



STUDIES ON NEWLY RECORDED ANTIPATHARIAN CORALS FROM ANDAMAN AND NICOBAR ISLANDS

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INTRODUCTION

The order antipatharia is Black or Horny Corals. They are like upright and plant-like forms, arranged around an axial skeleton of black horny material bearing thorns. Most forms inhabit deep water and live in the tropics. Although black corals are among the most common azooxanthellate corals in tropical reefs, they are the least studied group in Indian waters. One of the few ecological studies dedicated to black coral ecology is that of Grigg (1965) conducted in Hawaii. Other research works were devoted to the geographical and bathymetrical distributions or to the population structure of black corals in New Zealand (Grange, 1985, 1988; Grange and Singleton, 1988), St. Paul and Amsterdam Is., Southern Indian Ocean (Grasshoff, 1988), Hawaii (Grigg, 1965; 1974), East Malaysia (Oakley, 1997), the US Virgin Is. (Olsen and Wood, 1979), and the Caribbean Sea (Wamer, 1981; Sanchez *et al.*, 1998; Sanchez, 1999). A few studies have dealt with associated fauna (Totton, 1923; Wamer, 1981; Grange, 1991; Wirtz *et al.*, 2001), reproduction and growth (Oakley, 1988; Parker *et al.*, 1997), feeding strategies (Dantan, 1921; Lewis, 1978; Wamer 1981; Pax *et al.*, 1987), competition behavior (Goldberg, *et al.*, 1990), and the relationship with abiotic environmental features like currents (Wamer, 1981; Genin, *et al.*, 1986; Oakley, 1997). Other sparse ecological notes have been given by different authors dealing in taxonomic or faunistic works, in the Strait of Gibraltar (Grasshoff, 1989), Northeast Atlantic (Grasshoff, 1985), Bay of Biscay (Hickson,

1907), and Maldives and Laccadive Archipelagos (Cooper, 1903; 1909).

Taxonomic information on several species of antipatharians of the Indonesian Archipelago can be found in 2 detailed monographs (Brook, 1889, van Pesch, 1914). However neither of these provides a comprehensive evaluation of shallow-water species. Schultze (1896) has reported about on 7 species collected off the island of Ternate in the northern Moluccas. Hoeksema and van Ofwegen (2004) published descriptions and photos of some common shallow-water antipatharian species of the Indo-Malayan region. Information on some species of shallow- and deep-water Indo-Pacific antipatharians can also be found in taxonomic revisions of the families Aphanipathidae, Myriopathidae, Cladopathidae, and Schizopathidae published by Opresko (2001, 2002, 2003, 2004), but a comprehensive taxonomic study of the antipatharians of this region is still needed. The present work reports antipatharian coral assemblages at 4 different islands of the Andaman and Nicobar.

METHODOLOGY

This study was conducted by SCUBA diving in day time during July 2009 to March 2011 and the antipatharian coral (black corals) specimens were collected from Long Island (Lat. 12°21.749; Long. 092°55.410), Pongibalu (Lat. 11°30.956; Long. 092°39.201), Kamota Island (Lat. 08°02.183; Long. 093°32.573) and Havelock Island (Lat.

Key words : Antipatharians, Cirrhipathes, Antipathes, Stichopathes, Cupressopathes, Myriopathes, Antipathella, Plumapathes, Andaman and Nicobar islands.

12°03.334; Long. 092°57.716) in Andaman and Nicobar Islands.

Quantitative data were obtained at each dive site by using the adapted belt transect method (Bianchi *et al.*, 2003) counting all the colonies observed along 5 transects with 2 m wide (including 1 m on each side of the diver) at depths of 5 to 30 m. The data obtained through the study were analysed with on several biological indexes such as species richness (SR, the total number of species observed), abundance (the number of individuals of each species), the Shannon index (H' , calculated as $H' = -\sum p_i \log_2 p_i$, where p_i is n_i/N is the number of individuals of the i th-species, and N is the total number of individuals), and the evenness index (J' , indicating how the abundances are partitioned across the species). Density measurements (colonies/m²) were obtained by estimating a surface area of about 100 m² for each transect, which was calculated considering the width of the belt of observation (2 m) and the length of the transect of about 50 m.

For taxonomic studies, portion of colonies was sampled and directly fixed in 4% formaldehyde. The various species of black corals were identified on the basis of shape, thickness of the axis and the size and arrangement of the spines, respectively (Brook, 1889). Underwater photographs were made with a Sony - T900 digital camera and the

morphology of the collected samples were examined with the help of a (Leica -DFC 500) compound microscope.

