The effect of salinity on fecundity and production of giant shrimp larvae (Macrobrachium rosenbergii de Man)

I M Kawan*, I W Arya and D N Sadguna

Department of Fisheries, Faculty of Agriculture, Warmadewa University, Denpasar, Bali, Indonesia

*imadekawan@yahoo.co.id

Abstract. This study was conducted to determine the effect of salinity which can produce the most fecundity and number of giant shrimp larvae (Macrobrachium rosenbergii de Man). The experiment was designed using 24 units of randomized block design (RBD) using 20-30 g (B₁) and 40-50 g (B₂) heavy parent shrimp, with differences in salinity 0 pro-mile (0/o0), 3 pro-mile (0/o0), 5 pro-mile (0/o0), and 7 pro-mile (0/o0) which were repeated 3 times. The results showed that differences in salinity of the parent weight group (20-30 g and 40-50 g) had a very significant effect on fecundity and the number of larvae produced. The highest fecundity and production of shrimp larvae were obtained at salinity 5 Promil (0/o0) in the parent weight group 40-50 g.

1. Introduction
Giant shrimp species (Macrobranchium rosenbergii de Man) is a freshwater shrimp that has the prospect of being cultivated. Seed reserves are often an obstacle in sustainable shrimp farming. Cultivation of giant prawns has also begun to become an alternative for large-scale fish farmers in several areas such as Gianyar Regency, Karangasem Regency, Buleleng Regency and also several villages in Badung Regency and Denpasar.

Demand for giant prawns is increasing. By increasing demand for shrimp both in foreign markets and for domestic needs, many pond owners or ponds are shifting their efforts to the maintenance of giant prawns. One of the factors that enhances the cultivation of giant shrimp is the availability of a quality parent that produces a large number of seeds which also have good quality. The parent that is not qualified will be produced on seed production starting from the eggs produced to reach the fries that are ready for cultivation. Giant prawns have great properties in fresh water and spawn in brackish water (have higher salinity).

Hatcheries in Bali generally use salinity 3 to 5 Pro-mile (0/o0) in hatching tubs, but salinity is not known to give optimal results for each size (weight of the parent). Because the hatchery does mass spawning without determining the size of the parent (weight) of giant prawns by prioritizing eggs that have matured gonads.

The technology of giant shrimp hatchery needs to be developed in order to get the desired amount of seed production. Broodstock broods are only 30-40% capable of laying eggs from donated female breeds that are ready to reproduce [1]. Egg production and production of giant shrimp larvae are determined by genetic and environmental factors, where the number of eggs produced (Fecundity) is very dependent on the parent weight and the number of larvae that can live depends on the fluctuation of air salinity in hatching.
2. Materials and methods

The method used in this research is the experimental method. The experiment was designed using 24 units of randomized block design (RBD) using 20-30 g (B₁) and 40-50 g (B₂) heavy parent shrimp, with differences in salinity S₀: 0 pro-mile (%₉₀), S₁: 3 pro-mile (%₉₀), S₂: 5 pro-mile (%₉₀), and S₃: 7 pro-mile (%₉₀) which were repeated 3 times.

Observation of Fecundity is calculated from the weight of the egg and the number of eggs released in the hatching of giant shrimp eggs that are released from the mother's stomach. Then weigh the broodstock parent before weighing the eggs and after the eggs hatch. Calculating the number of eggs using the SNI standard for the number of eggs in each gram.

Hatchability Calculating hatchability of prawn eggs is calculated by dividing the number of eggs produced by the number of eggs released from the parent multiplied by 100%. To calculate the number of eggs that hatch, the calculation is done by taking a sample using a measuring cup. Samples were taken by sampling 50 ml and then counted the number of larvae and repeated 5 times. To find out the number of eggs that hatch from the volume of 12 liters of water, the average observation is 5 times.

The analysis used in this study is Variant Analysis (F Test) in accordance with the Design used (RBD). To find out the difference between treatments followed by further tests namely Duncan test. Whereas to find out the best salinity in the two heavy groups of shrimp parents, a regression test was conducted

3. Results

3.1. Fecundity

The results of the experiments carried out were obtained from egg fecundity in different parent weight groups for each training and replication (Table.1). Variation analysis and Duncan test showed a significant effect on body weight and salinity management (Tables 2). The relationship between salinity payments and fecundity (the number of eggs produced) follows a quadratic pattern (Figure 1).

