ISSN 2321–340X

Journal of Aquatic Biology & Fisheries | Vol. 4 | 2016 | pp. 31-44

ROCKY REEF-ASSOCIATED FISH DIVERSITY OF SOUTH KERALA COAST, INDIA

Baiju, P.T.,[1]* Prabhakaran, M.P.,[2] Benno Pereira, F.G.[3] and Jayaprakas, V.[1]

[1]*Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram 695581 Kerala, India.*
[2]*School of FRM & HT, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi – 682506, Kerala*
[3]*Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram 695581 Kerala, India*
***Email:** baijuaqua@gmail.com*

Abstract: Survey of fish species occurring in the marine coastal rocky reefs of south Kerala coast was conducted at four sites along south Kerala coast during 2013-2015. A total of 228 fish species in 112 genera, 60 families, and 16 orders were recorded from the study area. The most specious families are Pomacentridae (20), followed by Labridae (17), Lutjanidae (15), Chaetodontidae (11), Acanthuridae (10), Apogonidae (10), Serranidae (9), and Muraenidae (9). The most common species encountered were *Parupeneus indicus*, *Chaetodon collare*, *Abudefduf saxatilis*, and *Siganus canaliculatus*. Among the four sites, station II (Vizhinjam) showed the high species richness and diversity (167 species) Order Perciformes dominated in all the stations with highest representation at Vizhinjam (120 species). Appearance rates were high for schooling fishes such as *Atherinomorus lacunosus, Taeniamia fucata* and *Caesio caerulaurea* and low for solitary species such as *Cephalopholis argus, Cantherhines pardalis* and *Dendrochirus zebra*.

***Key words**: Rocky reef, fish, biodiversity, south Kerala coast*

INTRODUCTION

Though the commercial fish fauna of India has been studied extensively (James *et al.,* 1994, 1996), information is not extensive on non-commercial fishes (Kuthalingam *et al.,* 1979; James *et al.,* 1988; Murty, 2002). Shallow continental shelves contributing 40 per cent of the species inhabit in tropical or subtropical waters (Lowe-McConnell, 1999; Nelson, 2006; Eschmeyer *et al.,* 2010). India is endowed with huge aquatic resources in an area of 2.02 million km^2 of Exclusive Economic Zone (EEZ) (Madhavi, 2012). It is observed that, the categories of fishes occurring reefs in India include groups such as damsel fish (52 species), butterfly fishes (32 species), sweet lips (16 species), angel fishes (16 species), parrot fishes (14 species), snappers (42 species), wrasses (53 species), groupers (43 species), surgeon fish (18 species) (Venkatraman and Wafar, 2005). Total 720 species of reef fishes belonging to 90 families were found in Andaman and Nicobar Islands (Rao, 2003), 71 species in the reef areas of Gulf of Mannar (Mathews *et al.,* 2010), 121 species belonging to 27 families from Kavaratti Island of Lakshadweep (Vijayanand and Pillai, 2002) and 56 species were recorded from Mithapur reef of Gulf of Kutch (Subburaman *et al.,* 2014).

The most common observational method for studying shallow (< 20 m) reef fish is an underwater visual survey (UVS) made by snorkelling. While regional diversity is determined by processes operating at very large spatial and temporal scales (Rocha *et al.,* 2005; Robertson *et al.,* 2006), the factors that influence the structure of local assemblages of reef-associated organisms are more context-dependent due to the highly variable biotic and abiotic forcing, as well as by the regional disturbance regimes (Sale, 1991a, b, 2006).

There are more reports on the diversity of edible (Nayar, 1958) and ornamental fishes (Sivaprasad *et al.,* 2007; Sirajudheen and Bijukumar, 2011; Sirajudheen, 2012) of this area, but it's rare to find the works regarding with rocky shore fish diversity except couple of works done (Sluka, 2013; Sirajudheen and Bijukumar, 2014). This is a fresh attempt to assess the reef fish diversity and as

semblages on rocky reefs of Kerala coast. This paper presents details on diversity and assemblages of fishes of rocky reef habitats of Mulloor, Vizhinjam, Kovalam (Thiruvananthapuram) and Thirumullavaram (Kollam) coast, South west coast of India.

MATERIALS AND METHODS

Study Area

Four stations were selected from the southern part of the Kerala state, India for the survey (Fig. 1) on the basis of nature, type and distribution of reefs along the coast. The sampling sites were (1) Mulloor: ($8^0$22'04'' N - $77^0$00'11'' E to $8^0$22'02'' N - $77^0$00'12' E) (2) Vizhinjam: ($8^0$22'32'' N - $76^0$59'28'' E, to $8^0$22'36'' N - $76^0$59'32'' E) (3) Kovalam: (8^0 23'34.6'' N - $76^0$58'24.2'' E, to $8^0$23'34.4'' N - $76^0$58'21.6'' E, (4) Thirumullavram: 80 53' 49.2'' N - 76033'05.1'' E, to 8053'54.0'' N - 76033'04.5'' E). The reefs in Mulloor are characterized by the presence of natural rock in large area. Vizhinjam is characterized by the presence of a bay for harboring fishing boats and catamarans. It is protected by the breakwater system, made of rocks and concrete structures (tetrapods), protects against high waves and provides suitable environmental conditions for marine ornamental fishes. Reefs of the Kovalam are characterized by the presence of natural rocky habitats. These extended natural rocky armoring play the role of break water structures and these rocky fencing offering harboring sites for various plants and animals. The coastal regions of Thirumullavaram is partially formed of rocky and sand substratum and subjected to heavy wave action. The substratum in the intertidal and up to sub-tidal zones is composed of literate rocks and scattered granite boulders which offer variant habitat for floral growth.

The survey of fish species occurring in the marine coastal rocky reefs of the south Kerala coast was conducted at four sites during 2013-2015. The sampling sites were Mulloor (station I), Vizhinjam (station II), Kovalam (station III) (Thiruvananthapuram district of Kerala) and Thirumullavaram (station IV) (Kollam district of Kerala). The observed species were categorized as abundant (>30), common (10-30), rare (5-10) and very rare (1-5).

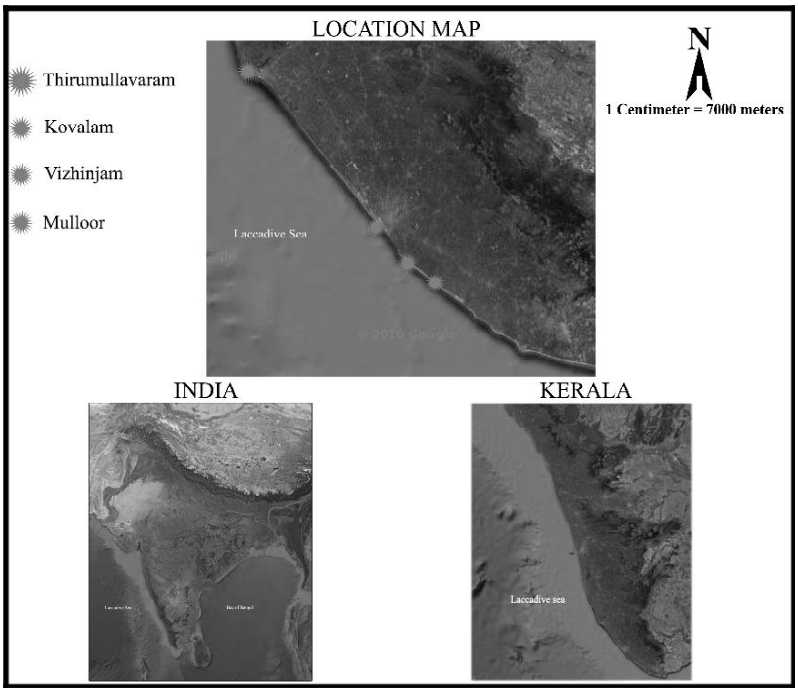

Fig. 1. Map showing the location of study sites along south Kerala, India

Sampling, survey and collection methods

Snorkelling with underwater video recording and line transect methods were used for assessing diversity and reef assemblages of fishesTransect lines (English *et al.,* 1997) having 50m were set up horizontally to the coast and 3 m on each side of transect line.

