**Journal of Coastal and Ocean Sciences**
Volume 6 No. 2, May 2025: 102-107

***e-issn: 2746-4512***
***p-issn: 2745-4355***

# Analysis of Environmental Conditions in Red-Eyed Snail *Silvofishery* in Buruk Bakul Village

**Gusnar Simangunsong[1], Budijono[1*], Muhammad Fauzi[1]**
[1]Department of Environmental Science, Postgraduate, Universitas Riau, Pekanbaru 28293 Indonesia
Corresponding Author: budijono@lecturer.unri.ac.id

Received: 5 April 2025; Accepted: 5 May 2025

**ABSTRACT**

Buruk Bakul Village has a mangrove distribution covering approximately 168 hectares. However, coastal abrasion, which reaches an average of 4 meters per year, directly impacts biodiversity, including a decline in gastropod populations due to loss of shelter and food sources. One affected species is the red-eyed snail (*Cerithidea obtusa*), which plays a vital role in the food chain of coastal ecosystems. This study aims to determine the practice of silvofishery on *C. obtusa* and environmental quality, as well as changes in environmental quality due to silvofishery practices. Sampling technique: Sampling was done using the stratified random sampling method. The results showed that Silvofishery practices integrating mangrove conservation with red-eyed snail cultivation in Buruk Bakul Village showed varying results depending on environmental conditions. Plot 3 recorded the best growth with a length of 1.22 cm and a weight of 1.91 g, which was supported by the fine mud substrate and high organic matter content. In contrast, plot 1 showed the lowest results with a length of 0.77 cm and a weight of 0.48 g. Environmental conditions such as soil pH, temperature, and organic matter significantly influence snail growth, with soil pH and temperature as the dominant factors.

**Keywords:** Silvofishery, *Cerithidea obtusa*, Buruk Bakul

## 1. INTRODUCTION

Buruk Bakul Village has a mangrove distribution covering about 168 ha. However, coastal abrasion that reaches an average of 4 m per year has led to the degradation of about 100 hectares of the area. Dominant mangrove vegetation types include *Rhizophora*, *Avicennia*, *Xylocarpus granatum*, and *Nypa fruticans*. This damage to mangrove vegetation directly impacts biodiversity, including a decline in gastropod populations due to loss of shelter and food sources. One of the affected species is the red-eyed snail (*Cerithidea obtusa*).

Red-eyed snails are a species that lives naturally in mangrove ecosystems and has high economic value as fishery commodities (Soeharmoko, 2010). Besides being favored for its taste, this snail is also known to contain high protein and minerals, which are believed to improve body fitness (Purwaningsih, 2012). Local communities used to catch these snails directly from their natural habitat. However, excessive and uncontrolled fishing practices, coupled with mangrove forest destruction activities, can cause a decline in the population of this species in nature (Febrita et al., 2013).

One approach considered adequate to address mangrove degradation while maintaining a balance between ecological and socioeconomic aspects of the community is the Silvofishery system. This concept combines aquaculture with mangrove conservation, creating natural habitats rich in organic matter and nutrients that support the survival of organisms such as red-eye snails (Samsumarlin et al., 2015). This system not only increases biodiversity and reduces the negative impacts of unsustainable aquaculture practices, but also provides alternative income for coastal communities.

Mangrove ecosystems in Buruk Bakul Village are now facing pressure due to human activities such as land encroachment, pond opening, and illegal logging. For this reason, Utilising mangrove areas for red-eye snail silvofishery can be an alternative solution for communities living around conservation areas. By utilising the land productively and maintaining mangrove vegetation, the community will be encouraged to protect the existence of mangrove forests in their area. In addition, land used for Silvofishery can also serve as a buffer zone for core conservation areas such as mangrove ecotourism (Wijaya et al., 2019).

According to data from the DKP (2022), the mangrove area in this region is estimated to exceed 20,000 hectares. However, there is a yearly decline due to the pressure of human activities. Therefore, applying Silvofishery systems has a strategic role in sustainable coastal resource management, based on community participation, land efficiency, and ecosystem preservation. This approach also contributes to the achievement of the Sustainable Development Goals (SDGs), particularly goals 14 (marine ecosystems) and 15 (life on land). It strengthens the social-ecological resilience of coastal communities in the face of climate change and environmental degradation.

