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Rocky reef associated macro invertebrates and urochordates of South Kerala Coast, India

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Abstract

The manuscript explores the diversity and assemblages of reef associated macro invertebrates and Urochordates of south Kerala coast. The paper also includes a minor Phylum (Urochordates). Quadrant (50cm) method was employed for the biodiversity assessment. A total of 231 macro-invertebrates belongings to seven Phyla were identified. Among them, Porifera (12species), Cnidaria (18species), Annelida (8species), Mollusca (115species), Platyhelminthes (2species), Arthropoda (53species), Echinodermata (23 species) and 6 species of ascidians are also included in this. Phylum Mollusca is the major Phyla with maximum number of species contribution and Platyhelminthes is least in the context. The result of the study shows a substratum dependent diversity of macro invertebrates' in the reefs. In this delineation, the station II (Vizhinjam) made a proficient position by bagging a maximum number of animals (215) and presence of all Phyla recorded in the entire study. The station III is second in the line-up with 119 species of macro invertebrates and a species of Ascidia. Followed by the station IV (Thirumullavaram) and I (Mulloor) with lowest species representations of 78 and 25 respectively.

Keywords: Rocky reef, diversity, macro invertebrates, Urochordates and south Kerala coast.

Introduction

In tropical waters, the shallow-water rocky reefs are providing both ecological and social values. Ecologically they are very important by providing healthy marine ecological conditions, and harbouring a wide range of biotic groups[1-3]. Study of biodiversity and community structure is one of the key factor to assessing the ecosystem functioning and status[4,5]. Macro faunal diversity of ecosystem influence and indicate the health status of delicate ecosystems like coral and rocky reefs[6,7]. Status of rocky reef associated invertebrate diversity and assemblage studies remain very scarce, although they constitute a major component of rocky reef ecosystems[8]. A few researchers around the world given the thrust the importance of ecosystem health assessment through biodiversity studies. More researches have been done on this aspect; studied the effect increasing anthropogenic disturbance on coral reefs[9-11]. The invertebrate's biodiversity of various ecosystems was studied and documented in different dimensions of biodiversity assessments[12]. Especially the molluscan diversity of intertidal rocky areas around the world[13].

The ecosystem biodiversity assessment studies and related ecological assessments were done around the country. The diversity of coral reef associated animals were frequently recorded and documented around the Indian coastal waters, marine gastropods are the major group in this venture[14]. The special inventory and ecological status of coral reefs of the central Indian Ocean was assessed by using resourcesat[15]. The species assemblage of the coral reef ecosystem of the Netrani Island of Karnataka coast[16]. The distribution status of alien and cryptogenic ascidians along the Southern Coasts of Indian Peninsula[17]. A detailed work on ascidian diversity and many comprehensive revisions were done from south India[18]. Ascidiandiversity and seasonal variations of Thoothukudi coast was studied and reported[19]. Reported the two new records of colonial ascidians species - *Aplidium brevilarvacium* Kott, 1963 and *Aplidium distaplium* Kott, 1992 from Indian waters[20]. Studies was done the occurrence of colonial ascidian like*Eudistoma kaverium* sp. nov and recorded the certan new species belongs to *Eudistoma* from Indian coastal waters[21].

In India, diversity and biodiversity assemblages of rocky reefs were studied and documented in very scarcely especially when coming to the west coast[22]. The ecology of Sea grass ecosystem of Minicoy, Lakshadweep was studied and documented[23]. Biodiversity studies of different ecosystems was studied and document around the world i.e., biodiversity of sea grass ecosystem, invertebrate assemblage on tropical reef flats, Biodiversity assessment studies on various invertebrates groups

were done by researchers from the different regions of the country[24-26]. The diversity and Importance of invertebrate's community in ecosystem like coral reef was studied and explained in the various parts of the world[27]. By pursuing the available literatures, studies on reef organisms and their taxonomy, diversity, ecology has most prominently focussed to towards the reef organisms, such as corals and fishes. The other side, a major group of reef associated invertebrates' includes smaller and cryptic organisms were deliberately ignored by the researchers due to taxonomic ambiguity and difficulties[28]. And also when comes to the Indian marine taxonomic studies, even though the coral reef studies have long tradition but the rocky reefs are remain unexplored. So it comes to the reality, even though studies on the taxonomic diversity of marine organisms have had a long tradition[29]. By pursuing the above mentioned literatures, the studies on rocky reefs biodiversity and assemblage studies is scare. So the present attempt will be a curtain raiser for such kind of efforts.

Methodology

Field study: Collections were done fortnightly; handpicked the samples while snorkelling from the selected sites like Mulloor, Vizhinjam, Kovalam and Thirumullavaram (Figure-1). Sample collections were done from these sites for a period of two years (June 2013- May 2015). Sites selections were based on the presence of prominent rocky reefs in the south west coast of Kerala. Specimens was preserved in formalin and brought to the laboratory for identification. Standard methods/protocols were followed in the identification[30]. The samples were sorted out in the laboratory, made into taxonomic groups, and preserved in formaldehyde. Species level identification was done later by using standard references[31].

Sampling methods and analysis: The specimens were collect by diving by the aids of snorkel andphotographs were taken in fresh condition, species level identification done by the standard procedures[32,33]. In this study, 50cm quadrant was used for the biodiversity assessment of sedentary animals like sponges, cnidarians, marine worms, molluscs, echinoderms and Urochordates. The statistical analysis of the data was performed with the programmes includingthe SPSS (Social Sciences version 11.0) and PRIMER v6[34]) (Plymouth Routines in Multivariate Ecological Research, version 6.1.9), for univariate and multivariate analyses of data.

Community structure: PRIMER v6 for windows was used for the analysis of community structure.

Results and discussion

A total of 231 macro-invertebrates and six species of tunicates belong to 8 phyla, 18 Classes, 53 Orders, 135 Families and 175 Geneses were identified. Among them, Phylum Mollusca crowned first with 116 species, followed by Arthropoda (53), Echinodermata (23), Cnidaria (18), Porifera (12), Annelida (8), Urochordata 6species, and Platyhelminthes the least in this context with 2 species. The highest degree of fluctuations in the diversity and assemblage of invertebrate wassite dependent. Because of the similarity in the methodology used for diversity assessment, the Phylum Urochordata is also included in the groups of macro invertebrates (Figure-3).

The reef environment is very productive and diverse than any other environment like sandy beaches. Reef associated life comprising of algae, sponges, annelids, Molluscs, crabs, prawns, echinoderms, fishes with several other members of minor phyla. The present study describes species diversity and assemblages of reef in some of the representative reef areas like Mulloor, Vizhinjam, Kovalam, and Thirumullavaram of the south west coast of Kerala.

