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Mangrove Associate gastropoda diversity of Turbadi, Raigad, coast of India

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Abstract
The diversity and taxonomical study of mangrove associated marine gastropod molluscs from muddy habitat were studied according to Shannon Wiener Diversity Index, during October 2013 to September 2014. The productive molluscan fauna in prevalence of different habitats of selected study sites of Raigad district coast, so a wide chance of research to further explore on the possibility of ecological value and there conservation.

Keywords: diversity, gastropod, turbadi, coast of India

1. Introduction
In India the marine molluscs are recorded from the diverse habitats. They occur in different habitats such as mangroves, coral reef, rocky coasts, sandy beaches, sea grass beds and also at greater depth in the sea, they are more diverse and abundant in the rocky intertidal zone along the coast, sandy stones, inter tidal flats, mangrove areas [1]. Mangroves are one of the biologically diverse ecosystems in the world, rich in organic matter and nutrients and support very large biomass of flora and fauna [2]. The gastropods are collected extensively for local consumption. Mangrove roots & lower parts of trunks provide substrate for oysters, mussels and gastropods. Because these animals are filter feeders, they are confined to microhabitats below mean high water and are usually only abundant in areas adjacent to open water [3]. An oysters, mussels and clams serve the nutritional needs of the coastal population they are good source of minerals, protein, and glycogen and easily digestible compared to other animal food [4]. In India, till today, 5,070 species of molluscs have been recorded of which, 3,370 are from marine habitats [5]. The gastropods such as sacred chank, *Trochus*, *Turbo* are exploited from the Indian marine region [6]. The present papers investigate the diversity of gastropod molluscs of mangrove, rocky coasts, and sandy beach from selected study localities of Raigad district coast.

2. Materials and Methods
Site-I Turbadi
(Lat. 18°14.469" North and Long. 073°01.156"East). The backwater soft muddy regions, there is exposed inter-tidal mudflat about 40-50m during low tide, in dense large mangroves trees were present like *Rhizophora mucronata* (Lamarck), *Ceriops tagal* (Perr.) (Robinson), *Avicennia alba* Blume with associated bivalve species *Crassostrea cutuckensis* (Newton & Smith), *Saccostrea cucullatea* (Born) were present during low water mark at high water mark to till low water mark, locality is about 100-150 m away from the village on the western side, there was one small natural protected jetty on the rock basement for the landing fish catch, during second survey whole muddy platform fulfill by stones granules and brick of Pisces, domestic water discharged occurred. Mangrove: *Rhizophora mucronata*, *Ceriops tagal*, *Avicennia alba*.

Site-II Waral
(Lat. 18°12.111"North and Long. 073°03.176" East). The back water soft muddy region, there is exposed inter-tidal mudflat about 5-10m during low tide, the locality is on eastern side away from the village about 150-200m, so there is domestic discharge occurrence, in dense large mangroves trees were present like *Avicennia alba* Blume, and *Sonneatia alba* J.Smith. Mangrove: *Avicennia alba*, *Sonneatia alba*.

Site-III Mendadi
(Lat. 18°11.036" North and Long. 073°02.999" East). The back water swamp muddy region, there is exposed inter-tidal mudflat about 40-50m during low tide, the locality about 10-15m away from the village on the southern side, dense large mangroves trees *Sonneratia alba* J. C. Smith were dominant, oysters were present on the black rocks, the village is attached to the locality due to there is domestic discharged, no fishing activates. Mangrove: *Sonneatia alba*, *Acanthus ilicifolius*.

Site-IV Pabhara
(Lat. 18°09.617" North and Long. 073°05.804" East). The back water soft muddy region, there is exposed inter-tidal mudflat about 5-10m during low tide, on western side far away from the village the locality is about 100-150m, in dense small mangroves trees *Sonneatia alba* J.Smith., were present with pebbles in the soft mud, due to the nearest village there is domestic discharge occurred, fishing activities were occurred by boat. Mangrove: *Sonneatia alba*.

Site-V Nigadi
(Lat.18°10.391"North Long. 073°05.263"East). The back water swampy muddy, there is exposed inter-tidal mud flat about 10m during low tide, region opens with in dense large mangroves trees *Avicinia marina* (Forsk.) Vierh., during the low tide, pebbles were present in the mud, there is no domestic discharge occurred, no fishing activities were occurred.
Mangrove: *Avicinia marina*.

