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ENVIRONMENTAL ENGINEERING THROUGH DOMESTICATION OF SALINITY ON THE GROWTH AND SURVIVAL OF CLOWN FISH (*Amphiprion melanopus*)

Rekayasa Lingkungan Melalui Domestikasi Salinitas Terhadap Pertumbuhan dan Kelangsungan Hidup Ikan Badut (*Amphiprion melanopus*)

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ABSTRACT

Clown fish (*Amphiprion melanopus*) is one of the ornamental fish that is in great demand because of its shape, color, uniqueness and active movements. Salinity is an important indicator that can influence the growth and survival of clownfish during the rearing period. This research aims to determine the effect of environmental engineering through salinity domestication on the growth and survival of clownfish. The method used in this research was a completely randomized design (CRD) method with 4 treatments repeated 3 times. The treatments used were 4 different salinities. Treatment A = 30 ppt (control), Treatment B = 25 ppt, Treatment C = 20 ppt, Treatment D = 15 ppt. The results of calculating the average growth in weight and length of clownfish obtained the best results in treatment A, while the average growth in length and weight was the lowest in treatment D. The survival rate during the study showed that in treatment A it was 83%, treatment B and C by 75% and treatment D by 67%. Based on the results of this research, it shows that environmental engineering through salinity domestication has a real influence on the growth in length and weight of clownfish, while survival rate does not have a real influence. This shows that clownfish can still adapt and can survive up to a salinity of 20 ppt with a survival rate of 75%.

Keywords: Clownfish, Domestication, Engineering, Salinity

ABSTRAK

Ikan badut (*Amphiprion melanopus*) merupakan salah satu ikan hias yang banyak diminati karena memiliki bentuk, warna, keunikan dan gerakan yang aktif. Salinitas merupakan indikator penting yang dapat memberikan pengaruh dalam pertumbuhan dan kelangsungan hidup ikan badut selama masa pemeliharaan. Penelitian ini bertujuan untuk mengetahui pengaruh rekayasa lingkungan melalui domestikasi salinitas terhadap pertumbuhan dan kelangsungan hidup ikan badut. Metode yang digunakan dalam penelitian ini adalah metode rancangan acak lengkap (RAL) dengan 4 perlakuan yang diulang sebanyak 3 kali. Perlakuan yang digunakan adalah 4 salinitas yang berbeda Perlakuan A = 30 ppt (kontrol), Perlakuan B = 25 ppt, Perlakuan C = 20 ppt, Perlakuan D = 15 ppt. Hasil perhitungan rata-rata pertumbuhan berat dan panjang ikan badut mendapatkan hasil terbaik pada perlakuan A sedangkan rata-rata pertumbuhan panjang dan berat terendah yaitu pada perlakuan D. Tingkat kelangsungan hidup selama penelitian menunjukan bahwa pada perlakuan A sebesar 83%, perlakuan B dan C sebesar 75% dan perlakuan D sebesar 67%. Berdasarkan hasil penelitian ini menunjukan bahwa rekayasa lingkungan melalui domestikasi salinitas memberikan pengaruh nyata pada pertumbuhan panjang dan berat ikan badut sedangkan pada tingkat kelangsungan hidup tidak memberikan pengaruh nyata. Hal ini menunjukan bahwa ikan badut masih bisa beradaptasi dan dapat bertahan hidup hingga salinitas 20 ppt dengan tingkat kelangsungan hidup sebesar 75%.

Kata Kunci: Ikan Badut, Domestikasi, Rekayasa, Salinitas

INTRODUCTION

Ornamental fish are a type of fish that has its own charm, starting from its color, body shape and unique behavior (Johan *et al.,* 2019). One of the most popular ornamental fish commodities is the clownfish because it has an exotic, unique body shape with agile movements (Bianco *et al.,* 2021). The demand for clownfish is quite high to meet the market at home and abroad, for this reason, by breeding or cultivating clownfish, it can reduce catching in the wild to prevent extinction.

