



TYPES AND CHARACTERISTICS OF THE MACROALGAE *Padina* spp. FROM PRAMUKA ISLAND & SEMAK DAUN ISLAND, KEPULAUAN SERIBU

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diatom, Haslea, macroalgae, morphology, *Padina*

ABSTRACT

Padina spp. is a marine macroalgae from the Phaeophyta Division that has aragonite crystals on the surface of its thallus. This macroalgae grows attached to the bottom substrate of the water and has the shape of a flat thallus in the form of wide and brown sheets. On the surface of the thallus, there are many Haslea diatoms which have marennine blue pigment. Marennine has potentials as an antioxidant, anti-bacterial and antiviral which can be used for human benefits. The purpose of this research was to determine the types and characteristics of *Padina* spp. located in Pramuka Island and Semak Daun Island, Kepulauan Seribu. The research took place from November 2019 - January 2020. The type of *Padina* was determined based on morphological characteristics, including the surface shape of the frond (thallus), color of the thallus, hairline and pattern, tetrasporangial sori and oogonial sori. The observed data were then processed using ImageJ software and the *Padina* determination key. The results indicated that the macroalgae samples 1B from Pramuka Island and 3C from Semak Daun Island were *Padina australis*, whereas sample 2B from Pramuka Island and 4B from Semak Daun Island were *Padina minor*. This information is in accordance with the results of previous researches on *Padina* in Kepulauan Seribu.

I. Introduction

Macroalgae are parts of highly valuable ecosystems, and are well known for the variety of potentials that can be explored from within. They play crucial roles in marine ecology and are also vital as primary producers to provide food, stability and other resources to coastal communities [1][2]. Brown macroalgae from the genus *Padina* are interesting breeds of marine flora that experience calcification; their unique trait [3]. They have a vast distribution scale and commonly found in marine waters, from shallow to deep waters. There are six known species in the Indonesian waters, i.e. *P. australis*, *P. boryana*, *P. minor*, *P. okinawaensis*, *P. sanctae-crucis* and *P. tetrastromatica*[3].

Macroalgae are known to have associations with various types of microorganisms such as diatoms. An association between the macroalgae *Padina* and an epiphytic diatom is discovered in Semak Daun Island. It is named *Haslea nusantara* and is morphologically similar to *H. ostrearia* in France, but genetically different [4]. *Haslea* contain blue pigments 'marennine' and are known to have antioxidant [5], antibacterial [6] and antiviral properties [6].

Recently, a project from *Hibah Internal Unpad* (HIU) has been launched in Universitas Padjadjaran, with an end-goal of mass culturing *Haslea nusantara*, extract their pigments and study their medicinal properties potentials and toxicity. Therefore, in order to cultivate the diatoms effectively, it is important to determine the macroalgae species which they use as their habitat.

II. Material and Method

Sample Collection

Sampling of macroalgae *Padina* spp was conducted in September 2019, at 4 stations in Semak Daun Island and Pramuka Island, Kepulauan Seribu (Figure 1).

