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The study of plankton parameters for the cultivation of *Eucheuma cottonii* seaweed around Pancana Beach, Barru Regency, Indonesia

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Abstract

Background: This study aims to determine the possibility of cultivating *Eucheuma cottonii* seaweed based on plankton aspects around Pancana Beach, Barru Regency, Indonesia.

Materials and Methods: The study was divided into 3 observation stations (ST) based on the characteristics of each location. Data was collected and analyzed by descriptive analysis.

Results: The results showed that based on the plankton aspect, the research location was still suitable for the cultivation of seaweed of the type *Eucheuma cottonii* when viewed from the aspects of plankton abundance, diversity, uniformity and dominance.

Conclusions: All study sites have suitable plankton abundance, diversity and uniformity which can support the growth and survival of *Eucheuma cottonii*, and no plankton dominates in these waters.

Keywords: Plankton; Seaweed; *Eucheuma cottonii*; Pancana

1 Introduction

Seaweed is a thallus plant that can be found in almost all Indonesian waters, especially on beaches that have flat coral reefs. Seaweed is a commodity that has high economic value, so that seaweed cultivation with various methods continues to be developed to fulfil market needs whose demand continues to increase. Seaweed production is currently not sufficient to fulfil the increasing market demand, this is because some still rely on natural resources and their availability is uncertain and depends on the season [9]. This plant occupies a position as a primary producer that supports the life of other biota at a higher tropic level. Seaweed lives on the seabed and its substrate can be sand, crushed coral, dead coral and hard objects submerged on the seabed [12].

Seaweed cultivation in Indonesia is now increasingly being developed, using existing lands [5], and the type of seaweed that is most widely cultivated is the type of *Eucheuma cottonii*. *Eucheuma cottonii* seaweed is included in the type of Rhodophyceae or red algae which is the type of seaweed that is most widely cultivated in Indonesian waters, because it has high economic value and has an important role in increasing fish production for food fulfillment, and nutrition as well as to fulfil domestic and foreign markets [2]. In nature, there are many disturbances, including predation, changes in fluctuations in water quality parameters, and lack of nutrients needed by *Eucheuma cottonii* [16].

Selection of the right location is an important factor in determining the feasibility of seaweed cultivation. The main factor for the success of seaweed cultivation is choosing the right location. Several success factors that need to be

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considered in seaweed cultivation apart from good seeds, methods, methods of maintenance [2], Several success factors that need to be considered in seaweed cultivation apart from good seeds, methods, methods of rearing, harvesting and post-harvest treatment, is the selection of locations that meet the requirements for the type of seaweed being cultivated. The main factor for the success of seaweed cultivation is choosing the right location. Determination of the location and conditions of the waters must be adjusted to the cultivation method to be used [14].

One of the determining factors in determining the location of seaweed cultivation is the availability of plankton. Plankton are microscopic organisms that have a very important role, namely as the basis of life, specifically in pelagic waters. Plankton are organisms that live floating in the waters, and its swimming ability is very weak so that its movements are greatly influenced by the presence of water currents around it [26]. Plankton are classified into two types, namely phytoplankton and zooplankton [19,20]. Phytoplankton are vegetable plankton which are autotrophic, which means they have the ability to photosynthesize and can convert inorganic compounds into organic compounds [25]. Zooplankton are animal plankton that are heterotrophic, that is they cannot produce their own organic compounds so that their survival depends on phytoplankton as a food source [11]. The existence of plankton very determines the balance of an aquatic ecosystem [25]. The existence of plankton in the waters is very important, which acts as natural food for fish [19], and as well as aquatic bioindicators that can be used in evaluating the fertility of a waters [17,29].

Pancana Beach, Barru Regency, Indonesia is one of the areas be fathomed of having the potential for the development of *Eucheuma cottonii* seaweed cultivation. This area is a coastal area that stretches and connects the coast of Pangkep Regency through Barru Regency to Mamuju Regency. This area is also inhabited by residents who generally work as fishermen. Pancana Beach also has several small rivers and enough large river, namely the Pancana River. Based on this potential, research has been done on the coastal potential of Pancana Beach, Barru Regency for the cultivation of seaweed of the type *Eucheuma cottonii* based on biological parameters, especially plankton. This study aims to determine the possibility of cultivating *Eucheuma cottonii* seaweed based on plankton aspects around Pancana Beach, Barru Regency, Indonesia.

