The existence of epiphyte on thallus *Eucheuma denticulatum* (Rhodophyceae) in varying depths cultivated with vertical net method

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Abstract. The existence of macroepiphyte is one of the issues seaweed farmers often face. This research aims to explore the existence of macroepiphyte attached to seaweed *Eucheuma denticulatum* at varying depths using vertical net method. Research found that the highest and the lowest velocity of macroepiphyte on day -10 in the depth of 50 cm and 200 cm is 248,4 and 121,28 ind/m²/day. On day-20, in the depth of 100 cm and 200 cm is 333,54 and 270,01 ind/m²/day. The most dominating macroepiphyte in the attachment velocity is *C. Crasa*. Physical and chemical parameter showed around 29°-30° C. Current velocity 0,050-0,067 m/sec. Brightness 92%. Salinity 30-33‰. Nitrate 0,237-0,0416 mg/L. Phosphate 0,0015-0,0036 mg/L. Dissolved oxygen 5,7-6,2 mg/L. The obtained optimum environmental parameter and the type of the macroepiphyte attachment did not show any significant negative effect to the growth of *E. denticulatum*.

1. Introduction
Seaweed *E. denticulatum* is one of the seaweeds serving as fishery commodity that is abundant in Indonesian water areas. Epiphyte is an organism that clings into living flora or fauna and lifeless things such as rock. Epiphyte grows by attaching to the bark of trunks and branches, leaves, and to the surface of a sinking rock. Epiphyte communities that have clinging nature tend to stay in one location. Hence, this fact is deemed as bio-indicator of the quality of the flowing water area [1] Macroepiphyte is an epiphyte that owns larger size of leaves than other varieties. The parts such as (root, branch, and leaf) can be differentiated clearly with the size of 1>mm and microepiphyte has <1mm smaller with no vessels [2]. Macroepiphyte is a group of lower microorganisms that has no vessels and is included in *Thallophyta* group or widely known as a plant with thallus [3]. Macroepiphyte is morphologically enriched with a root-like part (holdfast) functioning as an attaching organ in their water habitat. The growth of mosses and epiphyte will block sunlight which later result in the decreasing process of photosynthesis. This will make the cultivated seaweed thin, and the growing pace will decrease [4]. Epiphyte clinging to thallus algae does not give negative impacts directly. However, the very existence of them serves as the competitors for the host in resources gathering. Hence this competition will affect *E. denticulatum*. The absorption of nutrients and sunlight is one of which. Their existence can also invite harmful organism [5]. The rise of macroepiphyte that is deemed as a primary problem and how far they attack often depends on the cultivated seaweed quality, environmental parameters, and extreme weather fluctuation [6]. Epiphyte is a disturbing pest that decrease the seaweed production [7]. In cultivating activity, one of the factors is the existence of epiphyte. Seaweed is a potential host.
to be attached by macroepiphyte so that the production will be affected. The existence of epiphyte on thallus algae gives direct negative impacts, but it can also serve as a competitor for the host. Epiphyte and the host have the same purpose in absorbing the nutrients as well as the sunlight. Thus, the competition is inevitable [5]. The existence of macroepiphyte can create a competition of absorbing the sunlight, this will render the production rate plunging down [8]. The growth of mosses and epiphyte will block sunlight which later result in the decreasing process of photosynthesis. This will make the cultivated seaweed thin, and the growing pace will decrease [4]. Seaweed can benefit from the sunlight to optimize the photosynthesis process as well as the process of growing and absorbing nutrients [9]. A lot of macroepiphytes attaching to thallus seaweed can hinder their growth and absorbing nutrients, block the sunlight for photosynthesis, hence the food and room competition [10]. The important factor that influences the seaweed growth is the different portion of sunlight received by the seaweed growing in the different depths. It can influence the array of new cells that almost never undergo changes in the seaweed that only got a little portion of sunlight [11]. The existence of macroepiphyte keeps increasing due to the not-protective tools from the farmers. Vertinet is a rectangular seaweed cultivation tool towards the depths of the waters, which is used to protect seaweed from attacks by herbivorous fish and turtles. Vertinet method is needed to be done as one of the solutions to fix the cultivation management in the research location [12, 13].

2. Research Methods
This research was conducted in February – July 2019 within a water area in Tanjung Tiram village, Konawe Selatan District, Southeast Sulawesi. The water quality sample observation was done in the Laboratory of Marine and Fishery Faculty, Halu Oleo University, Kendari. The research location was divided into two observational points with the distance between point 1 and 2 around 100 meters. The specific point locations aim to enrich the data due to the homogeneity of the research location. Point 1 was at the coordinate 04° 01’ 59” LS dan 122° 40’25” BT. Point 2 was at the coordinate 04° 01’ 57” LS dan 122° 40’29” BT.

