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COASTAL MARINE FISH BIODIVERSITY ALONG THE WESTERN COAST OF INDIA

Robert D. Sluka

Chiltern Gateway Project, A Rocha UK, 18-19 Avenue Rd, Southall, Middlesex UB1 3BL, United Kingdom
bob.sluka@arocha.org

The commercial fish fauna of India has been studied extensively (James et al. 1994, 1996). However, little is known about noncommercial fishes (Kuthalingam et al. 1973, 1979; Sreenivasan & Lazarus 1973; James et al. 1988; Murty 2002). Underwater visual censuses have been reported from Lakshadweep (Anand & Pillai 2002, 2005), the Andaman and Nicobar Islands (Madhu & Madhu 2007; Rajaram & Nedumaran 2009) and from islands off the central western coast states of Goa and Karnataka (Sluka & Lazarus 2004, 2005, 2006, 2009, 2010; Zacharia et al. 2008; Thomas et al. 2011). The present study reports on marine fish biodiversity studies completed on the south-west coast of India. This represents the first report of southwestern Indian fish biodiversity made using underwater visual observations. This report documents 184 species from this coast, 12 of which appear to be new records for India.

Materials and Methods

Data were collected by one observer (RDS) on SCUBA by recording observations on underwater paper and comparing to standard fish identification books (De Bruin et al. 1994; Allen 1997; Kuitert 1998). Observations were made on rocky substrata between Vizhinjam, Kerala State and Muttom, Tamil Nadu State (Image 1), January–

March 2002 (n=7 sites and 30 hours sampling). Similar habitat was examined at Natrani Island, offshore of Murdeshwar, Karnataka State and Grand Island offshore of Panaji, Goa State (Image 1), September–October 2002 (n = all surveys sum to 8 and 13 hours of observation time, respectively, for each of these two sites). The habitat surveyed in Kerala and Tamil Nadu (depth range 3–30 m) was rocky with low coral cover (<1%) (Sluka et al. 2012). The most abundant benthic colonizers were fine turf algae, encrusting sponges, barnacles and mussels. At Muttom, three types of habitats were surveyed and each considered a separate site: (i) shallow (<10m), inshore (<500m from shore), dead coral reef; (ii) offshore rocky islands (15m depth); and (iii) submerged rocky habitat (30m depth). The habitat in western coast off Karnataka and Goa (depth range 2–12 m) was also rocky, but with higher coral cover (15% and 31% for Natrani and Grand Island, respectively). Other abundant benthic colonizers at these two sites were fine turfing algae, encrusting sponges, and polychaetes.

Species lists were developed and then checked for prior occurrences in India using Fishbase (www.fishbase.org) last updated on 26 April 2012. Other literature was also examined for occurrence records, including synonyms (Jones 1969; Murty 1969; Kuthalingam et al. 1973; Jones & Kumaran 1980; Fischer & Bianchi 1984; Murty et al. 1987; Allen 1991; Allen et al. 1998; Rao et al. 2000; Murty 2002; Suresh & Thomas 2007).

Results

A total of 184 species from 41 families were recorded

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in the study. The most speciose family was Serranidae ($S=20$), followed by the Acanthuridae ($S=18$), Labridae ($S=18$), and Pomacentridae ($S=16$) (Table 1). Nocturnal and cryptic families such as the Gobiidae, Blennidae, and Scorpaenidae were present, but not identified till the generic or species level due to difficulties with visual identification. Other habitats such as mangrove forests, sand and mud flats, and deeper rocky reefs should also be surveyed in order to develop complete checklists for this region. Based on Fishbase records and relevant literature, we observed 12 species that were not previously recorded from India (6.5% of all species observed). Twenty two species were recorded in other literature as occurring in India as well as being observed during this study. These should be added to occurrence records in Fishbase. Most of the non-commercial species observed are recorded from the western coast of India for the first time. Previous records of these species in India are usually from the Lakshadweep, or the Andaman and Nicobar Islands.