RESULT

During the survey, 8 species (*Cirrhopathes anguina*, *Cirrhopathes contorta*, *Antipathes elegans*, *Stichopathes solorensis*, *Cupressopathes gracilis*, *Myriopathes antrocrada*, *Antipathella subpinnata*, *Plumapathes pennacea*) of antipatharian corals belonging to 2 families and 7 genera were recorded for the first time in Andaman and Nicobar Islands as well as in India (Table 1). *Cirrhopathes anguina* species were very common at these four stations. Each island has reported only three species, except Havelock Island where two species *Cirrhopathes anguina* and *Myriopathes antrocrada* were reported (Table-1). These species were identified during visual census from their gross morphologies (Plate-1- 8).

We took into consideration of 4 main categories for subdividing the species on the basis of their pattern of ramification such as unbranched, arborescent, bush and fan shaped. *Stichopathes* and *Cirrhopathes* are unbranched. These two genera differ in the presence of one or numerous rows of polyps. The various species of *Cirrhopathes* were identified on the basis of shape, thickness of the axis and the size and arrangement of the polyps (Plate-9). The arborescent species *Antipathes* and

Table-1. List of antipatharian coral species studied and reported at four study sites

Sl. No.	Material Examined	Family	Genus	Species	1	2	3	4
1	ZSI/ANRC - 5607	Antipathidae	<i>Cirrhopathes</i>	<i>Cirrhopathes anguina</i>	*	*	*	*
2	ZSI/ANRC - 5608			<i>Cirrhopathes contorta</i>	-	*	-	-
3	ZSI/ANRC - 5613		<i>Antipathes</i>	<i>Antipathes elegans</i>	-	-	*	-
4	ZSI/ANRC - 5609		<i>Stichopathes</i>	<i>Stichopathes solorensis</i>	-	-	*	-
5	ZSI/ANRC - 5606	Myriopathidae	<i>Cupressopathes</i>	<i>Cupressopathes gracilis</i>	-	*	-	-
6	ZSI/ANRC - 5610		<i>Myriopathes</i>	<i>Myriopathes antrocrada</i>	-	-	-	*
7	ZSI/ANRC - 5612		<i>Antipathella</i>	<i>Antipathella subpinnata</i>	*	-	-	-
8	ZSI/ANRC - 5611		<i>Plumapathes</i>	<i>Plumapathes pennacea</i>	*	-	-	-

1 - Long Island; 2 - Pongibalu; 3 - Kamota Island; 4 - Havelock Island.

