, arsenic, lead, and other organic chemicals that are difficult to decompose and are highly toxic to marine biota (Hamuna et al., 2018); PT Greenlab Indo Global, 2024).

One way to analyze the level of water pollution is by measuring water quality parameters such as BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), and TSS (Total Suspended Solids). Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) parameters are key indicators to measure the level of organic pollution, while Dissolved Oxygen (DO) reflects the availability of dissolved oxygen. Increases in BOD and COD indicate high organic loads, which can reduce DO levels and potentially cause hypoxic or anoxic conditions that are detrimental to marine biota (Sari, 2018) Increased levels of BOD and COD in stark contrast to marine waters will spur excessive algae growth, causing oxygen stress and coral bleaching. This happens because BOD and COD carry large amounts of organic waste and chemical compounds into the water (Nugroho et al., 2024).

Water quality pollution not only impacts aquatic ecosystems in general, but can also affect the lives of cryptic organisms living inside dead coral reefs. Cryptic organisms, which play an important role in maintaining the balance of coral reef ecosystems, are very vulnerable to changes in environmental conditions due to increased levels of pollutants such as organic matter and suspended particles. The diversity and high productivity of coral reefs are not only determined by corals, algae and fish, but also by the animals that inhabit dead corals and coral fragments (Takada et al., 2016). Coral reef ecosystems rich in biodiversity are vulnerable to environmental stresses, including changes in water quality due to pollution. In addition to directly impacting coral health, environmental changes also affect other communities of organisms, such as cryptic biota living on dead corals. Dead coral fragments provide the most suitable habitat for new colony growth, as they provide biofilms and protection from predators and extreme conditions (Haris Rafilu et al., 2020). This diversity of cryptic biota has a significant ecological role in food chains and nutrient cycling in coral reef ecosystems (Moira & Luthfi, 2020).

Based on the above problems, this study aims to evaluate the level of organic pollution in the waters around Tarahan Island by analyzing the parameters of TSS, BOD and examining its impact on the presence and diversity of cryptic biota, especially the annelid phylum in the dead coral ecosystem. The results of this study are expected to provide a comprehensive picture of the influence of industrial activities on the quality of the marine environment and its implications for the balance of coastal ecosystems.

METHOD

Research Time and Location

Sampling of dead corals and water samples was conducted on March 26, 2025 to May 15, 2025 on Tarahan Island, Bojonegara District, Serang Regency, Banten. Water sampling was carried out in the Grenyang port area, in the middle of the journey to Tarahan Island and the coastal area of Tarahan Island, while coral samples were taken from Tarahan Island.

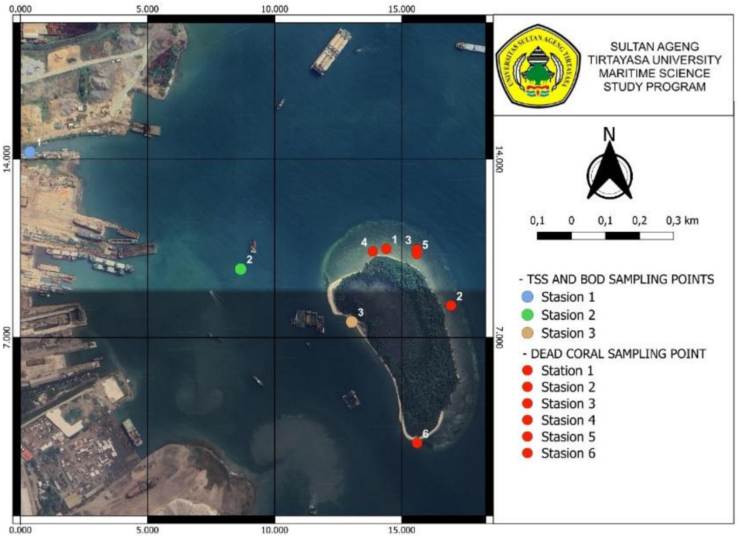

Figure 1. Research location map

Then preservation, biota identification and analysis of water samples were carried out at the Marine Biotechnology Laboratory, Faculty of Agriculture, Sultan Ageng Tirtayasa University.

