

A study on the occurrence and distribution of coral reef fishes along Cuddalore fish landing center, Tamilnadu, India

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Abstract

Ornamental fishes are fascinating beauties and they have been attracting people from time immemorial. Coral reef fishes from the trawl by-catch landings were collected from Cuddalore fishing harbour from January to December 2019. The data were approached to various statistical methods available in PRIMER (ver. 6.) and Origin Pro (ver. 7.5). In the present study, a total of 61 species belonging to 26 families and 42 genera were recorded. During the study period, Labridae were dominated with 9 species, Tetraodontidae, Serranidae, Lutjanidae and Chaetodontidae formed second dominant group with each in 5 species. Pomacanthidae and Acanthuridae came next in the order with 3 species followed by 2 species in Muraenidae, Ostraciidae, Balistidae, Monacanthidae, Scorpaenidae, Diodontidae and Mullidae family. 1 species from Plotosidae, Synodontidae, Holocentridae, Fistularidae, Apogonidae, Scatophagidae, Nemipteridae, Ephippidae, Carangidae, Pomacentridae, Scaridae and Zanclidae were recorded each family. Findings of the study reveal that, selected sites supports relatively rich assemblage of reef fishes and most of the species are plentiful in distribution thereby offering immense scope for the export and growth of aquarium trade in the country. Further the fishing community along the Cuddalore coast could deploy some trap methods to catch this coral reef fishes in live conditions for trade.

Keywords: Coral reef fishes, PRIMER, Diversity, Richness, Evenness, India

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Introduction

The coastal marine environment plays a vital role in India's economy by virtue of their resources, productive habitats and wide biodiversity. Reef fishes of India are fascinating beauties and they have been attracting people from time immemorial. Freshwater, brackish water bodies and the seas around the Indian sub-continent attract a variety of fishes dear to the hobbyist's world over. The tropical ornamental fishes from north eastern and southern provinces of India are a great demand in the hobbyist's market. The major marketers in the world from India are USA, German, Italy, France, Sweden, Spain and Japan. The marine ornamental fishes are abundant in the tropical seas particularly in regions which are rich in corals, seaweeds, sea grasses, and also in the regions of rocky bottom place. In the present study, area (Cuddalore coastal waters) predominant occurrence of coral reef fishes and their characteristic like shapes, sizes, colours, behaviour and ecology exhibited by reef fishes is amazing. About 170 varieties of marine origin are present in Andaman; Nicobar and Lakshadweep islands (Nair, 2006), Gulf of Kutch, Maharashtra, Cochin to Vizhinjam in Kerala and Gulf of Mannar, Palk Bay and Kanyakumari in Tamilnadu.

Most of the taxonomic studies on reef fishes in India are from coral reef ecosystems (Rao *et al.*, 2004; Chogale and Bhatkar, 2006; Ajith kumar *et al.*, 2007; Ahilan and Walkhom, 2007; Sivaprasad *et al.*, 2007). The only effort has so far been made to explore the

potential of marine ornamental fishes encountered in the trawl by-catch was studied by Sureshkumar *et al.* (2004). They reported 40 species of reef fishes belonging to 22 families from the trawl by-catches of Ponnani fishing harbour, north Kerala. Sirajudheen *et al.* (2014) record the marine ornamental fish diversity associated with the by-catch of trawlers operating from Neendakara fishing harbour, Kerala. The marine fishes reach their greatest diversity in the coral reef ecosystem. Studies on their species composition, species richness and diversity will go a long way in evolving suitable strategies for the protection and management of coral reef species. Besides this, it is also useful for marine aquarium trade. Although a lot of information is available on the coral reef fishes of the Gulf of Mannar in Tamil Nadu (Muralitharan, 1999), information about the diversity of such fishes in the Coromandel Coast in Tamil Nadu is very meagre. The present study was undertaken to gather information on the diversity of coral reef ornamental fishes associated with coral patches in the Cuddalore coastal waters and to, present preliminary observation may stimulate better investigations in future for thorough understanding of ornamental fishes along the Cuddalore Coast.

