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Analysis Of Water Quality Conditions in Pearl Oyster (Pinctada maxima) Hatcheries in Karangasem Bali

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Abstract. Indonesia has a high potential for pearl oyster farming due to its diverse marine habitats, warm waters, and abundant supply of seaweed, which is the preferred food for pearl oysters. Indonesia is home to several species of pearl oysters, including the *Pinctada maxima*, which are prized for their large size and the quality of their pearls. Water quality plays a crucial role in the cultivation of *Pinctada maxima*. This study aims to analyze the water quality conditions in pearl oyster (*Pinctada maxima*) hatcheries in Karangasem Bali. This research was carried out by measuring parameters including temperature, salinity, pH, and dissolved oxygen levels in the waters temporally in the morning and evening every day of cultivation. Variables of ammonia, nitrite, total suspended solids, total bacteria, and vibrio bacteria were carried out once a week. The results of temperature measurements range from 28.2-29^{0}C. Measurement of total suspended solids 0 mg/l. pH measurements ranged from 8.1-8.3. Dissolved oxygen measurements ranged from 4.16-4.27 mg/l. Salinity measurements obtained results of 35 ppt. Ammonia measurements range from 0-1.55 mg/l. Nitrite measurements range from 0.012-0.026. Measurement of total bacteria obtained <1 X 10^1 cfu/ml from all samples. Measurement of total vibrio yielded <1 X 10^1 cfu/ml from all samples. Based on the research that has been done, the results show that water quality is still in the optimal range for pearl oyster (*Pinctada maxima*) hatchery activities.

Keywords: *Pinctada maxima*; Water Quality; Hatchery

I. INTRODUCTION

Indonesia is a maritime country that is rich in marine resources. The country's long coastline, warm tropical waters, and diverse marine ecosystems provide ideal conditions for a range of fishing and aquaculture activities. Indonesia has great potential in the fisheries sector due to its vast and diverse aquatic environment. The country has abundant fishery resources, including marine fish, shrimp, oyster and other raw materials. This potential offers great opportunities for the development of the fisheries sector [1][2].

Indonesia has a high potential for pearl oyster farming due to its diverse marine habitats, warm waters, and abundant supply of seaweed, which is the preferred food for pearl oysters. Indonesia is home to several species of pearl oysters, including the *Pinctada maxima*, which are prized for their large size and the quality of their pearls [3]. *Pinctada maxima* is one of the main species of pearl oysters cultivated in Indonesia. The pearls produced by *Pinctada maxima* in Indonesia are known for their large size and high quality, making them highly sought after in both domestic and international markets [4]. *Pinctada maxima* is one of the most valuable species of pearl oysters cultivated for its high-quality pearls and can produce pearls in different colours and shapes. In recent years, the pearl industry in Indonesia has been growing, with an increasing number of farms being established. *Pinctada maxima* is relatively easy to farm and can be cultivated in large numbers, which makes it a suitable species for commercial aquaculture operations. *Pinctada maxima* is a resilient species with a strong shell and the ability to tolerate a wide range of environmental conditions, making it a suitable species for cultivation in different regions [5], [6].

Water quality plays a crucial role in the cultivation of *Pinctada maxima*. Oysters are sensitive to changes in water quality, which can affect their growth, survival, and the quality of the pearls they produce. Factors such as temperature, pH, salinity, dissolved oxygen levels, and the presence of pollutants and pathogens can all impact the health and survival of *Pinctada maxima*. High levels of pollutants, for example, can lead to increased mortality rates, decreased growth rates, and reduced pearl quality.

Pathogens can also cause diseases that can impact the health of the oysters and reduce their ability to produce pearls of good quality [7].

To ensure high-quality pearl production, it is important to maintain optimal water quality conditions in *Pinctada maxima* farming operations. This involves regular monitoring and testing of water parameters, controlling water temperature, maintaining appropriate salinity levels, and ensuring that water is free of pollutants and pathogens. The use of proper waste management practices, such as the proper disposal of farm waste, can also help to minimize the impact of pollutants on water quality [8]. In conclusion, water quality is a critical factor for the success of *Pinctada maxima* cultivation. Regular monitoring and management of water quality can help ensure optimal conditions for the growth and survival of oysters, as well as the production of high-quality pearls.