2 Material and methods

This study was carried out for 2 months, from July to August 2022 by taking 2 times of sampling to study aspects of seaweed cultivation including biological parameters, especially plankton. Determination of study locations based on differences in environmental characteristics at each research location. Station (ST) A is located on a small river around Butung, Station (ST) B is in the vicinity of residential areas and Station (ST) C is in the vicinity of the Pancana River Estuary.

The sampling method in this study used the vertical method. Vertical sampling of plankton was carried out using plankton net no. 25 which was equipped with a receptacle and ballast bottles. The plankton net is lowered slowly to a depth of 1-2 m and then pulled up so that the filtered sample enters the plankton net. The final step is to move the sample water into the sample bottle and then add 4 drops of 4% formalin solution, then the sample bottle is closed and labeled according to the sampling station then stored in a cool box. Then the samples were observed under a microscope and identified using a plankton identification book in the Laboratory [18]. After the data is collected and processed, the next process is to analyze the data using descriptive analysis.

3 Results

The role of plankton is very important in global environmental aspects related to global warming [10]. Phytoplankton are important organisms of aquatic ecosystems that occupy the lowest tropic level and have the ability to carry out photosynthesis. making these organisms a source of energy needed by all life in aquatic ecosystems, either directly or indirectly, through a food chain pattern [23].

3.1 Plankton Abundance (cell/ml)

One indication that can be used to show the level of fertility of the waters around a marine aquaculture unit is the composition and abundance of phytoplankton [23]. Several studies have proven that there is a close relationship between the availability of nutrients and the abundance of phytoplankton [8,23]. The abundance and composition of phytoplankton in the waters can be used as an indication of the level of fertility and changes in water conditions [13,18,23,28].

Table 1 Plankton Abundance Value at Study Locations

No.	Location	Plankton Type	Abundance (cell/ml)	Explanation
1	ST. A	*Chaetoceros* sp.	250	Sampling 1
			250	Sampling 2
		Prorocentrum micans	500	Sampling 1
			500	Sampling 2
		Navicula	750	Sampling 1
			1000	Sampling 2
		Plagiotropis sp.	500	Sampling 1
		Cyclotella sp.	1000	Sampling 1
			2500	Sampling 2
2	ST. B	*Navicula*	500	Sampling 1
			500	Sampling 2
		Thallasinema sp.	1000	Sampling 1
			1500	Sampling 2
		Prorocentrum micans	500	Sampling 1
		Cyclotella sp	1000	Sampling 2
		Chaetoceros sp.	500	Sampling 2
3	ST. C	*Chaetoceros* sp.	500	Sampling 1
		Prorocentrum micans	250	Sampling 1
			500	Sampling 2
		Thallosionema sp.	1000	Sampling 1
			2000	Sampling 2
		Navicula	500	Sampling 1
			500	Sampling 2
		Plagiotropis	500	Sampling 1
		Cyclotella sp	500	Sampling 2

Source: Primary Data After Processing (2022)

3.2 Plankton Diversity

The diversity index of phytoplankton generally ranges from 1-2.5 for coastal areas, especially estuary areas, polluted areas or upwelling areas [27]. The index range obtained is still included in the low diversity criteria [21,22]. The value of plankton diversity in this study was in the range of 0.128755033-0.367854877 (Table 2).

Table 2 Plankton Diversity Value at Study Locations

No.	Location	Plankton Type	Diversity	Explanation
1	ST. A	*Chaetoceros* sp.	0,207075554	Sampling 1
			0,128755033	Sampling 2
		Prorocentrum micans	0,298626578	Sampling 1
			0,202058292	Sampling 2
		Navicula	0,346573590	Sampling 1
			0,293213034	Sampling 2
		Plagiotropis sp.	0,298626578	Sampling 1
		Cyclotella sp.	0,366204096	Sampling 1
			0,365166293	Sampling 2
		Gymnodinium sp	0,342507925	Sampling 2
2	ST. B	*Navicula*	0,34657359	Sampling 1
			0,277987164	Sampling 2
		Thallasinema sp.	0,34657359	Sampling 1
			0,363127654	Sampling 2
		Prorocentrum micans	0,34657359	Sampling 1
		Cyclotella sp.	0,357932277	Sampling 2
		Chaetoceros sp.	0,277987164	Sampling 2
3	ST. C	*Chaetoceros* sp.	0,309954199	Sampling 1
		Prorocentrum micans	0,217990479	Sampling 1
			0,277987164	Sampling 2
		Thallosionema sp.	0,367854877	Sampling 1
			0,319780450	Sampling 2
		Navicula	0,309941999	Sampling 1
			0,277987164	Sampling 2
		Plagiotropis	0,309954199	Sampling 1
		Cyclotella sp.	0,277987164	Sampling 2