Material and methods

Coral reef ornamental fishes from the trawl by-catch landings were collected from Cuddalore fishing harbour (Lat. $11^{\circ} 42' N$; Long. $79^{\circ} 47' E$) from January to December 2019. Cuddalore, a coastal town is situated 200 km south of

Chennai and is the capital of one of the districts of Tamil Nadu state (Map-1). It is one of the most important fish landing centres of Tamil Nadu and is capable of handling about 12,000 to 14,000 tons of fishes per year. As many as 400-500 mechanized boats besides 500 catamarans are being operated for fishing activity here and trawlers are operated for more than one and a half day of sea fishing to about 100m depth. During commercial fish catch coral reef fishes were caught as by-catch. Among these, few species are sold fresh for human consumption in fish market and the rest are used as dry fish and few thrown as trash. From that the fresh fish specimen were collected cleaned, washed and stored in ice boxes with crushed ice for preservation. The collected fresh specimens were identified up to species level using FAO fishing identification sheets, text books, monographs, reprints and online databases (Day, 1878; Smith and Heemstra, 1986; Munro, 2000; Froese and Pauly, 2008-2012). The names used in the text followed Froese and Pauly (2012) and classification that of Nelson (2006). After identification, fishes were photographed and preserved in 10% formaldehyde. Furthermore, for data analysis various statistical methods namely univariate, graphical/distributional and multivariate methods available in PRIMER (ver. 6.) statistical software (Clarke and Warwick, 2001) and Origin Pro (ver. 7.5) were employed (Fig. 1).

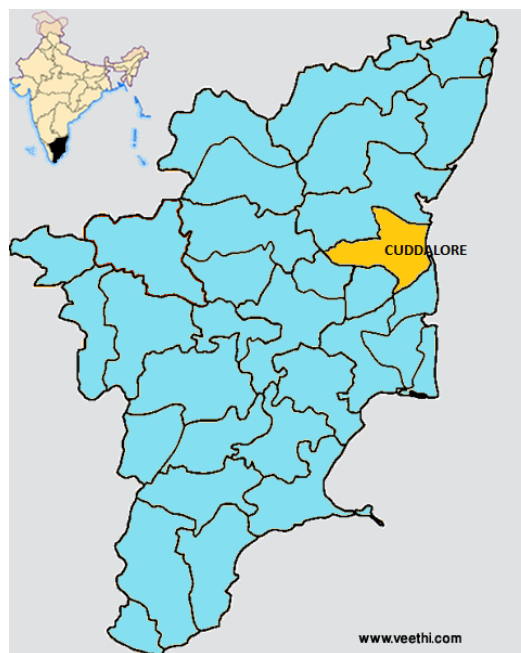


Figure 1: Showing the study area.

Results

In the present study, a total of 61 species belonging to 26 families and 42 genera were recorded. During the study period, Labridae were dominated with 9 species, Tetraodontidae, Serranidae, Lutjanidae and Chaetodontidae formed second dominant group with each in 5 species. Pomacanthidae and Acanthuridae came next in the order with 3 species followed by Muraenidae, Ostraciidae, Balistidae, Monacanthidae, Scorpaenidae, Diodontidae and Mullidae with 2 species in each family. Plotosidae, Synodontidae, Holocentridae, Fistularidae, Apogonidae, Scatophagidae, Nemipteridae, Ephippidae, Carangidae, Pomacentridae, Scaridae and Zanclidae were recorded 1 species in each family. Among the families, *Gymnothorax randalli*, *Fistularia petimba*, *Sargocentron rubrum*, *Arothron nigropunctatus*, *Torquigener*

brevipinnis, *Epinephelus flavocaeruleus*, *Epinephelus coioides*, *Lutjanus quinquelineatus*, *Lutjanus fulvus*, *Apolemichthys xanthurus*, *Dascyllus trimaculatus*, *Iniistius bimaculatus*, *Xiphochelium typus*, *Iniistius cyanifrons*, *Acanthurus mata*, *Halichoeres zeylonicus*, *Gnathanodon speciosus*, *Heniochus acuminatus*, *Parupeneus indicus*, *Upeneus sulphureus* and *Scatophagus argus* were found to be common in the sample collection (Table 1).