The process of fisheries cultivation activities can be carried out in various ways, one of which is through environmental engineering, which is the process of adapting the environment to be used according to the desired goals. One of the activities in environmental engineering carried out to preserve aquatic organisms is domestication (Situmeang, 2018). Domestication is one of the first steps in efforts to maintain animals, including fish that usually live wild in their natural (uncontrolled) habitat so that they can live and develop in controlled conditions (Diansyah *et al.,* 2016).

Salinity can be defined by the level of saltiness or the level of dissolved salts in the water. Salinity is an important indicator in maintaining clownfish, which are basically marine biota. Clownfish are known to generally inhabit areas in coral waters that have a salinity of between 30 - 35 ppt (Johan *et al.,* 2019). A salinity treatment that is different from its natural habitat can affect the condition of the fish, for example changes in fish behavior, which can affect metabolic performance and fish survival rates.

Thus, the author is interested in researching salinity by environmental engineering through the domestication of salinity on the growth and survival of clownfish in efforts to maintain clownfish.

METHODS

Time and Place

This research will be carried out from January to March 2024, at the Fish Hatchery Business Center "Aquakulture Kasih Karunia Suwawa" Bube Baru Village, Suwawa District, Bone Bolango Regency, Gorontalo Province.

Tools and Materials

The tools used in this research include 12 units 30 x 20 x 25 cm aquariums, aerators, oxygen meters, pH meters, refractometers, digital scales, calipers, seers and buckets. The materials used in the research included 48 clownfish 3-4 cm, sea water, fresh water and Hikari Marine-S brand feed.

Research Design

This research used the Completely Randomized Design (CRD) method. A Completely Randomized Design was carried out with 4 treatments and 3 replications. The aspect that will be examined in this research is the effect of different salinities on the growth and survival of clownfish (Soewandhi *et al.,* 2015). The treatment is:

Treatment A : Salinity 30 ppt (control)

Treatment B : Salinity 25 ppt
Treatment C : Salinity 20 ppt
Treatment D : Salinity 15 ppt

Hypothesis

The hypotheses of this research are:

H_0 = There is no influence of environmental engineering through salinity domestication on the growth and survival of clownfish (*Amphiprion melanopus*)

H_1 = There is an influence of environmental engineering through salinity domestication on the growth and survival of clownfish (*Amphiprion melanopus*)

Research Procedure

1. Container Preparation

The maintenance container used is a glass aquarium measuring 30 x 20 x 20 cm, totaling 12 pieces. Each aquarium will be equipped with aeration to increase dissolved oxygen levels in the water. The aquarium is filled with sea water according to the treatment that has been calculated using the dilution formula.

2. Acclimatization Process

The clownfish that have arrived will be immediately transferred to the holding aquarium and left for 1 day before being transferred to the treatment aquarium. The initial acclimatization process was carried out to prevent the fish from stress due to long travel, before the research treatment was carried out.

3. Clownfish Preparation

Clown fish samples were obtained from the waters of Tomini Bay, Lopo Village, Batudaa Pantai District, Gorontalo Regency, Gorontalo Province. Sampling was carried out using a fish trap, 48 fish were taken. The size of the fish taken ranged from 3-4 cm. Stocking of clown fish in the treatment aquarium will be carried out after measuring the body weight and length of the fish.

4. Feeding

The feed given is special ornamental fish pellet feed (Hikari Marine-S) with a protein content of 48%. Feed is given as much as 5% of the fish's body weight and is given twice a day, namely in the morning 07.00 WITA and in the afternoon 16.00 WITA.