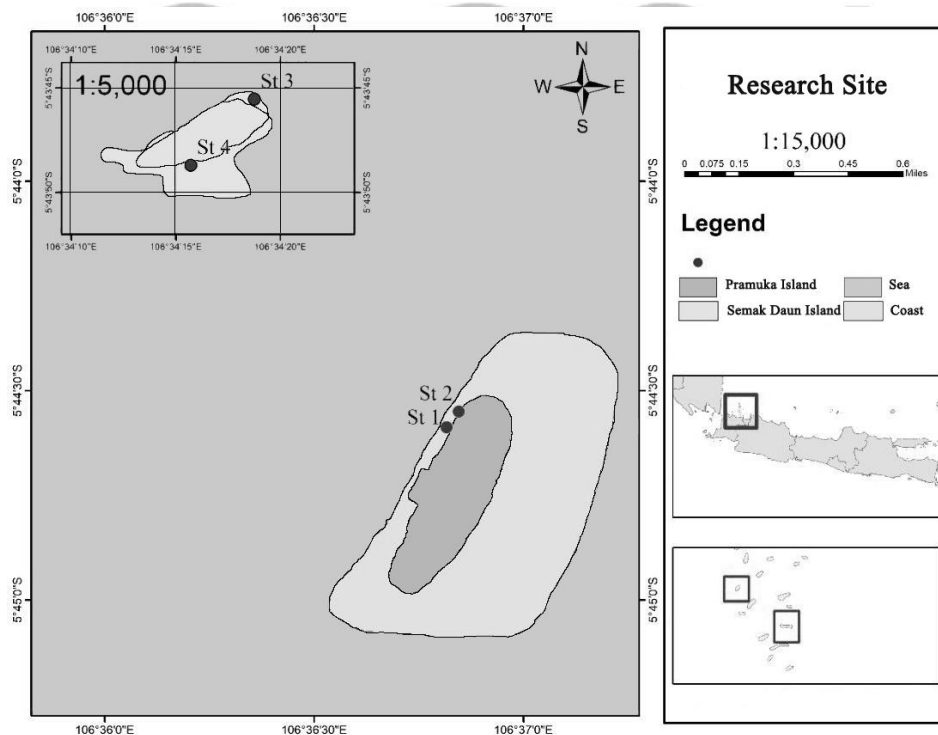


Figure 1. Sampling sites of *Padina* spp. in Semak Daun Island and Pramuka Island, Kepulauan Seribu

The macroalgae samples were taken directly by hand, then the thallus surface is carefully brushed and rinsed with sea water (Figure 2) and stored in falcon bottles. To preserve them, ethanol solution was added and the bottles were covered with parafilms. They were labeled, kept in ziplocks separately (in accordance to their respective stations) and stored in a coolbox. After arriving at the laboratory, the samples were stored in a refrigerator with temperatures reaching 5°C.



Figure 2. Macroalgae samples from Kepulauan Seribu

Water Quality Parameters

In the sample collection period, measurements of water quality parameters such as water temperature, pH, salinity and dissolved oxygen (DO), were carried out *in situ* at each site

Morphological Approach

The processes of morphological identification were carried out by visual observations, both visually and with microscope. Characteristics that were monitored consists of: thallus shape, inferior and superior surfaces, color, tetrasporangial sori, oogonial sori, calcification, lines and hair patterns. Its dimensions are measured accurately with ImageJ software.

Data analysis

The morphological characteristics of the macroalgae samples were identified and determined with a key species determination from [7]. The data is compared with results from previous researches.

III. Results and Discussion

Water Parameter

The measured water quality parameters (temperature, salinity, pH and DO) are factors that affect the growth of macroalgae. Water quality parameters of each station are listed in Table 1.

Tabel 1. Water Quality Parameter

Site	Temperature (°C)	Salinity (ppt)	pH	DO (mg/l)
Station 1	30,8	26	7	5
Station 2	29,7	31	7	4
Station 3	29,2	32	7	4
Station 4	30,1	31	7	4
Sea Water Quality Standard	28 - 30	33 - 34	7 - 8,5	>5

In general, the water in Pramuka Island and Semak Daun Island are not in accordance with the environmental quality standards issued by the Ministry of the Environment. From the 4 parameters observed, only the pH was within the ideal range.

However, water temperature in the two islands were sufficient for *Padina*. According to [8], the macroalgae *Padina* can grow and develop optimally at temperatures around 24-30°C, salinity 30-34 ppt, pH 6.8 - 9.6 and DO of > 4.54 mg/l. From these data, it can be concluded that the waters at the 4 stations have good qualities for *Padina*, although some parameters in a number of stations are not in the ideal range. This shows that *Padina* have good adaptability to water conditions with various parameter values [8].

Morphological characteristics

Generally, sample 1B, 2B, 3C and 4B have radial-shaped thallus and aragonite crystals on their surfaces. These crystals are prove of calcification - a unique trait of *Padina* - and are shaped like needles [9].

