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Occurrence and Distribution of Marsh Clam, *Polymesoda* spp. in Marudu Bay, Sabah, Malaysia

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Abstract

Marudu Bay is part of the Tun Mustapha Marine Park, the largest marine protected area within the Malaysian region of the Coral Triangle Initiative. The bay is known for its diversed fisheries resources including bivalves. Although some of these bivalve species are commercially important, their occurrence, distribution and stock status in the bay are not well documented. Hence, the current study was conducted to determine the occurrence, distribution and the stock status of marsh clam, *Polymerasoda* spp. in the mangrove swamp situated at the southernmost of the Marudu Bay. Samplings were carried out at the mangrove swamps which covered an area of 500 sequare meter per sampling site. Two marsh clams species, *Polymesoda erosa* and *P. expansa* were found to inhabit the sampling sites. In general, juvenile marsh clams were noticed to dominate the seaward mangrove swamp, whereas the high tidal regions were dominated by adults. The current study also suggested a link in the distribution and the morphometric measurements of the marsh clams with the sediment grain size.

Keywords

Mollusks, Coral Triangle Initiative, Tun Mustapha Marine Park

1. Introduction

Marudu Bay is known to house high species diversity of mollusks especially bivalves and gastropods [1]. Marsh clam also popularly known as mangrove clam, *Corbiculidae* is abundantly found in the mangrove swamps of Marudu Bay. This clam fetches high local market demand and serves as a delicacy to local people. Marsh clam is a deep burrowing bivalve distributed widely across the Indo-Pacific region but mostly in the tidal flat of Southeast Asia [2]. Three species of the marsh clam were reported to occur in the region including *Polymesoda erosa*, *P. bengalensis* and *P. expansa*. The distribution of *P. bengalensisis* is however, restricted only to the Bay of Bengal, whereas *P. erosa* and *P. expansa* are known to have a wider and somewhat overlapping distribution that ranges from India to Vanuatu; North to Vietnam and South to Eastern Java [3].

Currently, this clam is usually collected from the mangrove swamps of Marudu Bay by fisherman and sold in local wet markets. However, continuous harvesting of this clam is seen threatening the sustainability of the natural stock of the species [4]. Moreover, the demand for such seafood is expected to increase in the near future as the tourism industry in Sabah is becomingly popular to both international and local tourists [5]. This situation will become severe in the absence of good fishery management plan for the species. Nevertheless, in order to develop such plan, information on biology, reproduction and habitat distribution of the species must first be well understood. Unfortunately, very little is known about the abundance, habitat distribution and natural stock status of the clam in the coastal areas of Sabah, particularly in Marudu Bay. Such information gap can be a challenge in developing and implementing an effective fishery management plan for the species. If this situation is not tackled prudently, this remarkable yet highly demanded seafood resource will soon be depleted to a state beyond recovery. Despite vast information gap, the aim of the present study is to describe the abundance and distribution of marsh clam in the mangrove reserve forest at the southernmost of Marudu Bay.

2. Materials and Methods

2.1. Study Area

Four sampling stations were selected for this study as shown in **Figure 1**. The southwest coast of Marudu Bay is covered with 9550 ha of mangrove forest where it is known to harbor at least 6 mollusks species [6]. East coast of Marudu Bay is relatively more developed than the west coast, where many light and small medium industries can be found along the coastal areas.

2.2. Sampling

Systematic surveys were carried out from 8th to 14th May 2017 during low tide

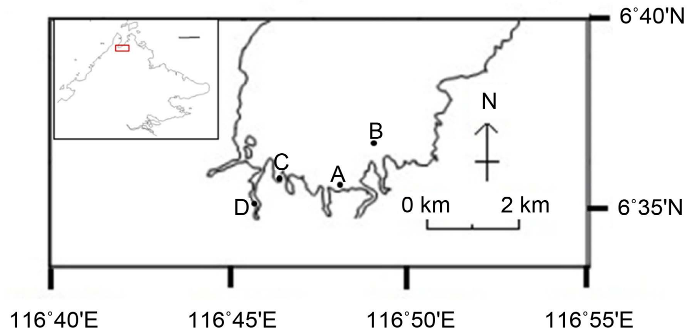

Figure 1. Sampling stations for marsh clam in Marudu Bay.

according to Garza *et al.* [7]. Clams were collected at the mangrove swamps which covered an area of 500 m^2 (50 m × 10 m) per site. Surface sediment of 15 cm depth was removed to obtain the buried clams. The clam specimens were then placed in labeled plastic bag and stored at 4˚C, and then transported to the laboratory for analysis within 24 h. In the laboratory, the samples were sorted and washed to remove all adhering organisms and other debris.