This study aims to assess the implementation of Silvofishery systems with ecological, social, and economic approaches, and focuses on the conservation and sustainable use of red-eye snails. This study also refers to similar research implemented in Vietnam in cultivating red-eye snails in the mangrove forests of Ca Mau Province (Chau et al., 2007).

## 2. RESEARCH METHOD

### Time and Place

This research was conducted from August to December 2024 in Buruk Bakul Village, Bukit Batu District, Bengkalis Regency, Riau Province. The research location was chosen because it has a large expanse of mangroves and a variety of mangrove species, making it suitable for Silvofishery studies. The sketch of this research location (Figure 1).

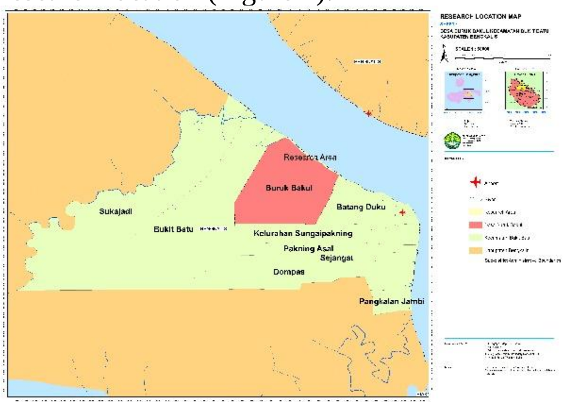


**Figure 1. Research location**

### Method

Sampling technique: Sampling was conducted using the stratified random sampling method. The population was divided into strata based on mangrove type (*R. apiculata*, *Sonneratia caseolaris*, and *S. alba*), and then samples were taken randomly from each stratum. This method was chosen to ensure sample representativeness and reduce bias.

### Procedures

Red-eyed snails were observed by measuring morphometric parameters (shell length, shell width, spire height) and weighing snails. Environmental parameters (water temperature, salinity, pH) were measured using calibrated equipment. Growth analysis of the absolute individual weight of red-eye snails was calculated referring to Effendie (1979) with the formula:

$$W = Wt - Wo$$

Description:

| | | |
|---|---|---|
| W | = | Absolute individual weight growth of test animals (g) |
| Wo | = | Weight of test animals at the beginning of the study (g) |
| Wt | = | Weight of test animals at the end of the study (g). |

The analysis of ecological parameters of each Silvofishery demonstration plot was carried out using two methods, namely direct measurement in the field and laboratory analysis. Parameters measured directly in the field include: Temperature, pH and salinity were measured 5 (five) times, each in August, September, October, November and December. The parameters analyzed in the laboratory include: organic matter, sediment fraction and nitrogen. Analysis of soil/sediment quality from the sylvofishery demonstration plots was carried out in several stages as follows: 1) Soil/sediment samples were taken from each demonstration plot. 2) Soil/sediment samples were labelled according to the demonstration plot. 3) Soil/sediment samples that have been labelled are put into the oven to dry according to the standard to be analysed. 4) After the soil sample is dry, it is ground until smooth, and 5) Nutrient analysis of each sample is carried out.

### Data Analysis

Data analysis was conducted using regression tests to analyse the relationship between water quality and snail density. Multivariate analysis (PCA and Cluster Analysis) was used to identify environmental and biological data patterns. Pearson Correlation Test (r):

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Description:

- $r$ = correlation coefficient
- $n$ = amount of data
- $x$ = value of variable
- X$y$ = value of variable Y
- ∑xy = The sum of the product of X and Y
- ∑x2 = sum of squares of X
- ∑y2 = sum of squares of Y Interpretation of value

$r$ close to +1 → strong positive relationship$r$ close to -1 → strong negative relationship$r$ close to 0 → no relationship. Simple Linear Regression Test:

$$Y = a + bX$$

Description:

- Y = dependent variable
- X = independent variable
- $a$ = intercept (Y value when X = 0)
- $b$ = Regression coefficient (how much Y changes every time X changes by 1 unit).

## 3. RESULT AND DISCUSSION

### Silvofishery Practices on *Cerithidea obtusa* and Environmental Quality

The relationship between silvofishery practices and red-eye snail cultivation and its effect on environmental quality can be observed in the following Figure 2.

