Journal of Aquatic Biology and Fisheries Vol. 2/2014/ pp. 697 to 703

ICHTHYOFAUNAL DIVERSITY ASSOCIATED WITH THE ROCKY HABITATS OF THIRUVANANTHAPURAM COAST, KERALA, INDIA

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Received on: 10 October 2013, accepted on: 12 December 2013

Abstract: Rocky shores are ideal habitats for a wide variety of marine flora and fauna. Thiruvananthapuram is the southernmost region of Kerala on southwest coast of India with coast line of 78 kilometers. The region is important for fishery, tourism and export from the historical period. The fishery of this area is mainly constituted by the traditional methods. The rocky shores of Kovalam, Vizhinjam and Mullur supports life of a wide variety of fish fauna. Even though there are many studies on various aspects of rocky shores in this region, there is no report on the intertidal fish diversity. This paper presents data on the diversity of fishes associated with the rocky habitats of Thiruvananthapuram coast. The survey conducted using fish traps, scoop nets and gill nets revealed the presence of 101 species of ornamental fish categorized under 8 orders, 37 families and 66 genera. Shannon diversity index of rocky shore fishes recorded a higher value of 3.862 and the species richness was 13.95. The values of evenness index (0.4711) showed less even distribution of species, with dominance index value of 0.9668. The species-rich fish families were Pomacentridae/Damsel fishes (10 species), Labridae/Wrasses (9 species), Serranidae/groupers (8 species), Chaetodontidae/ Butterfly fishes (7 species) and Lutjanidae/Snappers (5 species). The groupers, representing the genus *Epinephelus* with 7 species, represented the most diverse fish genus followed by butterfly fishes of genus *Chaetodon* (5 species) and snappers of the genus *Lutjanus* (4 species). The study revealed that the rocky shore habitats of southern Kerala, with rocky shorelines and artificial sea wall built for the harbour, is colonized by hard and soft corals along with many other invertebrates is a habitat rich in fish diversity. Developmental activities, coastal pollution and collection of these resources for ornamental fish trade using destructive methods will lead to the loss of these biodiversity. Therefore sustainable management and careful monitoring are to be ensured for conservation of this biodiversity.

Key words: Shore fishes, Intertidal fish diversity, Rocky shore, Biodiversity, Southwest coast.

INTRODUCTION

Rocky shore habitats are very important ecosystems in terms of their diversity, productivity, abundance and beauty. Rocky reef fish assemblages are considered one of the most complex and variable systems in nature (Sale, 1991). Many studies conducted worldwide in order to document and compare the rocky shore biodiversity. In Australia, Glasby and Connell (1998) and Glasby (1999) studied the variations in the intertidal biodiversity among natural rocky shores and other artificial structures. Rocky shore biodiversity in Italy was studied by Bulleri and Chapman (2004). Arreola-Robbles and Elorduy-garay (2002) studied the reef fish diversity of Gulf of California. The biodiversity associated with natural rocky shores of India have been limited primarily to the ecology and distribution of individual species or taxa such as sea weeds and their associates (Krishnaswamy, 1957; Rao and Sreeramulu, 1970).

Thiruvananthapuram, located on the South Kerala is an important place for fishery, tourism and export from the historical period. The commercial fishery of the area depends on traditional country crafts and gears. The natural rocky habitats available in the area coupled with the protection offered by the artificial structures used for the construction of break water system and presence of stony corals along this region makes it an ideal rendezvous of many fishes and other vertebrates ad invertebrates. A comparative study of intertidal biodiversity between the natural rocky shores and artificial rocky habitats of the Kovalam and Vizhinjam area is conducted by Ravinesh and Bijukumar (2013).

Even though there are reports on the diversity of edible (Nayar, 1958) and ornamental fishes (Sivaprasad *et al.*, 2007; Sirajudheen and Bijukumar, 2011; Sirajudheen, 2012) of this area, there is no report on the rocky shore fish diversity which is a major part of intertidal ecosystems. The present paper consists primary data on the current diversity of fishes associated with rocky shore habitats of Thiruvananthapuram coast, South west coast of India.

MATERIALS AND METHODS

Study area and collection methods

The study was carried out at three rocky beach habitats of Thiruvananthapuram coast namely Kovalam (08°23'-08.97"N., 76°58'-32.27"E.), Vizhinjam (08°22'33"N Lat., 76°59'28.44" E long.) and Mulloor (08°22'03"N., 77°00'10.51" E.) during October 2008 to September 2011. Sample specimens were collected by using a specially designed fish trap, scoop nets, and modified gill nets of varying mesh sizes.

