The Biodiversity of Gastropods In Karapyak Rocky Shores, Pangandaran Region, West Java Province, Indonesia

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ABSTRACT

Pangandaran rocky shores have a unique ecosystem and a variant of invertebrate organisms such as mollusk from the gastropod class. This study aims to analyze the biodiversity of gastropods on the rocky shore of Karapyak beach. This research consists of 5 stations. The quadrant set by 1 m x 1 m vertically toward the sea. The result found 773 individuals scattered in nine families. The family of Neritidae dominated (43%), followed by family cyprinoids with 6.3%. *Nerita plicata* is a species found to dominate in every station with an average abundance (256 ± 10) and/m^2. Using the Bray-Curtis cluster analysis, showed variations in the distribution and abundance of different gastropods vertically into the ocean and uniformly distributed horizontally to the shore. Substrate and tidal are the main variables in the spatial distribution of gastropods in the Karapyak beach.

Keywords: *Pangandaran, Karapyak, rocky shores, gastropod*

1. Introduction

Coastal zone is an ecosystem (towards land and sea) which there are a complex interaction both physical, chemical, biological, socio-economic and cultural factors. These are resulting complex problems and require a holistic solution. Coastal and marine areas in Indonesia have an important role in providing natural resources and environmental services that considerably have potential values. Coastal and marine areas are the location of several unique, interrelated, dynamic and productive ecosystems. Muliawan et al. (2016) stated that the coastal area generally functioned as a source of nutrients for biota and also for its residence, feeding ground, nursery ground, and spawning ground. One spot in coastal areas that have rich biodiversity is the intertidal zone (Hutomo and Moosa, 2005; Datta et al., 2010; Ruttenberg and Granek 2011; Hamza et al., 2018).

The intertidal zone is the smallest spot of world oceans, which are only a few meters between high and low tides. Although the area is very limited, it has the largest variety of environmental factors compared to other oceans (Petovic et al. 2017). This area has a greater variety of lives than those found in larger subtidal regions (Nybakken, 1992). This zone is mostly populated by organisms and has a great diversity both for animals and plants (Nybakken, 1992). One of them is gastropods from mollusk phyla. Gastropods have developed into the largest, diverse group of mollusks and one of the world's major organisms. Gastropods that occupy most habitats have evolved into groups of plankton eaters and grazers (Manohara et al, 2011).

Gastropods are the class of the most successful mollusks and have a widespread, ranging from land, fresh water, intertidal and into the deep sea (Nybakken 1992). Not much research on Gastropoda is done in the intertidal zone at Pangandaran coastal area, especially about the diversity of organisms that occupy the intertidal zone. High human

activities in utilizing the waters area can lead to the degradation of aquatic environment quality which can affect the ecosystem (Kari, 2002; Zahedi, 2008).

Pangandaran is a small peninsula on the southern coast of West Java, Indonesia. Pangandaran has a craggy beach type with narrow ravines, sloping northern slopes with Pananjung bay in the east and Parigi in the sandy west. This area belongs to an intertidal, the coastal zone that experiences shallow tides of sea water and gets sufficient light penetration. In this zone, there is an abundance of organisms that are associated with coral reefs, seagrass, mangroves, sand and coral reefs.

Anthropogenic pressures in Coastal Pangandaran resulted in the degradation of aquatic biota biodiversity. The scarcity of some species must be anticipated because it will result in the extinction of the biota. In addition to these, Pangandaran has problems due to lack of data. Based on these reasons, it is necessary to conduct a research on spatial and temporal variations of marine invertebrate biota as an effort to conserve biodiversity in Pangandaran Coast.

2. Reaearch Methods

The study was conducted at Karapyak rocky shores, Pangandaran. Samples were taken 5 times during the period from July to November 2017 from 5 stations (Figure 1). Identification of gastropods organisms in Aquatic Resource Laboratory at Fisheries and Marine Science Faculty, Padjadjaran University.

