

Selected deep sea species taxonomy of gastropoda and echinodermata, off Andaman and Nicobar Islands

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Abstract

Center for Marine Living Resources and Ecology (CMLRE), Ministry of Earth Sciences (MoES), Kochi conducted FORV Sagar Sampada Cruise 334, Leg II around the Andaman and Nicobar Islands between the time period of 23rd January 2015 and 12th February 2015 and samples were collected from 19 stations situated in 9 transects. Among these 19 stations, dredging operations were carried out for 9 stations and bottom trawl operation was carried out for 3 stations. However, samples brought to on board by only two operation of bottom trawl and three operations of dredge. Among the collected samples in these operation, the Gastropoda and Echinodermata was studied for its taxonomy and distribution. Seven Gastropoda and five echinodermata were identified from these collected specimens. Two specimens were identified as *Mammilla melanostoma* and *Granulifusus kiranus*. Four specimens were identified upto the genus level, i.e., Genus *Conus*, Genus *Mitra*, Genus *Gemmula*, Genus *Calliostoma* and specimen able to identified up to family level, i.e. from the Family Terebridae. Among the identified five echinoderms, the two sea star belong to the Genus *Astropecten* and Genus *Tessellaster*. The remaining three brittle star, one each belong to Family Ophiopodidae and Family Ophiomyxidae. The last one belong to Genus *Ophiothrix*. The among these 12 specimens, two gastropoda and Family Ophiopodidae specimens of echinodermata were observed more than 500m depth. The remaining four echinodermata and five gastropoda observed in less than 500m depth.

Keywords: Classification, Marine Animals, Gastropoda, Echinodermata

Introduction

The deep sea constitutes a special habitat by its unique ecological features in the biosphere. The deep sea system is mainly divided into two main regions namely, an upper archibenthic and a lower abyssal benthic. The archibenthic zone extends from the sublittoral zone (200 meters) to about a depth of 800-1100m. The abyssal benthic zone is composed of the entire benthic zone below the archibenthic zone. All the population below the littoral zone are considered as the deep sea fauna.

The most striking feature of the deep sea system is its changelessness. There is nothing to mark the flight of time. There are no well-defined seasons and remarkably constant conditions prevail day in and day out. These conditions have tremendous influence on the development and existence of organisms. Such habitats with special conditions are subjected to an ecological principle known

as “Theinmann’s principle”. According to this principle, the more isolated and specialized the habitat becomes poor in its diversities, but richer in individuals with astounding peculiarities.

The immense pressure, perpetual darkness, low temperatures and scarcity of food are some of the essential features of the deep-sea systems. These harsh conditions are not favourable to support life. However, deep sea fauna show remarkable adaptations, which enable them to survive the harsh conditions of the deep sea. The weak nature of the skeleton of deep-sea forms is due to the inability to synthesise calcium at lower temperatures that prevail in the ocean depths. The deep-sea molluscs are known for their fragile shells. Deep sea Lamellibranchs and gastropods are very small and they do not reach even a moderate size. Absence of food explains the dwarf nature of deep sea animals. Another remarkable feature

of the deep sea forms is the presence of colours. Red colour seems to predominate over the others. Dark violet and brown colours are also common.

Deep sea animals are mainly dependent on the organic matters as a food, dropping like gentle rains from the surface. The ageless uniformity of the deep sea environment has reduced the inter-specific competition to the minimum and hence the deep sea, constitute a sort of refuge for certain archaic forms of life. Some of the echinoderms, particularly the sea urchins, which were thought to be extinct, have been found in the depths. O'Hara and Harding (2015) were stated that the knowledge about diversity existed in the deep sea is inadequate. Even, new species were identified well sampled regions of deep sea also. Further, the findings are also challenged our concept of evolutions.

The phylum Echinodermata, a true ocean realm species, among them few are available under the reduced salinity conditions (Pawson et al., 2009). If habitats are suitable, the echinoderms can form populations of enormous size, and they can dramatically affect the general economy of the benthos (Pawson et al., 2009). There are approximately 6700 living species, and about 13,000 fossil species are known ranging from the lower Palaeozoic (Pawson, et al., 2009). Most sea stars are epibenthic, but numerous species burrow into soft substrates. Some sea star are capable of using their suctional tube feet to open oysters, clams and scallops (Pawson, et al., 2009). The scavenging and predator habit was observed in the brittle stars also. Some are feed aggregations and suspension feed ans some are capturing prey with their tube feet.