The sample collections were done by gillnets, traps, and hook and line. The fishes were identified and counted. Entire activities were recorded as video footage for further examinations. Sampling and survey were conducted monthly for two years. Fishes were collected using fish traps, scoop nets, hook and line and gillnets. Identification and distribution records of fishes from the Indian waters were verified with the help of Fishes were collected by using fish traps, scoop nets, hook and line and gillnets. Collected specimens were identified by using standard references Smith and Heemstra (1986), Munro (2000), Froese and Pauly (2010) and the species name updated with FISHBASE (www.fishbase.org) and the identified species were arranged as per the classification pattern by Nelson (2006).

Biodiversity

The class wise, orders wise, family wise species composition were assessed. The software programmes viz., SPSS (Statistical Programme for Social Sciences version 11.0) were used for the assessment of Seasonal and spatial variations of fish diversity.

RESULTS AND DISCUSSION

A total of 228 fish species were documented in the present study, which belongs to two classes, 15 orders, 60 families and 111 genera; Actinopterygii shared 98 per cent and Elasmobranchii two per cent of the total fish diversity (Table. 1).

In the order wise species contribution, order Perciformes contributed166 species (73% of the total species), followed by Tetradontiformes (7%; 16 species), Scorpaeniformes (4%; 10 species), Anguilliformes (4%; 9 species), Berciformes (2%), Pleuronectiformes (2%), Siluriformes (1%; 3 species), Torpediniformes (1%; 2 species), Myliobatiformes (1%; 2 species), Aulopiformes, Syngnathiformes, Mugiliformes (1 %; 2 species each), and Ophidoformes, Lophiformes, Orectolobiformes and Atheriniformes (0.5%; 1 species each) (Fig. 2.).

Species distribution in various sites

A total of 42 species were recorded from the station I (Mulloor). In the species contribution, station II (Vizhinjam) was the most specious site with 166 species. This station represents rocky shores including rocky pools created by natural rocks and artificial structures of harbour. From Kovalam (station 3) 88 species were recorded and the reef structures here is composed of mainly natural rocky structures. The station IV (Thirumullavaram) recorded the lowest species diversity, with 27 species.

The 44 fish species recorded from the station I belonged to 7 orders, 18 families and 27 genera. In station II the recorded 166 species were represented under 15 orders, 54 families and 94 genera. There were 81 fish species belonging to 8 orders, 32 families and 51 genera from the station III and 27 species grouped under 3 orders, 14 families and 16 genera from the station IV. The order Perciformes dominated in all the stations, with highest representation at Vizhinjam (120 species). The reef ecosystems of the study area showed a substratum depended diversity of fish species. It was observed that station I and IV showed poor species diversity due to the variations in habitat diversity compared to stations II and III. The stations I and IV are represented with the presence of single type of reef structure called middle relief which is in shallow coastal water is subjected to heavy wave action and high rate of siltation. This nature of the reefs will inhibit the fish species from aggregating in large numbers. Stations II and III were recognized by the presence of different reef substratum like wall type, pinnacle type, flat reef and artificial type reefs.

Station I

Totally 42 species were recorded from the station I; the species diversity was distributed in 7 Orders. Perciformes contributed 33 species, while lower diversity was found in Tetraodontiformes (3 species), Anguilliformes and Scorpaeniformes (2 species each), and Mugiliformes, Atheriniformes and Syngnathiformes (1 species each). Out of 21 families recorded from the site, Pomacentridae (6), Acanthuridae (5) and

Table 1. List of fishes recorded from southern Kerala, India

Sl No.	Scientific Name	Common Name	Abundance
	Super class : Gnathostomata		
	Class : Chondrichthyes		
	Order : Orectolobiformes		
	Family : Hemiscyllidae (Bamboo sharks)		
1.	*Chiloscyllium indicum* (Gmelin, 1789)	Slender bamboo shark	VR
	Order : Torpediniformes		
	Family : Torpedinidae (Electric rays)		
2.	*Torpedo sinuspersici* Olfers, 1831	Variable torpedo ray	VR
	Family : Narcinidae (Numb fishes)		
3.	*Narcine brunnea Annandale*, 1909	Brown numb fish	VR
	Order : Myliobatiformes		
	Family : Dasyatidae (Stingrays)		
4.	*Himantura walga* Roberts and Karnasuta, 1987	Dwarf whip ray	VR
5.	*Himantura imbricata* (Bloch and Schneider, 1801)	Scaly whip ray	VR
	Super class: Osteostracomorphi		
	Class : Actinopterigii/Ray Finned Fishes/Osteichthyes Bony Fish		
	Order : Anguilliformes True eels and Moray eel		
	Family : Muraenidae (Moray eels)		
6.	*Echidna nebulosa* (Ahl, 1789)	Snow flake moray	VR
7.	*Echidna nocturna* (Cope, 1872)	Freckled moray	VR
8.	*Gymnothorax favagineus* Bloch and Schneider, 1801	Laced moray	C
9.	*Gymnothorax javanicus* (Bleeker, 1859)	Giant moray	VR
10.	*Gymnothorax meleagris* (Shaw, 1795)	Turkey moray	VR
11.	*Gymnothorax pictus* (Ahl, 1789)	Paint spotted moray	VR
12.	*Gymnothorax pseudothyrsoideus* (Bleeker, 1853)	High fin moray	VR
13.	*Gymnothorax steindachneri* Jordan and Evermann, 1903	Steindachner's moray eel	VR
14.	*Muraena retifera* Goode and Bean, 1882	Reticulate moray	VR
	Order : Siluriformes		
	Family: Plotosidae (Eel tail catfishes)		
15.	*Euristhmus microceps* (Richardson, 1845)	Small head catfish	VR
16.	*Plotosus limbatus* Valenciennes, 1840	Dark fin eel catfish	VR
17.	*Plotosus lineatus* (Thunberg, 1787)	Striped eel cat fish	VR
	Order : Aulopiformes Lizardfish		
	Family : Synodontidae(Lizard fishes)		
18.	*Synodus indicus* (Day, 1873)	Indian lizard fish	VR
19.	*Synodus jaculum* Russell and Cressey, 1979	Lighthouse lizard fish	VR
	Order : Ophidiiformes Cusk eels, pearl fish, brotulas		
	Family : Ophidiidae (Cusk eels)		
20.	*Brotula barbata* (Bloch and Schneider, 1801)	Bearded brotula	VR
	Order : Lophiiformes Frogfish, Angelfish		
	Family : Antennariidae		
21.	*Antennatus sanguineus* (Gill, 1863)	Bloody frogfish	R
	Super order : Acanthopterygii		
	Series : Mugilomorpha		
	Order : Mugiliformes		
	Family : Mugilidae		
22.	*Chelon macrolepis* (Smith, 1846)	Large scale mullet	C
23.	*Mugil cephalus* Linnaeus,1758	Flathead grey mullet	C
	Order : Atheriniformes		
	Family : Atherinidae (Silversides)		
24.	*Atherinomorus lacunosus* (Forster, 1801)	Wide-banded hardy head silverside	A
	Order : Beryciformes		
	Family: Holocentridae (Squirrel fishes, soldier fishes)		
25.	*Myripristis amaena* (Castelnau, 1873)	Brick soldier fish	VR
26.	*Myripristis formosa* Randall and Greenfield, 1996		VR
27.	*Myripristis murdjan* (Forsskål, 1775)	Pinecone soldier fish	VR