| Treatment | Replication | Total | Average |
|-----------|-------------|-------|---------|
|           | B | S | 1 | 2 | 3 |         |         |
| B₁ S₀     | 27,500 | 17,500 | 37,500 | 82,500 | 27,500.00 |
| B₁ S₁     | 75,000 | 75,000 | 62,500 | 212,500 | 70,833.33 |
| B₁ S₂     | 125,000 | 100,000 | 100,000 | 325,000 | 108,333.33 |
| B₁ S₃     | 45,000 | 25,000 | 25,000 | 95,000 | 31,666.67 |
| Σ          | 272,500 | 217,500 | 225,000 | 715,000 | 59,583.33 |
| B₂ S₀     | 250,000 | 200,000 | 200,000 | 650,000 | 216,666.67 |
| B₂ S₁     | 300,000 | 250,000 | 250,000 | 800,000 | 266,666.67 |
| B₂ S₂     | 300,000 | 550,000 | 300,000 | 1,150,000 | 383,333.33 |
| B₂ S₃     | 200,000 | 100,000 | 250,000 | 5,500,00 | 183,333.33 |
| Σ          | 1,050,000 | 1,100,000 | 1,000,000 | 3,150,000,00 | 262,500.00 |
| Total      | 1,322,500 | 1,317,500 | 1,225,000 | 3,865,000.00 | 161,041.67 |

Note: B₁, Parent Weight Group (20-30 g.)
B₂, Parent Weight Group (20-30 g.)
S₀, 0 pro-mile salinity (%₉₀)
S₁, 3 pro-mile salinity (%₉₀)
S₂, 5 pro-mile salinity (%₉₀)
S₃, 7 pro-mile salinity (%₉₀)
Table 2. Duncan test at average fecundity on parent weight group and salinity.

| Treatment                  | Average Fecundity (number eggs) | Notation |
|----------------------------|---------------------------------|----------|
| Parent Weight Group        |                                 |          |
| B₂ (40-50 g)               | 262,500.00                      | a        |
| B₁ (20-30 g)               | 59,583.33                       | b        |
| Salinity (%₀₀)             |                                 |          |
| S₂                         | 245,833.33                      | a        |
| S₁                         | 168,750.00                      | ab       |
| S₀                         | 122,083.33                      | b        |
| S₃                         | 107,500.00                      | b        |

Note: The difference in notation shows a significant difference
B₁: Parent Weight Group (20-30 g); B₂: Parent Weight Group (20-30 g);
S₀: 0 pro-mile salinity (%₀₀); S₁: 3 pro-mile salinity (%₀₀); S₂: 5 pro-mile salinity (%₀₀);
S₃: 7 pro-mile salinity (%₀₀)

Figure 1. Chart the relationship between salinity and fecundity (number eggs).

Base on figure 1 above can be explained that the relationship between salinity and egg total from the equation $Y = 112,851 + 54,887.8X - 7,597.05X^2$ obtained optimum salinity ($X_{\text{Opt}} = 3.612442$) on the maximum number of eggs ($Y_{\text{max}} = 211,990.5$). This shows that for prawn broodstock which produces the highest number of eggs at salinity 3.6 Pro-mile (%₀₀).

3.2. Production of giant shrimp larvae (Macrobrachium rosenbergii de Man)
The results of the experiments conducted found that Larvae production in the parent weight group was different for each treatment and replication (Table 3). The variant analysis and Duncan test showed a significant effect on the parent weight group and salinity treatment (Table 4) on the production of larvae produced. The relationship between salinity treatment and fecundity (number of eggs produced) follows a quadratic pattern (Figure 2).
Table 3. Production of giant shrimp larvae on the treatment of parent weight (B) and salinity (S).

| Treatment | Replication | Total | Average |
|-----------|-------------|-------|---------|
| B         | S           |       |         |
| B_1       | S_0         | 3.690 | 2.300   | 3.360   | 9.350.00 | 3,116.67 |
|           | S_1         | 7.296 | 3.408   | 8.936   | 19.640.00 | 6,546.67 |
|           | S_2         | 53.750| 25.545  | 15.786  | 95.081.00 | 31,693.67 |
|           | S_3         | 12.672| 6.780   | 2.976   | 22.428.00 | 7,476.00 |
| Σ         |             | 77.408| 38.033.00 | 31.058.00 | 146.499.00 | 12,208.25 |
| B_2       | S_0         | 10.608| 17.904  | 16.589  | 45.101.00 | 15,033.67 |
|           | S_1         | 19.536| 20.464  | 18.432  | 58.432.00 | 19,477.33 |
|           | S_2         | 78.980| 45.600  | 45.430  | 170.010.00| 56,670.00 |
|           | S_3         | 25.900| 18.900  | 17.136  | 61.936.00 | 20,645.33 |
| Σ         |             | 135,024.00 | 102,868.00 | 97,587.00 | 335,479.00 | 27,956.58 |
| Total     |             | 212,432.00 | 140,901.00 | 128,645.00 | 481,978.00 | 20,082.42 |

Note: B_1: Parent Weight Group (20-30 g.); B_2: Parent Weight Group (20-30 g.)
S_0: 0 pro-mile salinity (%/0); S_1: 3 pro-mile salinity (%/0); S_2: 5 pro-mile salinity (%/0)
S_3: 7 pro-mile salinity (%/0)

