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MAPPING OF BENTHIC HABITAT IN BAIR ISLAND USING ALLEN CORAL ATLAS DATA

Pemetaan Habitat Bentik Di Pulau Bair Menggunakan Data *Allen Coral Atlas*

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ABSTRACT

Benthic habitat mapping in Bair Island, Southeast Maluku Regency, Maluku Province is the first step in the management and conservation of marine ecosystems that need to be improved. This study aims to map and calculate the extent of benthic habitat around Bair Island by utilizing Allen Coral Atlas (ACA) data. The methods used include multispectral satellite image analysis by performing atmospheric correction, water column correction and sun glare removal. Benthic habitats mapped included coral reefs, seagrasses, microalgae, dead corals and other substrates such as rocks and sand. The results showed that coral reefs dominated the coastal area of Bair Island with an area reaching 53,9 ha, seagrasses 8,4 ha and microalgae 9,8 ha and area of rubble 8,8 ha followed by the dominance of rocks 118 ha as well as sand 98,8 ha. The utilization of ACA data proved effective in providing accurate spatial information with high resolution, so that it can support ecosystem-based management on Bair Island.

Keywords: Allen Coral Atlas, Bair Island, Benthic Habitats, Mapping.

ABSTRAK

Pemetaan habitat bentik di Pulau Bair, Kabupaten Maluku Tenggara, Provinsi Maluku merupakan langkah awal dalam pengelolaan dan pelestarian ekosistem laut yang perlu untuk ditingkatkan. Penelitian ini bertujuan untuk memetakan dan menghitung luasan habitat bentik di sekitar Pulau Bair dengan memanfaatkan data Allen Coral Atlas (ACA). Metode yang digunakan meliputi analisis citra satelit multispektral dengan melakukan koreksi atmosfer, koreksi kolom air dan penghilangan silau matahari. Habitat bentik yang berhasil dipetakan mencakup terumbu karang, lamun, mikroalga, karang mati dan substrat lainnya seperti batu dan pasir. Hasil penelitian menunjukkan bahwa terumbu karang mendominasi kawasan pesisir Pulau Bair dengan luasan mencapai 53,9 ha, lamun 8,4 ha dan mikroalga 9,8 ha serta luasan karang mati 8,8 ha diikuti dominasi batu 118 ha juga pasir 98,8 ha. Pemanfaatan data ACA terbukti efektif dalam menyediakan informasi spasial yang akurat dengan resolusi tinggi, sehingga dapat mendukung pengelolaan berbasis ekosistem di Pulau Bair.

Kata Kunci: Allen Coral Atlas, Habitat Bentik, Pemetaan, Pulau Bair.

INTRODUCTION

Bair Island, located in the Kei Islands group, Maluku Province, is known as one of the areas with varied marine biodiversity. Its waters have a diverse benthic ecosystem including various types of coral reefs, seagrass, microalgae and other seabed substrates. Benthic ecosystems play an important role in maintaining the ecological balance of waters (Solihuddin *et al*., 2020), becoming a habitat for various marine organisms and becoming a source of livelihood for the surrounding community through fisheries and ecotourism.

Bair Island has become one of the marine tourism destinations that is starting to become popular in Indonesia. This is due to the beauty of its clear waters with gradations of blue and green and unique coral cliff formations so that it can be the main attraction for domestic and foreign tourists. In addition, marine biodiversity in the waters of Bair Island including benthic habitats such as coral reefs, seagrass and other organisms (Menandro *et al*., 2022) is an additional attraction that provides ecological and aesthetic value.

However, increasing tourism activities also have the potential to put pressure on the environmental sustainability of Bair Island, including threatening the destruction of benthic habitats, so it is necessary to identify and map benthic habitats to support sustainable tourism management. The lack of exploration data in this area is an option to use a Geographic Information System (GIS) approach utilizing high-resolution satellite imagery data that has been integrated into the Allen Coral Atlas data. Allen Coral Atlas data supports benthic habitat mapping that has been processed and obtains a classification of benthic habitat cover (Kennedy *et al*., 2020). The integration of Allen Coral Atlas data with Geographic Information Systems (GIS) has not been specifically implemented on Bair Island, but has been used effectively in the area around the Coral Triangle for benthic habitat mapping (Asaad *et al*., 2019).

