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Mollusca diversity in mangrove ecosystem of Delta Tumpat Kelantan

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Abstract

Mangroves play a significant ecological role as a physical habitat and nursery grounds for a wide variety of aquatic vertebrates and invertebrates include molluscs. This study focuses on assessing the diversity and characteristics of mollusc species in disturbed and undisturbed mangrove ecosystem areas in Delta Tumpat, Kelantan. In each site, molluscs were collected using dredging method during high tide and gleaning technique during low tide. Physical characteristics and diversity index (H′) were calculated for both sites. A total of 14 mollusc species were found in the study area including five species from Bivalvia and nine species from Gastropoda class. More species were found in the undisturbed area which had produced a high species diversity (H′=1.99) compared to the disturbed area. The biggest species found at both areas was *Telescopium telescopium* with 7.62cm in size. Meanwhile, *Cerithedia aurisfelis* was the smallest species found with the size of 0.87cm. The difference in the growth of molluscs species in mangrove ecosystems depends on the quality and quantity of available food resources.

1. INTRODUCTION

Mangrove forests consist of taxonomically diverse flora and fauna include salt-tolerant tree species and shrubs that grow in the intertidal (Kimirei, 2012). Mangroves are important for nutrients recycling and balancing the estuarine ecosystem as well as nursery habitat for a wide-ranging diversity of species and living organisms (Ronnback *et al*., 1999). Not only ecologically important, mangrove also provides significant socio-economic benefits such as timber, fish, and environmental services such as coast protection and water regulation (Bosire *et al*., 2008).

Mangrove aquatic residents such as tunicates, crustaceans, molluscs and fishes spend their entire life cycle in the mangrove area for habitat and shelter (Odum & McIvor, 1990). Molluscs are a heterogeneous group with different structural form and they are known for their shell structure (Adrienne *et al*., 2015). Mollusc species can be classified based on their morphological, anatomical and biological features. Molluscs have colonised all possible habitats from the deep sea to high mountains. They are more abundant in the littoral zones of tropical seas. The distribution of mollusc in mangrove ecosystem is different between natural and disturbed forest ecosystem. The disturbed mangrove area is defined as an area that has been influenced by encroachment activity such as tree cutting, housing settlement or reclamation of land for agriculture (Wah *et al*., 2011) or other permanent degradation by anthropogenic disturbance (Hannah *et al*., 1994). Meanwhile, the undisturbed mangrove area is explained by the untouched area by any tree distressing activity except the planting for site enrichment. This study was carried out to determine the mollusc species distribution and diversity in disturbed and undisturbed mangrove ecosystem areas in Delta Tumpat Kelantan.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted in the mangrove forest area in Delta Tumpat, Kelantan between latitude 6°11’ 53”N to 6°13’ 53”N and longitude of 102°9’23”E to102°14’23”E (Figure 1). There are 17 small islands in Delta Tumpat with an estimated total area of 1200 ha. Two different study sites were chosen to differentiate the diversity of mollusc distribution which were the disturbed and undisturbed sites. The disturbed area was severely affected by anthropogenic activities including a construction project and mass clearing of the mangroves to accommodate machinery and construction equipment as well as channelization of rivers by humans. On the other hand, the undisturbed area comprised the mixed forest and was supplied readily with salt or brackish water from the tide. Five different locations of the disturbed and

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undisturbed areas were selected randomly. In each site, samples of mollusc were taken five times to avoid bias.

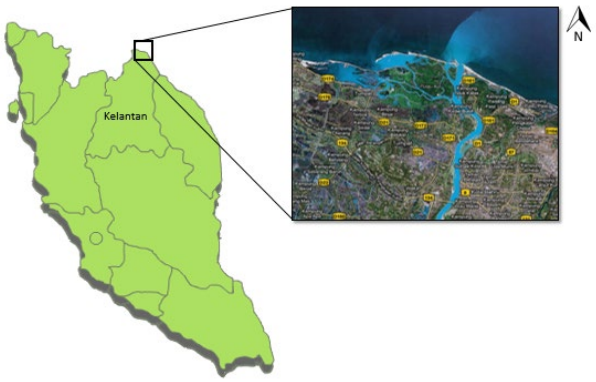

Figure 1. Location of the study area in Delta Tumpat, Kelantan

In collecting mollusc species at both sites, hand gloves were used for hand picking in the gleaning process during low tide. During high tides, dredging technique using net and hand dredges or rakes were used to catch the mollusc samples (Vanmali & Jadhav, 2015). The size of the mollusc was measured using vernier calipers and photos were taken for identification.

