JoAS Volume 10 No. 2 October 2025
DOI: https://doi.org/10.20473/joas.v10i2.75588
pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Journal of Aquaculture Science

Influence of Body Size on Fecundity and Egg Diameter and Their Correlations in Female Freshwater Lobsters (*Cherax quadricarinatus*)

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Article info:

Submitted: July 7, 2025
Revised: July 16, 2025
Accepted: August 1, 2025
Publish: October 1, 2025

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ABSTRACT

Broodstock size is crucial for determining reproductive success in freshwater lobsters (*Cherax quadricarinatus*), influencing fecundity and egg diameter. This study aims to analyze the effects of broodstock size on fecundity and egg diameter and their correlations to optimize hatchery management. Thirty egg-bearing female *C. quadricarinatus* were categorized into three size groups: small (10.5–12.5 cm), medium (12.6–14.5 cm), and large (14.6–16.5 cm). Fecundity and egg diameter were analyzed using one-way ANOVA and regression analysis. The results showed that larger females produced a significantly higher number of eggs ($p < 0.05$), while smaller females had larger egg diameters. Regression analysis revealed a positive correlation between body size and fecundity but a negative correlation with egg diameter. This study concluded that, among the tested size groups, medium-sized broodstock (12.6–14.5 cm) exhibited the most optimal balance between fecundity and egg size, making it the preferred choice for hatchery management. These findings provide valuable insights for improving broodstock selection and enhancing seed production efficiency in *C. quadricarinatus* aquaculture.

Keywords: aquaculture, broodstock, hatchery, management, reproductive success

INTRODUCTION

Freshwater lobster (*Cherax quadricarinatus*), commonly known as the redclaw crayfish, is an omnivorous crustacean native to Queensland, Australia. It has been widely cultivated in several countries, including China and Indonesia, due to its high market demand for both ornamental and consumption purposes (Zaky *et al.*, 2020). Several *Cherax* species from the family Parastacidae are found in Indonesia, including *C. quadricarinatus*, *C. lorentzi*, *C. albertisi*, *and C. lorentzi auranus* (Masykur and Harahap, 2020). Among these, *C. quadricarinatus* is the most extensively farmed due to its rapid growth, high reproductive capacity, and adaptability to intensive aquaculture systems (Kurniasih, 2008).

However, despite its potential, commercial production remains insufficient to meet market demands, primarily due to limitations in hatchery productivity and broodstock management (Komariyah *et al.*, 2021). One of the critical factors influencing the success of freshwater lobster aquaculture is the broodstock quality, which significantly affects reproductive performance. The hatchery phase plays a crucial role in increasing seed productivity, and its efficiency can be enhanced through the selection of high-quality broodstock (Raswa *et al.*, 2022).

In crustaceans, reproductive performance is determined by several factors, including gonadal maturation, age, fecundity, and egg

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

diameter (Ladio *et al.*, 2023). Fecundity plays a crucial role in supporting the success of fish (Fasya and Mufidah, 2022). Specifically, fecundity—the number of eggs produced per female—and egg diameter are key indicators of reproductive performance, as they directly affect larval survival and overall hatchery efficiency (Budi *et al.*, 2020).

Despite its significance, the relationship between body size and reproductive parameters such as fecundity and egg diameter in female *C. quadricarinatus* remains underexplored. Previous studies on freshwater lobsters have suggested that larger females tend to produce more eggs due to increased energy allocation towards reproduction rather than growth (Attard & Hudon, 1987; Feranosa *et al.*, 2024; Radkhah and Eagderi, 2015; Radkhah and Nowferesti, 2016). Additionally, variations in egg size may be influenced by maternal size, as larger females may allocate more nutrients to their eggs, affecting larval viability and development (Budi *et al.*, 2020). However, some studies suggest an inverse relationship, where egg diameter decreases as broodstock size increases, potentially due to energy partitioning between fecundity and egg quality (Budi *et al.*, 2020).

Understanding the effect of broodstock size on fecundity and egg diameter and their correlations is essential for optimizing hatchery management strategies. Proper broodstock selection based on size could enhance reproductive output and improve seed production efficiency in *C. quadricarinatus*. Therefore, this study aims to investigate the influence of body size on fecundity and egg diameter in *C. quadricarinatus* females and to analyze the correlation between these reproductive parameters. The findings of this study are expected to contribute to the development of sustainable breeding practices and improve seed production efficiency in freshwater lobster aquaculture.

