



Growth Rate of *Gracilaria* sp. which are cultivated using the Netline Method in Monoculture and Polyculture with Snapper (*Lates calcarifer*) in Traditional Brackish Water Ponds

Sri Rejeki^a, Vira Rizqi Rahmawati^a, Nurul Aulia Dinastuti^a, Restiana Wisnu Ariyati^{a*}

^aAquaculture Department, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Jl. Prof. Jacob Rais, Tembalang, Semarang, Indonesia 50275

ABSTRACT :

Gracilaria sp. seaweed is a marine commodity that has quite high economic value and can be cultured in the brackishwater pond. *Gracilaria* sp. can be cultivated in monoculture system and polyculture with other species such as fish and shrimp. The aim of this study was to compare the growth rate of monoculture *Gracilaria* sp. and polyculture with snapper (*Lates calcarifer*) and to find out the culture system that produces the highest growth rate of *Gracilaria* sp seaweed. The results show that different culture systems significantly affected the growth rate (RGR) and specific growth rate (SGR) of *Gracilaria* sp. The growth of *Gracilaria* sp. In polyculture syatem of *Gracilaria* and snapper was significantly higher than *Gracilaria* sp. monoculture. The RGR in polyculture system with snapper was $206,42 \pm 28,59\%$, while in monoculture system was $95,64 \pm 2,92\%$. Sililarly the SGR of *Gracilaria* sp. in the polyculture system with snapper ($2.48 \pm 0.20\%/day$) than in SGR of *Gracilaria* sp. in monoculture system ($1.49 \pm 0.03\%/day$).

Keywords: *Gracilaria* sp., snapper, monoculture, polyculture

Introduction :

Gracilaria sp. seaweed is a commodity that has high economic value that contains agar for food and cosmetics industries. *Gracilaria* sp. can be cultured in the brackish water pond. Increasing *Gracilaria*'s growth can be done with different culture systems: monoculture and polyculture systems. The advantages of polyculture are low costs and efficient use of pond. Therefore, seaweed farmers can culture other commodities such as snapper (*Lates calcarifer*). Snapper preyes on *Graciraria* sp. grazers, and *Gracilaria* is a phytoremediator in the pond (Insan et al., 2013).

Snapper is a fishery commodity with high economic value. The export value of fresh snapper reaches 300 tons per year and 80 tons per year for live snapper (Wirasakti et al., 2021). Snapper is a fastgrowing fish and able to tolerate salinity that can be cultured in freshwater and marine ponds (Hasibuan et al., 2018).

The objectives of this research are to compare the growth rate of the seaweed *Gracilaria* sp. between monoculture and polyculture with snapper and to find out the culture system that produces the highest growth rate of *Gracilaria* sp.

Materials and Methods :

The average length of snapper larvae was 13 cm with average individual weight of 10-15 g. Snapper larvae will be stocked in 3 treatment ponds. The condition of the snapper seeds selected is that they have no physical defects, are free from disease and have a good response. This was confirmed by Jaya et al. (2013), the snapper seeds used were healthy fish seeds and were not attacked by disease. This research was carried out experimentally with 2 treatments with 10 repetitions. The pond plot 3 in rectangular of 1 m² for observation plots as replications (Figure 1). Each pond plot is planted with 1 kg/m² of seaweed seeds. In this treatment, it was 0.25 fish/m².



Figure 1. Netline for gracilaria

The treatments used in this research are as follows:

- Treatment A: Seaweed
- Treatment B: Seaweed + Snapper

Gracilaria sp and snapper seeds. Seaweed seeds are sown above the net-line. Seaweed seeds are spread using the surface method. The initial weight of the seaweed tested was 2 kg/m². The snapper used for polyculture cultivation has an average size of 13 cm with an average weight of 15 g. Maintenance of *Gracilaria sp* is done by cleaning plants covered in mud once every two weeks.

The *Gracilaria sp* growth was carried every two weeks. Research data includes relative growth rate (RGR),

$$RGR = \frac{W_t - W_0}{W_0} \times 100\%$$

And specific growth rate (SGR).

$$SGR = \frac{\ln W_t - \ln W_0}{t} \times 100\%$$

Where: RGR is relative growth rate (%); SGR is specific growth rate (%/day); W_t is weight of test plants at the end of the study (grams); W_0 is weight of test plants at the start of maintenance (grams); t is research duration (days).

