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Original Research Article

Studies on the Shallow Water Octocorals from the Coast of Gulf Of Mannar, India

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Abstract: The studies on diversity and distribution of octocorals were carried out during pearl bed survey on 2008 to 2009 at Gulf of Mannar reef environment. A total of 25 species of octocoral fauna were found from 15 study sites from shallow reef areas. The maximum life form was observed in ST 9 (Thoothukudi) & ST 11 (Vembar) and minimum in ST 15 (Vembar). Of which the Alcyonacea was dominant group followed by Gorgonacea and Pennatulacea at all the study sites, which is contributed with result obtained based on De-Treneded Analysis and Ternary Plot. Bray-Curtis cluster analysis 67% similarity were obtained between the study sites and Principal Component Analysis significant positive correlation was noted between the study sites. The Shannon – Weaver diversity index range upto 1.06 higher degree of similarity of species was found between geographically nearby areas. Details of diversity with various ecological indices along with distributional patterns are depicted in the present paper.
Keywords: Octocorals, Soft corals, Sea pen, Sea fan, Gulf of Mannar.

INTRODUCTION

The subclass Octocorallia is with approximately 3000 species found across the World's. They are commonly known as Octocorals comprised of three orders: Helioporacea (blue coral), Pennatulacea (sea pens), and Alcyonacea (soft corals, Stolonifera, gorgonians and telestacea) found in intertidal to abyssal depths around World Ocean from tropical to polar seas [1]. First study on Indian Octocorals was made by Hickson [2, 3], from Lakshadweep and Maldives. In Gulf of Mannar and Sri Lankan coast up to 1200 meter by Pratt [4] and Thomson and Handerson [5, 6]. Royal Indian Marine Survey Ship made octocoral collection from Indian Ocean by Thomson and Simpson [7]. Thomas and George [8-10] listed some gorgonian octocorals from different study sites in Indian water. Some new findings reported from Lakshadweep Islands by Van Ofwegen and Vennam [11] and Alderslade and Shirwaiker [12]. Usha *et al.;* [13] reported octocoral distribution from the Gulf of Kachchh, Gujarat in west coast of India. The occurrence and distribution of soft corals were observed from Andaman and Nicobar Islands by Jayasree *et al.* [14]. While 54 species of alcyonacea octocorals reported by Rao and Kamala Devi [15].

Recently Geetha *et al.;* [16] reported 6 species of Pennatulacea from Gulf of Mannar; 3species of Pennatulacea reported from Andaman and Nicobar Island by Kumar *et al.;* [17]. Altogether 171 species of gorgonian octocorals have been reported from Indian water [18] among them 121 species from southeast coast [19] and 51 species identified from Andaman and Nicobar Islands Kumar *et al.;* [20].

MATERIALS AND METHODS

Distribution of Octocorals at Gulf of Mannar coast was determined by a series transects laid during the period from 2007 to 2009. The line intercept transect and Quadrate were employed to investigate the diversity and abundances of octocorals from the study sites with help of SCUBA diving up to 30 m depth. The number of transects examined within an area was based on the size of the area and the density of octocoral available in that area [21]. The specimens were identified based on the morphological characteristics of the colonies and sclerite structure. Sclerites were extracted using 5% Sodium hypochlorite [22]. The PAST software [23] was used for statistical analysis like Menhinick Diversity, Shannon – Weiner Diversity, Pielou's Evenness, Principal Component Analysis (PCA) scatter diagram, De-trended correspondence analysis and Ternary plot.

RESULTS

A total of 25 species of octocorals under 22 genera, 9 families were recorded from 15 study sites in Gulf of Mannar (Table 2, Fig.1). A maximum number of species were recorded from ST 9 & ST 11 (8 species) and minimum at ST 15 (2 species). The Menhinick Diversity index was recorded as highest at ST 1 (1.73) while ST 8 (0.82) represented the lowest diversity of Octocorals. The Shannon – Weiner Diversity index was maximum in ST 3 (1.06) and minimum in ST 15 (0.56). The Simpson's Diversity index, ST 6 (0.60) was noted maximum and ST (0.19) minimum and the Pielou's Evenness index for species community ranged from 0.67 at ST 2 to 0.96 at ST 3 & 4. A maximum number of individuals and percentage of cover reported in ST 9 & ST 11 (8.8%) and minimum in ST 15 (2.5%) (Table 3).

