Effect of Feed Dose and Stocking Density on Growth and Survival of Clown Fish (*Amphiprion ocellaris*) Maintained with Sea Anemons

.

ABSTRACT

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| The selling price of *Amphiprion ocellaris* clownfish varies where the selling price will increase according to the size of the body and its quality. The optimal stocking density of *Amphiprion* *ocellaris* clownfish in its maintenance is not yet known and the high price of feed is also a problem. Feed dosage of 5% and stocking density of 0.5 fish/L can increase the growth of *Amphiprion ocellaris* clownfish so that the use of dosage and density is effective to be applied to increase the growth of *Amphiprion ocellaris* clownfish. This research was conducted in February-March 2025 at the Lombok Marine Aquaculture Fisheries Center (BPBL), Gili Genting Hamlet, West Sekotong Village, Sekotong District, West Lombok Regency, West Nusa Tenggara. The method used in this study was an experimental method using a factorial completely randomized design (CRD) with two factors, namely the feed dose factor (3% and 5%) and the stocking density factor (0.5/L, 1/L, 1.5/L). This study consisted of 6 treatments and 3 replicates, resulting in 18 experimental units. The results showed that feed dose and stocking density had a significant effect on the research parameters, while their interaction did not have a significant effect. While the research parameters of feed utilization efficiency were not significant from the effect of feed doses and their interactions, and survival was not significant from the effect of feed doses, stocking density and their interactions. Water quality during the study was pH 7.9-8.1, dissolved oxygen 5.8-64 mg/L, and temperature 28-30oC. |

*Keywords : Clownfish; anemone fish; feed dosage; stocking density; clownfish growth*

1. INTRODUCTION

The most popular type of marine ornamental fish in Indonesia is clown fish, Amphiprion ocellaris which is symbiotic with sea anemones. Color patterns and variations in color combinations are used as characteristics in the identification of clownfish (Zulfikaret al. 2018). In addition to its color, the size and quality of the fish are also important factors, as the selling price increases with the size and quality of the fish. The price of *Amphiprion ocellaris* clownfish measuring 3-5 cm ranges from Rp. 5,000-10,000 per fish (Faturrahman et al. 2020). In conducting clownfish (*Amphiprion ocellaris*) farming activities, it is important to understand the factors that can influence growth and survival, ensuring the fish produced grow optimally. However, the current challenge is the high cost of feed, which is widely complained about, so the dosage given must be carefully considered. Feed administered in inappropriate doses can have adverse effects on fish growth and survival. Excessive feed intake leads to increased economic costs and deteriorated water quality (Hasanah et al. 2020).

In addition, the optimal stocking density for clownfish *Amphiprion ocellaris* in cohabitation with sea anemones is still unknown. The commonly used stocking density is 1-3/L depending on the size of the fish (Sari et al. 2014), and clownfish *Amphiprion ocellaris* farmers also use 2-3/L. However, based on previous research on a different species, *Amphiprion parcula*, the highest growth rates were achieved at a stocking density of 0.5 fish per liter (Chambel et al. 2015). In some clownfish farming activities, sea anemones are often not used, even though anemones are important for supporting their well-being. The presence of anemones in clownfish farming can make the fish feel safer and more protected, and this relationship is also believed to contribute to a longer lifespan for clownfish (Nguyen, 2020).

Based on the above discussion, the author conducted a study on the effects of feed dosage and stocking density on the growth and survival of clownfish *Amphiprion ocellaris* kept with sea anemones to determine the effects of feed dosage and stocking density involving anemones, as information to enhance knowledge in the field of aquaculture, with the hope that it can be improved in the future.

2. METHOD

This study was conducted over a period of 52 days, beginning in February-March 2025 at the Lombok Marine Aquaculture Center (BPBL) in Gili Genting Hamlet, Sekotong Barat Village, Sekotong Subdistrict, West Lombok Regency, West Nusa Tenggara. The method used in this study was an experimental method using a completely randomized design (CRD) factorial with two factors, namely feed dose (3% and 5%) and stocking density (0.5/L, 1/L, 1.5/L). This study consisted of 6 treatments and 3 replicates, resulting in 18 experimental units.