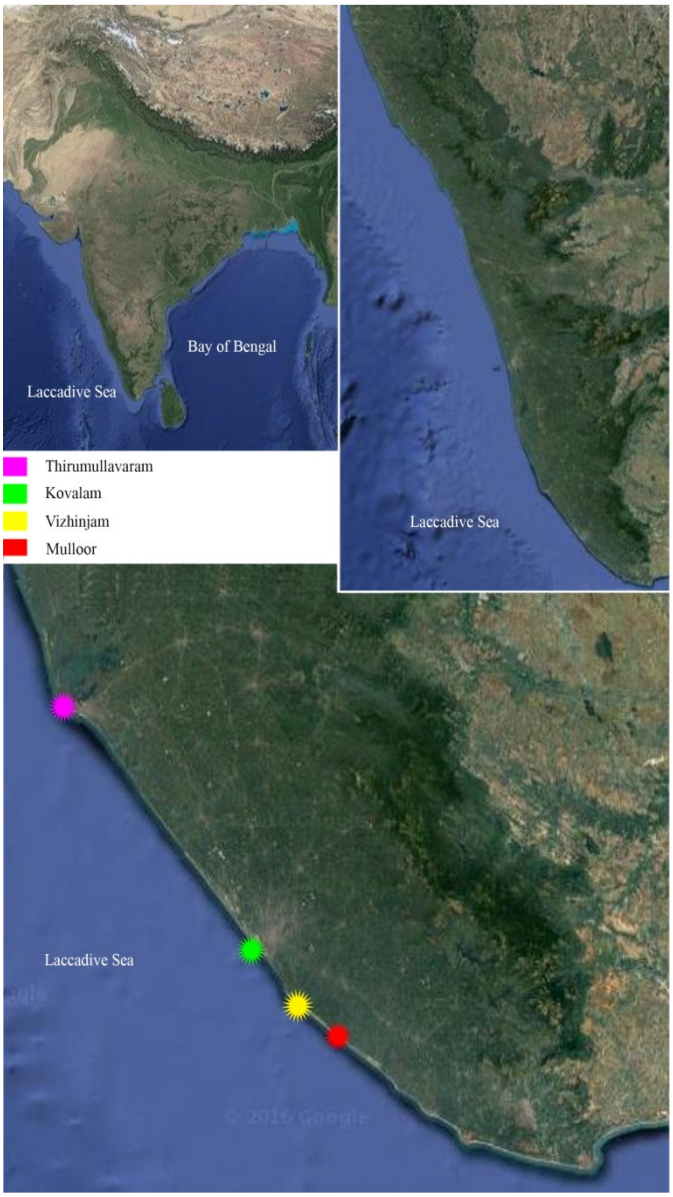

Figure-1: Map showing the study sites.

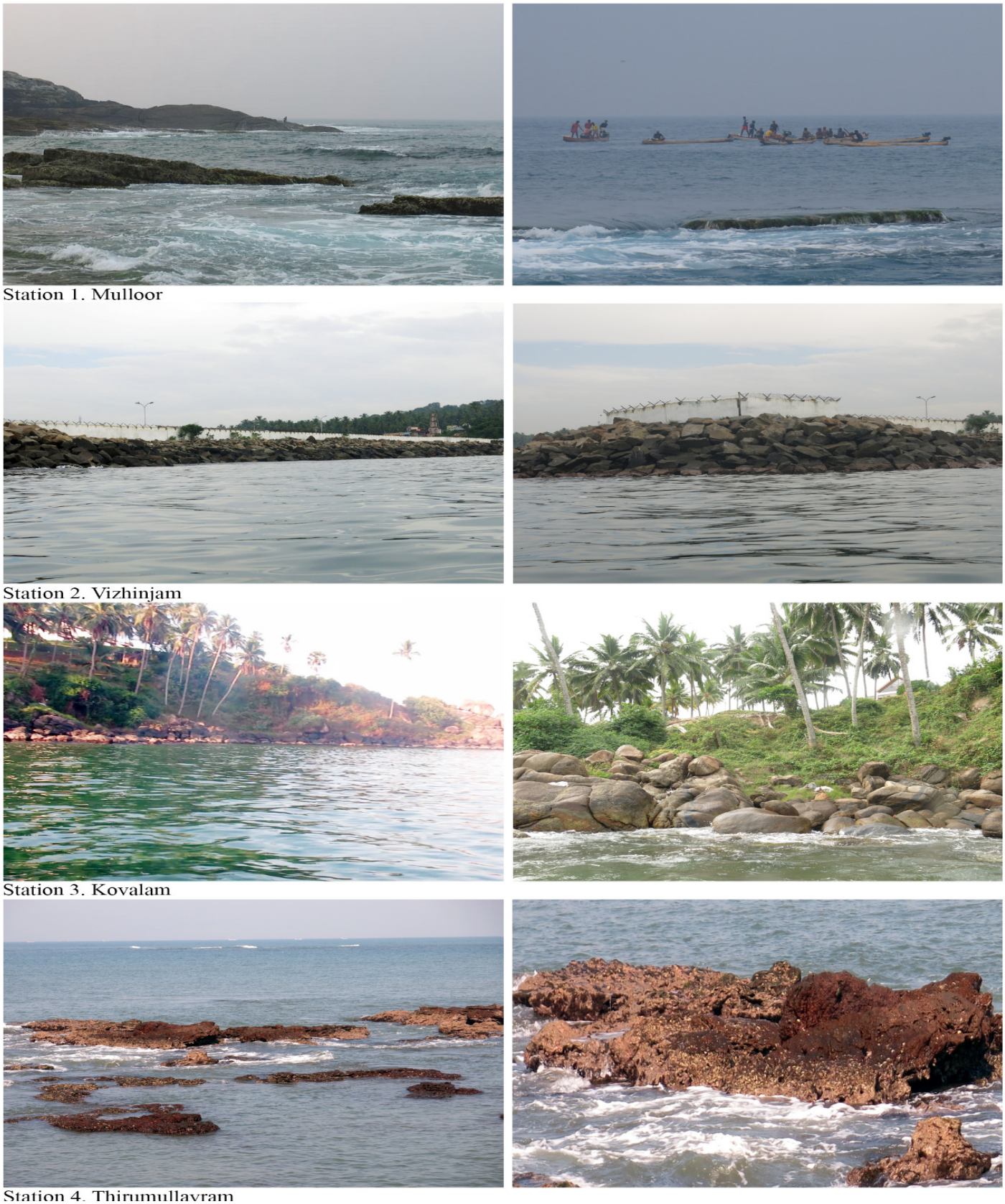

Figure-2: Study sites of the coast.

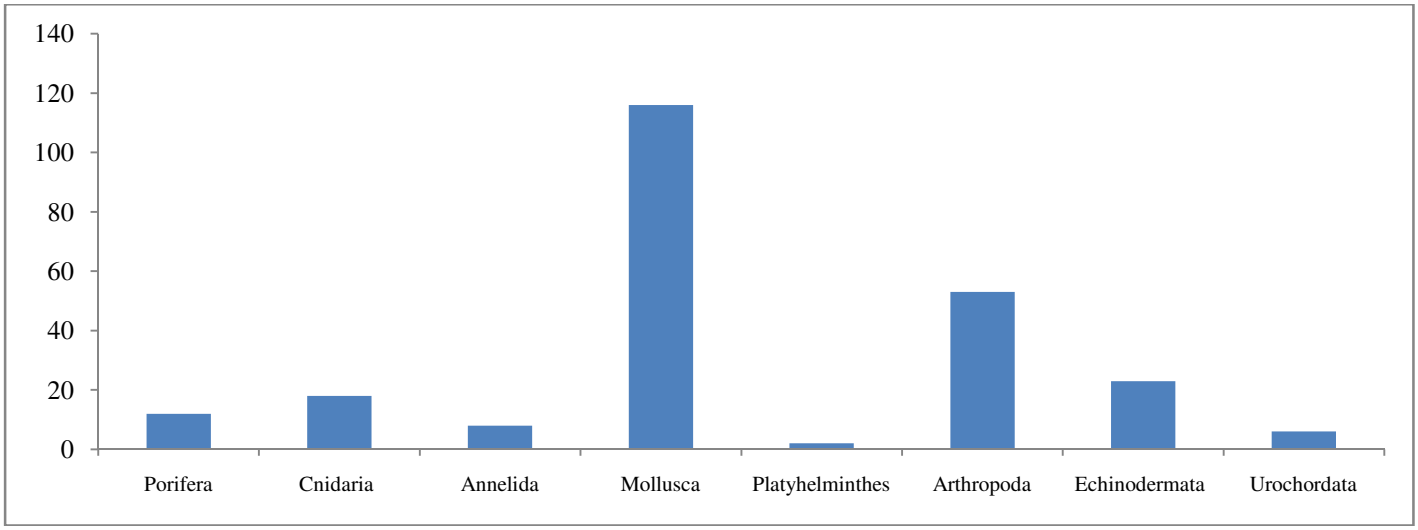

Figure-3: The species composition in different Phyla of the macro invertebrates.

Table-1: Taxonomy of Macro invertebrates.