Among the animal kingdom, next to insects, the class Gastropoda exhibit a vast number of species. The fossil were found from the period late Cambrian onwards. Out of 721 families, 245 familis were available only as a fossil record. (Bouchet et al., 2017). The remaining 476 families having around 80,000 living snails and slug species (Bouchet et al., 2005). Eventhough this class has an extraordinary diversification of habitats, most of these groups studied to intertidal to shallow water environments. The deep sea environment distributions and diversity are less known, that also particularly from the seas of India.

So, the present study is an attempt to understand the deep sea species diversity in large and in particular, Gastropoda and Echinodermata of Bay of Bengal and Andaman Sea.

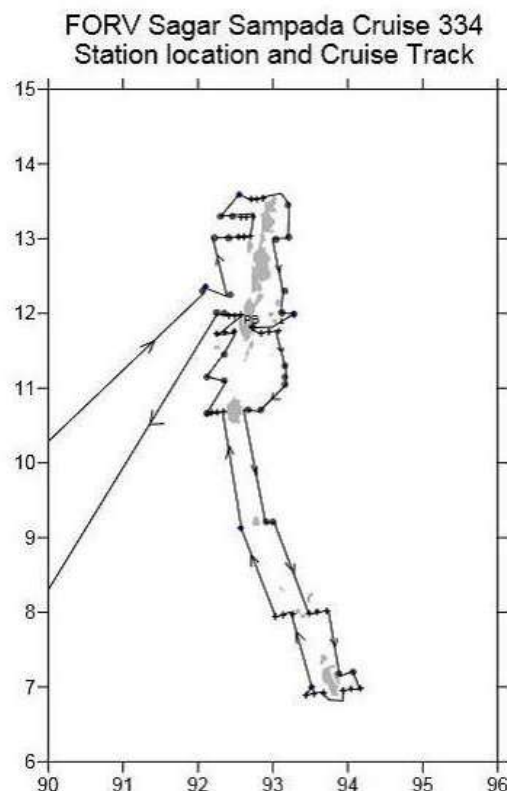


Fig.1. Study Area

Material and Methods

Center for Marine Living Resources and Ecology (CMLRE), Ministry of Earth Sciences (MoES), Kochi conducted FORV Sagar Sampada Cruise 334, Leg II around the Andaman and Nicobar Islands between the time period of 23rd January 2015 and 12th February 2015 with the following objectives such as to study the environment and productivity, marine benthos and assessment of demersal fishery resources. During the cruise, 19 stations were covered along with 9 transects in Bay of Bengal and Andaman Sea. The samples were collected along the Andaman waters between the Latitude 06°17' N to 10°48' N and Longitude 92°11' E to 94°49' E. Even though dredging operations were carried out for 9 stations and bottom trawl was operated at 3 stations,

only three dredge stations and two bottom trawl stations provided samples on deck. among the collected samples only gastropoda and echinodermata has been identified and reported in this work (Table 1). The collected biota

of the deep sea samples were identified upto the level of Family, Genus and Species, due to limited species number as well not having much elaborate key for this particular species concern.

Table 1. Stations locations and details of operations

Location	Station No.	Lat (N)	Long (E)	Date	Depth (m)	Operation
Off Hut Bay (Bay of Bengal)	2A	10°47'.250"	92°08'.690"	26.01.2015	460	Bottom Trawl
Off Terrsa Island (Bay of Bengal)	4B	09°13'.243"	92°40'.286"	28.01.2015	250	Dredge
Off Car Nicobar (Bay of Bengal)	5B	09°17'.762"	92°54'.542"	28.01.2015	350	Dredge
Off Terrsa Island (Andaman Sea)	7A	08°19'.360"	93°19'.154"	29.01.2015	660	Bottom Trawl
Off Campbell Bay (Indian Ocean)	16B	07°37'.750"	93°24'.030"	03.02.2015	572	Dredge

Results

The samples collected from the deep waters were identified on the following taxonomic character upto Family or Genus or Species Level. The keys used for this

work are as follows: Subbarao, 2003; Hadorn et al., 2005; Pomory, 2007; Raghunathan et al., 2013; Gondium et al., 2013; WoRMS, 2018; OBIS, 2018; Shell Catalogue, 2018.

