Enlargement technique of humpback grouper (*Cromileptes altivelis*) with floating nets cage

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Abstract. Grouper became an important export commodity especially to Hong Kong, Japan, Singapore and China. National and international market demand for humpback grouper which continues to increase causes overfishing in the sea. Humpback grouper is cultivated by using floating net cages to reduce dependence on nature. The working methods used in the study are direct observation to obtain primary and secondary data. The results have been carried out, the technique of enlarging humpback grouper begins with the preparation of floating net cages. Every cage checked and installed nets. The breedstock that have been spreaded are fed trash fish once a day in the morning. Grading is done once a month to reduce fish cannibalism levels. The water temperature in cages ranges from 30-30.6°C, salinity 34-35 ppt, pH 8.09-8.2 and dissolved oxygen 5.0-5.3 ppm. Prevention of pests and diseases is carried out by changing the net periodically, cleaning cages, and dipping with fresh water. SR value of 50%, FCR 3.27, and growth rate of 0.4167 grams. Humpback Grouper in Floating nets cage is not best for growth but is able to optimize production.

1. Introduction

Grouper fish is a leading Indonesian fishery commodity which has high economic value. Grouper is an important export commodity, especially to Hong Kong, Japan, Singapore and China. The production of grouper from aquaculture continues to increase by 1.5% every year and contributes to the total production of seafood for seafood [1]. Utilization of marine waters for aquaculture activities has long been developed and continues to be improved. One of the promising uses of marine aquaculture is the cultivation of rat grouper (*Cromileptes altivelis*).

The increasing national and international market demand for grouper (*C. altivelis*) has led to an increase in marine fishing activities. Continuous fishing that is not matched by cultivation can lead to overfishing. Grouper fish are included in the list of protected fish by the International Union for Conservation of Nature (IUCN) due to overfishing [2]. Cultivation activities continue to be developed to meet market demand and protect the grouper fish population in their habitat. The cultivation of rat grouper is widely distributed in the Riau Islands, Bali, Lampung, East Java, North Sulawesi and Lombok. Grouper cultivation can be done in ponds or in floating net cages. Most of the farmers cultivate using floating net cages. There are various kinds of supporting factors for the successful cultivation of humpback grouper, one of these factors is water quality. The use of floating net cages
allows continuous water circulation. The location of floating net cages is usually on beaches with minimal pollution. The worse the condition of the waters, the less hope that marine life can live according to their natural habitat [3].

Until now, rat grouper cultivation still has several problems, one of which is the use of trash fish feed. Trash fish feed has constraints in the study such as erratic stocks, low quality, and a high risk of pathogenic infection [4]. In addition, the use of trash fish can increase nitrogen and phosphorus levels in the water. The feed formulation needs to be developed to meet the needs of fish while still paying attention to the ecological impact on the waters. This is necessary to maintain a sustainable grouper fish cultivation [5].

2. Material and methods
2.1. Cage preparation
The cage used has a size of 3x3 m and uses a polyethylene net as a place for maintenance. The nets used are 3x3x3 m in size with mesh sizes of 0.5 and 1 inch. Net with 0.5 inch mesh size is used for fish 12-15 cm or 1 ounce, while 1 inch mesh is used for fish 300 gram and above. According to [6] that the size of the nets adjusts to the size of the fish to be stocked, fish that have an average weight of 400 grams can be moved to a 1.5 inch net.

Map cages and nets should be checked before stocking fish. The bolts on the plot are tightened and reinstalled if anything is loose. The nets that will be used previously are sprayed first with a water spraying machine to remove any stuck dirt or barnacles. The condition of the net is checked by spreading it out and seeing whether there is a broken corner or not, if there is a hole in the net, sew it with thread. The net that is ready is then tied to each corner of the plot. Each plot requires 4 weights to keep the net open completely. Each weight is tied to the bottom end of the net.

2.2. Spread the seeds
Unit For Technical Development Of Sea Culture (UPT PBL) Situbondo does not have its own grouper broodstock, so eggs or seeds have to be imported from outside hatcheries such as Center for Brackish Water Cultivation Fishery (BPBAP) Situbondo and Bali. The seeds used must come from a hatchery that has a CPIB certificate (Good Fish Hatchery Method). Humpback grouper seeds must have good criteria for cultivation.

