Evaluation of cages dimension to the growth of giant trevally
*Caranx ignobilis*

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**Abstract.** Fish growth is one of the most target in aquaculture with right method of feeding, water quality and size of cages where they were held. In this study, a 70-day research was conducted to evaluate the effect of floating net cages dimension on growth and survival of trevally *Caranx ignobilis* in Ambon Inner Bay of Indonesia. A total of 90 juvenile trevallies with an average weight of 17.18 ± 1.9 g was randomly stocked in six floating net cages at three different sizes as treatments in replicate groups. Fish were fed 10% of total body mass with by catch fish twice a day to satiation. Length and weight were recorded, growth performance of fish were assessed in the form of Specific Growth Rate (SGR), Food Conversion Ratio (FCR) and Survival rate (SR). The result showed there were no significant different growth rate (SGR) at different treatments (p>0.05), with the highest SR = 100% and lowest FCR = 2.9 both in treatment C. It means the best dimension of fish cage in this research was at the biggest size of cage 200 x 150 x 100 cm³.

1. **Introduction**

Aquaculture had played an important role in the global fisheries production nowadays, as the growth in the period of 1950 until 2018 was 8.1% per year [1]. One of challenges in Indonesia was over carrying capacity through cage culture practices that imply the concept of environmental degradation observed in the water bodies during cage-based production process. Intensive aquaculture relates to stocking densities and high amount of diet [2]. Increase in density will followed by an increase of production if the environment is in good condition [3].

Floating net cage aquaculture considered as an alternative to obtain fish from the wild fisheries and the utilization of available water resources for fish production. This method of production presents as the most appropriate to minimize the use of land and water resources. Some papers of the floating net cage studies were culture of freshwater fish [4, 5, 6]. This study was on marine floating cage net culture that get more attention for its potential and nowadays are very much in development [7].

Marine fish culture in floating net cage are growing fast in line with highly demand of fish in Ambon restaurant, mainly white snapper, grouper, barramundi and trevally as palatable species. Number of units of floating net cage has been increased recently over Ambon Bay [8], have consequences of space to set the cages become a constraint. Among all species of fish found cultured in the cages, trevally or Indonesian name Bubara and locally called ikan kuwe were most preferred.

Trevallies are pelagic, active swimming fish and highly streamline with very fine scales. Culture trevally has several advantages, such as less intensive care required, resist against diseases, can adopt to extreme quality changes of water and fast growing. There was a report on feed of trevally [9] but still lack of studies on cage size related to the growth of trevally. This study conducted to evaluate effect of cages dimension to the growth of giant trevally *Caranx ignobilis* rearing in floating net cage in inner bay of Ambon.
2. Materials and Method

2.1 Cage preparation and fish cultured
This research was conducted for 10 weeks includes cages preparation, cultured period and measurement or data collected. These cages made up of thick HDPE materials and polyethylene net were placed at the Ambon Bay with the depth of 5–10 m depend on the tide. The experimental design used completely randomised with 3 treatments and replications with cages dimensions of 75 x 100 x 100 cm (treatment A), 150 x 100 x 100 cm (treatment B) and 200 x 150 x 100 cm (treatment C). A total sample of 90 fish with the range size of 13-18 cm were put in six cages. Simple homogeneity test of $F_{max}$ was performed by dividing value of the maximum and minimum sample variance of fish length. Fish were obtain from the fisherman in the inner bay of Amob and fed with by cathes fish mince in this case Decapterus sp. Frequency of feeding was done twice a day of 10% total biomass, at 8 am and at 5 pm at satiation.

2.2. Growth performance
To analyze growth performance, Specific Growth Rate (SGR) and Food Conversion Ratio (FCR) were determine using the formula described [10, 11]. To calculate SGR equation used as follow; $SGR = (\ln W_t - \ln W_0)/t \times 100\%$; where $W_t$ = Final weight, $W_0$ = initial weight, $t$ = time of experiment. Food Conversion Ratio (FCR) is the amount of feed consumed by fish (g) to increase 1 g of fish weight, calculated to measure fish growth rate and consumed feed. The equation used was: $FCR = F/(W_t + W_m + W_0)$; where, $F$ is the amount of feed given during treatment (g), $W_0$ is initial fish biomass (g), $W_m$ is biomass of dead fish during treatment (g) and $W_t$ is final biomass of the fish (g) [12].

2.3. Data analysis
Data were analyzed using SPSS. A one-way ANOVA were used to compare the data on SGR, while FCR was analyzed using Excel.

3. Result and Discussion

3.1. Growth performance
Homogeneity test on length shows sample were homogen at the minimum and maximum values of variance 2.18 and 3.05 cm respectively with $F_{max} = 1.39 < F_{tab} = 3.51$ providing confident that all fishes used in the experiment had initial equal size. ANOVA test on the fish weight revealed no significant difference on the growth of giant trevally between treatments. Table 1 shows that growth of fish in the treatment C, the more spacious cages, seems just slightly higher (SGR = 7.6%) than the fish in treatment A (SGR = 7.4%) and treatment B (SGR = 7.4%), respectively. At different sizes of cage and number of fish were the same, similar growth rate shows clearly that growth of fish is not solely depend on space but could depend on their life stages, feed and season. For more efficient production, it would give more benefit to establish optimum density base on species cultured [13].