A Principal Component Analysis (PCA) of different live form categories and genera of octocoral and its contribution with respect to study sites are presented in the Fig 2. Diversity and distribution of octocorals were maximum at ST 9 & ST 11 and minimum at ST 15. Percentage of octocoral cover was varied between the study sites, for the 3 order Alcyonacea, Pennatulacea, Gorgonacea. Among them Alcyonacea and Gorgonacea were dominant at all the study sites whereas and Pennatulacea was rare in all the study sites. The distribution of Alcyonacea were positive correlation between the stations like ST 5, ST 6, ST 8, ST 9, ST 10, ST 11, ST 12, ST 13 respectively. Gorgonacea were positive correlation between ST 2, ST 4, ST 7, ST 9, ST 10, ST 11, ST 15 and Pennatulacea were ST 1, ST 4, ST 5, ST 6, ST 7, ST 8, ST 13, ST 14 and ST 15 respectively (Fig. 3).

De-Treneded analysis clearly showed that Alcyonacean and Gorgonacea diversity were highly significant and Pennatulacea was no significant between the study sites (Fig. 4). The percentage of octocorals were plotted in Ternary plot also illustrated all the study sites between the two orders Alcyonacea and Gorgonacea (Fig. 5). As per the result of Bray-Curtis cluster analysis under paired linkage (Fig. 6), the study sites were in two major groups with more than 67 % similarity. Among them one group ST 15 combined with ST 1, ST 3 and ST 14 (71 % similarity), ST 3 paired with ST 1 and ST 14 (78% Similarity) and ST 1 93% similarity between ST 14. In second group, ST 4 combined with remaining study sites (ST 7, ST 2, ST 12, ST 11, ST 9, ST 10, ST 13, ST 8, ST 6 and ST 5). The study site ST 9 100% similarity between ST 11 and ST 8 99% similarity with ST 13.

Table 1: Areas surveyed in the Gulf of Mannar for assessing the status of Octocorals

	Study Site	**Latitude**	**Longitude**
	ST 1	N $08^0$54'38.1	E $078^0$17'59.5
	ST 2	N $08^0$54'38.2	E $078^0$17'59.6
	ST 3	N $08^0$53'53.8	E $078^0$17'37.3
	ST 4	N $08^0$53'53.3	E $078^0$17'50.5
	ST 5	N $08^0$53'34.4	E $078^0$18'12.5
	ST 6	N $08^0$53'14.6	E $078^0$18'13.8
	ST 7	N $08^0$53'13.7	E $078^0$18'13.5
	ST 8	N $08^0$53'13.6	E $078^0$18'13.4
	ST 9	N $08^0$53'13.9	E $078^0$18'10.6
Thoothukudi Group	ST 10	N $08^0$53'15.1	E $078^0$18'20.1
	ST 11	N $09^0$01'51.6	E $078^0$33'19.5
	ST 12	N $09^0$00'58.0	E $078^0$31'50.9
	ST 13	N $09^0$00'55.4	E $078^0$31'55.9
	ST 14	N $09^0$04'55.1	E $078^0$30'10.1
Vembar Group	ST 15	N $09^0$01'17.5	E $078^0$29'14.5