5. Implementation

The process of implementing the treatment is carried out by first calculating the amount of sea water and fresh water that will be used in the treatment using the dilution formula according to Afandi *et al.,* (2014), namely , V1N1 = V2N2 (V1: Volume of water before dilution; N1: Initial salinity; V2: Volume of water after dilution; and N2: Salinity after dilution). The next stage is that the container is filled with total sea water for each treatment, then the fish are stocked in each aquarium according to the treatment. The fish that have been stocked will be left for 1 hour in the aquarium with aeration, then fresh water is added to each treatment every 1 hour.

The salinity in each container will be maintained according to each treatment. Treatment A/Control 30 ppt, treatment B 25 ppt, treatment C 20 ppt and treatment D 15 ppt. Control that can be done if salinity decreases is to recalculate using the dilution formula to see how much salt water needs to be added. Siphoning will be carried out every 2-3 days by looking at the turbidity of the water, siphoning is done by removing 25% / 2 liters of water and calculating again for water changes using the dilution formula.

6. Maintenance

During the rearing process, fish salinity is very important to pay attention to. It is necessary to pay attention to adjusting fish salinity. During the research, the salinity of the fish was monitored to adapt to treatment. Evaporation can be overcome by re-measuring the salinity content in the aquarium in each treatment to adjust it by recalculating using the dilution formula for adding or subtracting sea water in each treatment. Fish weight measurements were carried out once a week along with water quality temperature, DO and pH, while salinity measurements were carried out every day in the morning and evening.

Observation Parameters

1. Absolute Length Growth

Absolute length growth is calculated using a formula based on Akbar *et al.,* (2020):

$$Pm = Pt - Po$$

Information:
Pm : Absolute length growth (cm)
Pt : Final average length (cm)
Po : Initial average length (cm)

2. Absolute Weight Growth

Absolute weight growth is calculated using a formula based on Akbar *et al.,* (2020):

$$Wm = Wt - Wo$$

Information:
Wm : Absolute weight growth (gr)
Wt : Final average weight (gr)
Wo : Initial average weight (gr)

3. Survival Rate (SR)

The survival rate is calculated using the formula in Hartini *et al.,* (2013):

$$SR = (Nt/Nt) \times 100\%$$

Information:
SR : Survival (%)
Nt : Number of fish at the end of rearing (fish)
No : Number of fish at the start of stocking (fish)

4. Water Quality

Water quality parameters observed during the research included: Temperature, pH and DO (*Dissolved Oxygen*). Checking water quality once a week with measurements in the morning at 07.00-09.00 WITA. Salinity measurements were carried out every day before feeding, this was to see that the water quality remained stable during the research.

Data Analysis

Data analysis used to see the growth and survival of clownfish during the salinity domestication process is descriptive and quantitative. Descriptively, the data obtained regarding observations of growth and survival were using software in the form of Microsoft Excel and SPSS. If the treatment has a significant effect on the analysis of variance (ANNOVA), then a further test is continued, namely the BNT test using the Duncan method to determine the differences between treatments.

RESULT

Absolute Length Growth

Absolute length growth is the result of a reduction between the length of the fish from the tip of the head to the tail of the fish's body at the end of rearing to the body length at the beginning of rearing. Based on calculations, the results of the average growth in length of clownfish during the study are shown in Figure 1.