MATERIALS AND METHODS

This study was conducted on August 13, 2023, at the Training and Aquaculture Center of Freshwater Lobster, Gemma Farm, Kajoran, South Klaten, Central Java, Indonesia. This study was conducted under the supervision and approval of the Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga, as per the Dean's assignment letter number 1242/B/UN3.FIKKIA/TD.06/2024.

Test Animals

A total of 30 egg-bearing adult female *C. quadricarinatus*, approximately five months old, were obtained from Gemma Farm, Indonesia, to be used as test animals in this study. The females were categorized into three size groups based on carapace length: small (S: 10.5–12.5 cm), medium (M: 12.6–14.5 cm), and large (L: 14.6–16.5 cm) (Figure 1).

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Figure 1. Female freshwater lobsters (*C. quadricarinatus*) of different body sizes were used in this study (n = 10). Size categories: small (S: 10.5–12.5 cm), medium (M: 12.6–14.5 cm), and large (L: 14.6–16.5 cm).

Parameter Analysis

The parameters observed in this study were fecundity (eggs/female) and egg diameter (mm). Eggs attached to the pleopods of 10 individuals from each size group were carefully collected using an inoculation needle and transferred into separate petri dishes filled with distilled water. All eggs present on the pleopods were counted regardless of their fertilization status or morphological condition, including unfertilized and abnormal eggs. The eggs were then individually counted using a hand counter. The diameters of the eggs from the three size groups were measured using a light microscope at 40× magnification connected to a video monitor. The diameter of the ovoid-shaped eggs was calculated using the formula $\sqrt{(Dxd)}$, where D represents the larger axis and d represents the smaller axis of the egg (Budi *et al.*, 2020).

The observed parameters were analyzed both descriptively and statistically. Statistical analysis was conducted using a one-way analysis of variance (ANOVA) at a 95% confidence level. Significant differences between size groups were determined using Duncan's multiple range test, performed with SPSS version 7.0. Additionally, the relationships between body size, fecundity, and egg diameter were examined using linear regression graphs in Microsoft Excel.

RESULTS AND DISCUSSIONS

The fecundity and egg diameter of female *C. quadricarinatus* were significantly influenced by body size ($p < 0.05$), as shown in Figure 2. The highest fecundity was observed in the L group, while the lowest was recorded in the S group. Conversely, the S group had significantly larger egg diameters compared to the M and L groups, with no significant difference between M and L.

The relationship between body size with fecundity and egg diameter was further analyzed using linear regression analysis, as presented in Figure 3. The regression analysis indicated a positive correlation between body size and fecundity, suggesting that as the size of the female increased, the number of eggs produced also increased. Meanwhile, the regression analysis showed a negative correlation between body size and egg diameter, indicating that larger females produced smaller eggs.

pISSN 2550-0910; eISSN 2579-4817
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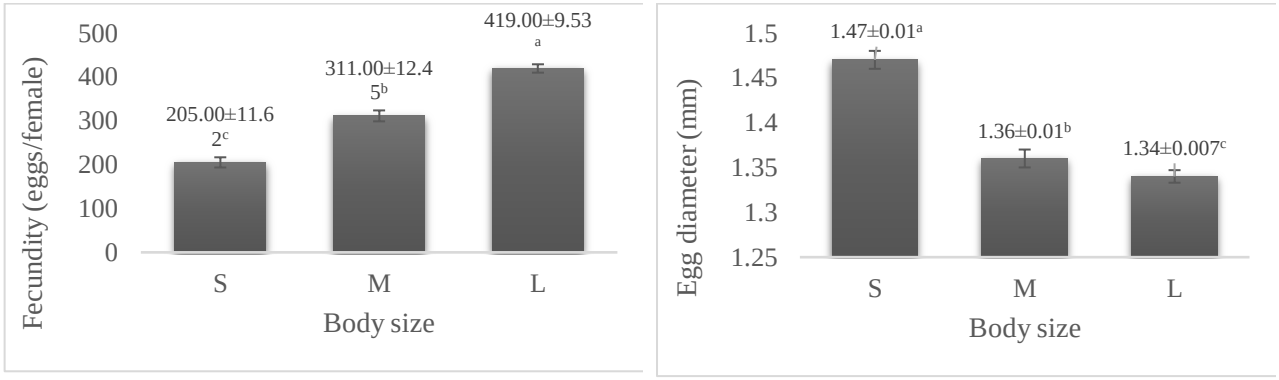

Figure 2. Fecundity (eggs/female) and egg diameter (mm) in different body sizes of female freshwater lobster (*C. quadricarinatus*) (n = 10, mean ± SD). Size categories: small (S: 10.5–12.5 cm), medium (M: 12.6–14.5 cm), and large (L: 14.6–16.5 cm). Distinct letters above the bars indicate statistically significant differences ($p < 0.05$).

