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Deep-sea Teleostean Species-Diversity off the South West coast of India (7º N-10º N lat.)

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Abstract

During the exploratory fishery survey conducted by M.F.V. Matsya Varshini of the FSI, Kochi base from February 2004 to April 2005 for assessing the abundance and distribution of the nonconventional deep-sea fin fish resources, an attempt has been made to prepare an inventory of the teleostean species-diversity in the 100 to 500 m depth zone off the south-west coast of India. A checklist of the 98 species belonging to 16 orders, 52 families, and 79 genera collected during the period along with the area and depth of collection is presented. The classification is based on Nelson (1984). Of the 98 species, 17 are identified to the generic level only. Even though this is not an exhaustive study, the presence of 16 orders and 98 species in the 100 to 500 m depth zone is a clear indicator of the rich teleostean species-diversity of this region. Global deep-sea demersal fish fauna is represented by 22 fish orders. Out of the 98 species recorded, 63 belong to the pre-perciform orders. The order Perciformes dominated the diversity with 29 species, followed by the order Lophiiformes (ten species) and order Scorpaeniformes (nine species). Families Myctophidae and Macrouridae with five species each topped in species diversity. Out of the 52 families, 22 families were represented by a single species. Families Cepolidae, Uranoscopidae, and Ariommatidae were represented in the 100-200 m depth zone only. A comparative account of the number of species recorded during previous surveys is furnished. Diversity indices using catch data collected through surveys of the south west coast of India have been worked out and explained in order to relate it with abundance indices. In future fishery surveys, emphasis must be given to exhaustive species-diversity studies and to make available specimens to facilitate the bar coding of the species.

Introduction

In India, deep-sea fishes are rapidly gaining importance as a potential resource, as the inshore fishery alone can no longer satisfy the growing demand for fish. Present trends in the landings indicate that most of our coastal fishery resources are either fully exploited or over exploited. Deep-sea sector beyond 100 m depth contour is considered as an important zone for the nonconventional fin fishes. Various surveys carried out by

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different agencies point out their presence in the above area. However, there is a lot of gap in the scientific knowledge of distribution and abundance of the above resource.

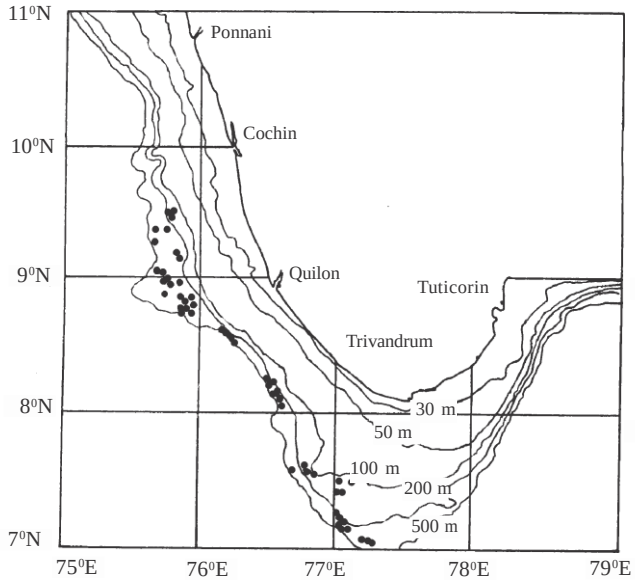
Biodiversity of deep- sea fishes of the world has always remained a challenge to eminent ichthyologists and taxonomists. Classical works of well-known ichthyologists and naturalists have thrown light into the peculiarities of these fish and has also given valuable information on the deep-sea ichthyodiversity of the world. The works of Day (1878); Gunther (1887); Alcock (1891, 1899); Goode and Bean (1895); Norman (1939); Marshall (1954,1974) and Smith and Heemstra (1986) are considered as important scientific contributions in the systematics of deep-sea fishes. Information on the biodiversity of unconventional fin fishes off the south west coast of India is based on the works of Samuel (1963), Tholasilingam et al. (1964); Silas and Prasad (1966); Oommen (1978,1980,1985); Joseph and John (1986); Balachandran and Nizar (1990); Khan et al (1996); and Venu and Kurup (2002). Identification of the important components of the resources and assessing their biomass are major prerequisites to formulate future plans for tapping them. Above knowledge about the resources helps the scientist and planners to recommend the sustainable yield and also the effort required to exploit the above stock. As a first step towards this an attempt has been made to understand the diversity of the deep-sea teleosts off the south west coast of India (7^0 N to 10^0N Lat.).