Table 1: Checklist of ornamental fishes recorded in Cuddalore landing centre.

No.	Species	No.	Species	No.	Species
	Muraenidae		Scorpaenidae	40	<i>Pomacanthus semicirculatus</i>
1	<i>Gymnothorax favagineus</i>	20	<i>Pterois volitans</i>		Chaetodontidae
2	<i>Gymnothorax randalli</i>	21	<i>Dendrochirus brachypterus</i>	41	<i>Chaetodon Auriga</i>
	Plotosidae		Serranidae	42	<i>Chaetodon collare</i>
3	<i>Plotosus lineatus</i>	22	<i>Cephalopholis Formosa</i>	43	<i>Chaetodon decussatus</i>
	Synodontidae	23	<i>Cephalopholis sonnerati</i>	44	<i>Heniochus acuminatus</i>
4	<i>Synodus indicus</i>	24	<i>Epinephelus coioides</i>	45	<i>Heniochus pleurotaenia</i>
	Holocentridae	25	<i>Epinephelus flavocaeruleus</i>		Carangidae
5	<i>Sargocentron rubrum</i>	26	<i>Epinephelus longispinis</i>	46	<i>Gnathanodon speciosus</i>
	Fistularidae		Apogonidae		Pomacentridae
6	<i>Fistularia petimba</i>	27	<i>Apogon aureus</i>	47	<i>Dascyllus trimaculatus</i>
	Diodontidae		Scatophagidae		Labridae
7	<i>Diodon holocanthus</i>	28	<i>Scatophagus argus</i>	48	<i>Cheilinus chlorurus</i>
8	<i>Diodon hystrix</i>		Lutjanidae	49	<i>Cheilinus undulates</i>
	Tetraodontidae	29	<i>Lutjanus enrenbergii</i>	50	<i>Labroides dimidiatus</i>
9	<i>Arothron stellatus</i>	30	<i>Lutjanus fulvus</i>	51	<i>Stethojulis interrupta</i>
10	<i>Arothron nigropunctatus</i>	31	<i>Lutjanus lutjanus</i>	52	<i>Xiphochelium typus</i>
11	<i>Lagocephalus lunaris</i>	32	<i>Lutjanus rivulatus</i>	53	<i>Iniistius bimaculatus</i>
12	<i>Takifugu oblongus</i>	33	<i>Lutjanus quinquelineatus</i>	54	<i>Iniistius cyanifrons</i>
13	<i>Torquigener brevipinnis</i>		Nemipteridae	55	<i>Halichoeres nigrescens</i>
	Ostraciidae	34	<i>Scolopsis vosmeri</i>	56	<i>Halichoeres zeylonicus</i>
14	<i>Lactoria cornuta</i>		Ephippidae		Scaridae
15	<i>Tetrosomus gibbosus</i>	35	<i>Platax orbicularis</i>	57	<i>Scarus rubroviolaceus</i>
	Balistidae		Mullidae		Zanclidae
16	<i>Abalistes stellatus</i>	36	<i>Parupeneus indicus</i>	58	<i>Zanclus cornutus</i>
17	<i>Balistoides viridescens</i>	37	<i>Upeneus sulphureus</i>		Acanthuridae
	Monacanthidae		Pomacanthidae	59	<i>Acanthurus lineatus</i>
18	<i>Aluterus monoceros</i>	38	<i>Apolemichthys xanthurus</i>	60	<i>Acanthurus mata</i>
19	<i>Monacanthus hispidus</i>	39	<i>Pomacanthus annularis</i>	61	<i>Acanthurus triostegus</i>

Numerical abundance of marine ornamental fishes

Family wise

With respect to population density of marine ornamental fishes in Cuddalore coastal waters during 2015, the density

varied from 13 to 598 nos. with maximum was recorded in Labridae family and minimum was recorded in Ephippidae family (Fig. 2).

