

Species Richness and Abundance of Bivalvia and Gastropoda (Molluscs) in Mangrove Forest of Dumai City, Riau Province

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ABSTRACT: The mangrove forest of Dumai city house many mollusc species within its narrow habitat. This study focused on the bivalves and Gastropods (molluscs) inhabit the mangrove forest along the coastline. Fourteen species of molluscs were recorded in this survey, eleven of which were gastropoda and three species were bivalves. Species richness and abundance were surveyed at three sites and each site was sampled at ten spots made of 30 spots along the coast. Although low in number, *Polymesoda expansa* and *Pharella acutidens* were widely distributed across the surveyed sites, while *Isognomon ehippium* was rare. It was evident from this survey that conservation measures, such as collection quotas need to be established to protect the stocks of those, especially the edible molluscs species in this area. The study also identified two gastropods, *Thais lacera* and *Telescopium telescopium* that is known useful pollution bioindicators.

KEYWORDS: Molluscs, Richness, Abundance, Mangrove, Dumai.

1 INTRODUCTION

Dumai is a city located on the east coast of Sumatra that deal directly with the Strait of Malacca as an international shipping lane, where the beach is still much overgrown by mangrove forest which is quite good. As an industrial and port city, Dumai at least have had 5 large Industrial Estate and 9 units of major ports of international quality, which can accommodate tankers, complete with supporting facilities. Such conditions, led to Dumai waters are very susceptible to ecological problems both now and in the future such as pollution from industrial waste, organic waste, mangrove deforestation, and settlements.

Mangrove forests have many functions in the marine ecosystem in the form of ecological functions and economic functions. In terms of ecological functions, mangroves are habitat for many species of aquatic organisms or terrestrial organisms. In addition to functioning as a place of refuge, mangroves also provide organic groceries, as spawning areas and care for marine organisms. One of the groups of organisms that inhabit the mangrove forest is the animal mollusks. The organism most commonly found on the forest floor of the forest, plant roots, the leaves, stems, and twigs. The dominant group of molluscs found in mangrove forests are of the class Gastropoda and Bivalvia. This is due to the ability of this group to adapt in the face of extreme environmental changes such as droughts mangrove, fluctuations in temperature and high salinity.

Molluscan shells have been popular since ancient times and are still used widely amongst cultures all over the world as tools, containers, musical devices, currency and decoration. Malay community in Riau still consume molluscs for a substantial portion of their diet. Yulianda (2009) stated that the mollusc exports in 2007 reached trillion rupiah, and the figure is higher than the previous year that only 21 trillion rupiah. With such a market, there is a great potential for over-harvesting and exploitation giving rise to conservation issues.

The mud clam *Polymesoda expansa* from the family Corbiculidae and *Pharella acutidens* from the family of Pharidae, are typical mangrove bivalve which lives semi-infaunally on the soft sediment that accumulates around the roots of the mangrove trees (Ingole *et al.*, 2002). The mangrove clam *P. expansa* is a deep burrowing bivalve found mostly in the tidal flat

of Southeast Asia (Morton, 1976). Three species of *Polymesoda* sp. has been reported from the Indo-Pacific region; *P. erosa*, *P. expansa* and *P. bengalensis* (Ingole *et al.*, 1994). Due to their high protein content and delicacy, mud clam is an important commodity in artisanal fishery which is the main activity in many islands of tropical and sub-tropical regions (Meehan, 1982). This study aims to determine the species richness and abundance of molluscs, particularly bivalves and gastropods that live in the town of Dumai coastal mangrove forests. This information is very useful as a baseline of biological resources, particularly mollusks that inhabit the mangrove forests in the region.

2 MATERIALS AND METHODS

Study area was located at mangrove forest of Dumai coastal waters. There were three chosen sites along the coast based on characteristic of the sites. Site #1 was near by Pertamina Harbour for oil shipping close to Duami river, very little mangrove threes. Site #2 was near the village of Purnama about for miles from site #1. This site covered by mangrove, and basically used by local people as common need for woods, while site #3 was about another five miles from site #2. This mangrove forest has been preserved since 1996 by University of Riau, where its second campus located (Appendix 1).

