The association of fecundity and morphometrics of mangrove snail *Terebralia palustris* Linnaeus 1967 in the mangrove ecosystem

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**Abstract.** *Terebralia palustris* is a snail that lives in the mangrove ecosystem. This snail is found around the mangrove roots. Snail fecundity is also influenced by several factors. This study aims to determine the association of fecundity with morphometrics and environmental factors. Sampling is done randomly. The research station is 2. Each station has one plot measuring 10 m x 10 m and in it, there is a small plot measuring 0.5 m x 0.5 m in 4 pieces. Data were analyzed by regression using SPSS version 21 software. The average fecundity of snails in September was 85887.64 granules, October was 45962.67 granules, and November was 35668.62 granules. The average temperature of seawater is 35.20 ± 0.16 °C, the average salinity of seawater is 32.27 ± 0.63 ‰, and the average pH of seawater is 6.39 ± 0.09. The results of the regression analysis showed signs that the snail morphometry of *T. palustris* did not affect snail fecundity because the significance value was far above 0.05. The results of the regression analysis showed that acidity factors significantly affected fecundity with a significance value of 0.047 and the other factors is not affect.

1. Introduction
Mangrove ecosystems are home to many types of biota [1,2]. Mangrove forests have physical, chemical and biological roles that greatly support the needs of human life and as a buffer for the balance of ecosystems in coastal areas [3]. One of them is the *Terebralia palustris* snail. The length of the shell can reach 19 cm and is generally 12 cm. Amounts are abundant in muddy mangroves and generally live in brackish water [4]. The legs are dark brown, the snout and cephalic tentacles are black, the head is muscular and the legs are large [5]. These snails belong to the Potamididae family [6].

These snails live in groups around mangrove roots [7]. This snail is known as "Bakoleng" on Pannikiang Island, Barru Regency. This snail is also consumed by residents there. Thus, information about management is needed to protect these snails. One of the information needed is snail fecundity...
and morphometrics. This research was conducted in the mangrove ecosystem on Pannikiang Island with the aim of analyzing the relationship of fecundity and morphometrics of *T. palustris* snails.

2. Experimental

2.1. Material and methods

This research was conducted on mangrove ecosystems in Pannikiang Island, Barru Regency, South Sulawesi Province, Indonesia for three months from September to November 2018. The coordinate points at station A are 4°20'23" S and 119°36'11" E while at station B are 4°21'37" S and 119°35'42" E. In this study, two research stations were used. Station A is located in the northern part of the island and Station B is located in the southern part of the island.

2.1.1. The sampling and measurement of environmental parameters. Seawater temperature, salinity, and acidity are measured in-situ. At each station, a plot of 0.25 m² (0.5 m x 0.5 m) plots of four is placed at random. All *T. palustris* specimens in the plot were taken (if > 50% of the body of the snail is included in the plot, then classified in the observation plot) [8,9]. Sampling is done at low tide.

2.1.2. Fecundity analysis. Mature female snail gonads are weighed and preserved to count the number of eggs. Furthermore, the ovary fraction is immersed in Gilson's solution. Soaking is attempted in such a way that all gonads are exposed to the solution. Observation of egg's snail using a stereomicroscope. Egg count using the gravimetric method.

2.1.3. Morphometric measurements of *T. palustris* snails. Morphometric measurements namely the length of the shell measured from the anterior end to the posterior end using a digital caliper with the accuracy of 0.1 mm and weighed using a digital scale with an accuracy of 0.01 gr.

![Figure 1. Dimensions of *T. palustris* snail size](image)

Shell dimension dimensions [10,11]:

- a. The length of the shell (SL), measured from the apex to the outer part of the shell
- b. Spire height (SpH), measured from the first curve to the outer
- c. Shell width (SW), the width of the shell
- d. Aperture length (AL), the internal length of the shell opening
- e. A wide aperture (AW), an internal width of the shell opening

2.2. Data analysis
3. Result and discussion

3.1. Fecundity, morphometrics, and environmental factors

The average fecundity of snails in September was 85887.64 granules, October was 45962.67 granules, and November was 35668.62 granules. Figure 1 shows that the highest fecundity among the three months of observation was in September 2018.

![Snail fecundity histogram](image)

Figure 2. Snail fecundity histogram

*T. palustris* morphometrics includes shell length (SL), spire height (SpH), shell width (SW), shell opening width (AW), shell opening length (AL), and snail weight (gr). The length of the shell (SL) is 98.10 ± 8.70 mm, the spire height (SpH) is 55.69 ± 5.57 mm, the width of the shell (SW) is 39.25 ± 2.53 mm, the width of the shell opening (AW) which is 19.47 ± 1.78 mm, the length of the opening of the shell (AL) is 38.30 ± 2.83 mm, and the weight of the snail is 51.88 ± 9.12 gr.