2.3. Bivalve Identification and Morphometric Measurement

All clam samples were counted and identified to species level. Individual specimens were then measured for its shell length, shell width and shell height using a vernier caliper to the nearest 0.1 mm. The maximum dimension of the anterior–posterior axis was recorded as shell length, the maximum lateral axis as shell width and the maximum distance between the valves when they are closed was considered as height. Few representative individuals (n = 5) of different groups of clams were preserved in 70% alcohol and further identified in the UMS laboratory according to Morris [8], Keen [9], Skoglund [10] and Carpenter and Niem [11].

2.4. Sediment Analysis

Surface sediment of 100 g was collected and stored at 4˚C. In laboratory, sediment subsample was air dried at room temperature, grinded and mixed thoroughly. The sediment particle size and clay-silt percentage were determined by a laser diffraction particle size analyzer (Sequola, Canada) according to Agrawal and Pottsmith [12].

2.5. Statistical Analyses

Statistical analyses were performed using the SPSS Windows Statistical Package (version 21). Tests were considered significant at $p < 0.05$. Prior to analyses, all variables were tested for normality and homogeneity of variances. One-way ANOVA was used to test for significant differences among sites for sediment clay-silk composition and shell length. The shell length distribution of mud clam in each station was illustrated in a histogram, whereas skewness and kurosis were calculated according to Groenveld and Meeden [13].

3. Results

3.1 Sediment Grain Size

The silt-clay composition of the sediment of the mangrove swamps in the sampling sites was found to range from 62.22% to 88.73% (**Figure 2**). However, no significant difference ($p > 0.05$) was observed in the silt-clay composition among the sites.

3.2. Bivalves Composition

There were only two species of marsh clam identified in sampling sites namely

P. erosa and *P. expansa*. The occurrence of *P. erosa* and *P. expansa* were 100% and 50%, respectively. Bivalve density (**Figure 3**) in station A (n = 32) and station B (n = 140) was significantly higher and lower ($p < 0.05$), respectively than that in other stations.

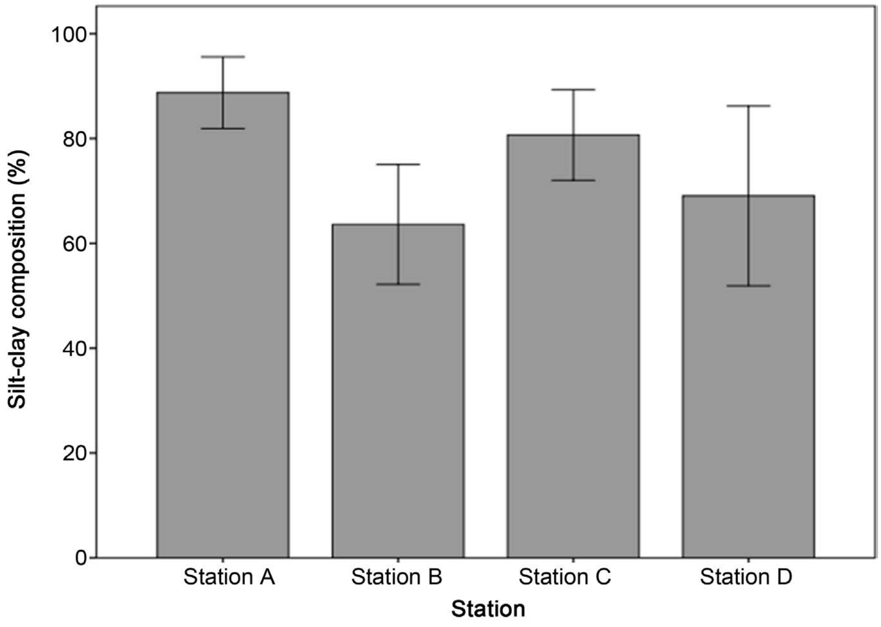

Figure 2. Silt-clay composition in the sediment of bay pocket of Marudu Bay.

