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Management of Broodstock for Pacific White Shrimp (*Litopenaeus vannamei*) at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) Karangasem, Bali

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ABSTRACT

Shrimp (*Litopenaeus vannamei*), as it directly impacts the quality and quantity of larvae produced for aquaculture. This study investigates the management practices at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) in Karangasem, Bali, focusing on the broodstock selection, breeding, and maintenance processes. The research evaluates the performance of broodstock in terms of growth, reproductive health, and overall productivity, aiming to optimize practices for sustainable shrimp farming. Data was collected through direct observation, water quality analysis, and broodstock health assessments. The findings highlight the importance of proper environmental conditions, nutritional management, and genetic selection in enhancing the reproductive success of *L. vannamei*. The study also discusses challenges faced by the facility, including disease management and genetic diversity, offering recommendations for improving broodstock management to ensure consistent, high-quality shrimp production. The number of male broodstock in the maintenance tank was around 250, and female broodstock was around 200, with a survival rate of 70%. This research contributes to advancing sustainable aquaculture practices and improving the shrimp farming industry in Indonesia.

INTRODUCTION

The Pacific white shrimp, or vannamei shrimp (*Litopenaeus vannamei*), is an introduced species originating from the Pacific coast of Latin America. Vannamei shrimp was first introduced in Indonesia in 2001 as an alternative to the native tiger shrimp (*Penaeus monodon*) and banana shrimp (*Penaeus merguensis*), whose production had started declining due to widespread mass mortality in shrimp farms throughout Indonesia (Purmasari *et al*., 2017).

Vannamei shrimp (*Litopenaeus vannamei*) has become one of the most widely farmed shrimp species in Indonesia. It offers several advantages: it is resilient to environmental changes, has disease resistance, and is competitive against broodstock from other countries.

Its maintenance period is relatively short, with high survival rates during cultivation. Additionally, the market demand is consistently increasing, growth is rapid, and it demonstrates strong resistance to diseases and environmental fluctuations. Vannamei shrimp also has high feed intake, high maintenance survival rates, and a low feed conversion ratio (FCR) (Sa'adah & Millah, 2019).

A key factor in the successful production of vannamei shrimp broodstock is the continuous availability of postlarvae year-round. To ensure high-quality postlarvae are available consistently, effective management skills and good broodstock management techniques are essential (Lestari *et al*., 2022).

The Pacific White Shrimp (*Litopenaeus vannamei*) is one of the most widely farmed species in the global aquaculture industry, known for its rapid growth, high market demand, and resilience in diverse farming conditions (Emereciano *et al*., 2022). The success of Pacific White Shrimp farming, however, relies heavily on the quality of broodstock used in production (Alfaro *et al*., 2019). Broodstock management plays a crucial role in ensuring the health, reproductive efficiency, and genetic quality of the shrimp population, which directly impacts the productivity and sustainability of shrimp farming operations. At the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) in Karangasem, Bali, the focus is on producing high-quality, genetically superior broodstock for the shrimp farming industry in Indonesia.

BPIU2K serves as a central hub for the production and management of shrimp broodstock, with the aim of supporting the expansion of the aquaculture sector while promoting sustainable practices. Effective broodstock management at BPIU2K involves a combination of precise environmental control, selective breeding, and optimal nutrition to ensure that the broodstock is healthy and capable of producing high-quality larvae. This facility has become a key player in improving the genetic stock of Pacific White Shrimp in Indonesia, addressing challenges such as inbreeding, disease outbreaks, and inconsistent larval production.

Therefore, the research on "Management of Vannamei Shrimp Broodstock (*Litopenaeus vannamei*) at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) Karangasem, Bali" is essential. The objective of this research is to learn and understand the proper methods and techniques in the management of vannamei shrimp broodstock (*Litopenaeus vannamei*) at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) Karangasem, Bali.The benefits of this research include equipping students with knowledge and skills in the management techniques of vannamei shrimp broodstock at the Center for Superior Shrimp and Shellfish Broodstock Production in Karangasem, Bali.

METHODS

Time and Place of Research

The research was conducted over a period of 4 months, from February 19 to June 21, 2024. This field research took place at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) in Karangasem, Bali.

