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A SURVEY ON DIVERSITY OF GASTROPOD SHELLS INHABITED BY HERMIT CRABS IN DHARMADAM COAST, KANNUR DISTRICT, KERALA, INDIA

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ABSTRACT
The present study was carried out in an attempt to understand and measure the status of the diversity of gastropod shells inhabited by Hermit crabs in Dharmadam Coast, Kannur district, Kerala, India. Samples were collected by handpicking during low tide at intervals for three months from November 2020 to January 2021. During the study a total of 15 species of gastropod shell belonging to 1phylum, 1 class, 4 orders, and 11families were identified. Of these, 7 species belong to the order Neogastropoda, 4 species to Littorinimorpha, 3 species to Caenogastropoda, and one species belong to Trochida. According to their family level, 3 species belongs to family Muricidae, 2 species each were reported from families Olividae and Turritellidae, and one species each belongs to the remaining 8 families. The variation in abundance of gastropods at the Dharmadam coast could have resulted from anthropogenic activities.It is a preliminary study on gastropod shell diversity. Further studies are needed for detailed exploration of the gastropod fauna, its habitat and threats being experienced by these organisms.

KEYWORDS: Gastropods, Molluscs, Diversity, Shell pattern, Dharmadam Coast.

INTRODUCTION
The phylum Mollusca is an extraordinarily varied phylum with estimates of 80,000 –100,000 delineated species and total diversity possibly as high as 200,000. They are second to the arthropods in species richness. The largest molluscan classes are Gastropoda and Bivalvia they are successfully colonized in continental waters.[1] India has recorded 5070 types of Mollusca and among them 3370 species were from marine territories.[2]From the Molluscs that were identified so far from the marine habitat of India, (220 families and 591 genera) 1900 were gastropods, 1100 were bivalves, 210 were cephalopods, 41 were polyplacophores and 20 were scaphopods.[3,4] Molluscs are one of the important communities of many ecological communities. They prove immensely beneficial both economically and medicinally.[5] They have been important to humans as a source of food, jewelry, tools, and even pets.[6]

Gastropods are algal feeders, detritivores, and deposit feeders.[7,8] They are soft-bodied animals, covered by a single coiled and calcareous shells varying in shape, size, and color. Gastropods are economically important as a source of protein, decorations, dye, and medicines.[9-11]Most of the gastropods lay egg capsules, and development is intracapsular with embryos emerging as crawling juveniles. Gastropods generally have one helically coiled shell; within that ground plan, there is immense variation in shape, size, ornamentation, coiling direction, and pigmentation. Having a single shell for the lifetime of the animal typically means that the same basic morphology must function over several orders of magnitude in size, from a planktonic larval stage to a large benthic animal. Gastropod shells develop by expanding their number of curls, or whorls, by exclusively developing at their opening. An outcome of this development design is that past whorls are held, recording the ontogenetic example of development.[12-15]

Hermit crabs are decapod crustaceans most of which have non-calcified abdomens requiring protection from predation. Inhabiting empty gastropod shells serves to guard most of the more than 800 delineated species of hermit crabs within the Superfamily Paguroidea, nearly all of that are marine.[16] The acquisition of an empty gastropod shell by a hermit crab brings the shell in a very sense ‘‘back to life’’ in this it has returned to its original mobile state. This capacity of hermit crabs to securely inhabit in gastropod shells is the result of a long evolutionary process that fashioned morphological compatibility between hermit crabs and snail shells.[17, 18]

MATERIALS AND METHODS

The present study was carried out in an attempt to understand and measure the status of the diversity of gastropod shells inhabited by Hermit crabs in the Dharmadam coast, Kannur district, Kerala, India.

Study Area

Dharmadam beach is lying in Dharmadam village near Thalassery in Kannur District, Kerala (Figure 1). It lies 100 meters from the mainland at Dharmadam. The beach is filled with fine-grain sand. Laterite rocks are present everywhere on the coast and sea. It is situated just south of the Muzhupilangad beach, which is the only drive-in beach in Kerala. It is a good fishing area. Fishes and mussels are collected from here and marketed by local people. Dharmadam beach is also an exposed beach with a mixed type of sediment composition; rocky and sandy. It is a very long and clean beach. The characteristics of the beach sand are fine with darker in color and adhering with scattered laterite rock formations, 15-30 m of the beach from high (HTM) to low (LTM) will be exposed at low tide time.[19]

Fig 1: View of Dharmadam Beach.