Materials and methods

M.F.V. Matsya Varshini, a purse-seiner cum stern trawler based at Kochi base of Fishery Survey of India conducts demersal trawl survey in south west coast, Wedge Bank and Gulf of Mannar. Exploratory fishing data of the above survey during the period between February 2004 and April 2005 is the base of this study. 100 to 500 m depth zone off the south west coast of India lying between 7^0N to 10^0N Latitude (Lat.) was the area of study. The vessel conducted 13 voyages during the period between February 2004 and April 2005. A total of 54 hauls have been made in the study area spending an effort of 60.33 hours. Out of the 54 hauls, eight hauls were made at 100 to 200 m depth strata and 46 hauls were made in the area between 200 and 500m depth zone. Distribution of hauls carried out during the period is shown in Fig.1

Detailed survey data during the months of March 2004, November 2004, and April 2005, during which the first author has participated onboard as scientist participant and cruise leader were utilized for estimating the species diversity index of the finfish

Figure1. Distribution of effort (hauls) during the period February 2004 to April 2005.



resources. A total of 24 hauls spending an effort of 28.58 hours have been carried out during the said period. A 45.6 m Expo model fish trawl and 45.12 m shrimp trawl were the gears used for the resource survey. Catches were sorted out-group wise/species wise immediately after each haul. The weight of each group/species was recorded to find out the species composition of the catches. Deck sampling procedures outlined by Pauly (1980) was followed to record the catches. Necessary entries were made in the catch data sheets for further analysis. Specimens collected from the haul were immediately photographed by using a digital camera. Specimens were identified up to species level by using standard references (Day 1878; Goode & Bean 1895; Alcock 1899; Munro 1955; Fischer & Bianchi 1984; and Smith & Heemstra 1986). Lat-wise diversity indices were estimated by following Shannon's diversity index (H) and Shannon's equitability (E_H) (Begon et al. 1996).

Results

During the period under study a total of 98 species belonging to 16 orders, 52 families, and 79 genera of non-conventional finfishes are recorded from the area. Out of the 98 species recorded from the area 63 species belong to pre-perciform orders. Except for the four species recorded from 100 to 200 m depth zone, all others are true deep-sea fishes. Out of the 52 families 22 are represented by single species. Family

Myctophidae and Macrouridae with 5 species each dominated over others in species richness. Check list of finfishes collected during the study is prepared following Nelson (1984). Areas of specimen collection, depth of collection, and total length of specimen used for the identification of the species are added in the checklist (Table. 1)

