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Species assemblage in the coral reef ecosystem of Netrani Island off Karnataka along the southwest coast of India

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Abstract

Netrani is an uninhabited island located nearly 18 km off Murdeshwar (Karnataka State) in the southwest coast of India (14°02′ N lat; 74°33′ E long.). So far the coral reef ecosystem around this island has not been reported in scientific literature. Therefore, an underwater visual census of the coral reef was undertaken in May 2006 by SCUBA diving. The survey has revealed the existence of a patchy reef surrounding this island consisting of 14 coral species belonging to 11 genera. Other flora and fauna comprised of fishes (92), seaweeds (7), sponges (6), jellyfish (2), holothuria (1), nudibranchs (7), zooplankton (25), bivalves (15), phytoplankton (16), gastropods (48), cephalopods (3), crabs (17), shrimps (2), lobsters (4), etc. Twenty-six species of fishes recorded from this island reef area were found to be new records from the Indian coast. Two IUCN Red Listed fish species, the humphead wrasse (*Cheilinus undulatus*) and the whale shark (*Rhincodon typus*) were recorded from the island area. Another IUCN red listed mollusc, the giant clam (*Tridacna maxima)* was found inhabiting this reef and this is a first report on the occurrence of this species from the mainland Indian waters. The Indian Navy based at Karwar uses the Netrani Island as target for shooting/shelling practice and evidence of the same was observed during the survey. The wealth of biodiversity around this reef emphasizes the need to conserve and preserve it.

Keywords: Netrani Island, species assemblage, Coral reef, *Tridacna maxima,* humphead wrasse

Introduction

The coral reefs reported from the coastal waters of the Indian mainland, Lakshadweep and Andaman & Nicobar Islands have always been a subject of scientific interest. They include the fringing reef ecosystems in the Gulf of Mannar, Palk Bay, Gulf of Kutch and the atolls of the Lakshadweep Islands and the continental island reefs of Andaman and Nicobar, all covering an estimated area of approximately 1,217 sq. km (Pillai,1996). Intensive scientific effort to study the coral reefs of India was started in the early 1960s by the Central Marine Fisheries Research Institute (Devaraj, 1997). Since then, good amount of information have been collected on the species diversity and composition of the coral fauna of India (George and Sukumaran, 2007; Nair and Qasim, 1978; Pillai, 1972, 1983, 1986, 1996; Pillai and Patel, 1988; Pillai and Jasmine, 1996; Qasim and Wafar, 1979; Reddiah, 1977; Scheer and Pillai, 1974; Wafar, 1986).

The taxonomic and ecological studies on the coral reef fauna was initiated as early as 1847 by Rink in Nicobar Island (Venkataraman and Wafar, 2005). Contemporary studies on corals are those of

Pillai (1996) and Venkataraman *et al.* (2003), which list a total of 218 species under 60 genera and 15 families. Fringing reefs are found in the Gulf of Mannar and Palk Bay, and patchy coral growths of wave cut platforms on subsided land are seen in Gulf of Kutch (Qasim and Wafar, 1979). Some patchy outcrops are also present near Vizhinjam and Enayam along the west coast of Kerala and Tamil Nadu (Pillai and Jasmine, 1996). Deep water and intertidal coral formations are reported from the Maharashtra and Karnataka coasts (Nair and Qasim, 1978; Qasim and Wafar, 1979; Wafar, 1986). While inventorying the marine and estuarine biodiversity of coastal Karnataka we found patchy growth of corals around the Netrani Island.

Although the local fishermen and some divers know the presence of the patchy reef around Netrani Island, it has not been the subject of scientific study and not reported in scientific literature. Although a recent report furnished the survey results of locating humphead wrasse fish from this island waters (Sluka and Lazarus, 2005), the coral reefs of Netrani Island and its conservation issues were not mentioned. As the inventory and database creation of the biological resources of critical habitats such as coral reefs is essential to protect the ecosystem functions, species assemblages and habitats, a detailed study of the flora and fauna of the reef ecosystem around Netrani Island was carried out in May 2006 and its conservation issues are discussed in this paper.