Data Collection

Samples were collected by handpicking during low tide at intervals for three months from November 2020 to January 2021. Fresh specimens were washed the hermit crabs were removed using forceps and needles. Shells were cleaned using a brush and washed with tap water to remove the algal film, other crustaceans, and debris. They were transferred to the clean polythene bags; one sample per bag and were brought to the laboratory.[20]

Identification of Gastropod Shell

Photographs of the collected shells were taken by using Realme Narzo 20 mobile. Identification of gastropod shells was based on morphological characteristics such as shape, spiral length, and shape, mouth opening, operculum shape, umbilicus shape, and size and color. Identification of species was based on the taxonomic key of Franklin and Laladhas[21] and Bijukumar.[22] Validity of the species names was also reviewed from the World Register of Marine Species (WoRMS) database. The shells, which are identified, are dried and cleaned. The external features of the shells were noted and similar ones were grouped.

RESULTS AND DISCUSSION

The present work aims on studying the diversity and distribution of gastropod shells inhabited by Hermit crabs in the Dharmadam coast, Kannur district, Kerala, India. During the study, a total of 15 species of gastropod shell belongs to 1phylum, 1 class, 4 orders, and 11 families were identified. Results of gastropod diversity are given in Table 1.

Table 1: Diversity of Gastropod Shells Inhabited by Hermit Crabs in Dharmadam Coast.

Sl No.	Scientific Name	Order	Family
1	*Thais lacera*	Neogastropoda	Muricidae
2	*Thais bufo*	Neogastropoda	Muricidae
3	*Thais tissoti*	Neogastropoda	Muricidae
4	*Babylonia spirata*	Neogastropoda	Babyloniidae
5	*Oliva gibbosa*	Neogastropoda	Olividae
6	*Agaronia sp.*	Neogastropoda	Olividae
7	*Pugilina cochlidium*	Neogastropoda	Melongenidae
8	*Tibia curta*	Littorinimorpha	Rostellariidae
9	*Gyrineum natator*	Littorinimorpha	Cymatiidae
10	*Bursa granularis*	Littorinimorpha	Bursidae
11	*Littorina littorea*	Littorinimorpha	Littorinidae

12	*Turritella acutangula*	Caenogastropoda	Turritellidae
13	*Turritella attenuata*	Caenogastropoda	Turritellidae
14	*Telescopium telescopium*	Caenogastropoda	Potamididae
15	*Trochus radiatus*	Trochida	Trochidae

From the results obtained from the present study, it could be stated that Order Neogastropoda was dominant among the 4 orders with 7 species. The species were *Thais lacera*, *Thais bufo*, *Thais tissoti*, *Babylonia spirata*, *Oliva gibbosa*, Agaronia sp., *Pugilina cochlidium* (Fig 2 to 8). Following the order, Neogastropoda was order Littorinimorpha that comprised of 4 species viz., *Tibia curta*, *Gyrineum natator*, *Bursa granularis*, *Littorina littorea* (Fig 9 to 12). Followed by Littorinimorpha is Caenogastropoda with 3 species (*Turritella acutangula*, *Turritella attenuata* and *Telescopium telescopium*) (Fig 13 to 15). Order Trochida recorded one species (*Trochus radiatus*) (Fig 16).

Fig 2: *Thais lacera*

Fig 3:*Thais bufo*

Fig 4: *Thais tissoti*

Fig 5: *Babylonia spirata*

Fig 6: *Oliva gibbosa*

Fig 7: Agaronia sp.