II. RESEARCH METHODS

The study used a descriptive method that analyzes data by explaining both with numbers and words systematically and describes the condition of water quality in pearl oyster hatchery ponds [9]. Sampling using purposive sampling. The purposive sampling method is to determine the sampling location based on consideration of the research objectives and targets [10]. This research was conducted for 1 month. The implementation of the research was carried out at the Production Center for Superior Shrimp and Kekerangan (BPIU2K), Kekerangan Station, Karangasem, Bali

Water Quality Measurement

Measurement of temperature and dissolved oxygen using DO meter. Salinity measurement using Refractometer. Measurement of pH using a pH meter. Measurement of Ammonia, Nitrite and TSS (Total Suspended Solid) using Hach DR/890 colorimeter. Measurement of total bacteria and total vibrio using the TPC (Total Plate Count) method. Sampling of water quality that is measured daily at 06.00, 13.00, 18.00 WITA is DO, salinity, pH, and temperature carried out directly at the maintenance site at the BPIU2K Tigaron, Karangasem. The measurement schedule every 7 days was carried out measuring ammonia, nitrate, nitrite, TSS, total bacteria and total Vibrio bacteria carried out at the BPIU2K Test Laboratory, Karangasem. All data that has been collected is compiled in tabular form, then analyzed descriptively.

Sampling location

Daily parameter tests such as temperature, ph, dissolved oxygen, and salinity were conducted at seawater reservoir before treatment (station 1), reservoir (station 2), larval rearing basin (station 4), wastewater treatment plant inlet (station 5) and at Wastewater treatment plant outlet (station 6). Weekly measurements such as ammonia, nitrate, and nitrite were conducted at the seawater reservoir before treatment (station 1), reservoir (station 2), larval rearing basin (station 4), wastewater treatment plant inlet (station 5), and at the wastewater treatment plant outlet (station 6). The measurements of suspended solids, total bacteria, and total Vibrio bacteria were carried out at the seawater reservoir before treatment (station 1), reservoir (station 2), larval rearing basin tap water (station 3), wastewater treatment plant inlet (station 5) and at the wastewater treatment plant outlet (station 6).

III. RESULTS AND DISCUSSION

Temperature

The results of temperature in this study can be seen in Fig 1. Based on the temperature measurement data at 06.00 WITA in the wastewater inlet sample of the wastewater treatment basin, the wastewater outlet sample of the wastewater treatment basin has the lowest value compared to the other 2 measurement times, which is 28.2 ºC. The peak temperature occurred at the measurement time at 13.00 WITA, which was 29ºC in the reservoir sample and the wastewater treatment plant outlet water sample.

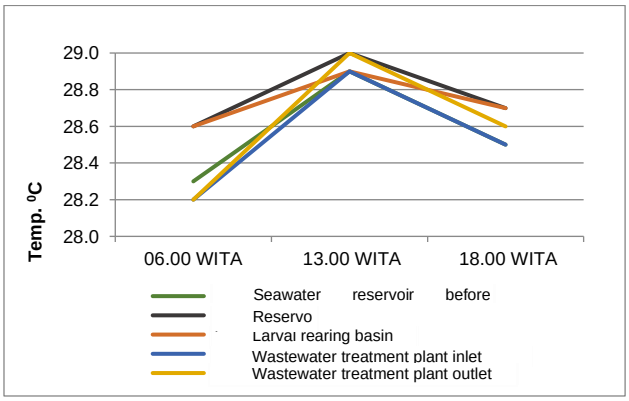

Figure 1. Temperature Measurement Results at *P. maxima* Hatchery

According to Simanjuntak [11], a drastic temperature drop occurs at night and will affect the temperature drop in the morning. While during the day there is a drastic increase in temperature. This event is caused by environmental conditions that affect the state of the water and the activities of organisms that live in the water environment. According to Hamzah and Nababan [12] stated that the optimum temperature range for *P. maxima* is between 23-28ºC. According to Wibisono [13], the temperature that can still be tolerated by marine biota ranges from 20°C-30°C. Based on this, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Total suspended solid

Measurement of total water soluble solids is carried out once a week. The samples measured in this parameter are seawater samples before treatment, hatchery tap water samples, reservoir water samples, wastewater treatment plant inlet water samples, wastewater treatment plant outlet water samples. The result of total suspended solids from all samples was 0 mg/l. According to the regulation of the Governor of Bali Number 8 of 2007 [14] and the Decree of the Minister of Environment No. 51 of 2004 [15] for marine biota, the tolerable level of total suspended solids is <20 ppm. According to Slamet [16], in conditions of total suspended solids of 0.007-0.011 ppm *Pinctada maxima* can still grow optimally. Based on the literature and these results, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

pH

The results of pH in this study can be seen in Fig 2. Based on the pH measurement data, it can be seen that the highest pH value in the hatchery sample at the measurement time at 13.00 WITA was 8.3 and the lowest at the seawater sample station before treatment, reservoir water sample, wastewater treatment plant outlet water sample at the measurement time at 06.00 WITA was 8.1.