Species Identification

The collected specimens were identified taxonomically in fresh condition by using standard identification keys such as Smith and Heemstra (1986), Nelson (1994), Munro (2000), and Froese and Pauly (2010).

Biodiversity

Biodiversity indices like Shannon Weiner index, Richness index, Dominance index and Evenness index indices were calculated using PAST software (Hammer *et al.,* 2006).

RESULTS AND DISCUSSION

The survey revealed the presence of 101 species of fishes categorized under 8 orders, 37 families and 66 genera (Table.1). Most of the species were under the order Perciformes (80 species) followed by Tetradontiformes (11 species) and Scorpaeniformes (3 species) (Fig. 1). The species-rich fish families were Pomacentridae/Damsel fishes (10 species), Labridae/Wrasses (9 species), Serranidae/groupers (8 species), Chaetodontidae/Butterfly fishes (7 species) and Lutjanidae/ Snappers (5 species) (Fig. 2). The groupers, representing the genus *Epinephelus* with 7 species, represented the most diverse fish genus followed by butterfly fishes of genus *Chaetodon* (5 species) and snappers of the genus *Lutjanus* (4 species). The biodiversity indices of rocky shore fishes collected from Thiruvananthapuram coast is presented in Table 2. Shannon diversity index of rocky shore fishes recorded a higher value of 3.862 and the species richness was 13.95. The values of evenness index (0.4711) showed less even distribution of species, with dominance index value of 0.9668.

The study revealed that the rocky shore habitats of southern Kerala, with rocky shorelines and artificial sea wall built for the harbour, is colonized by hard and soft corals along with many other invertebrates is a habitat rich in fish diversity. The absence of trawling in the region could also be a major reason for the fish species diversity. Underwater surveys conducted by CMFRI (2011) revealed the existence of patchy coral reefs in Vizhinjam-Thankassery waters. This could also be a primary reason for high diversity observed from this region in the present study. In a comparative study of intertidal biodiversity between the natural rocky shores and artificial rocky habitats of the study area, Ravinesh and Bijukumar (2013) found higher diversity in the natural rocky habitat whereas higher species dominance associated with sea wall constructions. Lam *et al.* (2009) were also reported similar results from Victoria harbour, Hong Kong.

Most of the species found in the Thiruvananthapuram coast were of ornamental importance and therefore needs conservation and careful monitoring in order to ensure the sustainable availability of fish fauna. Rocky shore habitats of Thiruvananthapuram coast are rich in marine ornamental fish diversity when compared to other shore habitats of Kerala (Sivaprasad *et al.,* 2007; Baiju, 2009; Sirajudheen and Bijukumar, 2011; Sirajudheen, 2012). Majority of fish species available in this area are fishes of the families Pomacentridae, Acanthuridae, Balistidae, Labridae, Pomacanthidae and Chaetodontidae, which are of great demand in the international market (Wabnitz *et al.,* 2003).

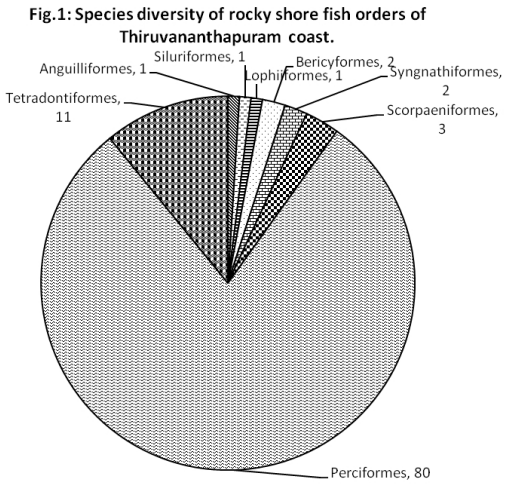
Conservation of marine biodiversity is a global issue and has been negatively affected in coastal areas (Gray, 1997). Developmental activities, coastal pollution and collection of these

Table 1. Classified list of fishes collected from rocky shore habitats of Thiruvananthapuram coast