Materials and methods

Study site: Netrani Island (14°02'N lat.; 74°33'E long.) with an area of approximately 2 km is located about 18 km off Murdeshwar, Karnataka State (Fig. 1). It is an uninhabited island which creeps up straight from the sea with rock edges and without any sandy beaches around it.

Underwater survey and sampling: The waters around the island was surveyed by SCUBA diving and samples consisting of dead corals and molluscan shells were collected at random. The underwater visual census was done at four sites around the island, the details of which are shown in Table 1. Care was taken not to disturb the live corals and other sedentary species. Coral reef

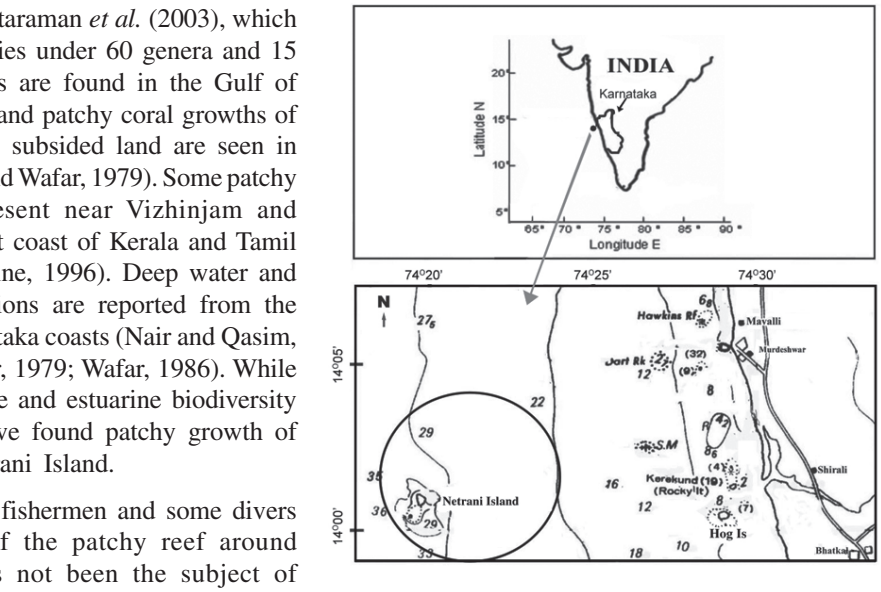


Fig. 1. Map showing the Netrani Island located off Murdeshwar (Karnataka State) in the southwest coast of India

surveys such as rapid visual transect (RVT), photoquadrant, video quadrant and quadrant search methods were employed for the study (Jones and Thompson, 1978; Coyer and Witman, 1990). Species were identified using the samples collected and from the video and digital photographs taken following standard procedures (Chan, 1998; Fischer and Bianchi, 1984; Gosner, 1971). Distribution records of fishes from the Indian waters were verified with the help of FISHBASE (*www.fishbase.org*).

Results and Discussion

The depth around the island is 6 to 40 m and seawater is very clear with a visibility ranging from 15 to 30 m. Our survey revealed the existence of a patchy coral reef ecosystem surrounding the Netrani Island. Along the Karnataka coast off Malpe, a submerged bank (Gaveshani bank) at a depth of 100 m with living corals was reported by Qasim and Wafar (1979). Coral patches have been recorded in the intertidal regions of Ratnagiri, Malvan and Redi, South of Mumbai, Gaveshani bank off Malpe and off Quilon (Hoon, 1997). The present finding indicates a continuity of coral patches along the central west coast of India

Table 1. Details of SCUBA diving stations and salient observations near the Netrani Island

