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HOUSEHOLD-SCALE REARING OF CANTANG GROUPER LARVAE (*EPINEPHELUS FUSCOGUTTATUS* × *EPINEPHELUS LANCEOLATUS*) AT UD. ARIF HATCHERY, GEROKGAK DISTRICT, BULELENG REGENCY, BALI

Pemeliharaan Larva Ikan Kerapu Cantang Skala Rumah Tangga (*Epinephelus fuscoguttatus* × *Epinephelus lanceolatus*) Di Ud. Arif Hatchery Kecamatan Gerokgak Kabupaten Buleleng, Bali

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ABSTRACT

The maintenance of cantang grouper larvae on a household scale faces challenges in maintaining water quality, feeding, and disease control. This study aims to analyze maintenance techniques to improve larval survival. The method used is descriptive with observation, interviews, and literature studies. The research was conducted at UD. Arif Hatchery, Bali, with the main parameters observed including temperature, salinity, pH, nitrite and nitrate levels, *Survival Rate*, and the effectiveness of natural and artificial feed. The results showed that the optimal water quality for the maintenance of grouper larvae was 27–30°C, salinity 30–33 ppt, pH 7.5–8.5, and nitrite levels <0.01 mg/L and nitrates <2 mg/L. Gradual feeding from rotifers, nauplius artemia, to artificial feed was able to increase the *larval survival rate*. Water management with *flow-through* systems and regular flushing also plays an important role in the success of maintenance. From this study, it can be concluded that the application of good maintenance techniques, including water quality control, feeding strategies, and disease management, greatly determines the success of the production of cantang grouper fish fry on a household scale.

Keywords: Cultivation, Cantang Grouper, Larvae, Household

ABSTRAK

Pemeliharaan larva ikan kerapu cantang pada skala rumah tangga menghadapi tantangan dalam menjaga kualitas air, pemberian pakan, dan pengendalian penyakit. Penelitian ini bertujuan untuk menganalisis teknik pemeliharaan guna meningkatkan kelangsungan hidup larva. Metode yang digunakan adalah deskriptif dengan observasi, wawancara, dan studi literatur. Penelitian dilakukan di UD. Arif Hatchery, Bali, dengan parameter utama yang diamati meliputi suhu, salinitas, pH, kadar nitrit dan nitrat, *Survival Rate*, serta efektivitas pakan alami dan buatan. Hasil penelitian menunjukkan bahwa kualitas air yang optimal untuk pemeliharaan larva ikan kerapu cantang adalah suhu 27–30°C, salinitas 30–33 ppt, pH 7,5–8,5, dan kadar nitrit <0,01 mg/L serta nitrat <2 mg/L. Pemberian pakan secara bertahap dari rotifera, nauplius artemia, hingga pakan buatan mampu meningkatkan *Survival Rate* larva. Pengelolaan air dengan sistem *flow-through* dan penyifonan rutin juga berperan penting dalam keberhasilan pemeliharaan. Dari penelitian ini, dapat disimpulkan bahwa penerapan teknik pemeliharaan yang baik, termasuk kontrol kualitas air, strategi pemberian pakan, dan pengelolaan penyakit, sangat menentukan keberhasilan produksi benih ikan kerapu cantang pada skala rumah tangga.

