The Variability in Population Structure of Gastropods in Sedati Waters, Sidoarjo Regency, East Java

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Abstract. Indonesia has a lot of mollusks wealth, one of which is gastropods. Sedati waters are one of the coastal areas of Sidoarjo Regency which has the potential of mollusk resources in the form of sea snails. Catching mollusks continuously can cause the threat of decreasing the population of mollusks in the waters. This study aims to determine the variability of the gastropods population structure in Sedati waters, Sidoarjo Regency, East Java. This study uses an observation method with analysis statistic of variance. Gastropods identification was done by measuring length and weight, and looking at morphological characteristics. The result are gastropods found and dominant in Sedati waters in October to December are Natica vitellus, Notocochlis tigrina, Babylonia spirata, Turricula javana, Cryptospira ventricosa, Murex trapa, Rapana venosa, Nassarius olivaceus and Nassarius stolatus. Gastropod density and biomass values at station C were greater than station A and B, with the highest values in December. The highest average value of gastropods biomass was 0.78 ton/km² and the highest average gastropods density was 5 ind/10 m², namely in December at station C. The distribution of gastropods in Sedati waters was influenced by environmental such as substrate conditions, water quality and oceanographic, as well as fishing activities by fishermen.

1. Introduction

Indonesia is known as an archipelago which has 75% of the sea and water areas. Indonesia has a very large mollusk wealth [1]. Mollusks reach 100,000 species that are spread almost all over the world. The Gastropod class is a member of the Mollusca phylum class which has a large number of members. 1,500 types of gastropods in Indonesia [2]. Gastropods are soft-bodied invertebrates that use their stomachs as legs. Gastropods have many important roles in the ecosystem. Ecologically, gastropods act as decomposers that can maintain ecosystem stability by breaking down organic matter and as detritivores that eat detritus. Gastropods also act as water bioindicators because they are sessile, which is a group of organisms that do not move much [3].

Geographically, Sidoarjo Regency has a coastal area that is part of the northern coast of East Java with a coastline length of 45,489 km. Sedati waters is one of the coastal areas of Sidoarjo Regency that has the potential for mollusk resources [4]. Catching mollusks without thinking about the presence of mollusks can cause a decrease in the mollusk population which can affect distribution patterns and biomass in the waters.

The distribution pattern is a pattern of distance between individuals within a population boundary...
The distribution of gastropods in water is determined by the biotic and abiotic environment, as well as the gastropods tolerance to environmental factors respectively. Biomass studies of a biota can provide information about the mass of meat in a habitat area and particular timing [6]. The distribution pattern and gastropod biomass in water depends on the basic substrate and the organic matter content in it.

Currently, there is no research that specifically examines the gastropod population structures in Sedati waters, Sidoarjo Regency, East Java. The results of this study are expected to provide information to the wider community about the distribution and biomass in certain habitats and times in terms of fishing that have an impact on the sustainability of gastropods.

2. Materials and methods
2.1 Time and places
This research was conducted from October to December 2019 in Sedati waters, Sidoarjo Regency, East Java. Observation of sample conducted was carried out at the Laboratory of Anatomy and Aquaculture, Faculty of Fisheries and Marine, Airlangga University, Surabaya; Soil Mechanics Laboratorium, Faculty of Civil Engineering and Planning, Sepuluh November Institute of Technology, Surabaya; Nutrition Laboratory, Faculty of Public Health, Airlangga University, Surabaya; Chemical Laboratory Research and Standardization Center, Surabaya; Meteorological Station Class I Juanda, Surabaya and Perak Maritime Meteorological Station, Surabaya.

2.2 Tools and materials
Equipment used include boats, dredged net, Ekman grab, plastic samples (2.5 kg), water bottles (1.5 L), coolbox, label paper, permanent markers, digital cameras, GPS, digital scales, HVS paper, chest boards, pencils, pH pens, DO meters, Secchi disks, thermometers and refractometers. The materials used in this study were gastropod samples, substrate samples, water samples, ice cubes and freshwater.

2.3 Research methods
This type of research is observational research. Determination of the sampling points using a purposive sampling method, while sampling using the method of Stratified Random Sampling.

2.4 Working procedure
2.4.1 Sampling location
The sampling location consists of three stations and each station is three dots. Station A is a station that is located at the northernmost tip of the Sedati area and borders the Waru area, station A is a station close to the pond. Station B is the middle part of Sedati waters and is the mouth of the Banjar Kemuning river [7]. Station C is at the southern end of the Sedati area and borders Porong, station C is a close to the mangrove area (Figure 1).

![Figure 1. Location](image)

2.4.2 Sampling and handling
The research took three samples, gastropods sample, substrates and water. Samples of gastropods were
taken using a dredged net. The operation of the dredged net is by dropping it into the water, and then pulled by a vessel. Substrate sampling using Ekman grab. Operation by lowering the Ekman grab to the bottom of the water with the jaws open, after reaching the bottom of the water, the weight of the Ekman grab is dropped to the bottom of the water. While water samples were taken from the boat using water sample bottles. Several water quality parameters that are measured directly at the research location include Dissolved Oxygen (DO), temperature, pH, salinity and brightness.

