

# Distribution patterns and the biomass of bivalves at Segoro Tambak estuary, Sedati, Sidoarjo, East Java

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**Submission date:** 08-Apr-2023 01:15PM (UTC+0800)

**Submission ID:** 2058870457

**File name:** Prosiding\_11.\_Distribution\_patterns\_and\_the\_biomass.pdf (617.76K)

**Word count:** 3352

**Character count:** 16830

## Distribution patterns and the biomass of bivalves at Segoro Tambak estuary, Sedati, Sidoarjo, East Java

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**Abstract.** Indonesia's marine waters have a variety of flora and fauna species that live and associate therein. This study used the observation method and a descriptive analysis. The results showed that the bivalvia distribution pattern in Segoro Tambak Estuary looks diverse with a distribution index value  $<1$  which was in the range of 0.3 - 0.4. The highest average bivalve biomass was temporarily at 2.02 ton/km<sup>2</sup>, which was in March, and the lowest was 0.95 ton/km<sup>2</sup> in January. The highest total average density was temporarily 6 ind/10m<sup>2</sup> in March and the lowest was 3 ind/10m<sup>2</sup> in February. Low wind and current speeds in March caused the highest density and biomass in March. The content of the organic matter such as BOD was in the range of 33.38 to 53.89 mg/l from the threshold of  $<20$  mg/l and the COD was in the range of 242.6-643.11 mg/l from the threshold of 80 mg/l. This far exceeds the threshold, but bivalves can still live in these waters because bivalves are aquatic bioindicators. Bivalve life at Segoro Tambak Estuary is also supported by muddy substrate conditions that are suitable for bivalve life.

### 1. Introduction

According to [1], Indonesia's marine waters have various species of flora and fauna that live and are associated therein [2]. Approximately 80%, or about 8,000 species, live in various depths of marine water and the rest live in freshwater [3]. Bivalves are a type of mollusk that lives in freshwater and marine habitats, mostly as a microphagous. In accordance with [1][2], bivalves as an organism are generally found in marine waters, especially in coastal zone or littoral zone that are widely used by most people. As stated by [3][4], the class of bivalves includes various kinds of shellfish and mussels as a component of the food chain. They are also indicators used for water quality monitoring. Many types of bivalve have an economic meaning, namely as food sources, such as *Anadara granosa*, *Anadara antiquate*, *Anadara gubernaculum* and *Anadara inaequalis* as a craft and others [5].

The spreading of bivalves in water is determined by the abiotic, biotic and bivalve tolerance of each of the environmental factors. The abiotic factors include water chemistry, the type of substrate, food availability and biotic factors such as life cycle patterns that are associated with the bivalve distribution patterns [6]. Distribution patterns can be defined as patterns of distance between individuals within a population of boundary [7]. According to [8], random distribution is a rare thing in nature. Similar distribution can occur when competition between individuals is hard; there is an



interaction of positive antagonism that encourages the sharing of the same space. However, [7] stated that the most common pattern of spread is clustering.

An estuary is closed water located in the downstream part of a river which is related to the sea. It is very possible that a mixture between the two will occur [9]. Mixing these two water masses can result in physical changes such as sedimentation. These physical changes can have a major influence on the biota, prompting them to adapt to their environment. The estuary area is a habitat for various kinds of benthic animal organisms, one of which is bivalves [1]. Segoro Tambak Estuary is a location for fishing for shellfish by the local community [10]. Fishing shells is done in the traditional way, but the exploitation of these resources tends to override the principles of natural resource sustainability. The pressure to preserve the resources of the shells at Segoro Tambak Estuary is feared to need to increase with the advanced activity of the people in the region.

So far, there has been no specific research that has examined the distribution patterns and biomass of the bivalves at Segoro Tambak Estuary. The purpose of this study was to determine the distribution patterns and biomass of bivalves at Segoro Tambak Estuary, Sedati, Sidoarjo, East Java.

## **2. Material and methods**

### **2.1 Place and time of the research**

This research was carried out at Segoro Tambak estuary, Sedati, Sidoarjo, East Java between January and March 2018. The sample processing was carried out at the Laboratory of Anatomy and Aquaculture, in the Faculty of Fisheries and Marine, Universitas Airlangga, in the Laboratory of Research and Standardization Agency (BARISTAND) Surabaya, in the Nutrition Laboratory of Public Health Faculty, Universitas Airlangga and in the Soil Mechanics Laboratory of the Institut Teknologi Sepuluh Nopember Surabaya.

### **2.2 Tools and material**

The tools that were used in this research include a boat, trawl, basket, water samplers, ice cooler box, plastic bag, refractometer, thermometer, Secci Disk, pH pen, paper tags, permanent marker, Ekman Grab, Global Positioning System (GPS), bivalvia samples, seawater, sediment, HNO<sub>3</sub> solvent, and ice cubes.