2.1. The Cultivation Installation
One unit of 40 x 200 cm rectangle verti net down vertically around 200 cm. It is made from net and half-inch PVC tube. Verti net is made of nylon net from meshize 1 cm [13]. The arranged verti nets are placed in two different locations with the distance around ± 100 m. Each verti net has different depths: 50 cm, 100 cm, and 200 cm which later be identified as Verti net A and verti net B. 15 (fifteen) E. Denticulatum seed is placed on each verti net at the different depths. The thallus net is attached to the net. Each thallus weighs 50 g. To differentiate, each verti net is labelled with different ties as verti net A and verti net B. The ties will also serve as a tool for observation.

2.2. Sampling Method
Samples were taken three times with the interval of 10 days. Twenty thallus (27) in total samples were taken at the depths of 50 cm, 100 cm and 200 cm. Thallus were taken by cutting the tie. Each sample was put into labelled plastic which later would be identified the existence of the macroepiphyte within.

2.3. Water Quality Parameter
Physical and chemical parameter were used together with macroepiphyte samples. Thermometer was used to scale physical parameter, Secchi disk for the brightness, the current velocity was scaled by a special tool, salinity by Hendrafraktometer. The scaling of DO and Nitrate was conducted in the Laboratory. The examination was done in the Laboratory of Marine and Fishery Faculty, Halu Oleo University. The researcher used brucin method (SNI 06-2480-1991) for scaling nitrate and spektrofotometer (APHA 4500-PD-1998) for phosphate.
2.4. Statistical Analysis
Scaling the density value of macroepiphyte was done to determine attachment rate of macroepiphyte in this research. The macroepiphyte attachment rate was calculated using relevant patterns. The analysis of attachment rate and water quality parameter was processed statistically with the assistance of SPSS software ver. 16.0.

3. Results

3.1. Macroepiphyte Species
The results shown that there are 9 varieties of macroepiphyte attaching to thallus *E. denticulatum* in Study site (Table 1).

| No | Class                  | Depth 50 cm | Depth 100 cm | Depth 200 cm |
|----|------------------------|-------------|--------------|--------------|
| 1  | *Rhodophyceae*         |             |              |              |
|    | Acanthopora spicifera  | –           | –            | –            |
|    | Boergeseniella sp.     | –           | √            | –            |
| 2  | *Phaeophyceae*         |             |              |              |
|    | Sargassum cristaefolium| –           | √            | –            |
|    | Padina minor           | –           | –            | √            |
|    | Padina pavonica        | –           | –            | √            |
| 3  | *Chlorophyceae*        |             |              |              |
|    | Chatomorpha crassa     | √           | √            | √            |
|    | Chondrophycus papillosa| –           | –            | –            |

Information: - Occurs (√), Not Occurs (−)

3.2. Macroepiphyte Density
Based on the density observation on day-10, the researcher found 3 species of macroepiphyte attaching to thallus *E. denticulatum* which were *C. crassa*, unidentified species 1, and unidentified species 2. The highest density in the depth of 50 cm, 75 and 200 ind/m² were *C. Crassa* type and unidentified species 2. (Figure 2).
3.3. Macroepiphyte Attachment Rate
The result of the attachment rate of macroepiphyte to seaweed *E. denticulatum* in total is shown on Table 2.