The collected mollusc specimens were identified by observing the morphological characteristics and special features by referring to anatomy keys for identification for mollusc species. Main physical parameter observed were based on the shell morphology, hinge, interlocking dentition and their shape with referred to standard available in the literature. Collected mollusc samples were separated by their classes which either bivalves or gastropods before taken to the laboratory for further analysis. Types, numbers of species and physical characteristics of collected mollusc were recorded. The flow of the study is presented in Figure 2.

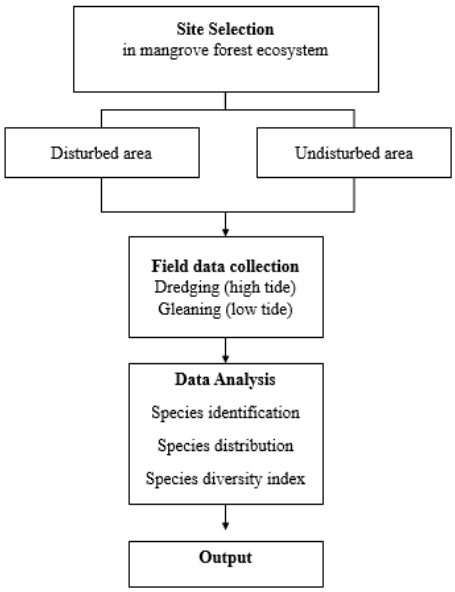

Figure 2. The flow of the study

Species Accumulative Curve (SAC) was used to structure samples collection among sites and to estimate the minimum effort required for adequate completeness of inventories (Moreno & Halffter, 2000). From this SAC, the rate of new species found can be calculated. SAC provides a better estimate of species richness in field data collection.

The Shanon-Wiener Index (H') was used to calculate the molluscs species diversity. It is a quantitative measure that reflects the number of different species and distribution of individual species in study area (Barnes *et al*. 1998). H' was calculated using Equation 1.

$$H' = -\sum_{i=1}^{s} pi \ln pi \,, \quad (1)$$

where,
s = species richness (number of species)
pi = total number of individuals in ith species / total number of individuals for all species
ln = natural logarithm.

Data of the mollusc collected from both disturbed and undisturbed sites were tabulated and interpretation of each site was explained as the output of the study.

3. RESULTS AND DISCUSSION

A total of 14 species were found in this study from two main classes. Five species from bivalve and nine species from gastropods. Table 1 shows mollusc found in the Tumpat Delta area by its classes and scientific names.

Table 1: Mollusc species found in the study area

No	Class	Family	Scientific Name
1	Bivalve	*Ostreidae*	*Saccostrea cucullata*
2	Bivalve	*Corbiculidae*	*Polymesoda expansa*
3	Bivalve	*Mactridae*	*Mactra corallina*
4	Bivalve	*Mactridae*	*Lutraria lutraria*
5	Bivalve	*Arcidae*	*Anadara fultoni*
6	Gastropods	*Pachychilidae*	*Faunus ater*
7	Gastropods	*Potamididae*	*Cerithidea cingulata*
8	Gastropods	*Potamididae*	*Telescopium telescopium*
9	Gastropods	*Potamididae*	*Cerithidea obtusa*
10	Gastropods	*Melampidae*	*Ellobium Aurisjuddae*
11	Gastropods	*Naticidae*	*Natica Tigrina*
12	Gastropods	*Melampidae*	*Cassidula aurisfelis*
13	Gastropods	*Littorinidae*	*Littoraria carinifera*
14	Gastropods	*Melampidae*	*Cassidula nucleus*

SAC of mollusc species found was plotted by disturbed (Figure 3a) and undisturbed (Figure 3b) areas. These curves were based on the number of catch sample data against the number of species found in both study sites. It showed that SAC at the disturbed area reached its minimum diversity better and stable than in the undisturbed area. It showed that in the undisturbed area, more species could be found if we prolonged the data collection.