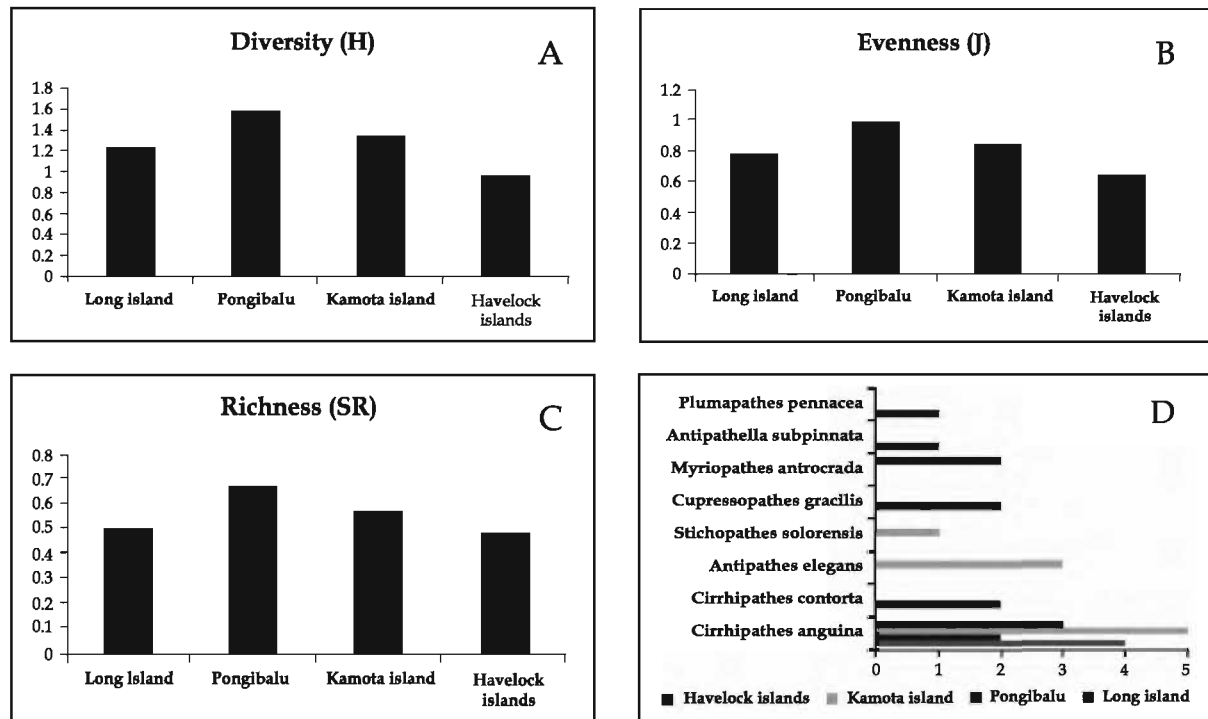


Figure 1, A- Shannon diversity index (H'), B- Pielou's evenness index (J'), C- Simpson richness index and D- Number of species at each study site.

show a distinct tree like shape, with a major axis giving rise to several secondary branches; they were easily identified on the basis of the pattern of ramification. The bushy *Plumapathes* is characterized by a net like corallum showing many anastomoses between its ramifications. The fan shaped species (*Antipathella subpinnata*) possess a planar or multi planar flabellate corallum and were identified on the basis of the pattern of ramification (Plate-1-8).

From qualitative and quantitative points of view, notable differences among the studied sites were recorded (Fig.-1, A-D). Maximum species diversity, richness and evenness were reported at Pongibalu and Kamorta Island and minimum at Havelock and Long Islands. The list of species reported during the study period is given below :

SYSTEMATIC POSITION

Phylum CNIDARIA Hatschek, 1888
 Class ANTHOZOA Ehrenberg, 1831
 Subclass HEXACORALLIA
 Order ANTIPATHARIA
 Family ANTIPATHIDAE
 Genus *Cirrhopathes*

1. *Cirrhopathes anguina* (Dana, 1846)

Material Examined : 5607 ZSI/ANRC, Live colony 60 cm to 1 meter; depth: 5-10 meters; Havelock wall site (Lat. 12°03.334; Long. 092°57.716), South Andaman; shallow to reef edge with turbid water.

Description : Colonies unbranched and greenish brown colour, 60-100 cm in height, average axis size 3.9 mm, average spine size 0.09 mm in size, Polyps pale brown colour (Plate-1), transverse diameter about 1-2 mm arranged in multiple irregular rows, Sagittal tentacles about 2-3 mm, lateral tentacles 1.05- 1.4 mm and oral cone about 0.5-0.7 mm in size.

Distribution : Indo Pacific and India: Andaman and Nicobar Islands.

Remarks : Mostly observed on shallow reef to reef edge at tropical countries.

2. *Cirrhopathes contorta* van Pesch, 1910

Material Examined : 5608 ZSI/ANRC, Live colony more than 1.5 meter; depth: 10 meters; Pongibalu jetty (Lat. 11°30.956; Long. 092°39.201), Mahatma Gandhi Marine National Park, South Andaman; Reef slope with turbid and current water.

Description : Colonies unbranched and dirty white colour, 1.5 m in height, average axis size 6.88 mm, spines 0.19 mm, Polyps white colour and arranged in multiple irregular rows (Plate-2), Sagittal tentacles about 1.3-2.15 mm, lateral tentacles 1- 1.45 mm and oral cone about 0.4-0.6 mm in size.

Distribution : Indo Pacific, Red Sea and India: Andaman and Nicobar Islands.

Remarks : New record for Indian water.

Genus *Antipathes*

3. *Antipathes elegans* (Thomson and Simpson, 1905)

Material Examined : 5613 ZSI/ANRC, Live colony height: 1 meter and width 50 cm; depth: 15 meters; Kamota Island (Lat. 08°02.183; Long 093°32.573); Reef slope with turbid and current water.

Description : Living colonies are orange colour, multibranched, bushy colonies reaching a size of 1 m or more and branches free (Plate-3). Spines are small, conical, smooth, mostly 0.08 - 0.1 mm in size. Polyps 1 - 1.4 mm in transverse diameter with short tentacles.

Distribution : Indian Ocean and India: Andaman and Nicobar Islands

Remarks : New record to India.