**2.1 Research Procedure**

The initial stage involves preparing the equipment and materials. Eighteen 15-liter containers are required. DO meter, camera, container, ruler, pH meter, pipe, scoop, thermometer, and scale. The materials required are seawater, sea anemones (*Heteractis magnifica*), worms, clownfish (*Amphiprion ocellaris*), and pellets. Once the equipment and materials are ready, the anemones are placed in the containers, and clownfish larvae are released at the specified stocking densities of 0.5 larvae/L, 1 larva/L, and 1.5 larvae/L. The clownfish larvae are 2–2.5 cm in size. They are fed at doses of 3% and 5%.

**2.2 Data Collection**

Water quality measurements were taken at 08:00 WITA. Water quality parameters included temperature, pH, and dissolved oxygen (DO). Absolute length was calculated using the formula according to (Wijaya et al. 2018), absolute weight was calculated using the formula according to (Hasanah et al. 2020), specific growth rate calculations were performed using the formula according to (Fitrinawati et al. 2024), survival rate calculations were performed using the formula according to (Sari et al. 2014), and feed utilization efficiency calculations were performed using the formula according to (Novita et al. 2019).

**2.3 Data Analysis**

The data obtained from the research results, such as absolute length gain, absolute weight gain, specific growth rate, survival rate, and feed conversion efficiency, were then statistically analyzed using two-way ANOVA with a 95% confidence level. Data showing a significant effect were further tested using the Duncan method.

3. RESULTS

The results showed that feed dose and stocking density had a significant effect on the research parameters, while their interaction did not have a significant effect. While the research parameters of feed utilization efficiency were not significant from the effect of feed doses and their interactions, and survival was not significant from the effect of feed doses, stocking density and their interactions. A recapitulation of the effect of feed dose, stocking density and their interaction on the research parameters can be seen in Table 1.

Table.1 Recapitulation of significant feed doses, stocking density and their interaction on the research parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Research Parameters |  | Treatment |  |
| Feed Dosage | Stocking Density | Interaction |
| Absolute Length Growth | \* | \* | ns |
| Absolute Weight Growth | \* | \* | ns |
| Specific Growth Rate | \* | \* | ns |
| Survival | ns | ns | ns |
| Feed Utilization Efficiency | ns | \* | ns |

Desc: \*significant at 5% level; ns is not significant

**3.1 Absolute Length and Weight Growth**

The results of further tests on the effect of feed dose and stocking density on absolute length growth of clownfish (*Amphiprion ocellaris*) can be seen in Figure 1.

 

1. (b)

Figure 1. Absolute length growth of clownfish at different feed doses (a), and different stocking densities (b)

The results of data analysis using two-way ANOVA at a 95% confidence interval indicate that feed dose (A) and stocking density (B) significantly affect the absolute length and absolute weight of clownfish, while their interaction is not significant. Based on Duncan's test results, it was found that the 5% feed dose (A2) was significantly different from the 3% feed dose (A1). At a stocking density of 0.5 fish/L (B1), there was a significant difference compared to stocking densities of 1 fish/L (B2) and 1.5 fish/L (B3).

The results of further tests on the effect of feed dose and stocking density on absolute weight growth of clownfish (*Amphiprion ocellaris*) can be seen in Figure 2.

 

1. (b)

Figure 2. Absolute weight growth of clownfish at different feed doses (a), and different stocking densities (b)

Based on the results of the two-way ANOVA test with a 95% confidence interval, the treatment of feed dose (A) and stocking density (B) has a significant effect on the growth of absolute weight of clownfish, while the interaction is not significant. Based on the results of the Duncan test, it was found that the 5% feed dose (A2) was significantly different from the 3% feed dose (A1). At a stocking density of 0.5 tails / L (B1) is significantly different from stocking density of 1 tail / L (B2) and stocking density of 1.5 tails / L (B3).

**3.2 Specific Growth Rate**

The results of further tests on the effect of feed dose and stocking density on Specific Growth Rate of clown fish (*Amphiprion ocellaris*) can be seen in Figure 3.