Date & time (hrs)	Station position	Station depth (m)	Duration of diving (minutes)	Major observations
08-5-2006 1130 – 1250	14° 00' 42" N lat. 74° 20' 07" E long.	12	80	Massive mushroom coral growth, seven species of parrotfish, triggerfish, fusilliers, trevallies and squirrelfish, cowrie shells, nudibranchs, angelfish, sergeant majors, wrasse and parrotfish, giant eels, honey-comb moray eels etc.
09-5-2006 0930 – 1040	14° 00' 52" N lat. 74° 19' 55" E long	10	70	Juveniles of blue streak cleaner wrasse, saddleback wrasses, yellow tail coris, purple wrasse and nudibranchs, humphead wrasse (*Cheilinus undulatus*) etc.
10-5-2006 1000 – 1110	14° 00' 22" N lat. 74° 19' 47" E long.	12-15	70	Blue-lined angelfish, two humphead wrasses, lobsters, sea cucumbers and giant clams
10-5-2006 1130- 1245	14° 00' 43" N lat. 74° 19' 45" E long.	15	75	Barracudas, cobias, cow-nosed ray, titan trigger fish, juvenile of whale shark, seaweeds etc.

Table 2. List of coral genera recorded from Netrani Island; distribution of genera in the Indian seas (modified from Wafar, 1986) is given for comparison

Family	Genera	Netrani Island	Palk Bay	Gulf of Mannar	Lakshadweep Island	Andaman Island	Nicobar Island	Gulf of Kutch	Central West Coast	Gaveshani Bank
Pocilloporidae	*Pocilllopora*	✓	✓	✓	✓	✓	✓			
Siderastridae	*Coscinaraea*	✓	✓	✓				✓	✓	
Poritidae	*Goniopora*	✓	✓	✓	✓		✓	✓		
	Porites	✓	✓	✓	✓	✓	✓	✓	✓	✓
Favidae	*Favia*	✓	✓	✓	✓	✓	✓	✓		
Subfamily: Faviinae	*Goniastrea*	✓	✓	✓	✓	✓	✓	✓	✓	
Favidae	*Leptastrea*	✓	✓	✓	✓		✓	✓		
Subfamily: Monastreinae	*Plesiastrea*	✓	✓	✓	✓		✓			
Mussidae	*Symphyllia*	✓	✓	✓	✓	✓	✓	✓		
Dendrophyllidae	*Turbinaria*	✓	✓	✓			✓	✓	✓	
	Dendrophyllia	✓								
Total genera reported		**11**	**21**	**27**	**28**	**25**	**42**	**20**	**8**	**5**

✓ indicates the genera common to Netrani and other ecosystems; total genera indicate all the reported coral genera of the given ecosystem.

between Mumbai and Malpe. The list of corals and the associated species recorded off the island are shown in Tables 2-4 and their conservation status as per the Red List published by the International Union for Conservation of Nature and Natural Resources (IUCN) and the Indian Wildlife (Protection) Act of 1972 is shown in Table 5.

Coral reef and associated species: From Netrani waters, 14 species of corals belonging to 11 genera were observed (Table 2 and 3). Of the species belonging to 39 genera of reef building corals recorded from the Indian coast (Pillai, 1972) nearly one third of the these genera are present in Netrani Island waters. Since the island is located far from

