

Distribution Patterns and Biomass of Bivalve in Juanda and Segoro Tambak Estuary in Sedati, Sidoarjo, East Java

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Distribution Patterns and Biomass of Bivalve in Juanda and Segoro Tambak Estuary in Sedati, Sidoarjo, East Java

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Abstract. Indonesian waters have a variety of flora and fauna species that live and associate therein. According to Yunus (2008) and Zarkasyi et al. (2016), the bivalvia group as an organism is generally found in marine waters, especially coastal areas or intertidal areas and is widely used by most people. This research used an observation method with descriptive analysis. The results show that the bivalvia distribution pattern in Juanda and Segoro Tambak rivers' estuaries looks consistent with a distribution index value of <1 , which is in the range of 0.3-0.5. The highest average bivalve biomass is temporally at 2.02 ton/km² in March at Segoro Tambak station and the average biomass value of the lowest bivalves is temporally at 0.65 ton/km² in January at Juanda station. The highest total average density is temporally at 6 ind/10m² in March at Segoro Tambak station and the lowest density value is 3 ind/10m² in February at Segoro Tambak station. **Keywords.** Bivalvie, distribution pattern, biomass, organic matter, water quality, oceanographic condition.

1. Introduction

According to Zarkasyi et al. (2016), Indonesian marine waters have a variety of flora and fauna species that live and are associated inside. Approximately 80% or about 8,000 species live in various depths of sea water and the rest in freshwater (Khalil, 2016). Bivalvia is a type of mollusk that lives in fresh and marine waters and generally as a microfauna. According to Yunus (2008) and Zarkasyi et al. (2016), bivalve groups as organisms are generally found in marine waters, especially coastal areas or intertidal areas which are widely used by most people.

According to Khalil (2016) and Junaidi et al. (2010), the bivalve biomass includes a variety of shells, gravestones and mussels as a component of the food chain, as well as an indicator of monitoring water quality. Many types of bivalves have economic meanings, namely food sources such as *Anadara granosa*, *Anadara antiquate*, *Anadara gubernaculum* and *Anadara inaequalis*, as handicrafts and others (Ambarwati and Trijoko, 2011).

The spread of bivalves in a waters is determined by the abiotic, biotic and bivalve tolerance of each of these environmental factors. Abiotic factors include the physics of water chemistry, substrate type, food availability and biotic factors such as life cycle patterns associated with the pattern of bivalve distribution (Mardatilla, 2016). Distribution or distribution patterns can be defined as patterns of distance between individuals within a population boundary (Campbell & Reece, 2008). According to Odum (1994), random distribution is rare in nature. Uniform spread can occur when competition between individuals is so intense that there is an interaction of positive antagonism that encourages the sharing of the same space. However Campbell & Reece (2008), states that the most common spread pattern is grouping.

The river estuary is a closed waters located in the downstream part of the river that is still in contact



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with the sea and is very likely to occur between the two (Taqwa et al., 2014). Mixing these two water masses can result in physical changes such as sedimentation. These physical changes can have a major influence on biota to adapt to their environment. The estuary area of the river is a habitat for various kinds of benthic animal organisms, one of which is bivalvia (Yunus, 2008). The Juanda River and Segoro Tambak estuaries are locations for shellfish capture by local communities (Sukandar et al., 2016). The seashell business is carried out in a traditional way, but the exploitation of these resources tends to override the principles of the preservation of natural resources. Pressure on the sustainability of shellfish resources in the Juanda River estuary and the Segoro Tambak area has increased with increasing community activities in the region.

So far there is no research that has specifically examined the patterns of distribution and biomass of bivalve at the estuary of the Juanda and Segoro Tambak River. The purpose of this research was to determine the distribution pattern and bivalve biomass at the estuary of the Juanda River and Segoro Tambak, Sedati, Sidoarjo, East Java.

2. Methodology

2.1 Place and time of research

This research was carried out at the estuary of the Juanda River and Segoro Tambak, Sedati, Sidoarjo, East Java from January to March 2018. Sampling was carried out at the Anatomy and Cultivation Laboratory of the Faculty of Fisheries and Marine Universitas Airlangga, Surabaya Industrial Research and Standardization Laboratory (BARISTAND), Nutrition Laboratory, Faculty of Public Health, Universitas Airlangga and Soil Mechanics Laboratory, Sepuluh November Institute of Technology, Surabaya.

2.2 Equipment and materials

The equipment used included boats, fishing gear, baskets, water samplers, cool boxes, plastic bags, refractometers, thermometers, Secci Disk, pH pens, paper labels, permanent markers, Ekman and GPS take, bivalve samples, seawater, sediments, HNO₃ solvents, and ice cubes.