Data Analysis and Observed Parameters

The data obtained from the research activities are analyzed scientifically through descriptive studies supported by relevant literature. The parameters observed during the

broodstock maintenance of shrimp include survival rate, absolute weight, absolute length, and hatching rate.

a. Absolute Length Growth

$$Lm = Lt - L0$$

Explanation:
Lm : Absolute length of the shrimp (cm)
Pt : Final length of the shrimp (cm)
P0 : Initial length of the shrimp (cm)

b. Absolute Weight Growth

$$W = Wt - W0W$$

Explanation:
W : Absolute weight (g)
Wt : Final biomass (g)
W0 : Initial biomass (g)

c. Survival Rate (SR)

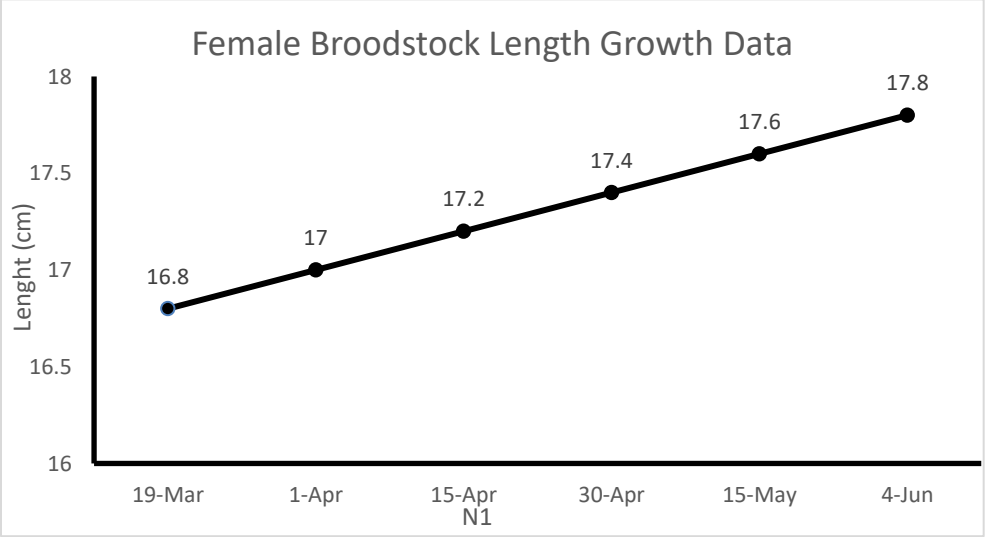
$$SR = Nt / N0 \times 100\%$$

Explanation:
SR : Survival rate (%)
Nt : Number of shrimp alive at the end of the maintenance period
N0 : Number of shrimp alive at the beginning of the maintenance period

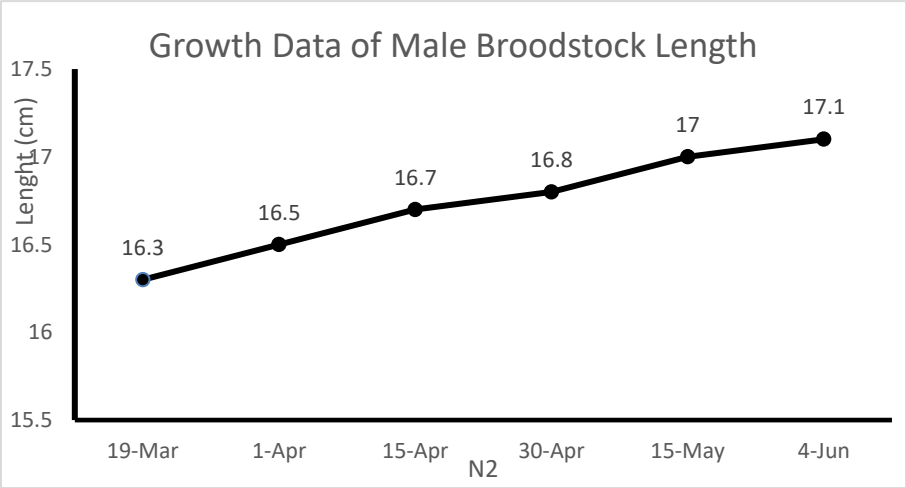
RESULTS

Here are the research results on the growth of absolute weight and length in shrimp broodstock at BPIU2K.