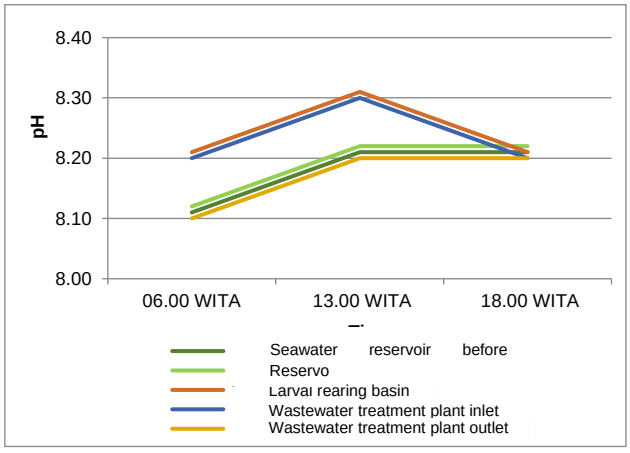

Figure 2. Results of pH Measurement in *Pinctada maxima* Hatchery

In the morning the temperature tends to be lower and will increase during the day so that it affects the pH of the water. [11]. The degree of water acidity that is suitable for the life of *Pinctada maxima* ranges from 7.8-8.6. Oysters will no longer be able to produce if the pH exceeds 9.00. Oyster activity will increase at pH 6.75 - pH 7.00 and decrease at pH 4.0-6.5 [17]. Based on the literature and these results, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Dissolved oxygen (DO)

The results of Dissolved oxygen (DO) in this study can be seen in Fig 3. Based on the data, it can be seen that the highest value of dissolved oxygen in the reservoir water sample, wastewater treatment plant inlet water sample, wastewater treatment plant outlet water sample at measurement time 13.00 pm amounting to 4.27 mg/l and the lowest in the wastewater treatment plant inlet water sample station at measurement 06.00 pm amounting to 4.16 mg/l. This is because in the morning the water temperature tends to be low and occurs during the day the temperature tends to be high so that it can affect the value of dissolved oxygen [11]. According to Tomatala [18], states that pearl oysters can live well in waters with dissolved oxygen content ranging from 3.2 - 6.8. Based on the literature and these results, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

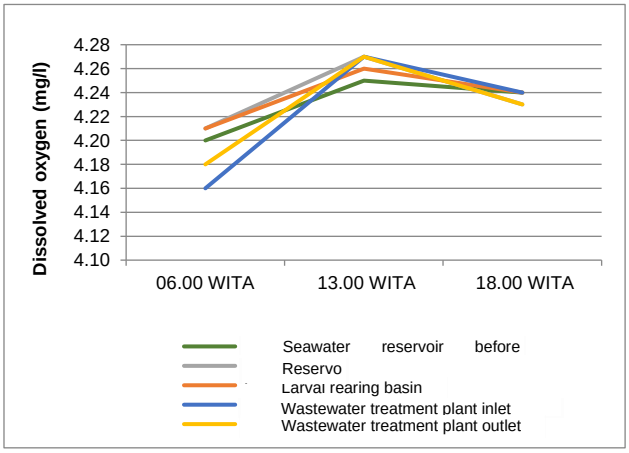

Figure 3. Dissolved Oxygen Measurement Results at *Pinctada maxima* Hatchery

Salinity

The average measurement of water salinity in the all sample is 35 ppt. According to Tomatala [18]; Jamilah [17] that good salinity conditions for the growth and survival of pearl oyster larvae are in the range of 32-35 ppt. Pearl oysters can live at 24 ppt and 50 ppt salinity for a short period of time, which is 2-3 days. Based on the literature and these results, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Ammonia

The results of ammonia in this study can be seen in Fig 5. Based on the measurement results, the highest ammonia value in the wastewater treatment plant inlet sample at week 1 and 3 measurements was 1.6 mg/l. The lowest ammonia value was obtained in the measurement of seawater samples of the larval rearing basin reservoir and wastewater treatment plant outlet, which was 0 mg/l. High ammonia levels at the wastewater treatment plant inlet are due to the remaining excretion of organisms, nitrite

reduction by bacteria, nitrogen gas reduction and waste from the cultivation process. As for other locations, there is already water treatment to reduce ammonia levels in the water [8]. Ammonia levels allowed based on KepMen LH number 51 of 2004 [15] in seawater quality standard levels for marine biota is 0.3 mg/l. Based on the literature and the results of the internship above, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Nitrite