### **2.3 Method**

This study used the observation method with a descriptive analysis, carried out by describing the data that was collected without intending to make conclusions that apply to the public or an attempt at generalization.

### **2.4 Bivalve sampling**

Bivalves sampling was carried out using trawl. A trawl is an item of fishing gear made from semicircular iron with a dividing net on the sides. The maximum number of trawls that it is possible to fit in one boat is three [11]. Garments that were equipped with a rope were lowered to the bottom of the water and pulled by the boat for one minute at a speed of 3-4 m/min at a predetermined point. Later on, the trawl was lifted after three minutes. Bivalves that were already clean from the mud were put into a plastic clip that had been labeled and distinguished by repetition. The bivalve samples were then put into a cooler box that contained ice cubes. After that, the bivalve samples were labeled and transported using a vehicle to the Laboratory of Anatomy and Cultivation of the Faculty of Fisheries and Marine, Airlangga University, in order to observe their biomass.

### **2.5 Sediment sampling**

The sediment sample was taken using an Ekman grab at the same point as the bivalve sampling. According to [12], the Ekman grab is suitable for soft sediment sampling from a boat because it can only be done at each point and does not need to be repeated. The Ekman grab was sunk to the bottom of the water, and then the ballast iron was pushed into the water so then the Ekman grab could be

closed. The closed Ekman grab was then lifted onto the boat to handle the sediment. After that, the sediment sample was put into a cooler box to be taken to the Soil Mechanics Laboratory of the Institut Teknologi Sepuluh November Surabaya and the Nutrition Laboratory of Public Health Faculty of Universitas Airlangga Surabaya in order to test the organic substrates and ingredients in the sediment.

#### 2.6 Water sampling

The seawater sample was taken to obtain data on the water's quality. The water sample was taken from the boat using a water sampler at a depth of 30 cm below the surface of the water and was put into a bottle. The water sample was immediately stored in a cool box that had been filled with ice cubes at a temperature of  $\pm 4^{\circ}\text{C}$ . Storage at a temperature of  $\pm 4^{\circ}\text{C}$  can preserve the sample for up to 1 - 2 days. The water sample that was obtained was immediately taken to the Laboratory of Research and Standardization Agency (BARISTAND) Surabaya to be tested for ammonia, nitrite, nitrate and COD.

#### 2.7 Data analysis

The data analysis was carried out descriptively, which involves describing the data that was obtained. The research data was processed using calculation parameters with identification data as a reference. The calculation parameters that were used included the distribution index (Id), density index (Q) and biomass index (B).

##### 2.7.1 Distribution index

$$Id = \frac{n \sum Xi^2 - N}{N(N - 1)}$$

Information:

- Id : Morisita index
- n : Number of sampling points
- N : Total amount of individuals obtained
- Xi : Amount of individuals in each point

The results of Morisita index were grouped as follows:

- Id < 1 : Various distribution patterns
- Id = 1 : Random individual distribution patterns
- Id > 1 : Grouped individual distribution patterns

##### 2.7.2 Density index

$$D = v \times t$$

Information:

- D : Long Sweep or / Distance swept (m)
- v : Withdrawal Speed (Km/hour)
- t : Withdrawal time (hours)

### 2.7.3 Biomass index

$$a = D \times h$$

Information:

- a : Unit length of swept area (m<sup>2</sup>)
- d : Long Sweep or / Distance swept (m)
- h : Trawl length (m)

$$Q = \frac{Cw}{\frac{a}{Cf}}$$

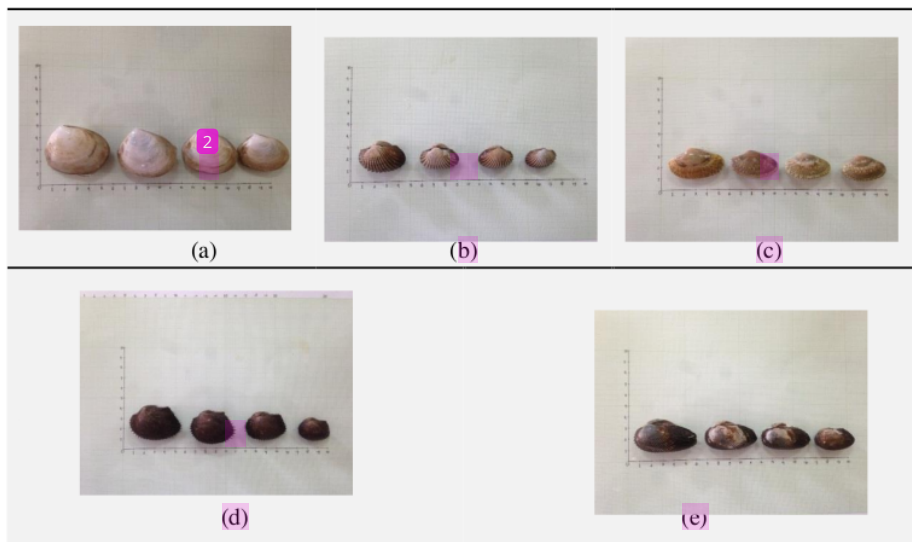
Information:

- Q : Density per sweep area (ind/m<sup>2</sup>)
- Cw : Fishing Results (ind)
- a : Length of sweep area (m<sup>2</sup>)
- Cf : Breakout factor (0.4)

## 3. Result and discussion

### 3.1 Result

Segoro Tambak Estuary is a clam fishing area. It is a meeting area of several river streams which have a more varied mixture of water and organic matter. The dominant bivalves that live in Segoro Tambak Estuary include *Anadara granosa*, *Anadara inaequalvis*, *Anadara gubernaculum*, *Mactra* sp. and *Paphia undulate*; all between 3 - 6 cm long and 4 - 5 cm wide. The most common bivalve species that can be found is *Anadara inaequalvis* and the least common is *Mactra* sp. The results of the bivalve identification can be seen in Figure 1.



**Figure 1.** The results of the bivalve identification from the predominant fishing at Segoro Tambak Estuary: (a) *Mactra* sp., (b) *Anadara granosa*, (c) *Anadara gubernaculum*, (d) *Anadara inaequalvis* and (e) *Paphia undulata*.

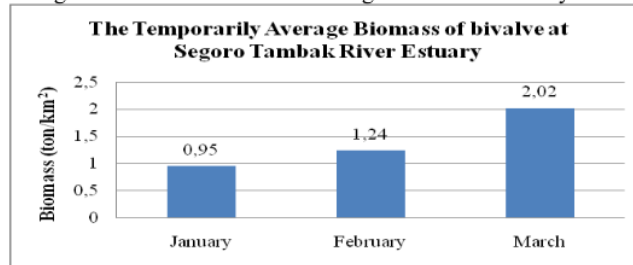
The results of the research at Segoro Tambak Estuary, Sedati, Sidoarjo, East Java for three months of observation showed that the bivalvia distribution pattern at Segoro Tambak Estuary looked to be diverse with a distribution index value <1, which is in the range of 0.3 - 0.4. The bivalve distribution pattern data can be seen in Table 1.

**Table 1.** Bivalve distribution patterns in Segoro Tambak Estuary for the January - March 2018 period.

Period	Distribution Index Value	Distribution Pattern
January	0,35	Similar
February	0,38	Similar
March	0,4	Similar

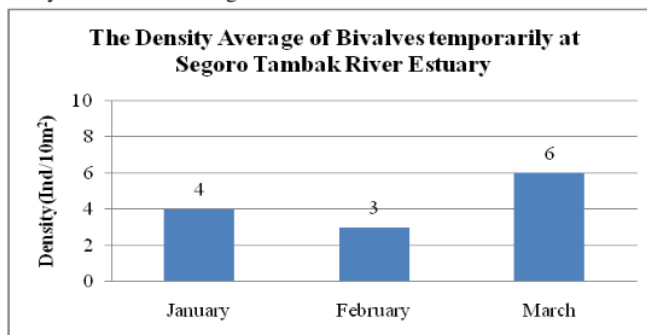
Information: Results of the primary data processing

The average biomass value of the highest bivalves was temporarily 2.02 tons/km<sup>2</sup> in March and the average biomass value of the lowest bivalves was temporarily 0.95 tons/km<sup>2</sup> in January. The temporarily data average biomass of the bivalves at Segoro Tambak Estuary can be seen in Figure 2.



**Figure 2.** The temporarily data average of the biomass of the bivalves at Segoro Tambak Estuary

The highest total average density value that was temporarily 6ind/10m<sup>2</sup> was found in March and the lowest density value which 3 ind/10m<sup>2</sup> in February. The density average of the bivalves at SegoroTambak Estuary can be seen in Figure 3.



**Figure 3.** The density average data of the bivalves temporarily at Segoro Tambak Estuary.

The test results of the sediment fraction of Segoro Tambak Estuary analyzed at the Soil Mechanics Laboratory of the Institut Teknologi Sepuluh November Surabaya showed that Segoro Tambak Estuary was dominated by mud. The results of the Segoro River Estuary sediment testing from the January - March period can be seen in Table 2.



