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Effect of Salinity Variation on Survival of Pearl Oyster Spawn (*Pinctada maxima*)

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ABSTRACT

Pearl oysters (*Pinctada maxima*) are a high-value fishery commodity with significant development prospects, due to increasing demand and selling value in domestic and international markets. One of the challenges in pearl oyster cultivation is determining the optimal salinity to improve spat (seed) survival. This study aims to evaluate the effect of various salinity levels on the survival of *Pinctada maxima* spat and determine the optimal salinity. The study used a completely randomized design (CRD) with four salinity treatments: 35 ppt, 30 ppt, 25 ppt, and 20 ppt, each with three replicates. Results showed that the highest survival rate was found at 35 ppt (63%) and 30 ppt (23%) salinity, while the lowest survival rate was at 25 ppt (7%) and 20 ppt (1%) salinity. Salinity of 35 ppt gave the best results for survival and weight growth of pearl oyster spat, followed by salinity of 30 ppt. These findings have important implications for the development of more effective and efficient culture methods to improve pearl production and quality.

INTRODUCTION

Pearl oyster (*Pinctada maxima*) is a fishery sector commodity that has economic value and prospects for future development. This can be seen from the increasing number of pearl jewelry enthusiasts and the price has increased from year to year. *Pinctada maxima* is one type of ketiraman from the bivalve class, this biota has enormous potential because almost all parts of its body have a selling value, besides that the meat contains very high protein. (Sarifin et, al. 2012).

The potential of Indonesian pearls traded in the world market has the opportunity to be developed. The pearl granules produced by *Pinctada maxima* are an important export commodity for Indonesia because they have a high selling value and are also a significant contributor to foreign exchange for the country (Sinaga, Hartoko and Wisnu, 2015). The export value of this commodity in 2016 reached a value of 45,293 thousand US dollars. This product is exported to 9 countries, the largest of which are Hong Kong, Australia, Japan and China (Kristiningrum and Bendjamin, 2018).

However, the supply of pearl oysters from catches in the free sea continues to decline from year to year so that it cannot meet the increasing demand. Overcoming various problems in the business of producing pearls, currently the business of producing pearls has been carried out in an integrated manner by companies with large capital, from seed rearing (spat), hatcheries or hatcheries to post-harvest (Directorate General of Aquaculture, 2013).

Pearl oyster spat is the initial stage of the pearl oyster life cycle. The rearing of pearl oyster spat is carried out to increase the production of pearl oyster seeds (spat) to meet the needs of pearl-producing oysters. Currently, Indonesia only provides 26% of the needs in the world market and this figure can still be increased to 50% (Ambarjaya, 2008).

Salinity is one of the important factors in pearl oyster cultivation activities and this type of bivalve prefers waters with high salinity. Hamzah (2015) suggested that the range of salinity that is still feasible for the maintenance of pearl oysters is between 24-36 ppt.

However, spat maintenance is very sensitive to changes in environmental conditions such as salinity. One of the obstacles in pearl oyster cultivation activities is the high mortality rate of seeds (spat) in the early days of maintenance. Salinity that is too high or low can disrupt osmoregulation in spat and cause stress and even death. Determining the optimal salinity for spat maintenance is very important so that they can grow and develop properly. Therefore, research on the effect of salinity variation on the survival of pearl oyster spat (*Pinctada maxima*) needs to be conducted.

LITERATURE REVIEW

A. Classification and morphology of pearl oysters

The classification of pearl oysters (*Pinctada maxima*) according to Sutaman (1993), is as follows:

Filum: Mollusks

Class: Bivalvia

Sub-class: Lamellabrancia

Order : Anysomyaria

Sub order : Pteriidae

Genus : Pinctada

Species: *Pinctada maxima*

Pearl oysters have shells that are not symmetrical and very hard, but all of their organs are completely boneless and very soft (Sutaman, 1993). Pearl oysters (P. maxima) are taxonomically categorized into the invertebrate kingdom, and enter the Phylum mollusca which means soft-bodied.