Absolute Length

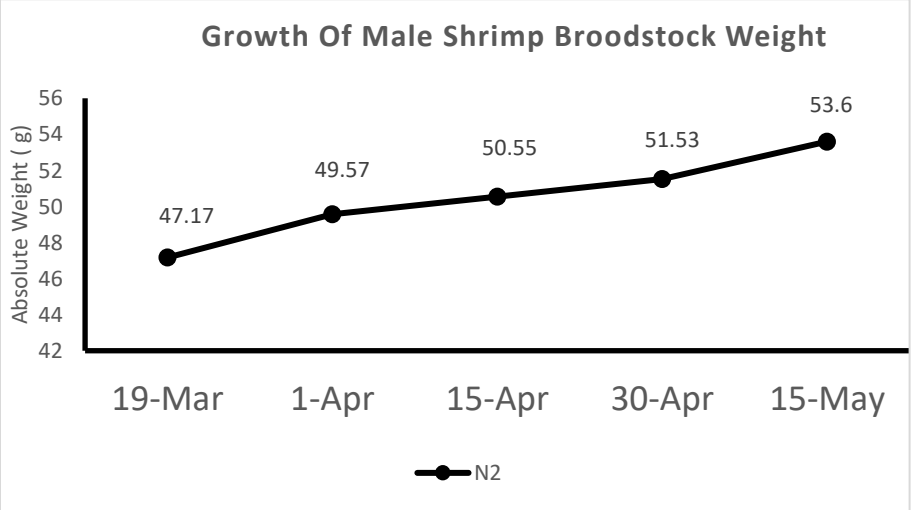


Graph 1. Growth of Female Shrimp Broodstock Length

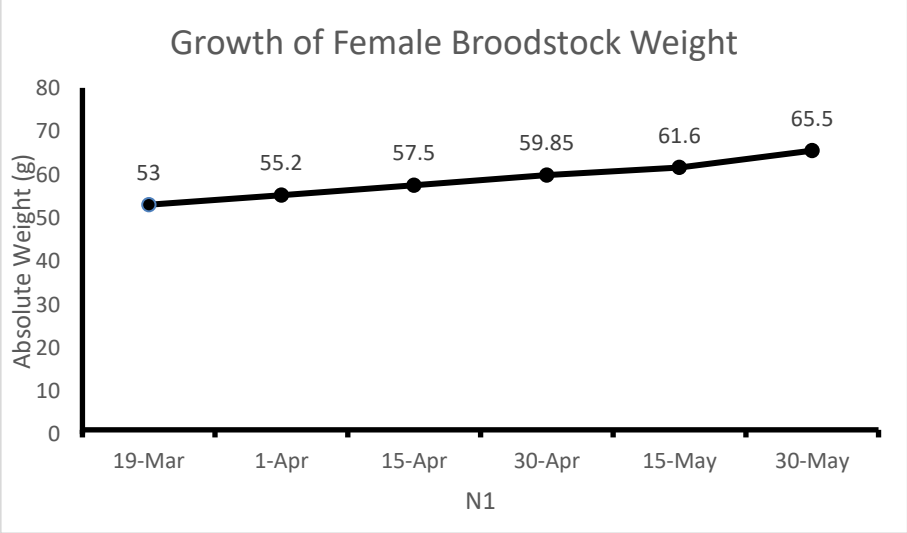


Graph 2. Growth of Male Shrimp Broodstock Length

Absolute Weight



Graph 3. Growth of Male Shrimp Broodstock Weight



Graph 4. Growth of Female Shrimp Broodstock Weight

DISCUSSION

Based on the research conducted, the Nucleus Center unit has three broodstock maintenance and maturation rooms, each containing four rectangular concrete tanks with a capacity of 30 m^3 and a water height of 70 cm. Each tank is equipped with three inlet channels: an aeration channel installed around the tank, a seawater channel, a freshwater channel, and one outlet located in the center of the tank. The preparation of the tanks includes sterilizing the maintenance tanks with chlorine, which is then rinsed with freshwater to eliminate pests and diseases. The tanks are then washed with detergent and rinsed again with freshwater to remove any remaining chemicals. Afterward, the aeration system is installed, and the tanks are dried for 3-7 days until the broodstock is ready to be stocked. The purpose of drying is to kill any remaining bacteria in the tanks. After this, seawater is added to a water height of 60-70 cm.