Kata Kunci: Budidaya, Ikan Kerapu Cantang, Larva, Rumah Tangga

INTRODUCTION

The cantang grouper (*Epinephelus fuscoguttatus* × *Epinephelus lanceolatus*) is a cross between a female tiger grouper and a male kertang grouper which has faster growth and high resistance to various environmental conditions and diseases. These advantages make the cantang grouper one of the leading fishery commodities in Indonesia (Sunaryat, 2018). The high market demand for this fish encourages the development of cultivation businesses, including on a household scale. However, to ensure successful cultivation, especially in larval maintenance, good and standard techniques are needed so that the seeds produced have superior quality and high durability. Maintenance of cantang grouper larvae (*Epinephelus fuscoguttatus* × *Epinephelus lanceolatus*) is a crucial stage in the cultivation cycle that determines the quality and availability of seeds. An optimal maintenance environment must be maintained, including stable water temperature (26–30°C), appropriate salinity (28–32 ppt), and adequate dissolved oxygen levels (>5 mg/L) (Utami & Rizki, 2022). Larval rearing is generally carried out in concrete or fiber tanks with a good circulation and filtration system to maintain stable water quality. In addition, implementing strict biosecurity is very important to prevent contamination and pathogen attacks that can cause mass death of larvae.

Feed is the main factor in the maintenance of cantang grouper larvae. In the early stages, larvae require natural feed such as rotifers and artemia nauplii which contain high protein and are rich in essential fatty acids. As they grow, larvae begin to be given artificial feed that has been enriched with multivitamins and probiotics to increase endurance and accelerate growth. The right feeding method, both in terms of frequency and quantity, greatly affects the survival rate of larvae. Feed enrichment with DHA Selco or Nannochloropsis sp. can also improve the nutritional quality received by larvae (Prayogo & Isfanji, 2014). The success of maintaining cantang grouper larvae is measured by two main parameters, namely Hatching Rate (HR) and Survival Rate (SR). HR indicates the percentage of eggs that successfully hatch, while SR measures the survival rate of larvae until they reach the size of seeds ready for sowing. To increase SR, environmental parameter monitoring must be carried out routinely, as well as the implementation of stress management strategies such as gradual acclimatization to changes in salinity and administration of immunostimulants (Affandi & Muahiddah, 2024). Scheduled water exchange techniques are also necessary to maintain water cleanliness and reduce the risk of ammonia and nitrite buildup which can be toxic to larvae.

The maintenance of cantang grouper larvae on a household scale is a potential solution to increase the availability of quality seeds for rearing businesses. With a simpler cultivation system and easy-to-implement technology, small farmers can produce marketable seeds at lower production costs. Maintenance standards such as the Indonesian National Standard (SNI) and the principles of Good Aquaculture Practices (GAP) must be applied to increase production efficiency and ensure the sustainability of cultivation businesses. Sanitation of maintenance containers, proper feed management, and the use of effective filtration systems are key factors in supporting the success of larval maintenance (Edy & Halim, 2022). With the development of larval maintenance technology, the production of high-quality cantang grouper seeds can continue to increase. This not only supports the sustainability of the mariculture industry but also contributes to the welfare of coastal communities that depend on the fisheries sector. Well-planned cantang grouper cultivation can reduce dependence on seeds from natural catches, thereby maintaining the balance of the marine ecosystem and increasing the competitiveness of Indonesian fishery products in the global market. (Widodo *et al*., 2022). Therefore, the aim of this study is to determine and analyze the maintenance techniques for cantang grouper larvae on a household scale to improve the survival and quality of seeds.

RESEARCH METHODS

This study was conducted in order to understand the maintenance techniques of cantang grouper larvae on a household scale. The research activities took place from September 23 to December 10, 2024 at UD. ARIF Hatchery, Pemuteran Village, Gerokgak District, Buleleng Regency, Bali. The method used is a descriptive method, a research approach that aims to describe or describe certain phenomena, symptoms, or conditions systematically, factually, and accurately without manipulating the variables being studied. This study focuses on an in-depth understanding of the object or subject being studied at the time the research was conducted (Mudjiyanto. 2018). Data were collected through direct observation, interviews with related parties, and literature studies from journals, previous reports, and relevant books. Data processing was carried out through several stages, including editing to ensure the accuracy of the data collected, and tabulation to compile data in a systematic format. Data analysis was carried out using a descriptive approach, comparing the data obtained with references from literature studies. In addition, financial aspects were analyzed using performance analysis to assess business sustainability. The parameters analyzed include fecundity and fertilization rate (FR), calculated based on the average weight of fish during maintenance and the success rate of egg fertilization in the spawning process.