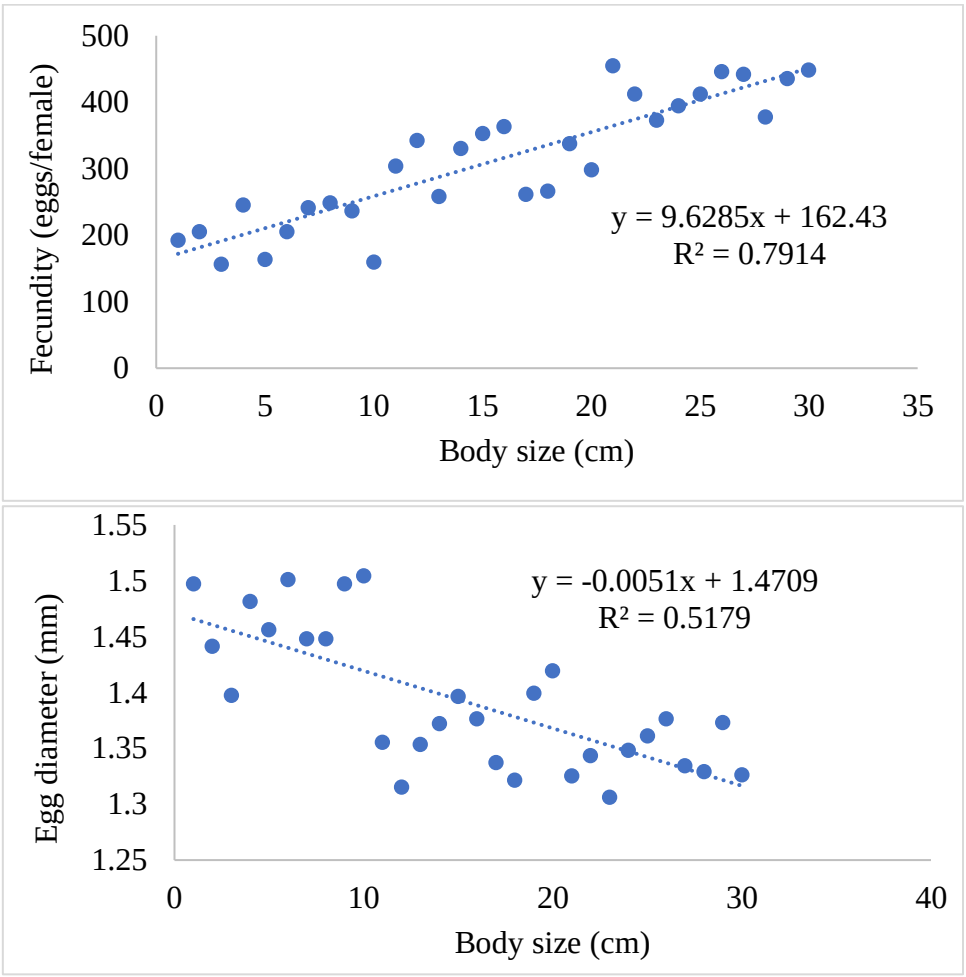

Figure 3. The relationships between the body size of the female freshwater lobsters (*Cherax quadricarinatus*) and fecundity, and the diameter of the eggs.

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Discussion

This study demonstrates that broodstock size has a significant influence on both fecundity and egg diameter in *C. quadricarinatus*. Larger females produced a greater number of eggs, whereas smaller females generated larger individual eggs. These findings highlight the importance of selecting high-quality broodstock to optimize seed production efficiency, as also emphasized by Raswa *et al.* (2022).

The observed increase in fecundity with broodstock size followed a positive linear relationship. Similar patterns have been reported in previous studies on *C. quadricarinatus* (Tropea *et al.*, 2012) and other crustacean species, such as *Philocheras trispinosus* (Oh and Hartnoll, 1999), *Penaeus paulensis* (Cavalli *et al.*, 1997), *Farfantepenaeus paulensis* (Peixoto *et al.*, 2004), red-front shrimp (*Caridina gracilirostris*) (Heerbrandt and Lin, 2006), rose shrimp (*Parapenaeus longirostris*) (Sobrino and García, 2007), and red cherry shrimp (*Neocaridina davidi*) (Budi *et al.*, 2020). The positive correlation between body size and fecundity is likely due to the increased reproductive organ capacity in larger individuals, enabling them to produce and accommodate more eggs (Budi *et al.*, 2020). Specifically, pleopod size plays a crucial role in supporting fecundity, as eggs in *C. quadricarinatus* attach to the pleopods. Given that pleopod size correlates with body size, larger females can carry a higher number of eggs. Further research is needed to elucidate the direct relationship between pleopod size and fecundity in this species.