Table 2: List of Octocorals species from the study sites in Gulf of Mannar

SYSTEMATIC POSITION	ST 1	ST 2	ST 3	ST 4	ST 5	ST 6	ST 7	ST 8	ST 9	ST 10	ST 11	ST 12	ST 13	ST 14	ST 15
Phylum Cnidaria **Class** Anthozoa **Sub Class** Octocorallia															
Family: Alcyoniidae															
Lobophytum sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sinularia sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Sarcophyton sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Family: Nephtheidae															
Dendronephthya sp.	_	_	_	_	_	_	_	_	_	_	_	_	+	_	_
Order Gorgonacea **Family:** Plexauridae															
Psammogorgia flabellum sp.	_	_	_	_	_	_	_	_	_	_	_	_	+	_	_
Astrogorgia sp.	_	+	_	_	_	_	_	_	_	_	_	_	_	_	_
Echinogorgia complexa	_	_	_	_	_	_	_	_	_	_	_	_	_	+	_
Echinogorgia longispinosa	_	_	_	_	_	_	_	_	_	_	_	_	+	_	_
Echinomuricea sp.	_	_	_	_	_	_	_	_	_	_	_	+	_	_	_
Menella sp.	_	_	_	_	_	_	_	+	_	_	_	_	_	_	_
Paracis sp.	_	_	_	_	_	_	_	_	_	_	_	+	_	_	_
Family: Acanthogorgiidae															
Muricella sp.	_	_	_	_	_	_	_	+	_	_	_	_	_	_	_
Family: Ellisellidae															
Dichotella sp.	_	_	_	_	_	_	+	_	_	_	_	_	_	_	_
Ellisella sp.	_	_	_	_	_	+	_	_	+	_	+	_	_	_	_
Juncella jencea	_	_	_	_	_	+	_	+	_	_	+	_	_	_	_
Family: Melithaea															
Melithaea sp.	_	+	_	_	_	_	_	_	+	_	_	_	_	_	_
Family: Subergorgiidae															
Annella reticulata	_	_	+	_	+	_	_	_	_	_	_	_	_	_	_
Annella mollis	_	_	_	+	_	_	_	_	_	_	+	_	_	_	_
Subergorgia suberosa	_	_	_	_	+	_	+	+	+	+	+	+	_	_	_
Order: Pennatulacea **Family:** Pennatulidae															
Crassophyllum cristatum	_	_	_	_	_	_	_	_	_	_	_	_	+	_	_
Sarcoptilus grandis	_	_	_	_	_	_	_	_	+	_	_	_	_	_	_
Sarcoptilus rigidus	_	_	_	_	_	_	_	_	_	+	_	_	_	_	_
Ptilosarcus undulates	_	_	_	_	_	+	_	_	_	_	_	_	_	_	_
Veretillum tenuis	_	_	_	_	_	_	+	_	_	_	+	_	_	_	_
Family: Virgulariidae															
Virgularia densa	_	_	_	_	_	_	_	_	+	_	_	_	_	_	_
Total	3	5	4	4	5	6	6	7	8	5	8	6	9	4	2

Table 3: Octocoral diversity index between the study stations

Study Station (ST)	Menhinick Diversity index	Shannon - Weiner Diversity Index	Simpson's Diversity Indices	Pielou's Evenness	Individuals	Percentage of cover (%)
ST 1	1.73	0.99	0.37	0.90	3	3.8

ST 2	1.34	0.70	0.24	0.67	5	6.1
ST 3	1.5	1.06	0.57	0.96	4	4.4
ST 4	1	0.65	0.39	0.96	4	4.4
ST 5	1.34	1.01	0.38	0.92	5	6.5
ST 6	1.23	1.01	0.60	0.92	6	6.1
ST 7	0.82	0.64	0.38	0.94	6	6.5
ST 8	1.13	0.99	0.55	0.90	7	7.5
ST 9	1.06	0.94	0.49	0.86	8	8.8
ST 10	1.34	0.92	0.29	0.84	5	6.6
ST 11	1.06	0.94	0.49	0.86	8	8.8
ST 12	1.23	0.98	0.44	0.89	6	7.1
ST 13	1.13	0.99	0.56	0.90	7	7.4
ST 14	1.5	1	0.52	0.91	4	4.4
ST 15	1.41	0.56	0.19	0.88	2	2.5