Genus *Stichopathes*

4. *Stichopathes solorensis* van Pesch, 1914

Material Examined : 5609 ZSI/ANRC, Live colony height: more than 1.8 meters; depth: 15 meters; Kamota Island (Lat. 08°02.183; Long.093°32.573); Reef slope with turbid and current water.

Description : Colonies unbranched and greenish grey colour, 1.8 m in height, Axis size 8.24 mm, spiral curving is irregular, spiral's height 9-57 cm, spines 0.13 mm in size, Polyps pale orange in colour and arranged in multiple irregular rows, tentacles about 1.3-2.15 mm, and oral cone about 0.5-0.6 mm in size (Plate-4).

Distribution : Indo-Pacific and India: Andaman and Nicobar Islands.

Remarks : New record to India.

Family MYRIOPATHIDAE

Genus *Cupressopathes*

5. *Cupressopathes gracilis* (Thomson and Simpson, 1905)

Material Examined : 5606 ZSI/ANRC, Live colony height: 75 cm; 60cm wide; depth: 20 meters; Pongibalu jetty (Lat. 11°30.956; Long. 092°39.201); near channel with high current and turbid water.

Description : Living colonies orange or brown colour and branched colonies; height 1.5 m and 60cm wide; inter node of braches 4.29 to 5.26 mm (Plate-5). Spines small, smooth, mostly 0.1 -0.15 mm in size. Polyps are very small tentacles.

Distribution : Gulf of Mexico, Indian Ocean, New Zealand, West North Atlantic and India: Andaman and Nicobar Islands.

Remarks : New record to India.

Genus *Myriopathes*

6. *Myriopathes antrocrada* (Opresko, 1999)

Material Examined : 5610 ZSI/ANRC, Live colony height: 75 cm; depth 25 meters; Havelock wall site (Lat. 12°03.334; Long. 092°57.716); Reef slope with current water.

Description : Live colonies 45 cm tall and 30 cm wide; reddish brown colour (Plate-6). The basal stem diameter 3.3 mm; large braches up to 9 cm long; spines conical and horn shaped, 0.14 to 0.18 mm sizes; polyps slightly elongated in the transverse axis, tentacles knob like and 0.15 mm long.

Distribution : Indonesia, Australia and India: Andaman and Nicobar Islands.

Remarks : New record to India.

Genus *Antipathella*

7. *Antipathella subpinnata* (Ellis and Solander, 1786)

Material Examined : 5612 ZSI/ANRC, Live colony height : 1 meter and 60 cm width; depth 15 meters; Long Island (Lat.12°21.749; Long. 092°55.410); Reef crust with turbid water.

Description : Live colonies brownish yellow colour; densely branched, small braches not even in size, the longest braches 13 cm length (Plate-7). The spines are needle like, 0.12 mm in size. Polyps are arranged uniseriably and 7-9 polyps per centimeter along the axis.

Distribution : East North Atlantic, Mediterranean Sea, New Zealand, Portugese, Spanish exclusive economic zone and India: Andaman and Nicobar Islands.

Remarks : New record to Indian water.

Genus *Plumapathes*

8. *Plumapathes pennacea* (Pallas, 1766)

Materials Examined : 5611 ZSI/ANRC, live colony height : 45cm and width: 60 cm; depth 25 meters; Long Island (Lat.12°21.749; Long 092°55.410); flat reef with turbid and current water.

Description : Live colonies brownish red colour and densely branched; primary pinnules simple and uniform in size. Spines are conical shape, 0.03 to 0.05 mm size. Needle like spines are in branches and stems, but similar size; polyps are arranged in a single series, 0.7 to 0.8 mm in size (Plate-8).

Distribution : Indo-Pacific, Caribbean Sea, Gulf of Mexico, South Atlantic, New Zealand and India : Andaman and Nicobar Islands.

Remarks : New record to Indian water.

DISCUSSION

The shallow water antipatharian coral community at the four study sites of the Andaman and Nicobar islands show very low species diversity during the study period. In this study, 8 species under 7 genera and, 2 family were reported first time from India including this area and the assemblage of black corals studied at SCUBA depths (30 m) is described on the basis of several standard ecological indexes, such as species richness (SR), Shannon index (H') and evenness Index (J'). Based on this maximum species diversity, richness and evenness were reported at Pongibalu and Kamota islands and minimum at Havelock and Long island. The high diversity of these sites can also be explained by the steep slope of the substratum since it is known that black coral settlement is more likely to occur on inclined and shaded calcareous substrata. A similar trend of increasing abundance and species diversity of black corals was also observed in the Caribbean (Grigg, 1965; Oakley, 1988; Sanchez *et al.*, 1998; Sanchez, 1999).