**Table 2.** Test results of the Segoro Tambak Estuary in the January - March period.

	Parameter	Unit	Value
<b>Organic Matter</b>	C	%	24,76-31,25
	N	%	9,25-10,73
	P	%	0,74-0,98
	COD	-	49,79-58,64
<b>Fraction</b>	Gravel	%	1,91
	Sand	%	9,43
	Mud	%	88,67
	Particle Size	Mm	<0,075
	Substrate Size	-	Muddy

Information: Results of the Primary Data Processing

The results of the water quality measurement was obtained from direct measurements in the field and also from in the laboratory. The data on the water quality of Segoro Tambak Estuary in the January - March period can be seen in Table 3.

**Table 3.** Results of the water quality measurement from Segoro Tambak River Estuary in the January - March Period

Parameter	Unit	Test Result	Quality Standard
Temperature	°C	27,7-30,8	28-32
Ph	-	7,9-8,4	6,5-8,5
DO	Ppm	5,16-6,53	>5
Salinity	Ppt	28-36	-
Transparency	M	0,8-2	>3
Suspended Solids (TS <sub>3</sub> )	mg/l	8-48	80
Free Ammonia (NH <sub>3</sub> -N)	mg/l	<0,0113	0,016
Nitrate (NO <sub>3</sub> -N)	mg/l	<0,011-<0,030	0,008
Nitrite (NO <sub>2</sub> -N)	mg/l	0,012-0,03	0,06
BOD	mg/l	33,38-53,89	<20
COD	mg/l	242,6-643,11	80

Information: Results of the Primary Data Processing

Quality standards based on the Minister of Environment Decree No. 51 of 2004

The data on the oceanographic condition, including wind speed and current speed, were obtained from Tanjung Perak Maritime Meteorology Station in Surabaya. The data on the wind and current speed of Segoro Tambak Estuary can be seen in Table 4.

**Table 4.** Data on the wind and current speed at Segoro Tambak.

Month	Wind Speed (knot)	Current Speed (cm/second)
January	3,70	1,81
February	3,72	1,51
March	2,12	0,68

Information: Secondary Data (Tanjung Perak Maritime Meteorology Station, Surabaya, 2018).

### 3.2 Discussion

The biomass and dispersal of the bivalves in the water was determined by the biotic and abiotic environment, in addition to the bivalve tolerance of each of the environmental factors [6]. These physical changes can have a major influence on the biota when it comes to adapting to their environment. The input of the water that comes from the river flow in Segoro Tambak Estuary will also affect the life of the biota inside. Segoro Tambak Estuary has more than one flowing river, so it has a high organic matter content [13]. This is in accordance with [9], who stated that mixing these two water masses can lead to physical changes such as sedimentation.

The bivalve distribution pattern at Segoro Tambak Estuary looks similar to the temporary observation with a distribution value  $<1$ . This is supported by the statement of [14], in that the value of the Morisita index ( $I_d < 1$ ) showed that the pattern of distribution of the biota in the waters was identical. A particular diversity distribution pattern can occur because the bivalve larvae are not settling in the water or substrate when the time comes to metamorphose into adulthood. The larvae react to certain physical chemical factors such as if the substrate is not good, if the biota is not permanent, and if was no metamorphosis [15].

Oceanographic conditions also have an effect on the bivalve distribution patterns in the water. This is related to the wind and current speed. The highest density and biomass occurred in March. This is because the wind and current speed in March had the lowest value compared to January and February. According to [16], the current is a limiting factor because it can affect bivalve life, where a strong current will blow the organism so then only certain types are able to survive.

Segoro Tambak Estuary is a water area that is related to mangrove areas, which are the main cause of the high organic matter content in these waters. Bivalves can still live in this condition despite the high levels of BOD and COD that are far beyond the normal limit. These conditions are because the nature of the bivalve as a bioindicator means that it can withstand high BOD and COD conditions. Bivalves do more osmoregulation processes than just digesting food, causing the biomass values to be low. This is consistent with [17]'s statement that the regulation of mollusk osmoregulation is a special adaptation technique that will keep them alive in a new environment, where there is an imbalance in the amount of water needed to maintain their body fluids wherever they live.

## 4. Conclusion

Research on the bivalvia distribution patterns in Segoro Tambak Estuary, Sedati, Sidoarjo, East Java between January and March 2018 resulted in a similar bivalve distribution pattern. The highest average bivalve biomass and density was in March. The pattern of the bivalvia distribution and biomass at Segoro Tambak Estuary was influenced by the environmental conditions, oceanographic conditions and fishing activities by local fishermen.

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#### **Acknowledgment**

The authors are grateful to the Faculty of Fisheries and Marine, Airlangga University which had provided us the area and laboratory space to conduct this research. All authors approved the final draft of the manuscript, and we declare that there is no conflict of interest in all aspects of the work.

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