Fecundity and Fertilization Rate (FR) are important parameters in evaluating the quality of fish reproduction, especially in the context of natural breeding. Fecundity refers to the number of eggs produced by the female parent in one reproductive cycle, while FR describes the percentage of fertilized eggs from the total eggs released. The difference in FR values between the two studies can be influenced by various factors, including the quality of the parent, spawning techniques, environmental conditions, and hatchery management. Therefore, monitoring and managing these factors are very important to improve the success of hatchery and the quality of fish seeds (Septihandoko. 2021).

RESULT

General Condition of Research Location

UD. Arif Hatchery is located on Jalan Sririt-Gilimanuk, Dusun Palasari, Pemuteran Village, Gerokgak District, Buleleng Regency, Bali, at coordinates 8°08’41” S and 114°39’30” E. This location is bordered by the Bali Sea to the north, residential areas to the south, Adi Assri Beach to the east, and Pemuteran Beach to the west. This strategic position greatly supports cultivation activities because of the abundant sea water sources from the Bali Sea. UD. Arif Hatchery focuses on the cultivation of cantang grouper *(Epinephelus fuscoguttatus* x *Epinephelus lanceolatus*), cantik grouper (*Epinephelus fuscoguttatus* x *Epinephelus microdon*), and milkfish (*Chanos chanos*), with the main products being eggs and larvae. To support cultivation activities, UD. Arif Hatchery has various facilities and infrastructure that support the spawning process, seeding, and production of natural feed. The available infrastructure includes storage facilities for broodstock fish such as kertang grouper, tiger grouper, batik grouper and milkfish, as well as cantang grouper hatchery tanks.

Figure 1. Research location map

In addition, there is a marine cultivation information management system and an operational management system that supports activity efficiency. Other supporting facilities include 3,500 Volt PLN electricity, 400 KVA generator, administration office, feed storage room, employee houses, and transportation in the form of two Granmax pickup units and one motorbike. This infrastructure ensures smooth operations and supports the growth of UD. Arif Hatchery as a supplier of quality fish eggs and larvae in and outside Bali.

Maintenance Activities of Cantang Grouper Larvae

1) Preparation of Larvae Maintenance Container

The container for maintaining cantang grouper larvae used on a household scale is generally a fiberglass or concrete tub with a size that is adjusted to the production capacity. The maintenance tub is placed in an area that gets enough sunlight to help stabilize the water temperature and support the growth of natural plankton.

Figure 2. Preparation of the Tank

Preparation of the larval maintenance container includes several stages as follows. Cleaning the container is done by reducing the water volume to 80% of the total capacity of the tank, cleaning the walls and bottom of the tank using a brush to remove moss and dirt, and sterilizing the container with 500 ppm Chlorine which is then rinsed with clean water to remove chemical residues. Filling with seawater is done after the filtration and sedimentation process to ensure that the water quality is free from pathogens and hazardous substances (Palupi *et al*., 2020). The water level in the tank is adjusted according to the development phase of the larvae, with gradual filling to avoid stress on the larvae. In addition, the installation of an aeration system is carried out with a sufficient number of aerators to increase oxygen levels in the water and help distribute feed evenly.

2) Maintenance of Cantang Grouper Larvae

Maintaining cantang grouper larvae on a household scale requires special attention to water quality, feeding, and managing larval density for optimal growth.

a. Feeding

- Early stage (0-3 days): Larvae rely on egg yolk as a source of nutrition.
- Day 3 to 10: Rotifers are given as feed to support larval development.
- Day 10 to 20: Larvae begin to be fed artemia nauplii as a higher protein source.
- After the 20th day: Larvae that have grown larger are gradually introduced to artificial feed in the form of micro pellets.

b. Water Quality Managemen.

