Omni-Akuatika, 17 (2): 112 - 117, 2021
ISSN: 1858-3873 print / 2476-9347 online

Research Article

journal homepage: http://ojs.omniakuatika.net

Morphometric Characteristic and Growth Responses of *Enhalus acoroides* Seedlings Under Different Substrate Composition Treatment

Aditya Hikmat Nugraha[1,2*], Said Almahdi[1], Aminatul Zahra[3], Ita Karlina[1]

[1] *Department of Marine Science, Faculty of Fisheries and Marine Science, Raja Ali Haji Maritime University, Tanjungpinang, 2911, Indonesia*
[2] *Indonesian Seagrass Foundation (LAMINA), Depok, 16421, Indonesia*
[3] *Department of Aquaculture, Faculty of Fisheries and Marine Science, Raja Ali Haji Maritime University, Tanjungpinang, 2911, Indonesia*

**Coresponding author: adityahn@umrah.ac.id*

Received 21February 2021; Accepted 7 January 2022; Available online 21 January 2022

ABSTRACT

Seagrass transplantation in the large-scale requires a large number of seagrass individu from donor ecosystem. This may give negative impact as damage and reducing the number of seagrass in donor ecosystem. One of methods to overcome this case is by developing transplants using seagrass nut as source for seed. Substrate is one of factors that influence the growth of seagrass. The aim of this study was to compare the effect of differences in substrate composition on morphologi and growth of Enhalus acoroides seeds. Observations were carried out by treatment using mud, sand and mixed substrates sand with mud. The survival rate of Enhalus acoroides seeds was quite high of 100% but it had a lower value of 93.30% on sand substrate. The longest leaf is on the mud substrate with a length of 5.9 cm, the leaf width has the same size in each substrate with a value of 0.4 cm, the highest number of leaves were found in the sand and mixture substrate with 5 strands, the longest root size was in the mixed substrate with a length of 5 cm. The growth of Enhalus acoroides seagrass seeds did not show any significant difference. The highest growth was found in the mud substrate with a value of 0.10 cm/day.

Keywords: *Enhalus acoroides,* seagrass,seed, substrate, transplantation

ABSTRAK

Transplantasi lamun pada skala besar mememerlukan tegakan lamun yang sangat banyak sebagai sumber benih yang berasal dari ekosistem pendonor. Hal tersebut memberikan dampak negatif seperti merusak dan mengurangi luasan ekosistem pendonor. Salah satu metode yang dapat digunakan dalam menanggulangi permasalahan tersebut yaitu dengan mengembangkan trasnplantasi lamun menggunakan biji lamun sebagai sumber benih. Substrat merupakan salah satu faktor yang mempengaruhi pertumbuhan lamun. Penelitian ini bertujuan untuk membandingkan pengaruh perbedaan jenis substrat terhadap karakteristik morfologi dan pertumbuhan benih lamun *Enhalus acoroides*. Terdapat tiga jenis perlakuan substrat pada penelitian ini yang terdiri dari lumpur, pasir dan campuran pasir beserta lumpur. Benih lamun memiliki tingkat sintasan yang tinggi sebesar 100% akan tetapi pada perlakuan dengan substrat pasir memiliki nilai sintasan sebesar 93.30%. Daun terpanjang terdapat pada perlakuan jenis substrat lumpur yaitu sebesar 5.9 cm, sedangkan umumnya lebar daun memiliki ukuran yang sama untuk ketiga jenis perlakuan yaitu sebesar 0.4 cm, jumlah daun terbanyak ditemukan pada perlakuan substrat pasir dan campuran pasir beserta lumpur yaitu sebanyak 5 daun/individu, akar lamun terpanjang ditemukan pada perlakuan substrat campuran pasir dan lumpur yaitu sebesar 5 cm. Tidak terdapat perbedaan yang signifikan pada pertumbuhan benih lamun. Pertumbuhan benih lamun tertinggi ditemukan pada perlakuan substrat lumpur yaitu sebesar 0.1 cm/hari.

Kata kunci: Benih, *Enhalus acoroides*, lamun, substrat, transplantation

,

http://dx.doi.org/10.20884/1.oa.2021.17.1.883

1. Introduction

Seagrass is the only flowering plant that capable to live submerged in the sea and live by forming an ecosystem called seagrass bed. Seagrass ecosystems play an important role as a source of primary productivity and as a habitat for feeding ground and spawning ground (Kawaroe et al., 2016). Seagrass can adapt to salty water conditions, withstand the currents and waves, able to reproduce in submerged condisition (Rahman et al., 2013).