28.	*Sargocentron rubrum* (Forsskål, 1775)	Redcoat	A
29.	*Sargocentron seychellense* (Smith and Smith, 1963)	Yellow-tipped squirrel fish	VR
	Order : Syngnathiformes Pipefish, sea horses		
	Family : Aulostomidae		
30.	*Aulostomus chinensis*(Linnaeus, 1766)	Chinese trumpet fish	R
	Family : Fistulariidae		
31.	*Fistularia petimba* Lacepède, 1803	Red cornet fish	R
	Order : Scorpaeniformes Scorpion fish, rockfish, lionfish, sculpins, poachers, greenlings, lingcod, comb fish		
	Family : Scorpaenidae		
32.	*Dendrochirus zebra* (Cuvier, 1829)	Zebra turkey fish	R
33.	*Parascorpaena picta* (Cuvier, 1829)	Northern scorpion fish	R
34.	*Parascorpaena aurita* (Rüppell, 1838)	Golden scorpion fish	R
35.	*Pterois mombasae* (Smith, 1957)	Frill fin turkey fish	R
36.	*Pterois volitans* (Linnaeus, 1758)	Red lionfish	C
37.	*Pterois russelii* Bennett,1831	Plain tail turkey fish	C
38.	*Scorpaenopsis cirrosa* (Thunberg, 1793)	Weedy sting fish	VR
39.	*Scorpaenopsis venosa* (Cuvier, 1829)	Raggy scorpion fish	VR
	Family : Apistidae		
40.	*Apistus carinatus* (Bloch and Schneider, 1801)	Ocellated wasp fish	VR
	Family : Synanceiidae		
41.	*Choridactylus multibarbus* Richardson,1848	Orange banded sting fish	VR
	Suborder : PercoideiSuper family : Percoidea		
	Order : Perciformes		
	Family : Ambassidae		
42.	*Ambassis ambassis* (Lacepède, 1802)	Commerson's glassy	C
43.	*Ambassis dussumieri*Cuvier,1828	Malabar glassy perchlet	C
	Family : Serranidae		
44.	*Caprodon longimanus* (Günther, 1859)	Pink maomao	R
45.	*Cephalopholis argus* Schneider, 1801	Peacock hind	VR
46.	*Cephalopholis formosa* (Shaw, 1812)	Blue lined hind	VR
47.	*Cephalopholis sonnerati* (Valenciennes, 1828)	Tomato hind	VR
48.	*Epinephelus bontoides* (Bleeker, 1855)	Palemargin grouper	VR
49.	*Epinephelus coioides* (Hamilton, 1822)	Orange-spotted grouper	VR
50.	*Epinephelus diacanthus* (Valenciennes, 1828)	Spiny cheek grouper	VR
51.	*Epinephelus faveatus* (Valenciennes, 1828)	Barred-chest grouper	VR
52.	*Epinephelus malabaricus* (Bloch and Schneider, 1801)	Malabar grouper	VR
	Family : Pseudochromidae (dottybacks)		
53.	*Pseudochromis caudalis*Boulenger,1898	Stripe-tailed dotty back	VR
	Family : Opistognathidae		
54.	*Opistognathus nigromarginatus* Rüppell,1830	Birdled jaw fish	VR
	Family : Priacanthidae		
55.	*Priacanthus arenatus* Cuvier,1829	Atlantic big eye	VR
56.	*Priacanthus blochii* Bleeker, 1853	Paeony bull eye	VR
57.	*Priacanthus sagittarius* Starnes, 1988	Arrow bull eye	VR
	Family : Apogonidae		
58.	*Apogon amboinensis* Bleeker,1853	Amboina cardinal fish	VR
59.	*Apogon limenus* Randall and Hoese, 1988	Sydney cardinal fish	VR
60.	*Apogon sinus* Randall, 2001		VR
61.	*Apogon cathetogramma* (Tanaka, 1917)		VR
62.	*Cheilodipterus arabicus* (Gmelin, 1789)	Tiger cardinal	VR
63.	*Lepidamia multitaeniata* (Cuvier, 1828)	Small scale cardinal	VR
64.	*Ostorhinchus moluccensis* (Valenciennes, 1832)	Moluccan cardinal fish	VR
65.	*Ostorhinchus fasciatus* (White, 1790)	Broad banded cardinal fish	VR
66.	*Ostorhinchus cookii* (Macleay, 1881)	Cook's cardinal fish	VR
67.	*Taeniamia fucata* (Cantor, 1849)	Orange lined cardinal fish	A
	Family : Sillaginidae		
68.	*Sillago ciliata* Cuvier, 1829	Sand sillago	VR
69.	*Sillago sihama* (Forsskål, 1775)	Silver sillago	VR

