



DIVERSITY OF MARINE ORNAMENTAL FISHES ASSOCIATED WITH TRAWL BY-CATCH LANDINGS IN NEENDAKARA FISHING HARBOUR, KERALA

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Abstract: Though the technology for the breeding and rearing of marine ornamental fishes has been developed for many species, collection of marine ornamental fish from the feral ecosystems, especially from the fragile coral reef ecosystems, continues unabated due to increased demand from the trade market. Many species with potential ornamental value are being discarded through trawl by-catch. Records on the ornamental fish diversity in the trawl by-catch are scanty. Taxonomic survey conducted to record the diversity of ornamental fishes in the trawl by-catch of the Neendakara fishing harbour of Kerala documented the presence of 138 species belonging to 14 orders 67 families and 108 genera. Most of the fishes comes under the order Perciformes (77 species), followed by Tetraodontiformes (21 species) and Scorpaeniformes (17 species). Species-rich fish families were Scorpaenidae (9 species), Serranidae (7 species) and Tetraodontidae (7 species). Breeding and seed production technologies have been developed for many species under families Pomacentridae, Lutjanidae and Serranidae. The discards include many species such as damselfishes, marine angel fishes, surgeonfishes, butterfly fishes and wrasses with great demand in the global ornamental fish market. These resources were discarded in the harbour due to low consumer acceptance as food fish. This paper discuss the need to develop technologies for keeping the highly priced ornamental fishes alive onboard for meeting the demand for ornamental fish, which will also supplement the income of the fishermen.

Key words: Aquarium Fish, By-Catch, Fish Diversity

INTRODUCTION

Many aquatic organisms including species with potential ornamental value are being discarded through trawl by-catches all over the world. These discards have received a great deal of scientific attention and their minimization being a goal of marine fisheries management. FAO discard database estimate annual average discards as 7.3 million tons (mt); contribution of Indian Ocean accounts for about 9% (Pillai *et al.*, 2009). The annual landing of the by-catch in the country is estimated to be around 1.3 mt (Chandrapal, 2005). Pramod (2010) recently estimated the bycatch of Indian trawlers as 1.2 mt. According to Kurup *et al.* (2003) the quantity of discards of bottom trawlers in Kerala during 2000-'01 and 2001-'02 were 2.62 and 2.25 lakh tonnes respectively. Biju Kumar and Deepthi (2009) reported on the fish

diversity and mean trophic index of fish fauna associated with trawl by-catch of Kerala coast. Sajeevan and Somavanshi (2013) collected 66 species of marine ornamental fish from the trawl fishery of west coast of India.

The growing popularity of marine aquarium made the marine ornamental fishes very popular in all parts of the world and the trade of marine ornamental fishes in the international market is a multimillion dollar industry. A total of 1,471 species of fishes are being traded worldwide with the best estimate of annual global trade ranging between 20 and 24 million individuals (Wabnitz *et al.*, 2003). The high demand for these resources increased the pressure on fragile coral reef ecosystems which support most of the marine ornamental species. On the other hand,

many valuable resources are being discarded along with trawl by-catches from different parts of the world.

Most of the taxonomic studies on marine ornamental fishes in India are from coral reef ecosystems (Ajithkumar *et al.*, 2007; Ahilan and Walkhom, 2007; Rao *et al.*, 2004; Chogale and Bhatkar, 2006; 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 by Sureshkumar *et al.* (2004). They reported 40 species of marine ornamental fishes belonging to 22 families from the trawl by-catches of Ponnani fishing harbour, north Kerala. This paper record the marine ornamental fish diversity associated with the by-catch of trawlers operating from Neendakara fishing harbour, Kerala.

MATERIAL AND METHODS

Ornamental fishes from the trawl by-catch landings were collected from Neendakara fishing harbour (08°56' 15.30" N., 76° 32' 20.23" E.), the largest fishing harbour of Kerala, during October 2008 to September 2011. The fresh specimens collected were cleaned, washed and preserved in 10% formaldehyde after noting the colouration and measuring the length and weight. Each specimen was identified up to species level using text books, monographs, reprints and online databases (Day, 1875; 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). The species collected were categorized as ornamental fish by following Burgess *et al.* (1990).