 

1. (b)

Figure 3. Specific growth rate of clownfish at different feed doses (a), and different stocking densities (b)

The results obtained from the two-way ANOVA test with a 95% confidence interval showed that feed dose (A) and stocking density (B) significantly affected the specific growth rate of clownfish, while their interaction was not significant. Based on the Duncan test results, it was found that the 5% feed dose (A2) was significantly different from the 3% feed dose (A1). Stocking density 0.5 fish/L (B1) and stocking density 1.5 fish/L (B2) were significantly different from stocking density 1.5 fish/L, but stocking density 0.5 fish/L (B1) was not significantly different from stocking density 1 fish/L (B2).

**3.3 Survival**

The results of further tests on the effect of feed dose and stocking density on survival in clown fish (*Amphiprion ocellaris*) can be seen in Figure 4.

 

1. (b)

Figure 4. Survival of clownfish at different feed doses (a), and different stocking densities (b)

The results of the two-way ANOVA test with a 95% confidence interval showed that feed dose (A), stocking density (B), and their interaction were not significant for clownfish survival. Based on the Duncan test results, it was found that the 3% feed dose (A1) was not significantly different from the 5% feed dose (A2). At a stocking density of 0.5 fish/L (B1), there was no significant difference compared to stocking densities of 1 fish/L (B2) and 1.5 fish/L (B3).

**3.4 Feed Utilization Efficiency**

The results of further tests on the effect of feed dose and stocking density on feed utilization efficiency in clown fish (*Amphiprion ocellaris*) can be seen in Figure 5.

 

1. (b)

Figure 5. Feed utilization efficiency of clownfish at different feed doses (a), and different stocking densities (b)

The results obtained from the two-way ANOVA test with a 95% confidence interval showed that the feed dose treatment (A) was not significant and the stocking density (B) had a significant effect on the feed efficiency of clownfish, while the interaction was not significant. Based on the Duncan test results, it was found that the 3% feed dose (A1) was not significantly different from the 5% feed dose (A2). At a stocking density of 0.5 fish/L (B1), there was a significant difference compared to stocking densities of 1 fish/L (B2) and 1.5 fish/L (B3).

**3.5 Water Quality**

The results of water quality measurements can be seen in Table 2. The water quality parameters measured include pH, DO and temperature.

Table 2. Water quality results during clownfish maintenance

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters | Results | Ideal Range | References |
| pH | 7.8-8.1 | 7-8.5 | (Johan et al. 2019) |
| DO (mg/L) | 5.8-6.4 | >4 | (Novita et al. 2019) |
| Temperature (oC) | 28-30 | 27-31 | (Hasanah et al. 2020) |

4. DISCUSSION

**4.1 Absolute Length and Absolute Weight Growth**

The absolute length growth of clownfish at different feed doses during cultivation was highest in the 5% feed dose treatment (A2), which was 0.66 cm. This high value is thought to be in line with the nutritional needs of the fish. This is consistent with the opinion that Sartikawati et al. (2020), which states that growth can be influenced by the availability of protein in food, which is a very important source of nutrition for fish growth. Meanwhile, according to Lupatsch et al. (2013), Small clownfish should be fed food with 40% protein, while for larger fish, 35% is sufficient.

The absolute length growth of clownfish at different stocking densities during cultivation ranged from 0.55 cm to 0.71 cm. The highest value was obtained at a stocking density of 0.5 fish/L (B1) and the lowest at a stocking density of 1.5 fish/L (B3). This is thought to be due to competition for food. This is in line with the opinion that Sulaiman et al. (2022), which states that the growth of organisms can be influenced by external and internal factors. External factors include the environment in which they live and the availability of food, while internal factors include heredity, resistance to disease, and the ability of fish to utilize food. This is also added by Apriliani et al. (2021), which states that when fish experience environmental stress, it will affect their appetite, thereby impacting their growth. In previous research by Chambel et al. (2015), It also mentions that in the different species *Amphiprion parcula*, the highest growth results were also produced at a stocking density of 0.5 fish/L. In addition, the presence of this anemone may also be the cause of clownfish stress. This is due to the insufficient number of anemones provided; the supply of anemones is believed to need to be proportional to the number of individuals in the aquarium so that clownfish can utilize them evenly. Naturally, anemones also provide protection for clownfish and serve as their habitat. This aligns with the opinion Nguyen, (2020), The presence of anemones in clownfish breeding can make these fish feel safer and more protected.