Table 1. Check List of Non-conventional Finfishes Collected

S.No	Species name	Common name	Area of collection Lat (N)/ long (E)	Depth (m)	Total length (cm)
(1)	(2)	(3)	(4)	(5)	(6
INFRADIVISION: ELOPOMORPHA, ORDER: ANGUILLIFORMES, SUBORDER: ANGUILLOIDEI					
I	FAMILY: CONGRIDAE	Conger eels			
1	*Ariosoma* sp.	Conger	08^{0}52.5’ 75^{0}45.0’	340	29.3
2	*Bathycongrus guttatus* (Gunther, 1887)		09^{0}20.2’ 75^{0}44.4’	357	30.0
3	*Coloconger raniceps* Alcock, 1889	Frog head conger	09^{0}20.2’ 75^{0}44.4’	357	24.5
II	FAMILY: MURAENESOCIDAE	Pike congers			
4	*Gavialiceps taeniola* (Woodmason, in Alcock, 1889)		08^{0}15.7’ 76^{0}30.7’	455	39.9
III	FAMILY: NEMICHTHYIDAE	Snipe eels			
5	*Nemichthys acanthonotus* Alcock, 1894	Slender snipe eel	08^{0}34.5’ 76^{0}13.1’	282	57.0
INFRADIVISION: EUTELEOSTEI, SUPERORDER: PROTOCANTHOPTERYGII, ORDER: SALMONIFORMES; SUBORDER : ARGENTINOIDEI					
IV	FAMILY: ALEPOCEPHALIDAE	Slickheads			
6	*Rouleina squamilatera* (Alcock, 1898)	Blunt snout slickhead	08^{0}06.8’ 76^{0}39.9’	461	22.0
SUPERORDER: STERNOPTERYGII, ORDER: STOMIIFORMES, SUBORDER GONOSTOMATOIDEI					
V	FAMILY: STERNOPTYCHIDAE	Hatchetfishes			
7	*Polyipnus spinosus* Gunther, 1891		09^{0}20.2’ 75^{0}44.4’	357	6.4
VI	FAMILY: PHOTICHTHYIDAE	Lightfishes			
VII	FAMILY: CHAULIODONTIDAE	Viperfishes			
9	*Chauliodus sloani* Schneider, 1801	Sloan’s viperfish	08^{0}59.6’ 75^{0}46.3’	334	16.3
VIII	FAMILY: ASTRONESTHIDAE	Snaggletooths			
10	*Astronesthes martensii* Kluzinger, 1871	Astronesthid fish	09^{0}20.2’ 75^{0}44.4’	357	11.9
11	*Astronesthes trifibulatus* Gibbs, Amaoka &Haruta, 1984		08^{0}15.7’ 76^{0}30.7’	455	12.9
IX	FAMILY: MALACOSTEIDAE	Loosejaws			
12	*Photostomias* sp.		08^{0}15.7’ 76^{0}30.7’	455	17.8

Table 1 Continued

(1)	(2)	(3)	(4)	(5)	(6)
SUPERORDER: SCOPELOMORPHA, ORDER: ALULOPIFORMES, SUBORDER: AULOPOIDEI					
X	FAMILY: CHLOROPHTHALMIDAE	Greeneyes			
13	*Chlorophthalmus agassizi* Bonaparte, 18403	Short nose greeneye	09^{0}20.2' 75^{0}44.4'	357	19.2
14	*Chlorphthalmus bicornis* Norman, 1934	Spiny jaw greeneye	09^{0}20.2' 75^{0}44.4'	357	10.4
15	*Chlorophthalmus punctatus* Gilchrist, 1904	Spotted greeneye	08^{0}52.5' 75^{0}49.1'	336	9.1
SUBORDER ALEPISAUROIDEI					
XI	FAMILY: PARALEPIDIDAE	Barracudinas			
16	*Stemonosudis rothschildi* Richards, 1967		09^{0}20.2' 75^{0}44.4'	357	26.7
17	*Lestrolepis intermedia* (Poey, 1868)		09^{0}20.2' 75^{0}44.4'	357	16.5
18	*Neoscopelus macrolepidotus* Johnson, 1863	Large scaled lanternfish	09^{0}11.5' 75^{0}48.4'	372	17.2
XIII	FAMILY: MYCTOPHIDAE	Lanternfishes			
19	*Diaphus splendidus* (Brauer, 1904)		09^{0}20.2' 75^{0}44.4'	357	16.5
20	*Diaphus antonbruuni* Nafpaktitis, 1978		08^{0}14.2' 76^{0}32.4'	435	15.3
21	*Diaphus* sp.		08^{0}45.0' 75^{0}53.0'	410	7.8
22	*Diaphus* sp.		08^{0}08.4' 76^{0}36.4'	418	6.6
23	*Lampadena luminosa* (Garman, 1899)		08^{0}15.7' 76^{0}30.7'	455	12.1
SUPERORDER: PARACANTHOPTERYGII,ORDER: GADIFORMES,SUBORDER :GADOIDEI					
XIV	FAMILY: MORIDAE	Deep-sea cods			
24	*Physiculus argyropastus* Alcock, 1894		09^{0}20.2' 75^{0}44.4'	357	26.5
25	*Gadella* sp.		08^{0}52.5' 75^{0}45.0'	340	22.7
SUBORDER: MACROUROIDEI					
XV	FAMILY: MACROURIDAE	Grenadiers			
26	*Malacocephalus laevis* (Lowe, 1843)	Soft-head grenadier	09^{0}20.2' 75^{0}44.4'	357	27.8
27	*Malacocephalus* sp.		08^{0}14.2' 76^{0}32.2'	435	37.8
28	*Mesobius* sp.		08^{0}15.7' 76^{0}30.7'	455	13.2
29	*Coelorinchus quadricristatus* (Alcock, 894)		08^{0}06.8' 76^{0}39.9'	461	21.0
30	*Coryphaenoides macrolophus* (Alcock, 1889)		08^{0}06.8' 76^{0}39.9'	461	15.3
ORDER: OPHIDIFORMES, SUBORDER: OPHIDIOIDEI					
XVI	FAMILY: OPHIDIIDAE	Cusk-eels			
31	*Neobythites macrops* (Gunther, 1889)		08^{0}15.7' 76^{0}30.7'	455	25.9
32	*Neobythites* sp.		08^{0}34.5' 76^{0}13.0'	340	14.3
33	*Hypopleuron caninum* Smith &Radcliffe, 1913		08^{0}34.5' 76^{0}13.0'	340	40.5
ORDER: LOPHIIFORMES, SUBORDER: LOPHIOIDEI					
XVII	FAMILY: LOPHIIDAE	Monks/Angler			
34	*Lophiodes mutilus* (Alcock, 1893)	Smooth angler	09^{0}11.5' 75^{0}48.4'	372	23.1
35	*Lophiodes* sp.	Angler	08^{0}52.5' 75^{0}45.0'	340	7.0

