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 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. Althogh low in number, *Polymesoda expansa* and *Pharella acutidens* were widely distributed across the surveyed sites, while *Isognomon ephippium* 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* that is known useful pollution bioindicators.

Keywords**:** *Molluscs, Bivalvia, Gastropoda, mangrove, Dumai*

1. INTRODUCTION

Members of Mollusca can be found in the sea, in fresh water and on land. There are approximately 50 000 living species and 60 000 known fossil records of molluscs (Brusca and Brusca 1990). There are eight living classes and two extinct classes. Molluscs are bilaterally symmetrical protostomes whose coelom functions as a hydrostatic skeleton. All are soft-bodied individuals, most with a shell of calcium carbonate for protection; for some, this is an internal remnant (e.g. the squid), while others, like the octopus lack a shell completely.

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. Few aboriginal people use molluscs for a substantial portion of their diet. Molluscs are still commercially-harvested food products: the annual world squid and octopus fishery, for example, exceeds two million metric tons per year (Brusca and Brusca 1990). 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* spp. 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).

One widely concern is the illegal trade of endangered species of molluscs such as *Strombus gigas* (the queen conch), a large-shelled species. The conch import and export are regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Environment Canadas news release stated that between September 2003 and December 2006 almost 120 000 kilograms of *S. gigas* had been taken from Caribbean waters and unlawfully exported to the United States and Canada. Experts estimated that this weight represents between 798 000 and 1.05 million conch (Environment Canada, 2008). With this alarming fact, it is important to update an inventory of mollusc species in Dumai waters as well as their abundance to determine what needs to be protected.

This paper evaluates both species richness and abundance of bivalves and gastropods in mangrove forest along the coast of Dumai city. It now serves as a baseline for monitoring changes in distribution and abundance in the future and provides information to scientists who want to study the molluscs of Dumnai waters.

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 chracteristic of the sites. Site #1 was near by Pertamina Harbour for oil shipping close to a small creek, very little mangrove threes. Site #3 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. As many as 10 spots of samples were taken from each site by using 1 M^2 metal frame (figure. 1).

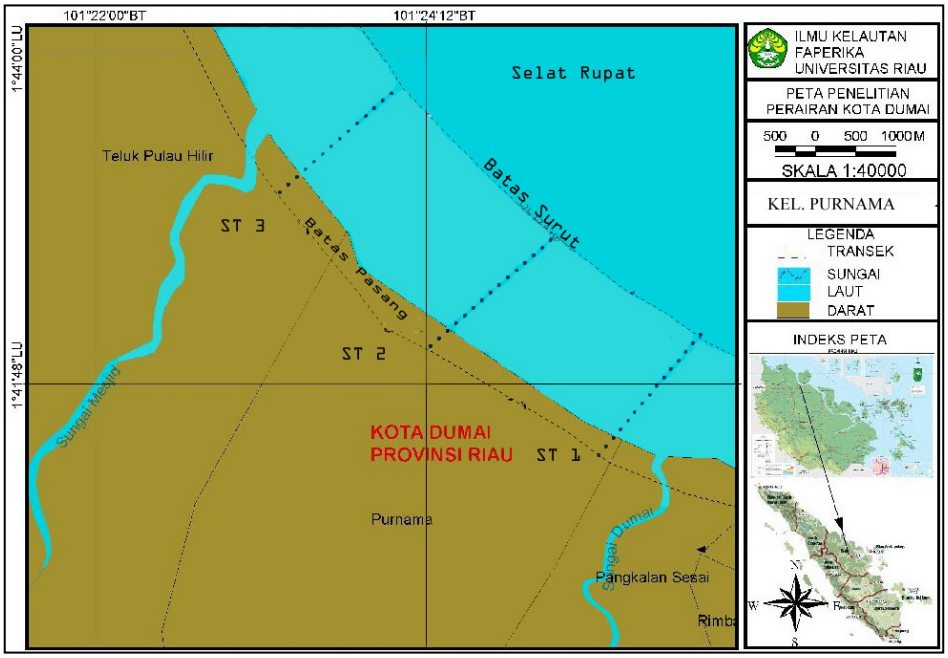

Figure 1. Location of the study area showing the sampling areas in Dumai coastline.

The mangrove molluscs were collected by hand picking in a transect of known area or using a quadrate frame 1x1 m size. At the same time the foulers like mussels and oysters were collected by scrapping those using knife either using a quadrate. Further the infaunal bivalves

were collected by hand digging the substratum (Alfred *et al*., 1997). The arboreal forms were collected from the stems, roots and other parts of the mangrove trees vertically by hand picking (Sasekumar, 1974).

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 individual ridges (or teeth) may be similar. The two valves are attracted to the soft body by adductor muscles that produce scar on the interior surface.

Sample were preserved after killed, by using the common chemical used for fixation of animals in the field is 10% neutral formalin solution. Those samples transported to Laboratory and finally preserved in 90% alcohol.

3. RESULTS

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).

Tabel 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).

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

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 2).