The highest absolute weight was at a feed dose of 5% (A2) at 0.26 grams and the lowest at a feed dose of 3% (A1) at 0.19 grams. The low absolute weight growth value obtained at a feed dose of 3% (A1) is thought to be because at that dose, clownfish still need additional nutrients to boost their growth. This is in line with the opinion that Lupatsch et al. (2013), Small clownfish should be fed food with 40% protein, while for reduction, 35% is sufficient for larger fish. In addition, the low absolute weight growth value at different feed doses is thought to be due to clownfish not eating all the food provided, with even more food left uneaten due to a lack of appetite, resulting in lower growth values. This is in line with the opinion that Fitrianingsih et al. (2013), which states that pellet feed is easily crushed, so that the feed is less responsive to clownfish. In addition, it is also added by Meni et al. (2022), Clownfish prefer floating food that does not sink easily, so in this situation, it can attract clownfish to eat it.

The values obtained at different stocking densities ranged from 0.17 to 0.27 grams. The highest value was achieved at a stocking density of 0.5 (B1), and the lowest at a stocking density of 1.5 (B3), which was 0.17 grams. The highest value is likely due to the fact that at a stocking density of 0.5 (B1), the fish are better able to obtain more available food for their energy supply. Conversely, the low value at a stocking density of 1.5 (B3) is likely due to the fish's reduced ability to obtain food due to dominance within the group. A similar phenomenon was observed in previous studies Chambel et al. (2015), mentioning that the clownfish species *Amphiprion parcula* also produced the highest growth results at a stocking density of 0.5 fish/L. Added to this opinion Nyoman et al. (2024), that growth will occur if the amount of nutrients absorbed from the feed is greater than the amount required for body maintenance. In addition, it is also suspected that at this age, clownfish have higher growth rates in length than in body weight. This is in line with the opinion Kilmanun et al. (2024), which states that juvenile clownfish tend to grow in length faster than in weight. The presence of anemones is also better utilized at lower stocking densities than at higher stocking densities. This is in line with the opinion that Nguyen, (2020), The presence of anemones in clownfish habitats can make these fish feel safer and more protected. This relationship is also believed to contribute to the longevity of clownfish.

**4.2 Specific Growth Rate**

The results obtained were that the specific growth rate was highest at the highest feed dose of 5% (A2), namely 0.49%/day, and lowest at the feed dose of 3% (A1), namely 0.43%/day. This indicates that higher feed doses result in higher specific growth rates. This is likely due to the greater availability of feed, allowing fish to consume larger quantities at this dose. This aligns with the opinion that Arsad et al. (2025), which states that the amount of feed that fish can consume is one of the factors that can affect their growth. The optimal protein content for clownfish, according to opinion, is Lupatsch et al. (2013), Small clownfish should be fed food with 40% protein, while for larger fish, 35% is sufficient. Therefore, if the fish has a poor appetite, it can affect its growth. In line with this, Pandunitaa et al. (2023), which states that fish behavior with minimal appetite can affect growth deficiency. This means that if fish tend to eat less feed, it will have an impact on their specific growth rate.

The specific growth rate results at different stocking densities showed the highest value at a stocking density of 0.5 fish/L (B1), which was 0.50%/day, and the lowest at a stocking density of 1.5 fish/L (B3), which was 0.42%/day. This highest value is thought to be because the feed is more evenly distributed, so the clownfish can get food easily without having to use extra energy to swim and fight for it, while at a stocking density of 1.5 fish/L, the clownfish use more energy to swim and get food. This is in line with the opinion of Apriliani et al. (2021), which states that the more active fish are, the more energy and nutrients they consume, which can slow down their growth. This can occur because the energy that should be utilized for growth is replaced for other things, namely fish movement. The same thing happened with the reported results Chambel et al. (2015), In the different clownfish species *Amphiprion parcula*, the highest growth results were also produced at a stocking density of 0.5 fish/L. Although there were anemones in the tank, they could not be fully utilized due to their limited number, even though anemones are the home of clownfish. This is in line with the opinion that Nguyen, (2020), The presence of anemones in clownfish habitats can make these fish feel safer and more protected. This relationship is also believed to contribute to the longevity of clownfish.