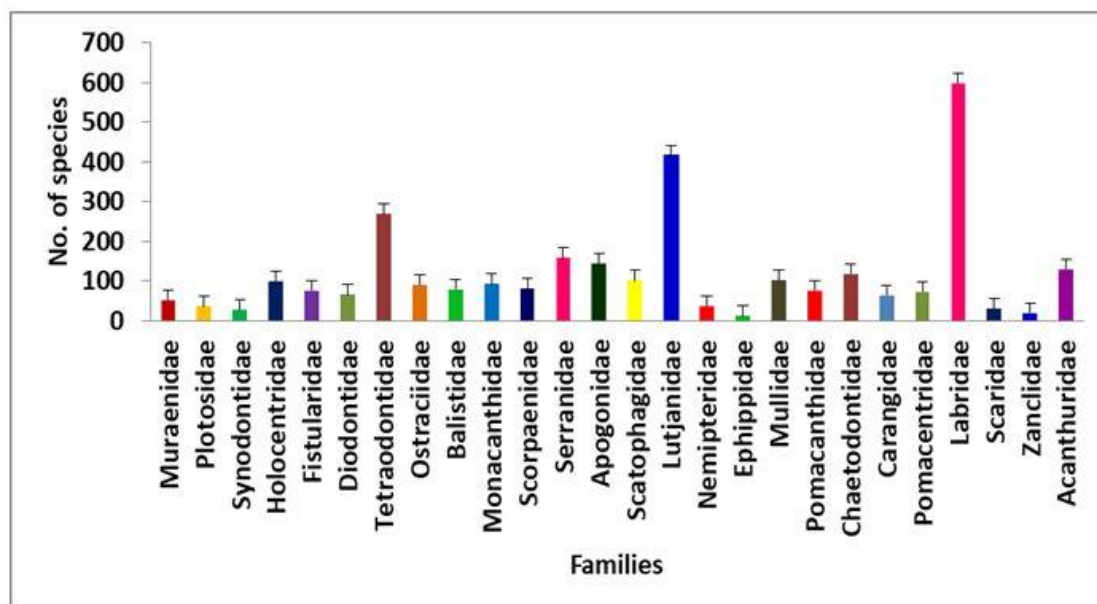


Figure 2: Family wise variation of marine ornamental fishes recorded in Cuddalore coastal waters.

Temporal variation

Population density varied between 5 and 257 individuals. With maximum number

in postmonsoon season and minimum in monsoon season (Fig. 3).

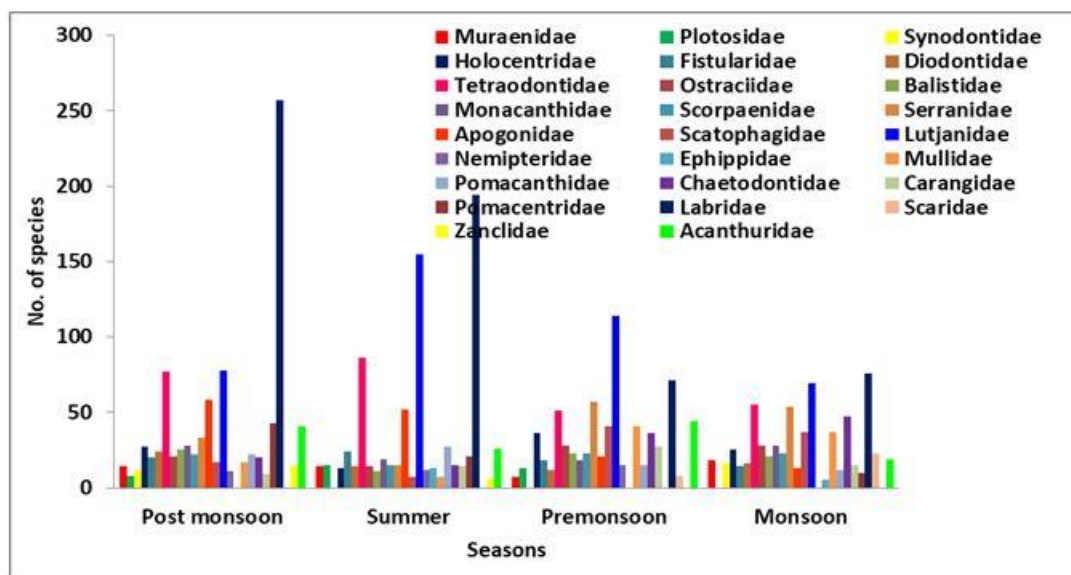


Figure 3: Season wise variation of marine reef fishes recorded in Cuddalore coastal waters.