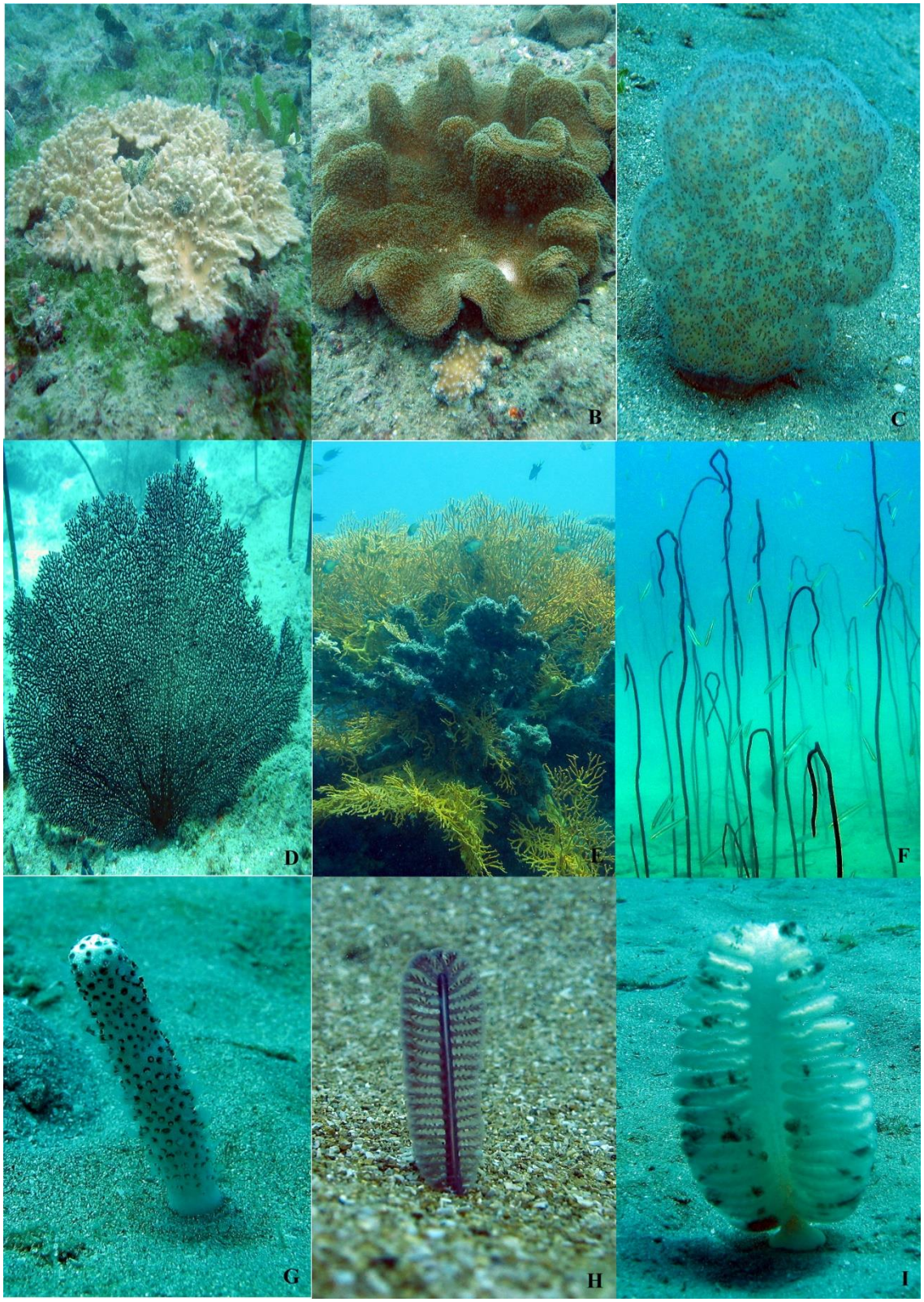

Fig 1: Underwater picture of some Octocorals from the study sites in Gulf of Mannar,
A – *Lobophytum* sp., B – *Sarcophyton* sp., C – *Dendronephthya* sp., D- *Echinogorgia complexa*, E – *Melithaea* sp., F – *Junceella juncea*, G – *Veretillum tenuis*, H – *Sarcoptilus ngidus* I – *Sarcoptilus grandi*