The criteria for a good seed are that the fish must be healthy, not defective, and do not carry disease [7]. The seeds have active movement and a high appetite. Selection of seeds must be of uniform size. This is because grouper fish are cannibals so that the uniform size of the seeds can reduce the potential for cannibalism. The seeds that are ready to be spread are brought to the cage in a plastic bag that is given oxygen. Sowing seeds in the cages must pay attention to several factors, including spreading them in the morning or evening because the water temperature is not too high. It is recommended that the distribution be carried out in the afternoon because the water temperature is going to a low condition, while in the morning the water temperature will increase during the day. Spread is not recommended if the sea conditions are waves or strong winds, this can stress the fish and can lead to death. The preferred size of seeds to stock in cages is above 7 cm, the size of 7-10 cm has a survival rate of 30% to 70% in the first two months of maintenance [1].

The spread begins with an acclimatization process that aims to stabilize the temperature and salinity between the seedling places and the waters in the marine cage. The seed bags are placed in the cage for 5-10 minutes. The bag containing the acclimatized seeds is then tilted so that the seeds can come out on their own [7].

The stocking density of seeds with a cage size of 3x3x3 m generally ranges from 300-500 individuals per plot, meaning that the density of seeds is 11-18 individuals / m3. The rat grouper that was cultivated in the UPT PBL KJA was only 1 plot with a stocking density of 100 individuals. This is due to the very long rearing period of the humpback grouper (1.5 - 2 years) so that the center prefers to raise beautiful and beautiful grouper which has faster growth (8 months).
2.3. Feeding technique
Trash fish is obtained from the Panarukan fishing port, Situbondo. Every day UPT PBL prepares 45 kg of trash fish for feed in the cage. The type of trash fish used for feed varies over time depending on the season of fish. However, in general, curisi fish and peperek fish.

The trash fish that will be used as feed is previously rinsed with water to remove odors and melt the remaining ice that is still stuck. The fish that has been rinsed are then cut into small pieces according to the mouth opening of the grouper. The aroma of the feed must be preferred by fish because it will affect the prey power of the fish [8]. Cutting trash fish is still done manually using scissors. The use of mowers was once carried out at UPT PBL Situbondo, but trash fish was destroyed and the grouper refused to eat.

Feeding is done once a day every morning at around 10.00 WIB. Feed is given little by little in each plot. This is because groupers only want to eat feed that is above or floating in the water column. The feed that sinks to the bottom will not be eaten by groupers and eventually rot. Feeding is done using the adlibitum method or given until the grouper does not want to eat anymore. Adlibitum feeding is feeding until the fish are full, as for the indicator of satiety in the fish, namely the fish does not respond to the feed given [9].

2.4. Grading
Grading is the process of separating groupers according to size. In one plot, even though given the same feed, the growth of each fish will be different. This difference in fish size can cause cannibalism between groupers. The uniformity of size to prevent grouper fish from preying on each other due to the nature of cannibalism [10]. Ideally, grading should be done once a month or there are already visible differences in size between fish. The distribution of sizes in grading is divided into three, namely small, medium, and large. The grading process is carried out simultaneously with counting the number of fish in the plot. This aims to determine the value of the survival rate. Grading grouper fish in UPT PBL KJA is no longer grading because it is 1.5 years old. The average grouper weighs 700 grams, so the potential for cannibalism is minimal.

2.5. Cage maintenance
Cage maintenance is very important to maintain the cage and extend its service life. Cage maintenance is carried out by changing the nets on the plot. Ideally, replacing the net is done every two weeks or according to the conditions of the fish. Replacement of the cage nets with a mesh size of 1 inch can be done every two weeks [6]. The conditions in the study indicate that most farmers rarely change their nets if the fish still look healthy. This is reasonable because the process of changing the net requires extra effort and time.