SPECIMEN 1 – MABO P001 (Fig.2)

Systematic Position



Fig.2 *Mammilla melanostoma*

TAXONOMY

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Sub-Class: Caenogastropoda

Order: Littorinimorpha

Super Family: Naticoidea

Sub Family: Polinicinae

Genus: *Mammilla* SCHUMACHER, 1817

Species: *Mammilla melanostoma* (GMELIN, 1791)

TYPE LOCALITY – Andaman Sea, Andaman and Nicobar Islands

DEPTH RANGE – Collected from 250 m. – Off Terrasa Island, Bay of Bengal (St.4B)

MEASUREMENT (mm)– Length 23 , aperture length 20, aperture width 12

DESCRIPTION – Shell of medium size, up to 35 mm in length, not thick, pyriformly ovate, spire short with a blunt apex. Aperture large, oblong semilunar, parietal callus folded partly covering the wide and deep umbilicus.

DISTRIBUTION – India- Lakshadweep: Minicoy Island; Tamil Nadu, Pondicherry (common), Andamans (rare). South Africa to Japan and Hawaii.

SPECIMEN 2 - MABO P002 (Fig.3)



Fig.3 *Conus* sp.

SPECIMEN 3 – MABO P003 (Fig.4)



Fig.4 *Granulifusus kiranus* SHUTO 1958

TAXONOMY

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Sub-Class: Caenogastropoda

Order: Neogastropoda

Super Family: Conoidea

Family: Conidae

Genus: *Conus* LINNAEUS, 1758

TYPE LOCALITY - Andaman Sea , Andaman and Nicobar Islands

DEPTH RANGE – Collected from 250 m. Off Terrasa Island, Bay of Bengal (St.4B)

MEASUREMENT (mm) –Total length 36, aperture length 29 , aperture width 3 .

DESCRIPTION – shell of medium length, cone shaped, spire low, aperture long and extending along the whole length of the body whorl, inner and outer lip almost parallel, outer lip is smooth, 5 whorl in spire and 4 suture.

DISTRIBUTION –Andaman and Nicobar Islands, Indo-Pacific, Red Sea.

TAXONOMY**Kingdom:** Animalia**Phylum:** Mollusca**Class:** Gastropoda**Sub-Class:** Caenogastropoda**Order:** Neogastropoda**Super Family:** Buccinoidea**Family:** Fascioliidae**Subfamily:** Fusinae**Genus:** *Granulifusus* KURODA & HABE 1954**Species:** *Granulifusus kiranus* SHUTO 1958**TYPE LOCALITY** - Andaman sea, Andaman and Nicobar Islands.**DEPTH RANGE** – Collected from 250m – Off Terrasa Island, Bay of Bengal (St.4B).**SPECIMEN 4 - MABO P004 (Fig.5)****Fig.5** *Mitra* sp.**TAXONOMY****Kingdom:** Animalia**Phylum:** Mollusca**Class:** Gastropoda**Sub-Class:** Caenogastropoda**Order:** Neogastropoda**Super Family:** Mitroidea**Family:** Mitridae**MEASUREMENTS (mm)** – Length -51, aperture length- 30, aperture width- 9**DESCRIPTION** – Shell of medium size, light weight, fusiform, spire slender, consisting of 6 convex whorls, siphonal canal short and broad. Spiral sculpture on upper whorls fine and inconspicuous, axial sculpture usually predominant, close-set and strong. On later whorls the opposite: spiral sculpture predominant, axial sculpture finer. 6 distinct suture. Aperture ovate, relatively large, upper end pointed, white. Outer lip convex, slightly crenulated, inside sculptured with fine, close-set internal lirae. Inner lip smooth, slightly glossy, parietal callus thin, extending on parietal wall, attached, underlying spiral sculpture still visible. Siphonal canal short, slightly curved, broad, widely open. Outer side sculptured with fine spiral threads. Operculum typical of genus, reddish-brown.**DISTRIBUTION** – Western Pacific, from central Honshu in the north to western Australia in the south. Indonesia and New Caledonia .**Subfamily:** Mitrinae**Genus:** *Mitra* Lamarck ,1798**TYPE LOCALITY** – Andaman Sea, Andaman and Nicobar Islands.**DEPTH RANGE** - Collected from 572m Off Great Nicobar, Indian Ocean (St.16B)**MEASUREMENT(mm)** – Length -29, aperture length -17, aperture width -5