	Family : Carangidae		
70.	*Carangoides bartholomaei* (Cuvier, 1833)		VR
71.	*Caranx ignobilis* (Forsskål, 1775)	Giant trevally	VR
72.	*Caranx heberi* (Bennett, 1830)	Black tip trevally	VR
73.	*Trachinotus coppingeri* Günther, 1884	Swallowtail dart	VR
74.	*Caranx latus* Agassiz, 1831	Horse-eye jack	VR
	Family : Leiognathidae		
75.	*Aurigequula fasciata* (Lacepède, 1803)	Striped pony fish	VR
76.	*Karalla daura* (Cuvier, 1829)	Gold stripe pony fish	C
	Family : Lutjanidae		
77.	*Lutjanus bohar* (Forsskål, 1775)	Two-spot red snapper	A
78.	*Lutjanusdecussatus* (Cuvier, 1828)	Checkered snapper	VR
79.	*Lutjanus kasmira* (Forsskål, 1775)	Common blue stripe snapper	VR
80.	*Lutjanus lemniscatus* (Valenciennes, 1828)	Yellow streaked snapper	A
81.	*Lutjanus lutjanus* Bloch, 1790	Big eye snapper	VR
82.	*Lutjanus argentimaculatus* (Forsskål, 1775)	Mangrove red snapper	VR
83.	*Lutjanus fulviflamma* (Forsskål, 1775)	Dory snapper	VR
84.	*Lutjanus fulvus* (Forster, 1801)	Black tail snapper	VR
85.	*Lutjanus indicus* Allen, White and Erdmann, 2013		VR
86.	*Lutjanus rivulatus* (Cuvier, 1828)	Blubber lip snapper	R
87.	*Lutjanus russellii* (Bleeker, 1849)	Russell's snapper	VR
88.	*Lutjanus stellatus* Akazaki, 1983	Star snapper	VR
89.	*Lutjanus viridis* (Valenciennes, 1846)	Blue and gold snapper	VR
90.	*Pinjalo pinjalo* (Bleeker, 1850)	Pinjalo	VR
91.	*Pristipomoides typus* Bleeker,1852	Sharp tooth job fish	VR
	Family : Caesionidae		
92.	*Caesio caerulaurea* Lacepède, 1801	Blue and gold fusilier	VR
93.	*Gymnocaesio gymnoptera* (Bleeker, 1856)	Slender fusilier	A
94.	*Pterocaesio marri* Schultz,1953	Marr's fusilier	VR
	Family : Gerreidae		
95.	*Gerres microphthalmus* Iwatsuki, Kimura and Yoshino, 2002		R
96.	*Gerres oyena* (Forsskål, 1775)	Common silver-biddy	VR
	Family : Haemulidae		
97.	*Plectorhinchus vittatus* (Linnaeus, 1758)	Indian Ocean oriental sweet lips	VR
98.	*Plectorhinchus chubbi* (Regan, 1919)	Dusky rubber lip	VR
99.	*Plectorhinchus gibbosus* (Lacepède, 1802)	Harry hot lips	
100.	*Pomadasys guoraca* (Cuvier, 1829)		C
101.	*Pomadasys aheneus* McKayandRandall,1995	Yellow back grunt	VR
102.	*Pomadasys furcatus* (Bloch and Schneider, 1801)	Banded grunter	VR
	Family : Nemipteridae		
103.	*Scolopsis vosmeri* (Bloch, 1792)	White cheek monocle bream	R
104.	*Scolopsisbimaculata* Rüppell, 1828	Thumbprint monocle bream	VR
	Family : Mullidae		
105.	*Parupeneus chrysopleuron* (Temminck and Schlegel, 1843)	Yellow striped goat fish	VR
106.	*Parupeneus fraserorum* Randall and King,2009		VR
107.	*Parupeneus indicus* (Shaw, 1803)	Indian goat fish	A
108.	*Parupeneus macronemus* (Lacepède, 1801)	Long-barbel goat fish	VR
109.	*Upeneus doriae* (Günther, 1869)	Gilded goat fish	VR
110.	*Upeneus oligospilus*Lachner, 1954	Short-fin goatfish	VR
	Family : Pempheridae		
111.	*Pempheris molucca* Cuvier,1829		A
112.	*Pempheris sarayu* Randall and Bineesh, 2014		A
113.	*Pempheris adusta* Bleeker, 1877	Dusky sweeper	A
	Family : Monodactylidae(Moony fishes or finger fishes)		
114.	*Monodactylus argenteus* (Linnaeus, 1758)	Silver moony	A
	Family : Kyphosidae		
115.	*Kyphosus vaigiensis* (Quoy and Gaimard, 1825)	Brassy chub	R

	Family : Drepaneidae		
116.	*Drepane punctata* (Linnaeus, 1758)	Spotted sickle fish	VR
	Family : Chaetodontidae		
117.	*Chaetodon auriga* Forsskål, 1775	Threadfin butterfly fish	VR
118.	*Chaetodon collare* Bloch,1787	Red tail butterfly fish	A
119.	*Chaetodon decussatus* Cuvier,1829	Indian vagabond butterfly fish	R
120.	*Chaetodon lunula* (Lacepède, 1802)	Raccoon butterfly fish	R
121.	*Chaetodono ctofasciatus* Bloch,1787	Eight band butterfly fish	R
122.	*Chaetodon plebeius* Cuvier,1831	Blue blotch butterfly fish	R
123.	*Chaetodon trifasciatus* Park, 1797	Melon butterfly fish	R
124.	*Heniochus acuminatus* (Linnaeus, 1758)	Pennat coralfish	R
125.	*Heniochus pleurotaenia* Ahl, 1923	Phantom banner fish	R
126.	*Heniochus chrysostomus* Cuvier, 1831	Three band pennant fish	R
127.	*Heniochus singularius* Smith and Radcliffe, 1911	Singular banner fish	R
	Family : Pomacanthidae		
128.	*Apolemichthys xanthurus* (Bennett, 1833)	Yellowtail angel fish	R
129.	*Pomacanthus annularis* (Bloch, 1787)	Blue ring angel fish	R
130.	*Pomacanthus imperator* (Bloch, 1787)	Emperor angel fish	R
131.	*Pomacanthus semicirculatus* (Cuvier, 1831)	Semicircle angel fish	R
	Super family : Cirrhitoidea		
	Family: Cirrhitidae(Hawk fishes)		
132.	*Cirrhitichthys bleekeri* Day, 1874		VR
133.	*Cirrhitichthys aureus* (Temminckand Schlegel 1842)	Yellow hawk fish	VR
134.	*Cirrhitus pinnulatus* (Forster, 1801)	Stocky hawk fish	VR
	Suborder : Labroidei		
	Family : Cichlidae (Cichlids)		
135.	*Etroplus suratensis* (Bloch, 1790)	Pearl spot	A
	Family : Pomacentridae (Damselfishes)		
136.	*Abudefduf bengalensis* (Bloch, 1787)	Bengal sergeant	VR
137.	*Abudefduf concolor* (Gill, 1862)		VR
138.	*Abudefduf saxatilis* (Linnaeus, 1758)	Sergeant-major	C
139.	*Abudefduf septemfasciatus* (Cuvier, 1830)	Banded sergeant	A
140.	*Abudefduf sordidus* (Forsskål, 1775)	Black spot sergeant	R
141.	*Abudefduf vaigiensis* (Quoy and Gaimard, 1825)	Indo-Pacific sergeant	C
142.	*Chromis flavicauda* (Günther, 1880)	Cobalt chromis	A
143.	*Chromis limbaughi* Greenfield and Woods,1980	Limbaugh's damselfish	A
144.	*Chrysiptera brownriggii* (Bennett, 1828)	Surge damselfish	VR
145.	*Chrysiptera sheila* Randall, 1994	Sheila's damselfish	VR
146.	*Chrysiptera unimaculata* (Cuvier, 1830)	One spot demoiselle	VR
147.	*Dischistodus prosopotaenia* (Bleeker, 1852)	Honey-head damsel	VR
148.	*Neoglyphidodon melas* (Cuvier, 1830)	Bowtie damselfish	VR
149.	*Neoglyphidodon bonang* (Bleeker, 1852)	Ocellated damsel	VR
150.	*Neopomacentrus cyanomos* (Bleeker, 1856)	Regal demoiselle	VR
151.	*Neopomacentrus nemurus* (Bleeker, 1857)	Coral demoiselle	A
152.	*Neopomacentrus sindensis* (Day, 1873)	Arabian demoiselle	A
153.	*Neopomacentrus metallicus* (Jordan and Seale, 1906)	Metallic demoiselle	C
154.	*Neopomacentrus xanthurus* AllenandRandall,1980	Red Sea demoiselle	A
155.	*Plectroglyphidodon lacrymatus* (Quoy and Gaimard, 1825)	White spotted devil	VR
	Family : Labridae (Wrasses)		
156.	*Anampses elegans* Ogilby,1889	Elegant wrasse	VR
157.	*Bodianus neilli* (Day, 1867)	Bay of Bengal hogfish	VR
158.	*Cheilinus chlorourus* (Bloch, 1791)	Floral wrasse	VR
159.	*Choerodon robustus* (Günther, 1862)	Robust tusk fish	VR
160.	*Coris formosa* (Bennett, 1830)	Queen coris	VR
161.	*Diproctacanthus xanthurus* (Bleeker, 1856)	Yellowtail tube lip	VR
162.	*Halichoeres binotopsis* (Bleeker, 1849)		VR
163.	*Halichoeresdispilus* (Günther, 1864)	Chameleon wrasse	VR
164.	*Halichoeres leucurus* (Walbaum, 1792)		VR
165.	*Halichoeres melanurus* (Bleeker, 1851)	Tail-spot wrasse	VR