The shape of living polyps is probably also related to habitat (Plate-9): in unbranched black corals, the large polyps bend their tentacles upward, forming a basket-like structure around the mouth, while in flabellate colonies, all tentacles extend out laterally, increasing the net effect produced by the branching pattern. The basket shape seems to be more suitable for the capture of large isolated prey,

whereas the net strategy optimizes the filtering of small suspended particles. Wamer (1977) described antipatharians as passive suspension feeders. Field observations made by Wamer (1981) indicate that direct interception is the most important way in which food can be trapped on the feeding surfaces, and that the major free-living prey are copepods. Lewis (1978) describes the use of a mucous-ciliary feeding strategy for fine suspended particulate matter in aquarium-reared specimens of *Cirripathes lütkeni*, *Plumapathes pennacea*, and *Antipathes* sp., as well as the occurrence of clusters of nematocysts on the tentacles and less commonly in the mesenterial filaments in order to catch larger prey. The wide open mouths were observed in *Stichopathes* and *Cirripathes* polyps during the daytime (Plate-9).

Sanchez *et al.* (1998) and Sanchez (1999) listed light attenuation, substratum inclination (shading), suspended food, flow regimes, wave exposure, and historical events as major factors explaining the distribution of black corals. In the study sites, the current (in terms of intensity and direction) is the major abiotic factor determining the distribution of different species. More extensive surveys in deeper waters of Andaman and Nicobar Islands may reveal out more antipatharian species.

ACKNOWLEDGEMENTS

The authors are thankful to the Ministry of Environment and Forests, Government of India for providing financial support.

SUMMARY

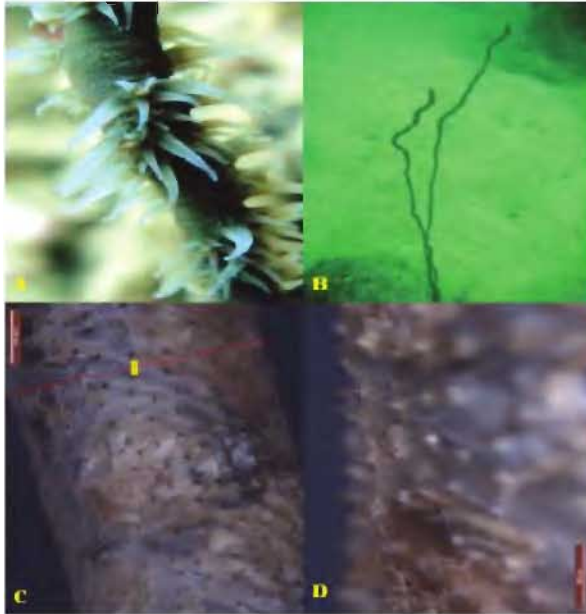
Ecological observations of 8 species of antipatharian corals (Black corals) under 7 genera and 2 families (*Cirripathes anguina*, *Cirripathes contorta*, *Antipathes elegans*, *Stichopathes solorensis*, *Cupressopathes gracilis*, *Myriopathes antrocrada*, *Antipathella subpinnata*, *Plumapathes pennacea*) living in shallow reefs at four study sites of the Andaman and Nicobar Islands are described for the first time. The community structure was evaluated using standard ecological parameters (species richness (SR), Shannon index (H') and evenness Index (J'). In general, the abundance of black corals increases with depth. The highly diversified black coral assemblage shows notable site-dependent differences.

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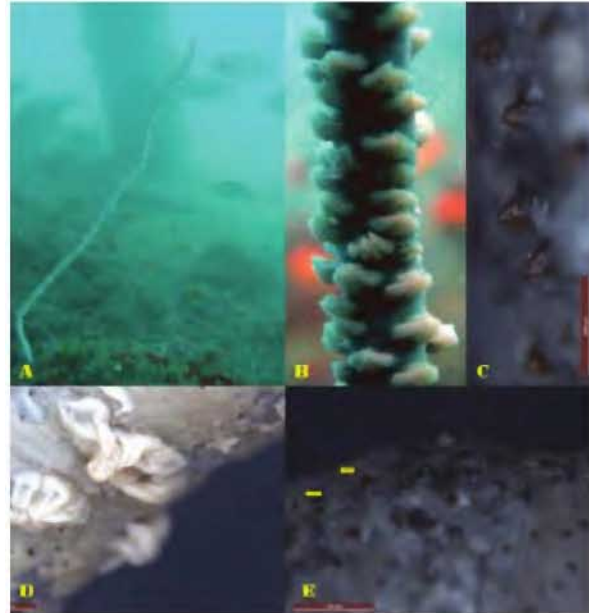
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PLATE - 1