Live animals collected by handpicking including mangrove associated gastropod species during low tide. Five quadrates of nylon rope each 1-m² was prepared, randomly at each locality

just over the bed. Twice in each season post-monsoon, winter and summer October 2013 to September 2014. Soon after fishing, they were brought to the laboratory and the shells were brushed to clean the fouling biomass and mud. They were then stocked in filtered seawater pumped in the laboratory from the localities for observation then animal preserved in 70% alcohol for taxonomical identification of morphological characters of typical animal, especially, lunal, umbo, and operculum. Internal parts teeth. The shells were identified from Zoological Survey of India, Kolkata. Also using the following references: Annotated checklist of Indian Marine Molluscs (Cephalopoda, Bivalve and Scaphopoda) Part-1 Ramakrishna and A. Dey. Occasional Paper no. 320, ZSI -2010. Guidance of Dr.Sherly Slack, Australia.

3. Results

Finally the gastropods are recorded from the selected localities of Raigad district coast during the study period. According to graph no II - Total 05 Orders, 05 families, 11 genus and 11 species, were recorded. The Order Archaeogastropoda belongs to one family Neritidae belongs to four species. Order Mesogastropoda belongs to one family Potamididae belongs to two species. While Order Neogastropoda belongs to one family Nassariidae belongs two species. Order Basommatophora belongs one family Ellobiidae belongs one species. And Order Systellommatophora belongs one family Onchidiidae belonging two species. The study sites have rich gastropod diversity. It is an indicates more diversity in muddy habitats. The order Archaeogastropoda is dominantly 04 species recorded. The gastropods are playing a vital role in the homeostasis. According Shannon diversity index (H) = 1.603 while Evenness is the 0.996 ≈1.

Table 1: Showing the Shannon Wiener diversity Index of study localities.

No. of sample	pi=sample/sum	ln (pi)	pi*ln (pi)
11	0.234	-1.452	-0.339
9	0.191	-1.655	-0.316
9	0.191	-1.655	-0.316
9	0.191	-1.655	-0.316
9	0.191	-1.655	-0.316
sum=47			Sum = -1.603

H=1.603

H_{max}= ln(N) = ln(5)=1.609

Evenness = H/H_{max} = 1.603/1.609 =0.996 ≈1

Result: Shannon diversity index (H) = 1.603

Evenness = 0.996 ≈1

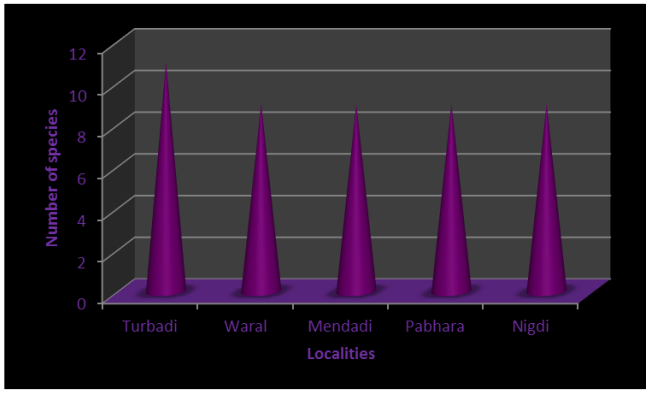

Fig 1: According to localities occurrence of gastropods on Raigad coast.

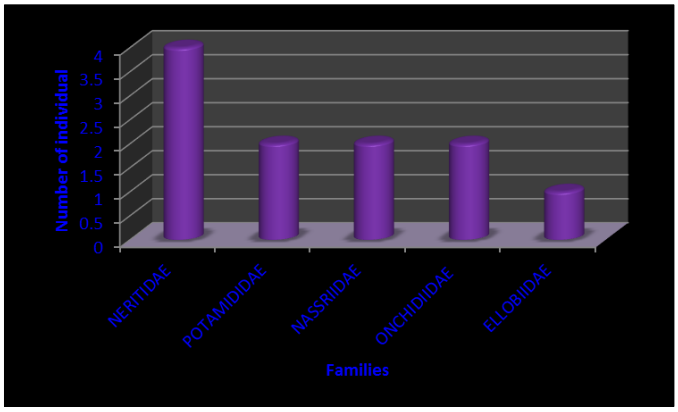

Fig 2: According to family occurrence of gastropods on Raigad coast.