- The optimum temperature ranges between 27-30°C.
- Salinity is maintained at 30-33 ppt.
- The pH of the water is maintained in the range of 7.5-8.5.
- Water changes are carried out gradually by 10-20% every day to maintain the quality of the larvae's environment.

c. Selection and Transfer

- Larvae that experience faster growth will be separated to avoid food competition and cannibalism.
- At the age of 30-40 days, larvae that have reached a certain size are moved to the nursery tank before finally being ready for the enlargement stage (Affandi & Muahiddah, 2024).

3) Feeding.

The process of feeding male and female grouper broodstock is done by giving tuna and squid once a day ad libitum. The ad libitum method means giving feed until the fish are full (Rochmad & Mukti, 2020). Male grouper broodstock are fed tuna which is rich in omega-3 fatty acids to accelerate growth. Meanwhile, female broodstock are fed squid because its high protein content can accelerate gonad maturity (Matakupan *et al*., 2022). The nutritional content of squid and tuna feed is presented in the following table:

Table 1. Nutritional Content of Squid Feed

Content	Presentation
Water	74,66-76,58%
Proteins	14,66-19,85%
Carbohydrate	2,09-7,3%
Ash	1,56-2,49%
Fiber	1,08-2,4%
Fat	0,91-1,23%

Table 4. Nutritional Content of Skipjack Tuna Feed

Content	Presentation
Dry ingredients	80,02%
Proteins	50,16%
Fat	6,50%
Calcium	6,27%
Phosphorus	3,45%
Fiber	0,63%

In addition to the main feed, grouper broodstock are also given vitamin C, vitamin E, and vitamin B complex to support gonad development and fecundity. These vitamins are mixed into the feed before being given to grouper broodstock. Lack of feed can affect fertility and inhibit the gonad maturity process. In addition, water quality control in the maintenance tank is carried out through routine water changes and siphoning to maintain optimal oxygen levels. The process of fish gonad maturity can be done through three methods: feeding, hormonal engineering, and environmental manipulation. Grouper fish generally spawn throughout the year during the dark moon, namely between the 25th and 5th of the following month in the Hijri calendar (Putra & Suhaili, 2020).

Supporting the gonad maturity process of grouper broodstock during maintenance is given vitamin C, vitamin E, and vitamin B complex to accelerate gonad development and fecundity by mixing it into the feed before being given to grouper broodstock. Feeding of brood fish is attempted as optimally as possible, namely by adding vitamin mix, vitamin C and vitamin E (Tridjoko *et al*., 2014). Lack of feed given to brood grouper can affect fertility and can inhibit the gonad maturity process. Furthermore, water quality control in the brood grouper maintenance tank needs to be carried out by changing the water for oxygen needs in the water and routine siphoning once a day. The gonad maturity process in fish can be done in 3 ways, namely: feed, hormonal engineering, and environment (Tridjoko *et al*., 2014). Grouper fish can spawn throughout the year during the dark moon when the moon does not shine brightly. According to Lailatul *et al*., (2013), the dark moon usually occurs between the 25th and the 5th of the following (Arabic month).

4) Water Quality Management

Water management in grouper broodstock maintenance is carried out using a 24-hour flow-through system. The steps for changing the water include:

a. Siphoning every morning to clean leftover feed and dirt that settles at the bottom of the tank.
b. Daily water replacement by reducing the water volume by 70-75% at 07.00 WITA and refilling at around 12.00 WITA. This is done to maintain water quality and trigger gonad maturity according to the natural habitat of the fish.
c.