Tools and Materials

The tools used are Bucket used to put dead coral samples, hammer to break dead coral samples. Trash bag to cover dead coral samples, and gallons to store seawater. Trays to measure the volume of dead coral samples, roll meters to measure biota samples (cryptic), and study lights to provide lighting when photographing biota. Chisels were used to adjust the pattern of dead coral fragments, while kratingdeng bottles were used to store water samples. Sprays were used to wet the dead coral samples, labels were used to annotate the samples, cup were used to cryptic biota storage container sand, tripods were used for balancing during photo sessions. Cameras were used to take pictures of the biota samples (crypts), life jackets were used for safety, and meters were used to measure the dead coral samples. Black mats were used to provide contrast when shooting, petri dishes to place samples before filtering, filter paper to filter TSS in samples, and DO meters were used to measure DO in water samples.

As for the materials used, Dead coral is used as a sample, while clove oil serves as an anaesthetic for biota. Manganese sulphate is used for the fixation of $MnSO_4$ solution, while iodide plays a role in making the sample alkaline and providing iodide ions. $MnSO_4$ forms manganese oxide precipitate under alkaline conditions. Amylum was used for the iodine concentration test, and alcohol was used to preserve the cryptic biota. Seawater was used to measure the volume of dead coral.

Sampling Method

Sampling was conducted in coral reef and coastal areas. Seen in Figure 1 Dead coral samples were taken at 6 station points in different locations. Dead coral colonies are wrapped in plastic before being released from the substrate with the aim that the biota inside is not lost. After that, it was stored in a bucket to facilitate the removal of samples. Water samples were taken from the coast then stored tightly without air bubbles in a 150ml bottle then added $MnSO4$ solution and 2 ml Alkali iodide solution. Sampling of dead corals using Purposive Sampling method. According to (Sugiyono, 2022): 9) purposive sampling is a data source sampling technique with certain considerations. The selection of the location is close to the industry around the coastal area to identify and evaluate the potential for pollution of marine waters caused by industrial waste discharged into the surrounding environment.

Data Type

This study used two types of data, namely primary data and secondary data. Primary data is obtained directly by sampling in the field, which consists of cryptic biota data and pollution data. Cryptic biota data was obtained by breaking chunks of dead coral, then pollution data was obtained by taking several 2 bottle samples, in the form of BOD (Biochemical Oxygen Demand) and TSS (Total Suspended Solids). In addition, documentation was carried out using a mobile camera and the coordinates of the observation location were recorded with the help of the GPS application. All primary data were collected during the research. In obtaining primary data, secondary data was followed which supported the results obtained. This secondary data is obtained from various sources that support the identification of primary data. The main sources used in secondary data are in the form of measurement results and samples obtained from relevant literature studies and previous research results, which serve as support and comparison of primary data collected by the World Register of Marine Species (WoRMS).

Cryptic Research Procedures

Dead corals were taken from a depth of 110 cm using the Snorkelling Technique. The selection of dead coral colonies used the Purposive Sampling method, which is a method used that is randomly selected. Dead coral colonies were then measured using a roller meter and photographed, the diameter of the dead coral taken had a length of 19 cm to 50 cm, and a width of 13 cm to 33 cm. The dead coral was then cut at the base using a hammer and chisel and then put into a new plastic garbage and then put into a bucket. This aims to prevent biota from escaping from the dead coral colonies taken. The dead corals in the bucket were then brought to the surface and further work was carried out on the surface. The dead coral that had been brought to the surface was then measured for diameter and volume using the water runoff method (Archimedes law) "if an object is dipped in a liquid, the object will be pressured upwards equal to the weight of the liquid that is pressed by the object." The dead coral was then broken using a chisel and hammer. After being broken, the sorting stage was then carried out. All organisms found in the dead coral colonies were then placed into plastic cups containing seawater and labels. Each individual was given a different label that informed the location and number of dead corals and individual numbers. Each organism that has been sorted is then identified. The next stage is relaxation; at the relaxation stage the organism is put into seawater mixed with 1% clove oil. The purpose of the relaxation stage is to make the organism faint so as to facilitate the photo taking stage. The next stage is taking photos; each organism is then photographed which is labelled as well as functioning as a scale. Samples that have been subsampled are then preserved using 7% alcohol solution.