2.5 Data analysis
The observation data were analyzed using Analysis of Variance (ANOVA) [8,9]. Data analysis carried out descriptively, namely describing or describing the data obtained and the data will be presented in tables and graphs [10,11]. Research parameters include distribution index (Id), biomass index (B) and density index (Q).

3. Result and discussion
Based on the catch, the dominant gastropod composition in Sedati waters from October to December 2019 consists of 2 orders, 6 families and 9 species (Table 1).

### Table 1. Composition of Gastropods in Sedati waters in October-December 2019

| Ordo, Family, Genus | Species    | October |   |   | November |   |   | December |   |   | Total |
|---------------------|------------|---------|---|---|----------|---|---|----------|---|---|-------|
| Littorinimorpha     |            |         |   |   |          |   |   |          |   |   |       |
| Naticidae           | N. vitellus| A B C   |   |   | A B C    |   |   | A B C    |   |   |       |
| Notocochlis         | N. tigrina | √ √ √   |   |   | √ √ √    |   |   | √ √ √    |   |   | 81    |
| Neogastropoda       |            |         |   |   |          |   |   |          |   |   |       |
| Babyloniidae        | B. spirata | √ √ √   |   |   | √ √ √    |   |   | √ √ √    |   |   | 118   |
| Clavatulidae        | T. javana  | √ √ √   |   |   | √ √ √    |   |   | √ √ √    |   |   | 39    |
| Marginellidae       | C. ventricosa| - - √ |   |   | - - √    |   |   | - - √    |   |   | 8     |
| Muricidae           | M. trapa   | √ √ √   |   |   | √ √ √    |   |   | √ √ √    |   |   | 45    |
| Nassariidae         | R. venosa  | √ √ √   |   |   | √ √ √    |   |   | √ √ √    |   |   | 134   |
| Nassarius           | R. olivaceus| √ - √ |   |   | √ √ √    |   |   | √ √ √    |   |   | 55    |
|                     | N. stolatus| √ - √ |   |   | √ √ √    |   |   | √ √ √    |   |   | 55    |
|                     |            | 106 13 30 9 110 36 32 58 139 533 | |

Note: (√) species and (-) no species.

The most common type of gastropod found in Sedati waters is Rapan venosa. Rapan venosa is a productive species and very tolerant of water conditions with low salinity, pollution and low oxygen levels. The species found at every point in all stations are Babylonia spirata, Turricula javana, Rapan venosa and Nassarius stolatus. This species specializes in hunting prey, thus being the dominant member of the benthic community and at the top of the food web [12]. Meanwhile, the least gastropod species found in Sedati waters is Cryptospira ventricosa. This species were found in shallow waters. The results show that the distribution patterns of the gastropods in Sedati waters were uniform with the distribution index value in the range <1 (Table 2). This uniform distribution pattern occurs because of individual competition so as to encourage an even distribution of space. However, in October at station A, and in November at station B, the individual distribution patterns were grouped with Id>1. This is because of the collection of individuals as a strategy in response to changes in weather and seasons, as well as changes in habitat and reproductive processes [13].

**Table 2. Gastropod Distribution Patterns at Sedati Waters in October-December 2019**
| Station | Month   | Distribution Index Value | Distribution Pattern |
|---------|---------|--------------------------|----------------------|
| A       | October | 1.52                     | Group                |
|         | November| 0.00                     | Uniform              |
|         | December| 0.04                     | Uniform              |
| B       | October | 0.02                     | Uniform              |
|         | November| 1.51                     | Group                |
|         | December| 0.13                     | Uniform              |
| C       | October | 0.12                     | Uniform              |
|         | November| 0.16                     | Uniform              |
|         | December| 0.75                     | Uniform              |

Weight biomass is the amount of weight of a population at a given time and is express in units of weights [14]. The results showed that the highest gastropod biomass value was in December at station C and the lowest was in November at station A. The low speed of currents and winds in December caused high biomass in December. In general, high biomass is influenced by low current and wind speeds, which causes the low distribution of biota [15]. Mean gastropod biomass in Sedati waters can be seen in Figure 2.

![Figure 2. Gastropod Average Biomass Data of each Station in Sedati Waters](image)

Gastropod density in Sedati waters at station A, station B and station C did not show a significant difference p>0.05. The results showed that the high gastropod density was in October at station A, in November at station B and in December at station C. The high density of gastropods at the station in that month was due to having the highest salinity compared to other stations. Gastropods prefer waters with high salinity. Water salinity that is too low results in a decrease in respiration rate and causes gastropods to withdraw and hide into their shells [16]. This is what causes death in gastropods because the gastropods are unable to meet their nutritional needs.

