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IDENTIFICATION OF MACROALGAE IN THE COASTAL AREA OF BUDO TOURISM VILLAGE, WORI, NORTH MINAHASA

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Abstract

Algae are lower plants that do not have differentiated structures such as roots, stems, and leaves; although they may appear to have differences, they are actually just thallus forms. Macroalgae have macroscopic body shape and size consisting of fronds without distinct roots, stems, and leaves. Macroalgal diversity is not only reflected in their ecological and economic significance but also in their high species richness and wide geographical distribution within aquatic ecosystems. However, research on the species diversity of macroalgae in Budo Tourism Village Beach, North Minahasa remains limited. This study aims to identify the macroalgal species in the Budo Tourism Village, Wori, North Minahasa area. The research employed the line transect and quadrat-based sampling method, which was implemented at two distinct station locations: Station I (rocky reef substrate) and Station II (sandy-muddy substrate). Macroalgae identification was facilitated by utilizing the comprehensive identification textbooks. The research reveals the presence of four macroalgal species, comprising three brown algae (Phaeophyceae), namely *Padina boergesenii*, *Sargassum llinearifolium*, *Turbinaria ornata* and one red algae (Rhodophyceae), *Gracilaria corticata*. *Sargassum linearifolium*, *Padina boergesenii*, and *Gracilaria corticata* was found in rocky reef substrate. *Turbinaria ornate* and *Padina boergesenii* was found in sandy-muddy substrate.

Key words: Budo Tourism Village Coast, Identification, Macroalgae, North Minahasa

INTRODUCTION

Indonesia is a country with a high level of biodiversity. It is also known as an archipelagic country with a vast marine area, which indicates a great marine biodiversity as well. One of the marine organisms commonly found on almost all beaches in Indonesia is algae. Algae are lower plants that do not have differentiated structures such as roots, stems, and leaves, although they may appear to have differences, they are actually just thallus forms (Kepel et al., 2018). According to their size, algae can be classified into two types: microalgae and macroalgae (Kepel et al., 2018). Macroalgae are algae that

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have a macroscopic body shape and size (Subagio & Kasim, 2019). Their body consists of fronds without distinct roots, stems, and leaves (Haryanti et al., 2008). Macroalgae can grow on various types of substrates, such as rocky substrates (Rahmat et al., 2020), coral reefs (Ceccarelli et al., 2018; Enochs et al., 2015; Smith et al., 2020; Tebbett et al., 2020), sandy substrates (Asmida et al., 2017), and mud (Ira et al., 2018; Silaban & Kadmaer, 2020) by attaching themselves to these substrates.

Macroalgae existence on various types of substrates plays a specific role because they are important in aquatic ecosystems. Similar to other aquatic ecosystems such as coral reefs, seagrass beds, and mangroves, which serve as feeding grounds and spawning grounds for both fish and non-fish resources, certain macroalgae ecosystems like *Sargassum sp*. can also function as current dampeners (Ariani et al., 2020). Therefore, macroalgae play a crucial role in aquatic ecosystems.

In addition to these roles, macroalgae are also a potential renewable resource in the marine environment. The diversity and abundance of algae in Indonesia are quite significant compared to other countries. However, the utilization of algae is still not optimal, especially in coastal areas of Indonesia. Many macroalgae (seaweeds) are left as marine waste, floating, drifting with currents, or stranded on the shore (Dang et al., 2017)

Around 6,000 species have been identified and classified as green algae (Chlorophyta), brown algae (Phaeophyta), and red algae (Rhodophyta) (Setiawati & Sari, 2017). In Indonesian marine, 88 species of algae have been found from all the algae in the world (Aslan, 1998; Belliveau & Paul, 2002; Sambamurty, 2005). The documentation of macroalgae species as a marine potential needs to be carried out, considering the significant and important ecosystem services of macroalgae to the environment (Sari et al., 2020), especially in providing habitats for various biota (Davies et al., 2007). Ecologically, macroalgae act as primary producers (Setiawati et al., 2017), fish food (with some types of fish that consume macroalgae being *Acanthurus coeruleus, Sparisoma aurofrenatum, and Kyphosus* spp.), as shelters, nurseries, carbon absorbers, and as bioindicators of pollution. Economically, macroalgae function as food, cosmetics, and are also very beneficial for humans (Irwandi et al., 2017), with various bioactive potentials including uses as antioxidants, anti-obesity, anti-diabetes, anti-bacterial, anti-inflammatory, and anti-cancer agents (Suparmi & Sahri, 2009).