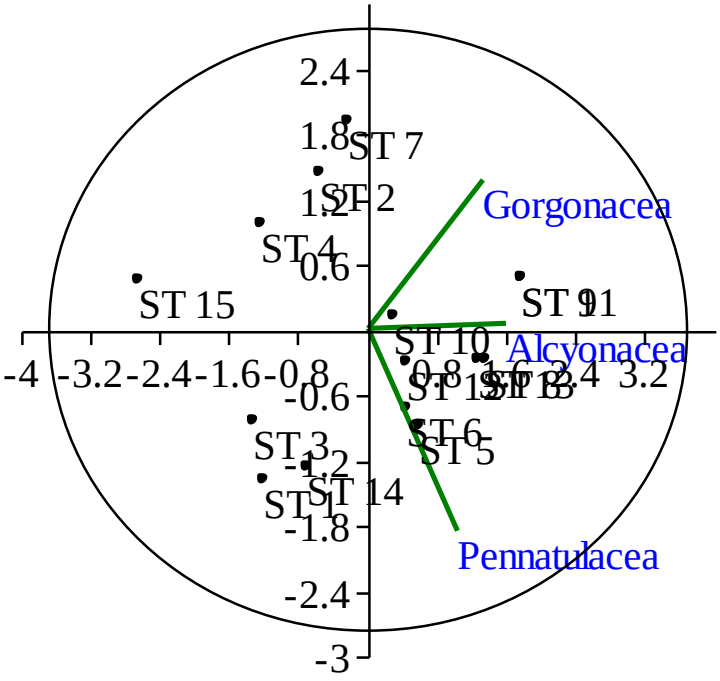

Fig 2: Principal Component Analyses (PCA) – Octocorals recorded in Gulf of Mannar study sites.

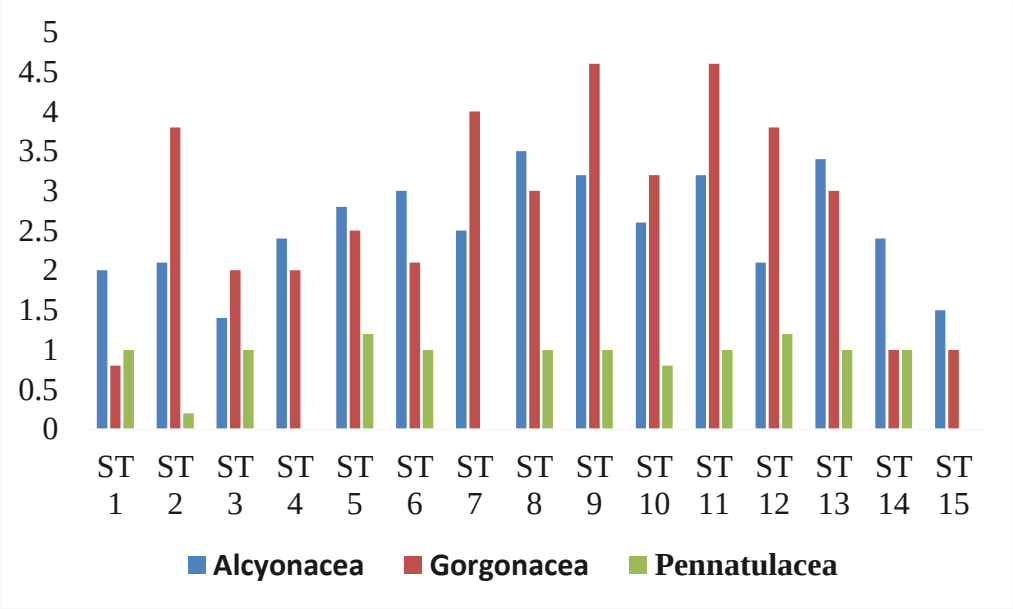

Fig 3: Percentage of Octocoral cover in the study sites.