Table 1 Continued

(1)	(2)	(3)	(4)	(5)	(6)
SUBORDER: ANTENNAROIDEI					
XVIII	FAMILY: CHAUNACIDAE	Sea toads			
36	*Chaunax pictus* Lowe, 1846	Pink frog- mouth	09^{0}15.0' 75^{0}42.6'	369	18.7
37	*Chaunax endeavouri* Whitley, 1929	Coffinfish	08^{0}14.2' 76^{0}32.2'	435	21.1
38	*Chaunacops melanostomus* Caruso, 1989		08^{0}14.2' 76^{0}32.2'	435	5.1
XIX	FAMILY: OGCOCEPHALIDAE	Sea bats			
39	*Halieutaea coccinea* Alcock, 1889	Spiny sea bat	09^{0}20.2' 75^{0}44.4'	357	20.6
40	*Halieutaea nigra* Alcock, 1891		08^{0}50.2' 75^{0}56.8'	330	7.0
41	*Halieutaea stellata* (Vahl, 1797)	Starry hand fish	08^{0}50.2' 75^{0}56.8'	330	11.5
SUBORDER: CERATIOIDEI					
XX	FAMILY: DICERATIIDAE	Horned anglers			
42	***Ceratius (Diceratias) bispinosus* (Gunther, 1887)**	Two rod anglerfish	08^{0}14.2' 76^{0}32.2'	435	11.4
43	*Phrynichthys wedli* Pietschman, 1926		08^{0}11.6' 76^{0}32.2'	490	10.7
SUPERORDER: ACANTHOPTERYGII, SERIES: PERCOMORPHA, ORDER: LAMPRIFORMES,SUBORDER: ATELEOPODOIDEI					
XXI	FAMILY: ATELEOPODIDAE	Tadpole fishes			
44	*Ateleopus indicus* Alcock, 1891		08^{0}14.2' 76^{0}32.2'	435	34.2
ORDER: BERYCIFORMES,SUBORDER :BERYCOIDEI					
XXII	FAMILY: TRACHICHTHYIDAE	Slimeheads			
45	*Gephyroberyx darwini* (Johnson, 1866)	Darwin's slimehead	08^{0}14.2' 76^{0}32.2'	435	9.3
46	*Hoplostethus mediterraneus* Cuvier, 1829	Mediterranian slimehead	08^{0}14.2' 76^{0}32.2'	435	6.5
XXIII	FAMILY: BERYCIDAE	Berycids			
47	*Beryx splendens* Lowe, 1834	Slender beryx	09^{0}20.2' 75^{0}44.4'	357	15.2
XXIV	FAMILY: HOLOCENTRIDAE	Squirrelfishes			
48	*Ostichthys acanthorhinus* Randal, Soldier fishShimizu& Yamakava, 1982	08^{0}50.2' 75^{0}56.8'	330	13.5	6.H
SUBORDER:POLYMIXIOIDEI					
XXV	FAMILY: POLYMIXIIDAE	Beardfishes			
49	*Polymixia japonicus* Gunther, 1877	Silver eye	07^{0}08.2' 77^{0}04.8'	226	11.2
50	*Polymixia fusca* Kotthaus, 1970		07^{0}08.2' 77^{0}04.8'	226	10.3
ORDER :ZEIFORMES					
XXVI	FAMILY: ZEIDAE	Dories			
51	*Zenopsis conchifer* (Lowe, 1850)	Silver John dory	09^{0}20.2' 75^{0}44.4'	357	36.1
52	*Cyttopsis roseus* (Lowe, 1843)	Rosy dory	09^{0}20.2' 75^{0}44.4'	357	16.4
ORDER: SYNGNATHIFORMES, SUBORDER: AULOSTOMOIDEI					
XXVII	FAMILY: MACRORAMPHOSIDAE	Snipefishes			
53	Macroramphosus *sp.*		07^{0}08.2' 77^{0}04.8'	226	8.7