The beach in Budo Tourism Village is one of the tourist locations in North Minahasa Regency, North Sulawesi, and is an intertidal zone covering an area of approximately 200 m² (Sepang, et. al., 2024). This location supports the life of algae in the intertidal zone waters. Besides the supportive location, the identification of macroalgae species at Budo Tourism Village Beach, Wori, is still minimal. This research aims to identify the types of macroalgae found around the Budo Tourism Village Beach area, North Minahasa.

RESEARCH METHODS

Study Field

This study was conducted within the coastal zone of Budo Tourism Village, Wori District, North

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Minahasa Regency. Sampling locations were strategically selected based on substrate heterogeneity, encompassing two distinct sites: a rocky reef substrate in proximity to the coastal tourist area and a sandy-muddy substrate adjacent to the mangrove forest (Figure 1).

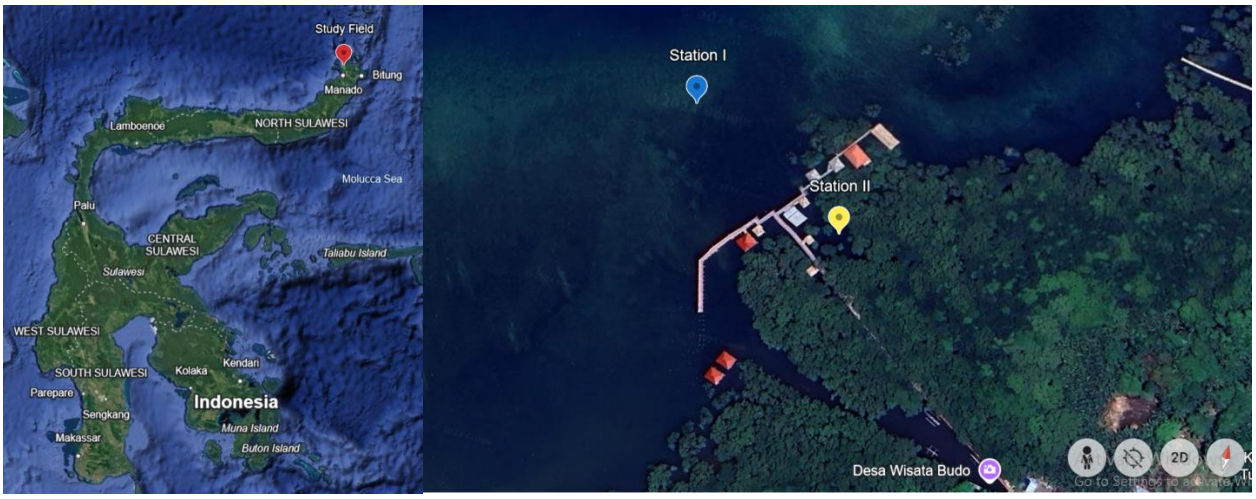

Figure 1. Research Location in Coastal Budo Tourism Village (red label) with two sampling locations based on substrate heterogeneity. Station I (Blue label): rocky reef substare; Station II (Yellow label: sandy-muddy substrate

Research Procedures

The sampling method used in this research was line transect method with quadrat sampling (English et al., 1997). Two stations were established based on the difference in substrate type: Station I with rocky reef substrate and Station II with sandy-muddy substrate. Each station had two transects, each perpendicular to the shoreline and extending towards the slope using a 50-meter-long raffia rope with five quadrats (1 x 1 m² plots) (Figure 2). The distance between quadrats was 10 m, and the distance between transects was 10 m. Sampling was captured during low tide using a digital camera.