	Order	Family	Genus	Species
Phylum: Porifera Class: Demospongiae	Axinellida	Axinellidae	*Auletta*	*Auletta elongata* Dendy, 1905
			Pione	*Pione vastifica* (Hancock, 1849)
	Poecilosclerida	Tedaniidae	*Tedania*	*Tedania (Tedania) anhelans* (Vio in Olivi, 1792)
	Dictyoceratida	Irciniidae	*Ircinia*	*Ircinia sp.* Nardo, 1833
		Dysideidae	*Dysidea*	*Dysidea fragilis* (Montagu, 1814)
	Tetractinellida	Ancorinidae	*Ecionemia*	*Ecionemia acervus* Bowerbank, 1864
	Haplosclerida	Callyspongiidae	*Callyspongia*	*Callyspongia (Cladochalina) diffusa* (Ridley, 1884)
				Callyspongia (Cladochalina) fibrosa (Ridley & Dendy, 1886)
		Chalinidae	*Haliclona*	*Haliclona tenuiramosa* (Burton, 1930)
		Niphatidae	*Gelliodes*	*Gelliodes carnosa* Dendy, 1889
	Poecilosclerida	Microcionidae	*Clathria*	*Clathria (Microciona) sp.* Bowerbank, 1862
	Suberitida	Halichondriidae	*Amorphinopsis*	*Amorphinopsis foetida* (Dendy, 1889)
Phylum:Cnidaria Class:Hydrozoa	Anthoathecata	Eudendriidae	*Eudendrium*	*Eudendrium annulatum* Norman, 1864
		Pennariidae	*Pennaria*	*Pennaria disticha* Goldfuss, 1820
	Leptothecata	Sertulariidae	*Dynamena*	*Dynamena pumila* (Linnaeus, 1758)
Class:Scyphozoa	Rhizostomeae	Cepheidae	*Cephea*	*Cephea cephea* (Forskål, 1775)
			Netrostoma	*Netrostoma coerulescens* Maas, 1903
Class:Anthozoa	Actiniaria	Actiniidae	*Anthopleura*	*Anthopleura nigrescens* (Verrill, 1928)
				Anthopleura spp. Duchassaing de Fonbressin & Michelotti, 1860
			Bunodosoma	*Bunodosoma goanense* den Hartog & Vennam, 1993
	Alcyonacea	Nephtheidae	*Dendronephthya*	*Dendronephthya sp.* Kuekenthal, 1905

	Scleractinia	Acroporidae	*Montipora*	*Montipora foliosa* (Pallas, 1766)
		Merulinidae	*Echinopora*	*Echinopora hirsutissima* Milne Edwards & Haime, 1849
			Favites	*Favites abdita* (Ellis & Solander, 1786)
		Pocilloporidae	*Pocillopora*	*Pocillopora damicornis* (Linnaeus, 1758)
				Pocillopora meandrina Dana, 1846
				Pocillopora verrucosa (Ellis and Solander, 1786)
				Pocillopora woodjonesi Vaughan, 1918
		Poritidae	*Porites*	*Porites exserta* Pillai 1969
	Zoantharia	Zoanthidae	*Zoanthus*	*Zoanthus sansibaricus* Carlgren, 1900
Phylum:Platyhelminthes Class:Turbellaria	Polycladida	Pericelidae	*Pericelis*	*Pericelis sp.* Laidlaw, 1902
		Pseudocerotidae	*Pseudobiceros*	*Pseudobiceros fulgor* Newman and Cannon, 1994
Phylum:Mollusca Class: Polyplacophora	Chitonida	Mopaliidae	*Plaxiphora*	*Plaxiphora (Plaxiphora) tricolor* Thiele, 1909
		Acanthochitonidae	*Acanthochitona*	*Acanthochitona mahensis* Winckworth, 1927
Class:Gastropoda	Petallogastropoa	Fissurellidae	*Clypidina*	*Clypidina notata* (Linnaeus, 1785)
			Scutus	*Scutus antipodes* Montfort, 1810
		Aplustridae	*Hydatina*	*Hydatina zonata* (Lightfoot, 1786)
		Lepetellidae	*Saptadanta*	*Saptadanta nasika* Prashad & Rao, 1934
		Nacellidae	*Cellana*	*Cellana radiata* (Born, 1778)
		Trochidae	*Trochus*	*Trochus maculatus* Linnaeus, 1758
				Trochus radiatus Gmelin, 1791
		Chilodontidae	*Euchelus*	*Euchelus asper* (Gmelin, 1791)
		Turbinidae	*Turbo*	*Turbo argyrostomus* Linnaeus, 1758
	Cycloneritimorpha	Neritidae	*Nerita*	*Nerita albicilla* Linnaeus, 1758
				Nerita maura Récluz, 1842
				Nerita plicata Linnaeus, 1758
				Nerita polita Linnaeus, 1758
	Littorinimorpha	Strombidae	*Margistrombus*	*Margistrombus marginatus* (Linnaeus, 1758)
		Ranellidae	*Lotoria*	*Lotoria perryi* (Emerson & Old, 1963)
			Monoplex	*Monoplex parthenopeus* (Salis Marschlins, 1793)
		Personidae	*Distorsio*	*Distorsio anus* (Linnaeus, 1758)
		Bursidae	*Tutufa*	*Tutufa (Tutufella) rubeta* (Linnaeus, 1758)
			Bursa	*Bursa granularis* Roding, 1798
		Cypraeidae	*Erosaria*	*Erosaria erosa* (Linnaeus, 1758)
				Erosaria ocellata (Linnaeus, 1758)

			Erronea	*Erronea caurica* (Linnaeus, 1758)
			Lyncina	*Lyncina carneola* (Linnaeus, 1758)
				Lyncina lynx (Linnaeus, 1758)
				Lyncina vitellus (Linnaeus, 1758)
			Mauritia	*Mauritia arabica* (Linnaeus, 1758)
				Mauritia mauritiana (Linnaeus, 1758)
			Monetaria	*Monetaria caputserpentis* (Linnaeus, 1758)
				Monetaria moneta (Linnaeus, 1758)
			Palmadusta	*Palmadusta asellus* (Linnaeus, C., 1758)
				Palmadusta clandestina (Linnaeus, 1767)
		Calyptraeidae	*Desmaulus*	*Desmaulus extinctorium* (Lamarck, 1822)
			Ergaea	*Ergaea walshi* (Reeve, 1859)
		Naticidae	*Natica*	*Natica cincta* Recluz, 1850
		Eulimidae	*Melanella*	*Melanella teinostoma* (A. Adams, 1854)
		Littorinidae	*Littoraria*	*Littoraria undulata* (Gray, 1839)
	Caenogastropoda	Planaxidae	*Planaxis*	*Planaxis sulcatus* (Born, 1778)
		Velutinidae	*Lamellaria*	*Lamellaria indica* Leach, 1867
		Epitoniidae	*Epitonium*	*Epitonium scalare* (Linnaeus, 1758)
	Neogastropoda	Buccinidae	*Engina*	*Engina phasinola* (Duclos, 1840)
				Engina mendicaria (Linnaeus, 1758)
				Engina mundula Melvill & Standen, 1885
			Pollia	*Pollia undosa* (Linnaeus, 1758)
		Melongenidae	*Volegalea*	*Volegalea cochlidium* (Linnaeus, 1758)
		Mitridae	*Mitra*	*Mitra acuminata* Swainson, 1824
				Mitra paupercula (Linnaeus, 1758)
		Volutidae	*Harpulina*	*Harpulina lapponicaloroisi* (Valenciennes, 1863)
		Turbinellidae	*Turbinella*	*Turbinella pyrum* (Linnaeus, 1767)
		Columbellidae		*Anachis terpsichore* (G. B. Sowerby II, 1822)
		Nassariidae	*Bullia*	*Bullia vittata* (Linnaeus, 1767)
		Harpidae	*Harpa*	*Harpa major* Röding, 1798
		Muricidae	*Ergalatax*	*Ergalatax contracta* (Reeve, 1846)
			Indothais	*Indothais lacera* (Born, 1778)
				Indothais sacellum (Gmelin, 1791)
			Mancinella	*Mancinella alouina* (Roding, 1798)
			Purpura	*Purpura panama* (Röding, 1798)