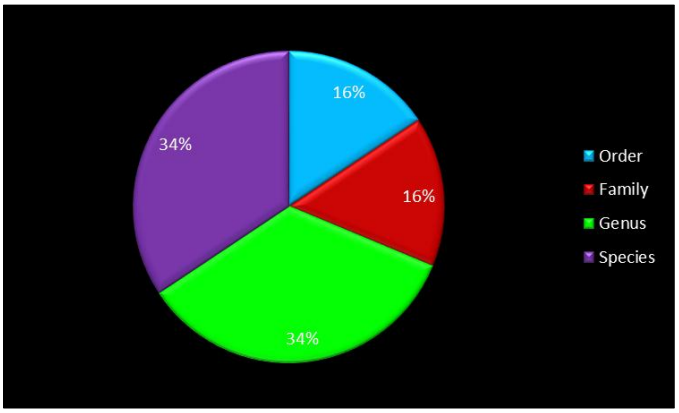

Fig 3: Taxonomical Identification of class gastropoda on Raigad coast.

According to study site I- Turbadi has maximum diversity, have dense forest of the mangrove trees in swampy area, therefore there biodiversity is rich, so across the study sites Turbadi was recorded higher numbers of gastropods. Acording to graph-II probably due to muddy habitat family Neritidae, and Nassariidae found more diversity. The *cerithidae cingulata* species were densely beds occurred on the mud banks, mud flats, sandy muddy area swamps, prop-roots and pneumatophores. The SCUBA one is the important tool used for this study, if needed with the help of SCUBA equipment use to dive underwater vertically and horizontally from the various kinds of zones of the Sea for to collect alive species.

4. Discussion

The diversity of gastropods molluscs at five localities of Raigad district coast varies significantly. The pulmonate snail *Cassidula nucleus* has been studied from Pichavaram mangroves [8]. The *Nerita (Dostia) crepidularia* in vellar estuary mangroves, its having a variety of habitats mangroves plant on the stems, intertidal mudflat during the high tide time animals moving to plant stem after that during low tide time animals moving to mud flats [9]. The lowest density was in the month of July because of monsoon season. In monsoon, due to self-dilution of the body fluid, the sensitive molluscs were unable to adjust the fluctuating osmotic balance quickly hence their mortality was high. After the month July because of adjustment, the mortality rate of molluscs decreased gradually. As a result, density of molluscs increased. It also understood that in the month of July, the salinity and temperature dropped down which made the

condition adverse for the molluscs [10]. The population density was at its peak in the month of November during post monsoon period. It is clearly noticed by many research workers that the post monsoon period is the most favorable time for the new inflow of molluscan species. The mangroves support high density of every type of molluscan species especially, *Telescopium*, *Potamides*, *Natica*, *Nerita*, and *Littorina* and *oysters*. The *Littorina sp*. was densely found on the trunks, pneumatophores as well as on stilt roots of mangrove plants. It is good harvesting place for variety of molluscan species [7].

The gastropods are generally benthos organism and they are regularly used as bio-indicators of aquatic healthy. These species can produce a billion of larvae in the form of planktons that sustains the biotic population & they have an essential role in food chain, & energy flow. The observation of these species populations in mangrove ecosystem is important to evaluate their condition [11]. In the region of *Nerita (Dostia) crepidularia*, *Littorina sp*, *Cerithidea sp*, were observed to the mud banks, mudflats, mangrove forest, sandy muddy area swamps, prop-roots and pneumatophores. *Telescopium telescopium* were found in the mud flats of mangroves plants.

The gastropoda can reach high biomass in mangroves ecosystem because of high primary production within the food web, as predators, herbivores, detritivores & filter feeders. The numerical abundance & biomass of molluscs can be equally impressive. The numerous investigation of mangroves associated molluscs in the world wide, The 39 gastropods species recorded from Australian mangroves [12]. The total account 23 molluscs species from the mangrove forest in Hong Kong [13]. The 44 species of Sematan mangrove forest of Malaysia recorded [14]. A total account of Sundarban 56 species of molluscs 31 gastropods & 25 bivalves recorded [15]. The 12 bivalve & 13 gastropods mangrove associated at Ratnagiri recorded [16].The 39 gastropods from 15 families recorded from Raigad district coast [17]. Gastropods are typically one of the dominant and most conspicuous macro fauna in mangrove systems, and occupy wide range of ecological niches.

5. Conclusion

The mangrove associated diversity of gastropod molluscs from selected five study sites of Raigad district coast varies significantly. At the study site I have greater diversity & commercial value importance. The total number & type of molluscs probably is influenced by their habitat & geographical condition, probably have suitable habitat to support rich diversity, also commercial & ecological molluscan importance. The order Archaeogastropoda has more diversity as well as dominantly with five families and eleven species recorded. On the locality I there *Telescopium telescopium* found which is this species is pollution indicators. The gastropods have a significant ecological role to play in the mangrove ecosystems, It is necessary to taxonomical study and the diversity of the group of threatened ecosystems. There is an urgent need conservation & sustainable utilization of gastropods.

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