Table 3. List of species other than finfishes recorded from Netrani Island

Groups	Species
Phytoplankton(16 species)	*Cerataulina* sp, *Climacodium frauenfeldianum, Corethron hystrix, Eucampia* sp, *Hemiaulus* sp., *Navicula* sp., *Nitzschia pungens, Nitzschia* sp., *Pleurosigma nitzschioides, Rhabdonema* sp., *Rhizosolenia alata, Rhizosolenia robusta, Rhizosolenia setigera, Rhizosolenia stoleteforthi, Skeletonema costatum, Thallasionema nitzschioides,*
Corals (14 species)	*Dendrophyllia* sp., *Turbinaria* sp., *Goniastrea pectinata, Goniastrea retiformis, Plesiastrea versipora, Leptastrea* sp., *Favia favus, Sympyllia* sp. *Pocillopora verrucosa, Pocillopora* sp., *Porites* sp., *Goniopora* sp., *Coscinarea monile, Coscinarea* sp.
Seaweed (7 species)	*Dictyota dichotoma, Ectocarpus* sp., *Ralfsia* sp., *Sargassum ilicifolium, Sargassum tenerum, Stoechospermum marginatum, Turbinaria ornata*
Porifera- sponges (6 species)	*Axinysria flabelliformes, Halisarca* sp., *Acanthella elongata, Echinodictylum longistylum, Raspailia hornelli, Adocia* sp.
Scyphozoa- jelly fish(2 species)	*Acromitus* sp., *Dactylometra* sp.
Ctenophora (2 species)	*Pleurobrachia* sp., *Beroe* sp.
Anthozoa- sea anemones (2 species)	*Anemonia* sp., *Bunodactis* sp.
Cnidaria (7 species)	*Botrynema ellinorae, Diphyes* sp., *Gemmaria* sp., *Monophyes* sp., *Physalia* sp., *Porpita* sp., *Sertularia* sp.
Holothuria (1 species)	*Holothuria (Mertensiothuria) leucospilota*
Zooplankton (25 species)	*Acartia clausi, Acartia spinicauda, Anomalocera patersoni, Botrynema ellinorae, Corycaeus danae, Labidocera minuta, Labidocera pavo, Labidocera pectinata, Nannocalanus minor, Tortanus discaudatus, Acartia danae, Acartia tonsa, Acrocalanus longicornis, Centropages furcatus, Evadne tergestina, Heterorhabdus spinifrons, Krohnitta subtilis, Lensia conoidea, Lucifer hanseni, Oikopleura cophocerca, Oikopleura dioica, Oikopleura vanhoeffeni, Paracalanus aculeatus, Sagitta enflata, Sagitta elegans*
Nudibranchs (7 species)	*Chromodoris* sp, *Glossodoris* sp., *Phyllidia varicosa, Phyllidiella zeylanica, Thorunna australis, Elysia ornata, Pseudobiceros* sp.
Bivalves (15 species)	*Anadara antiquata, Donax scortum, Mactra (Mactra) achatina, Mactra (Mactra) turgida, Mactra violacea, Brachidontes striatulus, Perna viridis, Crassostrea madrasensis, Saccostrea cucullata, Atrina (Atrina) vexillum, Tridacna crocea, Tridacna maxima, Dosinia cretacea, Gafrarium divaricata, Pinctada fucata*
Gastropods (48 species)	*Bursa spinosa, Bursa tuberculata, Cerithium morus, Cerithium rubus, Cerithidea cingulata, Terebra tenera, Conus capitaneus, Cymatium aquatile, Cymatium cingulatum, Distortio reticulata, Monetaria moneta, Drupa contracta, Ergalatax margariticola, Drupa tuberculata, Drupa xuthedra, Mancinella bufo, Murex malabaricus,Thais carinifera, Thais tissoti, Bullia melanoides, Natica didyma, Natica maculosa, Natica picta, Natica rufa, Nerita albicilla, Nerita oryzarum, Nerita polita, Nerita squamulata, Ritena costata, Oliva gibbosa, Oliva (Oliva) amethystina nebulosa,Oliva (Oliva) mantichora intricata, Cellana cernica, Cellana radiata, Cellana testudinaria, Clypidina notata,Planaxis similis, Planaxis sulcatus, Lambis chiragra, Trochus erythreus, Trochus radiatus, Trochus stellatus, Turbo brunneus, Turbo coronatus, Turritella duplicata, Turritella terebra, Turritella terebra cerea, Xancus pyrum*
Cephalopods (3 species)	*Loligo duvauceli, Sepia pharaonis, Sepiella inermis*
Shrimps (2 species)	*Rhynchocinetes durbanensis, Acetes indicus*
Crabs (17 species)	*Carpilius convexus, Carpilius maculatus, Sesarma tetragonum, Metopograpsus maculatus, Varuna litterata, Pseudograpsus elongatus, Pseudograpsus intermedius, Sesarma quadratum, Sesarma edwarsi, Sesarma lanatum, Grapsus albolineatus, Neorhynchoplax demeloi, Elamena cristatipes, Charybdis japonica, Charybdis annulata, Etisus levimanus, Leptodius exaratus*
Lobsters (4 species)	*Panulirus polyphagus, Panulirus versicolor, Panulirus penicillatus, Panulirus homarus*
Sea snakes (3 species)	*Hydrophis spiralis, Hydrophis cyanocinctus, Enhydrina schistosa*