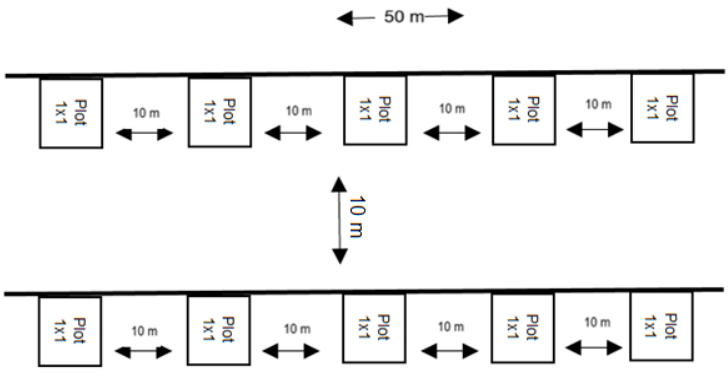

Figure 2. Research Line Transect and Quadrat Method

Subsequent to the acquisition of photographic documentation, the collected samples were subjected to a rigorous identification process. Macroalgae identification was facilitated by utilizing the comprehensive text books "Developments in Applied Phycology: Seaweeds of India: the diversity and

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distribution of seaweeds of Gujarat coast " by Jha et al. (2009) and "Seaweed and Seagrass of The Southern Andaman Sea Coast of Thailand" by Coppejans et al. (2017). The documented macroalgal specimens were meticulously analyzed by examining the distinctive morphological features and characteristics exhibited within each quadrat.

RESULTS AND DISCUSSION

The research conducted at Budo Tourism Village beach identified four macroalgal species. Three macroalgal species were found at the rocky reef substrate station, while two species were found at the sandy-muddy substrate station. The identification process categorized the four macroalgal species into two divisions: Phaeophyta (Padina, Sargassum, and Turbinaria) and Rhodophyta (Gracilaria) (Table 2). The rocky reef substrate station contained algal species from the genera Sargassum, Padina, and Gracilaria. The sandy-muddy substrate station contained algae species from the genera Turbinaria and Padina. The genus Padina was found at both substrate stations investigated.

Table 1. Macroalgae found at each station in Coastal area of Budo Tourism Village, Wori, North Minahasa

Station	Species
1. rocky reef substrate	*Sargassum linearifolium*
	Padina boergesenii
	Gracilaria corticata
2. sandy-muddy substrate	*Turbinaria ornata*
	Padina boergesenii

Table 2. Classification of Brown Algae (Phaeophyta) and Red Algae (Rhodophyta) found at both stations.

Divisi	Kelas	Ordo	Famili	Genus	Spesies
Phaeophyta	Phaeophyceae	Dictyotales	Dictyotaceae	Padina	*Padina boergesenii*
Phaeophyta	Phaeophyceae	Fucales	Sargassaceae	Sargassum	*Sargassum llinearifolium*
Phaeophyta	Phaeophyceae	Fucales	Sargassaceae	Turbinaria	*Turbinaria ornata*
Rhodophyta	Rhodophyceae	Gracilariales	Gracilariaceae	Gracilaria	*Gracilaria corticata*

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Figure 3. *Padina boergesenii*

Figure 4. *Sargassum linearifolium*

Figure 5. *Turbinaria ornata*

Figure 6. *Gracilaria corticacta*

Macroalgae Classification

1. Brown Algae (Phaeophyta)

***Padina boergesenii* Allender & Kraft**

Padina boergesenii exhibits a form and type of thallus fan shaped and frondose, characterized by a basal portion forming rhizomatous disc and broad lobe thallus (Figure 3). This species attains a maximum height of 15 cm and a width of 12 cm (Jha et al., 2009). *P. boergesenii* displays a distinctive light to dark brown coloration, accompanied by varying degrees of calcification on its ventral surface (Venkatesan et al., 2023; Hakim & Patel, 2020). This species is commonly encountered within the intertidal and subtidal zones (Brian, 2015). While typically observed adhering to rocky substrates (Jha et. al., 2009; Diaz-Pulido et. al., 2019), *P. boergesenii* has also been documented colonizing sandy-muddy substrates (Balakrisnan, 2018; Kalasariya et al., 2023). *P. boergesenii* exhibits a broad geographical distribution, primarily in tropical and subtropical regions, encompassing the Caribbean, Virgin Islands, Indian Ocean, Pakistan, and Indonesia (Brian, 2015).