**4.3 Survival**

The results obtained on the survival rate of clownfish with different feed doses were not significant. The high survival rate can be attributed to the fact that even though the fish were given different feed doses, they were still able to adapt and survive, so there was no significant difference between the 3% (A1) and 5% (A2) feed doses, as well as the presence of supporting environmental factors such as water quality. This is in line with the opinion Sari et al. (2014), which states that survival can be influenced by biotic factors such as the adaptability of animals and population density, as well as abiotic factors such as the physical and chemical properties of the aquatic environment. In addition, it is suspected that the constant availability of nutrients enables clownfish to survive with controlled feeding. This is in line with the opinion of Lupatsch et al. (2013), Small clownfish should be fed food with 40% protein, while for larger fish, 35% is sufficient.

A stocking density of 0.5 fish/L (B1) produced the highest value and a stocking density of 1.5 fish/L produced the lowest value, but there was no significant difference between the two. This was also the case in the reported results Chambel et al. (2015), In the different clownfish species *Amphiprion parcula*, the highest growth results were also produced at a stocking density of 0.5 fish/L. The high survival rate obtained is thought to be because the fish were still able to adapt to the different stocking densities applied, so the results were not significant. Meni et al. (2022), which states that fish will die if they are unable to obtain food within a short period of time. Added Nor et al. (2023), Death will occur if the fish are unable to obtain food and there are significant changes in the environment that cause the fish to become stressed. In addition, it is suspected that the limited number of anemones also causes the fish to feel uncomfortable. During observations, only some of the fish were able to stay on the anemones, while others did not even dare to approach them, suggesting that the other fish felt uncomfortable in these conditions. In fact, in natural conditions, anemones provide a comfortable home for clownfish. This is in line with Nguyen, (2020), The presence of anemones in clownfish habitats can make these fish feel safer and more protected. This relationship is also believed to contribute to the longevity of clownfish.

**4.4 Feed Utilization Efficiency**

The results of a two-way ANOVA analysis of the feed utilization efficiency of clownfish at different feed doses showed insignificant results. This is thought to be because the clownfish were still able to tolerate the feed doses applied, so the feed provided could still be optimized. This is in line with the opinion of Hasanah et al. (2020), which states that fish responses to restricted feeding vary depending on fish size, feeding frequency or feeding cycle, fish species, and environmental conditions. Thus, clownfish are still able to optimize the feed provided even at the applied dosage.

Different stocking densities yielded the highest value at 40.96% for the treatment of 0.5 fish/L and the lowest at 18.61% for the treatment of 1.5 fish/L. This is thought to be due to uneven feeding caused by competition within the group, forcing the fish to swim faster to compete for food. This aligns with the opinion that Chambel et al. (2015), which states that growth is inversely proportional to density caused by social interaction, the growth rate of clownfish corresponds to their position in the group. However, this can vary depending on the species. This also occurs in the protection behind the anemone. Observations have shown that only certain fish dwell in the anemone, while others stay away and are not allowed to approach, so that the anemone can become a comfortable home for clownfish. This is in accordance with Nguyen, (2020), The presence of anemones in clownfish habitats can make these fish feel safer and more protected, and this relationship is also believed to contribute to the longevity of clownfish. In Statement David et al. (2024), Good feed efficiency requires a feed efficiency value of more than 25%.

**4.5 Water Quality**

Water quality for clownfish maintenance is optimal. The pH measurement results of 7-8.1 are considered optimal, in line with Johan et al. (2019). Dissolved oxygen 5,8-6,4 mg/L normal according to Novitaet al. (2019). A temperature of 28-30°C is optimal according to Hasanah et al. (2020).

**5. CONCLUSIONS**

Based on the results of the research that has been done, it can be concluded that giving different doses of feed to clown fish can increase the value of growth. The best treatment is at 5% feed dose. In the application of different stocking densities, the high growth value is at 0.5 tails/L.

**RESPONSE (ARTIFICIAL INTELLIGENCE)**

The author hereby declares that generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators were used during the writing or editing of this manuscript.

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