RESULTS AND DISCUSSION

The survey revealed presence of 138 species of ornamental fishes belonging to 14 orders 67 families and 108 genera (Table 1). Most of the fishes comes under the order Perciformes (77 species), followed by Tetraodontiformes (21 species) and Scorpaeniformes (17 species). Species-rich fish families were Scorpaenidae (9 species), Serranidae (7 species) and Tetraodontidae (7 species). The groupers, cardinal fishes and snappers under the genera

Epinephelus, *Apogon* and *Lutjanus* respectively represented the most diverse ornamental fish genera with five species each, followed by genus *Minous* with three species.

The higher diversity of ornamental fishes in trawl by-catch reveals that the coastal areas along Kerala coast harbours high diversity of ornamental fishes. Marine ornamental fishes along the west coast of India are distributed up to a depth of over 400 metres (Raja, 2006). Most of these resources are not currently utilized for the purpose of aquarium keeping. A variety of ornamental fishes caught during trawling are discarded due to lack of infrastructure for keeping them alive onboard and lack of awareness among the fisherman about their potential and the absence of a marketing system for these fishes at fishing harbours (Sureshkumar *et al.*, 2004).

Dawes (2002) highlighted that the ornamental marine fish harvest (70-100 tonnes) represented a maximum of one millionth (0.00007-0.0001%) of the food fish harvest (100 million tonnes) and that even the by-catch (17 million tonnes) produced by the food fish trade was greater than the harvest for marine ornamentals (representing 0.0004-0.0006%). The problem of by-catch is much more pronounced in the case of trawling because of the colossal amounts of biodiversity associated with it and the extent of damage it caused to the ecosystem in general (Bijukumar and Deepthi, 2006). Recently, due to heavy demand for food fish and high cost, some of the species in the by-catch are being used for human consumption, fetching about 30-45/- per kg (Pillai *et al.*, 2009). If technologies are developed and standardized for keeping the highly priced ornamental fishes alive onboard and bring it to the suitable markets, this will help partially meeting the demand of ornamental fish.

Even though there is no record on stock depletion of any species of marine ornamental species in India, such chances cannot be ruled out in the context of developing trade. This demands the need for developing technologies for the sustainable utilization of these resources. Further, there is a need to conduct nationwide exploratory surveys of marine ornamental fish

Table 1. Classified list of marine ornamental fishes associated with trawl by-catch landings in Neendakara fishing harbour, Kerala

Sl. No.	Species	Common name	Abundance
1.	Phylum: Chordata	Grey bamboo shark	15
	Subphylum: Vertebrata		
	Class: Chondrichthyes		
	Subclass: Elasmobranchii		
	Order: Orectolobiformes		
	Family: Hemiscyllidae (Bamboo sharks) <i>Chiloscyllum griseum</i> Müller & Henle, 1838		
2.	Order: Rajiformes	Black spotted numb fish	12
	Family: Torpedinidae <i>Narcine timlei</i> (Bloch & Schneider, 1801)		
3.	Class: Actinopterygii	Tiger moray	36
	Subclass: Neopterygii		
	Order: Anguilliformes Family: Muraenidae (Moray eels) <i>Gymnothorax reticularis</i> Bloch, 1795		
4.	<i>Strophiodon sathete</i> (Hamilton, 1822)	Slender giant moray	4
5.	Family: Ophichthyidae (Snake eels)	Oriental sand-eel	5
	<i>Lamnostoma orientalis</i> (McClelland, 1844)		
6.	Family: Congridae (Conger and garden eels)	Long fin African conger	6
	<i>Conger cinereus</i> Rüppell, 1830		
7.	<i>Uroconger lepturus</i> (Richardson, 1845)	Yellow pike-conger	6
8.	Order: Clupeiformes	Chacunda gizzard shad	3
	Family: Dorosomidae <i>Anodontostoma chacunda</i> (Hamilton, 1822)		
9.	Order: Siluriformes	Striped eel catfish	9
	Family: Plotosidae <i>Plotosus lineatus</i> (Thunberg, 1787)		
10.	Order: Batrachoidiformes	Flat toadfish	5
	Family: Batrachoididae <i>Colletteichthys dussumieri</i> (Valenciennes, 1837)		
11.	Order: Lophiiformes	Smooth angler	16
	Family: Lophiidae <i>Lophiodes mutilus</i> (Alcock, 1894)		
12.	Family: Antennariidae	Scarlet frog fish	24
	<i>Antennarius nummifer</i> (Lesson, 1831)		
13.	<i>Antennarius striatus</i> (Shaw, 1794)	Striated frog fish	6
14.	Family: Ogcocephalidae	Batfish	8
	<i>Halieutaea stellata</i> (Vahl, 1797)		
15.	Order: Bericyformes	Darwin's slime head	2
	Family: Trachichthyidae <i>Gephyroberyx darwini</i> (Johnson, 1866)		