Discussion

All of the new records came from families of fish that

are small and not usually commercially exploited. The exception being species within the family Acanthuridae which are likely caught artisanally. None of the species within these families have been assessed for their IUCN Red List status (see IUCN 2011). Only a few families of marine fish have been assessed for Red List status. All species of angelfish (Pomacanthidae) observed have been assessed as Least Concern (LC), and also the species of Butterflyfish (Chaetodontidae), with the exception of *Chaetodon andamanensis* which is Data Deficient (DD) (Myers & Pratchett 2010). Fishbase lists this species as occurring in India, Indonesia, and the Maldives. Studies of this species would be of conservation value as there is little data to understand its current conservation status. Both parrotfish (Scaridae) species observed were in the Least Concern category. All wrasses (Labridae) observed were of Least Concern status, with the exception of the Humphead Wrasse *Cheilinus undulatus*, which is listed as Endangered (EN) (Russell 2004). In this study, this species was observed in low numbers (Sluka & Lazarus 2005). In another study, Nair (2004) reports on a specimen landed at Cochin Fisheries Harbour. This species is sought after in the live fish food trade and in

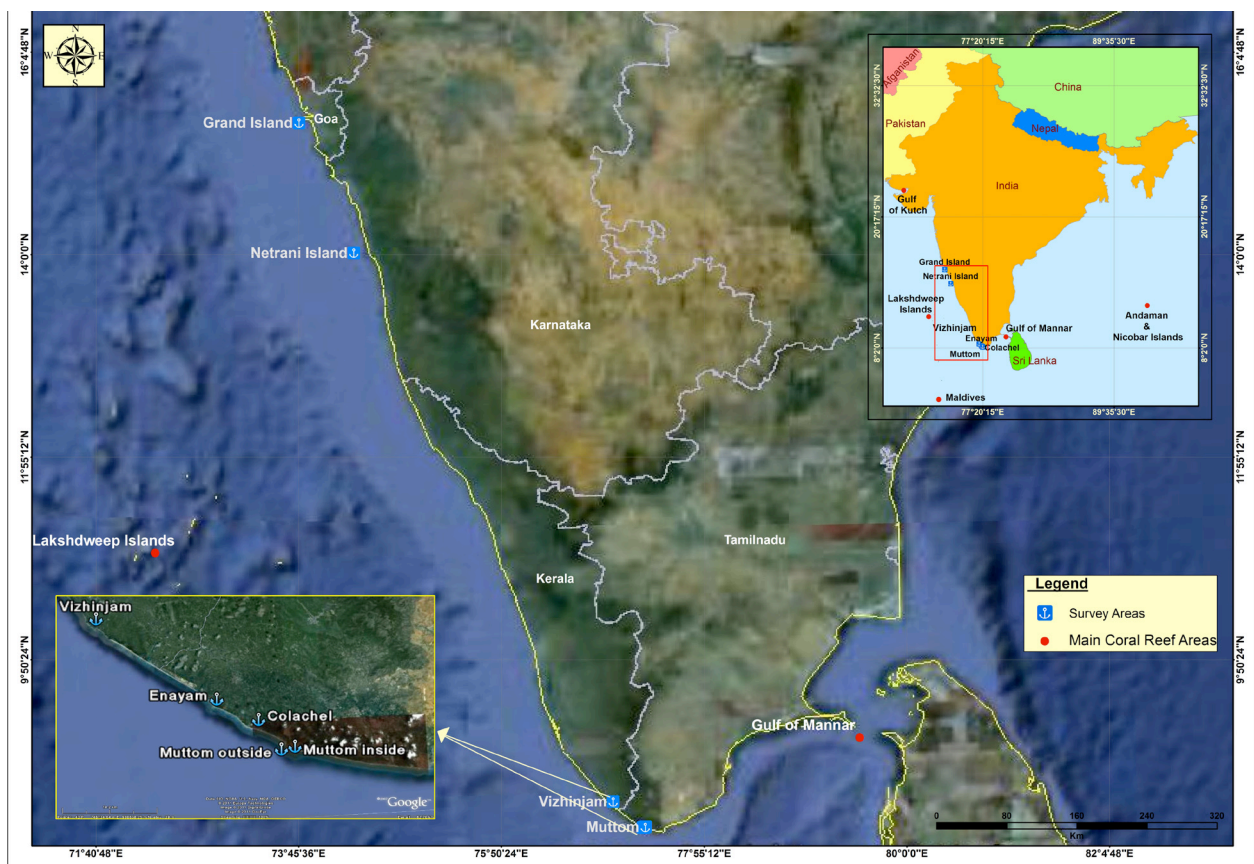


Image 1. Location of study sites along the west coast of India

many locations it is severely overfished. One species of shark *Nebrius ferrugineus* (Tawny Nurse Shark) was observed. This species is Vulnerable in the IUCN Red List (Pillans 2003).

Twenty serranids (Serranidae) were observed, 18 of these assessed for Red List status, with 10 in the LC category. Species that were DD included *Aethaloperca rogaa* (Heemstra et al. 2008a), *Epinephelus erythrurus* (Heemstra et al. 2008b), and *E. faveatus* (Russell et al. 2008). The first species is