No.	Species	Common name	Abundance
1	**Order: Anguilliformes; Family: Muraenidae** *Muraena retifera* Goode & Bean, 1882	Reticulate moray	2
2	**Order: Siluriformes; Family: Plotosidae** *Plotosus lineatus* (Thunberg, 1787)	Striped eel catfish	9
3	**Order: Lophiiformes; Family: Antennaridae** *Antennarius nummifer* (Lesson, 1831)	Scarlet Frog fish	24
4	**Order: Bericyformes** **Family: Holocentridae** (Squirrel Fish, Soldier Fish) *Sargacentron rubrum* (Forskal, 1775)	Russet squirrel fish, Red Soldier fish	7
5	*Myripristis murdjan* (Forsskål, 1775)	Pinecone soldier fish	19
6	**Order: Syngnathiformes** **Family: Syngnathidae** (Pipe fishes and Seahorses) *Hippocampus kuda* Bleeker, 1852	Spotted seahorse	2
7	*Trachyrhamphus bicoarctatus* (Bleeker, 1857)	Double-ended pipefish	2
8	**Order: Scorpaeniformes; Family: Scorpaenidae** *Pterois miles* (Bennett, 1828)	Devil fire fish	48
9	*Pterois volitans* (Linnaeus, 1758)	Winged fire fish	7
10	**Family: Apistidae** *Apistus carinatus* (Bloch & Schneider, 1801)	Ocellated wasp fish	9
11	**Order: Perciformes** **Family: Ambassidae** (Asiatic glassfishes) *Ambassis ambassis* (Lacepède, 1802)	Indian glass fish	11
12	**Family: Serranidae** (Sea basses: groupers and fairy basslets) *Cephalopholis boenack* (Bloch, 1790)	Blue lined coral-cod	2
13	*Epinephelus coeruleopunctatus* (Bloch, 1790)	Whitespotted grouper	1
14	*Epinephelus diacanthus* (Valenciennes, 1828)	Six barred reef cod	63
15	*Epinephelus longispinis* (Kner, 1864)	Trout reef cod	4
16	*Epinephelus malabaricus* (Bloch & Schneider, 1801)	Malabar grouper	7
17	*Epinephelus merra* (Bloch, 1793)	Wire-netting reef-cod	6
18	*Epinephelus radiatus*(Day, 1868)	Oblique-banded grouper	1
19	*Epinephelus tauvina* (Forskal, 1775)	Greasy grouper	3
20	**Family: Pseudochromidae** *Pseudochromis caudalis* Boulenger, 1898	-	1
21	**Family : Apogonidae** (Cardinalfishes) *Apogon aureus* (Lacepede, 1802)	Ring-tailed cardinal fish, Band tail Cardinal fish, golden Cardinal fish	31
22	*Apogon cookii* Macleay, 1881	Cook's cardinalfish	3
23	*Archamia fucata* (Cantor, 1849)	Orangelined cardinalfish	58
24	**Family : Carangidae** *Naucrates ductor* (Linnaeus, 1758)	Pilotfish	1
25	*Trachinotus baillonii* (Lacepède, 1801)	Baillon's dart	1
26	**Family: Lutjanidae** (Snappers) *Aphareus furca* (Lacepède, 1801)	Small tooth job fish	2
27	*Lutjanus decussatus* (Cuvier, 1828)*	Checkered snapper	1
28	*Lutjanus johnii* (Bloch, 1792)	John's snapper	2
29	*Lutjanus russelli* (Bleeker, 1849)	One spot snapper	10
30	*Lutjanus vitta* (Quoy & Gaimard, 1824)	Brownstripe red-snapper	8
31	**Family: Haemulidae** (Grunts) *Pomadasys furcatus* (Bloch & Schneider, 1801)	Banded grunter	2
32	*Pomadasys maculatum* (Bloch, 1797)	Saddle grunt	43