**Table 2.** Attachment rate of macroepiphyte to seaweed *E. denticulatum*

| Species of Macroepiphyte | Total attachment rate of Macroepiphyte (indv./m²/days) |
|--------------------------|--------------------------------------------------------|
|                          | 50 cm | 100 cm | 200 cm | 50 cm | 100 cm | 200 cm | 10 days | 20 days | 30 days | 10 days | 20 days | 30 days |
| **No** | **Class** | **Acanthopora spicifera** | **Boergeseniella sp.** | **Sargassum cristaefolium** | **Padina minor** | **Padina pavonica** | **Chatomorpha rasa** | **Chondrophycus papillosa** | **Unidentified sp. 1** | **Unidentified sp. 2** |
| 1 | Rhodophyceae | 0,1 | 23,8 | 0,03 | 0,1 | 45,18 | 0,03 | 0,1 | 29,78 | 0,03 |
| 2 | Phaeophyceae | **Sargassum cristaefolium** | 0,1 | 11,93 | 0,03 | 0,1 | 0,05 | 0,03 | 0,1 | 0,05 | 0,03 |
| | **Padina minor** | 0,1 | 0,05 | 19,37 | 0,1 | 0,05 | 0,03 | 0,1 | 0,05 | 0,03 |
| | **Padina pavonica** | 0,1 | 0,05 | 8,25 | 0,1 | 0,05 | 0,03 | 0,1 | 0,05 | 0,03 |
| 3 | Chlorophyceae | **Chatomorpha rasa** | 180,1 | 237,55 | 241,94 | 135,55 | 197,18 | 205,45 | 81,1 | 178,18 | 174,03 |
| | **Chondrophycus papillosa** | 0,1 | 0,05 | 30,24 | 0,1 | 0,05 | 0,03 | 0,1 | 0,05 | 0,03 |
| | **Unidentified sp. 1** | 0,1 | 0,05 | 21,48 | 0,05 | 15,02 | 0,1 | 0,05 | 0,03 |
| | **Unidentified sp. 2** | 67,6 | 36,86 | 44,74 | 33,85 | 90,89 | 48,37 | 39,48 | 61,8 | 48,97 |
3.4. Water Quality Parameter

The measurements of physical-chemical parameter include temperature, current velocity, brightness, salinity, nitrate, phosphate and DO. The result of the measurements can be seen on Table 3.

### Table 3. Measurement result of environmental parameter on study sites

| No | Environmental Parameters | Units | Ranges |
|----|--------------------------|-------|--------|
| 1  | Temperature              | °C    | 29-30  |
| 2  | Current Velocity         | m/s   | 0,092-0,473 |
| 3  | Brightness               | %     | 92     |
| 4  | Salinity                 | ‰     | 30-33  |
| 5  | Nitrate                  | mg/L  | 0,0237-0,0416 |
| 6  | Phosphate                | mg/L  | 0,0015-0,0036 |
| 7  | Dissolved Oxygen          | mg/L  | 5,7-6,2 |

Correlation analysis between attachment rate and water quality parameter showed that the ones that had real correlation to attachment rate were temperature and salinity which can be seen on Table 4.

### Table 4. Analysis correlation result between attachment rate and water quality parameter

| Epiphyte Attachment rate | Tempeature | Brightness | Dissolved Oxygen | Nitrate | Salinities | Phosphate | Current velocity |
|--------------------------|------------|------------|------------------|---------|------------|-----------|------------------|
| Epiphyte Attachment rate |            | -0,463     | 0,437            | -0,627  | 0,891      | -0,741    | 0,328           |
| Temperature              | -          | -0,223     | 0,338            | -0,910  | 0,688      | -0,394    | 0,338           |
| Current velocity         |            | -          | 0,441            | -0,064  | -0,218     | 0,361     | -0,840          |
| Brightness               |            |            | -                | 0,209   | 0,760      | -0,666    | -0,706          |
| Salinities               |            |            | -                | -0,382  | 0,008      | -0,256    |                 |
| Dissolved Oxigent Nitrate|            |            | -                | -0,922  | -0,092     |          |                 |
| Phosphate                |            |            |                  |         |            | 0,102     |                 |

**Correlation significant at level 0,001**

4. Discussion

During research, the researcher found 9 species of macroepiphyte attaching to thallus E. denticulatum. The numbers of macroepiphytes attaching were caused by the thallus’ form which was small and full of tiny thorns. This made macroepiphyte that were flowing with current be able to easily attach [14]. The most dominant macroepiphytes were C. crassa dan H. Cervicornis. C. crassa which is commonly found attaching to other macroalgae, thrived by spreading on the substrate of rocks and sand. It has cylinders thallus like hair resembling tangled thread [12, 13]. In the previous research in Tanjung Tiram village, it was found 16 species of macroepiphyte at E. denticulatum. All of them consisted of 8 species from Rhodophyta class, 6 from Chlorophyta and 2 from Phaeophyta class [17]. The morphology of the thallus seaweed was very important to the placement of epiphyte attachment. The complex structure of the thallus was great to be colonized by numbers of epiphytes because of its capability to provide shelter [18]. Macroalgae were found the most on the substrate of lifeless corals than those of living corals. This happened because the living corals had saliva and empowering cells that initially had been habituated by tube macroalgae which later be followed by bigger ones [19]. In the water area in Tual, Southeast Maluku, found 8 species of macroepiphytes attaching to seaweed such as Codium sp., E. clatharata, A. dendroides, A. spicifera, D. dichotoma, Padina sp., and blue green algae [20]. The research in Lakeba found 8 species of macroepiphytes clinging to seaweed E. spinosum such as macroepiphytes A. spicifera, C. papilosa, C. crassa, J. longifurca, P. triquete, U.
lactuca, T. ornata and unidentified species [21]. Six other species which were E. clatharata, C crassa, U. fasciata, J longifurca, Ps triquete and unidentified species [22]. One of the density factors which was influenced by physical-chemical of the water area was current velocity. The current velocity during research could be categorized as normal with the value of 0.097-0.473 m/s. The high velocity could break the thallus body and it tended to trigger macroepiphyte growth on thallus. The opposite would do no good to the thallus itself such as the thriving macroalgae can dominate the sunlight as well as nutrient absorption [23].