Nets that have been used for two weeks will usually be covered with barnacles and other marine plants. The smaller the mesh size, the faster it will be covered by barnacles. Sticking barnacles can interfere with water circulation by clogging the holes in the nets. The net which is full of barnacles is lifted and dried. The drying process takes 3-5 days depending on weather conditions. The dry nets are then beaten with bamboo to allow the stuck barnacles to come off. Cleaning of barnacles is also carried out by spraying high pressure sea water. The clean net is then checked for condition and sewn if any of the nets are torn.

Survival rate

\[ SR = \frac{N_t}{N_o} \times 100\% \]

Where:
- **SR**: Survival rate (survival rate)
- **Nt**: Number of fish at the end of rearing
- **No**: The number of fish at the beginning of stocking
Feed Convrtion Ratio

$$FCR = \frac{F}{Wt - Wo}$$

Where:
- FCR: Feed Conversion Ratio
- F: Amount of feed given (g)
- Wt: Weight of final research animal (g)
- Wo: Weight of study animal at baseline (g)

Growth Rate

$$GR = \frac{Wt - Wo}{t}$$

Where:
- GR: Growth Rate
- Wt: Weight of final research animal (g)
- Wo: Weight of study animal at baseline (g)
- t: Length of study (days)

3. Result and discussion

3.1. Harvesting

Harvesting is carried out when the grouper fish has reached the consumption size demanded by the market. Harvesting is done partially or totally depending on market demand. The total harvest is the overall harvest which is usually to meet market needs on a large scale and the size of the fish has met the criteria [11]. Grouper fish are usually harvested when they reach a weight of 500-700 grams per fish. The maintenance period for grouper fish to reach this size is approximately 1.5 years. The harvest process is usually carried out in the morning when the temperature is still not too hot to reduce the stress level of grouper fish. The price of live rat grouper can reach IDR 475,000 per kg, if in a dead condition the price can drop by 50%.

Grouper fish are satisfied first a day before harvesting. The purpose of fasting is to reduce the output of metabolic activity. Fish that are not fed at the time of packing will release a little feces so that the water does not become cloudy quickly. Too much feces can cause the water to become cloudy and stress the fish. Grouper fish are packed using drums with a density of 50 fish per drum. The crops are distributed to Bali, Surabaya and other cities according to market demand.

3.2. Eligibility level of life

Grouper fish, including fish that are cannibals, and most of the deaths at the beginning of the stocking are caused by cannibalism. The seeds that are ready to spread in the cages are over 7 cm in size. According to [12], seeds that are less than 5 cm in size cause a mortality rate during maintenance of 60% or even worse. Rat grouper fish in the UPT PBL Situbondo cage has a survival value of 50%. The initial stocking was 100 heads until now, after 1.5 years of rearing, the remaining 50 birds.

3.3. Feed conversion ratio

The feed conversion ratio is the ratio of the weight of the feed given during maintenance to the weight of the fish produced during the sampling. Trash fish is a common food source used by farmers in raising groupers. Trash fish was chosen because the price is cheaper than pelleted feed from the factory. The presence of plankton in the water as natural food or water quality control. The abundance of phytoplactones in a waters can be influenced by several environmental parameters and physiological characteristics [13,14,15]. The composition and abundance of phytoplankton will change at various levels in response to changes in environmental conditions, namely, physics, chemistry and
biology [16,17]. The factors supporting the growth of phytoplankton are very complex and interact with each other between physical, chemical and biological factors [18,19,20]. Interacting factors between the physico-chemical factors of the waters such as brightness, dissolved oxygen, temperature, availability of nutrients, nitrogen and phosphorus [21,22,23]. While the biological aspects are the presence of predators by animals, natural mortality and decomposition [24,25,26]. The types of phytoplankton that are often found in large quantities are phytoplankton from the diatom and dinoflagellate classes. The types of phytoplankton found in Wonorejo Mangrove waters are in the Bacillariophyceae class, namely from the genus *Nitzschia* sp., *Navicula* sp., *Tabellaria* sp., *Chetoceros* sp., *Coscinodiscus* sp. and *Hemiaulus* sp., while those from the Coscinodiscophyceae class, namely from the genus *Skeletonema* sp., Cynophyceae class, namely from the genus *Scenedesmus* sp., Dinophyceae class, namely from the genus *Protoperidinium* sp., *Ceratium* sp. and Class Fragilariophyceae, namely from the genus *Synedra* sp.