Table 1 Continued

(1)	(2)	(3)	(4)	(5)	(6)
SUBORDER: SYNGNATHOIDEI					
XXVIII	FAMILY: SYNGNATHIDAE	Pipefishes			
54	*Syngnathus acus* Linnaeus, 1758	Long snout pipefish	08^{0}50.2' 75^{0}56.8'	330	20.2
ORDER: SCORPAENIFORMES SUBORDER: SCORPAENOIDEI					
XXIX	FAMILY: SCORPAENIDAE	Scorpionfishes			
55	*Setarches quentheri* Johnson, 1862	Deep- water scorpion	08^{0}34.5' 76^{0}13.1'	282	10.2
56					0.6
	Setarches longimanus (Alcock, 1894)		09^{0}15.2' 75^{0}42.6'	369	0.6
57	*Ectreposebastes imus* Garman, 1899	Mid- water scorpion	08^{0}15.7' 76^{0}30.7'	455	11.2
XXX	FAMILY: TRIGLIDAE, SUBFAMILY: TRIGLINAE	Gurnards			
58	*Lepidotrigla* sp.		08^{0}59.6' 75^{0}46.3'	330	13.5
59	*Pterygotrigla hemisticta* (Temminck &Schlegel, 1842)	Black spotted gurnard	08^{0}59.6' 75^{0}46.3'	330	15.1
	SUBFAMILY: PERISTEDIINAE	Armoured gurnards			
60	*Satyrichthys adeni* (Lloyd, 1907)		08^{0}34.5' 76^{0}13.1'	282	29.9
61	*Satyrichthys* sp.		09^{0}15.2' 75^{0}42.6'	369	22.0
62	*Peristedion investigatoris* (Alcock, 1898)		09^{0}15.2' 75^{0}42.6'	369	12.4
63	*Peristedion halyi* (Day, 1888)		08^{0}34.5' 76^{0}13.1'	282	7.9
ORDER: PERCIFORMES, SUBORDER: PERCOIDEI					
XXXI	FAMILY: PERCICHTHYIDAE	Acropomatids			
64	*Acropoma japonicum* Gunther, 1859	Glowbelly	08^{0}59.6' 75^{0}46.3'	334	14.7
65	*Synagrops japonicus* (D'Oderelein, 1884)	Japanese splitfin	08^{0}06.8' 76^{0}39.9'	461	15.2
66	*Synagrops pellucidus* (Alcock, 1889)		07^{0}08.2' 77^{0}04.8'	226	10.2
67	*Neoscombrops annectens* Gilchrist, 1922	Scomber splitfin	08^{0}59.6' 75^{0}46.3'	334	12.3
XXXII	FAMILY: SERRANIDAE	Rock cods			
68	*Chelidoperca investigatoris* (Alcock, 1895)		07^{0}08.2' 77^{0}04.8'	226	11.2
XXXII	FAMILY:OSTRACOBERYCIDAE	shellskin alfonsinos			
69	*Ostracoberyx dorygenys* Fowler, 1934		08^{0}59.6' 75^{0}46.3'	330	8.7
XXXIV	FAMILY: EMMELICHTHYIDAE	Rovers			
70	*Emmelichthys nitidus*	Bonnet- mouth	08^{0}50.2' 75^{0}56.8'	330	20.5
XXXV	FAMILY: BATHYCLUPEIDAE	Bathyclupeids			
71	*Bathyclupea hoskynii* (Alcock, 1899)		09^{0}20.2' 75^{0}44.4'	357	12.9