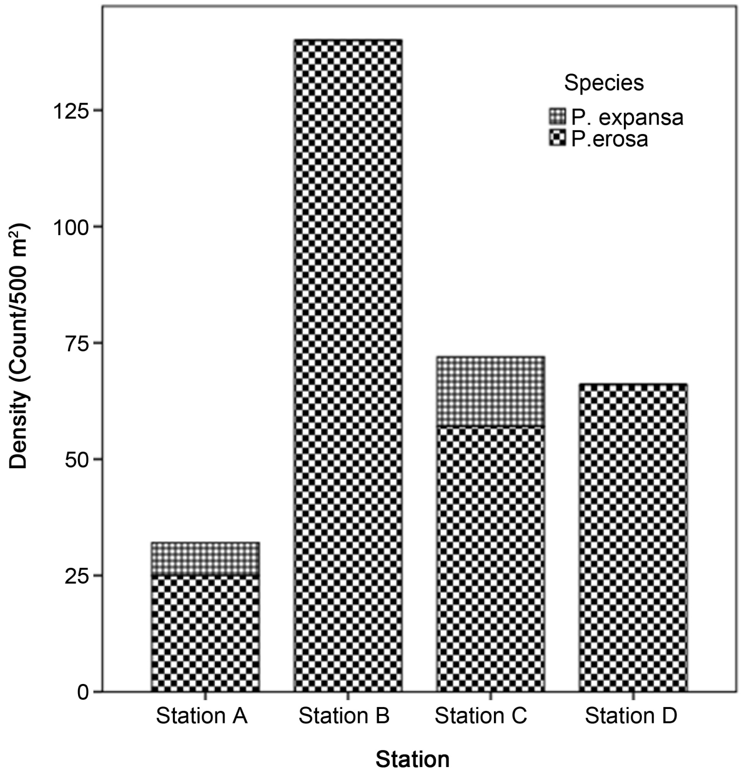

Figure 3. Density of *Polymesoda* spp at mangrove swamp of Marudu Bay.

3.3. Morphometric Measurement and Analysis

P. erosa in sites B and D recorded significantly higher ($p < 0.05$) and lower ($p < 0.05$) length/width ratio (1.10 to 1.14 vs 1.03 to 1.07, respectively) and length/depth ratio (1.96 to 2.03 vs 1.76 to 1.77, respectively), respectively than that in sites A and C (**Figure 4**). However, no significant difference ($p > 0.05$) was recorded in length/width or length/ depth ratio of the *P. expansa* collected from all the sites.

3.4. Size Distribution

Size distribution of *P. erosa* at the sampling sites is illustrated in **Figure 5**. The shell length of *P. erosa* ranged from 2.1 to 8.9 cm. The size distribution for *P. erosa* in all sites showed a bell shape distribution pattern with minor degrees of skewness and kurtosis. In site A, *P. erosa* population showed a clear leptokurtic and right skewed distribution. *P. erosa* in sites B and C showed an extreme left skewed distribution, where *P. erosa* in site D was moderately platykurtic and left skewed. Juvenile *P. erosa* in sites A, B, C and D was accounted for 0%, 15.7%, 0% and 7.6%, respectively. On the other hand, size distribution for the other species, *P. expansa* was not included in current study due to its low occurrence and less abundance.