Table 4. List of fish species recorded from Netrani Island, which are new records from Indian waters

Sl. No.	Species	Family	Common name
1	*Zebrasoma desjardinii*	Acanthuridae	Surgeonfish
2	*Apogon aureus*	Apogonidae	Ringtailed cardinalfish
3	*Chaetodon dolosus*	Chaetodontidae	African butterflyfish
4	*Heniochus diphreutes*	Chaetodontidae	False moorishidol
5	*Diodon liturosus*	Diodontidae	Black-blotched porcupinefish
6	*Amblyeleotris fasciata*	Gobiidae	Red banded prawn goby
7	*Amblyeleotris guttata*	Gobiidae	Spotted prawn goby
8	*Amblyeleotris periophthalma*	Gobiidae	Periophthalma prawn goby
9	*Amblyeleotris triguttata*	Gobiidae	Triple spot shrimp goby
10	*Amblyeleotris wheeleri*	Gobiidae	Gorgeous prawn goby
11	*Elacatinus genie*	Gobiidae	Cleaner Goby
12	*Plectorhinchus vittatus*	Haemulidae	Indian ocean oriental sweet lips
13	*Lutjanus dodecacanthoides*	Lutjanidae	Sun beam snapper
14	*Eubalichthys caeruleoguttatus*	Monocanthidae	Blue spotter leather jacket
15	*Gymnothroax eurostus*	Muraenidae	Abbotts moray eel
16	*Pomacanthus maculosus*	Pomacanthidae	Yellow bar angel fish
17	*Apolemichthys kingi*	Pomacanthidae	Tiger angel fish
18	*Dascyllus carneus*	Pomacentridae	Cloudy dascyllus
19	*Pomacentrus coelestis*	Pomacentridae	Neon damsel fish
20	*Pomacentrus philippinus*	Pomacentridae	Phillippine damsel
21	*Amphiprion perideraion*	Pomacentridae	Pink anemone fish
22	*Cetoscarus bicolor*	Scaridae	Bicolour parrot fish
23	*Chlorurus bleekeri*	Scaridae	Bleeker's parrot fish
24	*Chlorurus troschelii*	Scaridae	Troschel's parrot fish
25	*Scarus hoefleri*	Scaridae	Guinian parrot fish
26	*Tripterygion tripteronotus*	Tripterygidae	Three-fin blenny

Table 5. Species recorded from Netrani Island, which are included in the IUCN Red List of threatened species as per SSC (Species Survival Commission) and protected under Indian Wildlife (Protection) Act, 1972 (EN=Endangered; VU=Vulnerable, Schedule I, III and IV indicate the degree of endangeredness with animals in Schedule I the most endangered)

Group	IUCN Red List Categories		Indian Wild life Act (1972) Schedules		
	EN	VU	I	III	IV
Elasmobranchs		1*	1*		
Teleosts	1+	1			
Molluscs		1++	1++		2#
Sea cucumber			1		
Corals		14	14		
Sponges				4	

**Rhincodon typus*, *+Cheilinus undulatus*, *++Tridacna maxima*, *#Lambis chiragra, Placenta placenta*

the mainland, clear seawater, uniform salinity and temperature are ideal for colonization and survival of coral reefs.

Branching forms of corals were not recorded in Netrani Island during the present survey but a subsequent survey has revealed its presence in less quantity (*Sujitha, personal communication*). Acroporites have not been reported from the central west coast of India and Gaveshani bank (Nair and Qasim, 1978; Qasim and Wafar, 1979). The nearest known coral reef formation, the *Gaveshani bank* off Malpe, is located nearly 70 nautical miles south of Netrani Island. The number of coral genera (5) reported from this submerged island (Nair and Qasim, 1978) is less compared to that from the Netrani Island (Table 2). This may be due to the different coral sampling method using pipe dredge, which records only partially the species available (Nair and Qasim, 1978). The planktonic planulae from Lakshadweep Island have the possibility to drift and settle on the rocks near small islands such as Netrani Island depending upon the availability of ideal conditions. Therefore, we cannot rule out the possibility of finding out more coral patches associated with the tiny islands and rock banks along the west coast of India, if further investigations are carried out.