Source: Primary Data After Processing (2022)

3.3 Plankton Uniformity

Type uniformity is the distribution of the amount of individuals in each organism which can be determined by comparing the value of the diversity index with the maximum value [22]. The plankton uniformity value at the study site was 0.14279-0.23029 and the highest plankton uniformity value was at Station B, followed by Station C and Station A (Table 3). The plankton uniformity value in this study was lower than the results of study conducted [4] with an epiphytic microalgae uniformity index from all stations ranging from 0.488-0.740. If the uniformity value is close to 1 then this indicates the waters are in good condition, namely the amount of individuals of each species is relatively the same and the waters are considered balanced [7].

Table 3 Plankton Uniformity Value at Study Locations

No.	Location	Plankton Type	Uniformity
1	ST. A	*Chaetoceros sp.*	0,142793429
		Prorocentrum micans	
		Navicula	
		Plagiotropis sp.	
		Cyclotella sp.	
		Gymnodinium sp	
2	ST. B	*Navicula*	0,230296374
		Thallasinema sp.	
		Prorocentrum micans	
		Cyclotella sp.	
		Chaetoceros sp.	
	ST. C	*Chaetoceros sp.*	0,208062222
		Prorocentrum micans	
		Thallosionema sp.	
		Navicula	
		Plagiotropis	
		Cyclotella sp.	

Source: Primary Data After Processing (2022)

3.4 Plankton Dominance

Table 4 Plankton Dominance Value at Study Locations

No.	Location	Plankton Type	Dominance	
			(ni/N)=pi	(ni/N)2=pi2
1	ST. A	*Chaetoceros* sp.	0,4000	0,0016
		Prorocentrum micans	0,0800	0,0064
		Navicula	0,1600	0,0256
		Gymnodinium sp.	0,2400	0,0576
		Prorocentrum micans	0,0800	0,0064
		Cyclotella sp.	0,0400	0,1600
2	ST. B	*Navicula*	0,1429	0,0204
		Thallosionema sp.	0,4286	0,1837
		Cyclotella sp.	0,2857	0,0816
		Chaetoceros sp.	0,1430	0,0204
3	ST. C	*Cyclotella* sp.	0,1429	0,0204
		Prorocentrum micans	0,1429	0,0204
		Thallosionema sp.	0,5714	0,3265
		Navicula	0,1429	0,0204

Source: Primary Data After Processing (2022)

The dominance of the diatom class in waters because it has the ability to adapt to the environment, is cosmopolitan, and is resistant to extreme conditions, and has high reproductive power. The greater the dominance index value, the greater the tendency for certain species to dominate [12].

4 Discussion

The value of plankton abundance at the study site was in the range of 250-2500 cells/ml (Table 1). The result study in Ekas Bay, West Nusa Tenggara found that as many as 13 types of phytoplankton were found at the study site which were grouped into three classes, namely Bacillariophyceae, Chlorophyceae, and Dinophyceae [24]. The three types of phytoplankton with the greatest abundance found were *Nitzschia* sp., *Girosygma* sp., and *Coscinodiscus* sp. with the highest abundance of 26,928 ind./L. Diatoms are the most common class of phytoplankton found in Indonesian waters [19]. The abundance of epiphytic microalgae is determined by the amount of individuals found, and the more individuals, the higher the abundance [4]. Nutrient concentration is an important factor that very influences the abundance and amount of types of phytoplankton in the study area [24]. Thus it can be said that the study location has an abundance of plankton that is quite suitable and suitable for the cultivation of *Eucheuma cottonii*.