The water quality parameters observed during the research were temperature, pH, dissolved oxygen (DO), salinity was monitored daily by using Water Quality Checker, transparency using secchi-disc, nitrate, phosphate and ammonia were analysed weekly using Spectrophotometer.

Data of RGR and SGR of *Gracilaria sp.* were analysed using the Two Independent Sample T-Test with $\alpha = 0.05$. The data were tested using homogeneity test, additivity test and normality test prior the analyses of variance. The normality test is carried out to show that the data is normally distributed as a condition for carrying out the T test. The T-test data processing was using the SPSS 29 software. T-test analysis procedures are used to compare the means of two variables in one group. The assumptions used are that the data variables have a normal distribution and homogeneity of variance between data groups (Hernanto et al., 2015).

Result and Discussion :

The results showed that there was a significant different between monoculture *Gracilaria sp* and polyculture of *Gracilaria sp* and snapper on the relative growth rate (RGR) of *Gracilaria sp* (Figure 2). Similarly for the specific growth rate (SGR) of *Gracilaria sp*. (Figure 3).

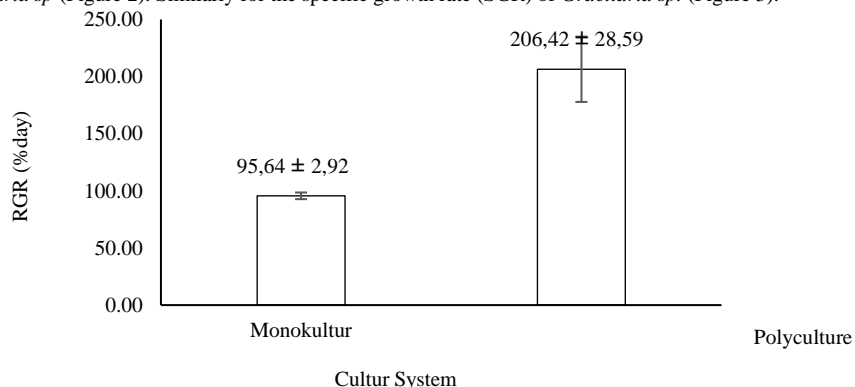


Figure 2. RGR of *Gracilaria sp.* In monokultur and polyculture system

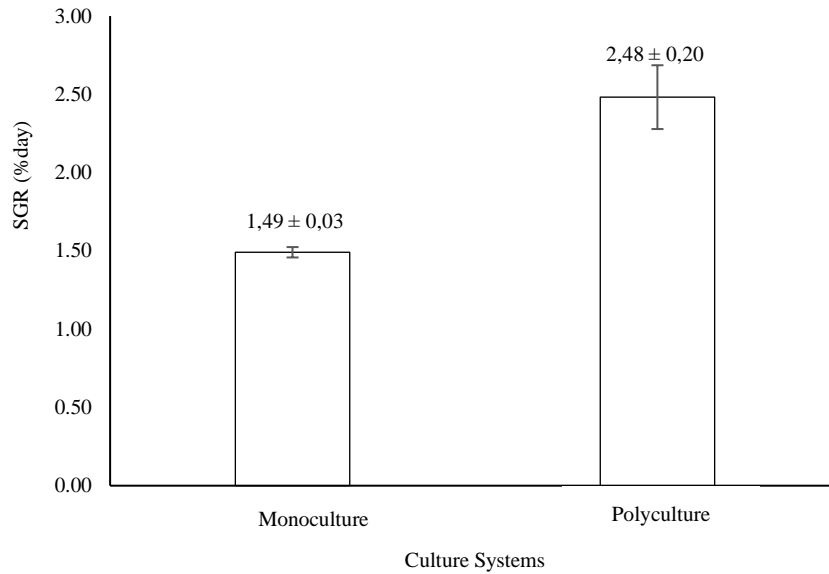
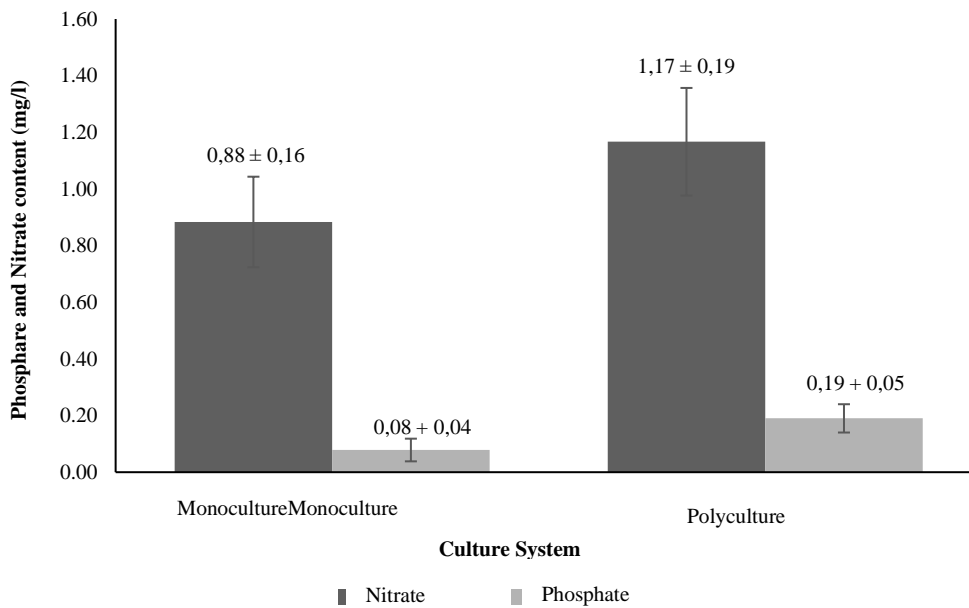