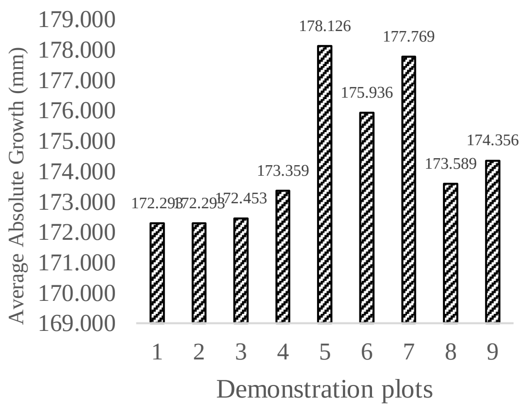


**Figure 2. Absolute growth**

Based on the study's results, the average absolute growth of body length (SL) of red-eye snails in various demonstration plots showed significant variations. The highest growth was recorded in plot 5 at 178.126 mm, followed by plot 7 at 177.769 mm and plot 6 at 175.936 mm, while the lowest growth was recorded in plot 2 at 172.293 mm.

This study's results align with the findings of Chau et al. (2007), who observed the growth of *C. obtusa* in a mangrove-shrimp culture system in Ca Mau Province, Vietnam. In that study, snail growth showed variation based on the environmental conditions of each pond plot, such as mangrove vegetation density, soil pH, and availability of natural food. They reported that optimal snail body length growth was achieved at sites with dense mangrove vegetation and fine-textured mud substrate, with growth lengths ranging from 170 mm to 180 mm over the observation period.

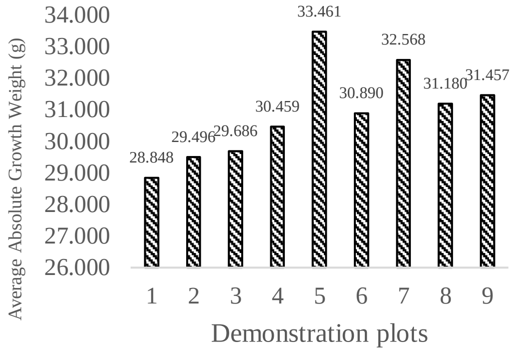


**Figure 3. Absolute growth weight**

Based on the study's results, the absolute weight growth of red-eye varied between plots, with the highest value found in plot five at 33.461 g and the lowest value in plot one at 28.848 g. This difference indicates environmental factors such as natural food quality, substrate conditions, and temperature. The analysis of ecological parameters of the study's results suggests that the aquatic environment's stability significantly influences the growth of individual biomass.

### Changes in Environmental Quality Due to Practices

Silvofishery activities in this study showed a real impact on environmental conditions in the nine demonstration plots. These can be observed through temperature, soil pH, and organic matter. The ecological quality measurements carried out are as follows. Based on the results of temperature measurements taken in each demonstration plot for five months, the highest temperature was recorded in the third measurement, while measurements with the lowest temperature occurred in the first, second, and fourth measurements. Although temperatures in the first, second, and fourth months showed higher numbers, the results of this study are still within the range that supports the continuity of Silvofishery activities.