a widespread Indo-Pacific species, but usually locally not very abundant. It is also not often caught in commercial fisheries. Fishbase states that nothing has been published on the biology of *E. erythrurus* and so this represents an opportunity to remedy its DD status. The distribution of *E. faveatus* is currently only known from southern India, Sri Lanka and Indonesia, so researchers in this area could contribute to a better understanding of its biology. Three species of serranid were Near Threatened (NT): *E. coioides* (Cornish & Harmelin-Vivien 2004), *E. diacanthus* (Sadovy et al. 2008), and *E. malabaricus* (Cornish 2006). The distribution of *E. diacanthus* is restricted to the continental northern Indian Ocean. Effort should be put into understanding fishing pressure on this species and developing conservation measures to halt overfishing. The other two species are large with maximum sizes over 1m and weighing 150kg, and heavily targeted globally for food. Two species observed were listed as Vulnerable (VU): *E. lanceolatus* (Man & Chuen 2006) and *Plectropomus areolatus* (Thierry et al. 2008). Both species are large, with the former reaching 2.7m in length and 400kg. For all grouper species, fishery regulations and implementation of conservation measures, including marine protected areas should be implemented.

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Table 1. Fish species observed in nearshore rocky/coral habitats of western India. An F in the Records column indicates this species recorded as present in India by the Fishbase database (www.fishbase.org) as of 26 April 2012. Other references which establish fish distribution records for India are given below the table. Data with NR in the records column indicate new records for India (n=12). IUCN status is given as LC = Least Concern, DD = Data Deficient, NT = Near Threatened, VU = Vulnerable, EN = Endangered, and NA = Not Assessed.