The skin of the pearl oyster (*Pinctada maxima*) is covered by a pair of shells that are not the same shape, the right skin is slightly flattened, while the left skin is slightly convex. According to Mulyanto (1987), the shells are united on the back (dorsal) which is connected by a hinge to open and close the shell. Sutaman (1993) explains that the anatomy of pearl oysters consists of three parts, namely the legs/byssus, mantle and visceral mass. The body of the pearl oyster is divided into three parts. According to Sutaman (1993), the anatomy of the pearl oyster consists of three parts, namely the legs/byssus, mantle and visceral mass.

B. Habitat and Distribution

The pearl oyster (pintacda maxima) is commonly found at depths of 20-70 m, with bottom waters or craggy sand. The place of life ranges from shallow waters with sandy water areas or craggy sand overgrown with seagrass plants to deep sea crags. Pearl oysters live attached to corals to depths ranging from 10-75 meters (Takemura in Winanto, 2009).

The growth of pearl oysters in subtropical regions takes place in the summer while in the winter the growth is slow or sometimes does not experience growth at all. This is why the growth time of pearl oysters in Indonesia (tropical region) tends to be 4.6 times faster than that of Japanese pearl oysters (subtropical region) (Winanto, 2004).

The growth of pearl oysters is strongly influenced by natural factors, namely biological, physical and chemical factors. Temperature is a physical factor that can affect the growth of pearl oysters, because in summer, when temperatures rise, pearl oysters can grow optimally. However, when the temperature and salinity throughout the year are stable with an ideal environment, the growth will also be stable (Haramain, 2005).

C. Water Quality

Water quality parameters in pearl oyster rearing that need to be considered are temperature, salinity and pH of the water (Mulyanto, 1987).

a) Temperature

Temperature plays an important role in the biophysiological activities of pearl oysters, water temperature is very instrumental in controlling metabolic processes.

According to the Director General of Capture Fisheries (2012), pearl oyster growth can occur at a temperature of 32^{o}C. This was also conveyed by Firmansah (2019), that the temperature between 28 to 32 ° C is still within the tolerance range that can be accepted by pearl oysters.

b) Dissolved oxygen (DO)

Dissolved oxygen (DO) is one of the factors that also needs to be considered in the maintenance of pearl oyster spat (*Pinctada maxima*). According to Mushaffa et, al. (2018) said that dissolved oxygen levels suitable for pearl oyster growth range between 5.8-6.3 ppm.

c) Degree of Acidity (pH)

The degree of water acidity that is suitable for the life of pearl oysters (P. maxima) according to Rosanawita (2017), ranges from 7.8-8.6 and can develop well in the range of 7.8-8.7. In principle, the habitat of pearl oysters in waters is with a pH higher than 6.75. Oysters will not reproduce if the pH is more than 9.00. Oyster activity will increase at pH 6.75 - 7.00 and decrease at pH 4.0 - 6.5.

d) Salinity

The quality of pearls formed in the oyster's body can be affected by salinity levels. Judging from its habitat, pearl oysters prefer to live in high salinity. According to Firmansah (2019), pearl oysters can live in water salinity ranging from 30-32 ppt. The salinity recommendation for pearl oyster cultivation according to Hamzah (2014), in the range of 25-35 ppt.

METHODOLOGY

This study used a completely randomized design (CRD) consisting of 4 treatments of salinity variations, namely:

Treatment A: Seawater with salinity of 35 ppt

Treatment B: Seawater with salinity of 30 ppt

Treatment C: Seawater with salinity of 25 ppt

Treatment D: Seawater with salinity of 20 ppt

where each treatment was repeated three times so that the total treatment was 12 treatments. With the research variables

1. Survival

Observations of the number of live oyster spat were measured at the beginning and end of the study by counting the entire number of surviving spat using the Effendi formula (1979):

$$SR = \frac{Nt}{No} x\ 100\%$$

Description :

SR = Survival Rate(%)

Nt = number of live spat at the end of the study (spat)

No = number of live spat at the beginning of the study (spat)

2. Growth of Absolute Width of Spat

To measure the absolute width of spat, the formula according to Effendie (1979) was used, namely:

$$L = Lt - Lo$$

Description :

L = growth in absolute width (cm)