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16.	Family: Holocentridae (Squirrel fishes) <i>Sargacentron rubrum</i> (Forskål, 1775)	Russet squirrel fish, Red soldier fish	7
17.	<i>Myripristis murdjan</i> (Forsskål, 1775)	Pinecone soldier fish	19
18.	Order: Zeiformes Family: Parazenidae <i>Cyttopsis rosea</i> (Lowe, 1843)	Rosy dory	1
19.	Order: Syngnathiformes Family: Syngnathidae <i>Hippocampus trimaculatus</i> Leach, 1814	Long-nose seahorse	3
20.	Order: Scorpaeniformes Family: Dactylopteridae (Flying gurnards) <i>Dactyloptena orientalis</i> (Cuvier, 1829)	Oriental flying gurnard	37
21.	Family: Scorpaenidae (Scorpion fishes or rock fishes) <i>Brachypterois serrulata</i> (Richardson, 1846)	Saw-cheek scorpion fish	39
22.	<i>Parapterois macrura</i> Alcock, 1896	Blackfoot fire fish	9
23.	<i>Pterois miles</i> (Bennett, 1828)	Devil fire fish	48
24.	<i>Pterois volitans</i> (Linnaeus, 1758)	Winged fire fish	7
25.	<i>Minous dempsterae</i> Eschmeyer, Hallacher & Rama-Rao, 1979*	Oblique-banded sting fish	59
26.	<i>Minous inermis</i> Alcock, 1889	Alcock's scorpion fish	34
27.	<i>Minous monodactylus</i> (Bloch & Schneider, 1801)	Grey goblin fish	65
28.	<i>Scorpaenanopsis papuensis</i> (Cuvier, 1829)	Papuan scorpion fish	5
29.	<i>Sebastapistes mauritiana</i> (Cuvier, 1829)	Spine blotch scorpion	11
30.	Family: Apistidae <i>Apistus carinatus</i> (Bloch & Schneider, 1801)	Ocellated wasp fish	9
31.	Family: Triglidae (Sea robins) <i>Lepiditrigla longipinnis</i> Alcock, 1890	-	50
32.	<i>Pterygotrigla (Otohime) arabica</i> (Boulenger, 1888)	Black spotted gurnard	20
33.	Family: Peristediidae <i>Satyrichthys adeni</i> (Lloyd, 1907)	-	14
34.	Family: Synanceiidae <i>Choridactylus multibarbus</i> Richardson, 1848	Orange banded sting fish	18
35.	Family: Tetrarogidae <i>Richardsonichthys leucogaster</i> (Richardson, 1848)	Whiteface wasp fish	2
36.	Family: Setarchidae <i>Setarches guentheri</i> Johnson, 1862	Channeled rock fish	11
37.	Order: Perciformes Family: Ambassidae (Asiatic glassfishes) <i>Ambassis ambassis</i> (Lacepède, 1802)	Indian glass fish	11
38.	Family: Serranidae <i>Epinephelus areolatus</i> (Forsskål, 1775)	Areolate grouper	6
39.	<i>Epinephelus diacanthus</i> (Valenciennes, 1828)	Six barred reef cod	63
40.	<i>Epinephelus epistictus</i> (Temminck & Schlegel, 1842)	Dotted grouper	5