			Tenguella	*Tenguella granulata* (Duclos, 1832)
			Morula	*Morula uva* (Röding, 1798)
			Vokesimurex	*Vokesimurex malabaricus* (Smith, E.A., 1894)
			Chicoreus	*Chicoreus ramosus* (Linnaeus, 1758)
			Haustellum	*Haustellum haustellum* (Linnaeus, 1758)
			Rapana	*Rapana rapiformis* Born, 1778
			Maculotriton	*Maculotriton serriale* (Deshayes, 1834)
		Olividae	*Oliva*	*Oliva oliva* (Linnaeus, 1758)
				Oliva vidua (Röding, 1798)
		Conidae	*Conus*	*Conus ebraeus* Linnaeus, 1758
				Conus inscriptus Reeve, 1843
				Conus miles Linnaeus, 1758
				Conus parvatus Walls, 1979
				Conus buxeus loroisii Kiener, 1846
				Conus catus Hwass in Bruguière, 1792
				Conus coronatus Gmelin, 1791
				Conus sanguinolentus Quoy & Gaimard, 1834
				Conus terebra Born, 1778
				Conus tessulatus Born, 1778
Class: Opisthobranchia	Pleurobranchomorpa	Pleurobranchidae	*Berthellina*	*Berthellina citrina* (Rüppell & Leuckart, 1828)
		Bornellidae	*Bornella*	*Bornella stellifera* (A. Adams & Reeve [in A. Adams], 1848)
	Nudibranchia	Chromodorididae	*Goniobranchus*	*Goniobranchus conchyliatus* (Yonow, 1984
		Dendrodorididae	*Dendrodoris*	*Dendrodoris fumata* (Rüppell & Leuckart, 1830)
				Dendrodoris tuberculosa (Quoy & Gaimard, 1832)
		Discodorididae	*Sebadoris*	*Sebadoris fragilis* (Alder & Hancock, 1864)
		Facelinidae	*Moridilla*	*Moridilla brockii* Bergh, 1888
			Phidiana	*Phidiana militaris* (Alder & Hancock, 1864)
	Cephalaspidea	Bullidae	*Bulla*	*Bulla ampulla* Linnaeus, 1758
	Anaspidea	Aplysiidae	*Aplysia*	*Aplysia oculifera* A. Adams & Reeve, 1850
	Sacoglossa	Oxynoidae	*Lobiger*	*Lobiger viridis* Pease, 1863
		Caliphyllidae	*Polybranchia*	*Polybranchia orientalis* (Kelaart, 1858)
Class:Bivalvia	Mytiloida	Mytilidae	*Perna*	*Perna viridis* (Linnaeus, 1758)
				Perna perna (Linnaeus, 1758)

	Arcoida	Arcidae	*Barbatia*	*Barbatia obliquata* (Wood, 1828)
	Pterioida	Pinnidae	*Pinna*	*Pinna bicolor* Gmelin, 1791
			Atrina	*Atrina vexillum* (Born, 1778)
		Pteriidae	*Pincatada*	*Pincatada fucata,* Roding, 1798
				Pinctada sugillata (Reeve, 1857)
				Pinctada margaritefera, Roding, 1798
	Pectinida	Placunidae	*Placuna*	*Placuna placenta* (Linnaeus, 1758)
		Anomiidae	*Anomia*	*Anomia ephippium* Linnaeus, 1758
		Pectinidae	*Volachlamys*	*Volachlamys tranquebarica* (Gmelin, 1791)
		Spondylidae	*Spondylus*	*Spondylus imperialis* Chenu, 1844
				Spondylus squamosus Schreibers, 1793
	Ostreoida	Gryphaeidae	*Hyotissa*	*Hyotissa hyotis* (Linnaeus, 1758)
		Ostreidae	*Saccostrea*	*Saccostrea cucullata*, Born 1778
	Veneroida	Veneridae	*Gafrarium*	*Gafrarium divaricatum* (Gmelin, 1791)
		Chamidae	*Chama*	*Chama pacifica*, Broderip, 1835
				Chama pellucida Broderip, 1835
		Cardiidae	*Vepricardium*	*Vepricardium asiaticum* (Bruguière, 1789)
Class:Cephalopoda	Myopsida	Loliginidae	*Sepioteuthis*	*Sepioteuthis lessoniana* Lesson, 1830
	Octopoda	Octopodidae	*Amphioctopus*	*Amphioctopus sp.* P. Fischer, 1882
			Callistoctopus	*Callistoctopus sp.1* Iw. Taki, 1964
				Callistoctopus sp. 2 Iw. Taki, 1964
				Callistoctopus luteus (Sasaki, 1929)
				Callistoctopus macropus (Risso, 1826)
	Sepiida	Sepiidae	*Sepia*	*Sepia ramani* Neethiselvan, 2001
Phylum:Annelida Class:Polychaeta	Phyllodocida	Hesionidae	*Hesione*	*Hesione reticulata* Marenzeller, 1879
		Iphionidae	*Iphione*	*Iphione muricata* (Lamarck, 1818)
		Phyllodocidae	*Eteone*	*Eteone flava* (Fabricius, 1780)
			Nereiphylla	*Nereiphylla castanea* (Marenzeller, 1879)
			Phyllodoce	*Phyllodoce citrina* Malmgren, 1865
	Terebellida	Cirratulidae	*Cirriformia*	*Cirriformia tentaculata* (Montagu, 1808)
		Terebellidae	*Loimia*	*Loimia medusa* (Savigny in Lamarck, 1818)
	Sabellida	Sabellidae	*Sabellastarte*	*Sabellastarte magnifica* (Shaw, 1800)
Phylum:Arthropoda Class:Malacostraca	Decapoda	Diogenidae	*Aniculus*	*Aniculus erythraeus* Forest, 1984
			Calcinus	*Calcinus gaimardii* (H. Milne Edwards, 1848)
			Dardanus	*Dardanus lagopodes* (Forskål, 1775)

				Dardanus setifer (H. Milne Edwards, 1836)
		Epialtidae	*Hyastenus*	*Hyastenus diacanthus* (De Haan, 1839)
				Hyastenus hendersoni (Laurie, 1906)
			Pugettia	*Pugettia gracilis* Dana, 1851
				Pugettia producta (Randall, 1840)
		Eriphiidae	*Eriphia*	*Eriphia sebana* (Shaw & Nodder, 1803)
		Grapsidae	*Grapsus*	*Grapsus albolineatus* Latreille, in Milbert, 1812
				Grapsus longitarsis Dana, 1851
			Pachygrapsus	*Pachygrapsus crassipes* Randall, 1840
		Matutidae	*Ashtoret*	*Ashtoret lunaris* (Forskål, 1775)
			Matuta	*Matuta planipes* Fabricius, 1798
		Menippidae	*Menippe*	*Menippe rumphii* (Fabricius, 1798)
		Ocypodidae	*Ocypode*	*Ocypode ceratophthalmus* (Pallas, 1772)
		Oziidae	*Ozius*	*Ozius guttatus* H. Milne Edwards, 1834
		Percnidae	*Percnon*	*Percnon planissimum* (Herbst, 1804)
		Plagusiidae	*Plagusia*	*Plagusia immaculata* Lamarck, 1818
				Plagusia squamosa Lamarck, 1818
		Porcellanidae	*Pachycheles*	*Pachycheles natalensis* (Krauss, 1843)
			Petrolisthes	*Petrolisthes boscii* (Audouin, 1826)
				Petrolisthes coccineus (Owen, 1839)
				Petrolisthes lamarckii (Leach, 1820)
			Pisidia	*Pisidia gordoni* (Johnson, 1970)
				Pisidia longicornis (Linnaeus, 1767)
		Portunidae	*Charybdis*	*Charybdis* (*Charybdis*) *hellerii* (A. Milne-Edwards, 1867)
				Charybdis (*Charybdis*) *lucifera* (Fabricius, 1798)
			Portunus	*Portunus* (*Portunus*) *pelagicus* (Linnaeus, 1758)
			Thalamita	*Thalamita prymna* (Herbst, 1803)
		Trapeziidae	*Trapezia*	*Trapezia tigrina* Eydoux & Souleyet, 1842
		Varunidae	*Hemigrapsus*	*Hemigrapsus sanguineus* (De Haan, 1835)
			Varuna	*Varuna litterata* (Fabricius, 1798)
		Xanthidae	*Atergatis*	*Atergatis floridus* (Linnaeus, 1767)
			Atergatis	*Atergatis integerrimus* (Lamarck, 1818)
			Atergatis	*Atergatis subdentatus* (De Haan, 1835)