DESCRIPTION – shell small, spire smaller than aperture, elongately fusiform shell, whorls 5, whorl 13 mm, 5

suture distinct, colour creamy yellow, operculum whitish, outer lip plane, columella contain three columellar folds.

DISTRIBUTION – Andaman Sea

SPECIMEN 5 – MABO P005 (Fig.6)

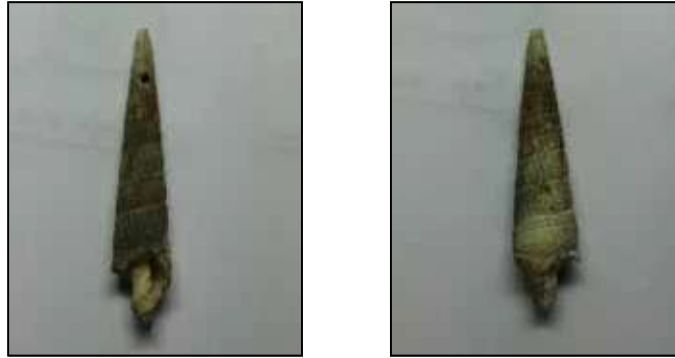


Fig.6 Terebridae

TAXONOMY –

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Sub-Class: Caenogastropoda

Order: Neogastropoda

Super Family: Conoidea

Family: Terebridae

TYPE LOCALITY – Andaman sea, Andaman and Nicobar Islands

DEPTH RANGE - Collected from 250 m.

Off Terrasa Island, Bay of Bengal (St.4B).

MEASUREMENT (mm) – Total length 36 , aperture length 10 , aperture width 2

DESCRIPTION – spire contain 21 whorls , 20 distinct suture , pointed spire , aperture small .

DISTRIBUTIONS – Off Terrasa Island, Bay of Bengal (St.4B). In the tropics the majority occur intertidally and in the shallow subtidal, down to about 40 metres. Subtidal species, down to about 350 metres.

SPECIMEN – 6 – MABO P006 (Fig.7)



Fig.7 Gemmula sp.

TAXONOMY

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Sub-Class: Caenogastropoda

Order: Neogastropoda

Super Family: Conoidea

Family: Turridae

Genus: *Gemmula* Weinkauff, 1875

TYPE LOCALITY – Andaman Sea, Andaman and

Nicobar Islands

DEPTH RANGE - Collected from 572m

Off Great Nicobar, Indian Ocean (St.16B)

MEASUREMENTS (mm) - length-49, aperture -20, aperture width -8.**DESCRIPTION** - Shell of medium size upto 50 mm in height, solid, spire high, more than half the total height, body cream in colour, aperture white, aperture straight, columella smooth, 13 whorls in spire, suture 10, outer lip thin, siphonal canal short, sculptured with strong spiral cord with close set gemmules.**DISTRIBUTION** - Andaman and Nicobar Islands**SPECIMEN 7 – MABO P007 (Fig.8)****Fig.8** *Calliostoma* sp.**TAXONOMY**

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Sub-Class: Caenogastropoda

Order: Trochida

Super Family: Trochoidea

Family: Calliostomatidae

Sub Family: Calliostomatinae

Genus: *Calliostoma* Swainson, 1840

TYPE LOCALITY – Andaman Sea, Andaman and Nicobar Islands

DEPTH RANGE – Collected from 250 m. From shallow water to bathyal depth.