Seagrass ecosystem area in the world is estimated aproximately 18 $x10^6$ ha and has decreased by 2-5 % every year (Sjafrie et al., 2018). Currently, the seagrass ecosystem is under the threat of damage due to human activities consist of ship anchors, fisheries activities and coastal area development (Fajarwati et al., 2015). Destruction of seagrass beds is quite intimidating and engender the decreasing of biodiversity One of solution that can be applied in improving the seagrass ecosystem is by seagrass transplantation (Riniatsih and Endrawati 2013).

Seagrass transplantation is applied by removing seagrass stands from one habitat and planting them elsewhere (Syawal et al., 2019). Seagrass transplantation in the large-scale requires a large number of seagrass individu from donor seagrass ecosystem. This may give negative impact as damage and reducing the number of seagrass in donor seagrass ecosystem. One of methods to overcome this case is by developing transplants using seagrass seeds from seagrass fruit. This method has not been applied because not all types of seagrass fruit are easy to find (Tangke, 2010).

One of seagrass species which easy to find is *Enhalus acoroides* (Ambo-rappe and Yasir., 2015). *Enhalus acoroides* is a seagrass that is commonly found in Indonesian waters, with a distinctive morphology and a large size than other types of seagrass (Irawan and Matuankotta., 2015). The substrate determines the ability of growing seagrass. Generally, these types of seagrass grow on a muddy substrate to a rocky substrate and the differences in substrate characteristics can affect the growth and distribution of seagrass (Sahertian and Wakano., 2017). The aim of this study was to compare the effect of differences in substrate composition on morphologi and growth of *Enhalus acoroides* seed.

2. Material and Methods

2.1. Resesearch Location

The collection of *Enhalus acoroides* fruit was carried out in Berakit Village,Bintan Island. The nursery process and observations were carried out at Marine Biology Laboratory, Faculty of Marine Science and Fisheries, Raja Ali Haji Maritime University.

2.2. Design Experiment

The seagrass fruit obtained is then cleaned and then the seeds are taken. There are three substrate treatments in this research: sand, mud and mixture of 50% sand and 50% mud. The seagrass seeds are then stored in a glass that already contains the substrate. Each treatment consisted of 15 seeds. The observation process was carried out for 2 months including observation of survival rate, morphology characteristic and growth of seeds. Observations of the morphological characteristics of seagrass seeds included measuring leaf length, leaf width, root length and counting the number of leaves in each stand.

2.3. Measurement of Survival Rate

The formula that used to calculate the survival rate of *Enhalus acoroides* seagrass seeds is :

$$SR = \frac{Nt}{N0} \times 100$$

Where :

SR = Survival rate (%)

N_t = Number of survival seagrass stands at the end of the study

N_0 = Number of stands of seagrass transplanted at the beginning of the study.

2.4. Measurement of Seed Growth

Leaf growth measurement was done by measuring the addition of leaf length every week. Growth observations were made from the beginning of planting the seeds to the end of the experiment for eigth weeks. Growth rate, calculated using the equation (Short and Duarte., 2001) :

$$P = \frac{(Pt - P0)}{t}$$

Where :

P = Growth rate (cm/day)

P_t = final length (cm)

P_0 = initial length (cm)

t = observation time (day)

2.5. Measurement of Seed Growth

The effect of different types of substrate composition on survival rates, morphometric and growth analyzed using the one way ANOVA test.

3. Results and Discussion.

3.1. Survival Rate of Seeds

Enhalus acoroides seeds in sand substrate was 93.3% survival rate, while in mud and mixed substrate had 100% survival rate (Figure 1). The high survival rate is caused by the strong rhizome morphology of *Enhalus acoroides* that embedded in the substrate which allows it to survive in a critical period (Tasabaramo et al., 2015). The research of Asriani (2014) report that the type of seagrass *Enhalus acoroides* has the highest value of survival rates.

The high survival rate of *Enhalus acoroides* seagrass seeds is caused by the lack of factors that disrupt the survival rate, such as the currents. Research by Rustam et al (2014) reports that current is one of the factors that engender in failure to the transplant because it may be washed the transplanted seagrass away. *Enhalus acoroides* seagrass with thick rhizomes has a higher survival rate than seagrass with smaller and slightly watery rhizomes (Harnianti et al., 2016). *E.acoroides* seeds grown on a controlled scale in the laboratory have a high level of tolerance to extreme environmental changes, this is characterized by low mortality and no stressed of seagrass seeds (Artika et al., 2020).

