Effect of dense stocking of *Gracilaria* sp on growth and survival of milkfish (*Chanos chanos forskal*) on polyculture culture systems

W Isroni 1, A S Bahri 2*, A A Amin 3

1Faculty of Fisheries and Marine Science, Universitas Airlangga. Kampus C, Jl.
Dharmahusada Permai No.330, Mulyorejo, Surabaya 60115, East Java,
2Malang Fisheries Science College / STIP, Jl. Cengger Ayam I No.5, Tulusrejo, Kec.
Lowokwaru, Malang 65141, East Java Indonesia.
3Coastal and Marine Research Center, Brawijaya University

*Corresponding author: wahyu.isroni@fpk.unair.ac.id*

**Abstract.** Milkfish cultivation has long been recognized by farmers and is now developing in almost all Indonesian waters. Fish culture technology is also experiencing rapid development, ranging from traditional maintenance to intensive technology that requires seed, water, and planned feed management. One way to fill the empty ecological space is to cultivate a mixture (polyculture) between several fisheries commodities. With this system, the benefits obtained are high land productivity. The development of aquaculture technology shows that milkfish (*Chanos chanos Forskal*) can be cultivated together with *Gracilaria* sp. Seaweed in a pond. This polyculture system can increase the efficiency of land use and farmers’ income in a sustainable manner. The study was conducted using the experimental method. The density of *gracilaria* sp distribution in this study was: treatment A (nongractilaria), treatment B (gracilaria 50 Kg), treatment C (gracilaria 100 Kg), treatment D (gracilaria 150 Kg) and Treatment E (gracilaria 200 Kg). The design used was a completely randomized design (CRD) with 5 treatments and 3 replications. The main parameters observed were growth including absolute length, absolute weight, specific growth rate, and survival. As supporting data the measurement of water quality is also carried out.

1. Introduction

Utilization of ecological space in milkfish polyculture and seaweed in ponds is expected to provide added value to the two commodities cultivated, for example, *Gracilaria* sp serves as a producer of oxygen and a shelter for milkfish from the sun's heat. While milkfish dispose of impurities that can be used as nutrients and fertilizer by *Gracilaria* sp, besides that the activity of milkfish that moves to the bottom of the waters to find food helps to control the growth of *Gracilaria* sp which is overgrown with algae and plankton to prevent blooming.

Thus, this polyculture system is expected to increase land productivity, commodity diversification, and efforts to reduce the risk of failure in aquaculture. Diversification of aquaculture commodities can guarantee the production process and increase added value in a cultivation business. However, information about the implementation of milkfish and seaweed polyculture cultivation in ponds is still not widely known by the public at large.

One way to increase production is by adjusting the density level. Good environmental conditions, adequate feeding, and proper density will increase fish growth [1]. Optimization of the density of the two commodities in the polyculture system is expected to be used for the effective utilization of the
ecological space of the pond waters, especially space and feed, to increase pond productivity as much as possible.

Sidoarjo Regency which will be used as a case in this study is based on several reasons including that Sidoarjo Regency has a coastal and aquaculture area of 29.99% of the area of Sidoarjo Regency, with a height of 0 - 3 meters above sea level and a sloping beach, next to south bordering the Madura Strait sea waters, having eleven rivers which empty into the Madura Strait coast, the area of the Sidoarjo Regency's ponds constitutes 25% of the total pond area of East Java Province covering 62,041.13 ha.

2. Materials and methods

2.1. Place and time of research
This research was conducted in February - March 2019 in the village of Kupang, Jabon District, Sidoarjo Regency.

2.2. Tools and materials
Milkfish material (Chanos chanos) as many as 1,000 fish measuring 7 - 9 cm with a weight of 20.2 grams, Gracilaria sp. As much as 500 kg, Central Protein prima feeds FF - 999.15 pieces of Pond Tools with an area of 1,000 m2, Lamotte SMART® Water Analysis Laboratory.