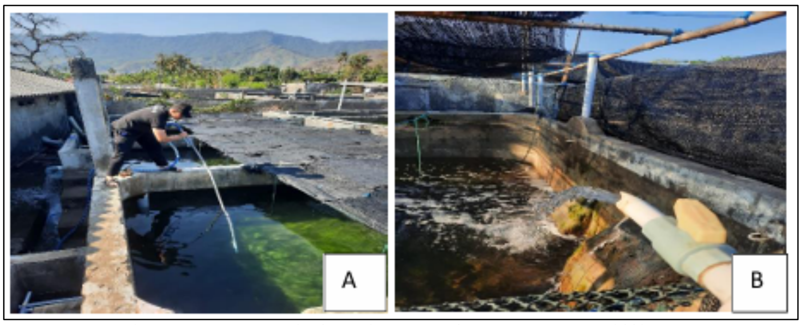

Figure 3. A. Siphoning and B. Water Filling

In the maintenance of cantang grouper larvae on a household scale, water quality management plays an important role in ensuring the growth and survival of the larvae. Two parameters that need to be considered are nitrite (NO_2^-) and nitrate (NO_3^-) levels. Nitrite is an intermediate compound in the nitrification process that can be toxic to fish if the levels are too high. High nitrite levels can interfere with the ability of fish blood to bind oxygen, causing stress, and even death. Therefore, nitrite levels in maintenance water should be kept as low as possible, ideally below 0.01 mg/l.

Nitrate is the end product of the nitrification process and is generally less toxic than nitrite. However, nitrate levels that are too high can cause excessive algae growth and reduce water quality. For fish farming, nitrate levels should be maintained at a safe level. As a reference, in milkfish farming, a nitrate level that is considered good is around 2 mg/l. Although the specifications for cantang grouper may differ, keeping nitrate levels as low as possible is still recommended. To keep nitrite and nitrate levels within safe limits, the following steps can be implemented (Azis & Subandiyono, 2021):

a. Effective Filtration System: Using biological filters to optimize the nitrification process, so that ammonia produced from leftover feed and fish waste can be converted into nitrate efficiently.
b. Regular Water Changes: Perform regular water changes to reduce nitrate accumulation in the system.
c. Feeding Control: Avoiding overfeeding which can increase ammonia production and, ultimately, nitrate.
d. Routine Monitoring: Conduct routine measurements of water quality parameters, including nitrite and nitrate, to ensure conditions remain optimal for larval growth.

By maintaining nitrite and nitrate levels within safe limits, it is hoped that the maintenance of cantang grouper larvae on a household scale can run successfully, resulting in optimal growth and a high survival rate.

5) Pest and Disease Control

During maintenance, broodstock grouper can experience disease infections due to environmental factors and poor feed quality (Folnuari *et al*., 2017). Diseases that often attack broodstock grouper include protozoa, virus, and parasite infections. During the examination at UD. Arif Hatchery, wounds were found on the skin and *Cymothoa* sp. parasite infections attached to the mouth organs of broodstock tiger grouper. Parasite control is carried out by:

a. Manual removal of parasites from the mouth organs of fish.
b. Administration of El Bajo medicine (yellow medicine).
c. Soaking fish in fresh water.
d. Water quality management to prevent further infections.

The cleaning of the maintenance tank is done twice a month, usually in conjunction with the full moon cycle and after the hybridization process. The purpose of washing is to clean leftover feed, dirt, and prevent the growth of moss on the walls of the tank.

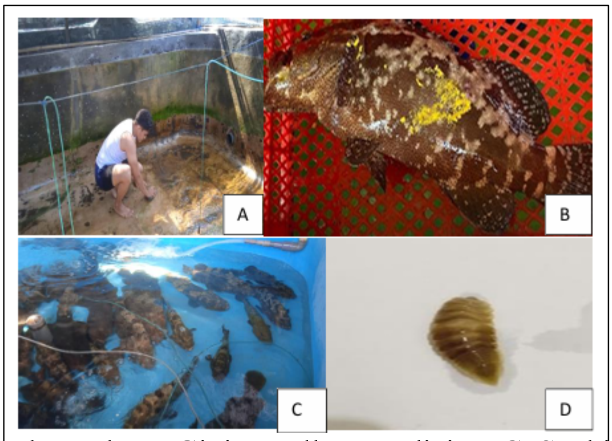

Figure 4. A. Cleaning the tank, B. Giving yellow medicine, C. Soaking in fresh water, D. *Cymothoa* sp. parasite.