Table 1 Continued

(1)	(2)	(3)	(4)	(5)	(6)
XXXVI	FAMILY: OWSTONIIDAE				
72	*Owstonia totomiensis* Taneka, 1908		07^{0}08.2' 77^{0}04.8'	226	36.8
XXXVII	FAMILY: CEPOLIDAE	Bandfishes			
73	*Acanthocepola limbata* (Valenciennes, 1835)	Bandfish	07^{0}33.8' 76^{0}50.3'	121	57.2
SUBORDER: TRACHINOIDEI					
XXXVIII	FAMILY:CHAMPSODONTIDAE	Gapers			
74	*Champsodon vorax* Gunther, 1867		08^{0}59.6' 75^{0}46.3'	330	5.9
XXXIX	FAMILY: URANOSCOPIDAE	Stargazers			
75	*Ichthyoscopus inermis* (Cuvier, 1829)		07^{0}33.8' 76^{0}50.3'	121	24.3
76	*Uranoscopus* sp.	Stargazer	07^{0}33.8' 76^{0}50.3'	121	19.7
77	*Xenocephalus elongatus elongates* (Temminck &Schlegel, 1843)		07^{0}08.8' 77^{0}04.3'	226	27.2
Xl	FAMILY: PERCOPHIDAE	Duckbills			
78	*Bemprops caudimacula* Steindachner, 1877		09^{0}20.2' 75^{0}44.4'	357	15.2
XLI	FAMILY: MUGILOIDIDAE	Sandsmelts			
79	*Parapercis* sp.		07^{0}08.2' 77^{0}04.8'	226	20.1
SUBORDER: CALLIONYMOIDEI					
XLII	FAMILY: CALLYONYMIDAE	Dragonets			
80	*Callionymus carebares* Alcock, 1890	Deep- water dragonet	09^{0}19.2' 75^{0}49.7'	249	12.8
SUBORDER :GOBIOIDEI					
XLIII	FAMILY: GOBIIDAE	Gobies			
81	*Gobius cometes* Alcock, 1899		08^{0}34.5' 76^{0}13.1'	282	10.1
SUBORDER: SCOMBROIDEI					
XLIV	FAMILY: GEMPYLIDAE	Snake mackerels			
82	Neoepinnula orientalis Sackfish(Gilchrist & Von Bonde, 1924)		09^{0}20.2' 75^{0}44.4'	357	17.4
83	*Ruvettus pretiosus* (Cocco, 1833)	Oilfish	09^{0}11.5' 75^{0}48.4'	372	33.9
84	*Promethichthys prometheus* (Cuvier, 1832)	Promethean escolar	09^{0}20.2' 75^{0}44.4'	357	16.8
	Rexea prometheoides (Bleeker, 1856)	Royal escolar	08^{0}14.2' 76^{0}32.2'	435	17.3
XLV	FAMILY: TRICHIURIDAE	Ribbon fishes			
86	*Benthodesmus elongatus* (Clarke, 1879)	Elongate frost fish	09^{0}15.2' 75^{0}42.6'	369	33.1
87	*Benthodesmus tenuis* (Gunther, 1877)	Slender frost fish	08^{0}43.2' 75^{0}58.4'	401	54.8
88	*Benthodesmus tuckeri* Parin & Becker, 1970	Tucker's frost fish	08^{0}43.2' 75^{0}58.4'	401	53.8