Sample 1B (Figure 3) and 3C (Figure 4) have similar traits. They are greenish-brown in color and the distance between each hair-line segments are consistent (about 2-3 mm). The hair-lines covered both the inferior and superior surfaces. Tetrasporangial sori are spotted on the superior surface. Based on the key determination of *Padina* species [7], sporangia that are found only in the superior surface of the thallus and hair present on both superior and inferior surfaces are characteristic of *P. australis*. Therefore it is assumed that sample 1B and 3C are *P. australis*. This data is supported by the morphological characteristics of *P. australis* from previous research results [3].

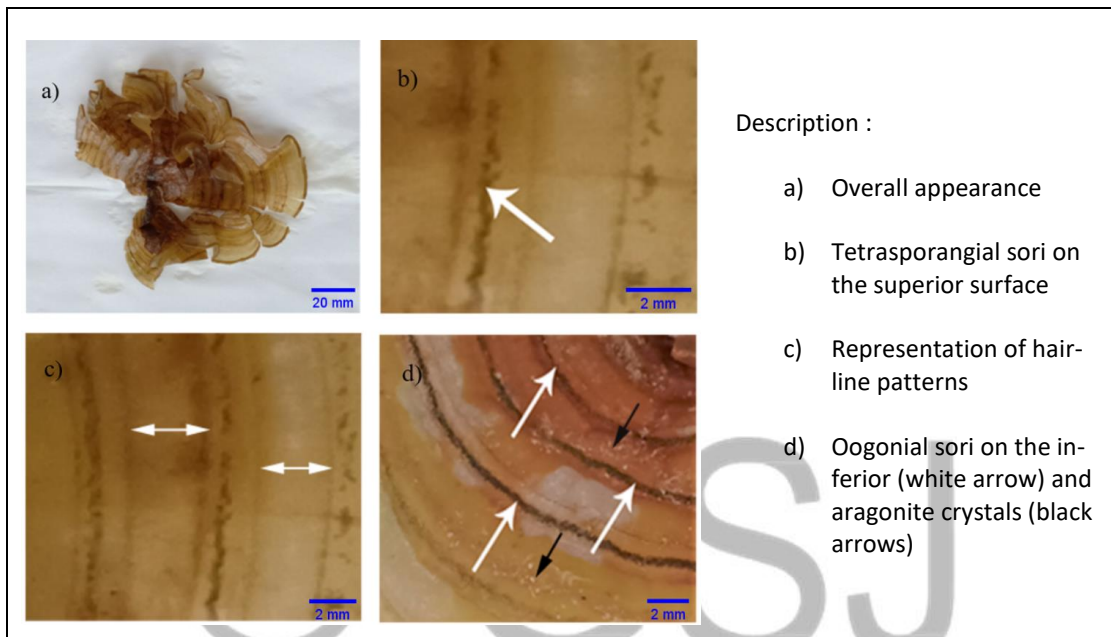


Figure 3. Characteristics of *Padina* 1B (Pramuka Island)