6) Parent Selection

Broodstock selection is carried out to separate fish that have mature gonads from those that have not. At UD. Arif Hatchery, selection is carried out every month, especially during the dark moon (tilem). Grouper broodstock selection criteria (Rochmad & Mukti, 2020):

- Female tiger grouper parent:
  - Slow motion
  - Decreased appetite
  - The abdomen is enlarged and red in the genital area
- Male parent of kertang grouper:
  - Genitals turn red
  - Decreased appetite
  - More aggressive movements

The female tiger grouper generally weighs 5-9 kg and has a body length of 60-80 cm with an age of 4-5 years. Gender differences can be identified from the reproductive organs:

- Male: Testes solid and prominent.
- Female: Ovaries enlarged without protrusions.

Gonad maturity selection is done by striping method, which is by massaging the lower part of the fish's body to remove eggs or sperm. If the eggs are removed on the first day, hybridization is done on the second to third day (Wijaya *et al*., 2024).

Spawning

UD. Arif Hatchery has 4 kertang grouper (*Epinephelus lanceolatus*) and 83 tiger grouper (*Epinephelus fuscoguttatus*), with a male to female ratio of 1:3. Of these, 35 female tiger groupers and 2 male kertang groupers were selected for hybridization. Gonad maturation was carried out in two 4 × 5 m^2 storage tanks, equipped with fine nets as egg collectors.

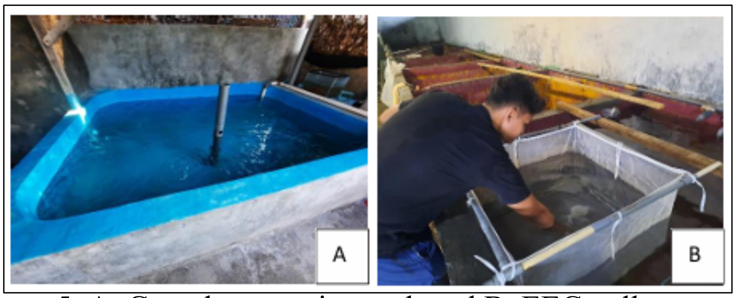

Figure 5. A. Gonad maturation tank and B. EEG collector tank

1) Hormone Injection

Female broodstock weighing ±5 kg are injected with HCG (Human Chorionic Gonadotropin) hormone at a dose of 750 IU or 2.5 ml/head using a 5 ml syringe. The injection is done intramuscularly in the back with a needle angle of 30°–40°. The female broodstock is then placed in a spawning tank with two males in low light conditions to avoid stress and accelerate spawning.

Figure 6. HCG Hormone Injection

2) Sperm Stripping

After hormone injection, male grouper broodstock were captured and covered with black cloth to reduce stress. Sperm were obtained by stripping the abdomen and collected in a microcentrifuge tube. Sperm were stored at 2–6°C for 6–7 hours before being used in the hybridization process.

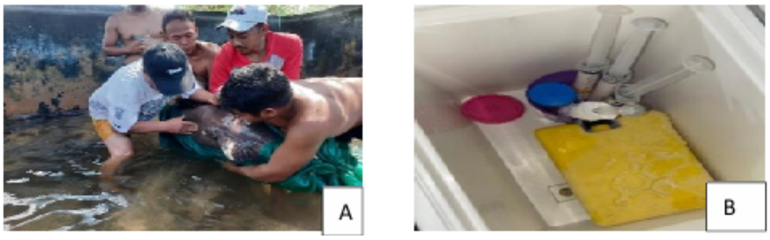

Figure 7. A. Sperm stripping and B. Sperm storage

3) Hybridization Technique

Stripped eggs from the female parent are collected in a basin and mixed with 2–3 ml of sperm using chicken feathers for 15–20 minutes in 1 liter of seawater. Fertilized eggs are then transferred to an egg collector in a 5 × 2 m tank. Each net can hold up to 11–12 million eggs. Two hours after spawning, the eggs are observed using a beaker glass. Good quality eggs appear clear, transparent, and float, while undeveloped eggs are yellowish white and settle.