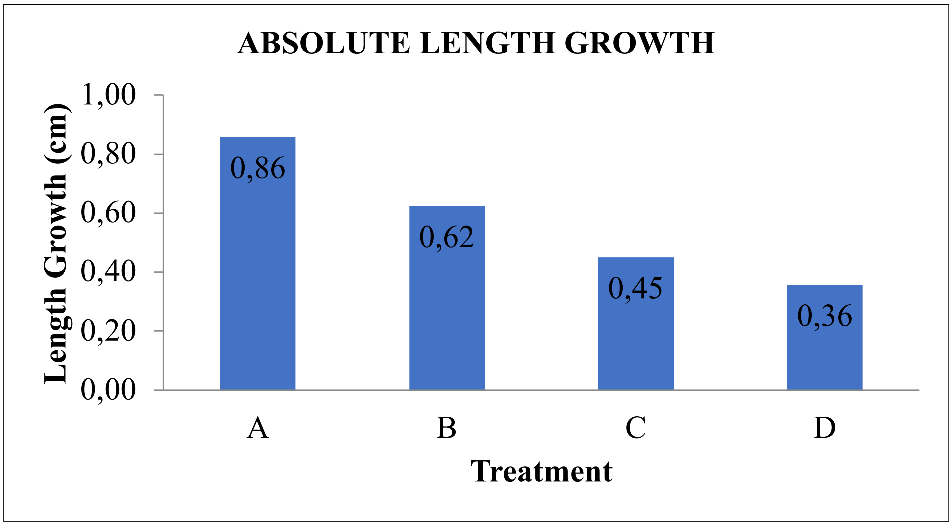

Figure 1. Absolute Length Growth

Based on the graphic image above, it shows that there were different increases during the research in each treatment. The increase in length growth of clownfish in each treatment was with an average value, namely treatment A had the highest average length growth, namely 0.86 cm, then treatment B (0.62 cm), treatment C (0.45 cm) and treatment D with an average length growth of 0.36 cm. ANOVA analysis of variance shows a Sig value of 0.001* (Sig. < 0.05), so the results show that there is a real influence on the length growth of clownfish.

Absolute Weight Growth

Absolute weight growth is the result of a reduction between the average weight of fish at the end of rearing and the average body weight at the beginning of rearing. Based on calculations, the average results of clownfish growth in length during the study are shown in Figure 2.

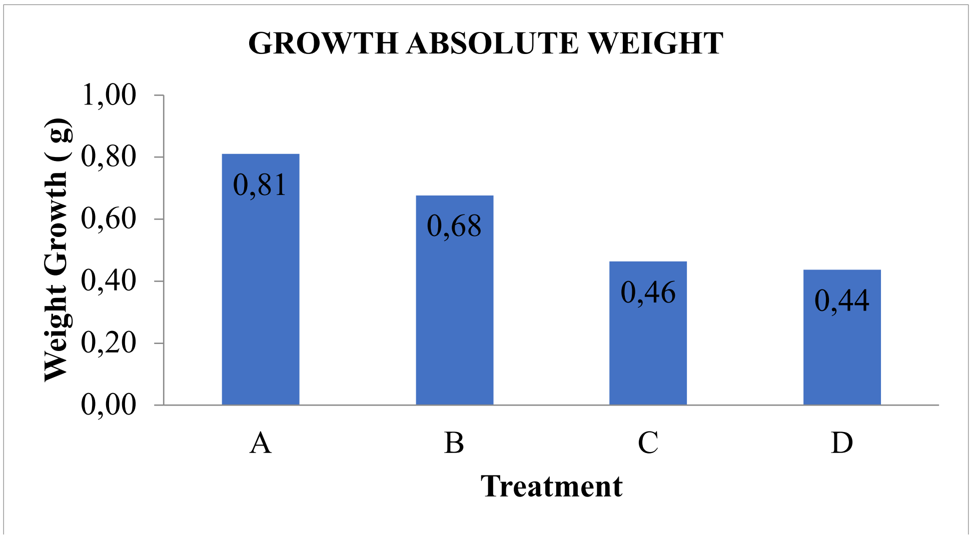

Figure 2. Absolute Weight Growth

Clownfish weight growth based on the graphic image above shows a significant increase in each treatment. The weight of fish in treatment A increased with an average weight value of 0.81 gr, treatment B (0.68 gr), treatment C (0.46 gr) and treatment D (0.44 gr). ANOVA analysis of variance shows a Sig value of 0.001* (Sig. < 0.05), so the results show that there is a real influence on the weight growth of clownfish.

Survival Rate

The survival rate *of* fish is the percentage of the number of live fish at a certain time compared to the number of fish at the start of rearing (Arzad *et al.,* 2019). The results obtained during the research can be seen in Figure 3.