Species	Record	IUCN	S. India	Netrani	Goa
Ginglymostomatidae					
<i>Nebrius ferrugineus</i>	F	VU			X
Muraenidae					
<i>Gymnomuraena zebra</i>	F	NA	X		
<i>Gymnothorax favagineus</i>	F	NA	X	X	X
<i>G. flavimarginatus</i>	F	NA	X	X	X
<i>G. javanicus</i>	F	NA	X		
<i>G. meleagris</i>	F	NA	X		X
<i>G. pictus</i>	F	NA	X	X	
Holocentridae					
<i>Myripristis botche</i>	F	NA	X		
<i>Sargocentron caudimaculatum</i>	F	NA	X		
<i>S. diadema</i>	F	NA	X		
<i>S. rubrum</i>	F	NA	X	X	X
Fistulariidae					
<i>Fistularia commersonii</i>	6	NA	X		
<i>F. petimba</i>	F	NA	X		
Scorpaenidae					
<i>Pterois miles</i>	2 ^a	NA	X	X	X
<i>P. mombasae</i>	F	NA	X		
Serranidae					
<i>Aethaloperca rogaa</i>	F	DD	X	X	
<i>Cephalopholis argus</i>	F	LC	X	X	
<i>C. formosa</i>	F	LC	X	X	X
<i>C. miniata</i>	F	LC	X		
<i>C. sonnerati</i>	F	LC	X	X	
<i>Diploprion bifasciatum</i>	F	NA	X		
<i>Epinephelus areolatus</i>	F	LC		X	
<i>E. coeruleopunctatus</i>	F	LC	X		
<i>E. coioides</i>	F	NT	X	X	X
<i>E. diacanthus</i>	F	NT	X	X	X
<i>E. erythrus</i>	F	DD	X	X	X
<i>E. fasciatus</i>	F	LC	X		
<i>E. faveatus</i>	F	DD	X		
<i>E. flavocaeruleus</i>	F	LC	X		
<i>E. lanceolatus</i>	F	VU		X	
<i>E. longispinis</i>	F	LC	X	X	
<i>E. malabaricus</i>	F	NT	X	X	
<i>E. tukula</i>	F	LC	X		X
<i>Plectropomus areolatus</i>	F	VU	X		
<i>Pseudanthias squamipinnis</i>	F	NA	X		

Species	Record	IUCN	S. India	Netrani	Goa
Priacanthidae					
<i>Priacanthus hamrur</i>	F	NA	X		
Apogonidae					
<i>Apogon aureus</i>	6	NA	X	X	
<i>A. hyalosoma</i>	6	NA	X		
<i>A. pseudotaeniatus</i>	8	NA	X		
<i>A. thermalis</i>	NR	NA	X		
<i>Rhabdamia gracilis</i>	F	NA	X		
Rachycentridae					
<i>Rachycentron canadum</i>	F	NA		X	
Echeneidae					
<i>Echeneis naucrates</i>	F	NA	X		X
Carangidae					
<i>Caranx heberi</i>	F	NA		X	
<i>C. melampygus</i>	F	NA	X		
<i>Gnathanodon speciosus</i>	F	NA	X		
<i>Trachinotus baillonii</i>	F	NA	X		
Leiognathidae					
<i>Leiognathus splendens</i>	F	NA	X		X
Lutjanidae					
<i>Aprion virescens</i>	F	NA	X		
<i>Lutjanus argentimaculatus</i>	F	NA	X	X	
<i>L. bohar</i>	F	NA	X		
<i>L. decussatus</i>	F	LC	X		
<i>L. fulvus</i>	F	NA	X	X	X
<i>L. gibbus</i>	F	NA	X		
<i>L. kasmira</i>	F	NA	X		
<i>L. lutjanus</i>	F	NA	X	X	
<i>L. madras</i>	F	NA		X	X
<i>L. monostigma</i>	F	NA		X	
<i>L. quinqueleatus</i>	F	NA	X	X	
<i>L. rivulatus</i>	F	NA	X	X	X
<i>L. russelli</i>	F	NA		X	X
<i>L. vitta</i>	F	NA	X	X	X
Caesonidae					
<i>Caesio cuning</i>	F	NA	X	X	X
<i>C. teres</i>	F	NA	X		
<i>C. varilineata</i>	F	NA	X	X	
<i>C. xanthonota</i>	F	NA	X		
<i>Pterocaesio chrysozona</i>	F	NA	X		
<i>P. tile</i>	F	NA	X		
Gerridae					
<i>Gerres erythrourus</i>	F	NA	X		
Haemulidae					
<i>Diagramma pictum cinerascens</i>	F	NA	X		
<i>Plectorhincus schotof</i>	F	NA	X	X	X