Egg size is a critical factor influencing early larval development, offspring fitness, and fry survival (Radkhah and Eagderi, 2015; Radkhah and Nowferesti, 2016). In the present study, larger females produced smaller eggs with lower variations in size, and egg diameter showed a negative correlation with broodstock size. This inverse relationship has also been reported in freshwater prawn (*Macrobrachium lamarrei*) (Shakuntala, 1977) and red cherry shrimp (Budi *et al.*, 2020). Although studies on the correlation between body size and egg size in shrimps remain limited, species-specific variations exist, and the underlying mechanisms require further investigation. The observed variations in egg size are often linked to energy allocation, as larger eggs typically contain more yolk reserves, leading to longer developmental periods (Clarke, 1993). This trend is consistent with previous studies showing a direct relationship between egg size and larval survival in brown trout (*Salmo trutta*) and other fish species (Bagenal, 1969; Radkhah and Eagderi, 2015; Radkhah and Nowferesti, 2016).

Overall, this study confirms that broodstock size significantly affects fecundity and egg diameter in *C. quadricarinatus*. Among the evaluated size groups, broodstock within the medium size range (12.6–14.5 cm) exhibited the best balance between fecundity and egg diameter, making it the most suitable option for hatchery management to enhance both seed production and larval survival. The trade-off between egg number and size underscores the need for strategic broodstock selection in hatchery management. Future studies should investigate the physiological mechanisms driving these relationships and assess the implications for larval survival and recruitment success in aquaculture settings.

CONCLUSIONS

This study demonstrates that broodstock size significantly affects fecundity and egg diameter in female *C. quadricarinatus*. Larger females produced more eggs, while smaller females generated larger individual eggs. The

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

positive correlation between body size and fecundity suggests that larger females have greater reproductive organ capacity, enabling higher egg production. In contrast, the negative correlation between body size and egg diameter indicates potential differences in energy allocation strategies. Among the tested size groups, the medium-sized broodstock (12.6–14.5 cm) presents the most optimal balance between fecundity and egg diameter, making it a suitable choice for hatchery management to maximize both seed production and larval survival. The trade-off between egg number and size should be considered when developing breeding strategies to optimize reproductive success. Further research is necessary to investigate the physiological mechanisms underlying these relationships and their implications for sustainable aquaculture practices.

AUTHOR CONTRIBUTIONS

The contributions of each author are as follows: DSB drafted the manuscript and designed the tables and graphs. NAP performed data collection and drafted the initial manuscript. P and NNQ formulated the conceptual ideas and revised the article.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

ACKNOWLEDGEMENTS

The authors express their sincere gratitude to the Training and Aquaculture Center of Freshwater Lobster, Gemma Farm, Klaten, Central Java, for providing the facilities and broodstock used in this study. We also thank the Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga, for the research approval and support. Special appreciation is extended to all staff and students involved in field sampling and laboratory analysis. This study would not have been possible without their valuable assistance and collaboration.

REFERENCES

Attard, J. & Hudon, C. (1987). Embryonic development and energetic investment in egg production in relation to size of female lobster (*Homarus americanus*). Canadian Journal of Fisheries and Aquatic Sciences, 44(6), 1157-1164.

Bagenal, T. B. (1969). Relationship between egg size and fry survival in brown trout *Salmo trutta* L. Journal of Fish Biology, 1(4), 349-353.

Bernardo, J. (1996). The particular maternal effect of propagule size, especially egg size: patterns, models, quality of evidence and interpretations. American zoologist, 36(2), 216-236.

Budi, D. S., Hartono, D., Maulana, F., Bodur, T., & Lutfiyah, L. (2020). Some fecundity parameters and ovarian maturity criteria of ornamental red cherry shrimp (*Neocaridina davidi*). Turkish Journal of Veterinary & Animal Sciences, 44(2), 456-462.