Percentage composition of reef fishes

The order wise percentage contributions of marine ornamental fishes recorded in Cuddalore coastal waters are given in (Fig. 4) and 8. Labridae were found to be the dominant family with 20%.

Lutjanidae formed next dominant family with 12%, followed by Tetraodontidae with 9%, Holocentridae, Serranidae and Apogonidae with each in 5%, Acanthuridae and Chaetodontidae with 4%, Mullidae, Pomacanthidae,

Scorpaenidae, Ostraciidae, Balistidae, Scatophagidae, Scorpaenidae with 3% in each. Carangidae, Diodontidae, Fistularidae with 2% in each family. Nemipteridae, Ehippidae, Plotosidae,

Synodontidae, Scaridae, Zanclidae last in the order with a percentage occurrence of 1%, respectively.

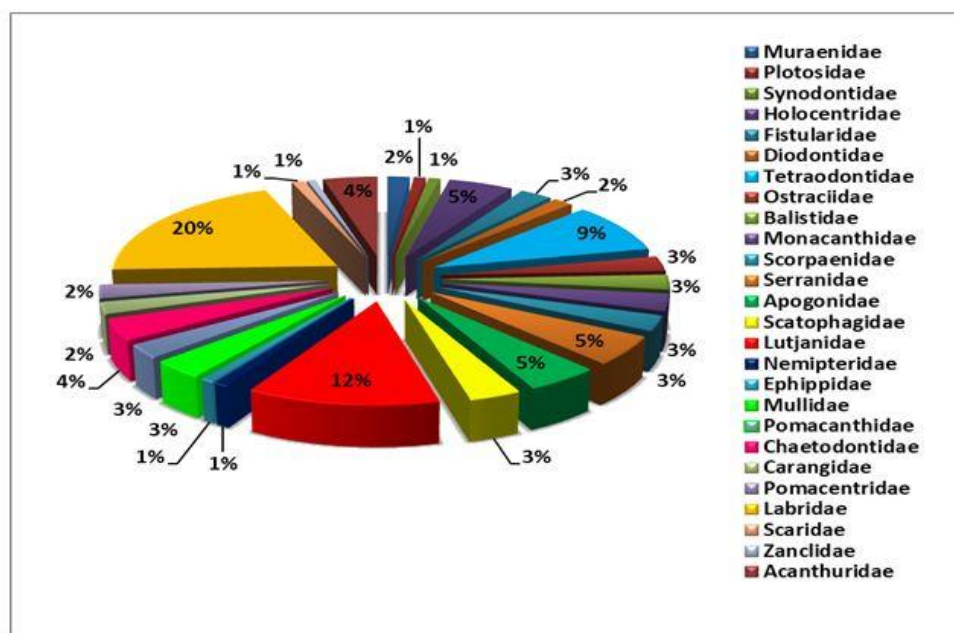


Figure 4: Percentage composition of marine ornamental fishes caught from Cuddalore coastal waters.

Diversity indices

The marine ornamental fish species diversity varied between 4.230 and 5.143 with maximum during post monsoon and minimum during pre monsoon. Species richness ranged from 4.789 to 8.103 with maximum during post monsoon and minimum during summer; with respect to Pielou's evenness, it varied from 0.862 to 0.956 with maximum during post monsoon and minimum during monsoon (Fig. 5).

Multivariate methods

Cluster Analysis and MDS (non-metric Multi-Dimensional Scaling)

Season-wise

In the present study, season wise cluster analysis & MDS methods were also

performed to ascertain the similarity between seasons in the samples collected. The samples of various seasons of the study area i.e., post monsoon; summer; pre monsoon; monsoon season; samples collected in this area were forming cluster indicating seasonal variations in species compositions. To confirm this grouping of seasons, MDS was also drawn with the same input data. The results revealed that the same clustering pattern was evident in the MDS as well. The stress value which is overlying on the top-right corner of the MDS plot was also found to be low (0.05) signifying the good ordination pattern of the samples (Figs. 6 & 7).