3.2. Morphometric characteristics of *Enhalus acoroides* seeds

Based on Figure 2, the length of the seagrass seeds on each substrate has a different length. The mud substrate has the longest leaf length with an average of 5.9 cm while the average of the length on the sand substrate is aproximately 5 cm. The mixed substrate had the lowest leaf length with an average value of 4.5 cm. *Enhalus acoroides* can growth in various substrates such as mud substrate,sand and sandy mud (Sarinawaty et al., 2020). The results of the research by Sahertian and Wakano (2017) reports that the growth of *Enhalus acoroides* seagrass on the mud substrate is better than the substrate of sand or sand mixed with dead coral fragments, the mud substrate has a smoother texture and is rich in nutrients.There was no difference in leaf width between the three types of substrates studied. Each substrate has an average value of 0.4 cm. Seagrass that grows on sandy substrates and coral fragments has smaller leaf sizes (Sahertian and Wakano., 2017). The number of leaves on each substrate had a different result. The mud substrate had an average number of 4 leaves, while in the sand and mixed substrate had an average number of 5.

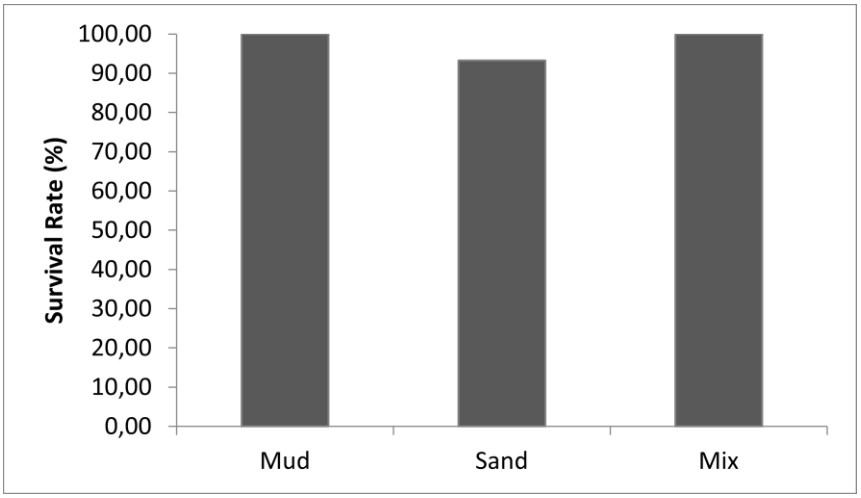

Figure 1. Survival Rate of *Enhalus acoroides* Seedling

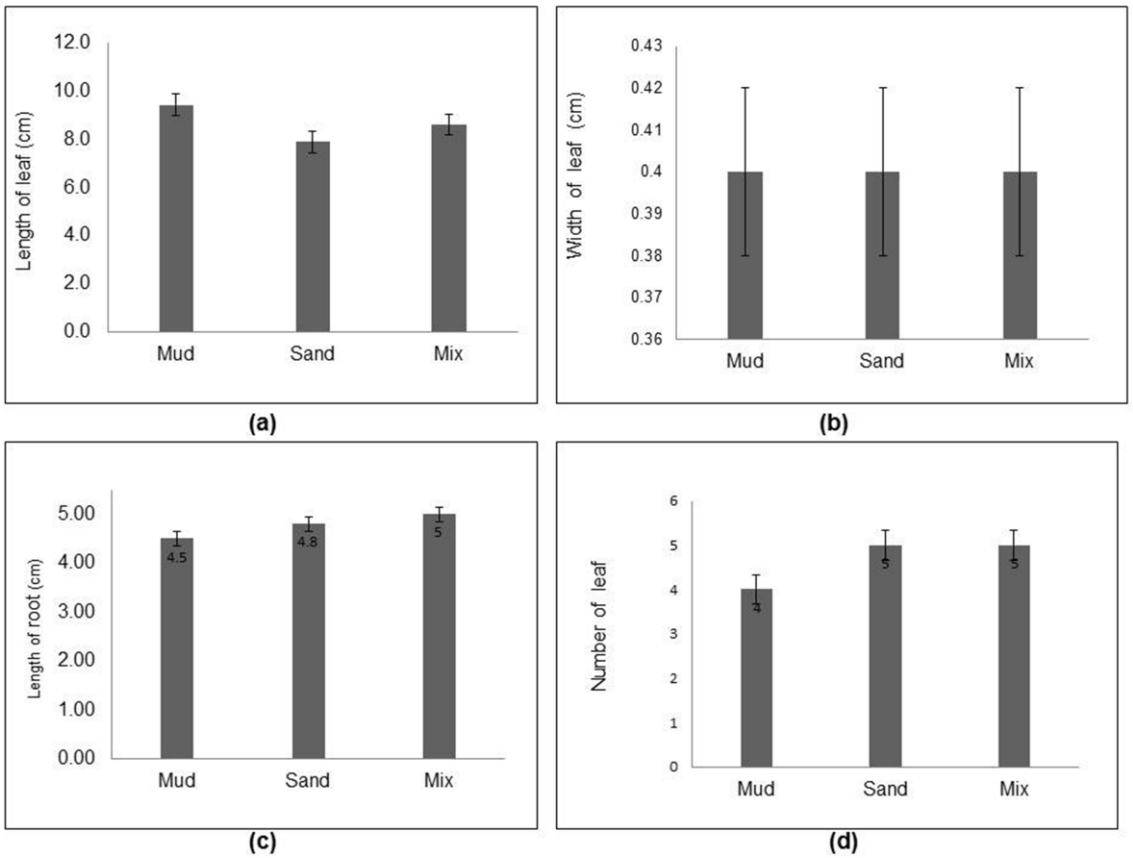

Figure 2. Morphometric characteristics of *E.acoroides* seagrass seeds (a) Length of leaf (b) leaf width (c) Length of root (c) Number of leaf (d)