2.3 Methods

This research used the observation method with descriptive analysis, carried out by describing or describing the data that has been collected because of existence without intending to make conclusions that apply to the general or generalizations.

2.4 Work Procedure for bivalve sampling

Bivalve sampling was carried out using a garit catcher. Garit was a fishing device made of a semicircular iron chain with its side parts having a limiting net and in one ship using a maximum of three berries (World Wide Fund for Nature Indonesia, 2015). Garit that had been equipped with a rope was lowered to the bottom of the water and pulled by the boat for one minute at a speed of 3-4 m/minute at a predetermined point. Garit could be removed after three minutes. Bivalves that had been cleared of mud and rubbish were put into plastic clips that have been labeled and differentiated based on the test. The bivalve sample that was already inside the plastic was then put into the cool box which was already filled with ice cubes. Samples of bivalves that had been labeled were transported by vehicle to the Anatomy and Cultivation Laboratory of the Faculty of Fisheries and Marine Universitas Airlangga to conduct the biomass observation.

2.5 Sediment sampling

Sediment samples were taken using an Ekman grab at the same point as bivalve sampling. According to Blackwell (2013), Ekman grab was suitable for soft sediment sampling from small vessels. This sampling was only done at each point and does not need to be repeated. The Ekman grab was sunk into the bottom of the water, then the ballast iron was pushed into the water so the Ekman grab could be closed. The closed Ekman grab could be lifted onto a boat for handling sediments. The sediment samples

were then put into the Cool box tightly closed and taken to the Ten Mechanics Laboratory of the Ten November Institute of Technology Surabaya and the Nutrition Laboratory of the Public Health Faculty of Universitas Airlangga Surabaya to test the substrate and organic material in the sediment.

2.6 Water sampling

Seawater sampling was carried out to obtain water quality data. Water samples were taken from the boat using a water sampler at a depth of 30 cm below the surface of the water and inserted in a bottle (Zhang, 2007). Those samples were immediately stored in a cool box filled with ice cubes at a temperature of $\pm 4^{\circ}\text{C}$. Storage at $\pm 4^{\circ}\text{C}$ can preserve samples for a storage period of 1-2 days. The collected water samples were immediately taken to the Surabaya Research and Standardization Laboratory (BARISTAND) Laboratory to test the content of ammonia, nitrite, nitrate and COD.

2.7 Data analysis

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

Distribution Index

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

Id=

mark:

Id = Morisita distribution index

n = Number of sampling points

N = Total number of individuals obtained

Xi = Number of individuals in each point the results of the Morisita index were grouped as follows:

Id < 1: Pattern of similar distribution

Id = 1: The pattern of individual random distribution

Id > 1: grouped Individual distribution pattern

Density Index

D = v x t

Description :

D : Length/Distance of sweep area (m)

v : Pull Speed (Km/ jam)

t : Pull Time (jam)

Biomass Index

a = D x h

Description:

a : sweep area unit (m²)

D : Length/Distance of sweep area (m)

h : Length of garit (m)

$$Q = \frac{Cw/a}{Cp}$$

Description:

- Q : Density per area of sweep (ind/m²)
 Cw : Capture Results (ind)
 a : sweep area (m²)
 Cf : Passing factor (0.4)

3. Results and discussion

3.1 Results

The Juanda and Segoro Tambak river estuary have different environmental conditions. The Juanda river estuary is the location of the entry and exit of fishing boats and as the port of fishing boats. Meanwhile, Segoro Tambak River estuary is a seashell fishing area and is a meeting of several rivers with a more varied mix of water and organic materials.

Bivalves that predominantly live in the estuary of the Juanda and Segoro Tambak rivers are *Anadara granosa*, *Anadara inequivalvis*, *Anadara gubernaculum*, *Mactra* sp. and *Paphia undulate* with a length of 3-6 cm and width of 4-5 cm. The most common bivalve species is *Anadara inequivalvis* and the least found is *Mactra* sp. The result of bivalvia identification of the dominant catch in Juanda River and Segoro Tambak estuaries can be seen in Figure 1.