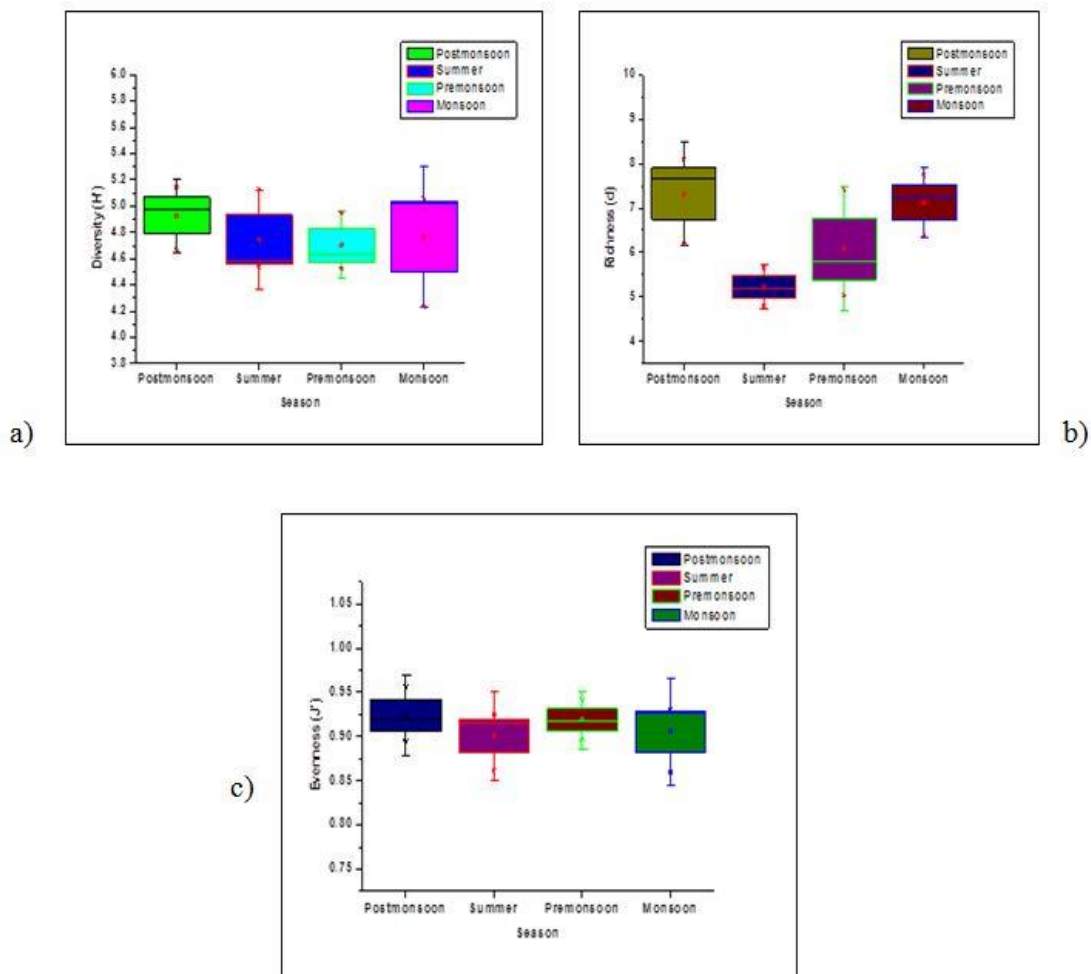


Figure 5: Seasonal variation of diversity indices: a)-Shannon diversity b)-Margalef richness and c)-Pielou's evenness calculated for the reef fishes recorded in Cuddalore coastal waters.

