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Diversity of gastropods (Mollusc) in the mangrove ecosystem of the Nirwana coast, Padang City, West Sumatra, Indonesia

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Abstract. The objective of the present study was to evaluate the diversity of gastropods in mangrove ecosystem of Nirwana coast, Padang City, West Sumatra, Indonesia. The sampling was done during March to December 2014 at three sampling locations on 1 x 1 m^2 of square transects. We recorded 15 species of gastropods belonging to 9 families, namely *Cerithium* sp., *Cymatium muricinum*, *Littoraria scabra*, *Monodonta labio*, *Morula fusca*, *Natica* sp., *Nerita albicilla*, *N. chamaeleon*, *N. histrio*, *N. planospira*, *N. polita*, *Neritina* sp., *Terebralia sulcata*, *Turbo argyrostomus* and *T. cinereus* where *L. scabra* was predominant in individual number (292 individuals/m^2) and it was found at all sampling stations. The diversity and dominance indices were in low category and eveness index was in high category. In conclusion, the condition of this ecosystem was stressful environment.
Key Words: *Littoraria*, *Cerithium*, *Rhizophora*, *Sonneratia*, gastropods.

Introduction. Mangroves are salt-tolerant trees that grow on sheltered tropical coastlines throughout the world (Tomlinson 1986). The mangrove forest is one of the most productive ecosystems (Noor et al 2006; Giesen et al 2007), rich in organic matter and nutrients (Reef et al 2010) and provides food, shelter and a home for marine species like fish, shrimp, crabs and mollusks (Manson et al 2005; Nybakken & Bertness 2005). Gastropods are one of the groups of mollusks that are dominant and are one of the most conspicuous macrofauna in mangrove ecosystems and most of them live on the ground. Approximately 20% of the gastropods in mangroves are species restricted to the tree zones (Kabir et al 2014).

Gastropods play a significant ecological role in mangrove areas, especially in the food web of the aquatic ecosystem (Kesavan et al 2009; Khade & Mane 2012). They are frequently used as bioindicators of health and ecological changes in mangrove ecosystems (Printakoon et al 2008; Yap et al 2009; Kabir 2014), biofilters in waste water (Hamsiah et al 2002) and potential antitumor compounds for humans (Putri et al 2012).

Studies on the diversity of gastropods in Sumatra, Indonesia have been reported by several researchers; for example Dewiyanti (2005) reported that 22 species of gastropods were found in the mangrove areas of Ulee-Lheue, Banda Aceh; Suwondo et al (2005) found 12 species of gastropods in the mangrove forest in Sipora island, Kepulauan Mentawai regency, West Sumatra; Dewiyanti & Karina (2012) reported that 14 species of gastropods were found at the mangrove ecosystem rehabilitation areas in

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Aceh Besar and Banda Aceh districts, Indonesia and Rahmawati et al (2015) reported 15 species of gastropods in the western coast of Aceh Besar District, Indonesia. However, no study has reported on the diversity of gastropods in mangrove ecosystems of the Nirwana coast, Padang City, West Sumatra, Indonesia.

A total of 14,281.04 ha of mangrove areas are located in Padang City, West Sumatra, Indonesia. These areas were treated by anthropogenic activities, for example human perturbation converted for settlements, agriculture and aquaculture industries. According to Alongi (2002) deforestation of mangroves has led to a decrease in species biodiversity in these ecosystems and threatens the existence of the local species. Therefore, information on diversity of gastropods is crucial to providing comprehensive data in relation to plans for a better conservation strategy of the gastropods in Padang City, West Sumatra, Indonesia.

Material and Method

Time and study site. This study was conducted from March to December 2014 in the mangrove ecosystem of the Nirwana coast, Padang city, West Sumatra, Indonesia (Figure 1). Three sampling sites were determined based on the mangrove condition; site 1 has a low density of mangroves with one species, *Sonneratia alba*. Site 2 has a moderate density of mangroves with two species, *Rhizophora apiculata* and *Sonneratia alba*. Site 3 has a high density of mangroves with one species, *Rhizophora apiculata*. The descriptions of each sampling site are presented in Table 1.