The sampling of gastropods organisms is done by the quadratic transect method placed at the observation station with purposive sampling. Quadratic transects are rectangular-sized 1x1 m^2 of 5 transects each station which is then divided into small quadrans with the size of each 20x20 cm^2. Gastropod samples were taken from five small portions of randomly selected transects (Fachrul 2007).
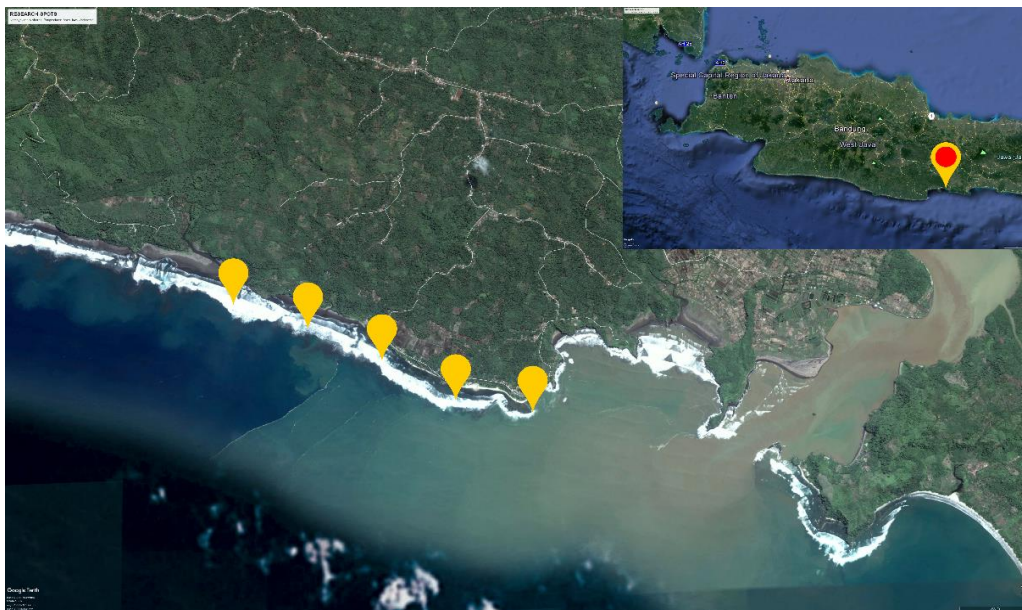

Figure 1. Sampling locations

Gastropods are identified to the genus level by looking at the morphology of the body, with the help of the identification book of Water Invertebrates (Fauchald 1977, Dharma 2005) and the writing of the nomenclature following the World Register of Marine Species (WoRMS: http://www.marinespecies.org/index. php). The measurement of physical and chemical parameters of sampling sites are presented in Table 1.

Table 1. Parameters and tools

Parameters	Units	Tools	Location
Temperature	°C	Thermometer	Insitu
Turbidity	cm	Secchi disk	Insitu
DO	mg/L	DO meter	Insitu
pH	-	pH meter	Insitu
Salinity	ppt	Refractometer	Insitu
Gastropods	Ind/m^2	Quadrant	in-situ and Laboratorium

The data of the Gastropoda community processed by using the density (K) and the Shannon index (H') (Clarke and Warwick, 2001), with the following formula:

Macrozoobenthos abundance (*K*)

$$K = \frac{10.000 \ xn_i}{A}$$

with: K = Macrozoobentos abundance (ind/m²), n_i = total macrozoobentos founded (ind), A = Tools aperture (cm²) dan 10.000 is a constant (convertion from cm² to m²).

Diversity index with *Shannon indexs* (*H'*) (shannon, 1948; Sarma and Das, 2004)

$H' = -\sum_{i=1}^{S}(p_i x Log_2 p_i)$, dimana $p_i = \frac{n_i}{N}$

with: H' = Diversity Index, S = the number of species in the community, P_i = ratio between total species-i with total individuals in the community, n_i = total individual species-I and N = total individuals in the community.

Multivariate data analysis *similarity Bray Curtis* was used to know the distribution of gastropods groups (Brower et al., 1990) by using MINITAB v15.1.2-EQUiNOX.

3.   Result and Discussion

Composition and the density of gastropods is one of community structures characteristics that can be used to identify the distribution of aquatic biota. Based on the results, founded 773 gastropods clustered to 9 families and 12 species (Tabel 2).