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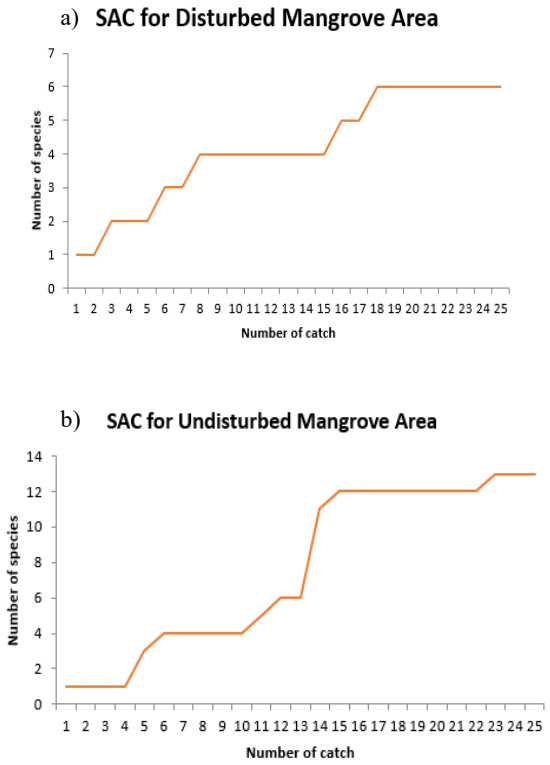

Figure 3. SAC for molluscs species found in (a) disturbed and (b) undisturbed mangrove areas in Delta Tumpat

The distribution of molluscs species by different sites is presented in Table 2. Six molluscs species that were found in a disturbed area and 13 species found in an undisturbed area. Five species can be found in both disturbed and undisturbed areas. The value of molluscs species diversity in the disturbed area was less compared to undisturbed mangrove with H'= 1.54 and 1.99, respectively. It shows that in the undisturbed area in Delta Tumpat, various numbers of mollusc species can be found.

Table 3 shows the comparison of molluscs size between the undisturbed and disturbed areas in Tumpat Delta, Kelantan. In the natural mangrove forest area, the biggest species found was *Telescopium telescopium* (7.62cm) and the smallest species was *Cassidula auriselis* (0.87cm). Meanwhile, in the disturbed area where the mangrove forest has been encroached by human activities, the most species found was *Mactra corallina* and *Lutraria lutraria* with average size of 2.76cm and 3.54cm, respectively. However, the biggest mollusc species found in the disturbed area was *Telescopium telescopium* with slightly bigger size than the one in the undisturbed area (7.62cm). *Cerithidea cingulata* was the smallest species found in disturbed area with 1.6cm in size.

T. telescopium was found in both areas with bigger size in the disturbed area. Having variation of growth rate between individuals of the same species that occupying the different areas could be attributed to the adaptations of different environmental conditions. It includes food quantity and quality which is similar to the study on *Potamopyrgus jenkinsi* (Dorgelo & Leonards, 2001). These demonstrate that different surrounding ecosystems affect the diversity and size of mollusc in terms of availability of high-quality food supplies for aquatic organism. A study by Lafferty (1993) explained that a high population density of mollusc will also affect the growth rate and maximum rate size of gastropods. The intraspecific competition for food or space between individuals of gastropods species may reduce their growth rates. Factors from wave and currents can also directly or indirectly change the structural characteristics and function of mangrove ecosystem (Jemali, 2012). Wave and currents are factors related to the habitat of mollusc which can define the mollusc distribution and diversity in mangrove area. Hence, the structural complexity of mangrove trees as well as natural or anthropogenic disturbances would also affect the diversity of the mollusc in Delta Tumpat Kelantan.

Table 2: Mollusc species collected in the different type of sites

Scientific Name	Number (N)	H'
Disturbed Area		1.54
Faunus ater	190	
Cerithidea cingulata	53	
Saccostrea cucullata	87	
Telescopium telescopium	47	
Polymesoda expansa	39	
Cerithidea obtusa	24	
Undisturbed Area		1.99
Faunus ater	20	
Cerithidea cingulata	31	
Telescopium telescopium	10	
Polymesoda expansa	36	
Mactra corallina	133	
Lutraria lutraria	154	
Anadara fultoni	23	
Cerithidea obtusa	40	
Ellobium aurisjuddae	5	
Natica tigrina	10	
Cassidula aurisfelis	3	
Littoraria carinifera	5	
Cassidula nucleus	11	