Pollution Research Procedures

Seawater samples were taken with 3 150 ml sample bottles at a depth of 40 cm because this depth is considered to be sufficiently representative of the vertical homogeneity of pollutant dispersion and avoids surface effects. The first sample bottle was used for BOD and then given a few drops of Mnso4. The second sample bottle was used for TSS measurement. The water samples were then placed in ice boxes and stored in a refrigerator in the laboratory.

Cryptic Data Analysis

Samples of cryptic organisms were analysed to identify the type of species in the phylum Annelida based on photo documentation that had been taken. Identification was done by referring to the marine taxonomic database available on the World Register of Marine Species (WoRMS) website.

TSS and BOD Data Analysis

Total Suspended Solids (TSS) analysis was conducted by first drying the filter paper in an oven at 105°C for one hour. After drying, the filter paper was cooled in a desiccator for 15-30 minutes before being weighed to obtain the initial weight (W1). The homogenized water sample, with a certain volume (e.g. 500 mL), was then filtered using a vacuum filtration system. During the filtration process, the liquid is poured slowly to ensure the entire volume passes through the filter without spillage or leakage. After filtration is complete, the filter paper is dried again in an oven at the same temperature for 1-2 hours, then cooled in a desiccator and reweighed to obtain the final weight (W2). The TSS value was calculated based on the difference in filter paper weight before and after filtration. Biochemical Oxygen Demand (BOD) analysis was conducted by measuring the dissolved oxygen (DO) concentration at the beginning and end using a DO meter. The measurement process involves adding manganese sulphate reagent, iodide solution, and amylum as much as 1 mL each into the sample. The sample was then shaken. The difference between the initial and final DO concentrations was used to calculate the BOD value, which represents the amount of oxygen used by microorganisms in the decomposition of organic matter in water.

RESULT AND DISCUSSION

TSS and Bod Variable

Table 1. Measurement results of TSS and BOD

Parameter	Unit (mg/l)	Quality standards (mg/l)
TSS	377.77778	80
BOD	0.616667	20

The measurement results of TSS and BOD variables in Tarahan Island are presented in Table 1. The results of measuring the weight of filter paper that has been done get a measurement result of 860mg/L After calculating the average value of TSS 377.77778 mg/L and BOD has an average concentration of 0.616667 mg/L. Because TSS is very high, although BOD is low, in general these waters are classified in the category of heavy pollution, especially physical pollution because the research location is close to the beach with shallow depths resulting in high TSS concentrations. The high concentration is due to the influx of organic matter from the fishing industry where the disposal of fishing industry waste. This has a significant impact on the survival of corals. High TSS concentrations and for a long time will reduce the photosynthetic activity of zooxanthellae because it inhibits light from entering, the higher the concentration, the density of zooxanthellae will experience a high decline (Rizka et al., 2020) These concentrations far exceed the coral's tolerance threshold for suspended sediments. Suspended particles can absorb light and will reduce the depth of the euphotic zone. The reduction of the euphotic zone to about 20-60 cm of coral tissue surface is also irritating, increases the metabolic burden on corals to clean themselves, and can cause soft tissue abrasion. Suspended particles can absorb light and will reduce the depth of the euphotic zone. A reduction in the euphotic zone of about 20-60 cm puts 8-15% pressure on coral reef habitats (Morgan *et al.,* 2020). In the long term, this will reduce coral resistance to disease and increase the risk of colonization by competing organisms such as algae. Further ecological impacts include disruption of coral reef community structure, decreased habitat for cryptic fauna and reef fishes, and reduced recruitment rates of coral larvae due to substrate cover by sediments. Thus, it poses a serious threat to the sustainability of the coral reef ecosystem as a whole.