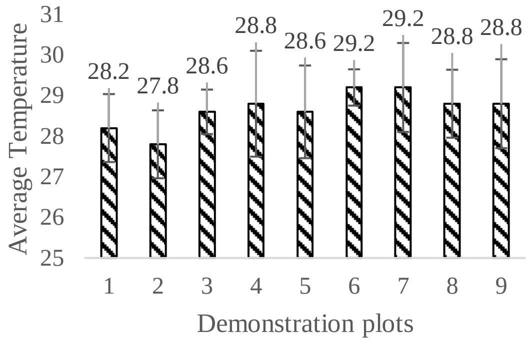


**Figure 4. Temperature**

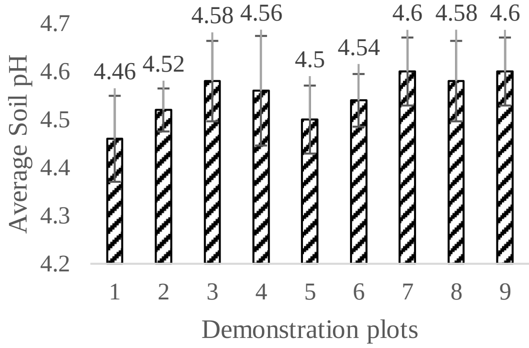


**Figure 5. Soil pH**

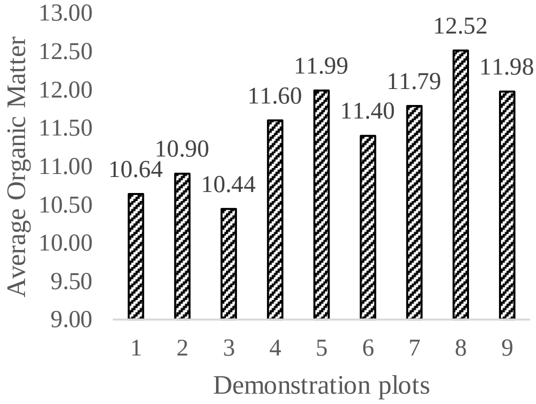


**Figure 6. Organic matter**

Based on the results of temperature (Figure 4) measurements taken in each demonstration plot for five months, the highest temperature was recorded in the third measurement, while measurements with the lowest temperature occurred in the first, second, and fourth measurements. Although temperatures in the first, second, and fourth months showed higher numbers, the results of this study are still within the range that supports the continuity of Silvofishery activities.

This is in line with research by Chau et al. (2007) in the mangrove forest of Ca Mau Province, Vietnam, which showed that water temperature ranged from 23.5°C to 33.0°C, with the highest temperature recorded in April. These temperature variations affected the reproductive cycle and proximate composition of *C. obtusa*. This study emphasises that a stable ambient temperature within the species' tolerance range is essential for optimal growth and reproduction.

The variation in pH values was relatively small based on the results of soil pH measurements carried out in nine demonstration plots for five months (Figure 5). The highest pH value was recorded in measurements in demonstration plot 7 and demonstration plot 9, each amounting to 4.60. In contrast, the lowest pH value was found in demonstration plot 1 with a pH value of 4.46. Although there are differences in pH values between demonstration plots, the results of this study indicate that the soil pH recorded is still within the range that supports the sustainability of mangrove ecosystems and Silvofishery systems. This is in line with the research of Yunantri et al. (2022) in the mangrove ecosystem of Lantamal Pier, Karang Indah Village, Merauke, which noted that soil pH ranged from 7.0 to 7.9.

This range is within the ideal range for gastropod survival and reproduction between pH 6 and 8.5. This study emphasises that an appropriate soil pH plays a vital role in supporting the presence of species such as *C. obtusa*, *Terebralia palustris*, and *Cerithium* sp.

Based on the results of the study, the average organic matter content in nine demonstration plots in the coastal area showed a range between 10.44% and 12.52%, with the highest value recorded in plot 8 at 12.52% and the lowest value in plot three at 10.44%. Most of these demonstration plots' relatively high organic matter content indicates significant accumulation in the coastal sediments. Such organic matter plays a vital role in Silvofishery systems, as it is the primary source of nutrients for microorganisms and benthic fauna, supporting fisheries productivity and the overall health of the mangrove ecosystem. The variation in organic matter content between demonstration plots is thought to be influenced by differences in mangrove vegetation, bioturbation activity, and tidal influence, which vary from site to site.

This finding is in line with the research of Mashoreng et al. (2022) in a study in the Lantebung mangrove ecotourism area, Makassar, which reported sediment organic matter content ranging from 5.77 to 7.40%, with an average of 6.68%. This difference is likely due to the age of mangrove vegetation, where older vegetation tends to accumulate more organic matter.

In measuring the strength and direction of the relationship between variables, correlation and linear regression were used to model the causal relationship and predict the value of the dependent variable based on the independent variable. Table 1 shows the results of this analysis, which form the basis for concluding the interrelationships and influences between factors in the research context.

**Table 1. Correlation and linear regression**

| No. | Variables | Correlation Coefficient (r) | P-value | Interpretation |
|---|---|---|---|---|
| 1. | Weight Gain | 0.91 | 0.0007 | Strong and positive |
| 2. | Total Organic | 0.55 | 0.1270 | Moderate and positive |
| 3. | Temperature | 0.62 | 0.0731 | Moderate to strong and positive |
| 4. | Soil pH | 0.11 | 0.7704 | Weak and positive |

Weight gain of *C. obtusa* in the Silvofishery area of Buruk Bakul Village showed a strong and positive relationship with temperature ($r = 0.62$; $p = 0.0731$) and water depth ($r = 0.56$; $p = 0.1142$). Although the p-value is not statistically significant, both environmental factors influence snail growth. In addition, total organic content also showed a moderate and positive correlation ($r = 0.55$), indicating that a substrate rich in organic matter supported the increase in body weight of *C. obtusa*.