Treatment with mud substrate had the lowest root length with a value of 4.5 cm while the longest roots were found in the mixed substrate with an average length of 5 cm. The sand substrate has a root length with the average value of 4.8 cm. *Enhalus acoroides* has rhizome roots with a diameter of 13.15 - 17.20 mm which is covered with stiff and many hard hairs and not branched (Rahman et al., 2013). This difference in roots is caused by the differences in grain size of the substrate. The coarser the substrate is, the longer and stronger the seagrass roots are. The strong roots of seagrass can grip the substrate and withstand by currents and waves (Wangkanusa et al., 2017). The mud substrate has a smooth, soft base texture and is rich in nutrients so it doesn't require a lot of energy when sticking the roots (Yunita et al., 2014).

In general, the results of statistical tests with one-way ANOVA analysis found p value> 0.05 where the difference in substrate composition did not significantly affect the morphological characters of *Enhalus acoroides* seagrass seeds. The difference seagrass morphometric caused by differences of seed quality like size of seeds. The difference in the size of the seeds is thought to be one of the factors that will influence the morphometric response of the seagrass (Artika et al., 2020). According to Lesilolo et al (2013), seed growth is influenced by the availability of food reserves in the seeds to support the growth process of seagrass.

3.3. Growth pattern *E.acoroides* seedlings.

Growth patterns of *Enhalus acoroides* seedlings on the mud substrate was higher than the other two substrates (Figure 3). Based on the result, *Enhalus acoroides* seagrass could grow on various substrates. The type of *Enhalus acoroides* seagrass can live in various substrates such as mud, sand and coral fragments (Sahertian and Wakano., 2017).

According to the growth rate calculation of *Enhalus acoroides* seagrass seeds from each substrate, it was found that the mud substrate