166.	*Halichoeres nebulosus* (Valenciennes, 1839)	Nebulous wrasse	VR
167.	*Halichoeres scapularis* (Bennett, 1832)	Zigzag wrasse	VR
168.	*Halichoeres nigrescens* (Bloch and Schneider, 1801)	Bubble fin wrasse	VR
169.	*Iniistiusb imaculatus* (Rüppell, 1829)	Two-spot razor fish	VR
170.	*Labroides dimidiatus* (Valenciennes, 1839)	Blue streak cleaner wrasse	C
171.	*Stethojulis strigiventer* (Bennett, 1833)	Three-ribbon wrasse	VR
172.	*Thalassoma lunare* (Linnaeus, 1758)	Moon wrasse	A
	Family : Scaridae (Parrot fishes)		
173.	*Scarus ovifrons* Temminck and Schlegel, 1846	Knob snout parrot fish	VR
174.	*Scarus ghobban* Forsskål,1775	Blue-barred parrot fish	VR
175.	*Scarus viridifucatus* (Smith, 1956)	Round head parrot fish	VR
	Suborder: Trachinoidei		
	Family : Uranoscopidae (Stargazers)		
176.	*Ichthyscopus lebeck* (Bloch and Schneider, 1801)	Long nosed stargazer	VR
	Suborder: Blennioidei		
	Family : Blenniidae (Comb tooth blennies)		
177.	*Alticus kirkii* (Günther, 1868)	Kirk's blenny	VR
178.	*Atrosalarias fuscus* (Rüppell, 1838)		VR
179.	*Entomacrodus nigricans* Gill, 1859	Pearl blenny	VR
180.	*Entomacrodus cadenati* Springer, 1967	West African rock hopper	VR
181.	*Entomacrodus lighti* (Herre, 1938)		VR
182.	*Entomacrodus vermiculatus* (Valenciennes, 1836)	Vermiculated blenny	VR
183.	*Entomacrodus vomerinus* (Valenciennes, 1836)		VR
184.	*Lupinoblennius paivai* (Pinto, 1958)	Paiva's blenny	VR
	Suborder : Gobioidei		
	Family : Gobiidae (Gobies)		
185.	*Bathygobius sp.*		VR
186.	*Bathygobius coalitus* (Bennett, 1832)	White spotted frill goby	VR
187.	*Bathygobius cyclopterus* (Valenciennes, 1837)	Spotted frill goby	VR
188.	*Bathygobius laddi* (Fowler, 1931)	Brown boy goby	VR
189.	*Bathygobius lineatus* (Jenyns, 1841)	Southern frill fin	VR
	Suborder : Acanthuroidei		
	Family : Scatophagidae (Scats)		
190.	*Scatophagus argus* (Linnaeus, 1766)	Spotted scat	VR
	Family : Siganidae (Rabbit fishes)		
191.	*Siganus canaliculatus* (Park, 1797)	White-spotted spine foot	C
192.	*Siganus javus* (Linnaeus, 1766)	Streaked spine foot	A
193.	*Siganus lineatus* (Valenciennes, 1835)	Golden-lined spine foot	VR
194.	*Siganus rivulatus* Forsskål and Niebuhr, 1775		C
	Family : Zanclidae (Moorish idol)		
195.	*Zanclus cornutus* (Linnaeus, 1758)	Moorish idol	R
	Family: Acanthuridae (Surgeon fishes)		
196.	*Acanthurus leucosternon* Bennett, 1833	Powder blue surgeonfish	VR
197.	*Acanthurus triostegus* (Linnaeus, 1758)	Convict surgeonfish	R
198.	*Acanthurus xanthopterus* Valenciennes, 1835	Yellow fin surgeonfish	R
199.	*Acanthurus bahianus* Castelnau,1855	Ocean surgeon	VR
200.	*Acanthurus dussumieri* Valenciennes,1835	Eye stripe surgeon fish	VR
201.	*Acanthurus grammoptilus* Richardson,1843	Fine lined surgeon fish	VR
202.	*Acanthurus lineatus* (Linnaeus, 1758)	Lined surgeonfish	C
203.	*Acanthurus nigroris* Valenciennes,1835	Blue lined surgeon fish	C
204.	*Acanthurus randalli* Briggs and Caldwell,1957	Gulf surgeon fish	R
205.	*Naso unicornis* (Forsskål, 1775)	Blues pine unicorn fish	C
	Suborder : Scombroidei		
	Family : Sphyraenidae (Barracudas)		
206.	*Sphyraena obtusata* Cuvier, 1829	Obtuse barracuda	A
207.	*Sphyraena qenie* Klunzinger, 1870		VR
	Order : Pleuronectiformes (Flatfishes)		
	Family : Paralichthyidae (large tooth flounders)		
208.	*Pseudorhombus javanicus* (Bleeker, 1853)	Javan Flounder	VR
209.	*Pseudorhombus arsius* (Hamilton, 1822)	Large tooth flounder	VR

210.	*Pseudorhombus triocellatus* (Bloch and Schneider, 1801)	Three spotted flounders	VR
	Family : Samaridae (Crested flounders)		
211.	*Samaris cristatus* Gray,1831	Cockatoo right eye flounder	VR
	Family : Soleidae (Soles)		
212.	*Synaptura commersonnii* (Lacepède, 1802)	Commerson's sole	VR
	Order : Tetraodontiformes		
	Family : Triacanthidae (Triple spines)		
213.	*Pseudotriacanthus strigilifer* (Cantor, 1849)	Long-spinedtripod fish	VR
	Family : Balistidae (Trigger fishes)		
214.	*Balistapus undulatus* (Park, 1797)	Orange-lined triggerfish	VR
215.	*Odonus niger* (Rüppell, 1836)	Red-toothed triggerfish	VR
216.	*Pseudobalistes flavimarginatus* (Rüppell, 1829)	Yellow margin triggerfish	VR
217.	*Sufflamen chrysopterum* (Bloch and Schneider, 1801)	Half moon triggerfish	VR
218.	*Sufflamen fraenatum* (Latreille, 1804)	Masked triggerfish	VR
	Family : Monacanthidae		
219.	*Cantherhine spardalis* (Rüppell, 1837)	Honey comb file fish	VR
	Family : Ostraciidae (Box fishes)		
220.	*Ostracion cubicus* Linnaeus, 1758	Yellow box fish	VR
221.	*Tetrosomus gibbosus* (Linnaeus, 1758)	Humpback turret fish	VR
	Family : Tetraodontidae (Puffers)		
222.	*Arothron hispidus* (Linnaeus, 1758)	White-spotted puffer	VR
223.	*Arothron nigropunctatus* (Bloch and Schneider, 1801)	Black spotted puffer	VR
224.	*Arothron immaculatus* (Bloch and Schneider, 1801)	Immaculate puffer	VR
225.	*Canthigaster bennetti* (Bleeker, 1854)	Bennett's sharp nose puffer	VR
	Family : Diodontidae (Porcupine fishes, Burr fishes)		
226.	*Cyclichthys orbicularis* (Bloch, 1785)	Bird beak burr fish	VR
227.	*Diodon holocanthus* Linnaeus, 1758	Long spined porcupine fish	C
228.	*Diodon hystrix* Linnaeus, 1758		C