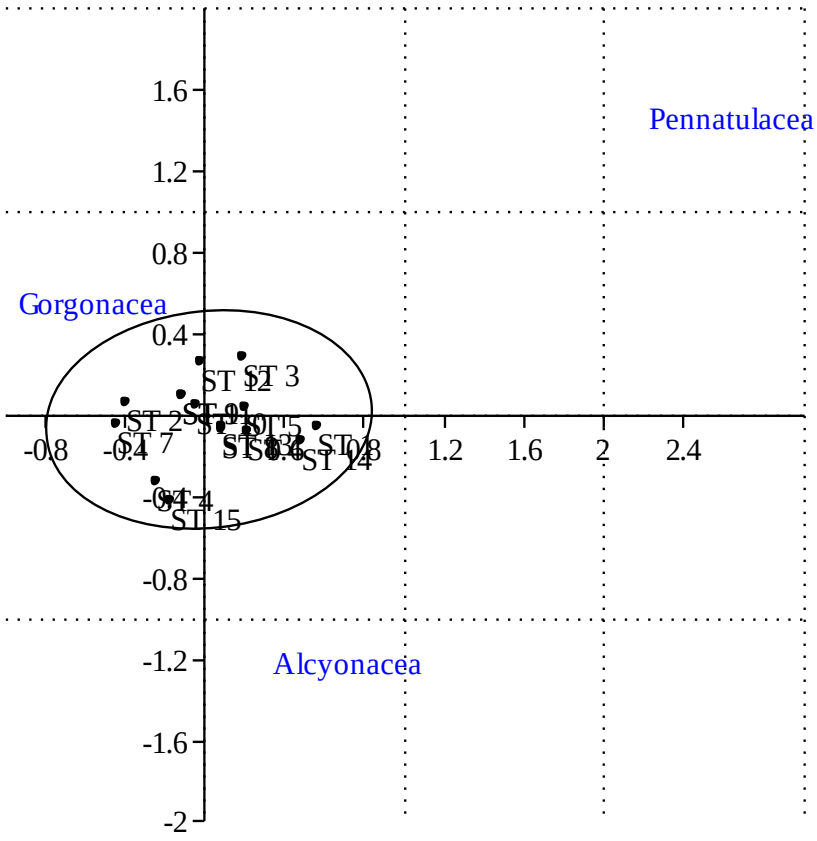

Fig 4: De-Trended correspondence analysis based Octocoral distribution between the study sites.

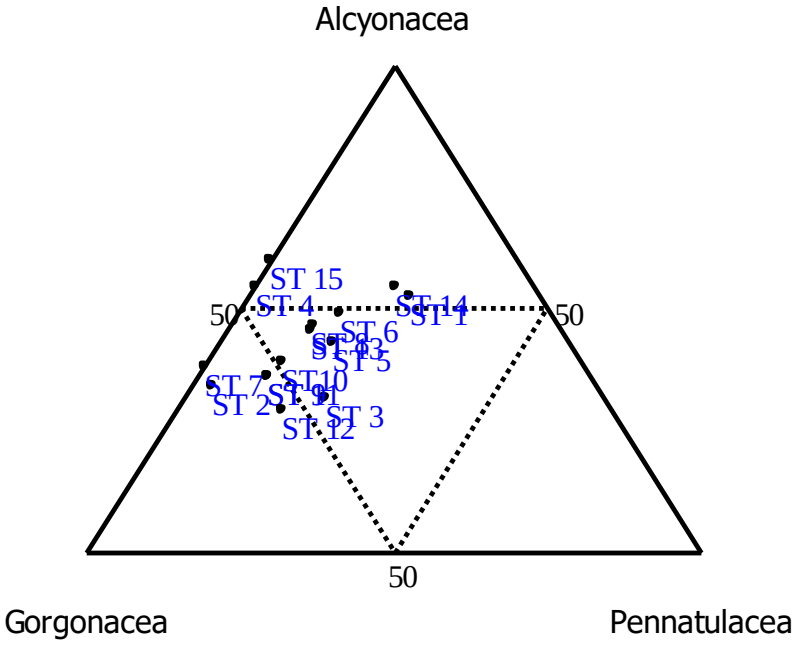

Fig 5: Ternary Plot analysis based Octocoral distribution between the study sites