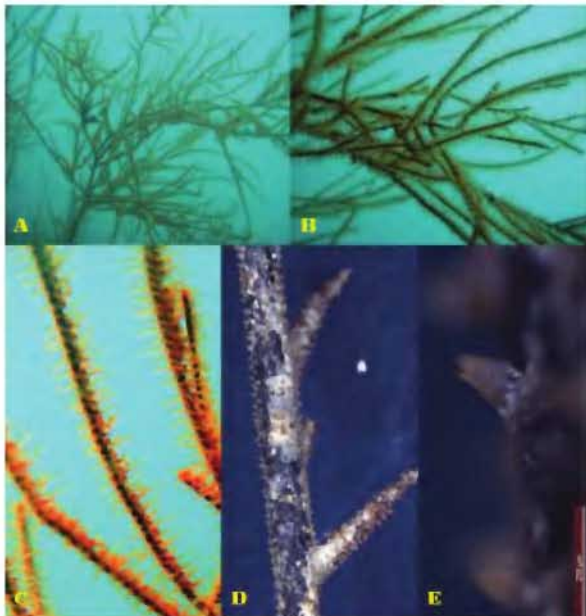
A- Extended polyps, B- Live colonies of a *Cirrhipathes anguina*, C- 3.9 mm thickness colonies, D- 0.09 mm spines.

PLATE - 2



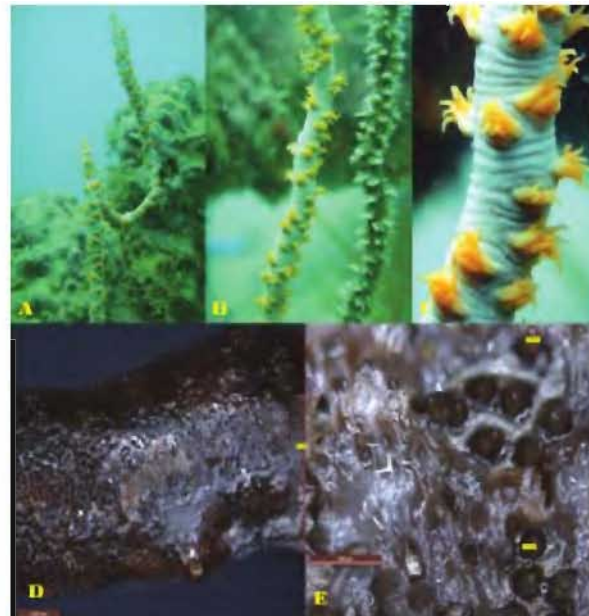
A-Live colonies of a *Cirrhipathes contorta*, B- Extended polyps, C and E 0.15 mm spines, D-2.83 mm polyps from preserved sample.

PLATE - 3



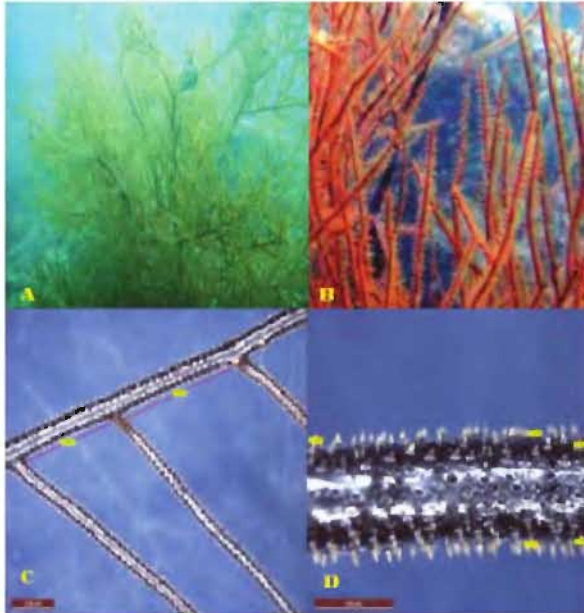
A-B Live colonies of a *Antipathes elegans*, C- Extended polyps, D- Leica -DFC 500 Microscopic image of braches, E - 0.14 mm spines.