Survival rate was higher in treatment C (100%) as no trevallies was found dead, in the contrary to treatment A (83.3%) and B (86.6%), some were dead. It is found that scales of giant trevally is very fine and easily to come off when they receive relative harsh handling. This may then lead them prone to injure allowing further investation of bacterial bearing desease. For many other culture fish, this may not be a serious problem if biomass estimation can be done with a nonintrusive methods [14] as every species would have different scale type and strength [15] As the experiment progress, mortality due to mishandling mechanism improved followed by reduction of number of fish dead. One may argue that this should not be a problem in real aqualculture activity as the removal of fish out of water for treatment or measurement may be minimal. Despite such, carefull handling of the juvenile fish of giant trevally remain critical including removal and apply special cure treatment of the injure fish. Scales and skin are most commonly damaged by handling stress [16]. From a close observation, if some of the fish scales get loose, two-three days later fish has developed some white spotting on the scales and fins which eventually turn to be skin diseased. This incidence occured only with the fish sampled for observation of their length and weight taken every two consecutive weeks.
Low of production cost can be seen on the value of FCR. The lower FCR the more efficient the cost. Giant trevallies as carnivorous fish has the lowest FCR of 2.9 in treatment C compare with the value of FCR from the treatment A (3.9) and B (3.7), respectively. This culture of giant trevallies in the biggest cages might give more space of movement and become more active during feeding and hence grow, while fish in smaller cages may have stress that prevent them to grow and hence have high FCR values. This study is in line with the result of seabass cultured in floating net cage [13] that has survival rate and growth higher at less dense but more in total biomass at more dense cage. This condition reveals that enough space in fish confinement will lead to high final production in this term total biomass.

Table 1. Growth and survival of Caranx ignobilis at different treatment on sizes of floating net cages

| Treatment | n  | Initial Weight (g) | Final Weight (g) | SGR (%) | SR (%) | FCR |
|-----------|----|--------------------|------------------|---------|--------|-----|
| A         | 15 | 17.4 ± 6.1         | 181.7 ± 31.5     | 7.4     | 83.3   | 3.9 |
| B         | 15 | 14.8 ± 5.3         | 183.8 ± 26.7     | 7.4     | 86.6   | 3.7 |
| C         | 15 | 19.3 ± 3.6         | 213.8 ± 23.6     | 7.6     | 100    | 2.9 |

There were different weight increase in all treatments, but clearly treatment C has a better figure. In the end of the measurement Week 10, treatment C reached body weight up to 213 g compare to treatment A and B only reached 181 and 183 g respectively. The weight increased fluctuated at Week 0, 2 and 6 caused by heavy rain that eventually dropped the salinity. Low water quality have consequences on the growth performance of fish with stress.

3.2. Cage size and shape
In general, it is easier to manage small cages than large one and usually provide a higher economic return per unit volume. However culture giant trevally will also need to consider their behaviour. This type of

Figure 1. Growth of giant trevally with the increasing of weight ± SD (a, b and c) in different size of cage as treatment A=75 x 100 x 100 cm; B=150 x 100 x 100 cm and C=200 x 150 x 100 cm
fish swim in the cage in a rotary motion, so it must be related to the shape of cage. A work in comparing the shape of cages between rectangular, square and circular in related to shrimp production was done [17]. They found that rectangular was given highest production, maybe related to more water inflow than the other two shapes. In this study, all cages were rectangular, however it may affect giant trevally differently with the shrimp. Although treatment C produced better growth of the fish, but further studies need to do related to the shapes of cages, consider that giant trevally swim in a circular movement.

Trevally in this research taken from nature. When it has been confined, their space become limit to the size of cages. It will affect their physiology, and affect their behaviour. When the water get murky cause by heavy rain, fish cannot go and get the better place. Domestication in the low level related to first trials of acclimatization to the captive environment [19] and he mentioned that only a limit number of species can reach to a high level. Some research on giant trevally showed they can still grow fast in the confining of floating net cages [20], means they have adoptive ability and become possible for marine culture.

3.3. Water quality
On environmental parameters, the average temperature in this study was between 27-28.7°C and fluctuated at the salinity between 24-26 ppt as shown in Table 2. Temperature was still in the range of preference of giant trevally but salinity was below the range stated. This should be considered as the factor of low growth rate. Growth of fish really depend on salinity and temperature combined, but temperature is more crucial also in reproduction and sometimes survival. The wide range of water parameters fish can adapt which is temperature between 27-30°C [20] and salinity between 27 – 30 ppt [21].

On the observation of fish feeding behaviour related to salinity in the heavy rain, salinity was drop down to 12 ppt, while the temperature remains in the normal level. That situation fish intake of feed is slower and less than normal day. Giant trevallys may get a very disturbed appetite at low salinity and it may affect low growth of fish.

Table 2. Average temperature and salinity in the period of fish cultured in comparison to the standard values from references

| Parameter     | Week | Optimum Range | Reference |
|---------------|------|---------------|-----------|
| Temperature (°C) | 0   | 2             | 4         | 6         | 8         | 10        | 27 - 30   | [20]       |
| Salinity (ppt) | 25.14 | 25.9          | 21.6      | 24        | 24.7      | 26        | 27 - 30   | [21]       |

4. Conclusion
Although the dimension of cages was not significantly affect the growth of giant trevally Caranx ignobilis, bigger cage give more space for fish to grow and it revealed in the specific growth performance. Survival Rate was high as well as Food Conversion Rate more efficient in the biggest cage 200x150x100 m³.

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