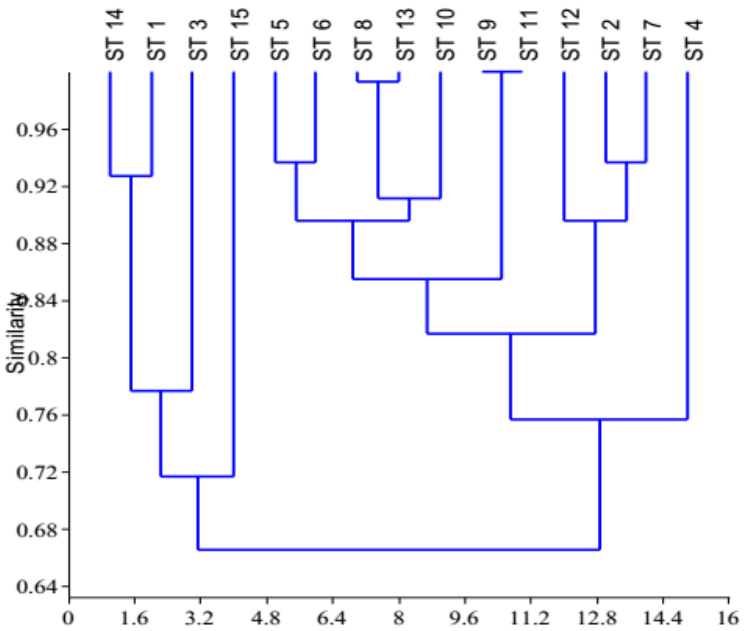

Fig 6: Bray-Curtis similarity cluster analysis under paired linkage for the Gulf of Mannar study sites based on the species of Octocoral

DISCUSSIONS

Octocorals are the most common and widely distributed group after hard corals on the reefs that occupy a great variety of ecological situations. Their habitat range from inter tidal exposed reefs to deeper reef slopes. Present study illustrates that coral reef of the Gulf of Mannar have a diverse octocoral fauna. Alcyonacea characteristic of shallow reef habitats such as inter tidal reef and reef flats. Distribution of Gorgonacea fond at reef slope to reef edge and Pennatulacea reported on outside the reef, mostly in sandy bottom at deeper water. A statistical analysis resulted Alcyonacea was reported most common group and Pennatulacea was least found group in all the study sites. The result of PCA, De-Treneded and Ternary plot analysis were also similar trend.

The order Alcyonacea was very common in shallow reef flat to upper reef zone and the family Nephtheidae and order Pennatulacea were reported in reef slope and sandy bottom [6, 7, 16, 17]. According to Kumar et al. [20], a total of 51 species of Gorgonacea were reported at reef slope to deeper sites in Andaman and Nicobar Islands. The present study reported 25 species of octocorals belonging 22 genera from the study sites in Gulf of Mannar. The abundance of octocorals cover is in the following order: ST 9> ST 11> ST 8 > ST 13> ST 12> ST 10> ST 7> ST 5> ST 6> ST 2> ST 3> ST 4> ST 14> ST 1> ST 15. Among the study sites, ST 9 and ST 11exhibited the highest octocoral cover, while the St 15 exhibited the least octocoral cover. Bray-Curtis similarity cluster analysis shows complete variations between the study sites based on octocoral species cover. Worldwide distribution of octocoral was quite distinctive in terms of their isolation and surviving in extreme oceanographic and climatic condition. In India, octocoral was least studied groups while more detailed examination needed to assess the octocoral diversity and distribution in shallow to deep waters.

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REFERENCES

1. Fabricius K, Alderslade P. Soft corals and sea fans: a comprehensive guide to the tropical shallow water genera of the central-west Pacific, the Indian Ocean and the Red Sea. Australian Institute of Marine Science (AIMS); 2001 Jun 1.
2. Hickson, S.J., The Alcyonaria of the Maldives. Pt. I. the genera Xenia, Teleso, Spongodes, Nephthea, Paraspongodes, Chironephthea, Siphonogorgia, Solenocaulon and Melitodes. In the fauna and geography of the Maldive and Laccadive