This aligns with the statement by Rasuliyanasari & Diniariwisan (2024), who stated that vannamei shrimp farming can run smoothly if the tank preparation and water used are done properly according to vannamei shrimp requirements. Tank preparation involves sterilizing the maintenance tanks with chlorine, followed by rinsing with freshwater to kill pests and diseases. The next step is washing with detergent and rinsing with freshwater to remove any residual chemicals used.

The vannamei shrimp broodstock *(Litopenaeus vannamei*) used at the Center for Superior Shrimp and Shellfish Broodstock Production (BPIU2K) in Karangasem, Bali, originates from maintenance at the Multiplication Center (MC) and meets the criteria for broodstock, with males weighing approximately 30 grams and reaching 16 cm in body length, and females weighing around 35 grams with a body length of 18 cm. Selected broodstock must meet specific criteria to produce high-quality seed. This aligns with the Indonesian National Standard (SNI) 01-7253-2006 for good broodstock selection, which requires intact organs, no deformities, a normal body shape with no erosion, normal movement, a clear brownish color, clean, non-swollen gills, and freedom from viruses such as IHHNV (Infectious Hypodermal and Hematopoietic Necrosis Virus), IMNV (Infectious Myonecrosis Virus), WSSV (White Spot Syndrome Virus), and TSV (Taura Syndrome Virus), as verified by laboratory testing. Quality broodstock must also have well-formed, clean, and undamaged reproductive organs. This is consistent with Afrianto & Muqsith (2014), who stated that vannamei shrimp suitable for broodstock weigh approximately 30-35 grams for males and 40-50 grams for females, with body lengths of 16-17 cm for males and 18-19 cm for females, and must be free of WSSV, TSV, and IHHNV viruses, as confirmed by PCR analysis.

Newly acquired broodstock cannot be immediately spawned; they must undergo acclimatization or quarantine first. The acclimatization process involves placing the broodstock in maintenance tanks to help the vannamei shrimp adjust to their new environmental conditions. Before being used as broodstock, vannamei shrimp are placed in a temporary tank (quarantine tank) to facilitate inspections. Inspections are conducted by directly observing the broodstock's condition. Based on reasearch, before being transferred to the maintenance tank in the nucleus center unit, vannamei shrimp broodstock are quarantined in the vannamei grow-out room at the Multiplication Center unit to check their condition before production. This aligns with Anam *et al*. (2016), who stated that newly arrived broodstock cannot be spawned immediately but must undergo quarantine and adaptation. The adaptation process usually takes 4-7 days before spawning. Acclimatization for newly arrived broodstock is done by placing them in a quarantine tank with prior

temperature and salinity adjustments. The acclimatization process involves placing a bucket containing the broodstock in the maintenance tank and slowly adding maintenance tank water to the bucket until the broodstock exit on their own. The purpose of acclimatization is to maintain the quality of the broodstock so they can adjust to the new environment.

Feed management in broodstock maintenance is a primary factor that must be carefully managed, with attention to dosage, timing, and feeding frequency. The feed given to shrimp broodstock includes marine worms (*Nereis* sp.) and squid (*Loligo* sp.), with a dosage of 70% of biomass for marine worms and 30% of biomass for squid. These fresh feeds are commonly used to accelerate gonad maturation and increase shrimp egg hatch rates due to their nutrient content, including amino acids, lipid fractions, and fatty acids such as Arachidonic Acid (AA), Eicosapentaenoic Acid (EPA), and Docosahexaenoic Acid (DHA).

Based on reasearch, the feed provided to broodstock consisted of fresh marine worms and squid, fed twice daily in the morning and evening. The amount of feed given was 9.6 kg of marine worms for females and 6 kg of squid for males per day, determined based on the number and biomass of the vannamei shrimp broodstock. This aligns with Rachmawati (2014), who stated that marine worms are the preferred natural feed for shrimp broodstock, followed by squid and clams. Tiger shrimp broodstock fed a combination of 50% squid and 50% marine worms resulted in higher absolute fecundity, relative fecundity, egg hatch rate, and larval growth to the zoea I stage compared to other feed combinations.