PLATE - 4



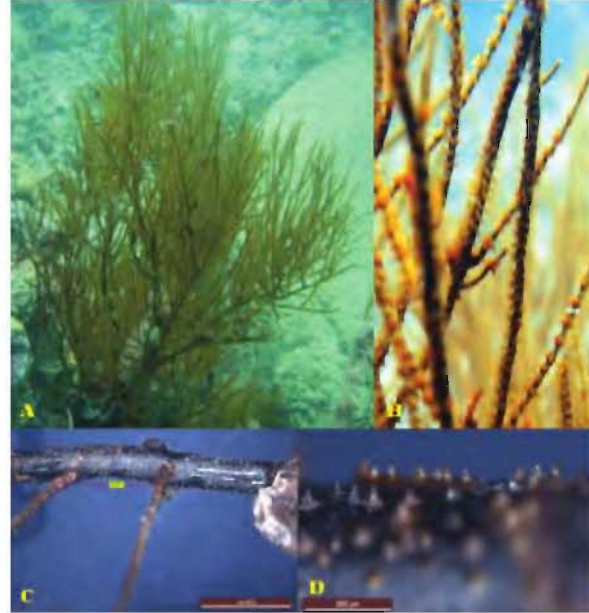
A and B - Live colonies of a *Stichopathes solorensis*, C- Extended polyps, D-8.24 mm thickness colonies, E- 0.11 mm spines.

PLATE - 5



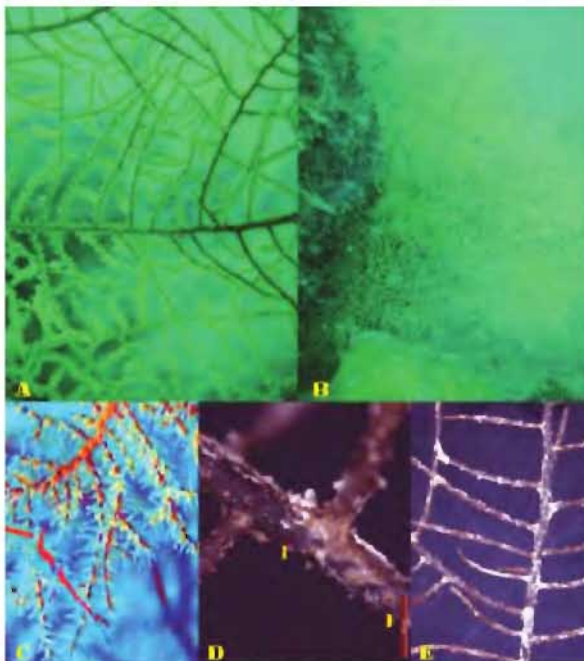
A-Live colonies of a *Cupressopathes gracilis*, B- Extended polyps, C- 5.2 mm inter node, D- 0.12mm spines.

PLATE - 6



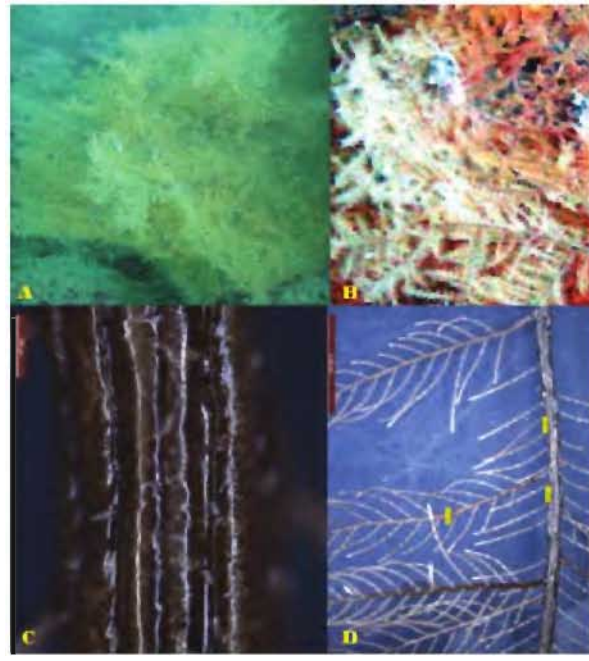
A - Live colonies of a *Myriopathes antrocrada*, B- Extended polyps, C- 4.17 mm inter node, D - 0.097 mm spines.