No.	Species	Common name	Abundance
33	*Plectorhinchus gibbosus* (Lacepède, 1802)	Harry hotlips	1
34	**Family: Polynemidae**	Black spot threadfin	
	Polydactylus sextarius (Bloch & Schneider, 1801)		2
35	**Family: Mullidae** (Goatfishes)	Yellow stripe goatfish	
	Mulloidichthys flavolineatus (Lacepède, 1801)		16
36	*Parupeneus indicus* (Shaw, 1803)	Indian goatfish	6
37	**Family: Pempheridae** (Sweepers)	Black-edged sweeper,	
	Pempheris mangula (Cuvier, 1829)		8
38	**Family: Chaetodontidae** (Butterflyfishes)	Threadfin butterfly fish	
	Chaetodon auriga (Forskal, 1775)		2
39	*Chaetodon collare* (Bloch, 1787)	Redtail butterfly fish, Pakistani butterfly fish	55
40	*Chaetodon decussatus* Cuvier, 1829	Indian vagabond butterfly fish	4
41	*Chaetodon lunula* (Lacepède, 1802)	Raccoon butterfly fish	1
42	*Chaetodon vagabundus* Linnaeus, 1758	Vagabond butterflyfish	1
43	*Heniochus acuminatus* (Linnaeus, 1758)	Pennet coral fish	11
44	*Heniochus singularius* Smith & Radcliffe, 1911	Singular bannerfish	1
45	**Family: Pomacanthidae**	Emperor angelfish	1
	Pomacanthus imperator (Bloch, 1787)		
46	*Pomacanthus semicirculatus* (Cuvier, 1831)	Semicircle angelfish, Blue angel fish	1
47	*Centropyge multispinis* (Playfair, 1867)	Dusky cherub	1
48	**Family: Therapontidae** (Grunters or tigerperches)	Fourlined terapon	3
	Pelates quadrillineatus (Bloch, 1790)		
49	*Therapon jarbua* (Forskal, 1775)	Crescent Perch, Palin Kitchen	43
50	*Therapon puta* Cuvier, 1829	Small-scaled terapon	16
51	*Therapon theraps* (Cuvier, 1829)	Large scale-terapon	63
52	**Family: Pomacentridae** (Damselfishes)	Sergeant major, Waigen Domoiselle	26
	Abudefduf saxatilis (Linnaeus, 1758)		
53	*Abudefduf septemfasciatus* (Cuvier, 1830)	Banded sergeant	4
54	*Abudefduf sordidus* (Forsskål, 1775)	Blackspot sergeant	8
55	*Chrysiptera unimaculata* (Cuvier, 1830)	Onespot demoiselle	1
56	*Neopomacentrus filamentosus* (Macleay, 1882)	Long-lobed damsel	132
57	*Neopomacentrus nemurus* (Bleeker, 1857)	Yellow-tipped damsel	12
58	*Neopomacentrus violascens* (Bleeker, 1848)	Violet demoiselle	79
59	*Plectroglyphidodon lacrymatus* (Quoy & Gaimard, 1825)	Jewel damsel	5
60	*Pomacentrus albicaudatus* Baschieri-Salvadori, 1955	Whitefin damsel	2
61	*Pomacentrus caeruleus* Quoy & Gaimard, 1825	Caerulean damsel	24
62	**Family : Labridae** (Rainbow Fish, Wrasses)	Red spotted green wrasse	3
	Cheilinus chlorurus (Bloch, 1791)		
63	*Halichoeres nigrescens* (Bloch & Schneider, 1801)	Bubblefin wrasse	3
64	*Halichoeres scapularis* (Bennett, 1832)	Zigzag wrasse	7
65	*Hemigymnus fasciatus* (Bloch, 1792)	Barred thick lip	1
66	*Labroides dimidiatus* (Valenciennes, 1839)	Blue streak cleaner wrasse	5
67	*Stethojulis albovittata* (Bonnaterre, 1788)	Bluelined wrasse	5
68	*Stethojulis strigiventer* (Bennett, 1833)	Three-ribbon wrasse	3
69	*Thalassoma lunare* (Linnaeus, 1758)	Moon wrasse	16
70	*Xyrichthys bimaculatus* Rüppell, 1829	Two-spot razorfish	13
71	**Family: Scaridae** (Parrot fishes)	Blue-barred parrotfish, Flame parrot fish	16
	Scarus ghobban (Forsskal, 1775)		
72	*Scarus russelii* Valenciennes, 1840	Eclipse parrotfish	2