VR-Very rare R - Rare C - Common A- Abundant

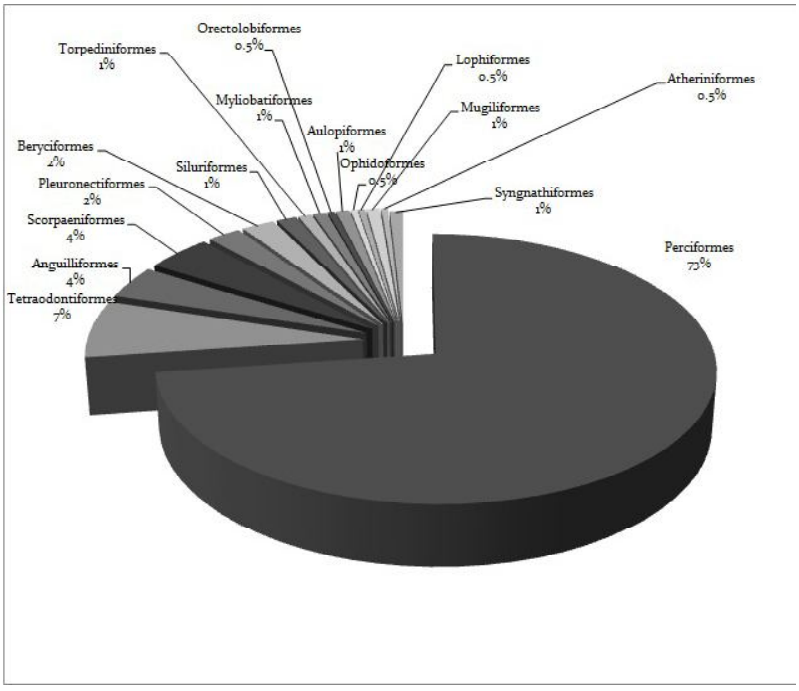

Fig. 2. Distribution of fish under various orders collected from southern Kerala

Lutjanidae (4) were distinct in their species representation, while families like Blenniidae and Siganidae (3 species), Muraenidae, Scorpaenidae, Labridae and Gobiidae (2 species each), Mugilidae, Atherinidae, Fistulariidae, Sillaginidae, Carangidae, Haemulidae, Mullidae, Monodactylidae, Chaetodontidae and Sphyraenidae (1 species) were less represented.

Station II

This station with highest fish species diversity (167 species) was represented by 15 orders, 54 families and 94 genera; the diversity included 5 Chondricthyes and 162 ray finned fishes. The highest number of species was found in the order of Perciformes with 120 species followed by Tetraodontiformes (9), Anguilliformes (8), Scorpaeniformes (7), Pleuronectiformes (5), Beryciformes (4), Siluriformes (3), Torpediniformes and Myliobatiformes (2 each), Orectolobiformes, Aulopiformes, Ophidoformes, Lophiformes, Mugiliformes, Atheriniformes (1 each). Species diversity at Vizhinjam was found to be higher in the family Muraenidae with 8 species and lowest in families like Hemiscyllidae, Torpedinidae, Narcinidae, Synodontidae, Ophiididae, Antennariidae, Mugilidae, Atherinidae, Apistidae and Synanceiidae with one species in each.

Station III

There were 79 fish species belonging to 8 orders, 32 families and 51 genera in the station III. The order Perciformes was the most species rich, followed by Tetraodontiformes (8 species), followed by Mugiliformes and Scorpaeniformes (2 species each), and Anguilliformes, Aulopiformes, Beryciformes and Syngnathiformes (1 species each). Lutjanidae and Labridae (10 species) were found to be the most specious families from this station, followed by the Pomacentridae (7 species), Serranidae, Apogonidae, Chaetodontidae, Acanthuridae (4 species each) and Balistidae (3 species).

Station IV

There were 27 species of fishes identified, classified under three major orders; order Perciformes was with 24 species and Anguilliformes and Tetraodontiformes with 2 and 1 species respectively. Majority of the fish species in this station belonged to family Pomacentridae (8 species). The second most abundant family Blennidae was with 4 species, followed by Muraenidae, Chaetodontidae, Labridae, Acanthuridae (2 spe

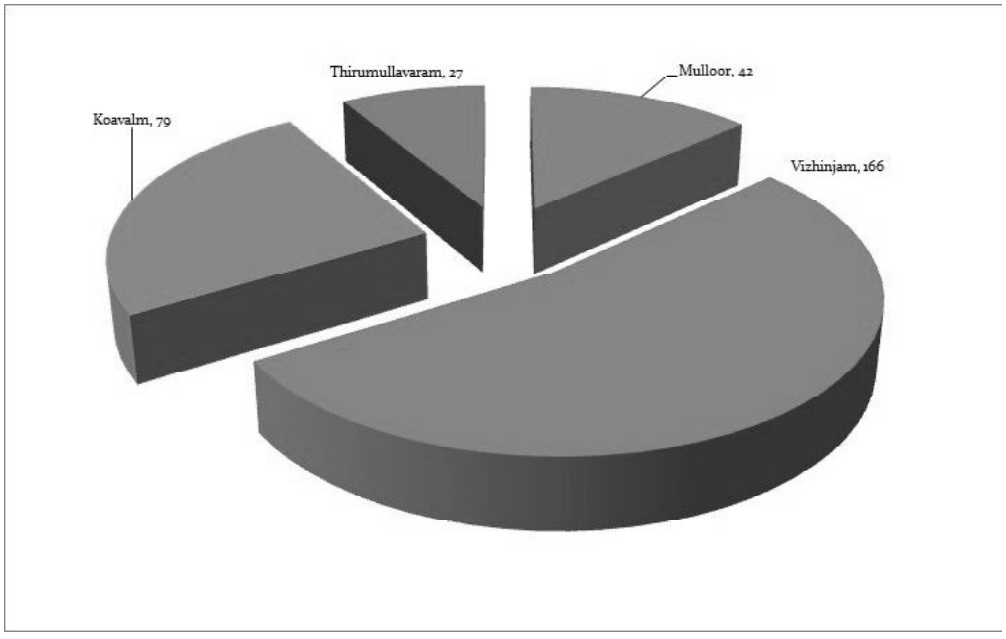

Fig. 3. Percentage composition of species in various study sites along south Kerala coast

Table 2. Spatial variations in abundance of fish fauna during 2013-2014

	Sta I	Sta II	Sta III	Sta IV
Monsoon	16±10.10	90.25±117.66	3.75±3.59	9±13.22
Post Monsoon	95.5±32.34	559.5±212.52	127±60.44	18±7.7
Pre Monsoon	46.5±27.01	261.75±336.06	97.25±63.53	6.75±4.27

Table 3. Spatial variations in abundance of fish fauna during 2014-2015

	Sta I	Sta II	Sta III	Sta IV
Monsoon	8±6.68	25025.75±50044.83	15.5±5.26	2.5±1.91
Post Monsoon	25047±50018.00	98±53.94	142.25±43.32	17.5±10.47
Pre Monsoon	34±18.97	33.5±527.75	17.5±326.51	28.25±19.16

Table 4. Seasonal variations in abundance of fish fauna 2013-2014

	Monsoon	Post Monsoon	Pre Monsoon
Sta I	16±10.10	95.5±32.34	46.5±27.01
Sta II	90.25±117.66	559.5±212.52	261.75±336.06
Sta III	3.75±3.59	127±60.44	97.25±63.53
Sta IV	9±13.22	18±7.7	6.75±4.27

Table 5. Seasonal variations in abundance of fish fauna during 2014-2015

	Monsoon	Post Monsoon	Pre Monsoon
Sta I	8±6.68	25047±50018.00	34±18.97
Sta II	25025.75±50044.83	98±53.94	33.5±527.75
Sta III	15.5±5.26	142.25±43.32	247±326.51
Sta IV	2.5±1.91	17.5±10.47	28.25±19.16

cies each), and Serranidae, Lutjanidae, Caesionidae, Mullidae, Gobiidae, Siganidae, Ostraciidae (1 species each).