Mollusc collection is done by drawing a line transect in each site from the high tide limit to the boundaries of a low ebb, across the intertidal zone. To obtain information about the type and density of mollusks in the study area, then along transects placed 10 plots measuring 1x1 M, whereas for infauna molluscs were collected by hand digging the substratum (Alfred *et al.*, 1997), using a shovel to a depth of 15 cm. Sediment is filtered with a filter that has a size of 0.5 cm mess. The foulers like mussels and oysters were collected by scrapping those using knife either using a quadrat. The arboreal forms were collected from the stems, roots and other parts of the mangrove trees vertically by hand picking (Sasekumar, 1974). Organisms were stored in a plastic bag and preserved with 10% neutral formalin solution. Those samples transported to Laboratory and finally preserved in 90% alcohol.

The shell characters such as shape, spire length and shape, mouth opening, opercular shape, umbilicus shape and size, colour and ornamentation of the shell are used mainly for the identification of gastropods apart from the internal characters of which the important one is radula. The bivalves are identified mainly based on the shell morphology. The shell comprises of two valves. The outer surface is usually covered with a periostracum. The outer surface may be striated or ribbed. The two valves are held together by an elastic ligament, which leaves a scar on the hinge. The hinge may in addition have interlocking ridges called the dentition. The two valves are attracted to the soft body by adductor muscles that produce scar on the interior surface.

3 RESULTS

3.1 SPECIES RICHNESS

Fourteen species of molluscs were recorded during this survey. Three species have been identified as bivalvia molluscs composed of *Polymesoda expansa* from the family of Corbiculidae, *Pharella acutidens* from the family of Pharidae, and *Isognomon ephippium* from the family of Pteriidae. In addition to these bivalves, there were eleven species of gastropoda (*T. lacera*, *L. angulifera*, *C. quadrata*, *C. Cingulata*, *C. Capucinus*, *T. Sulcata*, *T. Telescopium*, *N.lineata*, *T. Palustis*, *L. Melanostoma*, *C. Aurisfelis*, *P. plicata* and *C. Obtusata* were documented during surveys. The highest species richness was identified at site number 2 and 3 (Table 1).

Table 1. Distribution of molluscs species across surveyed sites.

Family	Genus	Species	Site 1	Site 2	Site 3
Ellobiidae	<i>Cassidula</i>	<i>Cassidula aurisfelis</i>	○	▪	▪
		<i>Pythia plicata</i>	○	▪	□
Muricidae	<i>Chicoreus</i>	<i>Chicoreus capucinus</i>	●	●	□
	<i>Thais</i>	<i>Thais lacera</i>	●	□	▪
Neritidae	<i>Nerita</i>	<i>Nerita lineata</i>	●	□	○
Littorinidae	<i>Littorina</i>	<i>Littorina angulifera</i>	○	□	●
	<i>Littorina</i>	<i>Littorina melanostoma</i>	▪	●	●
Corbiculidae	<i>Polymesoda</i>	<i>Polymesoda expansa</i>	▪	□	□
Pteriidae	<i>Isognomon</i>	<i>Isognomon ephippium</i>	○	●	▪
Phariidae	<i>Pharella</i>	<i>Pharella acutidens</i>	▪	▪	▪
Chrysomelidae	<i>Cassida</i>	<i>Cassida obtusata</i>	○	▪	▪
Potamidae	<i>Telescopium</i>	<i>Telescopium telescopium</i>	□	○	●
	<i>Terebralia</i>	<i>Terebralia sulcata</i>	●	□	○
	<i>Cerithium</i>	<i>Cerithidea quadrata</i>	●	●	●

Table 1. Distribution of molluscs species across surveyed sites. An open circle (○) indicate that the species was none (nothing found), a black circle (●) indicate that the species was abundant (more than 20 individuals), an open square (□) indicate the species was found occasionally (10-20 individuals), an black square (▪) indicate the that the species was rare (0-10 individuals).

3.2 SPECIES ABUNDANCE

Within the group of gastropoda, the species with the highest average abundance was *L. melanostoma*, followed by the species of *C. Cingulata* and *T. Sulcata*. While among those group of bivalvia, the highest abundance was *P. Expansa*, followed by *I. Ephippium* and *P. Acutidens* (Figure 1).