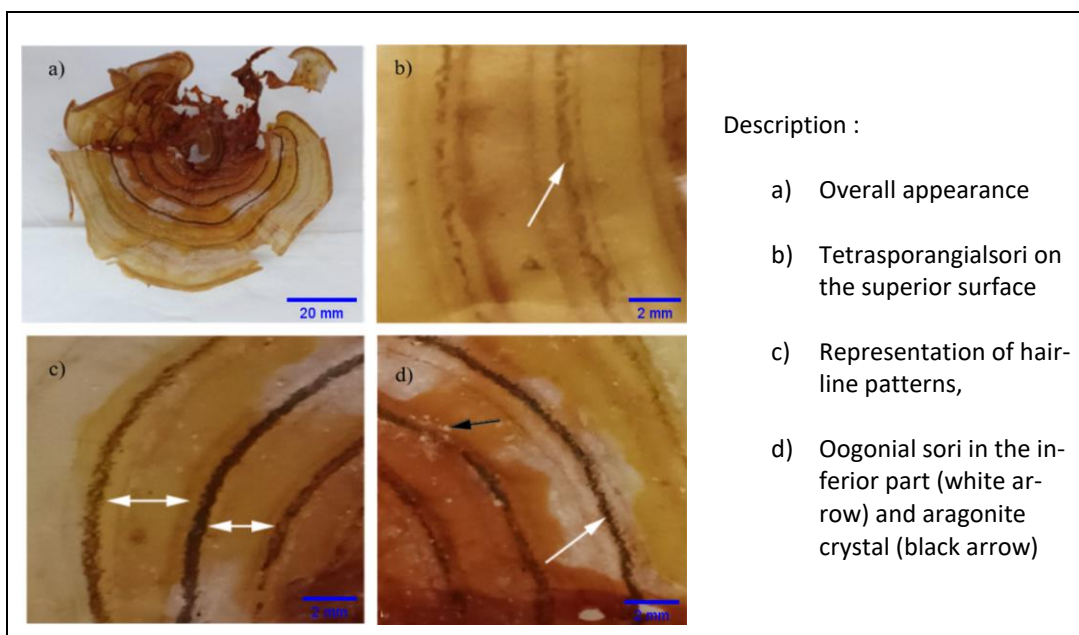


Figure 4. Characteristics of *Padina* 3C (Semak Daun Island)

Sample 2B (Figure 5) and 4B (Figure 6) have similar traits. They are brown in colour with a hint of greenish yellow and also have hairlines both in the superior and inferior surfaces. Some hairlines are continuous and they have a constant distance of 1.5 mm with one another. The tetrasporangial sori are only found in the inferior surface and are located close with the hairlines. According to the key determination of *Padina* [7], sporangia that are found only on the inferior parts of the thallus and tetrasporangia that are not covered by the indusium are characteristics of *P. minor*. Therefore it is assumed that sample 2B and 4B are *P. minor*. This data is supported by the morphological characteristics of *P. minor* from previous research results Win *et al.*(2013).