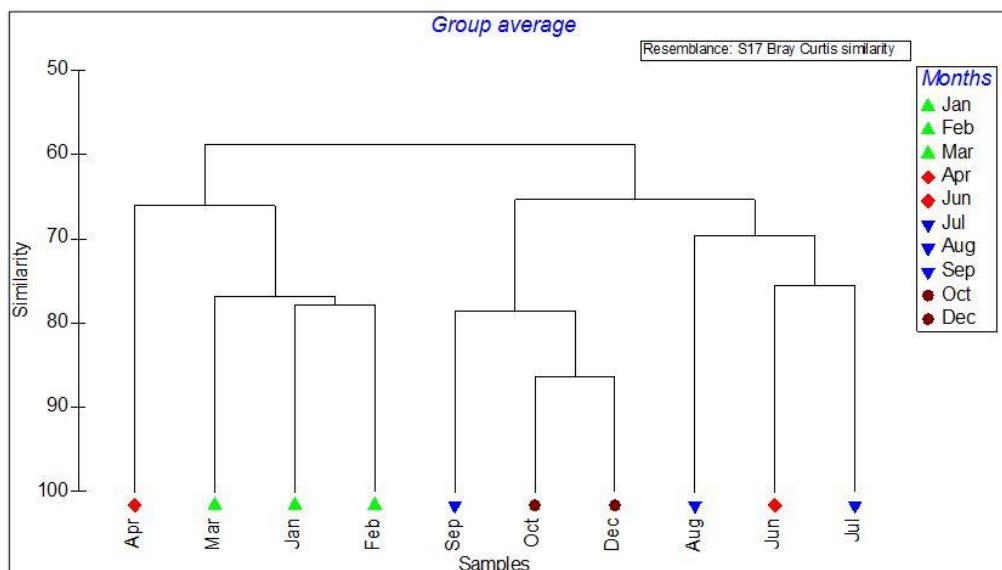


Figure 6: Dendrogram showing similarity for the fish samples collected in Cuddalore coastal waters.

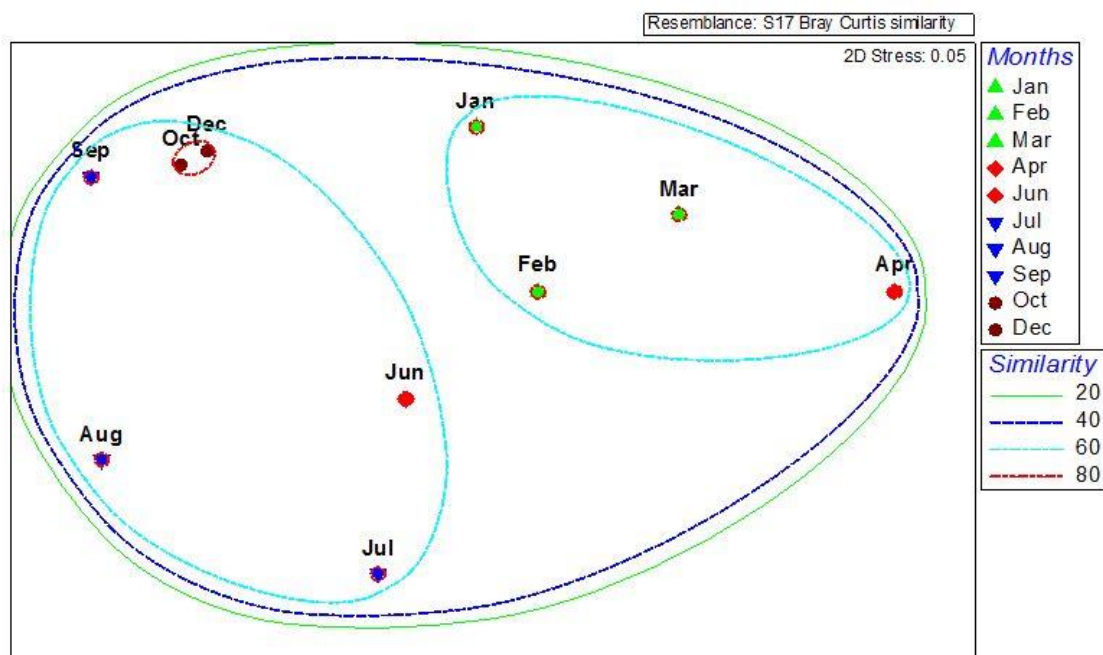


Figure 7: MDS drawn for the marine ornamental fish samples collected in Cuddalore coastal waters