41.	<i>Epinephelus malabaricus</i> (Bloch & Schneider, 1801)	Malabar grouper	7
42.	<i>Epinephelus merra</i> (Bloch, 1793)	Wire-netting reef-cod	6
43.	<i>Pseudanthias fasciatus</i> (Kamohara, 1954)	One-stripe anthias	1
44.	<i>Pseudanthias marcia</i> Randall & Hoover, 1993	Yellow striped fairy basslet	3
45.	Family: Priacanthidae (Big eyes or catalufas) <i>Priacanthus hamrur</i> (Forskål, 1775)	Moon-tail bulls-eye, Crescent tail big eye	26
46.	<i>Pristigenys niphonia</i> (Cuvier, 1829)	Japanese bigeye	1
47.	Family : Apogonidae (Cardinal fishes) <i>Apogon aureus</i> (Lacepede, 1802)	Ring-tailed cardinal fish	31
48.	<i>Apogon fasciatus</i> (White, 1790)	Two-stripe cardinal	3
49.	<i>Apogon multitaeniatus</i> Cuvier, 1828	Small-scale cardinal	1
50.	<i>Apogon quadrifasciatus</i> Cuvier, 1828	Seven banded cardinal	79
51.	<i>Apogon oxina</i> Fraser, 1999	-	3
52.	Family : Echeiidae (Sucker Fish) <i>Echeiis naucrates</i> Linnaeus, 1758	Shark sucker	5
53.	Family : Carangidae (Jacks, King Fishes) <i>Alectis ciliaris</i> (Bloch, 1787)	African pompano	7
54.	<i>Carangoides ferdau</i> (Forsdål, 1775)	Blue king fish	6
55.	<i>Carangoides malabaricus</i> (Bloch & Schneider, 1801)	Malabar trevally	2
56.	<i>Gnathanodon speciosus</i> (Forsskål, 1775)	Golden trevally	15
57.	<i>Uraspis helvola</i> (Forster, 1801)	-	1
58.	Family: Menidae <i>Mene maculata</i> (Bloch & Schneider, 1801)	Moon fish	8
59.	Family: Leiognathidae (Slimys, slipmouths, or ponyfishes) <i>Gazza minuta</i> (Bloch, 1795)	Tooth pony	6
60.	<i>Leiognathus daura</i> (Cuvier, 1829)	Gold striped pony fish	9
61.	<i>Secutor insidiator</i> (Bloch, 1787)	Pug-nose pony fish	25
62.	Family: Lutjanidae <i>Lutjanus erythropterus</i> Bloch, 1790	Crimson snapper	4
63.	<i>Lutjanus fulvus</i> (Forster, 1801)	Blacktail snapper	3
64.	<i>Lutjanus lutjanus</i> Bloch, 1790	Bigeye snapper	10
65.	<i>Lutjanus quinquelineatus</i> (Bloch, 1790)	Five-lined snapper	6
66.	<i>Lutjanus russelli</i> (Bleeker, 1849)	One spot snapper	10
67.	Family: Gerreidae <i>Gerres filamentosus</i> Cuvier, 1829	Whip-fin silver-biddy	13
68.	Family: Haemulidae <i>Pomadourys maculatum</i> (Bloch, 1797)	Saddle grunt	43
69.	<i>Spilotichthys pictus</i> (Thunberg, 1792)	Painted sweet lip	46
70.	Family: Nemipteridae (Threadfin breams, Whiptail breams) <i>Nemipterus japonicus</i> (Bloch, 1791)	Japanese thread fin bream	22
71.	<i>Parascolopsis aspinosa</i> (Rao & Rao, 1981)	Monocle bream	14
72.	<i>Scolopsis vosmeri</i> (Bloch, 1792)	Silver-flash spine cheek	14
73.	Family: Polynemidae (Threadfins) <i>Filimanus heptadactyla</i> (Cuvier, 1829)	Seven finger threadfin	1