Figure 8. A. Stripping eggs, B. Sperm injection, C. Stirring and adding water and D. Inserting eggs into the EEG collector.

One cycle of hybridization conducted at UD. Arif hatchery Buleleng assumed that the tiger grouper broodstock that experienced spawning were around 35 broodstock, then the fecundity calculation was 35 x 2,049,976 = 71,749,160 eggs. Therefore, the FR value of One cycle of hybridization conducted at UD. Arif hatchery Buleleng assumed that the tiger grouper broodstock that experienced spawning were around 35 broodstock, 70% x 71,749,160 = 50,224,412 tails.

Egg harvesting

UD. Arif Hatchery Buleleng harvests eggs from the egg collector by turning off the aeration first. The calculation of the number of eggs is done by the sampling method using a 15 ml measuring cup, where each 15 ml contains around 100,000 eggs. The eggs are packed in plastic bags filled with seawater with a salinity of >35 ppt, with a density of 50,000 eggs per bag for shipping within Bali and 25,000 eggs for outside Bali. The ratio of oxygen and water in the bag is 1:2. The plastic bag is then tied, put into a 75 × 40 × 30 cm Styrofoam, which can accommodate 8 bags. To maintain the temperature during transportation, 500 grams of ice cubes wrapped in newspaper are added to keep the temperature stable (Prayogo & Isfanji, 2014).

DISCUSSION

The maintenance of cantang grouper larvae (*Epinephelus fuscoguttatus* × *Epinephelus lanceolatus*) on a household scale requires special attention to several important aspects, including container preparation, water quality management, feeding, broodstock selection, and pest and disease control. Container preparation is a crucial initial stage, where fiberglass or concrete containers must be cleaned and sterilized with 500 ppm chlorine before use to ensure cleanliness and prevent bacterial infection. Filling with filtered and settled seawater also plays a role in maintaining water quality that is free from pathogens and hazardous substances, supporting the success of cantang grouper larval cultivation.

Water quality management during maintenance is vital, considering that parameters such as temperature, salinity, pH, nitrite levels, and nitrate must be maintained within optimal limits. The ideal temperature ranges from 27-30°C, salinity 30-33 ppt, and pH 7.5-8.5. Gradual water changes of 10-20% every day help maintain environmental stability for larvae, which is in accordance with the theory of aquatic ecology put forward by Odum (1993). The stability of these water parameters is also directly related to the decrease in ammonia and nitrite levels which can inhibit fish growth, as found in research (Utami & Rizki, 2022). Therefore, environmental control is essential in cultivation activities to ensure the balance of the aquatic ecosystem that supports fish growth.

Feeding according to the developmental stages of the larvae is a determining factor in the success of cultivation. In the early stages (0-3 days), the larvae rely on egg yolk as a source of nutrition, then from the 3rd to the 10th day they are given rotifers, followed by artemia nauplii until the 20th day as a higher source of protein. After the 20th day, the larvae are gradually introduced to artificial feed in the form of micro pellets. The combination of providing natural feed and artificial feed that is rich in nutrients has been shown to increase the growth of cantang grouper larvae as stated by (Affandi & Muahiddah, 2024). This is in line with Lovell's (1989) theory of fish nutrition, which emphasizes that each phase of fish development has different nutritional needs so that choosing the right type and size of feed plays an important role in increasing the growth rate and resistance of larvae to environmental stress.

The fecundity calculation results show that one tiger grouper broodstock has the potential to produce around 2,049,976 eggs in one spawning cycle. This value reflects a high reproductive rate, which is commonly found in marine fish species with external reproductive strategies and external fertilization. When multiplied by the number of broodstock participating in one hybridization cycle, which is 35 broodstock, the total population fecundity reaches 71,749,160 eggs.