Species diversity is a unique characteristic of the community level in biological organization which is expressed through community structure [6]. The species diversity index (H') of epiphytic microalgae at each station ranges from 1,840-1,014 cells/l [4]. The research location has various types of plankton so it is very suitable for cultivating *Eucheuma cottonii* seaweed.

The high and low uniformity values in a waters indicate that in that ecosystem there is a tendency for dominance due to the stability of environmental factors that can affect the level of uniformity of epiphytic microalgae [15]. Thus, even though the study location has a plankton uniformity value that has not yet reached one, it is still suitable for the cultivation of *Eucheuma cottonii* seaweed. water quality factors can affect the uniformity of epiphytic microalgae in waters [30].

Factors that influence the dominance of one species, namely light, temperature, and other chemical forms of nutrients [1]. Based on the results of the study it was found that at ST A the plankton species were dominated by *Chaetoceros* sp with dominance values ranging from 0.1600 to 0.400, while ST B and C were dominated by *Thallosionema* sp plankton with a value range from 0.1429 to 0.5714 (Table 4). The dominance index obtained in this study has a value that is almost the same as the results of research in Nunukan Island waters, which ranged from 0.251-0.525 [3,4]. Based on the results of this study, it shows an even dominance value, which means that there is no type of plankton that dominates its existence in the waters.

5 Conclusion

Based on the results of the study, it was shown that based on the plankton aspect, the study location was still suitable for the cultivation of seaweed of the type *Eucheuma cottonii* when viewed from the abundance, diversity, uniformity and dominance of plankton. That the plankton in the study site has good, appropriate abundance, diversity and uniformity of plankton and no plankton dominates the waters.

Compliance with ethical standards

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References

[1] Abida, I. W. Primary Productivity and Its Relationship with Light Intensity and Nutrient Availability in the Madura Strait Coastal Waters, Bangkalan Regency. Jurnal Ilmu Perikanan. 2010; 4: 420-432.

[2] Anggadiredja, J., Zatnika, A., Purwoto, H., and Istini, S. Seaweed, Cultivation, Processing and Marketing of Potential Fishery Commodities. Penebar Swadaya, Jakarta. 2006; 147p.

[3] Aprilliyani. Epiphytic Microalgae Communities Associated with Seaweed in Nunukan Island Waters. Thesis. Aquatic Resources Management Study Program, Faculty of Fisheries and Marine Sciences, Universitas Borneo Tarakan, Tarakan. 2018.

[4] Apriliyanti, M. S. Identification of Plankton from Seaweed Cultivation Area of Bantaeng Regency, South Sulawesi by DNA Barcoding Method. Thesis. Faculty of Agriculture. Universitas Lampung. Bandar Lampung. 2018.

[5] Aslan, L. M. Seaweed Cultivation. Kanisius Publishers, Yogyakarta. 1998.

[6] Barus, I.T.A. Environmental Abiotic Factors and the Diversity of Plankton as Water Quality Indicators in Lake Toba, North Sumatera, Indonesia. Jurnal Manusia dan Lingkungan. 2004; 11(2): 64-72

[7] Brower, J. E. H. Z. Jerroid and Car I. N. Field and Laboratory Methods for General Ecology. Jurnal Biologi Papua. 1990; 5: 50-55.

[8] Gao, X., and Song, J. Phytoplankton distribution and their relationship with the environment in the Cahngjiang Estuary, China. Marine Pollution Bulletin. 2005; 50: 327-335.

[9] Ginting, E. S., Rejeki, S., and Susilowati, T. The Effect of Soaking Liquid Organic Fertilizer With Different Doses on Seaweed Growth (Caulerpa lentillifera). Journal of Aquaculture. 2005. https://ejournal3.undip.ac.id/index.php/jamt/article/view/10050

[10] Harley, C.D.G., Hughes, R.A., Hultgren, K.M., Miner, B.G., Sorte, C.J.B., Thornber, C.S., Rodriguez, L.F., Tomanek, L., and Williams, S.L. The impacts of climate change in coastal marine systems. Ecology Letters. 2006; 9: 228-241.

[11] Indah, W. A. Community Structure and Phytoplankton Abundance in the Waters of the Porong Sidoarjo Estuary. Jurnal Kelautan. 2010; 3(1).