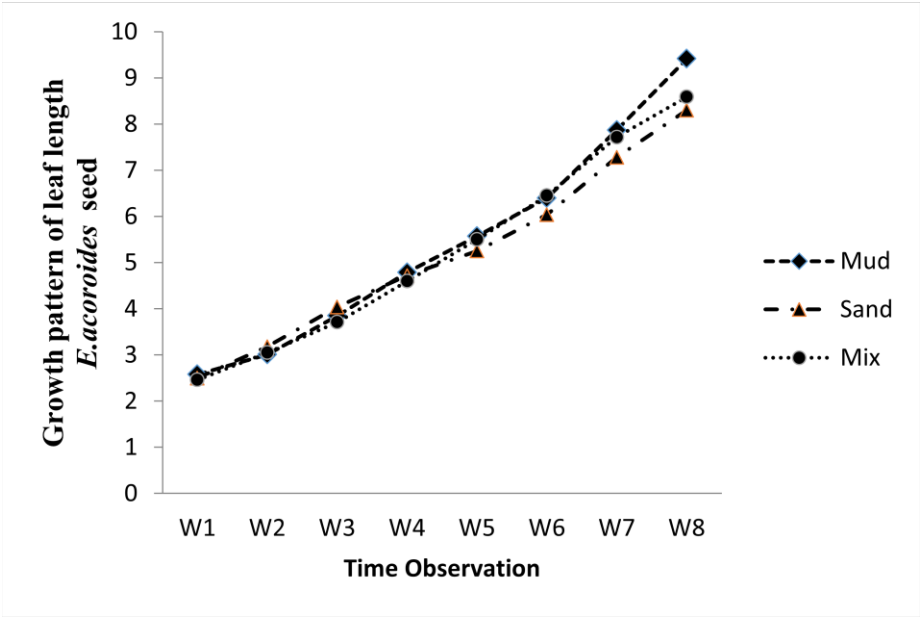

Figure 3. Leaf length growth of *E.acoroides* seagrass seeds

had a value of 0.10 cm / day, while on the sand substrate and the mixture had a value of 0.09 cm / day. Christon et al (2012) reports that the growth rate of *Enhalus acoroides* seagrass ranged from 0.67 to 0.89 cm per day. Research by Rahman *et al* (2013) reports that the average growth rate of *Enhalus acoroides* seagrass is 0.60 - 0.80 cm per day. Research by Nugraha *et* al (2021) reports the average growth rate of *Enhalus acoroidses* is 0.15 cm/day without CO2 treatment and 0.099 cm/day with gave CO2 treatment. The low growth of *Enhalus acoroides* seeds is due to the use of glass with less substrate, no water change and no nutrient addition, which results in low growth. According to Christon et al (2012), currents can carry nutrients from one place to another. The nutrients used by *Enhalus acoroides* seagrass seeds in the aquarium medium were only the nutrients in the substrate and there were no additional nutrients. The results of statistical tests with one-way ANOVA showed that the growth of *Enhalus acoroides* seagrass seeds was not significantly different (p> 0.05).

Seagrass growth is basically influenced by several factors such as temperature and pH (Supriadi, 2006; Nugraha et al, 2021). Temperature and pH can affect seagrass life, such as survival, respiration, photosynthesis, uptake of nutrients, growth and morphometric characteristic (Supriadi, 2006; Nugraha et al, 2021). The growth of leaf length and width is also influenced by the size of the seagrass seeds, as reported by Ambo-Rappe and Yasir (2015) that large seed size will produce seagrass growth while small seagrass seeds will produce small seagrass. The high growth of seagrass in the mud substrate is thought to be a form of response to nutrient conditions, generally the mud substrate has higher nutrients than other types of substrates (Delefosse et al, 2016). This has an impact on the high growth of seagrass in the mud substrate.

4. Conclusion

The differences in substrate types did not significantly affect the survival rate, morphometric characteristics and growth patterns of seagrass seeds. Generally, the survival rate of seagrass on all substrates is very high. The highest leaf length and growth rate were found in the treatment of mud substrate types.

Acknowledgements

This research was supported by a research grant from Raja Ali Haji Maritime University and PDP Scheme from Ministry of Education, Culture, Researh and Technology)

References

Ambo-rape, R., Yasir, I. 2015.The Effect of Storage Condition on Viability of Enhalus Acoroides Seedlings. *Aquatic Botany*. 127: 57-61.

Artika,S.R., Ambo-Rappe, R., Teichberg, M., Moreira-Saporiti, A., and Viana IG.2020.Morphological and Physiological Responses of *Enhalus acoroides* Seedlings Under Varying Temperature and Nutrient Treatment.Front. Mar. Sci. 7:325.doi: 10.3389/fmars.2020.00325

Christon.,Djunaedi, O, S., Purba, N, P. 2012. Ekosistem Lamun Di Kawasan Pesisir Kecamatan Kei Besar Selatan, Kabupaten Maluku Tenggara, Propinsi Maluku, *Indonesia.Perikanan dan Kelautan*. 3(3): 287-294.

Delefosse, M., Povidisa, K., Poncet, D., Kristensen, E. and Olesen, B.2016. Variation in size and chemical composition of seeds from theseagrass Zostera marina—ecological implications.*Aquatic Botany*. 131, 7–14.doi: 10.1016/j.aquabot.2016.02.003

Fajarwati,S,D., Setianingsih, A, I., Muzani. 2015. Analisis Kondisi Lamun (*Seagrass*) Di Perairan Pulau Pramuka, KepulauanSeribu *Spatial*.13(1):22-32.