Table 2. Gastropods founded on each station

Species	St1	St2	St3	St4	St5
Cerithyum muscarum	√	√			
Monetaria mauritiana		√		√	
Patella vulgata	√	√	√	√	√
Monetaria annulus	√	√	√	√	√
Nerita plicata	√	√	√	√	√
Acanthina punctulata			√		√
Turbo moluccensis		√	√	√	
Cerithyum obtusa			√	√	
Erronea cylindrica		√			√
Trochus niloticus linn.		√		√	
Cerithyum pantherina	√	√	√		√
Littorina scabra			√	√	√

The most numerous species found in station 2 (9 species), and the lowest found in station 1 (5 species). That differences caused by textures, reef compositions, and different current patterns. Sediment affected the density and species richness of macroinvertebrates (Lizarralde & Pittaluga 2010; Sahidin et al., 2014), included gastropods from mollusk phyla (Jordas and Damodaran 2009).
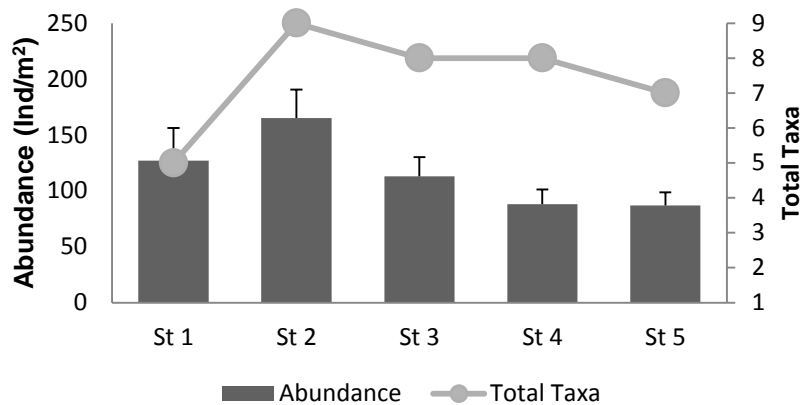
Figure 2. Gastropods Abundance and Taxa **(**St1=stastion 1 and St2=stastion 2 in west Karapyak Coast, St3=center Karapyak Coast, St4=stastion 4 and St 5=station 5 in east Karapyak Coast).

Gastropods distribution showed in certain habitats, a certain area, and certain time. The lowest density founded at station 4 and 5 (Figure 2). It's a rocky-sandy beach and has faster currents than the other stations. Low density on these stations caused by the absence of substrate for gastropods to attach (Hamza et al., 2018). The embedded site is useful to withstand continuous wave action that can move substrate particles.

The lowest abundance found in stations 3 and 4 with a range of H' = 2.35-2.63. It can be categorized into medium diversity. The low diversity in stations 3 and 4 because the station is located in the tourist center of Karapyak Beach, so the activity of tourists will decrease the number of gastropods. According to Barbour et al., (1987) the index value of diversity can range from 0-7, with criteria: 0-2 low), 2-3 (medium), and> 3 (high). The contamination and biota captured by tourists can be the cause of this low diversity. (Zahedi, 2008; Sirinthuwanich et al., 2017). tourist waste will have an impact on the abundance and diversity of benthic communities like gastropods (Wardiatno et al., 2017; Sahidin et al., 2018).

The highest diversity was found in stations 1 and 2 with values of 3.21 - 3.54. Its station can be categorized into high diversity. This area is located east of Karapyak Beach that is rarely visited by tourists, so its ecosystem is relatively undisturbed. In accordance with the results from Zahedi's (2008) research, tourists have a negative impact on the coastal environment including the lives of aquatic biota in the region.