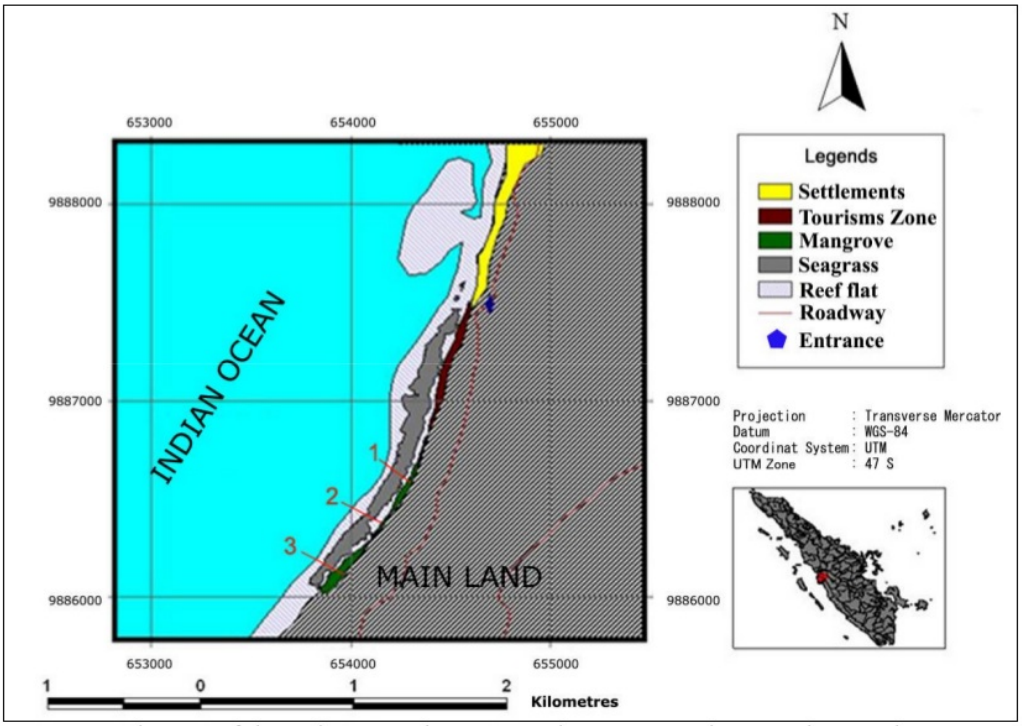

Figure 1. The map of the Padang City showing sampling sites. Numbers are the sampling sites: 1 = station 1; 2 = station 2 and 3 = station3.

Gastropods sampling and data analysis. Samples were collected by using the square transects of 1 x 1 (m^2) into 10 x 10 (m^2) as a plot determined randomly in every sampling station and every plot had three square transects. Gastropods were collected in two ways: by collecting for epifauna and taking the substrate to a depth of 15 cm for infauna. Gastropod samples were sorted and preserved in sample bottles containing 70%

alcohol (Dewiyanti & Karina 2012). Each sample bottle was labeled with the site, date and other important information. The samples were then transported to the Laboratory of Biology, University of Pasir Pengaraian, Rokan Hulu Regency, Indonesia and identified based on Poutiers (1998) and Abbott & Dance (2000). The diversity index was based on Krebs (1999), and the evenness index and dominance index were based on Magurran (1988).

Table 1

Sampling locations in mangrove ecosystem of nirwana coast and its characteristics

Station	*Coordinates*	*Characteristics*
Station 1	01^{0}01'23.0"S 100^{0}23'14.9"E	Density of mangrove is low with one species, *Sonneratia alba.* Close to population and fisherman settlement. Sandy and muddy substratum.
Station 2	01^{0}01'28.5"S 100^{0}23'13.8"E	Density of mangrove is moderate with two species *Rhizophora apiculata* and *Sonneratia alba*. Sandy and muddy substratum.
Station 3	01^{0}01'45.4"S 100^{0}23'03.2"E	Density of mangrove is high with one species, *R. apiculata*. Very far from settlement. Muddy substratum.

Results and Discussion

Species composition. A total of 15 species belonging to the families of Cerithidae (1 species), Littorinidae (1 species), Muricidae (1 species), Naticidae (1 species), Neritidae (6 species), Potamididae (1 species), Ranellidae (1 species), Trochidae (1 species) and Turbinidae (2 species) were recorded in this study (Table 2). Gastropods obtained during the study generally live on the surface of the substrate, attached to the rocks below the tree, roots and stems of the mangrove trees. The most common species in number of individual trees were *Littoraria scabra* (292 ind/m^2) and *Cerithium* sp. (188 ind/m^2). Based on the sampling station, all stations were similar in species richness, but station 2 had the highest in individual number with 388 (Table 2).

Table 2

Checklist of Gastropods and Abundance from sampling stations (ind/m^2)

Family	*Species*	*Stations*			*Total of individual*
		I	*II*	*III*	
Ceritidae	*Cerithium* sp.	89	65	34	188
Littorinidae	*Littoraria scabra*	92	113	87	292
Muricidae	*Morula fusca*	15	27	24	66
Naticidae	*Natica* sp.	0	1	0	1
Neritidae	*Nerita albicilla*	2	1	0	3
	N. chamaeleon	33	25	31	89
	N. histrio	14	13	32	59
	N. planospira	0	0	3	3
	N. polita	21	33	29	83
	Neritina sp.	2	4	6	12
Potamididae	*Terebralia sulcata*	0	0	79	79
Ranellidae	*Cymatium muricinum*	2	0	0	2
Trochidae	*Monodonta labio*	0	77	14	91
Turbinidae	*Turbo argyrostomus*	1	0	0	1
	T. cinereus	35	29	46	110
Total individual		306	388	385	1079
Number of species		11	11	11	-

I = low density of mangrove, II = moderate density of mangrove, III = high density of mangrove.