Table 1 Continued

(1)	(2)	(3)	(4)	(5)	(6)
89	*Trichiurus auriga* Klunzinger, 1884	Pearly hair tail	08^{0}06.8' 76^{0}39.9'	461	30.1
XLVI	FAMILY: CENTROLOPHIDAE	Ruffs /Medusafishes			
90	*Psenopsis cyanea* (Alcock, 1890)	Indian ruff	09^{0}20.2' 75^{0}44.4'	357	19.2
XLVII	FAMILY: NOMEIDAE	Drift fishes			
91	*Psenes squamiceps* (Lloyd, 1909)	Indian driftfish	08^{0}59.6' 75^{0}46.3'	334	18.1
XLVIII	FAMILY: ARIOMMATIDAE	Ariommatids			
92	*Ariomma indica (Day, 1870)*	Indian ariomma	07^{0}33.8' 76^{0}50.3'	121	14.6
ORDER: PLEURONECTIFORMES, SUBORDER: PLEURONECTOIDEI,					
XLIX	FAMILY: BOTHIDAE	Lefteye flounders			
93	*Citharichthys* sp.		09^{0}20.2' 75^{0}44.4'	357	14.9
94	*Chascanopsetta lugubris* Alcock, 1899	Pelican flounder	09^{0}15.2' 75^{0}42.6'	369	25.7
95	*Laeops macrophthalmus* (Alcock, 1889)		09^{0}11.5' 75^{0}48.4'	372	14.0
SUBORDER :SOLEOIDEI					
L	FAMILY: CYNOGLOSSIDAE	Tongue soles	08^{0}34.5' 76^{0}13.1'	282	9.7
96	*Symphurus* sp.				
ORDER: TETRAODONTIFORMES, SUBORDER :BALISTOIDEI					
LI	FAMILY: BALISTIDAE	Triggerfishes			
	SUBFAMILY:MONOCANTHINAE	Filefishes			
97	*Alutera scripta* Berry & Vogele, 1961	Scrawled filefish	08^{0}14.2' 76^{0}32.2'	435	45.4
SUBORDER: TETRAODONTOIDEI					
LII	FAMILY: TETRAODONTIDAE	Puffers			
98	*Amblyrhynchotes spinosissimus* (Regan, 1908)	Spiny blassops	07^{0}33.8' 76^{0}50.3'	121	12.0

In addition to the above, conventional finfishes like *Nemipterus* spp., *Saurida* spp., and *Priacanthus* spp. were also recorded from the 100 to 200 m depth zone. Latitude-wise species richness (S), Shannon's diversity index (H) and Shannon's equitability (E_H) and the Biomass estimated for selected species/groups (Sajeevan and Nair 2006) are furnished in Table 2.

Table 2. Latitudinal wise species diversity of nonconventional fin fishes off the S.W. Coast of India (7^0- 10^0N lat.) between 100 and 500 m depth.