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74.	<i>Polydactylus sextarius</i> (Bloch & Schneider, 1801)	Black spot threadfin	2
75.	Family: Mullidae (Goat fishes) <i>Mulloidichthys flavolineatus</i> (Lacepède, 1801)	Yellow stripe goat-fish	16
76.	<i>Parupeneus indicus</i> (Shaw, 1803)	Indian goat-fish	6
77.	<i>Upeneus japonicus</i> (Houttuyn, 1782)	Yellow fin goat-fish	8
78.	<i>Upeneus vittatus</i> (Forsskål, 1775)	Yellow striped goat-fish	8
79.	Family: Pempheridae (Sweepers) <i>Pempheris mangula</i> (Cuvier, 1829)	Black-edged sweeper,	8
80.	<i>Pempheris molucca</i> Cuvier, 1829	Moluccan sweeper	1
81.	Family : Drepanidae (Spotted Bat fish, Sickle fish) <i>Drepane punctata</i> (Linnaeus, 1758)	Spotted sickle fish	12
82.	Family: Chaetodontidae <i>Chaetodon collare</i> (Bloch, 1787)	Redtail butterfly fish, Pakistani butterfly	55
83.	<i>Chaetodon decussatus</i> Cuvier, 1829	Indian vagabond butterfly fish	4
84.	<i>Heniochus acuminatus</i> (Linnaeus, 1758)	Pennet coral fish	11
85.	<i>Roa jayakari</i> (Norman, 1939)	Golden-barred butterfly	5
86.	Family: Pomacanthidae (Angel fishes) <i>Apothemichthys xanthurus</i> (Bennett, 1833)	Yellow tail angelfish	4
87.	Family: Pentacerotidae (Armor heads) <i>Histioporus typus</i> Temminck & Schlegel, 1844	Sailfin armour head	6
88.	Family: Therapontidae (Grunters or tiger perches) <i>Pelates quadrilineatus</i> (Bloch, 1790)	Four-lined terapon	3
89.	<i>Therapon jarbua</i> (Forskål, 1775)	Crescent Perch	43
90.	<i>Therapon puta</i> Cuvier, 1829	Small-scaled terapon	16
91.	<i>Therapon theraps</i> (Cuvier, 1829)	Large scale-terapon	63
92.	Family: Cepolidae (Band fishes) <i>Acanthocephala limbata</i> (Valenciennes, 1835)	Black spot band-fish	7
93.	<i>Owstonia weberi</i> (Gilchrist, 1922)	-	2
94.	Family: Pomacentridae (Damsel fishes) <i>Abudefduf saxatilis</i> (Linnaeus, 1758)	Sergeant major, Waigen demoiselle	26
95.	<i>Abudefduf sordidus</i> (Forsskål, 1775)	Black spot sergeant	8
96.	<i>Neopomacentrus violascens</i> (Bleeker, 1848)	Violet demoiselle	79
97.	<i>Pomacentrus caeruleus</i> Quoy & Gaimard, 1825	Caerulean damsel	24
98.	Family : Labridae <i>Iniistius cyanifrons</i> (Valenciennes, 1840)	Razor fish	1
99.	<i>Xyrichtys bimaculatus</i> Rüppell, 1829	Two-spot razor fish	13
100.	Family: Pinguipedidae (Sandperches) <i>Parapercis punctata</i> (Cuvier, 1829)	-	3
101.	Family: Uranoscopidae (stargazers) <i>Uranoscopus gattatus</i> Cuvier, 1829	Oranoos-mahi	28
102.	Family : Gobiidae <i>Trypauchen vagina</i> (Bloch & Schneider, 1801)	-	10