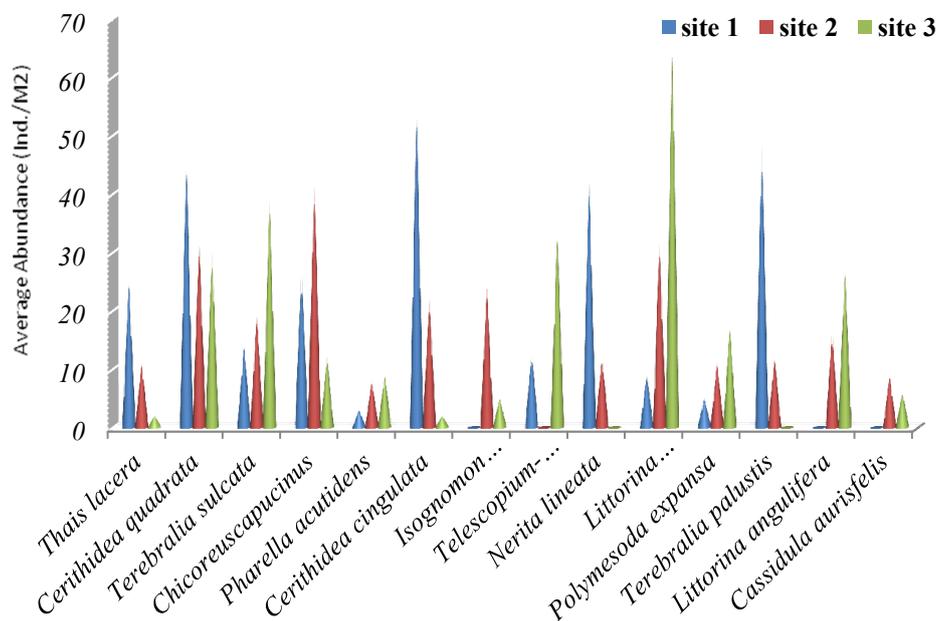


Figure 1. Average abundance of molluscs across the surveyed sites

3.3 HABITAT AND ABUNDANCE

The species *P. expansa* was more abundance in soft watery sediment just a few centimeters under the sediment surface. Unlike *P. expansa*, the species of *P. acutidens* commonly found much deeper down into bottom sediment, often hard to catch during low tide in the intertidal zone, most of the times this species rise up during the inundation in the early evening.

Some species of gastropoda recorded found crawling on the surface of muddy sediment, such as *T. lacera*, *C. quadrata*, *C. capucinus*, *T. telescopium*, *N. lineata*, *T. palustis*, and *C. Aurisfelis*. While a few species such as *L. melanostoma*, *L. anbulifera*, *P. plicata*, *C. obtusata*, often observed on the leave of mangrove tree or other object around the mangrove forest.

4 DISCUSSION

4.1 SPECIES INVENTORY

With many species inventory, it is apparent that there is much to learn about molluscs in Dumai mangrove forest. This study conducted during a very short of time only one day per site visited. One could be missed many species that actually inhabitant to the places. This could be due to the fact that they usually only forage at night, and hide under forest canopy during the day, making them difficult to record during the daytime (Humann and Deloach 2002). Common snails such as *Pythia plicata* and *Cassida obtusata* was not previously identified either; however, their shells have been collected before during a students field trip to the sites, hence if more time were allocated for mollusc surveys and identification, more species could be recorded.

One concern of biological scientists are several species of snails Muricidae are very important in the study of the environment, because it can act as a biological indicator for marine pollution, especially pollution caused by Tributyltin which many mix in the paint as antifouling on ship hulls (Barcellos da Costa *et al.*, 2008). Tributyltin (TBT) is jargon for organotin compounds that contain the $(C_4H_9)_3Sn$ group, such as tributyltin hydride or tributyltin oxide (Antizar-Ladislao, Blanca, 2008). Tributyltin acts as an endocrine disruptor in these gastropods and causes imposex. Imposex is the occurrence of induced male sex characteristics on normal female gastropods with the development of male sex organs (*i.e.* the penis and/or vas deferens) (Brady *et al.*, 2008). This is due to the fact that these molluscs “posses only a limited metabolic capacity to eliminate such composites and thus present a great potential for organotin bioaccumulation” (Barcellos da Costa *et al.* 2008).