Off Terrasa Island, Bay of Bengal (St.4B)

MEASUREMENTS (mm) – Total length 17, base width 20, aperture width 10**DESCRIPTION** – four whorls and four sutures, whorl slightly concave, spiral cords with beads, base of the shell slightly convex with 13 spirals which become gradually finer from the umbilicus outward. Aperture situated at the base. Outer lip of aperture thin .**DISTRIBUTION** – Andaman and Nicobar Islands

SPECIMEN 8 – MABO P008 (Fig.9)**Fig.9** *Astropecten* sp.**TAXONOMY****Kingdom:** Animalia**Phylum:** Echinodermata**Sub Phylum:** Asterozoa**Class:** Asteroidea**Super Order:** Valvatacea**Order:** Paxillosida**Family:** Astropectinidae**Genus:** *Astropecten* Gray, 1840**TYPE LOCALITY** – Andaman Sea, Andaman and Nicobar Islands**DEPTH RANGE** – Collected from 350 m

Off Car Nicobar, Bay of Bengal (St.5B)

MEASUREMENTS – Outer Radius - R= 18 mm, Inner Radius - r = 6 mm**DESCRIPTION** - This species have 5 arms. The flattened oral and aboral sides are observed (i.e., carinal plates). The periphery of these plates are larger. The larger supero-marginal and infero-marginal plates appears as block-like. A large spine has observed in the each infero-marginal plate. These spines are projecting horizontally from the upper end and form a peripheral fringe. The three sets of furrow spines are observed.**DISTRIBUTION** – Andaman and Nicobar Islands**SPECIMEN 9 - MABO P009 (Fig.10)****Fig.10** *Tessellaster* sp.

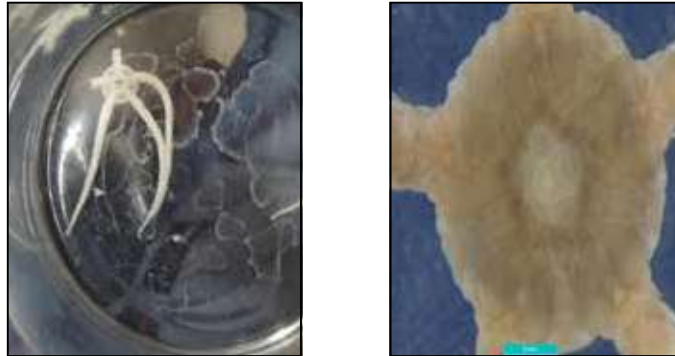
TAXONOMY**Kingdom:** Animalia**Phylum:** Echinodermata**Sub Phylum:** Asterozoa**Class:** Asteroidea**Super Order:** Valvatacea**Order:** Valvatida**Family:** Goniasteridae**Genus:** *Tessellaster* H. L. Clark, 1941**TYPE LOCALITY** – Andaman Sea, Andaman and Nicobar Islands**DEPTH RANGE** – Collected from 460 m.

Off Hut Bay, Bay of Bengal (St.2A)

MEASUREMENT – Outer Radius - R = 14 mm, Inner Radius - r = 4mm**DESCRIPTION** – General form stellate with long arms. The disk is large and inflated, and the arms are very long and narrow. The abactinal plates are arranged in a regular series parallel to the carinals. The abactinal surface extends slightly more than half way down the arm and is limited to the carinals and adradials on the arm. The abactinal plates are small and numerous. Abactinal plates completely covered by granules; The plates of the radial areas are low-tabulate and hexagonal. No secondary abactinal plates. Furrow margins of adambulacral plates strongly angular, becoming apophyses distally. No internal radiating ossicles. No super-ambulacral ossicles.**DISTRIBUTION** - Andaman and Nicobar Islands**SPECIMEN 10 – MABO P010 (Fig.11, 14)****Fig.11 Ophiomyxidae****TAXONOMY****Kingdom:** Animalia**Phylum:** Echinodermata**Sub Phylum:** Asterozoa**Class:** Ophiuroidea**Sub Class:** Myophiuroidea**Infra Class:** Metothiurida**Super Order:** Ophimtegrida**Order:** Ophiurida (Ophicanthida)**Sub Order:** Ophiodermatina**Family:** Ophiomyxidae**TYPE LOCALITY** – Andaman Sea , Andaman and Nicobar Islands**DEPTH RANGE** – Collected from 460 m.