103.	Family: Ephippidae (Bat fishes) <i>Platax orbicularis</i> (Forsskål, 1775)	Orbicular bat fish	5
104.	Family: Scatophagidae (Scats) <i>Scatophagus argus</i> (Linnaeus, 1766)	Spotted scat, Scat. Spotted butterfish	15
105.	Family : Siganidae (Rabbit fishes) <i>Siganus canaliculatus</i> (Park, 1797)	White-spotted spine-foot	3
106.	<i>Siganus javus</i> (Linnaeus, 1766)	Streaked spinefoot	20
107.	<i>Siganus sutor</i> (Valenciennes, 1835)	White spotted rabbit	27
108.	Family: Zanclidae (Moorish idol) <i>Zanclus cornutus</i> (Linnaeus, 1758)	Moorish idol	11
109.	Family : Acanthuridae <i>Acanthurus nigrofuscus</i> (Forsskal, 1775)	White tailed surgeon fish	35
110.	<i>Naso lituratus</i> (Forster, 1801)	Orange spine unicorn	2
111.	Family: Sphyrnidae (Barracudas) <i>Sphyrna barracuda</i> (Edwards, 1771)	Great barracuda	7
112.	Family: Stromateidae <i>Pampus argenteus</i> (Euphrasen, 1788)	Silver pomfret	2
113.	Family: Caproidae <i>Antigonia rubescens</i> (Günther, 1860)	Indo-Pacific boarfish	3
114.	Order : Pleuronectiformes Family: Bothidae (Lefteye flounders) <i>Laeops nigromaculatus</i> (Cuvier, 1829)	Seven-finger thread fish	4
115.	Family: Paralichthyidae (Large-tooth flounders) <i>Pseudorhombus arsius</i> (Hamilton, 1822)	Large tooth flounder	15
116.	Family: Soleidae (Soles) <i>Synaptura commersonii</i> (Lacepède, 1802)	Commerson's sole	11
117.	<i>Zebrias synapturoides</i> (Jenkins, 1910)	-	11
118.	Order : Tetrodontiformes Family : Triacanthodidae (Triple spines) <i>Macrorhamphosodes platycheilus</i> Fowler, 1934	Trumpet snout spike fish	6
119.	<i>Paratriacanthodes retrospinis</i> Fowler, 1934	Saw spine spike fish	2
120.	Family : Triacanthidae <i>Pseudotriacanthus strigilifer</i> (Cantor, 1849)	Long-spined tripod fish	1
121.	<i>Triacanthus biaculeatus</i> (Bloch, 1786)	Short-nosed tripod fish	18
122.	Family: Balistidae (Trigger fishes) <i>Abalistes stellatus</i> (Lacepède, 1798)	-	20
123.	<i>Odonus niger</i> (Rüppell, 1836)	Red-toothed trigger fish, Trigger fish	31
124.	<i>Pseudobalistes flavimarginatus</i> (Rüppell, 1829)	Yellow margin trigger fish	9
125.	<i>Sufflamen fraenatus</i> (Latreille, 1804)	Masked trigger fish, Marked file fish	29
126.	Family : Monacanthidae <i>Aluterus monocerus</i> (Linnaeus, 1758)	Unicorn leather jacket	8
127.	<i>Paramonacanthus frenatus</i> (Peters, 1855)	Wedge tail file fish	1
128.	<i>Paramonacanthus pusillus</i> (Rüppell, 1829)	-	63

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129.	Family : Ostraciidae <i>Tetrosomus gibbosus</i> (Linnaeus, 1758)	Humpback turret fish	9
130.	Family : Tetraodontidae (Puffer fish, Blow fish, Toad fish) <i>Arothron hispidus</i> (Linnaeus, 1758)	White-spotted puffer, White-spotted blassoc	20
131.	<i>Arothron immaculatus</i> (Bloch & Schneider, 1801)	Immaculate puffer, Black edged blassoc	9
132.	<i>Arothron stellatus</i> (Bloch & Schneider, 1801)	Staring blow fish	15
133.	<i>Chelonodon patoca</i> (Hamilton, 1822)	Milk spotted puffer	4
134.	<i>Lagocephalus inermis</i> (Temminck & Schlegel, 1850)	Smooth backed blow fish	45
135.	<i>Lagocephalus lunaris</i> (Bloch & Schneider, 1801)	Green rough backed blow fish	9
136.	<i>Torquigener brevipinnis</i> (Regan, 1903)		7
137.	Family :Diodontidae (Porcupine fishes) <i>Cyclichthys orbicularis</i> (Bloch, 1785)	Bird beak burr fish	10
138.	<i>Diodon hystrix</i> Linnaeus, 1758	Porcupine fish	14

species to know their distribution and population status. By-catch reduction devices should be encouraged to protect the beautiful resources and their habitats. Zero fish nets (nets with extremely small mesh size), which kill even eggs and fish fry and other small organisms should be strictly banned in order to reduce non-target catching of marine ornamental fishes and juveniles.

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