Cavalli, R. O., Scardua, M. P., & Wasielesky Jr, W. (1997). Reproductive performance of different sized wild and pond-reared *Penaeus paulensis* females. Journal of the World Aquaculture Society, 28(3), 260-267.

Clarke, A. (1993). Egg size and egg composition in polar shrimps (Caridea; Decapoda). Journal of Experimental Marine Biology and Ecology, 168(2), 189-203.

Fasya, A. H., & Mufidah F. (2022). The Effect of Parental Length and Weight on Fecundity of *Betta* sp. Journal of Aquaculture Science, 7(2), 130–134.

Feranosa, C., Komariyah, S., & Haser, T. F. (2024). Different dosages effectiveness of Ovaprim on the maturation of freshwater lobster (*Cherax quadricarinatus*). Acta Aquatica: Aquatic Sciences Journal, 11(1), 19-22.

Heerbrandt, T. C., & Lin, J. (2006). Larviculture of red front shrimp, *Caridina gracilirostris* (Atyidae, Decapoda). Journal of the World Aquaculture Society, 37(2), 186-190.

Komariyah, S., Haser, T. F., & Putriningtias, A. (2021). The Effectiveness of Maturation Stimulation Method on Fecundity and Egg Diameter of Freshwater Lobster (*Cherax quadricarinatus*). Jurnal Agroqua: Media Informasi Agronomi dan Budidaya Perairan, 19(2), 328-333.

Kurniasih, T. (2008). Lobster air tawar (parastacidae: *Cherax*), aspek biologi, habitat, penyebaran, dan potensi pengembangannya. Media akuakultur, 3(1), 31-35.

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

Ladio, M., Komariyah, S., & Putriningtias, D. A. (2023). Effectiveness of different dosages of vitamin E on the maturation of freshwater lobster (*Cherax quadricarinatus*). Acta Aquatica: Aquatic Sciences Journal, 11-14.

Masykur, H. Z., & Harahap, S. R. (2020). Pengaruh Pemberian Jenis Pakan yang Berbeda Terhadap Pertumbuhan Lobster Air Tawar (*Cherax quadricarinatus*). Perikanan Dan Lingkungan: Journal of Fisheries and Environment, 9(1), 28-35.

Oh, C. W., & Hartnoll, R. G. (1999). Size at sexual maturity, reproductive output, and seasonal reproduction of Philocheras trispinosus (Decapoda) in Port Erin Bay, Isle of Man. Journal of Crustacean Biology, 19(2), 252-259.

Peixoto, S., Cavalli, R. O., Wasielesky, W., D'Incao, F., Krummenauer, D., & Milach, Â. M. (2004). Effects of age and size on reproductive performance of captive *Farfantepenaeus paulensis* broodstock. *Aquacultur*e, 238(1-4), 173-182.

Radkhah, A., & Eagderi, S. (2015). Length-weight and length-length relationships and condition factor of six cyprinid fish species of Zarrineh River (Urmia Lake basin, Iran). Iranian Journal of Ichthyology, 2(1), 61–64.

Radkhah A., & Nowferesti H. (2016). Studies on length-weight, length-length relationships and condition factor of *Capoeta aculeata* in Gamasiab river, Kermanshah province, Iran. ABAH Bioflux, 8(1), 29-33.

Raswa, R., Mustamiin, M., & Putra, W. P. (2022). Penerapan Mikro Kontrol Untuk Peningkatan Budidaya Lobster Air Tawar. IKRA-ITH ABDIMAS, 5(2), 169-176.

Shakuntala, K. (1977). The relation between body size and number of eggs in the freshwater prawn, *Macrobrachium lamarrei* (H. Milne Edwards) (Decapoda, Caridea). Crustacean,17-22.

Sobrino, I. & García, T. (2007). Reproductive aspects of the rose shrimp *Parapenaeus longirostris* (Lucas, 1846) in the Gulf of Cadiz (southwestern Iberian Peninsula). Boletín Inst. Español Oceanogr., 23(1-4), 57–71.

Tropea, C., Arias, M., Calvo, N. S., & López Greco, L. S. (2012). Influence of female size on offspring quality of the freshwater crayfish *Cherax quadricarinatus* (Parastacidae: Decapoda). Journal of Crustacean Biology, 32(6), 883-890.

Zaky, K. A., Rahim, A. R., & Aminin, A. (2020). Jenis shelter yang berbeda terhadap pertumbuhan dan sintasan lobster air tawar red claw (*Cherax quadricarinatus*). Jurnal Perikanan Pantura, 3(1), 23-30.