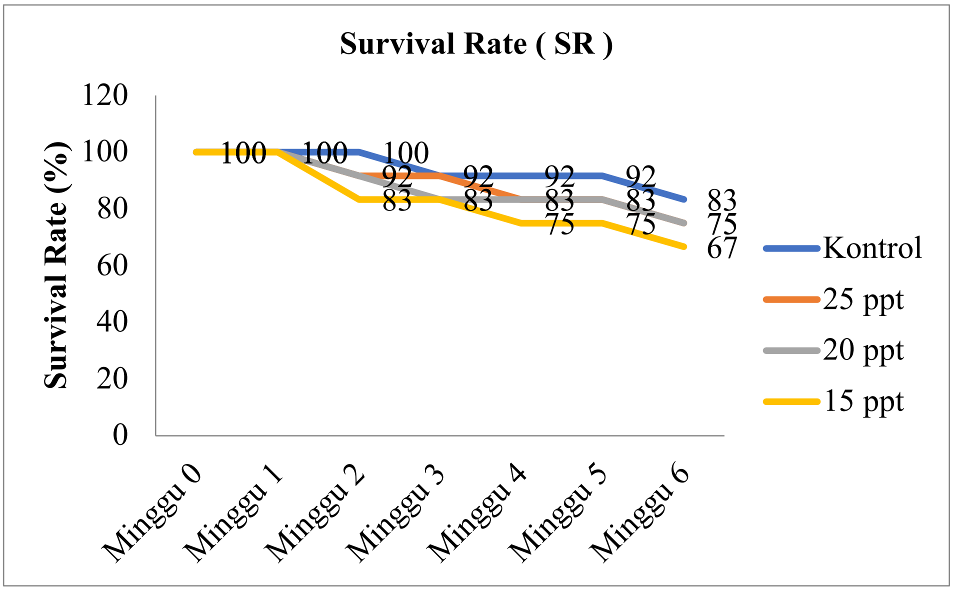

Figure 3. Survival Rate (SR)

The best survival rate was in treatment A with a survival rate of 83%, treatment B was 75%, treatment C was 75%, while the lowest survival rate was in treatment D at 67%. ANOVA analysis of variance showed a Sig value of 0.802 (Sig. > 0.05), so the results showed that the treatment had no real effect on the survival rate of clownfish.

Water Quality

Water quality data measured during the research are presented in Table 1.

Table 1. Clownfish Water Quality Data

Parameter	PA	PB	PC	PD
Temperature (ºC)	27.9	28	27.9	27.8
pH	8.3	8.2	8.2	8.3
DO (mg/l)	4.7	4.8	4.7	4.8
Salinity (ppt)	30	25	20	15

DISCUSSION

Fish growth can be influenced by the level of fish consumption of the feed provided. Fish growth can also be influenced by salinity, this is related because changes in salinity that occur affect the metabolic performance of fish which makes feed an energy producer. This result is in accordance with research (Soewandhi *et al.,* 2015) related to changes in fish behavior in low salinity media. Salinity can directly affect the physiology of aquatic organisms, making it a very important ecological factor (Urbina & Glover, 2015).

The increase in clownfish growth is in line with the fish's level of adaptation to its environment. Based on research conducted by Diansyah *et al.,* (2016), the results show that the growth rate of fish decreases as salinity levels decrease. Apart from that, salinity is related to osmoregulation in fish, so the adaptability of clownfish basically still utilizes the energy obtained from food for growth (Soewandhi *et al.,* 2015).

In treatments A and B, clownfish experienced a faster increase in growth, this is in line with research by Yuliani *et al.,* (2018) that salinity can change the influence of osmoregulation, energy metabolism and growth. The osmoregulation process is the process of controlling the balance of water and salt in the fish's body. Fish will experience high osmotic pressure, namely when the salt concentration in seawater is higher than in their bodies (Nurhaida *et al.,* 2023).