Fig 8: *Pugilina cochlidium*

Fig 9: *Tibia curta*

Fig 10: *Gyrineum natator*

Fig 11: *Bursa granularis*

Fig 12: *Littorina littorea*

Fig 13:*Turritella acutangula*

Fig 14: *Turritella attenuata*

Fig 15: *Telescopiumtelescopium*

Fig 16: *Trochus radiates*

A similar study was conducted by Pawar and Tawaha[20] on the biodiversity of marine gastropods along the Uran coast, Navi Mumbai, west coast of India. The study reported a total of 60 species of gastropods belonging to 38 genera, 25 families, and 8 orders from the Uran coast. The family Muricidae, Neritidae, Trochidae, Bursidae, Cypraeidae, Lottidae, Turbinidae, Cerithidae, Potamididae, Naticidae, Conidae and Volemidae were recorded among the families Muricidae is the dominant one. In the present study, 4 similar families were reported. They are Muricidae, Trochidae, Bursidae, and Potamididae. In the current study also Muricidae family is dominated by 3 species. A study conducted by Susilo*et al*.,[23] revealed 118 individual gastropoda consist of five families and six species. In the present study, a total of 15 Gastropod shells were identified, which belong to 4 Orders and 11 families were recorded.

In the present study, it could be stated that Family Muricidae was dominant among the 11 families with 3 species viz., *Thais lacer*, *Thais bufo* and *Thais tissoti*. Following the family Muricidae was family Turritellidae and Olividae both comprised of 2 species viz., *Turritella acutangula* and*Turritella attenuata* in Turritellidae and *Oliva gibbosa* and Agaronia sp in Olividae. Family Potamididae (*Telescopium telescopium*), Family Rostellariidae (*Tibia curta*), Family Cymatiidae (*Gyrineum natator*), Family Bursidae (*Bursa granularis*), Family Babylonidae (*Babylonia spirata*), Family Melogenidae (*Pugilina cochlidium*), Family Trochidae (*Trochus radiatus*), Family Littorinidae (*Littorina littorea*) comprised of one species each.

The number of species found in the study area was less than the result of the research conducted by David,[24] who found as many as 86 species in 16 sampling locations in India. In 2015 Jumawan *et al*., [25] found 31 species of gastropod shells on the island of Mindanao, Philippines. Cahyadi *et al*., [26] studied on Biodiversity of Gastropods in Intertidal Zone of Krakal Beach, Gunungkidul, Yogyakarta. This study found 7 families from Gastropod in the intertidal zone of Krakal beach, those are Aplustridae, Conidae, Cypraeidae, Mitridae, Muricidae, Nacellidae, and Turbinidae. Similar to these observations, the family Muricidae was recorded to be dominant in the current study.

Gastropods of American Samoa comprised 385 species belonging to 90 genera and 16 families.[27] There were 895 species of gastropods reported from Guam by Smith [28] and the 1000 species in New Caledonia by Bouchet *et al.*,[29] 1380 species from Guam by Carlson and Hoff[30] and Paulay,[31] 91 species from Anambas and Natuna Islands in the South China Sea was reported by Tan and Kastoro.[32] Likewise many studies have been conducted by different workers at the world level on distribution of gastropods. In Tamil Nadu coast, 15 species of gastropods from 11 genera and 8 families were recorded in Portono, Parangipettai by Arularasan and Kasinathan.[33] Mohanasundaram[34] recorded 40 species of gastropods, 32 species of gastropods were recorded in Pazhayar and Cuddalore by Sivakumar.[35] There were 59 species of gastropods from 35 genera and 25 families in Mudasal Odai and 57 species from 35 genera and 25 families have been recorded from Cuddalore by Babu.[36] These observations were in parallel to the observations of the present study.

The number of gastropod species is comparatively less in the present study area. This may be due to climatic changes, pollution, tide, and shore morphology. Human consumption and other use of gastropods like shell consumption also reduce the diversity of gastropod fauna. Physical factors, food resources, and anthropogenic disturbances also affect the water quality which may reduce the diversity of gastropod species. Since no earlier reports are available on species diversity of gastropods from the Dharmadam coast, Kannur district, Kerala. So data presented here can be taken as baseline data in knowing the status of gastropods and for further examination.

CONCLUSION

In the present study, the results showed that the Dharmadam coast harbors a diverse group of gastropods. Gastropod species belonging to family Muricidae were dominant followed by families Turritellidae and Olividae over all the families recorded in the study. Variation in the abundance of species may result from anthropogenic activities. Activities like overharvesting, habitat loss, disposal of sewage, wastes and effluents, sedimentation and tourism will affect the coastal ecosystem. Further long term research is needed to explore the diversity of gastropod, population estimation, its habitat, seasonal

variations and threats being experienced by these animals.

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