Species	Record	IUCN	S. India	Netrani	Goa
<i>Pomadasys furcatum</i>	F	NA	X	X	X
<i>P. gibbosus</i>	F	NA	X	X	X
<i>P. orientalis</i>	6	NA	X		
Sparidae					
<i>Rhabdosargus sarba</i>	F	NA	X		
Lethrinidae					
<i>Lethrinus harak</i>	F	NA	X		
<i>L. nebulosus</i>	F	NA	X		
<i>Monotaxis grandoculis</i>	F	NA	X		
Nemipteridae					
<i>Scolopsis auratus</i>	F	NA	X		
<i>S. vosmeri</i>	F	NA	X	X	X
Mullidae					
<i>Parupeneus barberinus</i>	F	NA	X		
<i>P. cyclostomus</i>	F	NA	X		
<i>P. indicus</i>	F	NA	X	X	X
<i>P. multifasciatus</i>	F	NA	X		
<i>Upeneus vittatus</i>	F	NA	X		
Pempheridae					
<i>Pempheris schwenkii</i>	NR	NA		X	X
<i>P. vanicolensis</i>	F	NA	X		
Kyphosidae					
<i>Kyphosus vaigiensis</i>	F	NA	X		
Ephippidae					
<i>Platax orbicularis</i>	6	NA	X		
Monodactylidae					
<i>Monodactylus argenteus</i>	F	NA	X		X
Scatophagidae					
<i>Scatophagus argus</i>	F	NA	X		
Chaetodontidae					
<i>Chaetodon andamanensis</i>	F	DD			
<i>C. auriga</i>	F	LC	X	X	
<i>C. collare</i>	F	LC	X	X	X
<i>C. decussatus</i>	F	LC	X	X	X
<i>C. lineolatus</i>	6	LC	X		
<i>C. lunula</i>	F	LC	X		
<i>C. vagabundus</i>	1	LC	X		
<i>Forcipiger longirostris</i>	F	LC	X		
<i>Heniochus acuminatus</i>	F	LC	X	X	X
Pomacanthidae					
<i>Apolemichthys xanthurus</i>	F	LC	X		
<i>Centropyge flavipectoralis</i>	5	LC	X		
<i>Pomacanthus annularis</i>	F	LC	X	X	X
<i>P. imperator</i>	F	LC	X		
<i>P. semicirculatus</i>	F	LC	X		
Cirrhitidae					
<i>Cirrhitichthys bleekeri</i>	F	NA	X		
<i>C. oxycephalus</i>	NR	NA	X		
Pomacentridae					

Species	Record	IUCN	S. India	Netrani	Goa
<i>Abudefduf bengalensis</i>	F	NA		X	X
<i>A. notatus</i>	6	NA	X		
<i>A. septemfasciatus</i>	F	NA	X		
<i>A. sordidus</i>	F	NA	X	X	X
<i>A. vaigiensis</i>	F	NA	X	X	X
<i>Amphiprion sebae</i>	F	NA	X		
<i>Chromis atripectoralis</i>	F	NA	X	X	X
<i>C. viridis</i>	F	NA	X		
<i>Chrysiptera biocellata</i>	F	NA	X		
<i>C. leucopoma</i>	1	NA	X		
<i>C. unimaculata</i>	F	NA	X	X	X
<i>Dascyllus trimaculatus</i>	F	NA	X		
<i>Neopomacentrus cyanamos</i>	4	NA	X		X
<i>Pomacentrus caeruleus</i>	4	NA	X		
<i>P. chrysurus</i>	NR	NA	X		
<i>P. indicus</i>	NR	NA	X		
Labridae					
<i>Anampses caeruleopunctatus</i>	F	LC	X		
<i>Bodianus axillaris</i>	7	LC	X		
<i>B. diana</i>	7	LC	X		
<i>B. neilli</i>	F	LC	X	X	
<i>Cheilinus undulatus</i>	F	EN	X		
<i>Coris formosa</i>	F	LC	X	X	
<i>Gomphosus caeruleus</i>	F	LC	X		
<i>Halichoeres hortulanus</i>	F	LC	X		
<i>H. marginatus</i>	F	LC	X		
<i>H. nebulosus</i>	F	LC	X		
<i>H. nigrescens</i>	F	LC		X	X
<i>H. zeylonicus</i>	F	LC	X		
<i>Labroides dimidiatus</i>	F	LC	X	X	X
<i>Stethojulis strigiventer</i>	F	LC		X	
<i>S. trilineata</i>	F	LC	X		
<i>Thalassoma hardwicke</i>	F	LC	X		
<i>T. janseni</i>	F	LC	X		
<i>T. lunare</i>	F	LC	X	X	X
Scaridae					
<i>Scarus ghobban</i>	F	LC	X	X	X
<i>Scarus rubriovlaceus</i>	F	LC	X	X	
Blenniidae					
<i>Plagiotremus rhinorhynchus</i>	F	NA	X		
Siganidae					
<i>Siganus canaliculatus</i>	F	NA		X	X
<i>S. javas</i>	F	NA	X	X	X
<i>S. guttatus</i>	F	NA	X		
Zanclidae					
<i>Zanclus cornutus</i>	F	NA	X	X	X
Acanthuridae					
<i>Acanthurus auranticavus</i>	NR	NA		X	X