This high fecundity value is an important indicator in mass seeding efforts, because the more eggs produced, the greater the potential for seed production. However, the high number of eggs does not necessarily guarantee successful reproduction if it is not followed by a good fertilization rate. This figure is comparable to the fecundity of koi fish reported by Al Ishaqi and Sari (2020), which ranges from 100,000 to 300,000 eggs per parent, depending on the strain and size of the parent.

From the results of the Fertilization Rate (FR) calculation, it is known that the fertilization rate is at 70%, which means that of the total eggs released, only 70% were successfully fertilized and developed into embryos. This figure is quite good and shows that the fertilization process is running relatively optimally. When FR is applied to the total fecundity of all broodstock (71,749,160 eggs), the number of eggs that were successfully fertilized is estimated to be 50,224,412 eggs. The results of the FR calculation show that 70% of the eggs produced were successfully fertilized, resulting in around 50,224,412 fertilized eggs from the total fecundity. This figure is comparable to the FR reported by Al Ishaqi and Sari (2020) in koi fish, which ranges from 71% to 83% depending on the parent strain. In addition, a study by Setia Budi *et al*., (2023) on betta fish (Betta splendens) showed that FR can be influenced by fish strain, with significant differences between strains. This indicates that FR can vary between species and even between strains within the same species, depending on genetic and environmental factors.

The number of fertilized eggs is an important parameter in determining the success of spawning. A high FR value indicates that the spawning technique and environmental conditions in the hatchery support effective fertilization. However, the final success still depends heavily on the following stages such as the hatching rate and the survival rate of larvae, which must be considered in the continued cultivation process.

Selection of quality broodstock also plays an important role in successful spawning and healthy larval production. Female tiger grouper broodstock ready to spawn show slow movements and an enlarged stomach, while male kertang grouper broodstock show changes in genital color to red and more aggressive movements. Selection of superior broodstock has the potential to produce larvae with a higher survival rate (Folnuari *et al*., 2017). This is in accordance with the genetic theory put forward by Falconer & Mackay (1996), which states that selection of superior broodstock can improve the genetic quality of offspring and the sustainability of production in aquaculture systems.

Pest and disease control is an important preventive measure in the maintenance of cantang grouper larvae. Parasite infections such as *Cymothoa* sp. can cause wounds on the skin and mouth organs of fish, so it is necessary to manually remove parasites, administer medication, soak fish in fresh water, and manage good water quality. According to the theory of fish pathology by Roberts (2012), disease prevention in aquaculture does not only depend on treatment, but also preventive measures such as environmental management and sanitation of the cultivation system (Rochmad & Mukti, 2020). By implementing these steps consistently, the maintenance of cantang grouper larvae on a household scale can achieve optimal survival and growth rates, thus supporting the overall success of cultivation.

CONCLUSION

The maintenance of cantang grouper larvae on a household scale requires special attention to container preparation, water quality management, feeding, and pest and disease control. Optimal water quality, including temperature, salinity, pH, and nitrite and nitrate levels, are the main factors in supporting the growth and survival of larvae. In addition, providing feed that is appropriate to the stage of larval development and selecting good broodstock also play a role in increasing cultivation productivity. With the implementation of proper management, the maintenance of cantang grouper larvae can produce a high survival rate and support the success of sustainable fish farming. To increase the success of cantang grouper cultivation on a household scale, it is recommended that farmers routinely monitor water quality using accurate measuring instruments to prevent environmental parameter imbalances that can harm the larvae. In addition, feed diversification and the provision of additional supplements such as vitamins and minerals need to be considered to support the optimal growth of larvae and broodstock. The use of a more effective filtration system and the application of digital-based monitoring technology can also be a solution to increasing the efficiency and productivity of cantang grouper cultivation in the future.

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