PLATE - 7



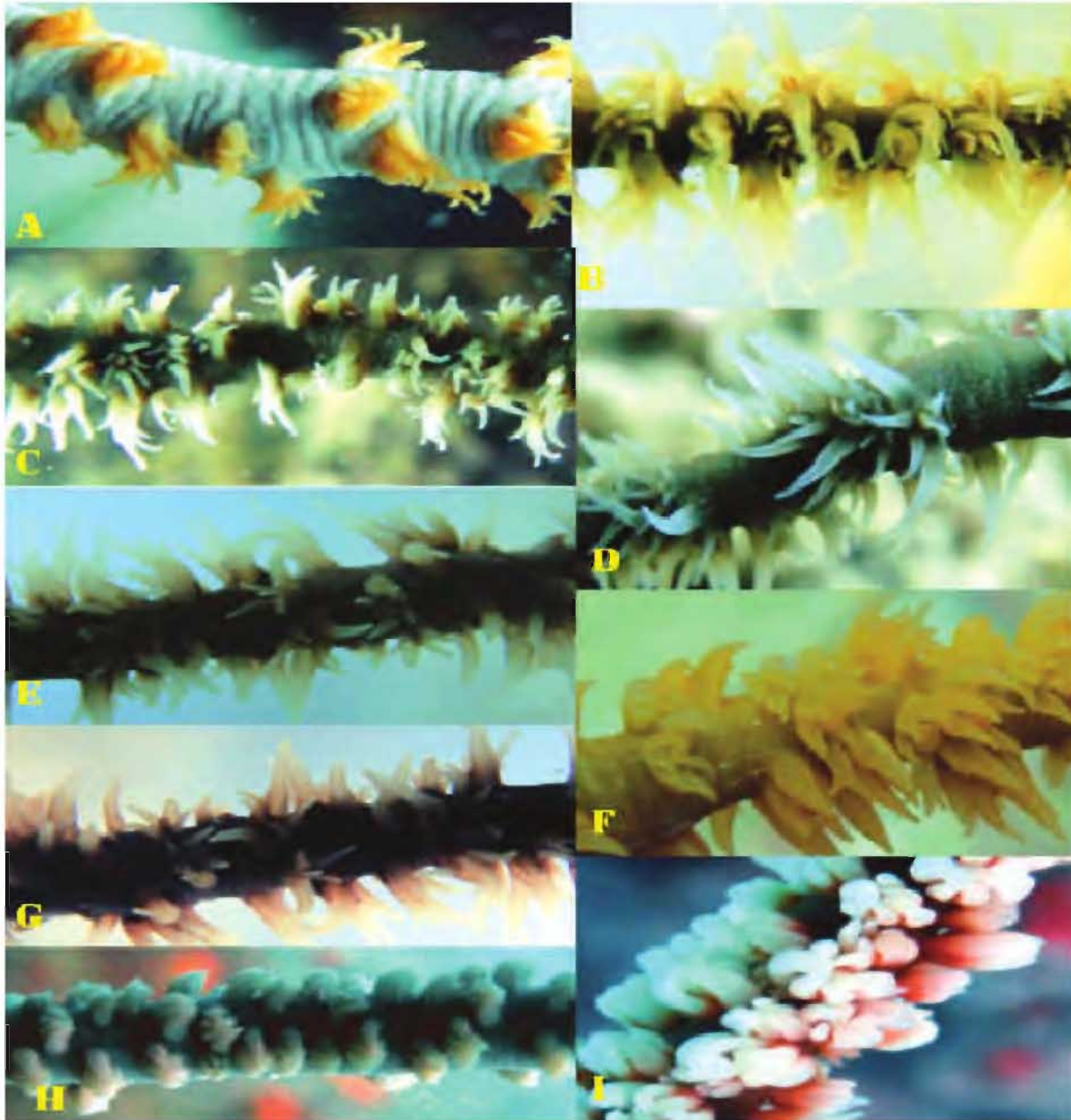
A-B Live colonies of *Antipathella subpinnata*, C- Extended polyps, D - 0.08 mm spines, E- 1 mm inter node.

PLATE - 8



A - Live colonies of a *Plumapathes pennacea*, B- Extended polyps, C- 0.15 mm spines, D - 0.63 mm inter note.

PLATE - 9



Living antipatharian polyp's morphology from different study sites: A- Contracted polyps of a *Stichopathes solorensis*, B- Extended polyps of a *Cirrhipathes anguina*, C-G and I Types of polyp from *Cirrhipathes* sp, H- Contracted polyps of a *Cirrhipathes contorta*.