The result of the calculation of the feed conversion ratio is 3.27. According to [27] stated that two to four times more trash fish feed is wasted than pellet feed.

3.4. Growth rate
The growth rate is the daily increase in fish weight during the rearing period. The result of calculating the growth rate of humpback grouper as attached in the attachment is 0.4167 g/day. According to [28] seed size rat grouper has a growth rate of 2.65 g/day. The growth rate of humpback grouper is very low when compared to the bright and beautiful hybrid grouper. The growth rate of cantang grouper is 3.45 g/day, while the beautiful grouper is 1.33 g/day [29].

3.5. Water quality
Water quality plays a very important role in the fish farming process. Water quality monitoring is carried out to observe the condition of cultivated waters. The water quality parameters observed were temperature, pH, dissolved oxygen, and salinity. The water quality in the cages is very different from that in the ponds. Water conditions are very dependent on nature and difficult to control if there is the spread of disease or an explosion of certain types of algae. The measurement results can be seen in the table below.

| Date                | Dissolved Oxygen (ppm) | pH   | Temperature (°C) | Salinity (ppt) |
|---------------------|------------------------|------|-----------------|----------------|
| 24 December 2018    | 5.2                    | 8.09 | 30.4            | 34             |
| 31 December 2018    | 5.3                    | 8.2  | 30.6            | 34             |
| 7 January 2019      | 5.0                    | 8.3  | 30.5            | 34             |
| 15 January 2019     | 5.2                    | 8.1  | 30.0            | 35             |

3.5.1. Temperature
Temperature is measured using a thermometer inserted into the water column. The results of temperature measurements in the floating net cages of UPT PBL Situbondo are in the range of 30-30.6°C. According to [30] the cage temperature in Situbondo waters ranges from 30-31°C where the temperature is suitable for fish maintenance. The temperature in the cage tends to be stable and good for fish growth. Water temperature affects the metabolic activity of fish, if the temperature changes drastically it can cause death.

3.5.2. Degree of acidity (pH)
The degree of acidity (pH) is one of the water quality parameters that affect fish life. The results of pH measurements in the floating net cages of UPT PBL Situbondo were in the range of 8.09 - 8.2. The pH value is considered good for grouper rearing. The appropriate pH range for grouper culture in cages is
5. Dissolved oxygen
Dissolved oxygen levels are measured using a DO meter. According to [33] that dissolved oxygen levels are good for grouper fish life is above 3.5 ppm. The dissolved oxygen level is not much different from what [34] states that the optimal dissolved oxygen content for grouper fish is 4-8 ppm. The results of dissolved oxygen measurements in the floating net cages of UPT PBL Situbondo ranged from 5.0-5.3 ppm. This value is still good enough for rat grouper cultivation.

4. Conclusion
The technique of enlarging grouper fish (C. altivelis) in floating net cages includes cage preparation, seed distribution, feeding techniques, grading, parasite control and harvesting. The value of water quality in the rearing grouper (C. altivelis) is suitable for the maintenance of grouper mice.