The average temperature of seawater is 35.20 ± 0.16 °C, the average salinity of seawater is 32.27 ± 0.63 ‰, and the average pH of seawater is 6.39 ± 0.09. Slightly different results were found in the mangrove reforestation areas of Pramuka Island, Bake Island, and Kepulauan Seribu Islands, namely temperatures between 30˚C to 32˚C, salinity between 30 ‰ to 33 ‰, and pH between 6.6 to 7.7 [12]. The pH of seawater in the mangrove in Banggi Coast, Central Java is > 7, salinity between 26 %o to 34.07 %o [13].

3.2. Fecundity relationship with morphometrics

All morphometric parameters (SL, SpH, SW, AW, AL, and weight) correlate with each other with a significance value of 0.000. The same thing is also found in *Tympanotonus fuscatus* snails, which are long and heavy correlated with each other [14]. Fecundity also correlates with all *T. palustris* morphometric parameters with a significance value of 0.000. ANOVA or F test results with a significance value of 0.002 which shows values below 0.05 so that it can be said that all morphometric parameters (SL, SpH, SW, AW, AL, and weight) together affect the fecundity of *T. palustris* snails. The results of the regression equation:

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Y = -147679.699 - 1011.645X_1 - 4109X_2 + 2368.260X_3 + 3890.055X_4 + 6312.640X_5 + 283.048X_6
\]

(1)
Where $Y$ is the $T.\, palustris$ fecundity, $X_1$ is SL (shell length), $X_2$ is SW (shell width), $X_3$ is SpH (spire height), $X_4$ is AW (shell opening width), $X_5$ is AL (shell opening length), and $X_6$ is snail weight. The t-test results showed that none of the variables had a significant effect with a significance value above 0.05.

3.3. Fecundity relationship with environmental factors

Fecundity, temperature, salinity, and acidity correlate with significance values below 0.00 except fecundity with acidity (pH). Fecundity with acidity is not correlated with a significance value of 0.23. ANOVA results or F tests with a significance value of 0.00 that indicate values below 0.05 can be said that the parameters of temperature, salinity, and pH of seawater together affect the fecundity of $T.\, palustris$ snails. The results of the regression equation:

$$Y = 237278.865 - 11795.373X_7 + 4270.827X_8 + 15008.225X_9$$

Where $Y$ is the $T.\, palustris$ fecundity, $X_7$ is the temperature of seawater, $X_8$ is the salinity of seawater, and $X_9$ is the acidity of seawater (pH). The t-test results showed that only the $X_9$ variable, namely the acidity of the sea water, affected the $T.\, palustris$ fecundity with a significance value below 0.05, 0.047. This is also in line with the statement that biotic factors in the aquatic system play a significant role in the growth of snail populations especially the snail fecundity. Abiotic factors such as temperature, pH, dissolved oxygen, carbon dioxide, and electrical conductivity and infection of Fasciola gigantica can affect the snail $Lymnaea\, acuminata$ snail [15]. In the $Lymnaea\, acuminata$ snail in The Southern area of Gorakhpur it is also found that biotic factors in the aquatic system play a significant role in the growth of snail populations especially the snail fecundity. Abiotic factors such as temperature, pH, dissolved oxygen, carbon dioxide, and electrical conductivity and infection of Fasciola gigantica can affect the snail $Lymnaea\, acuminata$ [16]. The acidity (pH) of water most determines the distribution and density of macrobenthic fauna in the mangrove reforestation area of Pramuka, Panggang and Karya islands, Kepulauan Seribu Regency [12]. The different levels of nutrients and climate also affect $Telescopium\, telescopium$ population densities [17,18]. Research in Panikkiang Island had total value of the total stem carbon deposits in the mangrove stands on Pannikiang Island in the northern part of Barru Regency reached a total carbon stem portion of 640,512 tons with a maximum range of 859,174 tons and a minimum of 421,871 tons [19].

4. Conclusion

The average fecundity of snails in September was 85887.64 granules, October was 45962.67 granules, and November was 35668.62 granules. The average temperature of seawater is 35.20 ± 0.16 °C, the average salinity of seawater is 32.27 ± 0.63 ‰, and the average pH of seawater is 6.39 ± 0.09. Morphometric factors do not affect the $T.\, palustris$ snail fecundity. Acidification of seawater (pH) influences the $T.\, palustris$ snail fecundity.