Several studies have utilized geographic information systems (GIS) to map benthic habitats as follows (Lazuardi & Wicaksono, 2021) comparing the accuracy of spatial resolution (3m, 6m, 10m) to map coral reef classes on Parang Island using several satellite datasets; (Kartikasari *et al*., 2021) focusing on spatial classification of coral reef habitats for conservation support in North Bali; (Morsy *et al*., 2023) focusing on the use of machine learning combined with SfM photogrammetry and extreme gradient boosting (XGBoost) classifiers for 3D mapping of benthic habitats; (Van An *et al*., 2023) utilizing PlanetScope imagery to classify tropical marine benthic habitats in the area around the Lyson Islands, Vietnam; (Mukrimin *et al*., 2021) examining shallow marine benthic habitats on Tiga Island using the OBIA approach; (Munasik *et al*., 2020) shows coral reef damage due to the grounding of a barge in Karimunjawa National Park.

Benthic habitat mapping in the Maluku Province area is still very minimal using the GIS approach, especially on Bair Island which has never been mapped before, so this study needs to be carried out with the aim of mapping the distribution of benthic habitats and examining the extent of habitat classification through a GIS approach by utilizing Allen Coral Atlas data.

RESEARCH METHODS

Research Location

The research location is on Bair Island, this island is part of the Kei Islands group which is administratively located in Southeast Maluku Regency, Maluku Province. Benthic habitat mapping covers the water area of Bair Island with coordinates 132.70-132.71^{o}BT and -5.43-5.60^{o}LS (Figure 1). The research was conducted from October to December 2024 and data processing was carried out at the Inderaja and GIS Laboratory, Marine Technology Study Program, Tual State Fisheries Polytechnic.

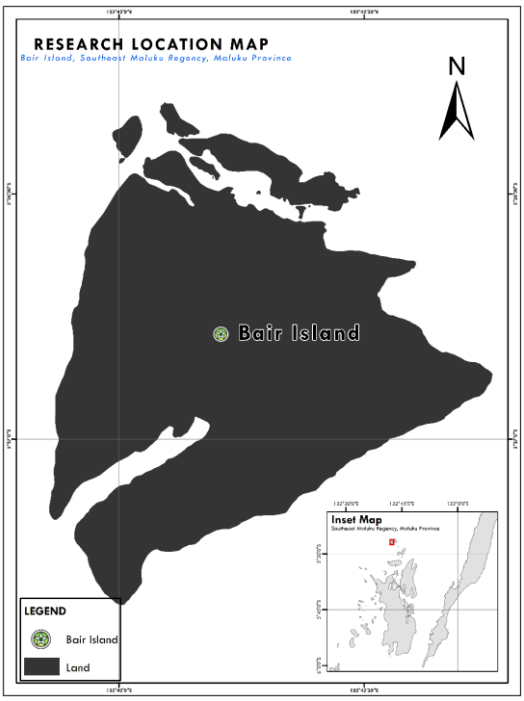

Figure 1. Research location map
(Bair Island, Southeast Maluku Regency, Maluku Province)

Data and Tools Used

This study uses Allen Coral Atlas data accessed through the page https://www.allencoralatlas.org (Li *et al.*, 2019). Allen Coral atlas data can be used as a monitoring and observation tool (Misiuk & Brown, 2024) which aims to provide high-resolution maps providing the latest information from global coral reef imagery with detailed composition and structure (Wen *et al*., 2021). Meanwhile, for data processing, a computer equipped with several software such as ArcGIS version 10.8 was used to create research location maps and benthic habitat maps, Ocean Data View version 5.7.1 was used to extract data, Quantum GIS version 3.40 was used for image data processing and OrigiPro version 2021 was used for graphing.