Figure 3. SGR of *Gracilaria* sp. In monokultur and polyculture system

The concentration of nitrate and phosphate in waters of monoculture and polyculture systems showed that there are differences (Figure 4), however this data was analyzed descriptively Similarly for other water quality parameters (Table 1)



The results of water quality parameters during the research showed that the water quality parameter values were still in a suitable condition for *Gracilaria* sp and snapper culture

Table 1. Water Quality Parameters

No.	Parameters	Monocultur	Polycultur	Suitability
1.	Temperature (°C)	27,9 – 31,6	27,2 – 31,4	20 – 34 ^a
2.	pH	7,1 – 8,6	7,1 – 8,5	6,8 – 7,8 ^b
3.	DO (ppm)	1,54 – 6,44	1,15 – 5,67	2 – 4 ^c
4.	Salinity (ppt)	17,2 – 28,3	16,8 – 27,5	15 – 40 ^d
5.	Turbidity (NTU)	9,0 – 34,4	10,4 – 27,1	20 ^e
6.	Transparancy (cm)	30 – 64	32 – 67	50 – 70 ^b
9.	Ammonia (mg/l)	0,01 – 0,18	0 – 0,14	0,3 ^f

Notes: a) Rejeki *et al.* (2018); b) SNI (2010); c) Tarmizi *et al.* (2022); d) Widowati *et al.* (2020); e) Walhi (2006); f) KepMen LH (2004)

Growth rate of *Gracilaria sp.* in monoculture system was $95,64 \pm 2,92\%$ and in polyculture system seaweed cultivation with snapper was $206,42 \pm 28,59\%$. Meanwhile, the specific growth rate in cultivation using a monoculture system was $1,49 \pm 0,03\%/day$ and the specific growth rate in seaweed cultivation in a polyculture system with snapper was $2,48 \pm 0,20\%/day$. There is a significant effect on the relative growth rate (RGR) and specific growth rate (SGR) of monoculture *Gracilaria sp.* and polyculture with snapper. The Growth rate of *Gracilaria sp.* in polyculture with snapper is higher than in monoculture. The higher growth rate of polyculture of *Gracilaria sp.* with snapper most probably due to the nutrient content produced by snapper such as metabolic waste where seaweed can play a role in reducing metabolic waste. *Gracilaria sp.* able to absorb ions such as ammonia, nitrate and phosphate. *Gracilaria sp.* can utilize nitrate as a nutrient for thallus growth and phosphate plays an important role in accelerating and strengthening young plants into adult plants (Wandira et al., 2018). The phosphate content in monoculture was found between $0,08 \pm 0,04$ ppm and in polyculture with snapper was between $0,19 \pm 0,05$ ppm. The optimum phosphate range for seaweed growth is 0.051-1.00 mg/l (Cintya et al., 2018). Phosphate plays an important role in plant cell metabolic processes. Phosphate is a form of phosphorus that can be utilized by aquatic plants and algae and can be an indicator of aquatic productivity. Water quality parameters during the research showed that the water quality parameter values : Temperature, pH, DO, salinity, turbidity, transparency, ammonia, phosphate and nitrate were still in a suitable condition for *Gracilaria sp* and snapper culture according to Rejeki et al. (2018); SNI (2010); Tarmizi et al. (2022); Widowati et al. (2020); Walhi (2006) and KepMen LH (2004).