4. Discussion

4.1. Sediment Distribution

Silt-clay composition of the sampling sites was not statistically different, despite the observation that the silt-clay composition in sites A and C were relatively

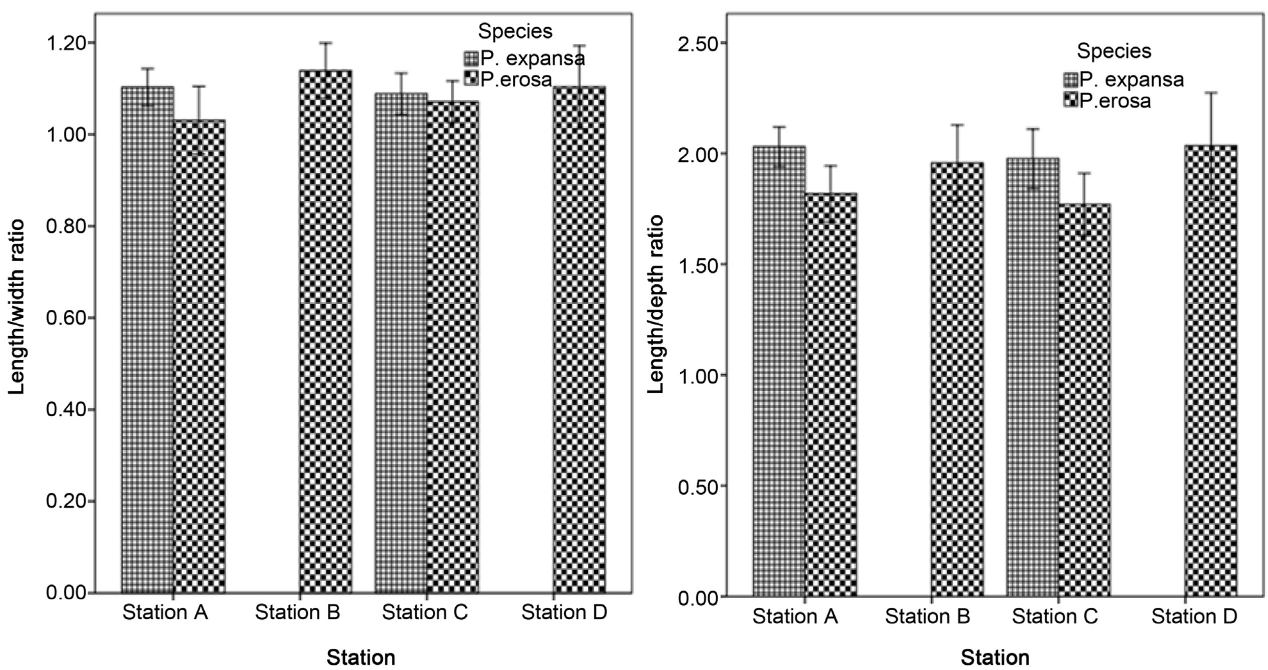

Figure 4. Biometric ratio of *Polymesoda* spp at mangrove swamp of Marudu Bay.