Species Identification

Table 2. Species Identification

Station	Species	Total
1	*Platynereis dumerilii*	3
	Alitta succinea	3
	Myxicola infundibulum	2
	Themiste lageniformis	1
2	*Platynereis dumerilii*	1
	Alitta succinea	1
	Marcierella Enigmatica	2
	Eteone Savigny	1
3	*Hediste Malmgren*	*2*
	Eunereis Longissima	*1*
	Platynereis dumerilii	3
	Alitta succinea	3
4	*Celebratulus lacteus*	3
	Lineus ruber	1
5	*Alitta succinea*	9
6	*Alitta succinea*	2

As can be seen from table 2, the most common species found was Alitta succinea. 18 individuals were found. The high number of individuals of this species indicates that Alitta succinea has a variety of temperatures and salinities (eurythermal and euryhaline), and is able to survive in environments with low oxygen levels (hypoxia), indicating its ability to live in habitats that are often exposed to pollution or extreme environmental changes. In addition, the dominance of this species also indicates its important role in the macrobenthic community and its ability to adapt and compete with other species in the habitat (Alvarez-Aguilar et al., 2022). Alitta succinea is recognized as a species capable of surviving in environments with chemical, physical, and structural changes, demonstrating its resistance to pollution in marine habitats (Hannon & Schulze, 2024)

Composition of Individuals of the Phylum

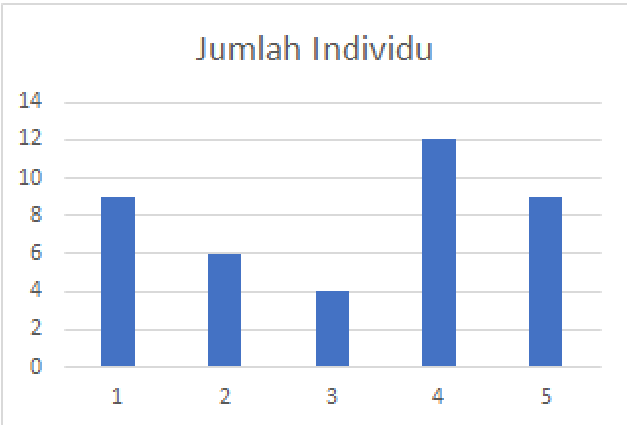

Figure 2. Number of species

The phylum Annelida was found in all six observation stations with a total of 42 species. Figure 2 explains the number of species of the Annelida phylum. At station 1 found 9 species, at station 2 found 6, at station 3 found 4 species, at station 4 found 12, at station 5 found 9 species, at station 6 found 2. The variation in the number of species at each station is likely influenced by differences in environmental conditions such as substrate, salinity, and pollution levels that vary at each location. Annelids including cryptic species that live can live in dead corals that have many cavities. Supported by (Komarullah et al., 2019) which says the cryptic density is influenced by cavities in dead corals. The supporting conditions for annelid diversity are due to food sources, and chemical physical conditions such as TSS and BOD (Dewiyanti et al., 2017)

CONCLUSION

Based on the results of this study, it can be concluded that the level of pollution in the waters around Tarahan Island is quite high, as indicated by the TSS concentration of 377.77778 mg/L and BOD has an average concentration of 0.616667 mg/L. This increase in pollution parameters has the potential to threaten the existence and diversity of cryptic organisms living on dead corals, such as the 42 individuals found from the Annelida phylum. These pollution indicators also show that industrial activities in coastal areas have a negative impact on coral reef ecosystems, including a decrease in environmental quality and the sustainability of cryptic organisms. Thus, this study emphasizes the importance of industrial waste management to preserve marine ecosystems.

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