The flora recorded from the waters comprised of 16 species of phytoplankton and 7 species of seaweeds. Invertebrate fauna consisted of 14 species of corals, 6 species of sponges, 7 species of cnidarians, 1 species of holothuria, 8 species of nudibranchs, 48 species of gastropods, 15 species of bivalves, 3 species of cephalopods, 17 species of crabs etc. (Table 3). Photographs of some corals and nudibranchs are given in Fig. 2 and 3 respectively. Live giant clams (*Tridacna maxima*) measuring 15-20 cm were attached to the rocky substratum near the island (Fig. 4). So far, *Tridacna maxima* was recorded only from Andaman & Nicobar and Lakshadweep islands and the present report is the first record on the distribution of the giant clam outside the above areas from the mainland Indian waters.

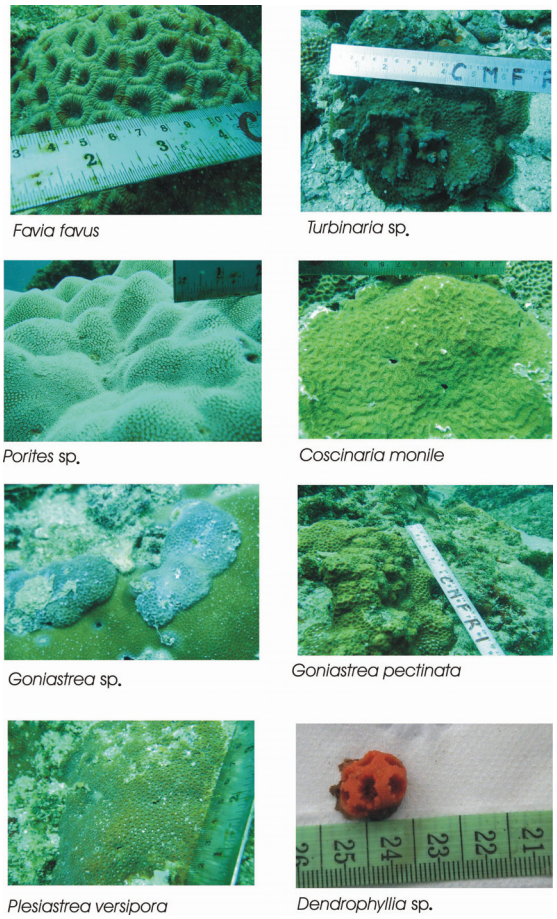


Fig. 2. Underwater photographs showing corals from the study area

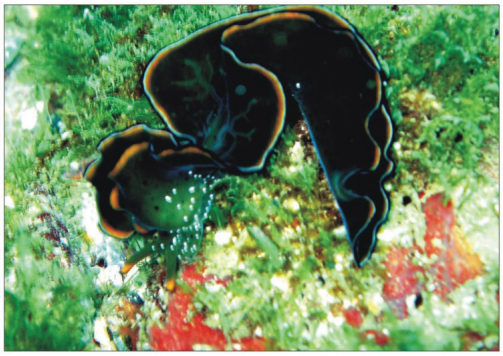
Icthyofaunal diversity: A total of 92 coral associated fishes belonging to 35 families and 58 genera were recorded from Netrani Island in which 26 species belonging to 4 genera were new records from the Indian coast and were verified from the distribution records of these species from Indian waters from FISHBASE (Table 4; Fig. 5). The largest family with more species representation was Serranidae (13 species) followed by Gobidae (8 species), Lutjanidae (8 species), Pomacentridae (6 species), Muraenidae (5 species) Scaridae (5 species) and Chaetodontidae (4 species). The Lakshadweep and Andaman & Nicobar coral reefs were reported to harbour nearly 600 fish species

Thorunna australis

Phyllidia australis

Pseudobiceros sp.