[12] Kadi, A. Distribution of Halimeda Algae in Indonesia Anonymously (Ed.). Indonesian Marine Oceanology Research, Book I : Biology, Geology, Environment and Oceanography. LIPI. Jakarta. 1989; 39-42.

[13] Karydis, M. and Tsirtsis, G. Ecological Indeces: a Biometric Approach for Assessing Eutropication Levels in the Marine Environment. The Science of the Environment. 1996; 186: 209-219.

[14] Khasanah, U. Waters Suitability Analysis for *Eucheuma cottonii* Seaweed Cultivation Sites in the Waters of Sajoanging District, Wajo Regency. Department of Marine Science, Faculty of Marine Science and Fisheries, Universitas Hasanuddin. Makassar. 2013.

[15] Krebs, C. J. Ecologycal Methodology. Jurnal Balik Diwa. 1989; 6: 1-16.

[16] Kushartono, E. W., Suryono and E. Setiyaningrum. M. R. Application of Differences in N, P and K Compositions in *Eucheuma cottonii* Cultivation in Teluk Awur Waters, Jepara. Jurnal Ilmu Kelautan. 2009; 14(3): 164 -169.

[17] Melati., Herman., and Listari. 2005. Phytoplankton Community as Aquatic Bio-Indicator in Jakarta Bay. Depok, National Seminar of MIPA. 2005; 75p.

[18] Munthe, Y. V., Aryawati, R., and Isnaini. 2012. Community Structure and Distribution of Phytoplankton in Sungsang Waters, South Sumatra. Maspari Journal, 4(1).

[19] Nontji, A. Sea Plankton. Pusat Penelitian Oseanografi. Lembaga Ilmu Pengetahuan Indonesia (LIPI). LIPI Press. 2008; 331p.

[20] Novrilianty, H., M. Hudatwi., and E. Utami. The Diversity of Plankton Species as an Indicator of Water Quality in the Waters of Batu Belubang Beach and Panjang Island, Central Bangka Regency. Journal Perikanan. 2022; 12 (3): 333-345. http://doi.org/10.29303/jp.v12i3.325

[21] Odum, E.P. Fundamentals of Ecology. Third edition. Saunders, W.B. Company. Philadelphia, London, Toronto.1971; 574p.

[22] Odum, E. P. Ecology Fundamentals. Jurnal Biologi.1998; 8: 100-117.

[23] Radiarta, I.N. The Relationship Between Distribution of Phytoplankton and Water Quality in the Alas Strait, Sumbawa Regency, West Nusa Tenggara. Jurnal Bumi Lestari. 2013; 13(2): 234-243.

[24] Radiarta, I.N., Erlania, dan K. Sugama. Spatial and Temporal Analysis of Phytoplankton Communities Around Integrated Marine Aquaculture in Ekas Bay, West Nusa Tenggara. Jurnal Riset Akuakultur. 2015; 10(2): 283-291.

[25] Rofiki, N., Amin, B., and Sofyan Husein Siregar. Analysis of Organic Matter and Phytoplankton Abundance in the Waters of the Guntung River Estuary, Kateman District, Indragiri Hilir Regency, Riau Province. Berkala Perikanan Terubuk. 2019; 43(2).

[26] Silaban, S. M., Thamrin, and Siregar, S. H. Abundance of Phytoplankton and Primary Productivity Levels in the Waters of Kasiak Island West Sumateraprovince. Journal of Coastal and Ocean Sciences. 2022; 3(2).

[27] Soedibjo, B.S. Phytoplankton Community Structure and its Relationship with Several Environmental Parameters in Jakarta Bay waters. Oceanology and Limnology in Indonesia. 2006; 40: 65-78.

[28] Thoha, H., and Amri, K. The Composition and Abundance of Phytoplankton in the Waters of South Kalimantan. Oceanology and Limnology in Indonesia. 2011; 37(2): 371- 382.

[29] Umar, N.A. Composition and Abundance of Phytoplankton Relation to Abundance of Zooplankton (Kopepods) and Mangrove Crab Larvae (Scylla spp.). Thesis. Bogor: Institut Pertanian Bogor. 2002; 164 p.

[30] Widianingsih., R. Hartati., H. Endrawati and M. Hilal. Study of Total Lipid Levels and Density of Nitzschia sp. in Cultures with Different Salinities. Journal of Marine and Coastal Science. 2012; 5: 35-45.