Off Hut Bay, Bay of Bengal (St.2A)

DESCRIPTION – The thick, naked tegment covered the pentagonal disk. The elongated internal margins has observed in the radial shield with an enlarged size. Three spines are observed in each lateral arm plate, without dental papillae and one apical papillae on apex of jaw. The jaw exhibited three enlarged oral papillae.**DISTRIBUTION** –Andaman and Nicobar Island

SPECIMEN 11 – MABO P011 (Fig.12, 15)**Fig.12 Ophiolepididae****TAXONOMY****Kingdom:** Animalia**Phylum:** Echinodermata**Sub Phylum:** Asterozoa**Class:** Ophiuroidea**Sub Class:** Myophiuroidea**Infra Class:** Metothiuirida**Super Order:** Ophimtegrida**Order:** Amphilepidida**Sub Order:** Ophionereidina**Family:** Ophiolepididae**TYPE LOCALITY** - Andaman Sea, Andaman & Nicobar Islands**DEPTH RANGE** - Collected from 660m.

Off Terra Island, Andaman Sea (St.07A)

DESCRIPTION – The circular disc has larger cover with im-bricating scales. The scales further surrounded by smaller scales of different shapes and sizes. The primary plate located in the center are rounded. The triangular radial shields separated distally by three large scales. The imbricating scales covered on ventral interradius, which is slightly smaller and narrower than dorsal scales. The long and narrow bursal slits are observed. The oral shields are pentagonal and elongate. The distal margin is convex. The each side of the jaw angle exhibit four to five oral papillae. Fan like dorsal arm plate with triangular shape. The lateral arm plate has 2 spines and one spine is larger than other.

DISTRIBUTION - Andaman and Nicobar, Brazil, Indo-Pacific.**SPECIMEN 12 – MABO P012 (Fig.13, 16)****Fig.13 Ophiothrix sp.**

TAXONOMY**Kingdom:** Animalia**Phylum:** Echinodermata**Sub Phylum:** Asterozoa**Class:** Ophiuroidea**Sub Class:** Myophiuroidea**Infra Class:** Metothiurida**Super Order:** Ophintegrida**Order:** Amphilepidida**Sub Order:** Gnathophiurina**Super Family:** Ophiactoidae**Family:** Ophiotrichidae**Genus:** *Ophiotrix* MULLER & TROSCHER, 1840**TYPE LOCALITY** – Andaman Sea , Andaman & Nicobar Islands**DEPTH RANGE** – Collected from 250 and 350 m

Off Terrsa Island, Bay of Bengal (St.4B)

Off Car Nicobar, Bay of Bengal (St.5B).

DESCRIPTION – Disc circular, covered by spine and granules. Presence of a clump of dental papillae at the apex of the jaw, oral papillae absent. Disc bearing spines, the arm spine slender, thorny, much longer than the arm segments. Each segment contain 12 spines, radial shield triangular, close to each arm (Fig.16).

DISTRIBUTION – Andaman and Nicobar Island**Discussion**

The samples which were collected from deep sea benthic environment were studied to understand the distribution and diversity of organism in the particular environment. Twelve samples were studied in detail for their taxonomic identification and distribution pattern. Out of 12 samples, 7 belong to Phylum Mollusca and 5 to Phylum Echinodermata. The samples were identified up to the levels of Family, Genus and Species depending upon the availability of identifying keys.

Table 2 Species distribution with reference to stations

Location	Station No.	Identified Fauna	Depth (m)	Operation
Off Hut Bay (Bay of Bengal)	2A	<i>Tessellaster</i> Ophiomyxidae	460	Bottom Trawl
Off Terrsa Island (Bay of Bengal)	4B	<i>Mammilla melanostoma</i> <i>Conus</i> <i>Granulifusus kiranus</i> Terebridae <i>Calliostoma</i> <i>Ophiotrix</i>	250	Dredge
Off Car Nicobar (Bay of Bengal)	5B	<i>Astropecten</i> <i>Ophiotrix</i>	350	Dredge
Off Terrsa Island (Andaman Sea)	7A	Ophiolepididae	660	Bottom Trawl
Off Campbell Bay (Indian Ocean)	16B	<i>Mitra</i> <i>Gemmula</i>	572	Dredge