Cerithium sp., *L. scabra*, *M. fusca*, *N. chamaeleon*, *N. histrio*, *N. polita*, *Neritina* sp. and *T. cinereus*, as they were noted in all sampling stations. *L. scabra* has the highest occurrence in this study because this species is adaptable in mangrove ecosystems and

brackish environments. It feeds on microflora on the mangrove skin and also feeds on the leaves of mangroves. It occurs in groups or large populations and has a special ability, attaching to roots and stems of the mangroves that give darker shell coloration, while also attaching to the leaves that give brighter and cleaner shell coloration, to avoid and survive predators (Reid 1986; Kabir 2014). The *Cerithium* sp. occurs as the second largest number of individual species in this study. This organism is a world wide marine mollusc, most common in shallow waters in tropical and subtropical regions. They are found in a range of habitats such as sand flats and are abundant on trees and roots on the seaward side of mangroves which serve as microalgal or detritus feeders (Houbrick 1992; Poutiers 1998; Beechey 2005). The Neritidae was the predominant family in this study. This group lives along shorelines in warm temperaturesin tropical, marine, or brackish environments and either on rocks or mangrove trees (Poutiers 1998; Abbott & Dance 2000). On the other hand, the native mollusc in the mangrove ecosystem, *T. sulcata,* occurs in station 3. According to Romimohtaro & Sya'rani (1981) *T. sulcata* is the native species in mangrove forests; they commonly live on *R. apiculata* with high density because mangroves have the ability to hold nutrients from the water and produce organic materials from leaf litter that act as food for the species.

Diversity, evenness and dominance index. The diversity index (Shannon index, H') varied from 1.799 to 2.009, with an average of 1.915 which indicates a low level (Figure 2). The evenness index (E) ranged from 0.750 to 0.873 with an average of 0.81, which indicates a high level. In addition, the dominance index (C) ranged from 0.14 to 0.209 with an average 0.17 and indicates low dominance (Figure 2).

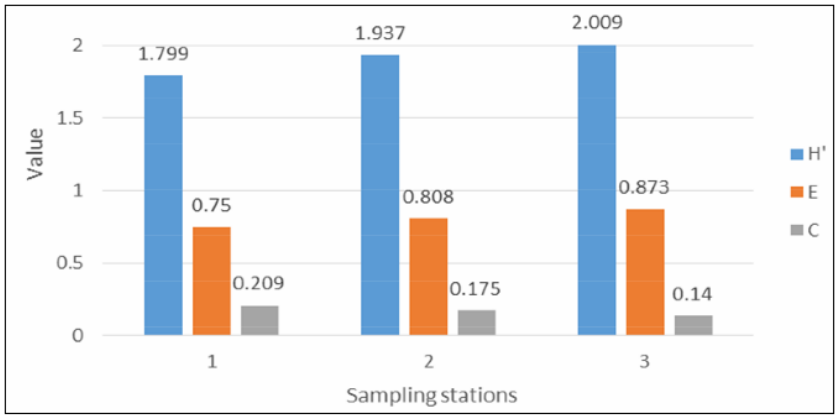

Figure 2. The value of diversity index (H'), eveness index (E) and dominance index (C) according to sampling sites.

The low diversity index value indicates stressful environmental conditions due to anthropogenic activities and ecologies. According to Shanmugam & Vairamani (2008) the increase in the human population has led to an increase in the production of waste from industrial and domestic activities. The dumping of waste in the breeding grounds of molluscs has led to mass mortality of molluscs. Waste materials like plastics cover the surface of substrates that contain food materials, thus preventing the gastropods from feeding (Vermeij & Zipser 1986).

Terebralia is a native mollusc in mangrove ecosystems, *L. scabra* is facultative and *Nerita* is a migrant mollusc (Dewiyanti & Karina 2012). In addition the *T. sulcata* and *L. scabra* are the most common species in mangrove ecosystems (Ellison et al 1999). The study recorded that Neritidae has a higher species richness, probably because this organism can tolerate freshwater and sea water conditions. This family was common in mangrove ecosystems because of their habitat on the shoreline (close to mangroves). Mangroves provide food and shelter from predators and currents, and is also a suitable

habitat for spawning and nursery areas of mollusks (Ronnback 1999; Shanmugam & Vairamani 2008).

L. scabra was found in large numbers, but it was not the predominant species because all of the gastropod species had the same opportunity to live in mangroves in this study. Magurran (1988) explained that the species with the highest number of occurrences does not necessarily mean it is also the dominant species. The high dominance of one species probably indicates a stressful environment while a higher diversity indicates a stable condition of the ecosystem (Macintosh et al 2002).

Conclusions. The diversity and dominance indices of gastropods in the mangrove ecosystem of the Nirwana coast were at a low level where *L. scabra* and *Cerithium* sp. were predominant in this area. In addition, the evenness index was at high level. Overall, this ecosystem was a stressful environment.

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