			Demania	*Demania intermedia* Guinot, 1969
			Epiactaea	*Epiactaea margaritifera* (Odhner, 1925)
			Leptodius	*Leptodius exaratus* (H. Milne Edwards, 1834)
			Liomera	*Liomera cinctimana* (White, 1847)
	Infra Order Brachyura	Leucosiidae	*Pyrhila*	*Pyrhila pisum* (De Haan, 1841)
			Seulocia	*Seulocia pubescens* (Miers, 1877)
	Infra order Anomura	Hippidae	*Emerita*	*Emerita emeritus* (Linnaeus, 1767)
	Decapoda	Alpheidae	*Alpheus*	*Alpheus gracilipes* Stimpson, 1860
				Alpheus pacificus Dana, 1852
				Alpheus parvirostris Dana, 1852
				Alpheus splendidus Coutière, 1897
			Athanas	*Athanas sp.* Leach, 1814 [in Leach, 1813-1814]
	Infraorder Achelata	Palinuridae	*Panulirus*	*Panulirus homarus* homarus (Linnaeus, 1758)
	Infraorder Caridea	Alpheidae	*Synalpheus*	*Synalpheus stimpsonii* (de Man, 1888)
		Hippolytidae	*Lysmata*	*Lysmata vittata* (Stimpson, 1860)
				Lysmata wurdemanni (Gibbes, 1850)
	Stomatopoda	Squillidae	*Miyakella*	*Miyakella nepa* (Latreille, in Latreille, Le Peletier, Serville & Guérin, 1828)
Phylum:Echinodermata Class:Crinoidea	Comatulida	Comatulidae	*Comaster*	*Comaster schlegelii* (Carpenter, 1881)
			Comatella	*Comatella nigra* (Carpenter, 1888)
		Mariametridae	*Lamprometra*	*Lamprometra palmata* (Müller, 1841)
Class:Echinoidea	Camarodonta	Echinometridae	*Echinometra*	*Echinometra mathaei* (Blainville, 1825)
		Temnopleuridae	*Salmacis*	*Salmacis bicolor* L. Agassiz in L. Agassiz & Desor, 1846
		Toxopneustidae	*Tripneustes*	*Tripneustes gratilla* (Linnaeus, 1758)
	Diadematoida	Diadematidae	*Diadema*	*Diadema paucispinum* A. Agassiz, 1863
			Echinothrix	*Echinothrix calamaris* (Pallas, 1774)
	Stomopneustoida	Stomopneustidae	*Stomopneustes*	*Stomopneustes variolaris* (Lamarck, 1816)
Class: Asteroidea	Valvatida	Asterinidae	*Aquilonastra*	*Aquilonastra burtoni* (Gray, 1840)
		Goniasteridae	*Stellaster*	*Stellaster childreni* Gray, 1840
Class: Ophiuroidea	Ophiurida	Ophiocomidae	*Ophiocoma*	*Ophiocoma erinaceus* Müller & Troschel, 1842
		Ophiodermatidae	*Ophiopsammus*	*Ophiopsammus sp*. Lütken, 1869
		Ophiotrichidae	*Macrophiothrix*	*Macrophiothrix aspidota* (Müller & Troschel, 1842)
			Ophiocnemis	*Ophiocnemis marmorata* (Lamarck, 1816)
			Ophiomaza	*Ophiomaza cacaotica* Lyman, 1871
Class: Holothuroidea	Aspidochirotida	Holothuriidae	*Holothuria*	*Holothuria* (*Halodeima*) *atra* Jaeger,

				1833
				Holothuria (*Halodeima*) *edulis* Lesson, 1830
				Holothuria (Mertensiothuria) leucospilota (Brandt, 1835)
				Holothuria (*Semperothuria*) *cinerascens* (Brandt, 1835)
	Dendrochirotida	Cucumariidae	*Actinocucumis*	*Actinocucumis typica* Ludwig, 1875
			Staurothyone	*Staurothyone rosacea* (Semper, 1869)
		Phyllophoridae	*Stolus*	*Stolus buccalis* (Stimpson, 1855)
Phylum:Chordata Subphylum: Urocordata Class: Ascidiacea	Stolidobranchia	Styelidae	*Styela*	*Styela plicata* (Lesueur, 1823)
	Aplousobranchia	Didemnidae	*Didemnum*	*Didemnidaesp*. Giard, 1872
				Didemnum moseleyi (Herdman, 1886)
			Diplosoma	*Diplosoma listerianum* (Milne Edwards, 1841)
			Leptoclinides	*Leptoclinides madara* Tokioka, 1953
	Phlebobranchia	Ascidiidae	*Phallusia*	*Phallusia nigra* Savigny, 1816

Porifera: Total 12 species of sponges recorded in the study which belongs to single class, 6 orders 9 families and 11 geneses. Order Haplosclerida represents maximum number of species by bagging 5, followed by Clionaida with 3 and Dictyoceratida, Haplosclerida, Poecilosclerida and Suberitida representing 1 each. It's found that the most specious families in the phylum Porifera are Clionidae, Callyspongiidae, and Chalinidae with 2 species on each. Spirastrellidae Dictyodendrillidae, Dysideidae, Niphatidae, Microcionidae, Halichondriidae was divided with one on each.

Cnidaria: Cnidarian diversity is scattered in three major classes, the class Anthozoa lined up in the first position with 13 species. Hydrozoa and Scyphozoa are following with minor contributions of 3 and 2 species respectively. When comes to the family wise species composition, diversity is distributed in 10 families like Pocillopridae with maximum species (5), Actiniidae (3), Cephidae and Merulinidae (2) followed by Eudendridae, Pennaridae, Sertulariidae, Nephtheidae, Acroporidae and Zoanthidae are 1 on each.

Platyhelminthes: Phylum Platyhelminthes is distinguished by the lowest number of species recorded in the study. Two species of flatworms coming under families Pericelidae, Pseudocerotidae are from a single order Polycladida.

Mollusca: It is the major phyla with the maximum number of species represented among invertebrates, a total of 116 molluscan species were reported in this study. In the Phylum Mollusca, the class Gastropoda represents the maximum number with 75 species, Bivalvia (19 species), 12 species in Opisthobranchia, Cephalopoda with 7 species and the class Polyplacophora is represented only with 2 species. Among the 18 Molluscan orders recorded in the study, Neogastropoda Littorinomorpha and Chitonida are highlighted with strong species representation of 35, 22 and 11 respectively. Orders like Nudibranchia and Octopoda is next in the row with 7 and 6 species in each. Pterioda and Pectinida shows the similarity in their participation with 5 species.

Annelida: Total 8 species belong to 3 orders, Phyllodocida with maximum species representation of (5), followed by Terebellida (2) and Sabellida (1). Among the 6 families reported, Phyllodocidae (3 species) with maximum species representation followed by 1 species in rest of the each families.