Osmoregulation activities are related to the way fish take in water through the process of osmosis from the environment through the gills, skin and digestive tract, so that sudden changes in salinity have an impact on the fish's metabolic performance (Rahman *et al.,* 2017). The osmoregulation process that occurs in fish is due to an imbalance between the concentration of the fish's body solution and the environment, especially when the fish is outside its tolerance limits (Pamungkas, 2012). This is what causes when the salinity changes suddenly the fish will experience stress and even die. The low growth in treatment D indicates a disruption in osmoregulation in clownfish resulting in efficient energy expenditure to prevent loss of salt levels in the body and disrupt metabolic processes (Diansyah *et al.,* 2016).

The results during rearing showed that treatment A provided the best survival rate of 83%. This shows that at a salinity of 30 ppt the fish were still able to adjust their osmotic pressure. Based on research by Agustina & Derli (2013), clownfish can still live up to a salinity of 20 ppt and are not influenced by the osmotic effects of differences in media salinity. So in treatments B and C the SR range obtained during the maintenance period was 75%. Meanwhile, Agustina & Derli (2013) stated that fish can choose salinity levels that tend to be in accordance with their body's osmotic pressure. This is what makes fish unable to adjust to the osmotic pressure in the environment at a salinity of 15 ppt.

Water quality measurements aim to determine the condition of water quality parameters during the research. The parameters observed during the research were temperature, pH, DO and salinity. The temperature range during the study was between 26.9-28.9°C, which is the optimal temperature for clownfish. Good temperatures during clownfish cultivation range between 25-30°C (Ruhyadi *et al.,* 2017). High and low temperatures can have an influence on fish growth. The impact of low temperatures is that fish will lose their appetite and become more susceptible to disease, whereas if temperatures are too high, fish experience respiratory stress and this can result in permanent gill damage (Harmilia, 2020).

The degree of acidity (pH) is the negative logarithm and concentration of hydrogen ions released in a liquid and is an indicator of whether a body of water is good or bad (Hamuna *et al.,* 2018). The pH parameter ranges from 7.9-8.5. Based on the results obtained, it can be seen that during the period of clownfish rearing, the quality of the pH parameters was still in a normal condition. The optimal pH to support clownfish cultivation is around 7-8.5 (Pattiradja *et al.,* 2022).

Dissolved oxygen (DO) is the concentration of dissolved oxygen in water. Changes in dissolved oxygen concentration can have a direct effect resulting in the death of aquatic organisms. The DO parameter results ranged from 4.3-5.3 mg/l. This result is still within the optimal range for clownfish, namely 4-7 mg/l (Zulfikar *et al.,* 2018). Dissolved oxygen is related to the decomposition process in water, so that if the DO concentration is low it has an impact on appetite and affects growth and resistance to disease (Rumondang *et al.,* 2023).

Salinity is the total concentration of ions found in waters. Salinity describes the total solids in the water, after all the carbonates have been converted into oxides, all bromides and ionides are replaced by chlorides, and all organic materials have been oxidized (Azizah, 2017). Clownfish have an appropriate salinity level during the cultivation period, namely between 28-32 ppm (Zulfikar *et al.,* 2018). In this study, media salinity was based on treatment. The salinity of clownfish during the study was adjusted to the treatment, namely in treatment A which was the control, namely 30 ppt, treatment B 25 ppt, treatment C 20 ppt and treatment D 15 ppt.

CONCLUSION

Based on the results of research conducted for 42 days, it was found that environmental engineering through salinity domestication had a significant effect on the growth of clownfish

(*Amphiprion melanopus*) (Sig. < 0.05). Regarding survival, the results showed no significant effect (Sig. > 0.05). Meanwhile, the best salinity for the growth and survival of clownfish is in treatment A (30 ppt), but based on the results obtained clownfish can still survive at a salinity of 20 ppt in treatment C with an SR of 75%.

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