Nitrite measurement results in this study can be seen in Fig 6. Based on the measurement results, the highest value of nitrite in seawater samples (pipes) at the measurement time of week 1 was 0.026 mg/l. The lowest nitrite value was obtained in the measurement of the reservoir sample at the measurement time of week 3, which was 0.009 mg/l. The high nitrite measurement at the location of the seawater pipe is due to water that has not received any treatment of nitrite from industrial waste and is still contained in seawater, enters the water taken. Whereas for water that has received treatment the results will show lower nitrite levels [19]. According to Jamila [17], nitrite levels ranging from 0.5 - 5 mg/L will endanger the life of organisms. A nitrite concentration of 0.25 mg/l can cause stress and even death to the organisms being reared. Polluted waters usually contain nitrite up to 2 mg/l. If the nitrite concentration in the water is high, it will interfere with the life of pearl mussels because the form of nitrite can bind to blood hemoglobin and is toxic. Based on the literature and the results of the internship above, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Total Bacteria

Measurement of total bacteria is carried out once a week, namely the samples measured in this parameter are seawater samples before treatment, pearl basin water samples, wastewater treatment plant inlet water samples, wastewater treatment plant outlet water samples. The results of total bacteria from all samples were < 1 x 10^1 cfu/ml. According to SNI in Putriana et al., the standard value of total bacteria in cultured waters is 5 x 10^5 cfu/ml. The threshold value of total bacteria levels for good marine biota according to Bali Governor Regulation No. 8 of 2007 [14] and Decree of the Minister of Environment No. 51 of 2004 [15] is below 1x106 cfu/ml. Based on this, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

Total Vibrio

Total vibrio measurements were carried out once a week on seawater samples before treatment, pearl basin water samples, wastewater treatment plant inlet water samples, wastewater treatment plant outlet water samples. The total vibrio results from all samples were < 1 x 10^1 cfu/ml. Standard value of vibrio bacteria in aquaculture waters is 5 X 10^4 cfu/ml [20]. The threshold value of total Vibrio levels for good marine biota according to Bali Governor Regulation No. 8 of 2007 [14] and Decree of the Minister of Environment No. 51 of 2004 [15] is below 1 x 10^6 cfu/ml. Based on this, the water conditions in the pearl oyster hatchery are optimal for the life of *Pinctada maxima*.

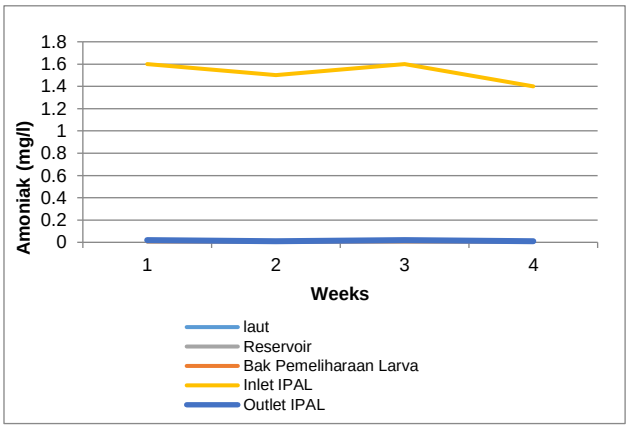

Figure 5. Ammonia measurement results at *Pinctada maxima* Hatchery

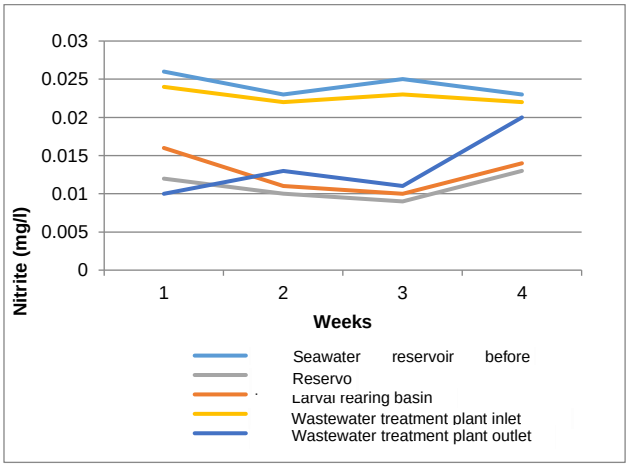

Figure 6. Nitrite Measurement Results at *Pinctada maxima* Hatchery

IV. CONCLUSIONS

Based on the research data that has been collected, a conclusion can be drawn that water quality is still in the optimum range in pearl oyster (*Pinctada maxima*) hatchery activities. The temperature measurement results range from 28.2-29^{0}C. Measurement of total suspended solids obtained 0 mg/l. The pH measurement ranged from 8.1-8.3. DO measurements ranged from 4.16-4.27 mg/l. Salinity measurements were found to be 35 ppt. Ammonia measurements ranged from 0-1.55 mg/l. Nitrite

measurements ranged from 0.012-0.026. Measurement of total bacteria obtained results <1 X 10^1 cfu/ml from all samples. Measurement of total vibrio obtained results < 1 X 10^1 cfu / ml from all samples.

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