Tributyltin is toxic to aquatic organisms include fish, birds and mammals and “demonstrated to have hormone disruption properties in these animals” (OSPAR 1999). A case study from the Baltic Sea showed a widespread contamination in nine fish species. Studies suggest that organotins may threaten humans who consume large quantities of fish in their normal diet. The human immune system is affected by TBT because the chemical disrupts the immune cells, particularly those that fight infection (OSPAR 1999).

4.2 ABUNDANCE AND DISTRIBUTION

The abundance and distribution varied among species identified within the survey. Two species of bivalves namely *P. expansa* and *Pharella acutidens* have been known as common edible bivalves in the area surveyed, local people called lokan or kerang bakau. In fact their population were badly low, but very important protein source for coastal people. Although both species found distribute across the surveyed sites, but very low in number.

According to Nasution (2008), these species live under the muddy sediment (infauna) with a high organic content. The population of the bivalva were relatively low and distribute unequally through the mangrove forest. Their high population found to concentrate in the tide pool during the ebb tide. Many possible reason can be mention, such as irrational and over exploitation, human activity stress in the natural habitat (mangrove vegetation, expansion of agricultural diversity in the area, habitat destruction due to reclamation activities, factories, mining operations, etc.

Polymesoda and *Pharella* are harvested for its meat for local consumption and fish bait. These molluscs are limited to the accessible shallow and mudflat zone, making them easy to collect. The meat yield is relatively low per shell and therefore requires the collection of many individuals. Their low mobility rate leaves them vulnerable to predators and it limits their distribution. Their short larval phase limits their dispersal and increases local settlement which also aids in easy of collection by fishermen (Toller and Gordon, 2005).

This study showed that mollusc species can inhabit a variety of substrates and structures, but are primarily influenced by their food source. *Isognomon* is a suspension feeder and therefore requires being attaches with byssal threads to a solid substrate such as mangrove roots or other hard object. However, in the survey conducted it appeared to attach directly to mangrove roots. The surrounding structure then provided support and the shell, often covered in fouling organisms.

Gastropoda molluscs such as *C. quadrata*, *T. telescopium*, and *N. lineata* were found crawling on the intertidal mudflat, feeding on filamentous algae that grow on the substrate. This is an optimal location to feed because it is protected by the surf from grazing fish and echinoderms that would compete for this algae as well as from marine animals that would prey on them. However, it does make the organism more vulnerable to terrestrial predators, such as birds and humans.

4.3 HABITAT AND ABUNDANCE

Habitat is also affected by food preference. The intertidal zone provide *C. quadrata*, *T. telescopium*, *N. lineata* and others gastropoda a plenty algae as food source. The morphology of gastropoda supports the organism to reside in such a habitat. Most of molluscs found at all sites and this suggests that they are very adaptable. *Thais* species feed upon other molluscs by boring into their shell to obtain the underlying flesh (Brusca and Brusca 1990). These results would suggest that *Thais lacera* is able to consume molluscs that inhabit a variety of habitats throughout the intertidal.

There is much to learn from the study of Mollusca. They are very useful not only as bioindicators of pollution, but also for medical purposes. Recently, the toxin from *Conus magus* has been used in the development of the strong pain medication. Many scientists believe other *Conus* species may yield more medicines in treating disease such as Alzheimer's, Parkinson's and epilepsy (BBC News, 1996). According to Humann and Deloach (2002) species such as *Conus floridanus*, *Conus cedonulli* and *Conus regius*, all of which secrete a neurotoxic venom.

5 CONCLUSION

The present study revealed the importance informations due the axistency of native molluscs inhabit mangrove forest in Dumai coast. There were nine Family, thirteen genus and fourteen species of molluscs identified. Among these molluscs, there are three importance bivalves, the edible *Polymesosa expansa*, *Pharella acutidens*, and *Isognomon ehippium*, but very low in number. Most of the species recorded distribute equally across the surveyed sites, but interm of number, Littorinidae and Potamidae were the predominant family in the area.

Although among those eleven species of gastropoda have less importance economucally, but from the ecological point of view, they are significantly importance in food web within the mangrove ecosystem, as well as in pollution studies. Deterioration of mangrove ecosystem will have a direct effect on the molluscs communities.

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