The varieties and numbers of macroepiphyte attached to thallus E. denticulatum on verti net could cause the failure of the seaweed harvest. Because of the body of the seaweed was so thin and fragile, harvesting them would mean more loss [12, 24]. The researcher found the different in numbers and species of the macroepiphyte attaching. Epiphyte is one of the parasites that can cause harvest failure, the said one is Neosphonia apiculata [10]. The attachment of macroepiphyte can harm thallus seaweed. The growth rate of the seaweed will remain stagnant day per day because of the competitive match over sunlight and nutrients [13, 25]. The existence of macroepiphyte can be a new competitor due to its ability to cling to thallus seaweed [20]. Macroepiphyte and disease infection can make the seed quality bad to cultivate [14, 26]. The inability to thrive in the deep water is caused by the small supply of sunlight and oxygen [11]. The sunlight absorption is a limiting factor to the growth of the seaweed thus the depth of the water must be paid attention to when it comes to seaweed cultivating [28].

Macroepiphyte at a specific species looks like a brownish hair, attaching to thallus, this renders the thalli’s surface wavy. Macroepiphyte E. flaccida live by gathering at the wounded part or on the base of thallus. They slowly cover all the surface of the thallus. The macroepiphyte is included to the type that can be easily remove because of its weak adhesive power. This type also merges with water dirt. They can rot the thallus if left attaching for too long [27, 29]. Each organism has different threshold towards several environmental parameters such as salinity including seaweed. Some has high threshold so that they can endure and thrive in the environment deemed not well for others. That condition indicates that macroepiphyte attachment rate does not have significant influence towards thallus as the media to attach [30]. If we put that into 5 species, the average effects caused by macroepiphyte can be put into type -3 in which the macroepiphyte attaches without destroying the metabolism cells that can help other cells to grow [31]. The high rate of macroepiphyte attachment can be caused by the optimum nitrate concentration which can support the growth of the macroepiphyte. The phosphate concentration found during research was so low around 0,0015-0,0036 mg/L. That value can be considered low for the the optimum value needed. One of the causes of the loss of the attaching algae which was found in the first week during the research in Bantaeng district was the low concentration of phosphate in the water area. The macroepiphyte attached was A. spicifera, Boergeseniella sp., C. crasa, C. papillosa, P. minor, P. pavonica, Un identified species 1 and unidentified species 2. That research gives us hints that there are different patterns to the species of macroepiphyte attaching [23]. There are changes in either the species and light intensity towards attaching biota with simpler morphology like thread. Enthermorpha and Chaetomorpha will attach in moderate number and will dissipate and be replaced by other species with more complex form. Macroepiphyte with strong adhesive power which can penetrate into cell wall and corticosteroids tend to cling strongly and to cause harms to the growth of seaweed. In the opposite, the weak adhesive type doesn’t cause significant harm to the seaweed. The macroepiphyte’s growth really depends on the physical and chemical parameters. If they are not fit living, then they will be replaced by those who fit [31].

5. Conclusion
Macroepiphyte attaching to thallus E. denticulatum during research were 9 species; A. spicifera, Boergeseniella sp., C. crasa, C. papillosa, P. minor, P. pavonica, S. cristaefolium. The highest and lowest attachment rate happened on day-10 in the depth of 50 cm and 200 cm which were 248,4 and
121,28 ind/m²/day. Temperature and salinity were significantly influence and give positive effect towards the macroepiphyte attachment rate.