Water management in the broodstock maintenance tanks is also performed daily because the high stocking density of broodstock and the large amount of fresh feed provided significantly affect the water quality in the tanks. As a result, high ammonia levels from leftover feed and metabolic waste can cause the water to become turbid. Poor water quality can negatively impact the health of the shrimp broodstock. Therefore, water changes are carried out every day in all maintenance and adaptation tanks. Water changes are done at 08:00 WITA, 14:00 WITA, in the female tanks and all adaptation tanks, and at 16:00 WITA in the male tanks. The water is drained through the outlet pipe, with 60-70% of the water being replaced. Water management is also carried out during the sampling of broodstock for mating.

This aligns with Sumsanto (2023), who stated that water quality management in all maintenance tanks is achieved by performing water changes using a flow-through method, with a range of 200-250% water replacement, conducted at 06:00-10:00, 13:00-16:00, 19:00-23:00, and 02:00-06:00 WITA. During each of these periods, water changes are carried out at an average rate of 50%. This water replacement process is done after the removal of leftover feed in the morning. Continuous water changes are implemented to prevent the accumulation of leftover feed or waste from the broodstock, and to prevent the entry of diseases.

Based on the graph data on the growth in leght of male and female shrimp broodstock above, the results show variation (Graph 1 and Graph 2). On March 19, 2024, the length of the female shrimp was 16.8 cm, and the male broodstock length was 16.3 cm. On April 1, the length of the female broodstock changed, increasing by 0.5 cm daily for both male and female broodstock. Measurements of length were taken every 15 days, including measurements of both weight and length, to determine the amount of feed to be provided as length and weight increased. This aligns with the statement by Manurung *et al*. (2018), which states that growth represents a change in form, both in length and weight, over time.

Based on the graph data on the growth in weight of male and female shrimp broodstock above, the results show variation (Graph 3 and Graph 4). On March 19, 2024, the female shrimp weighed 53 grams, while the male broodstock weighed 47.17 grams. By April 1, the female broodstock weight had increased by 2 grams and continued to increase until May 30,

2024. During this period, the male broodstock showed weight gains ranging from 1-2 grams. This difference was due to the varying amounts of feed and the feeding rate percentages for each broodstock, resulting in differences in feed provided. This aligns with the statement by Fitriana *et al*. (2019), which states that feed plays an important role in increasing production in aquaculture activities. The feed provided must be high quality, nutritious, and meet the requirements for shrimp consumption, and it should be continuously available to avoid disrupting the production process and to support growth (Chen *et al*., 2024).

Based on the research conducted, the initial stocking of shrimp broodstock consisted of approximately 250 female and 300 male shrimp. During the maintenance process, both male and female broodstock experienced mortality, reducing their numbers over time. This decline can affect the survival rate of the shrimp. The number of male broodstock in the maintenance tank was around 250, and female broodstock was around 200, with a survival rate of 70%. This aligns with Aminin *et al*. (2023), who stated that a high survival rate (SR) is achieved if SR >70%, a medium category is SR 50-60%, and a low category is SR <50%. The survival rate of vannamei shrimp is attributed to their strong immune system.

CONCLUSION

Based on the research, it can be concluded that students can learn the correct methods and techniques for managing the maintenance of vannamei shrimp broodstock (*Litopenaeus vannamei*) at the Karangasem Superior Shrimp Broodstock and Shellfish Production Center. This includes feed management, water management, and good water quality management, all of which can improve the quality of superior shrimp broodstock. Such broodstock can be used either for production or as breeding stock for spawning, resulting in high-quality shrimp larvae.

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REFERENCES

Afrianto, S., & Muqsith, A. (2014). Manajemen Produksi Nauplius Udang Vaname (*Litopenaeus vannamei*) di Instalasi Pembenihan Udang Balai Perikanan Budidaya Air Payau, Gelung, Situbondo, Jawa Timur. Samakia: Jurnal Ilmu Perikanan, 5(2), 53-64.

Alfaro-Montoya, J., Braga, A., & Umaña-Castro, R. (2019). Research frontiers in penaeid shrimp reproduction: Future trends to improve commercial production. Aquaculture, 503, 70-87.