The highest abundance can be found in species *Nerita plicata* (family Neritidae) with average abundance 258±10 ind/m^2 and *Cerithyum sp* (family Cerotidae) 113±15 ind/m^2 (Figure 2). Neritidae is active and able to adapt to dynamic current conditions because it can attach to the stone to avoid the interferences from outside both the current and the predator (Darma, 2005).
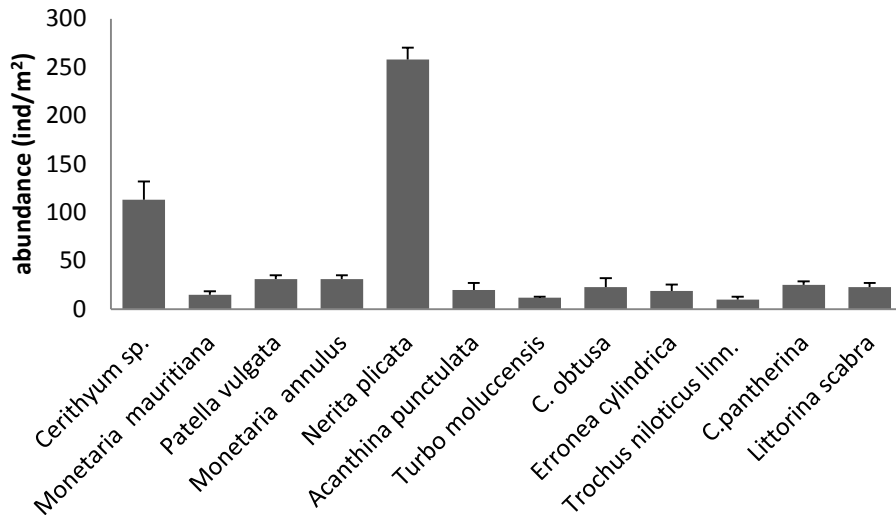
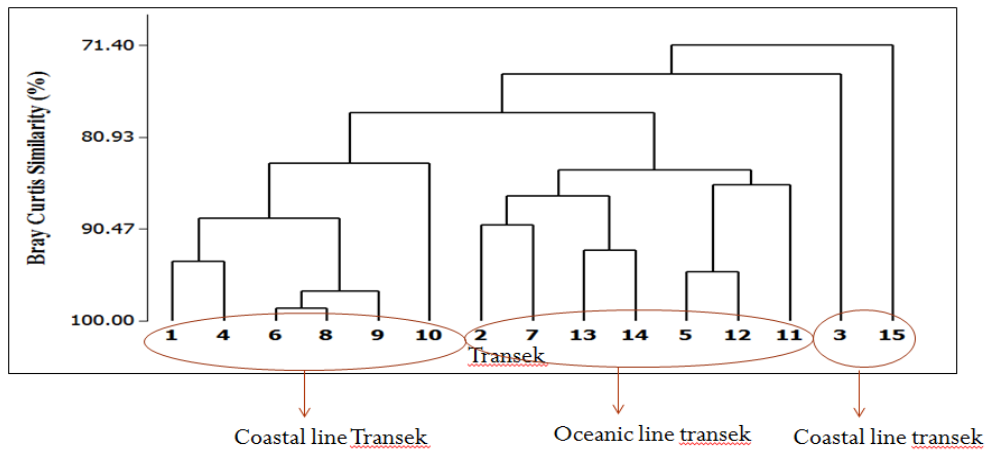Figure 3. The abundance of gastropods from each species

Figure 4. Gastropods spatial distribution in Karapyak Beach

Nerita plicata, Monetaria annulus, and *Patella pulgata* dominated founded in all stations. Mikkelsen (2011) concluded this types of gastropods are kind of mollusk which has a habit to settle in one area and colonize. Bray Curtis (Figure 4) similarity analysis showed the variation of spatial distribution based on zonation. Gastropods species and abundance similarities founded between transects on each station which horizontally toward the beach. It happened because the characteristics of water qualities parameters and the currents were relatively similar. Gastropods founded at beach zones are gastropods that are sleek and embedded in the rocks/reefs. The gastropods found perpendicular to the coast have significant differences both abundance and the species found. Gastropods found in the marine zone are dominated by active gastropods such as genus nerita and turbo. In accordance to Lizarralde and Pitulung (2010) studies that the distribution of gastropods is influenced by the current strength and substrate differences.

Table 3. Water quality parameters

Parameters	Units	Stations			Standards*
		1	2	3	
Temperature	^{0}C	29,7 – 30,6	30,0 – 30,7	30,1 – 31,8	28 – 32
pH	-	8,1 – 8,3	8,1 – 8,3	7,1 – 8,5	7,0 – 8,5
Salinity	‰	28,5 – 30,2	27,5 – 30,1	12,2 – 30,3	-
DO	mg/l	6,5 – 8,3	6,3 – 8,9	6,5 – 10,6	> 5

*Ministry of Indonesian Environment and Forestry number 51 (2004)

The results of water quality measurement in the sites (Table 3), when compared with the water quality standards from the Ministry of Indonesian Environment and Forestry (MKLH) (2004) on water quality standards for marine biota, indicates that the temperature, pH, and salinity are still within the supporting range for marine life (Table 3).

4. Conclusion

Nerita plicata with high abundance (256±10) Ind/m^2 is the most dominant species founded on each station. Bray-Curtis cluster analysis showed the different spatial distribution between gastropods observed perpendicular to the shore, but almost similar when observed horizontally in the shoreline. Substrates and tides were the key parameters that affected the gastropods spatial distribution at Karapyak Coastal.

5. Acknowledgment

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