All the 7 samples of Phylum Mollusca belong to Class Gastropoda. Identified gastropods belong to three Orders and seven Families (Table 2). Out of seven gastropoda, one was identified up to the Family level, four up to Genus level and other two up to Species

level. The identified three Orders are Littorinimorpha, Neogastropoda and Trochida. The Order Littorinimorpha specimen was identified as Family Naticidae, Genus *Mammilla* and Species *Mammilla melanostoma*. The five specimens belong to Order Neogastropoda. The identified

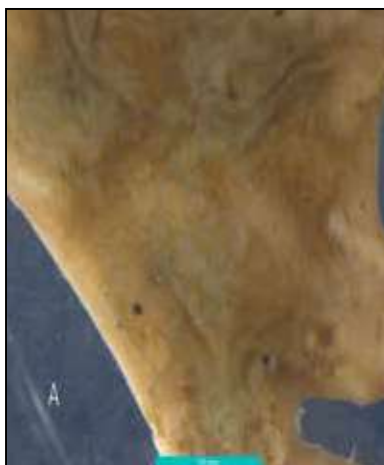
Families are Conidae, Fascioliariidae, Mitridae, Terebridae and Turridae. Family Conidae specimen was further identified as a Genus *Conus* and named as *Conus* sp. The species from Family Fascioliariidae belong to the genus *Granulifusus* and identified as *Granulifusus kiranus*. The species from Family Mitridae belong to Genus *Mitra* and identified as *Mitra* sp. The other specimen belong to Family Terebridae was unable to identify further. The specimen belong to Family Turridae was identified for the Genus *Gemmula* and named as *Gemmula* sp. The other specimen from the Family Calliostomatidae belong to Genus *Calliostoma* and identified as *Calliostoma* sp.

Among five echinoderms two are sea star and three are brittle star. Two sea stars were identified under the Order Paxillosida and Valvatida belongs to Class Asteroidea. One sea star belong to Family Astropectinidae comes from the Order Paxillosida. The other sea star belong to Family Goniasteridae belong to Order Valvatida. The species from the Family Astropectinidae further identified as Genus *Astropecten* named as *Astropecten* sp.. The species of the Family Goniasteridae identified as the Genus *Tessellaster* named as *Tessellaster* sp.

Among the three brittle stars, all identified from the Class Ophiuroidea. Under this Class the specimens belongs to Order Ophiacanthida and Amphilepidida. The specimen identified under Order Ophiacanthida from the Family Ophiomyxidae. However, the other two

specimens belong to Order Amphilepidida considered under the Families Ophiolepididae and Ophiotrichidae. The specimen from the Family Ophiolepididae were not identified further. The remaining specimen from the Family Ophiotrichidae identified to the Genus *Ophiothrix* and named as *Ophiothrix* sp.

Two gastropods belong to Genus *Mitra* and Genus *Gemmula* identified in the Station 16.B, have a water depth of 572m, in Indian Ocean region off Great Nicobar Islands. Remaining five specimens of identified gastropods from the depth of 250m at off Terra Island, at Bay of Bengal (St.4B) waters along with one echinodermata Genus *Ophiothrix*. The St.2A located in off Hut Bay (Bay of Bengal) consists of two echinodermata specimens of Genus *Tessellaster* and Family Ophiomyxidae. The St.5B, located in d Off Car Nicobar (Bay of Bengal) represented two echinodermata viz., Genus *Astropecten* and Genus *Ophiothrix*. The St.7a, deepest studied stations located in Off Terra Island (Andaman Sea) has on echinodermata specimen, i.e. Family Ophiolepididae. These distributions suggested that two gastropoda and one echinodermata specimens were able to sustain more than 500m depth. Remaining nine specimens able to available in less than 500m depth. The present study once again confirms the essentiality of a detailed study for understanding deep sea fauna and its distribution in the Andaman Sea region.