Discussion

Knowledge on marine, estuarine, and freshwater ecosystems has advanced with respect to fish species identification for historical evaluation of fish stocks. Collaborative research efforts have helped in the identification and taxonomic categorization of the world's fish species estuarine fishes notwithstanding. In the present study, a total of 61 species belonging to 26 families and 42 genera were recorded. Due to fishing ban in this region in May month and no fishing activity during November due to cyclone and heavy rains, the latter month was omitted. No fishing (cyclone and heavy rains) activity November month was excluded in the present study. During the study period, Labridae were dominated with 9 species, Tetraodontidae, Serranidae, Lutjanidae and Chaetodontidae formed second dominant group with each in 5 species. Pomacanthidae and

Acanthuridae came next in the order with 3 species followed by Muraenidae, Ostraciidae, Balistidae, Monacanthidae, Scorpaenidae, Diodontidae and Mullidae with 2 species in each family. Plotosidae, Synodontidae, Holocentridae, Fistularidae, Apogonidae, Scatophagidae, Nemipteridae, Ephippidae, Carangidae, Pomacentridae, Scaridae and Zanclidae were recorded 1 species in each family. Ajmal Khan *et al.* (2008) reported only 25 species of coral reef fishes belonging to 16 families were identified in Cuddalore coastal waters.

One hundred and twenty-one coral reef fishes have been reported to occur in the reef slope of the Kavaratti atoll of Lakshadweep (Vijay Anand and Pillai, 2002) and 65 species have been recorded from the seagrass bed of the same atoll (Vijay Anand and Pillai, 2007). In the reef slope of the Kavarathi atoll, Lakshadweep, Labridae,

Chaetodontidae, Balistidae, Pomacentridae and Acanthuridae were found to be the most species families (Vijay Anand and Pillai, 2002). In the seagrass beds of the above island, Labridae, Chaetodontidae, Acanthuridae and Mullidae were found to be the most speciose families (Vijay Anand and Pillai, 2007). However, in the present study Labridae were dominated with 9 species, Tetraodontidae, Serranidae, Lutjanidae and Chaetodontidae formed second dominant group with each in 5 species. All the other families were represented by 3, 2 and 1 species only. The species diversity recorded in the reef slope of Kavaratti atoll was in the range of 3.32-4.45 and in the seagrass bed of the above island was in the range of 2.49-3.14 (Vijay Anand and Pillai, 2002; 2007).

The high diversity in the reef slope was attributed to availability of food resources. In the present study also, higher diversity was observed even though the number of species recorded was less which contributed to the higher evenness values (0.86-0.95) (Clark, 1999). Muralitharan (1998) recorded 213 species of reef fishes from the Gulf of Mannar which is considered as National Biosphere resource. Venkataramani and Jawahar (2004) noticed about 113 marine ornamental finfish species in Gulf of Mannar and also claimed that this area could be exploited extra for ornamental fish trade in India. However, the numerical abundance of reef fishes, along the Cuddalore coast during the year, strongly suggests that this coast has to be

surveyed adequately for the existence of reef formation in order to keep the fragile ecosystem and the efficient management of the reef ichthyo fauna associated with reef formation. Clearly, if we wish to protect global biodiversity, we must understand the richness of biodiversity, processes that protect diversity at the best level.

Conclusion

Findings of this study revealed that the selected sites support relatively rich assemblage of reef fishes and with of the species in distribution thereby offering immense scope for the export and growth of aquarium trade in the country. The ultimate solution to a long-term sustainable trade of maritime ornamental fishes can be achieved only through the development of fool proof aquaculture technologies. Furthermore, the fishing community along the Cuddalore coast may deploy some trap methods to catch coral reef fishes in live conditions for trade in this way; it will also bring them more money and enhances the trade in a viable manner. This region is having a very good potential for ornamental fishery in future.

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