Abundance of fish

Rocky reefs support high abundance of fishes. The physical structures of the reefs supports the ichthyofauna for shelter, nursery ground and for finding out food sources. Spatial and seasonal variations on abundance of fish in various years are given in Tables 2 to 4. Out of the 228 species observed from four sites, 10 % (23 species) was abundant, 9% (21 species) was common, 13% (30 species) was rare and 68% (154 species) was very rare.

During 2013-14 station II showed highest variation (559.5±212.52) in the post monsoon season and the lowest (3.75±3.59) in the station III during the monsoon season. During 2014-15 marked variations were shown by the station I and II during the post monsoon and monsoon seasons respectively. This is because of the presence of high schooling coastal species *Atherinomorus lacunosus* and the lowest value was recorded in the station IV (2.5±1.91) during the monsoon season.

DISCUSSION

Sindorf *et al.* (2015) reported a total of 235 individuals in 15 families (34 species) from Watamu Marine National Park, Kenya (Western Indian Ocean). Zacharia *et al.* (2008) studied the fish diversity associated with coral reef patches around Netrani Island, in Karnataka (south India) by visual census method; they succeeded to report nearly 69 species of fishes from 39 genera, 19 families and 3 orders in the transect survey from four sites. Sluka (2013) reported 184 species from western coast in a paper published on coastal marine fish biodiversity along the western coast of India. This work has been done extensively on rocky substrata between Vizhinjam, Kerala State and Muttom, Tamil Nadu State. Even though the

present work restricted in the range between Mulloor, Vizhinjam, Kovalam and Thirumullavaram able to record 228 species of fishes belongs to 16 orders, 60 families and 111 genera. Parmar *et al.* (2015) investigated the ichthyofaunal diversity of coral reefs of the Gulf of Kutch, Gujarat, and western India; they revealed about 41 species belonging to 27 families and 35 genera were listed out. In the present study, 228 species were recorded from four stations along southern Kerala coast. Fish diversity of the Kerala coast were documented by the many researchers especially in the coast of Thiruvananthapuram (Sivaprasad *et al.,* 2007; Baiju, 2009; Sirajudheen and Bijukumar, 2011, 2014; Sirajudheen, 2012).

The present work is an attempt to study the diversity of rocky reef fishes of Kerala coast. Underwater visual census have been reported from Lakshadweep (Vijayanand and Pillai, 2005), the Andaman and Nicobar Islands (Madhu and Madhu, 2007; Rajaram and Nedumaran, 2009) and from islands off the central western coast states of Goa and Karnataka (Sluka and Lazarus, 2004, 2005, 2006, 2009, 2010; Zacharia *et al.,* 2008; Sujitha *et al.,* 2011). The present study represents the first report on south Kerala rocky reef fish biodiversity made using underwater visual observations.

The study by Prabhakaran (2008) recorded a total of 203 species of fishes belong to 2 classes, 11orders, 43 families and 93 genera including, 6 species belong to the **class** Chondreichthyes and 197 species belong to Osteichthyes from Lakshadweep. Sirajudheen and Bijukumar (2014) carried out a work on ichthyofaunal diversity associated with the rocky habitats of Thiruvananthapuram coast, Kerala, India and listed out 101 species of ornamental fish categorized under 8 orders, 37 families and 66 genera. Piazzi *et al.* (2012) evaluated the spatial and temporal patterns of diversity in Mediterranean rocky reef fish assemblages; they studied the alpha and beta diversity of the fish assemblages including the seasonal changes and diversity variations in relation with depth. The present study also observed the seasonal and spatial variations in fish species diversity of rocky reef in various sites of the South Kerala coast.

The results of the present study showed a diversity of 228 fish species in 111 genera, 60 families, and 16 orders were recorded from the south Kerala coast.

ACKNOWLEDGEMENT

The research was performed at selected places of Kerala coast; we expressing our heart fed thanks to local fishing groups of the area for their assistances during the field study. We are registering our thanks to the Kerala State Welfare department for providing the financial support to the work.

REFERENCES

Anand, P. E. V. and Pillai, N. G. K. 2002. Habitat distribution and species diversity of coral reef fishes in the reef slope of the Kavaratti atoll, Lakshadweep, India. *Journal of the Marine Biological Association of India* **45** (1): 88–98.

Anand, P. E. V. and Pillai, N. G. K. 2005. Community organization of coral reef fishes in the rubble subhabitat of Kavaratti Atoll, Lakshadweep, India. *Journal of the Marine Biological Association of India* **47** (1): 77–82.

Baiju, P. T. 2009. Marine ornamental fish diversity of Vizhinjam Bay, Lakshadweep Sea. M. Phil Thesis. University of Kerala, Thiruvananthapuram, Kerala, pp. 80.

English, S., Wilkinson, C. and V. Baker, 1997. Survey manual for tropical marine resources. ASEAN-Australia Marine Science Project: Living Coastal Resources. 2nd Edition. Australian Institute of Marine Science, Townsville, Australia: 390 p.

Eschmeyer, W. N., Fricke, R., Fong J. D.and Polack, D. A. 2010. Marine fish diversity: history of knowledge and discovery (Pisces). *Zootaxa,* **2525:** 19-50.

Fishbase. www.fishbase.org, 2014.

Froese, R. and Pauly, D. 2010. FishBase. World Wide Web electronic publication. Avilable from: http://www.fishbase.org.

James, P. S. B. R., Lazarus, S. and Arumugam, G. 1994. The present status of 'major perch' fisheries in India. *Central Marine Fisheries Research Institute Bulletin* **47:** 1–9.

James, P. S. B. R., Lazarus, S. and Pilllai, C. S. G. 1988. On the availability of tuna live-bait fishes at Vizhinjam.*Marine Fisheries Inforfmation Series: Technical Extension Series* **84:** 8–10.

James, P. S. B. R., Murty, V .S. and Nammalwar, P. 1996. Groupers and snappers of India: biology and exploitation, pp. 106–136. In: Arreguin-Sanchez, F., J.L. Munro, M.C. Balgos and D. Pauly (eds.) *Biol*

ogy, Fisheries and Culture of Tropical Groupers and Snappers. ICLARM Conference Proceedings **48**, 449 pp.

Kuthalingam, M. D. K., Rajagopal, M. S., Sreenivasan, P. V., Radhakrishnan, N., Lazarus, S. and Livingston, P. 1973. On some interesting fishes from the south-west coast of India. *Journal of the Marine Biological Association of India* **15:** 877–882.

Lowe-Mc Connell, R. H. 1999. Estudosecológicos de comunidades de peixestropicais. São Paulo, EDUSP, 536p.