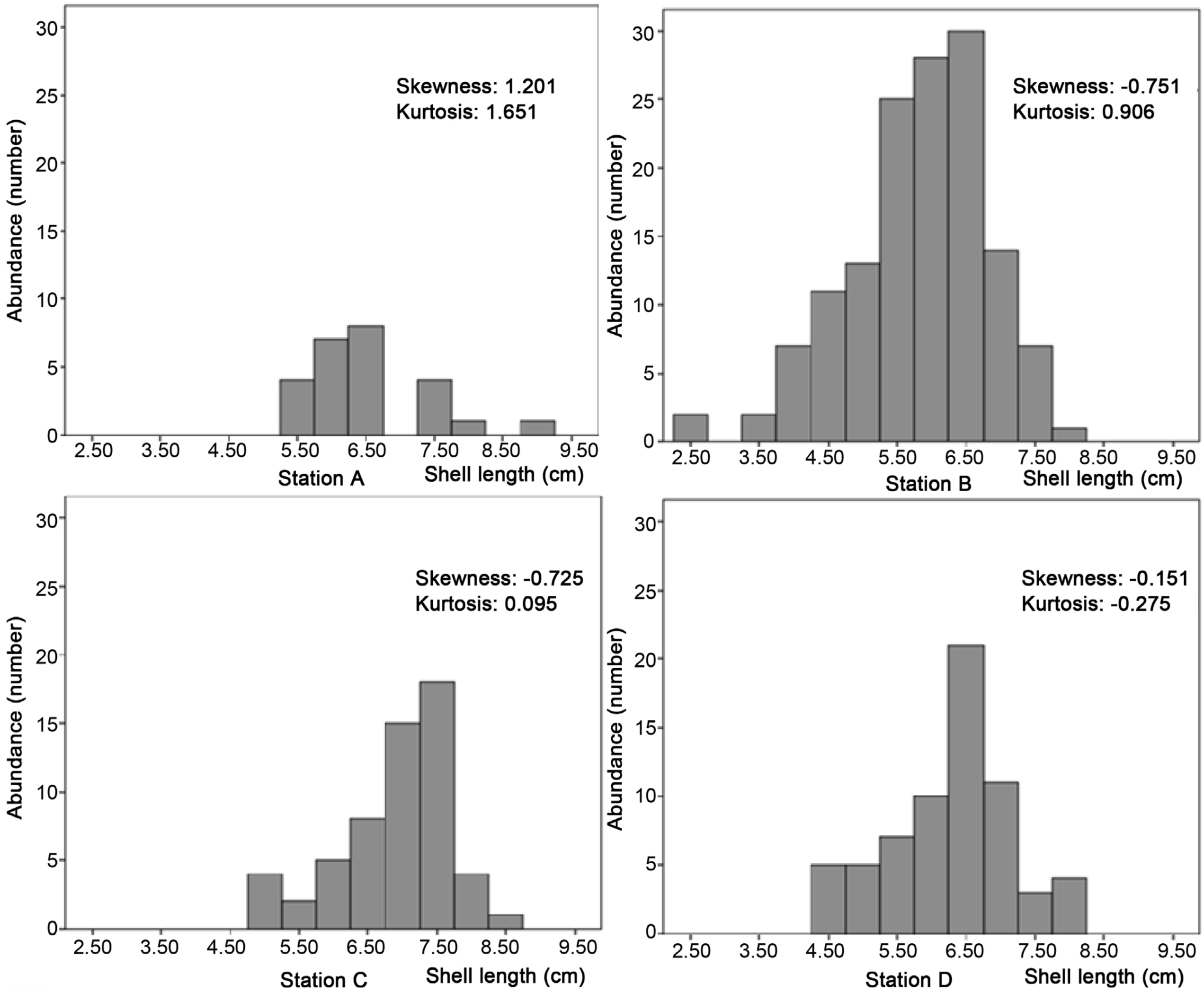

Figure 5. Size distribution of *P. erosa* at mangrove swamp of Marudu Bay.

higher than that in sites B and D. Since the sample size in current study was relatively small, therefore we did not rule out the possibility of sediment grain size distribution could be influenced by the relatively small sample size.

4.2. Species Distribution

Two marsh clam species, *P. erosa* and *P. expansa* were found to inhabit the sampling sites. Occurrence of *P. erosa* in the mangrove swamp of Marudu Bay had previously been reported by Zakaria and Rajpar [6]. The occurrence and distribution of many marine benthic organisms are known to associate with substrate types [14]. In current study, the occurrence of *P. expansa* was relatively lower compared to *P. erosa*, where the former has only been observed in the sites with silt-clay content of more than 80%. This observation was in agreement with the finding of Dolorosa and Galon [15], where distribution of marsh clam can vary between patches of mangroves due to the influence of environmental conditions. Active habitat choice for a specific sedimentary environment, in the form of habitat selection by settling larvae, may explain the lower distribution of *P. expansa* in Marudu Bay.

It is also interesting to note that there were no other bivalve species found inhabiting the sampling stations. Mangrove sediment is known to contain high organic level which may not be suitable to many organisms [16], this makes the area uninhabitable by other bivalve species. The abundance of marsh clam in site A (32 ind/500m^2) was very low. Site A is located at a river mouth which may provide an easy access to bivalve collectors. Observation during sampling also strengthen the fact that site A is a site whereby frequently be visited by bivalve collectors hence experience high exploitation. Intensification in term of frequency and effort of bivalve fishing over a long period of time in a particular site can be harmful to the population dynamic of the bivalve in that habitat. Temporally site closure management strategies have been reported to be an effective way to increase the marsh clams population in Philippine [17]. Hence, such a strategy can be adopted to site A in the present study to avoid further population depletion. On the other hand, site B which is located relatively far from the rivers and away from fishermen reach was observed to experience low level of exploitation. In this connection, site B could be a good alternative marsh calm fishing ground when temporally site closure management strategy has been implemented in site A. Despite the increase fishing cost due to more fuel is required to reach site B, it can be compensated by more catch with equal or lower fishing effort.