This condition indicates that the water quality and substrate conditions in the Buruk Bakul mangrove ecosystem naturally support snail growth. Meanwhile, the soil pH ($r = 0.11$) and water pH ($r = 0.16$) parameters show a weak and positive correlation, indicating that pH fluctuations do not significantly affect snail weight gain in the study site. In general, temperature is the most critical environmental parameter in managing the Silvofishery system in this area. This finding aligns with Effendie (2003); Kordi (2010), who state that temperature plays a vital role in supporting the growth of aquatic biota, including gastropods such as *C. obtusa*.

## 4. CONCLUSION

The silvofishery practice of integrating mangrove conservation with red-eyed snail cultivation in Buruk Bakul Village showed variable growth results between demonstration plots, depending on local environmental conditions. Plot 3 showed the best growth, with an average length of 1.22 cm and weight of 1.91 g, supported by the fine mud substrate and high organic matter content. In contrast, plot 1 recorded the lowest growth, with a length of 0.77 cm and a weight of 0.48 g. Environmental factors such as soil pH, temperature, and organic matter content proved to significantly affect red-eye snail growth, with soil pH and temperature being the dominant factors.

## REFERENCES

[DKP] Dinas Kelautan dan Perikanan Kabupaten Bengkalis. (2022). *Laporan Status Ekosistem Mangrove Kabupaten Bengkalis*. Pemerintah Kabupaten Bengkalis. Riau. https://dkp.riau.go.id/.

Chau, N.D., Thao, N.T., & Nhan, D.K. (2007). Integrated Shrimp-Mangrove Farming Systems in the Mekong Delta of Vietnam. *Aquaculture Research*, 38(12): 1234-1242.

Effendie, M.I. (1979). *Biologi Perikanan*. Yayasan Pustaka Nusatama. Yogyakarta.

Febrita, E., & Trisnani, T. (2013). Kandungan Logam Berat Tembaga (Cu) pada Siput Merah (*Cerithidea sp)* di Perairan Laut Dumai Provinsi Riau. *Biogenesis*, *8*(1): 36-40.

Kordi, M.G.H. (2010). *Budi Daya Ikan di Tambak dan Keramba.* Rineka Cipta. Jakarta.

Mashoreng, S., Hatta, M., & Rusti, R. (2022). Sediment Organic Matter Content Based on the Different Ages of Mangrove Vegetation in the Lantebung Mangrove Ecotourism Area, Makassar. *Jurnal Ilmu Kelautan Spermonde,* 8(1).

Purwaningsih, S. (2012). Antioxidant Activity and Nutrient Composition of Matah Merah Snail (*Cerithidea obtusa*)). *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, *17*(1): 39-48.

Samsumarlin, S., Rachman, I., & Toknok, B. (2015). Studi Zonasi Vegetasi Mangrove Muara di Desa Umbele Kecamatan Bumi Raya Kabupaten Morowali Sulawesi Tengah. *Warta Rimba*, 3(2): 148–154.

Soeharmoko, S. (2010). Inventarisasi Jenis Kekerangan yang Dikonsumsi Masyarakat di Kepulauan Riau. *Jurnal Dinamika Maritim*, 2(1):36-42.

Wijaya, N.I., Trisyani, N., & Sulestiani, A. (2019). Potensi Pengembangan Budidaya *Silvofishery* di Area Mangrove Wonorejo Surabaya. *Penelitian Hutan dan Konservasi Alam,* 16(2): 173-189.

Yunantri, M., Wahyuningsih, E., & Kresnasari, D. (2022). Pengaruh Faktor Lingkungan terhadap Keberadaan Gastropoda pada Ekosistem Mangrove di Dermaga Lantamal, Kelurahan Karang Indah, Distrik Merauke, Kabupaten Merauke. *Musamus Fisheries and Marine Journal*, 33-48.