Table 4. Duncan test at average production of giant shrimp larvae on parent weight group and salinity.

| Treatment | Average larvae production (tail) | Notation |
|-----------|----------------------------------|----------|
| Parent Weight Group |                                  |          |
| B_2       | 27,956.58                        | a        |
| B_1       | 12,208.25                        | b        |
| Salinity   |                                  |          |
| S_2       | 44,181.83                        | a        |
| S_1       | 14,060.67                        | b        |
| S_0       | 13,012.00                        | b        |
| S_3       | 9,075.17                         | b        |

Note: The difference in notation shows a significant difference
B_1: Parent Weight Group (20-30 g.); B_2: Parent Weight Group (20-30 g.)
S_0: 0 pro-mile salinity (%/0); S_1: 3 pro-mile salinity (%/0); S_2: 5 pro-mile salinity (%/0)
S_3: 7 pro-mile salinity (%/0)

\[ Y=5,995.47 + 10,469.8X - 1,213.25X^2 \]

\[ Y=5,995.47 + 10,469.8X - 1,213.25X^2 \]

\[ R-Sq = 0.384 \]

Figure 2. Chart The Relationship between salinity and Production of giant shrimp larvae (tails).
The figure 2 above can be explained that the relationship between salinity and Production of shrimp larvae from the equation \( Y = 5,995.47 + 10,469.8 \, X - 1,213.25X^2 \) obtained optimum salinity \((X_{\text{Opt}} \approx 4.3)\), so that the maximum shrimp larvae produce \((Y_{\text{max}}) = 28,582\) tail.

4. Discussion

Increased salinity is not possible to add to the eggs that hatch because the eggs in the gonad have run out so that to obtain optimal salinity used quadratic regression pattern. The biological cubic regression pattern is not possible because eggs that have hatched cannot become eggs again. When viewed from the average data the results of the study have experienced a decrease in salinity \(7\%\) so that the regression pattern is used.

Based on the optimum point of salinity treatment which gave the maximum value of egg weight, number of eggs, production of larvae and hatchability of eggs, namely Optimum salinity for egg weight, namely \(3.6\%\), egg counts \(3.6\%\), number of larvae \(4.3\%\), and hatchability of \(7.7\%\), so that the optimum average salinity obtained which gives the best results of hatching of shrimp parents is \(5.3\%\).

The methods most effective achieve the ability to live the longest until 24 days is the methods of hatching mediano -0 ppt Salinity, and larval rearing medium salinity increased as larval aged 1 to 6 days in salinity 0 to 13 ppt and larval aged 17 days of 12 ppt salinity reduced gradually until 0 ppt to post-larva [2]. Increased salinity requires shorter egg incubation times, at 5 pro-mile salinity requiring 10 days incubation time [3].

The Research at Varian genetic on the Giant Freshwater Prawn Larvae is the best survival rate from genetic resources pagan with \(\text{SR} = 93.07\%\), survival rate genetic resources Barito with \(\text{SR} = 90.40\%\) and survival rate genetic resources Kintap with \(\text{SR} = 86.93\%\) [4].

Potassium levels with \(75\) ppm and media salinity \(4\) ppt have been given the best performance to juvenile prawn \((\text{M.rosenbergii de Man})\) [5]. The absolute fecundity of prawns is \(180-5800\) eggs [6].

The results of the study conducted found that the average UG-BAHARI variety of the parent could produce \(7,160 \pm 999\) post larval; UG-TARIK variety weighs \(73.34\) g of post-larval production of \(8,667 \pm 764\) head; UG-KUMAI \(22.74\) g post-larval production was \(6,591 \pm 1,723\) and UG-JENEBE weighed \(45.84\) g post-larval production \(8,179 \pm 2,896\) [7].

The optimal dose of vitamin E supplementation of \(600\) IU increases the survival of larvae aged 10 days in female prawns without ablation and giant shrimp that is unilaterally ablated [8]. Found prospective betel leaf extract as a densification material for giant prawn larvae \((\text{M.rosenbergii de Man})\) [9]. Crossing strains will also provide differences in larval development to reach post larvae [10].

5. Conclusions

The difference in salinity of the parent weight group \((20-30\, g \text{ and } 40-50\, g)\) has a very significant role in fecundity and the number of larvae produced. The highest percentage (egg production) was produced with the approval of 5 pro-mile salinity \((\%\)) at \(40-50\, g\) main weight, which is \(383,333\) grains. The highest production of giant shrimp larvae is obtained at salinity 5 Promil \((\%)\) in the 40-50 g main weight group which is \(56,670\) tail. The salinity can give maximum value to the number of eggs 3.6 pro-mile salinity \((\%\)), and the number of larvae is 4.3 pro-mile salinity \((\%\)).

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