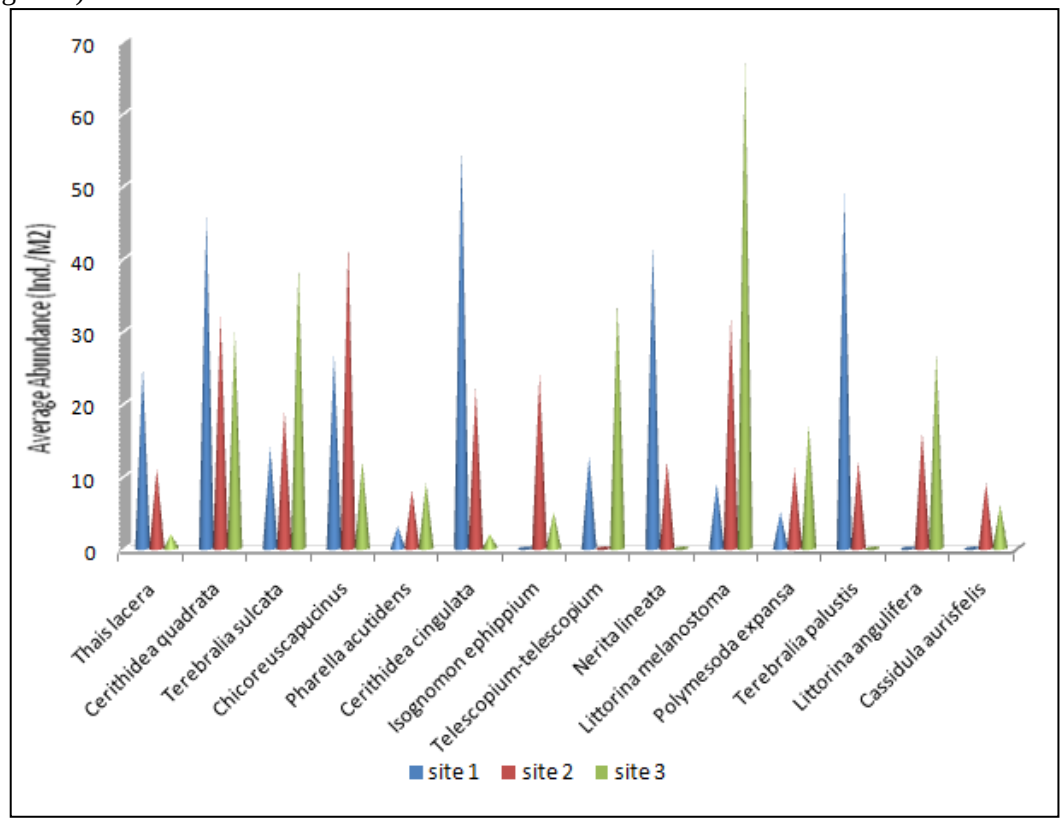

Figure 2. Average abundance of molluscs across the surveyed sites

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* usually found much deeper down into bottomsediment, 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 crowling on the surface of mudy 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 aroun the mangrove forest.

4. DISCUSSION

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 underforest cannopy during the day, making them difficult to record during the daytime (Humann and Deloach 2002).

Common snails such as *Pythia plicata* and *Cassida obtusata* were not previously identified either; however, their shells have been collected before during a students field trip tothe sites, hence if more time were allocated for mollusc surveys and identification, more species could be recorded.

One concern is the two species of Muricidae snails are important biological indicators of pollution in the marine ecosystem, specifically against the chemical tributylin (TBT) that is used in antifouling paints on ship hulls (Barcellos da Costa *et al*. 2008). TBT 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).

According to the World Wildlife Fund, TBT is toxic to 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).

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 survyed sites, but very low in number. 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 ocject. 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 crowling 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.

Habitat and abundance

Habitat is also affected by food preference. The intertidal zone provide *C. quadrata, T. telescopium, N. lineata* and others gastropoda a planty 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.

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.

Conclussion

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 ephippium*, 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.

Altough 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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REFERENCES

Alfred, J.B., R.K. Varshney and A.K. Ghosh (Eds.) (1997). An assessment manual for faunal biodiversity in South Asia. SACEP/NORAD publication series on Biodiversity in South Asia No. 1: 181pp.

Barcellos da Costa M, Fernandex MA, Barbiero DC, Vaz de Melo FT, Otegui MPB, Ferreira BS (2008) First record of imposex in *Thais deltoidea* in Vitoria, ES, Brazil. Brazilian Journal of Oceanography 56(2): 145-148. BBC News (2006) Snail venom painkiller launched. <http://news.bbc.co.uk>

Brady B, Rees CM, Fabris, GH (2008) Coastal Indicators: Imposex frequency. Australian Online Coastal Information. Canberra, Austrailia. <http://www.ozcoasts.org.au/indicators/imposex_frequency.jsp>

Brusca RC, Brusca, GJ (1990) Invertebrates. Sinauer Associates, Inc. Sunderland, Massachusetts

Humann P, Deloach N (2002) Reef Creature Identification: Florida Caribbean Bahamas. New World Publications, Inc. Jacksonville, Florida

Environment Canada (2008) Canadian and United States Wildlife Officers Dismantle Major Endangered Species Smuggling Operation, News Releases. Environment Canada. Gatineau, Quebec. <www.ec.gc.ca>

Ingole, B.S., L. Krishna Kumara, Z.A. Ansari and A.H. Parulekar, 1994. New record of mangrove clam *Geloina erosa* (Solander 1789) from the West Coast of India. J. Bombay Natl, History Soc., 91: 338-339.

Meehan, B., 1982. Shell Bed to Shell Midden. Australian Institute of Aboriginal Studies, Canberra, ISBN-13: 9780855751319, Pages: 189.

Morton, B. 1978. The diurnal rhythm and the process of feeding and digestion in *Tridacna crocea* (Bivalvia: Tridacnidae). Journal of Zoology, London. 185:371–387.

OSPAR (1999) Update on Organotin Compounds: The Accumulation and Impact of Organotins on Marine Mammals, Seabirds and Fish for Human Consumption. London, England. <www.ngo.grida.no/wwfneap/Publication>

Sasekumar, A. (1974). Distribution of the macro fauna on a Malayan mangrove

shore. *J. Anim. Ecol.,* **43** : 51-69.

Toller W, Gordon S (2005) A population survey of the West Indian topshell or whelk (*Cittarium pica*) in the U.S. Virgin Islands. Department of Planning and Natural Resources Division

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