Arthropoda: Overall, 53 species were counted under the phylumArthropoda. The species belongs to 6 orders, with maximum species representation in the order Decapoda (45), followed by Caridea (3), Brachyura (2) and orders like Anomura, Achelata, Stomatopoda are recognized with equal number of species representation of 1 species each. For all families recorded in the phylum Arthropoda (22), the families with comparatively more number of species were the Xanthidae (7 species), the Porcellanidae (6 species), Alpheidae (5 species) and families like Diogenidae, Epialatidaeand Portunidae (4 species).

Echinodermata: 23 species in the phylum Echinodermata were scattered in 5 classes with Holothuroidea (7 species), Echinoidea (6 species), Ophiuroidea (5 species), Crinoidea (3 species) and Asteroidea (2 species)
Out of 8 orders in the phylum Echinodermata, the highest number of species was recorded in Ophiurida (5), followed by Aspidochirotida (4 species), Comatulida, Camarodonta, Dendrochirotida (3 species each), Diadematoida and Valvatida (2 species each) and Stomopneustoida with one species.

Out of 15 Families recorded from the Phylum Echinodermata, Holothuriidae have the maximum number of species representation (4), followed by Ophiotichidae (3). Few families like Comatulidae, Diadematidae and Cucumariidae (2 species in each) and Mariametridae, Echinometridae, Temnopleuridae, Toxopneustidae, Stomopneustide, Asterinidae, Goniasteridae, Ophiocomidae, Ophiodermatidae and Phyllophoridae (1 species in each) were recognized with equal number of species distribution.

Urochordata: Six species of ascidians were recorded in the study, which belongs to the Phylum Chordata; sub Phylum Urochordata, Class Ascidiacea. These six species are scattered in 3 Orders, Stolidobranchia (1), Aplousobranchia (4) and Phlebobranchia (1). When comes to family wise species diversity, it is scattered in 3 families, Styelidae (1 species), Didemnidae (4 species) and Ascidiidae (1 species).

Table-2: Percentage composition of dominant species at the four stations.

Station I	%	Station II	%
Spirastrella hartmani	3	*Cliona celata*	2
Acanthochitona mahensis	3	*Eudendrium annulatum*	4
Clypidina notata	9	*Bunodosoma goanense*	2
Cellana radiata	4	*Pocillopora meandrina*	2
Trochus maculatus	5	*Loimia medusa*	3
Trochus radiatus	3	*Plaxiphora (Plaxiphora) tricolor*	2
Euchelus asper	4	*Clypidina notata*	2
Tutufa (Tutufella) rubeta	5	*Cellana radiata*	2
Pollia undosa	12	*Perna perna*	59
Perna perna	32	*Perna viridis*	16
Perna viridis	20	*Pericelis sp*	2
		Stomopneustes variolaris	2
		Staurothyone rosacea	2
Station III	%	Station IV	%
Callyspongia (Cladochalina) fibrosa	1	*Favites abdita*	10
Bunodosoma goanense	1	*Porites exserta*	8
Zoanthus sansibaricus	2	*Nerita albicilla*	11
Clypidina notata	2	*Mauritia arabica*	8
Cellana radiata	3	*Bullia vittata*	11
Mauritia arabica	1	*Mitra acuminata*	8
Perna perna	46	*Indothais sacellum*	9
Perna viridis	35	*Thalamita prymna*	14
Echinometra mathaei	5	*Stomopneustes variolaris*	13
Tripneustes gratilla	2	*Holothuria (Halodeima) edulis*	8
Stomopneustes variolaris	2	*Favites abdita*	10

For assessing the species dominance intensity in each station, certain species were selected on the basis of a number of individuals observed in each sampling and find the Percentage of dominance and were tabled (Table-2). As per the findings the *Perna perna* and *Perna viridis* were the most dominant species in all stations except station IV, this is because, the first three stations are with prominent mussel beds in the coast. And these stations are well known for mussel fishery.

Distribution: In the site wise species composition, the station II (Vizhinjam) made the prominent position by bagging 52% of the total species distribution. Station III (Kovalam) covered 24%, station IV (Thirumullavaram) 18% and a station I (Mulloor) 6% (Figure-4).

Spatial variations in faunal group density: Station I – Mulloor: Mean density of invertebrates in this station was 108 indls/quadrant. Highest density of macro invertebrates (172 indls/quadrant) was recorded during January (2013-2014), followed by 144 indls/quadrant in December I and 136 indls/quadrant in April (2013-2014). Lowest density of 8 indls/quadrant was observed in May and August during the year of 2014-2015 (Table-3 and 4).

Station II–Vizhinjam: In this station, the density was comparatively high having the total mean density 663.5 indls / quadrant. Highest density of 808 indls/quadrant was recorded in January (2014-2015), followed by 774 indls/quadrant in January (2013-2014) and 654 indls/quadrant in February (2013-2014). 76 indls/quadrant was the lowest density recorded in this station in August at the time of 2014-2015 (Table-3 and 4).

Station III – Kovalam: Total mean density of invertebrates in this station was 530.5 indls/quadrant. A maximum density of 663 indls/quadrant was recorded in December (2013-2014), followed by 564 indls/quadrant in March and 522 indls/quadrant in October during 2014-2015. Lowest density of 4 indls/ quadrant was recorded in July in2014-2015 (Table-3 and 4).

Station IV–Thirumullavaram: The total mean density recorded at this station was 98 indls/quadrant. Highest density of 192 indls/quadrant was recorded in Jan (2013-2014), followed by 120 indls/quadrant inJanuary 2014-2015 and 116 indls/quadrant in February (2013-2014). Lowest density of 8 indls/quadrant was in August (2013-2014) (Table-3 and 4).

Seasonal variations in faunal group density: The results of the seasonal variation (over entire study period) studies were divided into two study periods (2013 June -2014 May and 2014 June -2015 May). At the station I, highest mean density was recorded during post monsoon (108±59.42 indls/quadrant) and lowest (37±27.40 indls/quadrant) during monsoon. During the pre-monsoon, it was 74±52.10 indls/quadrant. In the station II, highest mean density was 663.5±87.6 indls/quadrant, which was recorded during post monsoon. It was 525.75±100.65 indls/ quadrant during pre-monsoon and 261±89.88 indls/quadrant during monsoon. 530.5±203.66 indls/quadrant was the highest seasonal mean density in the station III, which was observed during post monsoon, followed by 424.5±142.59 indls/quadrant during pre-monsoon and 41±32.39 indls/quadrant during monsoon. Highest seasonal mean density (98±64.79 indls/ quadrant) in the station IV was recorded during Post Monsoon. 77±45.77 and 10±8.33 indls/quadrant were recorded during pre-monsoon and monsoon respectively. High species densities were observed during post monsoon seasons in all four stations. In the second year of the study, there were marked variations in all seasons. During the monsoon at the station I, 29±18.00 indls/quadrant was recorded, which is lower than the previous year. The station II recorded a slight decline from the first year and the highest seasonal mean density of 522.5±212.39 indls/quadrant was in post monsoon, followed by 498.25±119.54 indls/quadrant in pre monsoon and lowest in monsoon with 257±170.94 indls/quadrant. At station III, monsoon mean density of 244±180.43 indls/quadrant, which is a massive hike from the first year, but post and pre monsoon were showed turn down from the first year with mean density of 362.75±115.78 and 269±93.87 indls/quadrant correspondingly. The monsoon of the station IV climb with 19±6.83 indls/quadrant followed by post and pre monsoon were perceived attention by means of declined mean density readings in comparison with first year 65±37 and 46±26.23 respectively (Table-5 and 6).