Species	Record	IUCN	S. India	Netrani	Goa
<i>A. bariene</i>	NR	NA	X		
<i>A. leucocheilos</i>	NR	NA	X	X	
<i>A. leucosternon</i>	F	NA	X		
<i>A. lineatus</i>	F	NA	X		
<i>A. mata</i>	F	NA	X	X	
<i>A. nigricauda</i>	6	NA	X		
<i>A. tennentii</i>	F	NA	X		
<i>A. thompsoni</i>	F	NA		X	
<i>A. triostegus</i>	F	NA	X		
<i>A. xanthopterus</i>	F	NA			
<i>Ctenochaetus binotatus</i>	NR	NA	X		
<i>C. striatus</i>	F	NA	X		
<i>C. strigosus</i>	F	NA	X	X	
<i>Naso brachycentron</i>	F	NA	X		
<i>N. brevirostris</i>	F	NA	X		
<i>N. hexacanthus</i>	NR	NA	X		
<i>Zebrosoma desjardini</i>	1	NA	X		
Sphyraenidae					
<i>Sphyraena barracuda</i>	F	NA	X		
<i>S. jello</i>	F	NA	X		
Balistidae					
<i>Balistoides viridescens</i>	1	NA	X		
<i>Odonus niger</i>	F	NA	X	X	X
<i>Pseudobalistes flavimarginatus</i>	F	NA	X		
<i>P. fuscus</i>	F	NA	X		
<i>Sufflamen chrysopterus</i>	6	NA	X		
<i>S. fraenatum</i>	3	LC	X	X	X
Monacanthidae					
<i>Pervagor janthinosa</i>	NR	NA	X		
Ostraciidae					
<i>Ostracion cubicus</i>	F	NA	X		
<i>Tetrosomas concatenatus</i>	NR	NA		X	
Tetradontidae					
<i>Arothron hispidus</i>	F	NA	X		
<i>A. immaculatus</i>	F	NA	X		
<i>A. meleagris</i>	F	NA		X	
<i>A. nigropunctatus</i>	F	NA		X	X
<i>Chelonodon patoca</i>	F	NA			X
Diodontidae					
<i>Diodon holocanthus</i>	F	NA	X		
<i>D. hystrix</i>	F	NA	X	X	X
<i>D. liturosus</i>	6	NA	X	X	

(¹ Jones 1969; ² Murty 1969; ³ Fischer & Bianchi 1984; ⁴ Allen 1991; ⁵ Allen et al. 1998; ⁶ Rao et al. 2000; ⁷ Sluka & Lazarus 2004; ⁸ Suresh & Thomas 2007).

⁹ Fishbase records *Pterois volitans* as present in India. However, the range of this species as given in the Fishbase record indicates otherwise and is likely a mistake as *P. volitans* is replaced by the very similar *P. miles* in the western Indian Ocean.

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