4.3. Morphometric Analysis

Studying bivalve growth and establishing allometric relationships are essential for generating useful information for managing resources and understanding changing environmental condition and pollution [18]. The length-width and length-height ratio of *P. erosa* in sites B and D were significantly higher and lower, respectively compared to the other sites. This means that the increase in shell length is superior to increase in shell width and height. Sediment grain size has been reported to influence the shell morphology of bivalve [19]. Coincidently, the silt-clay composition in sites B and D were relatively lower than that in sites A and C, which suggest the shell of *P. erosa* at sites B and D become progressively longer to smoother movement in grosser sediment [20]. Although the relationship between allometric ratios (length/width and length/depth ratios) and silt-clay composition were not statistically different, a link between allometric ratios and sediment grain size is visible in the current study.

4.4. Size Distribution

The shell length range of *P. erosa* in Marudu Bay (2.1 to 8.9 cm) was comparable to those reported in Butuan bay, Philippines (2.9 to 8 cm) [21]. The distribution of *P. erosa* in current study was varied among sampling stations. This observation was in agreement with the finding of Clemente and Ingole [14], where non-random, patchy distribution of *P. erosa* has been reported in the Chorao mangrove swamp, Goa. Higher number of juvenile *P. erosa* was observed in site B which was located far from river. Similar result was also been reported by Elvira and Jumawan [21], where areas nearby river mouth of Agusan river, Philippines has significantly fewer juvenile marsh clam (12%) compared to those located at 1 km away from Agusan river mouth (33%) [21]. Moreover, Clemente and Ingole [14] also reported the majority of the juveniles were confined to the seaward zone while adults were found conspicuously towards the landward zone.

5. Conclusion

In conclusion, two marsh clam species, *P. erosa* and *P. expansa* can be found in the mangrove swamp of Marudu Bay. Juvenile clams were found to dominate in landward mangrove swamps, whereas the seaward of mangrove swamps were mostly dominated by adult clams. The current study also suggests a link in the distribution and the morphometric measurements of the marsh clams with the sediment grain size in the habitat. Further study which covers larger sampling areas with longer sampling period is highly recommended to have a better understanding on the effects of sediment grain size on the distribution and morphometric measurement, and population dynamic of marsh clam in Marudu Bay.

Acknowledgements

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References

[1] Tan, K.S. and Ransangan, J. (2016) Feasibility of Green Mussel, *Perna viridis* Farming in Marudu Bay, Malaysia. *Aquaculture Report*, **4**, 130-135. https://doi.org/10.1016/j.aqrep.2016.06.006

[2] Tan, K.S. and W.W. Kastoro, W.W. (2004) A Small Collection of Gastropods and Bivalves from the Anambas and Natuna Islands, South China Sea. *Raffles Bulletin of Zoology*, **11**, 47-54.

[3] Ingole, B.S., Naik, S., Furtado, R., Ansari, Z.A. and Chatter, A.J. (2002) Population Characteristics of the Mangrove Clam *Polymesoda Geloina erosa* (Solander, 1786) in the Chorao Mangrove, Goa. *Proceedings of the National Conference on Coastal Agriculture,* Old Goa, 6-7 April 2002, 211-212.

[4] Tan, K.S. and Ransangan, J. (2016) High Mortality and Poor Growth of Green Mussels, *Perna viridis*, in High Chlorophyll-a Environment. *Ocean Science Journal,* **51**, 43-57. https://doi.org/10.1007/s12601-016-0005-0

[5] Said, H.M. (2011) Promoting Community Based Tourism in Bajau Laut Community in Kampong Pulau Gaya, Sabah. *Universiti Tun Abdul Razak E-Journal*, **7**, 46-57.