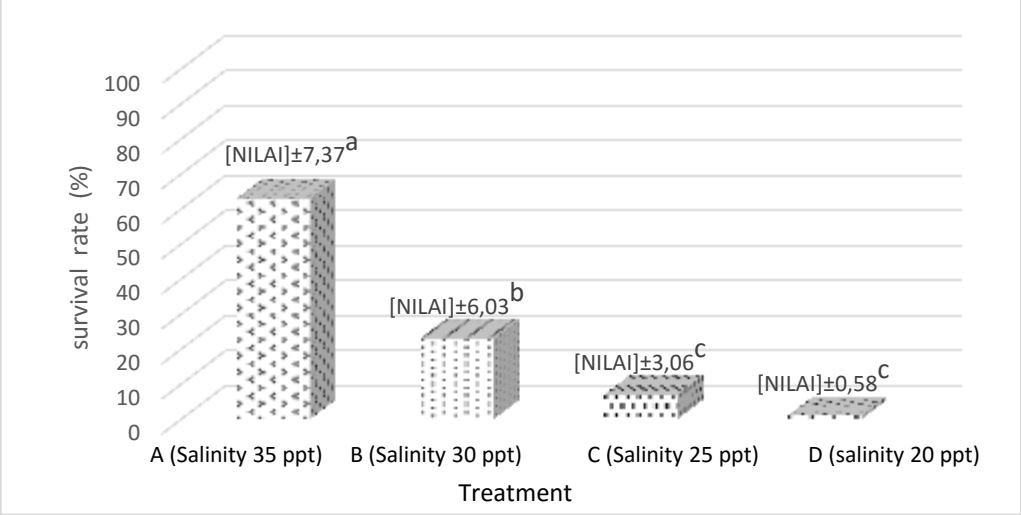
Lt = starting width (cm)

Lo = Final width (cm)

RESEARCH RESULTS

A. Survival Rate

The results of data on the survival rate of pearl oyster spat (*Pinctada maxima*) in each treatment are treatment A (salinity 35 ppt) survival rate of 63%, treatment B (salinity 30 ppt) survival rate of 23%, treatment C (salinity 25 ppt) survival rate of 7%, and the survival rate of spat in treatment D (salinity 20 ppt) 1%.



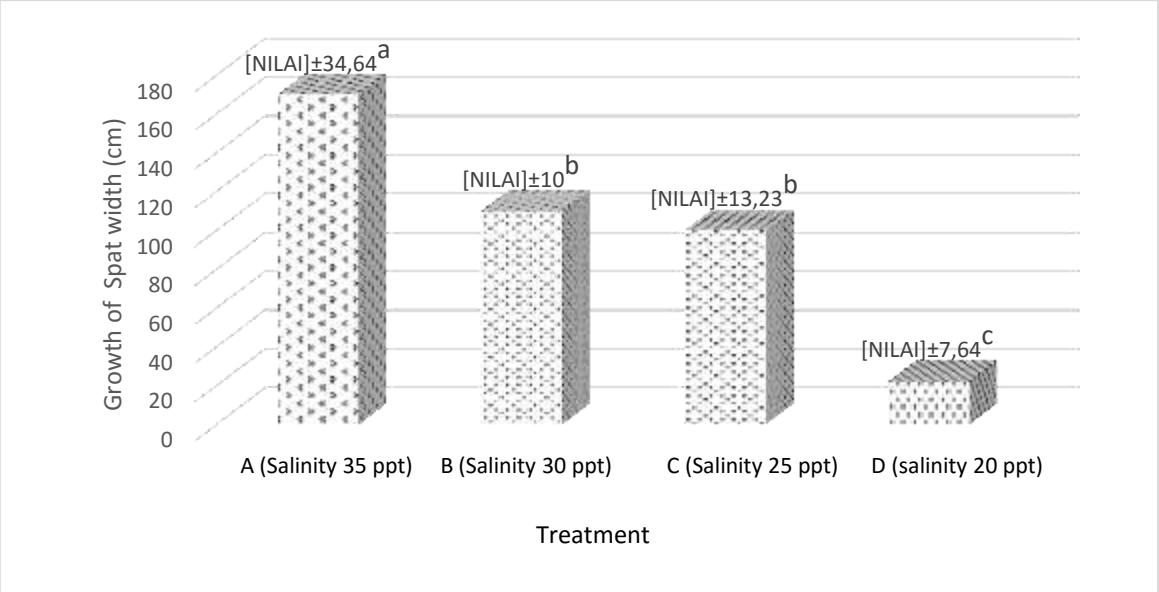
Picture 1. Survival Rate during research

The figure above shows that the highest average SR value is found in treatment A which is 35 ppt salinity of 63 ± 7.37% followed by treatment B which is 30 ppt salinity of 23 ± 6.03%. This is because the salinity of 35 and 30 ppt is in the optimal range for the growth of pearl oyster spat and does not inhibit the process of osmoregulation in the body.