Archipelagoes, Gradiner, S.J. (ed), 1903, 2(1): pp.473-502.
3. Hickson, S.J., The Alcyonaria of Maldives. Pt. III. The families Muriceidae, Gorgonethidae, Melitodidae and the genera Pannatula and Eunephthea. In: the fauna and geography of the Maldive and Laccadive Archipelagoes. Gardiner, S.J. (ed.), 1905, 2(4): 807-826.
4. Pratt EM. Report on some Alcyoniidae collected by Prof. Herdman at Ceylon in 1902. Report to the Government of Ceylon on the Pearl and Oyster Fisheries of the Gulf of Mannar. 1905; 3:247-68.
5. Thomson JA, Henderson WD. Alcyonaria; Ceylon Pearl Oyster Fisheries Report. In Roy. Soc., London 1905 (pp. 271-328).
6. Thomson JA, Simpson JJ, Henderson WD. An account of the alcyonarians collected by the Royal Indian Marine Survey Ship Investigator in the Indian Ocean. Order of the Trustees of the Indian Museum; 1906.
7. Thomson JA, Simpson JJ. An account of the Alcyonarians collected by the RIM SS Investigator in the Indian Ocean. II. The Alcyonarians of the littoral area: XII. 1909; 319.
8. Thomas PA, George RM. A systematic appraisal of the commercially important gorgonids of the Indian Seas. Journal of the Marine Biological Association of India, (1986), 28: pp.96-112.
9. Thomas PA, George RM. Gorgonid resources of India. Marine Fisheries Information Service, Technical and Extension Series. 1987; 74:1-3.
10. Thomas PA, George RM. Discovery of a deep water gorgonid bed off Bombay and its qualitative appraisal.
11. Van Ofwegen LP, Vennam J. Notes on Octocorallia from the laccadives (SW India). Zool. Meded.(Leiden). 1991;65:143-54.
12. Alderslade P, Shirwaiker P. New species of soft corals (Coelenterata: Octocorallia) from the Laccadive Archipelago. Beagle: Records of the Museums and Art Galleries of the Northern Territory, The. 1991 Sep;8:189.
13. Usha B, Panda SK, Madhu VR, Meenakumari B. Occurrence of live Octocorals in the Trawling Grounds of Veraval Coast of Gujarat, Arabian Sea. Turkish Journal of Fisheries and Aquatic Sciences. 2008; 8(2).
14. Jayasree V, Bhat KL, Parulekar AH. Occurrence and distribution of soft corals (Octocorallia: Alcyonacea) from the Andaman and Nicobar Islands.
15. Rao DV, Devi K. Studies on the soft corals (Octocorallia: Alcyonacea) of Andaman Islands, Bay of Bengal. Rec. zool. Surv. India, Occ. Paper No. 2003; 206:1-99.
16. Geetha S, Kumar JSY, Sornaraj R. Short Communication Observation of Pennatulacea (Order) From Gulf of Mannar Biosphere Reserve, Indian.
17. Kumar JSY, Raghunathan C, Venkataraman K. New Records of Octocorallia (Order: Pennatulacea) from Indian Waters.
18. Kumar JSY, Raghunathan, C., Check List of Indian Gorgonians with A New Report of Melithaea variabilis (Family: Melithaeidae) From Andaman and Nicobar Island, India. Sch. Acad. J. Biosci. 2015, 3(9):804-813.
19. Fernando SA. Monograph on gorgonids (Sea fans) of India. Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu, India, 2011, pp. 1-145.
20. Kumar JSY, Raghunathan C, Venkataraman K, Abundance of shallow water octocorals in the Andaman and Nicobar Archipelago, India. “Marine Faunal Diversity in India, Taxonomy, Ecology and Conservation”, Venkataraman K and Sivaperuman C (Eds.). Elsevier’s Science and Technology Rights Department in Oxford, UK. 2014. DOI: 10.1016/B978-0-12-801948-1.00003-3; (2): 15 – 33.
21. English S, Wilkinson C, Baker V. Survey manual for tropical marine resources. Australian Institute of Marine Science (AIMS); 1994 Jan 1.
22. Breedy-Shadid O. A new species of Pacifigorgia from the eastern Pacific (Coelenterata: Octocorallia: Gorgoniidae). Una nueva especie de Pacifigorgia Del Pacífico oriental (Coelenterata: Octocorallia: Gorgoniidae). Bulletin of the Biological Society of Washington. 2001(10):181-7.
23. Hammer Ø. PAST Paleontological Statistics Version 3.0: Reference Manual. University of Oslo; 2013.