Parameters	Lat. 7^0N-8^0N	Lat. 8^0N-9^0N	Lat. 9^0N-10^0N	Lat. 7^0N-10^0N
Species richness (S)	66	95	82	98
Shannon's diversity index (H)	1.429	1.662	2.493	1.957
Shannon's equitability (E_H)	0.341	0.366	0.564	0.427
Biomass (B) in tonnnes	52504.77	38219.04	7718.35	98442.16

Discussion

Global fish fauna comprise over 25000 species and of these10 to15% are found in the deep-sea environment. According to Cohen (1970) 1010 deep demersal fish and 1280 deep pelagic species are represented in the world ocean. Myers (1940) observed that Indo-Pacific fish fauna is the richest among the four tropical fish fauna. This is evident from the richness of the inshore fish fauna of the area. But only very little knowledge is available regarding the diversity of offshore fishes. Joseph and John (1986) reported that in contrast to the inshore region, the offshore region is poor in diversity represented by only a few species. Results of the present study, which recorded 98 species of non-conventional finfishes belonging to 16 orders, point out the richness of the offshore finfish diversity. This richness of the fauna becomes more clear when we consider the fact that there are only 22 orders of deep demersal fish fauna distributed all over the world (Helfman et al. 2003). As seen in Table 2, Lat. 8^0N to 9^0N dominates in species richness, but Lat. 9^0N to 10^0N dominates in the diversity and evenness. Diversity and biomass of non-conventional finfishes off the south west coast of India shows an inverse relationship. Diversity increases towards the northern latitudes but biomass decreases. Abundance of pearly hair tail *Trichiurus auriga,* Trichiuridae and Indian ruff *Psenopsis cyanea,* Centrolophidae in southern latitude may be a reason for the above phenomena.

A comparative statement of the number of deep-sea species recorded by different authors from the Indian region is furnished in the Table 3.

Oommen (1980) reported 63 species of fishes from the deep waters of the Quilon Bank. Bottom trawls were used for the above survey. Balachandran and Nizar (1990) reported 87 species of nonconventional finfishes from the Indian EEZ. Both bottom and pelagic trawls were used for this study. Khan et al. (1996) reported 34 species from the southeastern Arabian Sea. Demersal trawl nets were used for the above survey.

Table 3. Comparative statement of number of species of nonconventional deep-sea fin fishes recorded by different authors.

Authors	Area	Depth (m)	Number of species reported	Remarks
Oommen, 1980	QuilonBank (8^0-9^0N lat.)	175-370	63	Include 5 species of Elasmobranchs
Balachandran and Nizar, 1990	Indian EEZ	100-4524	87	Include both pelagic demersal deep-sea finfishes
Khan et al. 1996	South-eastern Arabian Sea (8^0-13^0N lat.)	170-777	34	Demersal fin fishes
Venu and Kurup, 2002a	West coast of India (7^0-21^0N lat.)	201-750	23	Demersal fin fishes
Present study	South-west coast of India (7-10^0 N lat.)	100-500	98	Non-conventional demersal fin fishes

Venu and Kurup (2002) reported 23 species from the west coast of India. Bottom trawl nets were used for the survey. Major objective of all the above surveys was the study of distribution and abundance of the deep-sea finfish resources. Perhaps not much attention was paid to study the species diversity. The total number of 151 species were recorded by the above surveys from waters deeper than 100 m. Out of the 98 species of nonconventional fin fishes recorded during the present study, 56 species were not reported by the above authors. So the total number of nonconventional finfish species from the deeper waters of the Indian EEZ comes to 207. Alcock (1899) reported 169 deep-sea finfish species from the continental slopes of the Indian Ocean. Certainly there could be many more species that have not been represented in the samples or have been overlooked. An exhaustive search in http://www.fishbase.org, regarding the country-wise occurrence of deep-sea fishes show that out of the 98 species recorded during the present study, 30 species are not reported from the Indian EEZ by any of the previous authors.

Conclusion

The annual marine fish production in India remained static since 1997 when the production reached 2.97 million tonnes (CMFRI 2006). Further improvement in the landings can only be possible by targeting the harvest of under and unexploited resources

especially in depths beyond 100 m. The present study confirms the richness of diversity and abundance of deep-sea nonconventional fin fishes off the south west coast of India (7^0-10^0N lat.). Since the present study cannot be considered as an exhaustive effort to understand the species diversity of deep-sea teleost fishes, further surveys using different types of gears, covering the entire Indian EEZ are needed. In future fishery surveys, emphasis must be given to exhaustive species-diversity assessment and also to make available properly preserved materials to facilitate the barcoding of the different species.

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