Phyllidiella zevlancia



Chromodoris sp.

Glossodoris sp.

Fig. 3. Photographs of some of the nudibranchs observed from Netrani waters

each including resident and migrant species (Bakus, 1994; Jones and Kumaran, 1980). Of the 92 fish species recorded in the present survey, the humphead wrasse, *Cheilinus undulatus* is included as an endangered species in the IUCN Red List (Table 5). Sluka and Lazarus (2005) first studied the distribution of this species along the west coast of India including Netrani Island and they recorded five specimens off Vizhinjam-Muttom. This species is widely distributed throughout the Indo-Pacific area but in low densities. The occurrence of this fish is considered as an indicator of the pristine and undisturbed nature of the reef (Sluka and Lazarus, 2005).

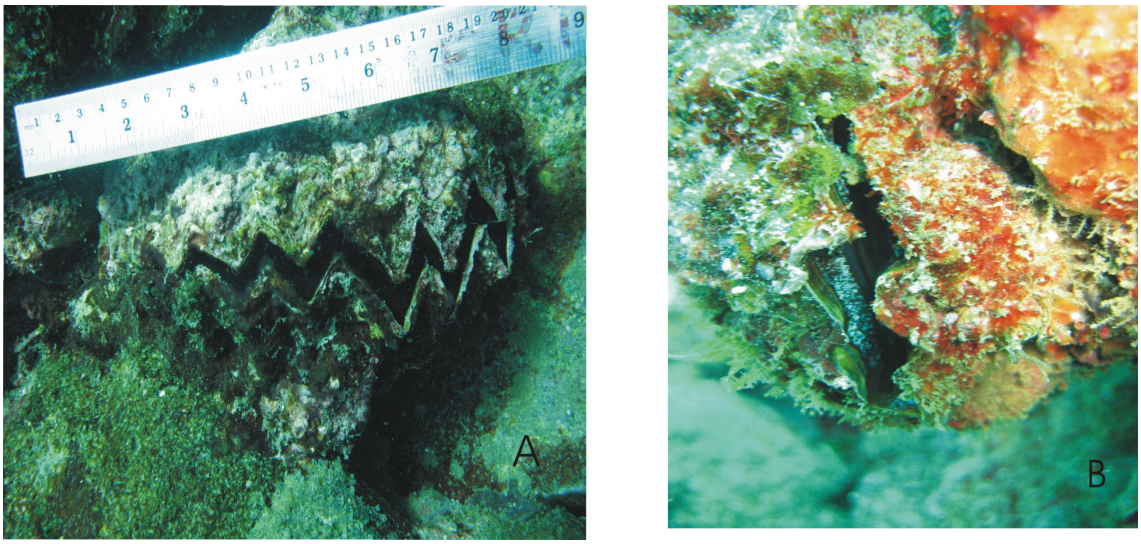


Fig. 4. Photographs showing the giant clam (*Tridacna maxima*) from Netrani Island

Fig. 5. Underwater fish photographs showing some of the new Indian records of from the coral reef ecosystem of Netrani Island. The endangered fish *Cheilinus undulatus* is also shown

Conservation issues: The present record of 26 new fish species belonging to four genera and several other IUCN red listed species from this island is very significant. The Indian Navy based at Karwar uses the Netrani Island for target shooting and shelling practice. During our survey, we observed several scars on the sides of the island due to shelling, including large white target marks