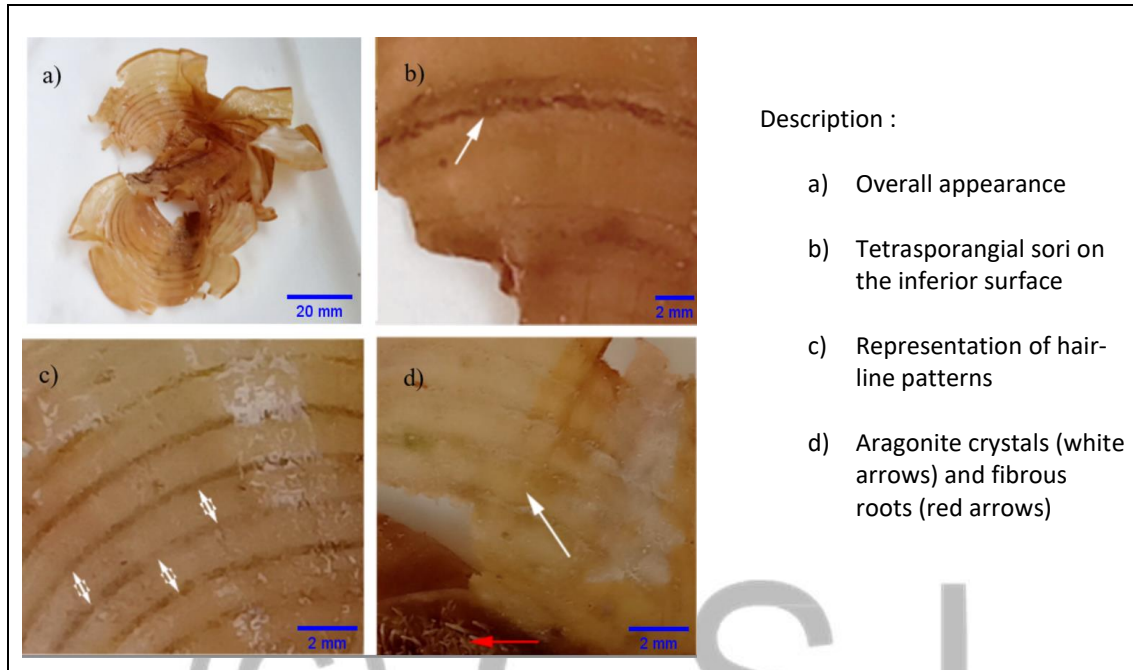


Figure 5. Characteristics of *Padina* 2B (Pramuka Island)

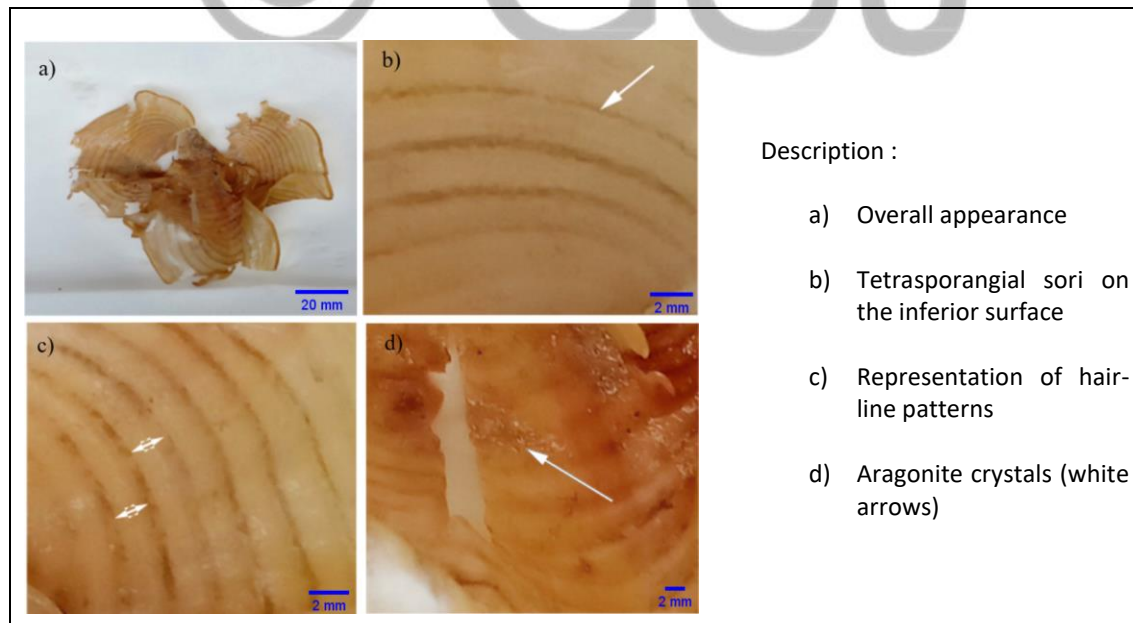


Figure 6. Characteristics of *Padina* 4B (Semak Daun Island)

Although *P. australis* from Sample 1B (Pramuka Island) and Sample 3C (Semak Daun Island) have their shares of similar characteristics, they do differ in the thallus' and roots' dimensions. The difference is, however, not significant. The same applies to *P. minor* from Sample 2B (Pramuka Island) and Sample 4B (Semak Daun Island), their differences were only in size. This indicates the absence of phenotypic plasticity in *Padina* from both islands which most likely occur due to the relatively similar water quality parameters. Based on the morphological data from Figure 3, Figure 4, Figure 5, and Figure 6, the most striking difference between these 2 species

is the lighter color of *P. minor* and the darker hairlines of *P. australis* with more distance variations in their gaps

P. australis has two cell layers throughout, with a thickness of 110–120 µm at the base and 95–100 µm at the other. The cells on the superior surface are also slightly thicker than the cells on the inferior. The tetrasporangia are round in shape. *P. australis* has similar characteristics to *P. ishigakiensis* in the thallus structure, but can be distinguished by the hairline pattern in which the distance between the lines are the same in *P. australis* but different in *P. ishigakiensis* (Win *et al.*, 2013).