Table 3: The average size of Mollusca by species found in the study area

Scientific Name	Disturbed Area (cm)	Undisturbed Area (cm)
Faunus ater	5.76	5.89
Cerithidea cingulata	1.6	1.56
Saccostrea cucullata	4.27	-
Telescopium telescopium	7.62	6.85
Polymesoda expansa	4.74	5.38
Cerithidea obtusa	3.53	2.97
Mactra corallina	-	2.76
Lutraria lutraria	-	3.54
Anadara fultoni	-	2.74
Ellobium aurisjuddae	-	2.62
Natica tigrina	-	2.34
Cassidula aurisfelis	-	0.87
Littoraria carinifera	-	1.82
Cassidula nucleus	-	1.75

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4. CONCLUSION

Mollusc species composition at Delta Tumpat was denoted by four dominant taxa namely *F.ater*, *M.coralline*, *L.lutraria* and *S.telescopium*. The undisturbed mangrove forest area in Tumpat Kelantan has a higher mollusc species diversity compared to the disturbed area. *T.telescopium* was mutually found in both sites and it was the largest mollusc found in this study. More species can be found in undisturbed area with bigger sizes compared to disturbed area in Delta Tumpat.

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REFERENCES

Adrienne J. Thomas A. N. and Mathias H. (2015). Microstructural details in shells of the gastropod genera Carychiella and Carychium of the Middle Miocene. *International Journal of Palenteology and Startigraphy, 49* (1), 87-101.

Bosire, J.O., Dahdouh-Guebas, F., Walton, M., Crona, B.I., Lewis III, R.R., Field, C., Kairo, J.G. and Koedam, N. (2008). Functionality of restored mangroves: A review. *Aquatic Botany, 89*, 252-259.

Dorgelo, J. and Leonards, P.E.G. (2001) Relationship between C/N ratio of food types and growth rate in the snail *Potamopyrgus Jenkinsi* (E.A.Smith). *Journal of North American Benthological Society*, *20*, 60-67.

Hannah, L., Lohse, D., Hutchinson, C., Carr, J.L. and Lankerani, A. (1994) A Preliminary Inventory of Human Disturbance of World Ecosystems. *Ambio, 23*, 246-50.

Jemali N.J.N, Masami S., de Boer W.F and Siahainea A. (2012). Structural complexity and disturbances: indicator of mangrove forest in Berau Delta, East Kalimantan, Indonesia. *Journal of Japanese Society of Coastal Forest, 11*(1), 7-10.

Kimirei,I. A. (2012). Importance of mangroves and seagrass beds as nurseries for coral reef fishes in Tanzania. PhD Thesis, Faculty of Science, Radboud University Nijmegen, The Netherlands.

Kober, K. (2004). Foraging ecology and habitat use of wading birds and shorebirds in the mangrove ecosystem of the Caete Bay, Northeast Para, Brazil. Retrieved from http://webdoc.sub.gwdg.de/ebook/diss/Bremen/2004/E-Diss1014_kober.pdf

Lafferty, K.D. (1993) Effects of parasitic castration on growth, reproduction and population dynamics of the marine snail *Cerithidea Californica*. *Marine Ecology Progress Series, 96*, 229-237.

Moreno, C.E. and Halffter, G. (2000) Assessing the completeness of bat biodiversity inventories using species accumulation curves. *Journal of Applied Ecology, 37*, 149–158.

Odum, W.E., and C.C. McIvor. (1990). Mangroves. Pages 517-548 in R.L. Myers and J.J Ewel, (eds.), Ecosystems of Florida. University Press of Florida, Gainesville, Florida.

Ronnback, P. (1999). The ecological basis for economic value of seafood production supported by mangrove ecosystems. *Ecological Economics, 29*, 235-252.

Sasekumar, A. (1974). Distribution of the macro fauna on a Malayan mangrove shore. *Ournal of Animal Ecology, 43*, 51-69.

Satyanarayana, B., Idris, I.F., Mohamad, K.A., Husain, M-L., Shazili,

Noor A.M., and Dahdouh-Guebas, F. (2010). Mangroves species distribution and abundance in relation to local environmental settings: a case-study at Tumpat, Kelantan Delta, east coast of peninsular Malaysia. *Botanica Marina, 53*, 79-88.

Vanmali, H.S., and Jadhav, R.N. (2015). Assessment of molluscan diversity of Dativare Coast of Vaitarna Estuary, Dist.-Palghar, Maharashtra (India). *International Journal of Engineering and Science, 5*(9), 1-6.

Wah. L.M., Andy R. Mojjol and Ejria Saleh, (2011). Diversity of mangroves ecosystem in semporna mangrove forest. *Borneo Science, 28*, 8-17.

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