Methods

The Allen Coral Atlas data was created with funding from the late Paul Allen's Vulcan Inc. and is managed by Arizona State University's Center for Global Discovery and Conservation Science. High-resolution satellite imagery is the source and is used for comprehensive analysis by applying multispectral satellite imagery analysis through atmospheric correction, water column correction, and sun glare removal (Kennedy *et al*., 2021) to map and monitor the world's coral reefs in unprecedented detail.

Benthic habitats have been classified which is an interpretation of high-resolution satellite imagery from the Planet's Scope satellite (Roelfsema *et al*., 2020). This image has been processed using the GDCS algorithm (Lyons *et al*., 2020) with the aim of producing surface, subsurface and benthic habitat reflectance data from the imagery used, after which it is integrated into the Allen Coral Atlas data which is easy to process in the study area. Several image corrections are used to obtain maximum results, namely atmospheric correction, water column correction and sun glare removal. The benthic habitat zone is mapped to a depth of 10 meters using a Geographic Information System (GIS) and the area of each habitat classification on Bair Island is calculated.

RESULT

This study produced a map of benthic habitats on Bair Island (Figure 2), there are several classes, namely Coral, Seagrass, Micro Algae, Rock, Dead Coral and Sand. The area of benthic habitats varies greatly. The area of benthic habitats can be seen in Figure 3.The results obtained provide a comprehensive picture by showing each class of habitat in the waters of Bair Island.

The results of this study are an initial step that has not been done before with the aim of supporting tourism potential that can be used as a selling point to attract domestic and foreign tourists to visit Bair Island.

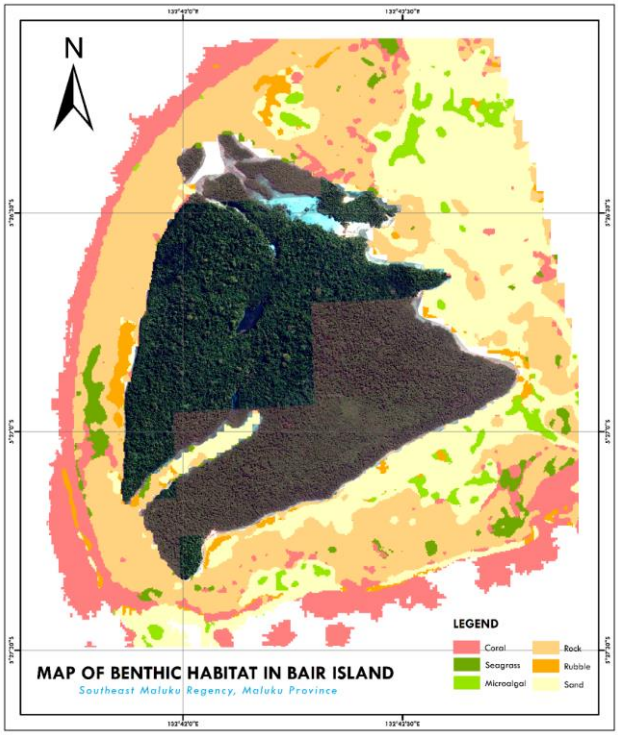

Figure 2. Benthic Habitat Map on Bair Island (Southeast Maluku Regency, Maluku Province)