The lowest density occurs in October at station B and in November at station A (Figure 3). The low density at station A and station B is due to the fact that this area is a pond area and is close to residential areas, resulting in a large amount of waste entering the water. Overfishing by fishermen is also a factor in the low density of gastropods. The occurrence of differences in density values can be influenced by various factors, including water quality, base substrate and oceanographic conditions [17].
Biomass and distribution of gastropods in waters are determined by the biotic and abiotic environment, as well as the gastropods' tolerance to environmental factors respectively [18]. Abiotic factors that can influence the growth of other Physico-chemical properties of the aquatic environment [19]. Natural food is plankton which is divided into two types, phytoplankton and zooplankton [20]. Environmental parameters play an important role in regulating the metabolic processes of aquatic organisms [21]. Gastropod distribution patterns can be influenced by the organic material contained in the substrate where the gastropods live. The organic matter content of station B is higher than station A and station C. Station B gets water flow from the river mouth, so it has a high organic matter content compared to station A and station C. The river estuary is an active meeting area between water masses from land and sea that is still influenced by the characteristics of the sea such as tides, salinity, and seawater intrusion. River estuaries can also be said to be fertilizing agents in coastal areas [22].

The substrate types at all research stations are generally silty clay. The silt clay substrate has very fine particles of 0.002 mm to 0.06 mm. The finer the particles of the sand substrate, the higher the organic material contained, but the lower the oxygen. The finer the substrate texture, the greater its ability to trap nutrients [23]. In addition, the substrate that is sandy cannot be attached to the gastropods because the current can continuously move the substrate particles and tends to make it easier to shift and move in other directions, and is easier to break bonds compared to the mud substrate.

The quality of water at each station shows that the values of temperature, pH, DO, salinity, brightness and TSS are still within good limits for marine life [24]. The range of temperature values in Sedati waters is still relatively good for mollusks. The optimal water temperature for the growth of macrozoobenthic animals ranges from 25-35°C [25]. Also, the salinity in the waters of Sedati is still relatively good for gastropods. The salinity values obtained at the three observation stations ranged from 30-38‰. The range of salinity that is still able to support the life of aquatic organisms, especially macrozoobenthic fauna are 15-30‰ and benthic animals generally can tolerate salinity ranging from 25-40‰ [26]. The optimal water quality influences a high survival rate [27].

The value of water quality shows that phosphate (PO₄), nitrate (NO₃-N) and ammonia (NH₃) exceed the threshold concerning seawater quality standards [24]. Changes this occur to water quality will influence the sustainability of aquatic organisms [28]. Good phosphate for waters is 0.05 mg/L, nitrate 0.008 mg/L and ammonia 0.3 mg/L. The high levels of phosphate, nitrate and ammonia in the waters are caused by anthropogenic factors such as household waste (detergents), agriculture (fertilizer), fisheries and industry [29,30]. The value of turbidity in Sedati waters is also very high, which is due to several environmental factors and human activities.

The BOD value at the three stations is >20 mg/L, while the seawater quality standard is <20 mg/L [24]. The content of BOD and COD also exceeds the threshold concerning seawater quality standards.
Gastropods are bioindicators so that can last with high BOD and COD conditions. That regulation of osmoregulation of mollusks is a specific adaptation technique that will make them last in new environments, where there is an imbalance in the amount of water to maintain their body fluids wherever they live [32].

Sedati waters from October to December have a flow rate of 5.09-10.45 cm/second. Waters that have a flow rate of <0.1 m/sec are included in slow-flowing waters [33]. The current and wind speed values in December are lower than in October and November. The difference in the value of current and wind speed can occur because during the three months of sampling in the waters there is a change from the dry season to the rainy season in November to December. Currents can be a limiting factor for aquatic organisms but can also be a supporting factor [34]. Flows is a limiting factor because strong flows can carry gastropods. However, flows can also support gastropods, as they always need current to get food. Flows are a means of transporting food and oxygen for marine life [23].

4. Conclusion
Based on the results of data analysis regarding variability in population structure of gastropods in Sedati waters, Sidoarjo Regency, East Java, it can be concluded that; the types of gastropods found and dominant at the time of the study were Natica vitellus, Notocochlis tigrina, Babylonia spirata, Turricula javana, Cryptospira ventricosa, Murex trapa, Rapana venosa, Nassarius olivaceus and Nassarius stolatus. The distribution pattern of gastropods in Sedati waters is uniform and grouped. Gastropod density and biomass value at station C were greater than at stations A and B with the highest values in December. The highest gastropod biomass value was 0.78 ton/km2 and the highest gastropod density value was 5 ind/10m2, namely in December at station C. The distribution of gastropods in Sedati waters is influenced by environmental conditions, namely the substrate, water quality and oceanographic conditions, as well as fishing activities by fishermen.

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