2.3. The procedure of research preparation
Preparing ponds measuring 2,000 m² totaling 15 plots. Dry the pond for 2 days until the soil looks dry and cracked. Drying is done so that the pond land is exposed to sunlight, the goal is to make pests such as snails, barnacles, written oysters, srindit, and bacteria that cause disease to die so that the soil becomes fertile and clean of all kinds of pests. After 2 days, the pond is filled with water that flows through the river upstream. After the pond is filled with water, water quality control (adjusting temperature, pH, salinity) is done using Lamotte SMART® Water Analysis Laboratory.

Before the study began, milkfish and Gracilaria sp. first adapted to the pond conditions. Therefore Gracilaria sp. is a producer in a pond, so this plant must be sown first. The spread of Gracilaria sp. carried out after pond irrigation has reached 50 cm high. Gracilariasp stocking. carried out evenly with a spacing every 1 m scattered 10 g Gracilaria sp. at a depth of 50 cm according to treatment. After Gracilaria sp. stocked, then prepare the milkfish.

The milkfish is put into an oxygen-filled plastic bag according to the treatment. Plastic bags containing milkfish are put into the pond until the water temperature in the bag is the same as the water temperature in the pond, then open the plastic bag and let the pond water enter little by little into the plastic bag. In this step, the pH and salinity adjustment process occur between the water in the bag and the pond water. The adapted milkfish will swim out of the plastic bag to the pond waters. After the pond, milkfish and Gracilaria sp. adapt, then the research is immediately carried out.

2.4. Data analysis
Data were analyzed statistically including absolute biomass growth data of test fish and long growth rate. To determine the effect of treatment (the independent variable) on the response of the measured parameters (dependent variable) the analysis of variance or the F test is used. If the F test is significantly different followed by the least significant difference test (BNT) to determine the treatment that gives the best response.

3. Results and discussion
The pond measuring 1,000 m² is a large enough place for the movement of milkfish in searching for food and activities. The long growth of milkfish in treatment E (200 kg Gracilaria sp.) It is caused by competition in fighting over feed which is not too difficult, but it can be said to be balanced because the size of the ponds is following the milkfish stocking density. This is because milkfish can move freely and eat natural food (plankton, clapfruit, algae, and other epiphytic organisms) as well as additional feed in the form of pellets given in the pond without having to fight over the feed and the availability of feed in the pond by feed requirements milkfish.

The growth of the absolute weight of milkfish in the polyculture system with Gracilaria sp. influenced by the increasing density of Gracilaria sp. while the growth of Gracilaria sp. influenced
by the presence of milkfish populations. Milkfish that are kept in a monoculture manner in ponds, grow more slowly than those cultivated with seaweed.

![Figure 1. Graph of Average Growth Results of Absolute Weight of Milkfish (Chanos chanos Forskal) Each - Every Treatment During Research](image)

The low growth of absolute weight in treatment A is due to the fact that milkfish only eat natural food in the form of plankton and clapfruit which grows because they utilize nutrients from the results of the decomposition of organic material at the initial fertilization at the bottom of the pond. The high growth of the absolute weight of milkfish in polyculture with Gracilaria sp (Treatment B, C, D, and E), besides getting natural feed in the form of plankton and clapfruit, milkfish also utilize epiphytic organisms in thallus Gracilaria sp.

Soil organic matter after being broken down by bacteria into Nitrate and NH$_4^+$ ions can be directly utilized for the growth of natural food [2]. Dissolved oxygen that comes from the movement of water due to milkfish activity is very influential on the speed of change in the suspension of organic matter into nutrients needed by Gracilaria sp for its growth.

Water that is rich in nutrients, free of suspension of organic matter and pest pests is an absolute requirement for seaweed growth [3]. Milkfish is an aquatic animal that normally feeds on ponds, including; plankton, klekap (collection of microorganisms that live on the surface of pond bottom), green algae such as silk moss (Chaetomorpha sp.) and chicken belly moss (Enteromorpha sp.) [4]. The results of the analysis of the milkfish hull eat a lot of basic microorganisms [5].