References

[1] Chen G, Ye Y and Lu C 2007 Changes of macro-benthic faunal community with stand age of rehabilitated Kandelia candel mangrove in Jiulongjiang Estuary , China I 215–24
[2] Maia R C and Coutinho R 2013 The influence of mangrove structure on the spatial distribution of Melampus coffeus (Gastropoda: Ellobiidae) in Brazilian estuaries Panam. J. Aquat. Sci. 8 21–9
[3] M Iksan, L Aba, F I Taharu, A Alfian, D P I Ardyati, Jumiati, W O D Alzarliani H and S H L 2019 The diversity of mangrove forests in Kumbewaha , Buton Island , Indonesia IOP Conf. Ser. Earth Environ. Sci. 343 1–6
[4] Carpenter K E and Niem V H 1998 FAO species identification guide for fishery purpose. The living marine resources of the Western Central Pacific. Volume I. Seaweeds, corals, bivalves and gastropods. (Rome: FAO)
[5] Houbrick R S 1991 Systematic review and functional morphology of the mangrove snails Terebralia and Telescopium (Potamididae: Prosobranchia) *Malacologia* 33 289–338

[6] WoRMS 2011 Terebralia palustris *WoRMS Editor. Board*

[7] Samsi A N 2017 Derajat kemiripan ekosistem mangrove alami dan hasil rehabilitasi *Celeb. Biodiversitas* 1 11–6

[8] Penha-lopes G, Bouillon S, Mangion P and Macia A 2009 Estuarine, Coastal and Shelf Science Population structure, density and food sources of Terebralia palustris (Potamididae: Gastropoda) in a low intertidal Avicennia marina mangrove stand (Inhaca Island, Mozambique) *Estuar. Coast. Shelf Sci.* 84 318–25

[9] Susan V D, Pillai N G K and Satheeshkumar P 2012 A Checklist and Spatial Distribution of Molluscan Fauna in Minicoy Island, Lakshadweep, India *4* 449–53

[10] Haumahu S and Uneputty P A 2018 Morphometric variation of ten species of Nerita (Molluscs: Gastropods) in rocky intertidal zone of Oma Village, Central Moluccas, Eastern Indonesia *Int. J. Fish. Aquat. Stud.* 6 276–80

[11] Eddiwan K I, Adriman and Sihotang C 2017 Journal of Coastal Zone Morphometric Variations and Long Weight Relationships Red Eye Snail (Cerithidea obtusa) *J. Coast. Zo. Manag.* 20 1–7

[12] Syahrial, Purwanti N, Sagala H A M U, Atikah Nu, Sari Y, Oktavian B and Simbolon N 2019 Environmental Characteristics and Conditions of Macrobentic Fauna in the Mangrove Reforestation Area of Pramuka, Panggang, and Karya Island, Sribu Islands, Indonesia *J. Ilm. Perikan. dan Kelaut.* 11 9–20

[13] Ariyanto D, Bengen D G, Prartono T and Wardiatno Y 2018 The association of Cassidula nucleus (Gmelin 1791) and Cassidula angulifera (Petit 1841) with mangrove in Banggi Coast, Central Java, Indonesia *AACL Bioflux* 11 348–61

[14] Solomon O O, Ahmed O O and Kunzmann A 2017 Assessment of length-weight relationship and condition factor of periwinkle (*Tympanotonus fuscatus*, *Linnaeus 1758*) from okrika estuary, niger-delta area of nigeria *Environ. Risk Assessment Remediat.* 1 1–6

[15] Jigyasu H V and Singh V K 2010 Effect of environmental factors on the fecundity, hatchability and survival of snail *Lymnaea* (Radix) acuminata (Lamarck); vector of fascioliasis Harsh Vardhan Jigyasu and Vinay Kumar Singh *J. Water Health* 8 109–15

[16] Singh N, Kumar P and Singh D K 2013 Influence of Abiotic Factors and Infection of Fasciola gigantica on Oviposition of Vector Snail *Lymnaea acuminata* *Annu. Rev. Res. Biol.* 3 1032–9

[17] Efendi Y and Ramses R 2017 The Differences of Population Density and Morphometrics Character of Berungan (Telescopium telescopium) from Two Mangrove Area (Leachate Runoff and Charcoal Furnace Area) in Batam City, Indonesia *Omni-Akuatika* 13 96–102

[18] Ariyanto D, Bengen D G, Prartono T and Wardiatno Y 2018 Length-Weight relationships and condition factors of Telescopium telescopium (Gastropoda: Potamididae) in banggi coast of central Java, Java Island, Indonesia *Int. J. Fish. Aquat. Stud.* 6 548–50

[19] E Kezia, B Nurkin, B Bachtiar, S Millang M R and S H L 2019 Potential of mangrove stands carbon deposits in the north part Pannikang islands, Barru Regency, South Sulawesi province *IOP Conf. Ser. Earth Environ. Sci.* 343 1–10