P. minor also has two cell layers throughout its body. The tetrasporangia are also round in shape and ranges in diameter from 50–70 µm. *P. minor* has almost the same characteristics as *P. boryana* but can be distinguished by looking at the position of the hairline. The hairlines are present on the superior and inferior surfaces in *P. minor* but only on one side in *P. boryana*. Another variation in the characteristic is that *P. minor* only has 2 cell layers in the thallus while *P. boryana* has 2–3 cell layers (Win *et al.*, 2013).

Conclusion

The results from this study suggest that there are 2 species of macroalgae in Semak Daun Island and Pramuka Island. The morphological data based on the key species determination indicate that the samples 1B (Pramuka Island) and 3C (Semak Daun Island) are *Padina australis*, whereas samples 2B (Pramuka Island) and 4B (Semak Daun Island) are *Padina minor*.

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References

- [1] L. Eggertsen, L. Fontoura, and N. Kautsky, "Seaweed beds support more juvenile reef fish than seagrass beds in a south-western Atlantic tropical seascape," *ELSEVIER*, vol. 196, no. Estuarine, Coastal and Shelf Science, pp. 97–108, 2017, doi: 10.1016/j.ecss.2017.06.041.
- [2] I. Ira, R. Rahmadani, and N. Irawati, "Komposisi jenis Makroalga di Perairan Pulau Hari Sulawesi Tenggara (Spesies Composition Of Makroalga In Hari Island, South East Sulawesi)," *J. Biol. Trop.*, vol. 18, no. 2, pp. 141–158, 2018, doi: 10.29303/jbt.v18i2.770.
- [3] N. Win, T. Hanyuda, S. G. A. Draisma, P.-E. Lim, S.-M. Phang, and H. Kawai, "Taxonomy of the genus *Padina* (Dictyotales, Phaeophyceae) based on morphological and molecular evidences, with key to species identification," *Taxon. Southeast Asian Seaweeds*, vol. 7, no. May 2015, pp. 119–174, 2013.
- [4] F. S. Prasetya *et al.*, "Hasleanusantara (Bacillariophyceae), a new blue diatom from the Java Sea, Indonesia: morphology, biometry and molecular characterization," vol. 3913, no. x, pp. 1–15, 2019.
- [5] J. B. Pouvreaux *et al.*, "Antioxidant and free radical scavenging properties of marennine, a blue-green polyphenols pigment from the diatom *Hasleaostrearia* (Gailon/Bory) Simonsen responsible for the natural greening of cultured oysters," *J. Agric. Food Chem.*, vol. 56, no. 15, pp. 6278–6286, 2008, doi: 10.1021/jf073187n.
- [6] R. Gastineau *et al.*, "Biological activities of purified marennine, the blue pigment responsible for the greening of oysters," *J. Agric. Food Chem.*, vol. 60, no. 14, pp. 3599–3605, 2012, doi: 10.1021/jf205004x.
- [7] P. J. L. Geraldino, L. M. Liao, and S.-M. Boo, "Morphological Study of the Marine Algal Genus *Padina* (Dictyotales, Phaeophyceae) from Southern Philippines: 3 Species New to Philippines," *Algae*, vol. 20, no. 2, pp. 99–112, 2005, doi: 10.4490/algae.2005.20.2.099.
- [8] L. M. Aslan, *Budidaya Rumput Laut*. Yogyakarta: Kanisius, 1998.
- [9] M. Benita, Z. Dubinsky, and D. Iluz, "Padinapavonica: Morphology and Calcification Functions and Mechanism," *Am. J. Plant Sci.*, vol. 09, no. 06, pp. 1156–1168, 2018, doi: 10.4236/ajps.2018.96087.