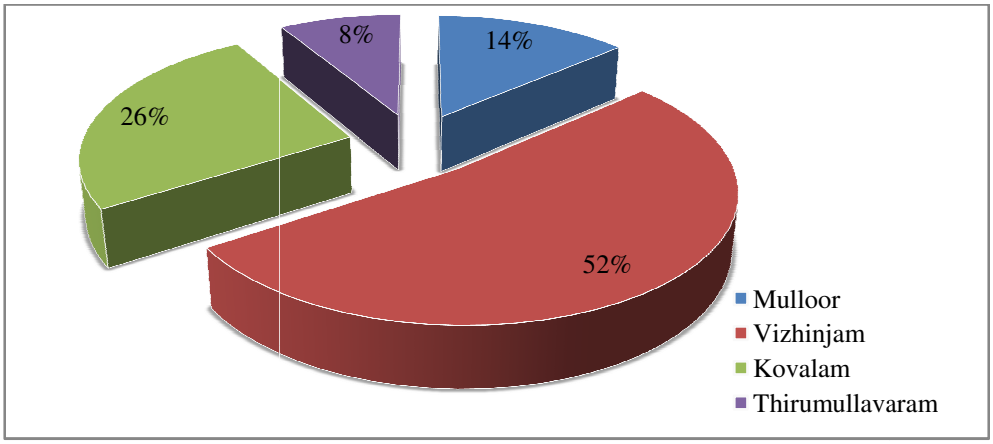

Figure-4: The site wise percentage composition of species.

Table-3: Mean diversity indices (Spatial variation) in faunal diversity of 2013-2014.

Season	Station I Mean ±SD	Station II Mean ±SD	Station III Mean ±SD	Station IV Mean ±SD
Monsoon	37±27.40	261±89.88	41±32.39	10±8.33
Post Monsoon	108±59.42	663.5±87.6	530.5±203.66	98±64.79
Pre Monsoon	74±52.10	525.75±100.65	424.5±142.59	77±45.77

Table-4: Mean diversity indices (Spatial variation) in faunal diversity of 2014-2015.

Season	Station I Mean ±SD	Station II Mean ±SD	Station III Mean ±SD	Station IV Mean ±SD
Monsoon	29±18.00	257±170.94	244±180.43	19±6.83
Post Monsoon	78±24.55	522.5±212.39	362.75±115.78	65±37
Pre Monsoon	47±32.56	498.25±119.54	269±93.87	46±26.23

Table-5: Mean diversity indices (Seasonal variation) in faunal diversity of 2013-2014.

Station	Monsoon Mean ±SD	Post Monsoon Mean ±SD	Pre Monsoon Mean ±SD
Station I	37±27.40	108±59.42	74±52.10
Station II	261±89.88	663.5±87.6	525.75±100.65
Station III	41±32.39	530.5±203.66	424.5±142.59
Station IV	10±8.33	98±64.79	77±45.77

Table-6: Mean diversity indices (Seasonal variation) in faunal diversity 2014-2015.

	Monsoon Mean ±SD	Post Monsoon Mean ±SD	Pre Monsoon Mean ±SD
Station I	29±18.00	78±24.55	47±32.56
Station II	257±170.94	522.5±212.39	498.25±119.54
Station III	244±180.43	362.75±115.78	269±93.87
Station IV	19±6.83	65±37	46±26.23

Discussion: At presently, plenty of studies have highlighted from around the world to explicit the role of rock reefs to maintaining ecology and biodiversity of the marine environment. In a study, the structure and species composition of epibenthic macro invertebrate communities of rocky reefs along the Gulf of California. The study includes the quantitative assessment of taxa dominance between Cnidaria, Bivalvia, Annelida, Ascidiacea and Porifera, and Echinodermata, Decapoda, Cephalopoda, Gastropoda, Polycladida[35]. But the present study analysis the biodiversity of 231 species of macro invertebrates belongs to seven phyla Porifera, Cnidaria, Mollusca, Platyhelminthes, Annelida, Arthropoda, Echinodermata and Ascidiacea. Studied and explored the influence of habitat structure and environmental conditions on spatial distribution patterns of macro invertebrate assemblages associated with sea grass beds in a southern Gulf of Mexico coastal lagoon. A total of 40 benthic macro invertebrate species were recorded in that study, molluscs being the most important group in terms of diversity and abundance[36]. The result encompasses in the present investigation also matching the Avila's result with Phylum Mollosca parting the major biota (116 species) in the invertebrate's diversity. The Distribution of Alien and Cryptogenic Ascidians was studied along the Southern Coasts of Indian Peninsula. The result of this

studyyielded 34 non-indigenous ascidians out of which 41 species has been reported in the present study 6 species of Ascidians belonging to 3 orders, 3 families and 5 genera were reported in the present study[37]. The coral reef associated gastropod assemblages; distribution and diversity patternwas studied and documented the Gulf of Mannar Island. And the study accomplished to reported a total of 40 species belongs to 19 families of gastropods were identified and the species distributed in 7 species in Cypraeidae, to 7 in Muricidae, followed by Strombidae, Naticidae and Trochidae3 on each, Fasiolariidae, Turbinellidae and Buccinidae (2 species) and least in Architectonicidae, Fasciolariidae, Turritellidae, Cassidae, Conidae, Ranellidae, Personidae, Volemidae, Nassariidae, Neritidae and Olividae were 1[38]. Studied the distribution of macro invertebrates on intertidal rocky shores in Gorgona Island, Colombia coast and they observed a total diversity of 121 species of macro invertebrates with a species distribution pattern of Mollusca was the richest and most abundant taxon (59 species), followed by Crustacea (33 species) and the other groups accounted 22[39]. The present study results shows a wide array of macro invertebrates diversity includes a total of 231 macro-invertebrates belongings to seven Phyla were identified. Among them, Porifera 12, Cnidaria 18, Annelida 8, Mollusca 115, Platyhelminthes 2, Arthropoda 53, Echinodermata 23 species and 6 species of ascidians are also included in this manuscript. Phylum Mollusca is the major Phyla with maximum number of species contribution and Platyhelminthes is least in the context. The diversity of reef associated biota of Pirotan Island of Gulf of Kachchh at Gujarat coast was studied and reported and the result encompasses a total number of 89 faunal and 31 floral (seaweeds and sea grasses) species were recorded during the study period from the various reef habitats[40]. The present study shows the substratum depended diversity of 231 macro invertebrates includes Porifera 12, Cnidaria 18, Annelida 8, Mollusca 115, Platyhelminthes 2, Arthropoda 53, Echinodermata 23 species and 6 species of ascidians are also included in this paper. There are certain similarities were observed in these two study results such as number of species in Platyhelminthes 2 species. The influence of anthropogenic activities on intertidal invertebrate faunal community structure and effects in their distribution pattern was studied at Kathiawarcoast. A total of 60 species from 6 phyla were recorded in the study[41]. In the present study, a total of 231 macro invertebrates associated with rocky reefs of south Kerala coast were recorded from four study sites. High diversity of macro invertebrates were observed in the station II, the density was comparatively high having the total means density 663.5 indls/quadrant. Highest density of 808 indls/quadrant was recorded in January II, followed by 774 indls/quadrant in January I and 654 indls/quadrant in February I. The spatial and temporal variability of mobile macro-invertebrate assemblages associated to coralligenous habitat, at Pianosa Island, in the Tuscan Archipelago National Park (north-western Mediterranean Sea). The study report was able to concluded with total species composition of 236 mobile macro-invertebrate belongs to Platyhelminthes 2 species, Sipuncula 4 species, Nemertea 6 species, Mollusca 27 species, Annelida 86 species, Arthropoda 103 species, and Echinodermata 8 species[42]. The present study result also equalize by 231 species of macro invertebrates and 6 species of ascidians, with species composition of Porifera (12), Cnidaria (18), Annelida (8), Mollusca (115), Platyhelminthes (2), Arthropoda (53), Echinodermata (23) and Urochordata (6 species). In an examination the distribution and diversity of hydroids (Cnidaria, Hydrozoa) was recorded and result encompasses a total of 32 species were identified from micro to macro scale[43]. In the present study, 18 species of Cnidarians including the 3 species of hydroids (*Eudendrium annulatum, Pennaria disticha, Dynamena pumila*) were identified and their assemblage studies also done.