[6] Zakaria, M. and Rajpar, M.N. (2015) Assessing the Fauna Diversity of Marudu Bay Mangrove Forest, Sabah, Malaysia, for Future Conservation. *Diversity,* **7**,137-148. https://doi.org/10.3390/d7020137

[7] Gaza, R.F., Rojas, V.L., Rodriquez, P.F. and Ramirez, C.T. (2014) Diversity, Distribution and Composition of the Bivalvia Class on the Rocky Intertidal Zone of Marine Priority Region 32, Mexico. *Open Journal of Ecology,* **4**, 961-973. https://doi.org/10.4236/oje.2014.415080

[8] Morris, P.A. (1966) A Field Guide to Shells of the Pacific Coast and Hawaii. Houghton Mifflin, Boston, 297.

[9] Keen, M.A. (1971) Sea Shells of Tropical Western America. Stanford University, Stanford, 1064.

[10] Skoglund, C. (1992) Additions to the Panamic Province Gastropod (Mollusca) Literature 1971-1992. *The Festivus*, **XXIV**, 169.

[11] Carpenter, K.E. and Niem, V.H. (Eds) (1998) FAO Species Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. Volume 1. Seaweeds, Corals, Bivalves and Gastropods. Food and Agriculture Organisation of the United Nations, Rome, 686.

[12] Agrawal, Y.C. and Pottsmith, H.C. (2000) Instruments for Particle Size and Settling Velocity Observations in Sediment Transport. *Marine Geology,* **168**, 89-114. https://doi.org/10.1016/S0025-3227(00)00044-X

[13] Groeneveld, R.A. and Meeden, G. (1984) Measuring Skewness and Kurtosis. *The Statistician,* **33**, 391-399. https://doi.org/10.2307/2987742

[14] Clemente, S. and Ingole, B. (2011) Recruitment of Mud Clam *Polymesoda erosa* (Solander, 1876) in a Mangrove Habitat of Chorao Island, Goa. *Brazilian Journal of Oceanography*, **59**,153-162. https://doi.org/10.1590/S1679-87592011000200004

[15] Dolorosa, R.G. and Galon, F.G. (2014) Population Dynamics of the Mangrove Clam *Polymesoda erosa* (Bivalvia: *Corbiculidae*) in Iwahig, Palawan, Philippines. *International Journal of Fauna and Biological Studies*, **1**, 11-15.

[16] Tan, K.S., Al-Azad, S. and Ransangan, J. (2014) Isolation and Characterization of Purple Non-Sulfur Bacteria, *Afifella marina*, Producing Large Amount of Carotenoids from Mangrove Microhabitats. *Journal of Microbiology and Biotechnology,* **24**, 1034-1043. https://doi.org/10.4014/jmb.1308.08072

[17] Aswani, S., Floresm, C.F. and Broitman, B.R. (2015). Human Harvesting Impacts on Managed Areas: Ecological Effects of Socially-Compatible Shellfish Reserves. *Review of Fish Biology Fisheries,* **25**, 217-230. https://doi.org/10.1007/s11160-014-9376-4

[18] Palmer, A.R. (1992) Calcification in Marine Molluscs: How Costly Is It? *Proceedings of the National Academy of Sciences of the USA*, **89**, 1379-1382. https://doi.org/10.1073/pnas.89.4.1379

[19] Claxton, W.T., Wilson, A.B., Mackie, G.I. and Boulding, E.G. (1998) A Genetic and Morphological Comparison of Shallow and Deep-Water Populations of the Introduced Dressenid Bivalve *Dresseina bugensis*. *Canadian Journal Zoology*, **76**, 1269-1276. https://doi.org/10.1139/z98-064

[20] McLachlan, A. and Brown, A. (2006) The Ecology of Sandy Shore. Academic Press, Elsevier, Cambridge, 373.

[21] Elvira, M.V. and Jumawan, J.C. (2017) Species Abundance Distribution of Mud Clam (*Polymesoda erosa*) in Selected Mangrove Wetlands of Butuan Bay, Philippines. *Journal of Biodiversity and Environmental Science,* **11**, 1-6.