Madhavi, K., Vinaya, K., Reddy, V. D. A. and Reddy, V. G. 2012.Conservation of Fish Faunastic Diversity – An Indian Perspective. *European Journal of Zoological Research*; **1** (3):80-85.

Madhu, R. and Madhu, K. 2007.Occurrence of anenomefishes and host sea anenomes in Andaman and Nicobar Islands. *Journal of the Marine Biological Association of India* **49** (2): 118–126.

Mathews, G., Diraviyaraj, K., Thinesh, T., Edward, J. P. and Wilhemsson, D. 2010. Status of seagrass diversity, distribution and abundance in Gulf of Mannar Marine National Park and Palk Bay (Pamban to Thondi), Southeastern India. *South Indian Coastal and Marine Bulletin*; **2** (2):1-21.

Munro, I. S. R. 2000. The Marine and Freshwater fishes of Ceylon. Narendra Publishing House, Delhi. pp. 351.

Murty, V. S. 2002. Marine ornamental fish resources of Lakshadweep.*Central Marine Fisheries Research Institute Special Publication* No. **72,** 134pp.

Nayar, S. G. 1958. A preliminary account of the fisheries of Vizhinjam. *Ind. J. of Fish*. **5** (1): 32-55.

Nelson, J. S. 2006. Fishes of the world. 4th ed. Hoboken, John Wiley and Sons, Inc., 601p.

Parmar, H., Barad, D. and Parasharya, D. 2105. Reef dependent ichthyofauna of the Gulf of Kutch, Gujarat, Western India. *International Journal of Fisheries and Aquatic Studies*; **2** (6): 33-37.

Piazzi1, L. Cecchi E. and Serena, F. 2012. Spatial and temporal patterns of diversity in Mediterranean rocky reef fish assemblages. Vie et milieu - life and environment, 2012, **62 (3):** 129-136

Prabhakaran. M. P. 2008 studied the Ecological Studies on the Sea grass Ecosystem of Minicoy Lagoon Lakshadweep. *Ph. D thesis Cochin University of Science and Technology*.pp 327.

Rajaram, R. and Nedumaran, T. 2009.Ichthyofaunal diversity in Great Nicobar Biosphere Reserve, Bay of Bengal. *Journal of Threatened Taxa* **1** (3): 166–169.

Rao, D. V. 2003. Guide to Reef Fishes of Andaman and Nicobar Islands. *Zoological Survey of India,* Kolkata. 555 pp.

Robertson, D. R., Karg, F., Moura, R. L., Victor, B. C. and Bernardi, G. 2006. Mechanisms of speciation and faunal enrichment in Atlantic parrot fishes. *Molecular Phylogenetics and Evolution,* **40:** 795-807.

Rocha, L. A., Robertson, D. R., Roman, J. and Bowen, B. W. 2005. Ecological speciation in tropical reef fishes. Proceedings of the Royal Society B, 272: 573-579.

Sale, P. F. 1991a. The ecology of fishes on coral reefs. London, Academic Press, Inc., 754 p.

Sale, P. F. 1991b. Reef fish communities: open non equilibrial systems. Pp. 564-598. In: Sale, P. F. (Ed.). The Ecology of Fishes on Coral Reefs. San Diego, Academic Press, Inc., 754 p.

Sale, P. F. 2006. Coral reef fishes: dynamics and diversity in a complex ecosystem. San Diego, Academic Press, Inc., 549p.

Sirajudheen, T. K. 2012. *Studies on the Diversity of Marine ornamental fishes of Kerala coast.* Ph.D. Thesis, University of Kerala, India, pp. 401.

Sirajudheen, T. K. and Bijukumar, A. 2011.Marine Ornamental Fish resources of Vizhinjam Bay, Kerala. In Proceedings of the National seminar on Emerging Trends in Biodiversity conservation and sustainable Management. Organized by Dept. of Zoology, Christian College, Chengannur, Kerala. 58-70.

Sirajudheen, T. K. and Bijukumar, A. 2014. Ichthyofaunal diversity associated with the rocky habitats of Thiruvananthapuram coast, Kerala, India. *Journal of Aquatic Biology and Fisheries*, **2:** 697-703.

Sivaprasad, P. S., Paul, C. E., Sajeevkumar, B., Natarajan, P. and Jayapraksh,V. 2007. *Marine Ornamental Fishes of Vizhinjam, Kerala. A Taxonomic Guide.* Dept. of Aquatic Biology and Fish. Univ. Kerala, 94 pp.

Sluka, R. D (2013) Coastal marine fish biodiversity along the west coast of India. *J Threat Taxation* **5:** 3574–3579

Sluka, R. D. and Lazarus, S. 2004. Grouper and wrasse biodiversity along the west coast of India. *Newsletter of the IUCN Grouper and Wrasses Specialist Group* **8:** 6–10.

Sluka, R. D. and Lazarus, S. 2005. Hump head Wrasse (*Cheilinus undulatus*) rare on the west coast of India. *Journal of the Marine Biological Association of the United Kingdom* **85:** 1293–1294.

Sluka, R. D. and Lazarus, S. 2006. Groupers and wrasses of Minicoy Island, Lakshadweep, India. *Newsletter of the IUCN Grouper and Wrasses Specialist Group* 9: 4–5.

Sluka, R. D. and Lazarus, S. 2009. Reefs of the India's west coast. *Reef Encounter* 37: 18.

Sluka, R. D. and Lazarus, S. 2010. Grouper (Pisces: Serranidae) relative abundance and diversity on the west coast of India. *Marine Biodiversity Records* 3: e71 doi: 10.1017/S1755267210000606.

Smith, M. M. and Heemstra, P. C. 1986. Smith's Sea fishes. Springer Verlag Berlin Heidelberg New York, London, Paris, Tokyo. 1047 pp.

Subburaman, S., Goutham, S., Joshi, D., Venkaesh, S., Kumar, P. B. M. and Matval, M. 2014. Daring to Restore: Coral Reef recovery in Mithapur. *Wildlife Trust of India*, 102.

Thomas, S., Sreeram, M. P. and V. S. Kakati, Mary, K. M. and Rani, M. G. 2011. Coral fish diversity in Netrani waters off Murudeshwar Karnataka, south India. *Indian J. Fish.,* **58** (1): 45-51.

Venkatraman, K. and Wafar, M. 2005. Coastal and Marine Biodiversity of India. *Indian Journal of Marine Science*; **34** (1):54-57.

Victoria Sindorf, Benjamin Cowburn and Robert D. Sluka 2015. Rocky intertidal fish assemblage of the Watamu Marine National Park, Kenya (Western Indian Ocean). *Environ. Biol. Fish.* Vol. **98: 3.** 1-11.

Vijay, A. P. E. and Pillai, N. G. K. 2002. Habitat distribution and species diversity of coral reef fishes in the reef slope of Kavaratti atoll, Lakshadweep, India. *Journal of Marine Biological Assessment of India*; **45(4):**88-98.

Zacharia, P. U., Krishnakumar, P. K., Dineshbabu, A. P., Vijayakumaran, K., Rohit, P., Thomas, S., Sasikumar, G., Kaladharan, P., Durgekar, R.N. and Mohamed, K.S. 2008. Species assemblage in the coral reef ecosystem of Netrani Island off Karnataka along the southwest coast of India. *Journal of the Marine Biological Association of India* **50** (1): 87–97.