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References
[1] Chindah A C 2009 *Scienata. Africana*. 2 106-116
[2] Aththorick A T, Siregar E S and Hartati S 2007 *Sumatera. Biology. Journal*. 02 12-16
[3] Pelinggo R E and Tito O D 2009 Modul 7: Seaweed Production Westren Mindona State University (WMSU) Zamboanga: Philiphina
[4] Susanto A B 2005 *Ilmu. Kelautan*. 10 158-164
[5] Arisandi A, Farid A, Wahyuni A E and Rokhmaniati S 2013 *Journal. of Marine. Science*. 18 1-6
[6] Vairappan C S 2006 *Journal Applied phycology* 18 611–617
[7] Marlia, Kasim M and Abdullah 2016 *Journal. of Aquatic. Resources. Management*. 1 451- 461.
[8] Sulistijo and Atmadja W S 1996 Perkembangan budidaya Rumput Laut di Indonesia. Puslitbang Oseanografi LIPI. Jakarta
[9] Widyaustuti S 2010 *Agrotekcos*. 20 41-50
[10] Vairappan C S, Hong C S, Hutardo A Q, Soya E, Lhunsum G B and Crihelay 2007 *Journal. Of Applied. Phycology*. 20 22,-23
[11] Kune S 2007 *Journal. Agribisnis*. 3 34-42
[12] Kasim M, Jamil M R and Irawati 2017 *AAACL. Bioflux*. 10 633-639
[13] Kasim M, Marlia, Abdullah, Balubi A M and Djilal W 2019 *AAACL. Bioflux*. 12 1710-1717
[14] Kasim M, Asjan, Effendy I J, Wanurgayah and Ishaq E *AAACL. Bioflux*. 11 1155-1163
[15] Nurdiana, Kasim M and Yusuf S 2016 *Journal. of Aquatic. Resources. Management*. 1195-200
[16] Nelawati 2019 Comparative study of macroepiphyte attachment rate to seaweed thallus (*Eucheuma denticulatum*) at different depths using verti net in the waters of Tanjung Oyster Village, South Konawe Regency Thesis Department of Aquatic Resources Management Faculty of Fisheries and Marine Sciences, Halu Oleo University Kendari 102p
[17] Supriatno, Kasim M and Irawati N 2016 *Journal. of Aquatic. Resources. Management*. 1 225-236
[18] Kasim M, Balubi A M, Mustafa A, Nurdin R, Patadjai R S and Jalil W 2020 Floating Cage : A New Innovation of Seaweed Culture. Chapter Book. Emerging Technologies, Environment and Sustainable Aquaculture Intech Open
[19] Oktaviani D 2002 Distribusi Sapsial Makroalgai di Perairan Kepulauan Spermonde. Jurusan Ilmu kelautan, Universitas Hasanuddin: Makassar
[20] Yulianto K and Hatta 1996 Pengaruh beberapa Faktor Pengontrol Terhadap Keberhasilan Budi daya *Kappaphycus striatum* Rumput Laut di Perairan Tual Maluku Tenggara.
[21] Jamil R, Kasim M and Irawati N 2016 *Journal. of Aquatic. Resources. Management*. 1 333-341
[22] Sarifa S, Kasim M and Emiyarti 2018 *Journal. of Aquatic. Resources. Management*. 4165-174
[23] Rombe K H, Yasir and Amran M A 2013 Komposisi Jenis Laju Pertumbuhan Makroalgai Fouling pada Media Budi daya Ganggang Laut di Perairan Kabupaten Bantaeng. Jurusan Ilmu Kelautan. Fakultas Ilmu Kelautan dan Perikanan. Universitas Hasanuddin : Makassar. 9-12p.
[24] Kasim M, Mustafa A and Munier T 2016 *AAACL. Bioflux*. 9 291–299
[25] Yulianti Y, Kasim M and Irawati N 2018 *Journal. of Aquatic. Resources. Management*. 3 151-158
[26] Mala L, Latama G, Abustang and Tuwo A 2016 *Jurnal. Rumput. Laut. Indonesia*. 1 52-56
[27] Budiyanto, Kasim M and Abadi S Y 2019 *AAACL. Bioflux*. 12 167-178
[28] Kadi A 2005 Oseana. 30 19-29
[29] Rahman A and Kolopita E F M 2015 Jurnal. Budidaya. Perairan. 3 93-100
[30] Abdan, Rahman A and Ruslaini 2013 Journal. of Mina. Laut. Indonesia. 03 113-123
[31] Leonardi P I, Miravalles A B, Faugeron S, Flores V, Beltran J and Correa A 2006 Europam. Journal. of Phycology. 41 247- 257.