Aminin, A., Firmani, U., & Syaifullah, M. (2023). Demplot Pendederan Udang Vaname (*Litopenaeus Vannamei*) dengan Teknologi Bioflok pada Kolam Terpal Secara Intensif di Kecamatan Duduk Sampean Kabupaten Gresik. DedikasiMU: Journal of Community Service, 5(2), 237-247.

Anam, C., Khumaidi, A., & Muqsith, A. (2016). Pengelolaan Produksi Pembenihan Vaname (*Litopenaeus Vannamei*) Naupli di Instalasi Budidaya Udang (IBU) Balai Budidaya Air Payau Gelung (BPBAP) Situbondo Jawa Timur. Samakia: Jurnal Ilmu Perikanan, 7 (2), 57-65.

Chen, Y., Mitra, A., Rahimnejad, S., Chi, S., Kumar, V., Tan, B., ... & Xie, S. (2024). Retrospect of fish meal substitution in Pacific white shrimp (*Litopenaeus vannamei*) feed: Alternatives, limitations and future prospects. Reviews in Aquaculture, 16(1), 382-409.

Emerenciano, M. G., Rombenso, A. N., Vieira, F. D. N., Martins, M. A., Coman, G. J., Truong, H. H., ... & Simon, C. J. (2022). Intensification of penaeid shrimp culture: an applied review of advances in production systems, nutrition and breeding. Animals, 12(3), 236. http://dx.doi.org/10.30587/dedikasimu.v5i2.5664

Fitriana, N., Handayani, L., & Nurhayati, N. (2019). Penambahan Nanokalsium Cangkang Tiram (*Crassostrea gigas*) pada Pakan dengan Dosis Berbeda Terhadap Pertumbuhan Udang Galah (*Macrobachium rosenbergii*). Acta Aquatica: Aquatic Sciences Journal, 6(2), 80-85. https://doi.org/10.29103/aa.v6i2.1423

Lestari, S. A., Ilham, I., & Abdullah, A. (2022). Alur Proses Produksi Benur Vaname (*Litopenaeus vannamei*) Di Pt Central Pertiwi Bahari Shrimp Hatchery Makassar Sulawesi Selatan. Journal of Applied Agribussiness and Agrotechnology, 1(2), 1-14.

Manurung, A. P., Yusanti, I. A., & Haris, R. B. K. (2018). Tingkat Pertumbuhan dan Kelangsungan Hidup, pada Pembesaran Udang Galah (*Macrobrachium rosenbergii*) Strain Siratu dan Strain Gimacro II. Jurnal Ilmu-ilmu Perikanan dan Budidaya Perairan, 13(1), 25-35. https://doi.org/10.31851/jipbp.v13i.2060

Rachmawati, D. (2014). Performa Kematangan Gonad, Fekunditas dan Derajat Penetasan Melalui Pemberian Kombinasi Pakan Alami pada Induk Udang Windu (*Penaeus monodon*). Jurnal Manajemen dan Teknologi Akuakultur, 3 (3), 1-7. http://ejournal-s1.undip.ac.id/index.php/jamt

Rasuliyanasari, M., & Diniariwisan, D. (2024). Teknik Pembenihan Larva Udang Vaname (*Litopenaeus vannamei*) di Balai Produksi Induk Udang Unggul dan Kekerangan Karangasem, Bali. Jurnal Vokasi Ilmu-Ilmu Perikanan (JVIP), 4(2), 168-175. http://dx.doi.org/10.35726/jvip.v4i2.7153

Sa'adah, W., & Milah, K. (2019). Permintaan Udang Vaname (*Litopenaeus vannamei*) di Kelompok Pembudidaya Udang At-Taqwa Paciran Lamongan. Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis, 5(2), 243-251. http://dx.doi.org/10.25157/ma.v5i2.2222

Sumsanto, M. (2023). Studi Teknik Pengelolaan Kualitas Air pada Pemeliharaan Induk Udang Vaname (*Litopenaeus Vannamei*) di PT. Suri Tani Pemuka Unit Hatchery Singaraja, Bali. Jurnal Lemuru, 5(3), 507-516. https://doi.org/10.36526/jl.v5i3.3073