Harnianti, N., Karlina, I., Irawan, H. 2017. Laju pertumbuhan jenis Lamun *Enhalus acoroides* dengan teknik transplantasi polybag dan Sprig Anchor pada jumlah tunas yang berbeda dalam rimpang di Perairan Bintan. *IntekAkuakultur*, *1*(1):15-26.

Irawan, A., Matuankotta C. 2015. *Enhalus acoroides*, lamun terbesar di Indonesia.*Oseana*.60(1):19-26.

Kawaroe, M., Nugraha, A. H., Juraij, J.,Tasabaramo, I. A. 2016.Seagrass biodiversity at three marine ecoregions of Indonesia: Sunda Shelf, Sulawesi Sea, and Banda Sea. *Biodiversitas Journal of Biological Diversity*.*17*(2):585-591.

Lesilolo, M. K., J. Rirydan E. A. Matula. 2013.Pengujian viabilitas dan vigor benih beberapa jenis tlesilolanaman yang Beredar di Pasaran Kota Ambon.*Agrologia*2(1): 1 – 9.

Nugraha, A.H., Zahra, A.,Hafsar, K., Almahdi, S.,2021. Morphometric and growth responses of *Enhalus acoroides* seedlings under carbon dioxide enrichment: An experimental assesmement. IOP Conf. Ser.: Earth Environ. Sci. 744 012051

Rahman, A., Rivai, M, N., Mudin, Y. 2013. Analisis pertumbuhan lamun (*Enhalus acoroides*) berdasarkan parameter oseanografi di Perairan Desa Dolonga dan Desa Kalia. *Gravitasi*.15(1).1-7

Riniatsih, I., Endrawati, H. 2013. Pertumbuhan Lamun Hasil Transplantasi Jenis *Cymodocea rotundata* di Padang Lamun Teluk Awu rJepara. *Buletin Oseanografi Marina*. 2: 34 – 40.

Rustam, A., Bengen, D. G., Arifin, Z., Gaol, J. L., Arhatin, R. E. 2013. Growth rate and productivity dynamics of Enhalusacoroides leaves at the seagrass ecosystem In Pari Islands based on In Situ AndAlos Satellite Data. *International Journal of Remote Sensing and Earth Sciences (IJReSES)*, *10*(1).

Sahertian, D, E., Wakano, D. 2017. Laju pertumbuhan daun *Enhalus acoroides* pada substrat berbeda di perairan pantai Desa Poka Pulau Ambon.*Biology Science & Education*.62-68.

Sarinawaty, P., F. Idris, & A.H. Nugraha. 2020. Karakteristik morfometrik lamun *Enhalus acoroides* dan *Thalassia hemprichii* di Pesisir Pulau Bintan. *J. of Marine Research* , 9(4): 478-484. https://doi.org/10.14710/jmr.v9i4.28432

Sjafrie, N, D, M., Hernawan, U, E., Prayudha, B., Supriyadi, I, H., Iswari, M, Y., Rahmat.,Anggraini, K., Rahmawati, S., Suryaso. 2018. Status Padang Lamun Indonesia Ver.2. Pusat Penelitian Oseaonografi. 40.

Supriadi, S., Soedharma, D., Kaswadji, R. F. 2006.Beberapa Aspek pertumbuhan lamun *Enhalus acoroides* (Linn.F) Royle di Pulau Barrang Lompo Makassar. *MajalahIlmiahBiologi BIOSFERA: A Scientific Journal*.*23*(1):1-8.

Syawal, A, M., Ira.,Afu L, A. 2019. Laju pertumbuhan dan kelangsungan hidup lamun hasil transplantasi di PerairanTelukKendari. SapaLaut. 4(2): 69-77.

Tangke, U. 2010. Ekosistem padang lamun (manfaat, fungs idan rehabilitasi). *Agrikan: Jurnal Agribisnis Perikanan*.*3*(1):9-29.

Wangkanusa, M, S., Kondoy, K, I, F., rondomuwi, A, B. 2017. Identifikasi kerapatan dan karakter morfometrik lamun *Enhalus acoroides* pada substrat yang berbeda di PantaiTongkeina Kota Manado. *JurnalIlmiahPlatax*. *5*(2):210-220.

Yunitha, A., Wardianto, Y., Yulianda, F. 2014. Diameter substrat danjenis lamun di Pesisir Bahoi Minahasa Utara: sebuah analisis korelasi. *IlmuPertanian Indonesia (JIPI)*. 19(3): 130-135.