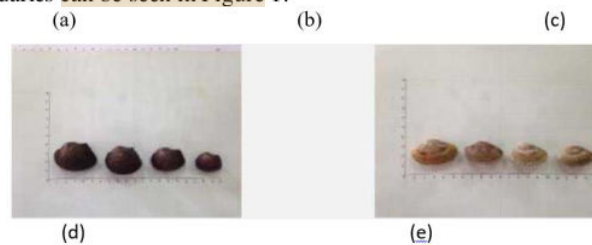


Figure 1. The bivalve identification results of dominant catches in Juanda River and Segoro Tambak estuaries. (a) *Mactra* sp., (b) *Anadara granosa*, (c) *Anadara gubernaculum* (d) *Anadara inequivalvis* dan (e) *Paphia undulata*.

The results of the research in Juanda River and Segoro Tambak estuaries, Sedati, Sidoarjo, East Java for three months of observation show that the pattern of bivalve distribution in Juanda River and Segoro Tambak estuaries looks consistent with <1 distribution index value, which is in the range of 0.3-0.5. Data on bivalve distribution patterns can be seen in Table 1.

Table 1. Pattern of bivalve distribution in Juanda River and Segoro Tambak estuaries during January-March 2018.

Station	Period	Distribution Index Value	Distribution Pattern
Juanda	January	0.33	Uniform
	February	0.5	Uniform
	March	0.47	Uniform
Segoro Tambak	January	0.35	Uniform
	February	0.38	Uniform
	March	0.4	Uniform

Note: Results of primary data processing

The highest average bivalve biomass value is temporally at 2.02 tons/km² in March at Segoro Tambak station and the lowest average biomass value is temporally at 0.65 ton/km² in January at Juanda station. The average bivalve biomass data for each station temporally in Juanda River and Segoro Tambak estuaries can be seen in Figure 2.

The Temporal Average of Bivalvia Biomass in Juanda and Segoro Tambak River Estuaries

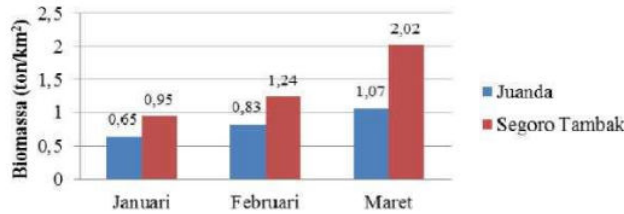


Figure 2. The temporal average of bivalvia biomass in each station in Juanda and Segoro Tambak river estuaries.

The highest average value of the total temporal density is 6 ind/10m² in March at Segoro Tambak station and the lowest density value is 3 ind/10m² in February at Segoro Tambak station (Figure 3).

The Temporal Average of Bivalvia Density in Juanda and Segoro Tambak River Estuaries

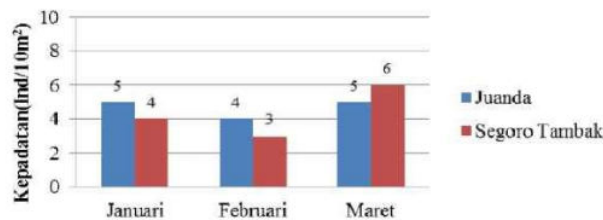


Figure 3. The temporal average of bivalvia density in each station in Juanda and Segoro Tambak river estuaries.

The test results of the sedimentary fraction of the Juanda River and Segoro Tambak at the Soil Mechanics Laboratory of the Ten November Institute of Technology in Surabaya show that the two stations are dominated by mud but with different percentages. Results of the Juanda and Segoro Tambak estuary sediment test for January-March period can be seen in Table 2.

Table 2. Results of the Juanda and Segoro Tambak estuary sediment test for January-March period

Parameter	Unit	Station	
		Juanda	Segoro Tambak
Organic Material	C	25.05-31.58	24.76-31.25
	N	8.93-10.46	9.25-10.73
	P	0.73-1.03	0.74-0.98
	COD	50.28-67.09	49.79-58.64
Fraction	Gravel	0.00	1.91'
	Sand	4.34	9.43
	Mud	95.66	88.67
	Particle Size	<0.075	<0.075
	Substrate type	Muddy	Muddy

Note: Results of primary data processing

The results of water quality measurement are obtained from direct measurements in the field and laboratory. Data on the water quality of Juanda and Segoro Tambak estuaries in the field from January to March can be seen in the Table 3.