Based on the measurement results, water quality parameters during the study showed that the range values were still within good tolerance limits to support the growth of milkfish. Observation of temperature during the study showed a range between 27.70 - 30.18°C. The temperature of 20-29°C can support the growth of milkfish, and the optimal temperature for Gracilaria sp ranges from 20-28°C [6]. The temperature range of 26 - 31.6 °C is the optimum range for fish because at this temperature range, the metabolism of fish can take place well, so that fish growth takes place well too [7].

The results of the measurement of water pH during the study ranged from 7.75 - 8.02 based on these data it can be said the water pH during the study was the optimal pH to support the growth and survival of the milkfish and Gracilaria sp that were kept. This condition is very supportive because the pH of 7.0 to 8.0 is the optimal pH for milkfish and pH 6.5 to 8.5 is the optimal pH for Gracilaria sp. Temperature and pH are the limiting factors that influence and determine the speed of metabolic reactions in feed consumption. If the pH value is low, the water can cause clumping of mucus on the gills and the fish will suffocate so that the energy to maintain the body rather than for growth [8].

The results of dissolved oxygen measurements during the study ranged from 6.08 to 8.38 mg / l. The dissolved oxygen range value is taken from observations at 08.00 WIB and 16.00 WIB. This value still meets the appropriate range for milkfish cultivation and Gracilaria sp. The optimum oxygen content for milkfish culture is 3.0 - 8.0 [9]. Dissolved oxygen concentration changes in daily cycles.
At dawn, the dissolved oxygen concentration is low and will be higher during the day due to photosynthesis carried out by *Gracilaria* sp. until it reaches its maximum point past noon around 14.00 WIB. At night, when photosynthesis does not occur, the breathing of organisms in the pond requires oxygen, thereby causing a decrease in the concentration of dissolved oxygen. The salinity range during the study was relatively stable at around 27.14 - 29.96 ‰. Milkfish can grow well at 5-40 ppt salinity and can even tolerate up to 60 ppt.

4. Conclusion
Dense stocking of different *Gracilaria* sp has a very significant influence on the growth of milkfish (*Chanos chanos Forskal*) that are kept. This is then shown by several growth parameters namely Absolute Weight The best result of the absolute weight parameter of milkfish is obtained at Treatment E (*Gracilaria* 200 Kg) of 8.18 g, then successively followed by Treatment D (*Gracilaria* 150 Kg) of 8.06 g; C (*Gracilaria* 100 Kg) of 7.86 g; Treatment B (*Gracilaria* 50 Kg) was 7.45 g, and Treatment A (no *Gracilaria*) was 6.97 g.

5. References
[1] Weatherley A H 1972 *Growth and Ecology of Fish Population* (London : Academic Press)
[2] Mintardjo K, Sunaryanto A, Utaminingsih, Hermiyaningsih 1984 *Persyaratan Tanah dan Air* (Direktorat Jendral Perikanan, Direktorat Pertanian) p 89.
[3] Mubarak H, Ilyas S, Ismail W, Wahyuni I S 1990 *Petunjuk Teknis Budidaya Rumput Laut* (Jakarta : Pusat Penelitian dan Pengembangan Perikanan) p 94
[4] Martosudarmo B, Sudarmini, B S Ranoemihardjo 1984 *Biologi Bandeng (Chanos chanos Forskal)* (Jepara : Balai Budidaya Air Payau) p 98
[5] Poernomo A 1976 *Notes dan Food And Feeding Habits Of Milkfish (Chanos chanos)* from the Sea. (Iloilo : Internat Milksih Workshop Conf) p 113.
[6] Mulyanto 1992 *Lingkungan Hidup untuk Ikan.* (Jakarta : Departemen Pendidikan dan Kebudayaan) p 138
[7] Kim and Ho 1970 *Economically Important Seaweed in Chile* (London) p 964
[8] Zonneveld 1991 *Prinsip – Prinsip Budidaya Ikan.* Jakarta : PT Gramedia p 318
[9] Ismail and Masya 1994 “Teori Prosedur” Jakarta: Grasindo