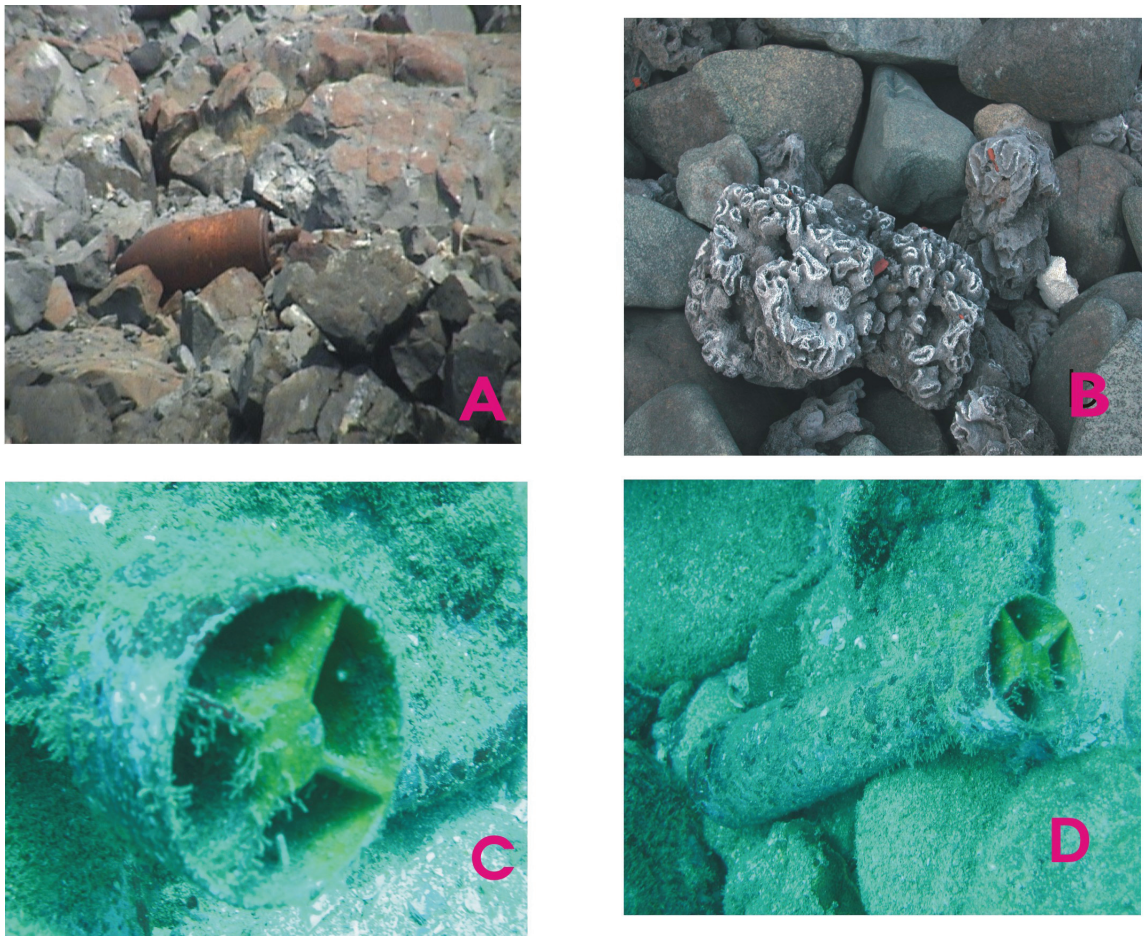


Fig. 6. Photographs showing the damage to the reef due to the target shelling by Indian Navy A) shell lying among the rocks, B) dead coral, C) and D) torpedo cases lying underwater

inscribed on the rock. We have also observed wide spread damage to coral reef of Netrani Island due to continuous shelling. Several naval artillery shells on the sides of the island and torpedo cases in the coastal waters were found scattered underwater (Fig. 6). Local fishermen informed us about the regular shelling practices conducted by the Indian Navy targeting this island.

The Netrani Island can be conserved by declaring it as protected area and a Marine Park. Three coral growing areas in India viz., Wandoor in South Andamans, Gulf of Kachchh and Gulf of Mannar, have already been declared as Marine Parks (Wildlife Institute of India, 2007). At present, Netrani Island is an internationally recognized underwater diving destination for tourists (*www.barracudadiving.com*). Hence, it is necessary to control and regulate commercial fisheries, underwater diving and amateur collection of corals and other reef organisms, particularly sedentary species from the area.

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