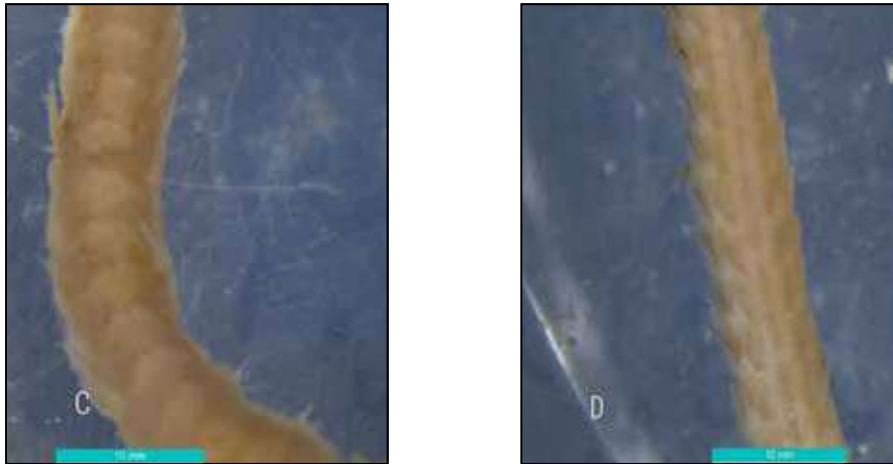


Fig 14 Specimen of Family Ophiomyxidae A; Dorsal view B; Ventral view C; Dorsal view of arm; D. Ventral view of arm.

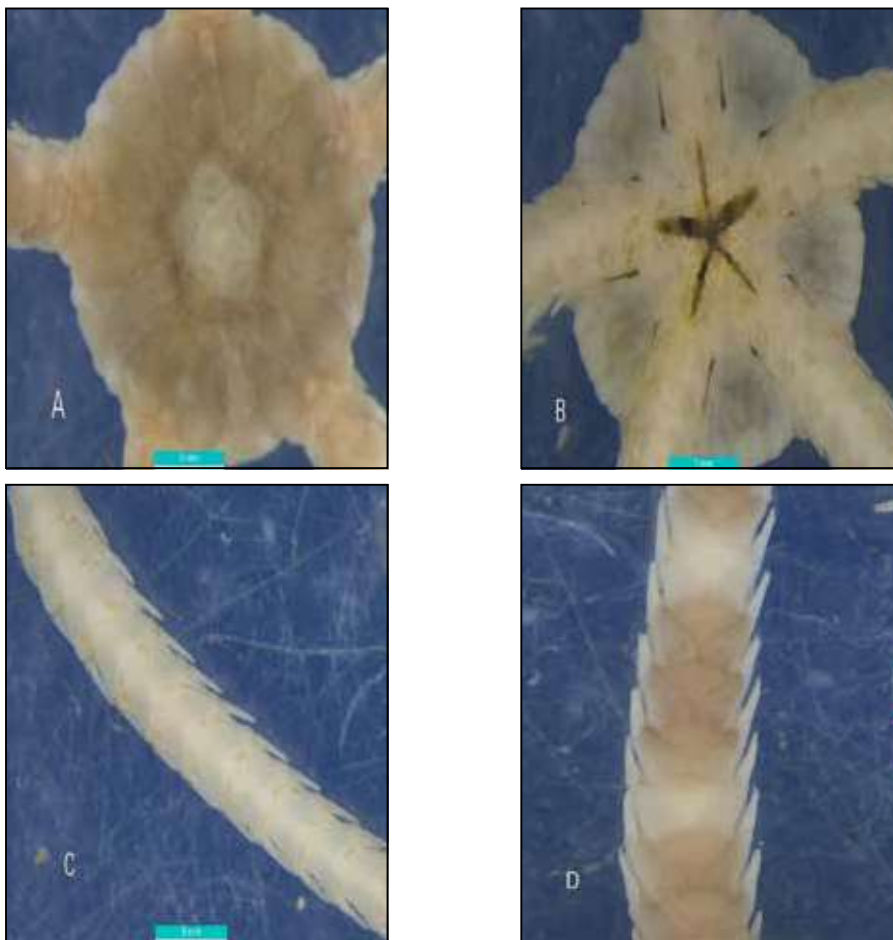


Fig 15. Specimen of the Family Ophiolepididae - A dorsal view; B. Ventral view; C. Ventral view of arm; D. Dorsal view of arm.



Fig 16. Specimen of Genus *Ophiothrix* A. Dorsal view B. Ventral view C. Dorsal view of arm D. Ventral view of arm

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