From this explanation it can be concluded that the culture systems affected the growth of *Gracilaria sp.* The polyculture system between *Gracilaria sp.* and snapper shows better *Gracilaria sp* growth than monoculture system.

REFERENCES :

1. Hasibuan, R. B., H. Irawan & T. Yulianto. 2018. Pengaruh Suhu Terhadap Daya Tetas Telur Ikan Kakap Putih (*Lates calcalifer*). Intek Akuakultur., 2(2): 49-57.
2. Insan, A. I., D. S. Widyartini & Sarwanto. 2013. Posisi Tanam Rumput Laut Dengan Modifikasi Sistem Jaring Terhadap Pertumbuhan & Produksi *Eucheuma cottonii* Di Perairan Pantura Brebes. Jurnal Litbang Provinsi Jawa Tengah., 11 (1): 125-133.
3. Hernanto, A. D., S. Rejeki & R. W. Ariyanti. 2015. Pertumbuhan Budidaya Rumput Laut (*Eucheuma cottoni* & *Gracilaria sp.*) Dengan Metode Long Line di Perairan Pantai Bulu Jepara. Journal of Aquaculture Management and Technology., 4(2): 60-66.
4. Jaya, B., Fitri Agustriani & Isnaini, 2013. Laju Pertumbuhan & Tingkat Kelangsungan hidup Benih Kakap Putih (*Lates calcalifer*, Bloch) dengan Pemberian Pakan yang Berbeda. Maspari Journal, 2013, 5 (1), 56-63.
5. KepMen LH. Keputusan Menteri Negara Lingkungan Hidup No. 51 Tahun 2004, Tentang Bahan Baku Mutu Air Laut.
6. Rejeki, S., R. W. Ariyati., L. L. Widowati and R. H. Bosma. 2018. The effect of three cultivation methods and two seedling types on growth, agar content and gel strength of *Gracilaria verrucosa*. Egyptian Journal of Aquatic Research. 44: 65-70.
7. SNI. Standar Nasional Indonesia. 2010. Produksi Rumput Laut *Gracilaria (Gracilaria verrucosa)* Dengan Metode Tebar di Tambak Secara Polikultur. BSNI 7578:2010.
8. Tarmizi, A., N. Diniarti & F. Azhar. 2022. Analisis Kesesuaian Lokasi Di Perairan Pulau Lombok Untuk Pengembangan Budidaya Rumput Laut (*Gracilaria sp.*). Jurnal Media Akuakultur Indonesia., 2(2): 190-205.
9. Walhi. 2006. Dampak Lingkungan Hidup Operasi Pertambangan Tembaga & Emas Freeport-Rio Tinto di Papua. WALHI. Jakarta Indonesia.
10. Widowati, L. L., T. Elfitasari., S. B. Prayitno., S. Rejeki., P. W. Purnomo., R. W. Ariyati and R. Bosma. 2020. The Role Of Seaweed (*Gracilaria verucosa*) In Co-Cultivation With Tiger Shrimp (*Penaeus monodon*) As An Ecological Intensification. Saintek Perikanan : Indonesian Journal of Fisheries Science and Technology., 16(3) : 179-186.
11. Wirasakti, P., N. Diniarti & B. H. Astriana. 2021. Pengaruh Warna Wadah Pemeliharaan Yang Berbeda Terhadap Pertumbuhan & Kelangsungan Hidup Benih Ikan Kakap Putih (*Lates calcalifer*). Jurnal Perikanan., 11(1): 98-110.