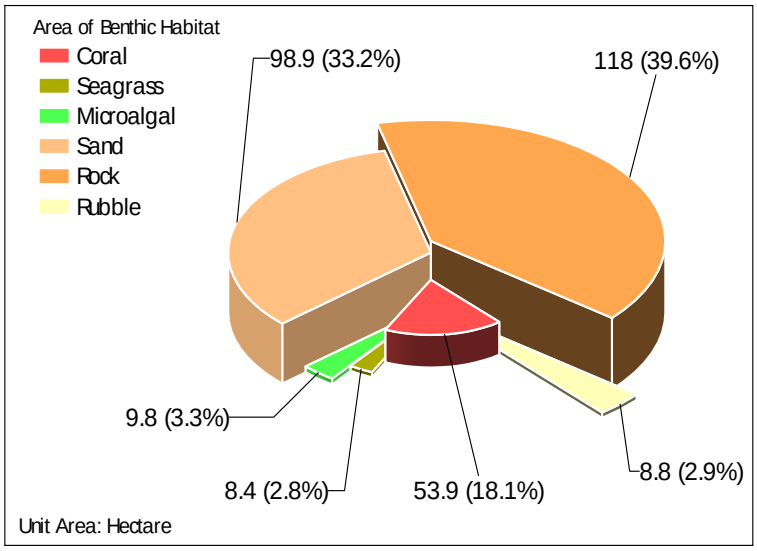

Figure 3. Benthic Habitat Area on Bair Island (Southeast Maluku Regency, Maluku Province)

DISCUSSION

This study is an initial study that utilizes secondary data from high-resolution image interpretation with the aim of estimating the distribution of benthic habitats on Bair Island that were previously unknown. The results of benthic habitat mapping to a water depth of 10 meters show a classification distribution dominated by rocks (39.6%) and followed sequentially by sand (33.2%), coral reefs (18.1%), microalgae (3.3%), dead coral (2.9%) and seagrass (2.8%). The substrate in the benthic habitat on Bair Island is dominated by rocks and sand.

From the results of the benthic habitat distribution map (Figure 2), it can be seen that the coral reefs are located further out to sea from the island and are predominantly located in the western part of the island, while in the eastern part there are almost no coral reefs where this part is dominated by sand. Coral reefs on Bair Island have an area of 53.9 Ha. Seagrass has a random distribution but is mostly seen dominantly in the western part of the island with a total area of seagrass of 8.4 Ha. Microalgae have different distributions with varying distributions, but in the western part of the island, no microalgae were found, but they are dominant in the southeast and south with a total area of 9.8 Ha. The benthic habitat substrate is dominated by rocks and sand with an area of 118 Ha and 98.8 Ha respectively. Bair Island also has dead coral with an area of 8.8 Ha, so it is necessary to maintain environmental conditions so that coral reefs do not experience continuous damage.

Benthic habitats also affect the condition of the waters around Bair Island, the condition of the waters looks very beautiful with the presence of coral reefs, seagrass and microalgae that are randomly distributed, the best conditions can also occur where the environment affects the condition of the benthic habitat such as changes in the shape of coral reefs (Barus *et al*., 2018; Daniel & Santosa, 2014). The waters of Bair Island are relatively shallow so that the benthic habitat, one of which is coral reefs, is very clearly visible. Benthic habitats also affect the blue pigment of seawater (Prasetyo *et al*., 2022) on the coast of this island, showing that the seawater is very interesting to document. By knowing the distribution of benthic habitats, which support commercial and subsistence fisheries by being a breeding and maintenance place for various types of fish and invertebrates (Mukrimin *et al*., 2021), it is possible to develop the fisheries and aquaculture sectors. In addition to satellite imagery, it is also necessary to correct it with observation data using data produced by multibeam echosounders to map benthic habitats (Brown *et al*., 2019) on Bair Island in the future.

CONCLUSION

Benthic habitat on Bair Island consists of coral reefs, seagrass and microalgae with varying distribution patterns and areas. The eastern and western parts of the island provide different benthic distributions, while the northern and southern parts have the same benthic distribution but different areas. The western part of the island has a wider distribution of coral reefs than the eastern part, as well as seagrass, while microalgae have varying distribution patterns, but the distribution in the western part of the island is almost non-existent. The substrate of the benthic habitat on Bair Island is dominated by rocks and sand. Dead coral on Bair Island is a concern for the community and government in protecting the environment.

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