The lowest level of presentation of the average SR value is found in treatment D, namely 20 ppt salinity of 1 ± 0.58% and in treatment C, namely 25 ppt salinity, the average value of SR is 7 ± 3.06%. This is because the spat are in a range that is not optimal and there is an inhibition in the osmoregulation process which will have an impact on greater energy utilization, thus disrupting the growth and survival of oysters. According to Braley et al, (2016) said that salinity that is too high or very low can affect the concentration of minerals in water, thus affecting the stability of osmotic pressure and environmental conditions. If there is a sudden decrease in salinity in a large enough range, it will make it difficult for pearl oysters to regulate their body osmoregulation so that it can cause death.

B. Growth of Spat Width

The results of absolute weight gain data of pearl oyster spat (*Pinctada maxima*) in each treatment are treatment A (salinity 35 ppt) absolute weight 170 mm, treatment B (salinity 30 ppt) absolute weight of spat 110 mm, treatment C (salinity 25 ppt) absolute weight 100 mm, and absolute weight gain in treatment D (salinity 20 ppt) of 22 mm.



Picture 2. Growth of Spat Width

The ANOVA test results showed that different salinity treatments gave a real effect of F count (29.049) > from F table 5% (0.000) on the absolute width of pearl oyster spat, so the BNT further test was conducted. Further test data

obtained showed that treatment A was significantly different from treatment B, C and D but treatment B and C were not significantly different from each other.

Treatment A (salinity 35 ppt) showed the highest width gain with an average value of 170 ± 34.64 mm or about 0.017 cm. this is because the salinity of 35 ppt is in accordance with its natural habitat so it does not cause loss of appetite, apart from that the feed given also has balanced nutrition and nutritional content that is suitable for the growth needs of oysters, so that the length gain in this treatment is higher than the length gain in other treatments. This was also conveyed by Anggoro et al (2012), that salinity is one of the physiological factors that affect feed utilization and bivalve growth..

The lowest width gain was found in treatment D (20 ppt salinity) which was 22 ± 7.64 mm or 0.0022 cm. The low width gain in treatment D was due to the 20 ppt salinity that was not suitable for life, which ultimately reduced appetite and could interfere with the growth of pearl oyster spat. Pearl oyster spat reared at 20 ppt salinity can live, but in the research conducted, their survival did not last long and also experienced very slow growth. This is in accordance with the opinion of Harramain (2005) that oysters live in high salinity, and if the salinity throughout the year is stable with an ideal environment, then their growth will also be stable.

DISCUSSION

Salinity variations affect the survival of pearl oyster spat, salinity that produces the highest spat survival is at 35 ppt salinity and followed by 30 ppt salinity. This is because the salinity of 35 and 30 ppt is in the optimal range for the growth of pearl oyster spat and does not inhibit the process of osmoregulation in the body so as not to interfere with the appetite of the spat, therefore also the growth of the absolute width of the highest spat is at 35 ppt salinity.

CONCLUSIONS AND SUGGESTIONS

1. Different salinity has a very significant effect on the survival and growth of pearl oyster spat (*Pinctada maxima*). The best survival and width growth of pearl oyster spat is found in treatment A, namely 35 ppt salinity with a width growth of 170 ± 34.64 mm or 0.017 cm and an average survival rate of 63 ± 7.37%.
2. Recommended for pearl oyster (*Pinctada maxima*) spat rearing with 35 ppt salinity.

FURTHER RESEARCH

Further research can be conducted on the effect of salinity variations on the survival of pearl oyster spat (*Pinctada maxima*) until the spat enters the attachment stage on the collector.

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