***Sargassum linearifolium* (Turner) C. Agardh**

Sargassum linearifolium exhibits a distinctive bushy, foliose thallus morphology characterized by a dark brown pigmentation (Figure 4). The thallus attains a height ranging from 60 to 120 cm. Its primary axis is characterized by a round and angled configuration (Jha et al., 2009). The primary axis and its branching patterns display a spiral arrangement and are sparsely muricate with leaves (Jha et al., 2009). This species further exhibits simple leaves, measuring 2-5 cm in length and 2.5 mm in width. These leaves are linear, veined, and possess pointed apices with short petioles. The margins of the leaves display indentations, serrations, and occasionally exhibit wing-like structures at the base of the

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median portion or serrated formations on the petiole (Jha et al., 2009). *S. linearifolium* is commonly observed attached to rocky substrates within the intertidal zone, specifically within the infralittoral fringe and sublittoral zone, as well as in tide pools (Jha et al., 2009).

***Turbinaria ornata* (Turner) J. Agardh**

Turbinaria ornata exhibits a branched thallus morphology characterized by ramified with obconical leaves (Figure 5). These leaves possess a rigid texture and display a color spectrum ranging from dark brown to light brown. The thallus can attain a maximum height of 50 cm and exhibits a dense branching pattern. The primary axis originates from a dichotomously branched holdfast. The erect, cylindrical main axis displays irregular branching patterns. The leaves are densely arranged, exhibiting a turbinate to obonical leaves morphology with a rough texture. They measure 0.5-1.5 cm in length and 10-15 mm in width at the distal end. The distal end of the leaves is triangular, slightly concave, and features a double row of spines on its surface. The petiole is round (Jha et al., 2009; Coppejans et al., 2017). This species is commonly observed on sandy-muddy substrates but exhibits an affinity for attaching to hard substrates such as dead coral skeletons (Bittick et al., 2019), rocks (Jha et al., 2009), and also on rocky substrates in intertidal zones (Zubia & Payri 2004).

2. Red Algae (Rhodophyta)

***Gracilaria corticacta* (J. Agardh) J. Agardh var*. clyndrica* Umamaheswara Rao**

Gracilaria corticacta (J. Agardh) exhibits a dense, cartilaginous thallus morphology characterized by a deep red to yellowish-red pigmentation (Figure 6). The thallus can attain a height of 10 cm or greater and demonstrates a rigid texture. It is distinguished by the presence of numerous colored spots on the frond. The frond displays an alternating, irregular dichotomous branching pattern, with the branches embedded at the base and densely clustered, terminating in pointed or spiny apices (Coppejans et al., 2017). *G. corticata* is typically observed growing on intertidal rock (Baghel et. al., 2011) and calcareous substrates (Jha et al., 2009).

The spatial distribution of macroalgae is influenced by substrate type, including sandy and rocky substrates, as well as environmental parameters such as nutrient availability, water clarity, sunlight intensity, temperature, and pH. Additionally, macroalgae distribution is influenced by predation pressure from organisms such as fish, sea turtles, and sea urchins (Tuiyo, 2014). The presence of seagrass meadows also plays a significant role in shaping macroalgae distribution and growth patterns (Richard & Quijon, 2023). Stations characterized by rocky reef and sandy-muddy substrates often exhibit the presence of seagrass meadows. The seagrass species identified at Budo Beach include *Enhalus acoroides, Cymodocea rotundata, Thalassia hemprichii*, and *Syringodium isoetifolium* (Lengkong, 2022). Lengkong (2022) further notes that *Thalassia hemprichii* is the dominant seagrass species at Budo Beach and serves as a critical ecosystem stabilizer. The presence of seagrass meadows creates competition for nutrient uptake and sunlight, although the negative impact is more pronounced on seagrass growth compared to macroalgae (Hessing-Lewis et al., 2011; Zribi et al., 2023).

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CONCLUSION

The research conducted at Budo Tourism Village Beach identified a total of four macroalgal species at both observation stations: *Gracilaria corticata*, *Sargassum linearifolium*, *Turbinaria ornata*, and *Padina boergesenii*. These species are classified into two classes: brown algae (Phaeophyceae) with 3 spesies of *Padina boergesenii, Sargassum linearifolium, Turbinaria ornata,* and red algae (Rhodophyceae), 1 spsies of *Gracilaria corticata*.

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