The diversity and distribution of Brachyuran crabs from Ritchieo's Archipelago studied and reported 51 species of Brachyuran crabs belonging to 20 genera, 5 families under order Decapoda in the class Malacostraca[44]. The result of the present study also included the diversity and an assemblage of 53 species among class Malacostraca, order Decapoda, 22 families and 38 genera. In a survey, the diversity and distribution of reef associated echinoderms fauna in South Andaman, India. The study result yielded 75 species of echinoderms belonging to 13 orders and 16 families in this region. Out of five classes of echinoderms, Holothuroidea (37%) and Asteroidea (24%) showed the maximum percentage of species composition[45]. The present study revealed the presence of 23 species; and the species assemblage comprises in 20 genera and 15 families, 8 orders and 5 classes of the phylum Arthropod. Among the five classes of the phylum Arthropoda reported in the present study with a species composition of Crinoidea 13%, Echinoidea 26%, Asteroidea 9%, Ophiuroidea 22%, and Holothuroidea 30%.A study on assemblages of macro-fauna associated with two sea grass beds in Kingdom of Bahrain, and they also assessed the implications of its conservation. And the study recorded 82 species of macro-fauna from the two different sites in Kingdom of Bahrain[46]. The present study resulted with 237 species from four sites. And the result encompasses of totally 231 species of invertebrates and 6 species of Urochordates belongs to the single class Ascidacea.

The diversity studies of Opisthobranch fauna of Lakshadweep islands, India, 60 species of sea slugswas reported belonging to 25 families, including the 52 new records to Lakshadweep and 40 new records to India. The current study results are covering the 12 species of Opisthobranchs[47]. Biodiversity of marine Molluscs of Andhra Pradesh coast was studied and reported a total of 77 species of Molluscs which includes 44 species of Gastropods, 23 species of Bivalves and 3 species of Cephalopods[48]. The biodiversity study conducted in Ratnagiri coast about intertidal macrofaunal invertebrates diversity and the study result includes a total of 83 invertebrate species belongs to 6 phyla, 12 classes, 34 orders and 50 families[49]. The present study result encompasses the diversity of 231 species of invertebrates and 6 species of ascidians. The study has

completed in two year period from 2013 June to 2015 May. Underwater visual census method coupled with quadrant was used for the assessment of biodiversity. The community structure and distribution pattern of intertidal invertebrate macrofauna of the Kathiawar peninsular coastline off the Arabian Sea (India) studied and recorded a total of 60 species from 6 phyla[50].

A few studies has put forwarded form south Kerala coast in comparison with present study. The intertidal tidal biodiversity of sea wall at Vizhinjam and rocky shore Kovalam was studied and reported a total of 147 species, including 32 species of sea weeds, followed by 31 species of molluscs, 16 brachyuran crabs, 12 species of amphipods 11 species of sponges, 9 species of echinoderms, 6 species of coelenterates, ascidians and annelids7 species, 6 species of isopods, 4 species of alpheid shrimps, bryozoansand sipunculids 2 species, barnacle and hermit crab was counted 1 species on each[51]. But the present study was able to record a comparatively different biotic composition of 237 species including flora and fauna. And the two results shows that the intertidal and sub tidal rocky reef biodiversity have significant difference in species diversity.The mussel fishery associated diversity of Vizhinjam Bay, Vizhinjam coast, Kerala was studied and recorded. In that study, diversity composition of invertebrates 82% (80 species) followed by chordates 12 % (16 species) and marine flora 6% (8 species)[52]. But the present study observed the Vizhinjam coast is recorded the maximum of 215 species of invertebrates.It is assumed from the above discussions and comparisons that among the marine coastal ecosystems, the rocky reefs are rarely studied and documented especially when coming to the west coast of India. So the present effort can be considered as the biodiversity assessment of rocky reefs of Kerala by the aids of underwater visual census method coupled with quadrant studies for the biodiversity of slow moving and non-motile invertebrates.

These results suggest that distribution patterns of associated macro fauna are influenced by both the physical characteristics of the rocky reefs and environmental factors. On the other hand, previous studies have determined that ecosystems like coral reefs, sea grass meadow and rocky reefs supporting and patron of wide varieties of plants and animals, including invertebrates play a decisive role in the ecological balance of these systems. The findings of this study appear to be consistent, In general, the coastal rocky reefs is found to harbour rich biodiversity and in the long run it could provide a better substratum for the invertebrates diversity. Further modelling studies are required to analyses the biodiversity of these ecosystems' and their role in the ecology of marine ecosystems.

From the percentage composition studies of dominant species from each study sites, the species like *Perna perna* and *Perna viridis* was the most dominant species in all stations except station IV, this is because, the first three stations are detected with the possession of prominent mussel beds in the coast. And these stations are well known for mussel fishing activities. Among the four sites, station II (Vizhinjam) shows the high species diversity in all seasons of the throughout study periods. Followed by Station III (Kovalam) shows the species diversity and richness. The stations I (Mulloor) and IV (Thirumullavaram) were shown comparatively low species diversity and composition. This is because of the differences in substratum providing by each sites. The station II providing a mixture of natural and artificial reef structures, which may providing a wide range of habitat for various animal biota. The station III, within extensive natural rocky reefs which offering large surface area for wide range of animals. Even though the station I characterised by natural reefs, it is one of the deepest portion of the coast. So the restricted diving observations and collection of samples from the station, especially in monsoon seasons. And the station IV, porous rocks and high sedimentation rate makes the station with low species composition.

Conclusion

The rocky reef has received considerable attention of marine biologists in different parts of the world. From India there has been only limited number of studies on biodiversity and related assemblage studies of rocky reefs. These dynamic and productive ecosystems are the abode of rich biodiversity. Despite this, few studies have done on biodiversity of the rocky reefs focused on the ecological role of these structures or have attempted to assess the extent to which they can act as surrogates coral reefs.

In this context, the present paper was designed to give an outlook of the rocky reef associated invertebrates biodiversity of the Mulloor, Vizhinjam and Kovalam in Thiruvananthapuram and Thirumullavaram at Kollam district of Kerala. A two year survey was conducted between June 2013 to June 2015 to study the rocky reef associated invertebrates biodiversity and its assemblage studies. The assemblage studies were done with use of 50cm quadrant fabricated with the sand filled PVC pipes. These quadrants were placed over the reef surfaces and count the species observed inside the quadrant and found the square root of the number of observed animals. The taxonomy of all the species associated with rocky reefs was assessed using standard publications and with the assistance of experts in the fields. The photographs of all the species and under waters videos were taken for the further studies by the aids of underwater digital camera. Biodiversity indices such as Shannon index, richness index, dominance index and evenness index were prepared to study the biodiversity.

The survey of rocky reef associated invertebrates biodiversity with assemblage studies of Mulloor, Vizhinjam, Kovalam and Thirumullavaram recorded a total of 231 species of invertebrates and 6 species of ascidians. The biodiversity included Porifera 12 species, (1 classes, 6 orders, and 9 families and 11 genera), Cnidaria 18 species (3 classes, 7 orders, and 11

families and 14 genera), Annelida 8 species (1 classes, 1 orders, and 2 families and 2 genera), Mollusca 115 species (5 classes, 20 orders, and 59 families and 81 genera), Platyhelminthes 2 species (1 classes, 3 orders, and 6 families and 8 genera), Arthropoda 53 species (1 classes, 6 orders, and 22 families and 38 genera), Echinodermata 23 species (1 classes, 6 orders, and 9 families and 11 genera), and 6 species (5 classes,8 orders, and 15 families and 20 genera and Urochordata 6 species (1 classes, 3 orders, 3 families and 5 genera).

From the percentage composition studies of dominant species from each study sites, the species like *Perna perna* and *Perna viridis* was the most dominant species in all stations except station IV, this is because, the first three stations are detected with the possession of prominent mussel beds in the coast and also these stations are well known for mussel fishing.

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