5. References
[1] Afero F, Miao S, and Perez-Rogers A 2010 Aquac. Int. 18(5), 725-739.
[2] Shapawi R, Mustafa S, and Ng W K 2008 Aquac. Res. 39(3), 315-323.
[3] Anggraini D R, Damai A A, and Hasani Q 2018 e-JRTBP 6(2), 719-728 [in Indonesian].
[4] Kim J H, Gomez D K, Choresca C H, and Park S C 2007 Aquac. 272(1-4), 105-110.
[5] Suprayudi M A, Hajiali F, Utomo N B P, Ekasari J, and Fauzi I 2016 Hayati 23(1), 18-21 [in Indonesian].
[6] Sayuti 2014 Cultivating Grouper Using Floating Net Cage (Aceh: Malikussaleh University).
[7] Chobiyah I 2014 Growing Freshwater Pomfret Fish (Magelang: Agricultural Extension Information Center).
[8] Kurnia B, Akbar S and Salam 2000 Penggelondongan Ikan Kerapu Macan dengan Pakan Buatan yang Mengandung Prosentase Ikan Rucah Berbeda (Lampung: Balai Besar Perikanan Budidaya Laut Lampung) [in Indonesian].
[9] Lucas W G F, Kalesar O J, and Lumenta C 2015 Jurnal Budidaya Perairan 3(2), 19-28 [in Indonesian].
[10] Putri D I L, Tumulyadi A, and Sukandar 2013 Jurnal Mahasiswa Pemanfaatan Sumberdaya Perikanan Dan Kelautan 1(1), 1-15 [in Indonesian].
[11] Fauzi A 2018 Feasibility analysis of tiger grouper (Epinephelus fuscoguttatus) floating net cage system CV. Ocean Mega Persada in Gundil hamlet, Klatakan village, Kendit sub-district, Situbondo district (Malang: Universitas Muhammadiyah Malang).
[12] Shadovy Y J, Donaldson T J, Graham T R, McGilvray F, Muldoon G J, Phillips M J, Rimmer M A, Smith A, and Yetting B 2005 While stock last: the live reed food fish trade ADB Pacific study series (Manila: Asian Development Bank).
[13] Sari L A, Wulansari P D, Nindarwi D D, Arsad S, and Affandi M 2019 Ecol. Environ. Conserv. 25, S26-S31.
[14] Sari L A, Purseyo K T, Arsad S, Masithah E D, Setiawan E, and Affandi M 2019 Pollut. Res. 38, S27-S32.
[15] Sari L A, Satyantini W H, Manan A, Pursetyo K T, Dewi N N 2018 IOP Conference Series: Earth and Environmental Science 137(1).

[16] Nindarwi D D, Sari L A, Wulansari P D, Samara S H, and Santanumurti MB 2020 IOP Conference Series: Earth and Environmental Science 441(1).

[17] Liyana S H, Sari L A, Dewi N N, Masithah E D, Sahidu A M, and Pursetyo K t2019 IOP Conference Series: Earth and Environmental Science 236(1).

[18] Dwiardani K H, Sari L A, Wulansari P D, Nindarwi D D, and Arsad S 2020 IOP Conference Series: Earth and Environmental Science 441(1).

[19] Holy N H and Sari L A 2020 IOP Conference Series: Earth and Environmental Science Sci 441(1).

[20] Pratama N A, Rahardja B S, and Sari L A 2020 IOP Conference Series: Earth and Environmental Science 441(1).

[21] Putri A D A and Tjahjaningsih W 2018 JAFH. 7(3), 111-117 [in Indonesian].

[22] Syaifudin M, Sulmartiwi L, and Andriyono S 2017 JAFH. 6(1), 41-47 [in Indonesian].

[23] Sari L A, Masithah E D, and Alamsjah M A 2018 JFMR. 2(1), 9-14 [in Indonesian].

[24] Azmi K A, S Arsad, L A Sari 2020 IOP Conference Series: Earth and Environmental Science 441(1).

[25] Rinawati M, Sari L A, and Pursetyo K T 2020 IOP Conference Series: Earth and Environmental Science 441(1).

[26] Sim S Y, Rimmer M A, Toledo J D, Sugama K, Rumengan I, Williams K C, and Phillips M J 2005 Panduan Teknologi Hatcheri Ikan Laut Skala Kecil (Bangkok Thailand: NACA) p 17 [in Indonesian].

[27] Septinawati A and Tjahjaningsih W 2010 JIPK. 2(1), 67-75 [in Indonesian].

[28] Kristanto H A, Giri I N A and Sutarmat T 2015 Prosiding Forum Inovasi Teknolgi Akuakultur (Jakarta: Pusat Penelitian dan Pengembangan Perikanan, Badan Penelitian dan Pengembangan Kelautan dan Perikanan) [in Indonesian].

[29] Fidyandini H P, Subekti S, and Kismiyati 2012 JMCS. 1(2), 91-112 [in Indonesian].

[30] Rofizar A, Jaya Y V, and Irawan H 2017 Intek Akuakultur 1(1), 37-50 [in Indonesian].

[31] Langkosono 2007 Neptunus 14(1), 61-67 [in Indonesian].

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