Table 3. Results of water quality measurements in Juanda and Segoro Tambak river estuaries for January-March period

Testing Result

Parameter	Unit	Juanda	Segoro Tambak	Quality Standard
Temperature	°C	27.8-31	27.7-30.8	28-32
pH	-	7.7-8.4	7.9-8.4	6.5-8.5
DO	Ppm	6.09-6.95	5.16-6.53	>5
Salinity	Ppt	24-38	28-36	-
Bright	M	0.75-2.5	0.8-2	>3
Suspended Solids (TS)	mg/l	5-27	8-48	80
Free Ammonia (NH ₃ -N)	mg/l	<0.0113	<0.0113	0.016
Nitrate (NO ₃ -N)	mg/l	<0.011-1.089	<0.011-<0.030	0.008
Nitrite (NO ₂ -N)	mg/l	0.008-0.03	0.012-0.03	0.06
BOD	mg/l	37.85-62.18	33.38-53.89	<20
COD	mg/l	257.91-1112.5	242.6-643.11	80

Note: Results of primary data processing

Quality standards are based on Ministerial Decree of LH No. 51 of 2004

Data of oceanographic condition that include current speed and wind speed are collected from Maritime Meteorology Station, Tanjung Perak, Surabaya. Data on current speed and wind speed of Juanda and Segoro Tambak river estuaries can be seen in Table 4.

Table 4. Data on current speed and wind speed of Juanda and Segoro Tambak river estuaries

Station	Month	Wind speed (knot)	Current speed (cm/second)
Juanda	January	3.43	1.84
	February	3.41	1.65
	March	2.00	0.67
Segoro Tambak	January	3.70	1.81
	February	3.72	1.51
	March	2.12	0.68

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

3.2 Discussion

Biomass and the spread of bivalves in the waters are determined by the abiotic, biotic and bivalve environment of each of these environmental factors (Mardatilla, 2016). The difference in the input of water originating from the river flow at the Juanda and Segoro Tambak River estuaries would also affect the life of the biota in it. The Segoro Tambak river estuary has more than one flowing river, so it has a high organic content compared to the Juanda River estuary which only has one (Dewi et al., 2017)

The pattern of bivalve distribution looks consistent at each station with a temporal observation at <1 distribution value. This is supported by Brower's statement (1977) that the morisita index value (Id<1) shows that the pattern of distribution of biota in the waters is uniform. The pattern of uniform distribution can occur because bivalve larvae do not settle on existing waters or substrates when it is time to metamorphose into adult form. Larvae react to certain physical chemical factors; if the substrate is not good, this biota is not settled and no metamorphosis occurs (Lindawaty et al., 2016).

Oceanographic conditions also influence the pattern of bivalve distribution in waters. This is related to current speed and wind speed. According to Pancawati et al. (2014), flow is a limiting factor because

it can affect the life of bivalves where strong currents will knock down the organism, so only certain species can survive.

Bivalve biomass in Juanda and Segoro Tambak River estuary can be influenced by environmental quality factors and oceanographic conditions (Dewi et al., 2016). The value of bivalve biomass at Segoro Tambak station is greater than the value of bivalve biomass at Juanda station with the highest value being in March and the lowest value in January.

The Juanda and Segoro Tambak River estuaries are waters directly related to the mangrove area; this is the main cause of the high content of organic materials in these waters.

Juanda station has higher BOD and COD value compared to Segoro Tambak station. This is because the Juanda station is directly connected with the mangrove area while the Segoro Tambak station is not.

The temporal average of bivalve density in Juanda Station is higher than that of Segoro Tambak station. This is due to the higher content of BOD and COD in Juanda Station than that of Segoro Tambak station, but the biomass in Juanda Station is lower. This condition is attributed to the nature of bivalves as a bio indicator, which enables it to survive with high level BOD and COD conditions. However, bivalves carry out osmoregulation more than digest food, which leads to low value of biomass. This is in accordance with Lantu's statement (2010) that osmoregulation of mollusks is a special adaptation technique that will make them survive in a new environment, where there is a balance in the amount of water to maintain their body fluids wherever they live.

4. Conclusions and suggestions

4.1 Conclusions

Research on the pattern of bivalve distribution in Juanda and Segoro Tambak River estuaries, Sedati, Sidoarjo, East Java from January to March 2018 found that the bivalve distribution pattern in Juanda and Segoro Tambak river estuaries appears to be consistent. The highest bivalve biomass is found in March at Segoro Tambak station. The highest density of bivalves is found in Segoro Tambak station in March. The pattern of distribution and bivalve biomass in Juanda and Segoro Tambak river estuaries is influenced by environmental conditions, oceanographic conditions and fishing activities by local fishermen.

4.2 Suggestion

Juanda and Segoro Tambak River Estuaries are fishing areas, but it is recommended for the community as well as future researchers to continue to preserve nature in the catchment area by using only environmentally friendly boats and making capture selections so as to have a sustainable presence of bivalves in these waters. The results of this research can be used as an overview and data for further researches.

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