No.	Species	Common name	Abundance
73	**Family: Pinguipedidae** (Sandperches) *Parapercis punctata* (Cuvier, 1829)		3
74	**Family: Uranoscopidae** (stargazers) *Uranoscopus gattatus* Cuvier, 1829	Oranoos-mahi	28
75	**Family: Clinidae** *Heteroclinus eckloniae* (McKay, 1970)	Kelp weed fish	1
76	**Family : Blenniidae** (Combtooth blennies) *Entomacrodus nigricans* Gill, 1859	Pearl blenny	3
77	*Istiblennius lineatus* (Valenciennes, 1836)	Lined rockskipper	14
78	*Petroscirtes mitratus* Rüppell, 1830	Rippled rock skipper, Smooth hipped blenny	1
79	*Scartella cristata* (Linnaeus, 1758)	Molly miller	8
80	**Family: Ephippidae** *Platax pinnatus* (Linnaeus, 1758)	Dusky batfish	5
81	*Platax teira* (Forsskål, 1775)	Long fin bat fish	5
82	**Family: Scatophagidae** (Scats) *Scatophagus argus* (Linnaeus, 1766)	Spotted scat, Scat. Spotted butterfish	15
83	**Family : Siganidae** (Rabbit Fishes) *Siganus canaliculatus* (Park, 1797)	White-spotted spinefoot	3
84	*Siganus javus* (Linnaeus, 1766)	Streaked spinefoot	20
85	*Siganus sutor* (Valenciennes, 1835)	White spotted rabbit fish	27
86	**Family: Zanclidae** (Moorish idol) *Zanclus cornutus* (Linnaeus, 1758)	Moorish idol	11
87	**Family : Acanthuridae** (Surgeonfishes) *Acanthurus lineatus* (Linnaeus, 1758)	Lined surgeonfish, Blue lined surgeonfish	3
88	*Acanthurus mata* (Cuvier, 1829)	Lined Surgeon fish	2
89	*Acanthurus nigrofuscus* (Forsskal, 1775)	Brown surgeonfish, White tailed surgeon fish	35
90	*Ctenochaetus striatus* (Quoy & Gaimard, 1825)	Striated surgeonfish	1
91	**Order : Tetradontiformes** **Family: Balistidae** *Odonus niger* (Rüppell, 1836)	Redtoothed triggerfish, Trigger fish	31
92	*Pseudobalistes flavimarginatus* (Rüppell 1829)	Yellow margin trigger fish	9
93	*Sufflamen fraenatus* (Latreille1804)	Masked triggerfish, Marked file fish	29
94	**Family : Monacanthidae** (Filefishes) *Cantherhines pardalis* (Ruppell, 1837)	Honeycomb file fish	3
95	*Pervagor melanocephalus* (Bleeker, 1853)	Red tail filefish	2
96	**Family : Ostraciidae** (Box Fish, Cow Fish) *Ostracion cubicus* Linnaeus, 1758	Yellow box fish	2
97	**Family : Tetraodontidae** (Puffer Fish, Blow Fish, Toad Fish) *Arothron hispidus* (Linnaeus, 1758)	White-spotted puffer, White-spotted blassop, White-spotted blown fish	20
98	*Arothron immaculatus* (Bloch & Schneider, 1801)	Immaculate puffer, Black edged blossop	9
100	*Arothron nigropunctatus* (Bloch & Schneider, 1801)	Black spotted puffer	2
101	*Canthigaster bennetti* (Bleeker, 1854)	Mooi toble	2
102	**Family :Diodontidae** *Diodon hystrix* Linnaeus 1758	Porcupine Fish	14



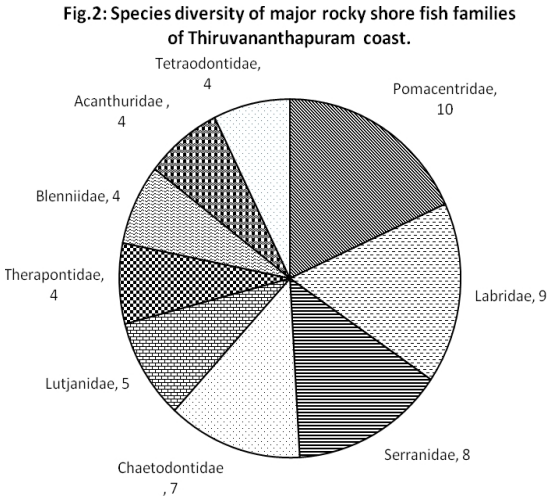


Table 2. Biodiversity indices of rocky shore fishes of Thiruvananthapuram coast

Shannon_H	3.862
Simpson_1-D	0.9668
Evenness_e^H/S	0.4711
Margalef	13.95

resources for ornamental fish trade using destructive methods will lead to the loss of these biodiversity. Therefore sustainable management and careful monitoring are to be ensured for conservation of the shore fish diversity of Thiruvananthapuram coast.

ACKNOWLEDGEMENTS

The authors thank Kerala State Council for Science, Technology and Environment (KSCSTE) for financial support of the work.

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