



## First record of patchy coral reef off Terekhol, North Goa, India

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This study reports the first time record of the patchy coral reef (~ 2 km<sup>2</sup>) of Terekhol in North Goa, the western coast of India during January – February 2020. There were more than 07 genera/species of hard corals in the reef and is dominated by a reef building *Turbinaria mesenterina* (Dendrophylliidae), which is considered as a sediment tolerant coral species. A total of 25 fish species were counted and the major species recorded were *Chromis viridis*, *Chromis* sp., *Dascyllus* sp., *Abudefduf saxatilis*, *Abudefduf bengalensis*, *Acanthurus blochii*, *Acanthurus nigroris*, *Acanthurus* sp., and *Odonus niger* that contributed 80 % of the total fish community. The documentation and record of the reef area could give identity to the ecosystem in the spatial platform and the conservation efforts can be planned for the reef by limiting the anthropogenic activities in and around the ecosystem.

[**Keywords:** Anthropogenic activities, Coral reef, Goa, Hard coral, India]

### Introduction

Being a fascinating and a colourful wonderland of underwater, coral reefs support nearly 25 % of all the marine biodiversity, and goods and services of US\$ 375 billion year<sup>1</sup>. Even though contemporary corals emerge nearly 240 million years ago, however, the coral reef is among the most threatened and vulnerable ecosystems on the earth<sup>2</sup>; largely due to the climatic perturbations. India is blessed with > 2500 km<sup>2</sup> of coral reef area, comprising of three main types of coral reefs, 1: Fringing reef (Andaman & Nicobar Islands, Gulf of Kutch, Gulf of Mannar), 2: Barrier reef (Gulf of Mannar, Andaman & The Nicobar Islands); and 3: Atoll (Lakshadweep Islands). Other than these main types, there are some patch reefs, with small structures located all along the coast and within the coral banks and in a lagoon of other reefs.

The exploration of coral reefs and coral communities along southwest coast of India is given least attention as they didn't form major coral reef systems compared to Lakshadweep, Gulf of Mannar, Gulf of Kutch and Andaman Nicobar Islands. Moreover, the stony corals of south west coast of India have not been scientifically documented in depth. There are coral reef formations located near shore in patches along the central west coast of India comprising Maharashtra, Goa, and Karnataka between 17° and 15° N latitudes<sup>3-5</sup>. Since the known patchy reefs are located near to the coast, visibility in these ecosystems stands a major hurdle in conducting underwater visual census throughout the seasons. The visibility (4 – 6 m) becomes favourable only during December to February to carry out scientific studies in these patchy coral reefs. However, the recent studies indicated that there are patchy reef formations occur along the southwest coast of India, which are underexplored and needs proper monitoring and evaluation. Recently coral reef and fish communities and associated biodiversity of Grande Island and St. George Island in Goa have been explored by various researchers<sup>6-8</sup>.

### Material and Methods

This report provides first time record of patchy reef habitats along the Terekhol region off Goa. The reef patches distributed in an area of ~ 2 km<sup>2</sup> at depth ranging from 4 to 5 m (Fig. 1). The reef patches were surveyed for marine life including reef building coral species, and fish species during January – February, 2020. The belt transect method (6 counts) was followed to monitor the coral reef species and in each transect, 300 m<sup>2</sup> area was covered (30 m × 10 m). The gap between transects was 200 m. The 10 m width was counted using a rod. The reef is rocky reef with rubbles and the major macroalgae attached to the reef are *Ulva* sp., *Sargassum* sp., *Gracilaria* sp. and *Padina* sp. The substrate is rocky in most of the reef and the rest is sandy in nature.

### Results

The patchy reef at Terekhol is comprised by more than 07 genera/species of hard corals (*Porites* sp., *Goniopora* sp., *Dipsastrea* sp., *Coscinaraea* sp.,

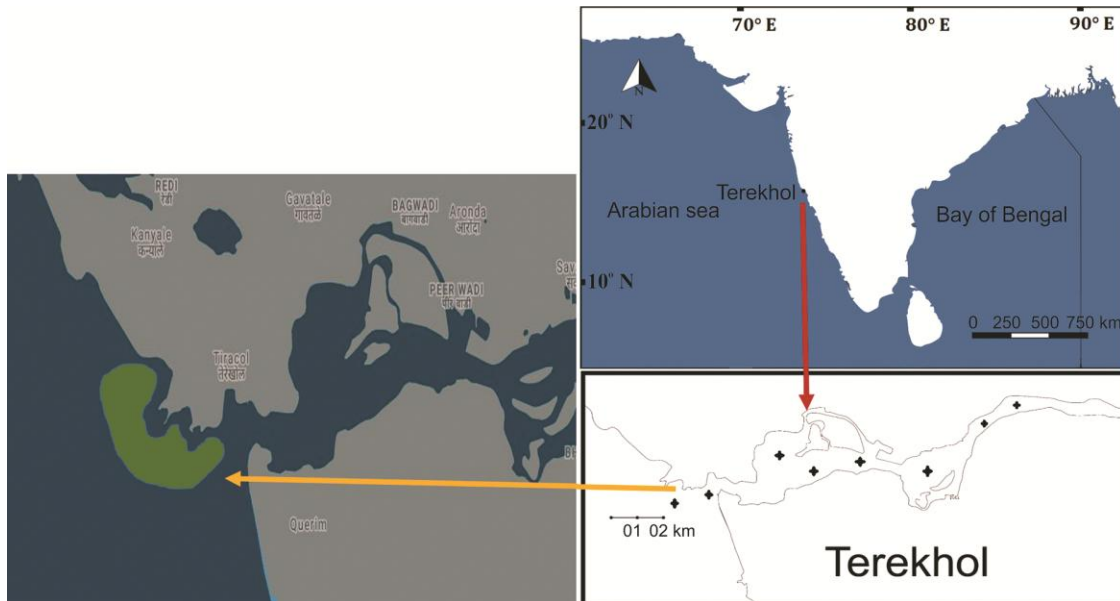


Fig. 1 — The map displaying the reef location and extent along Terekhol coast (The black stars indicate the major fishing locations)

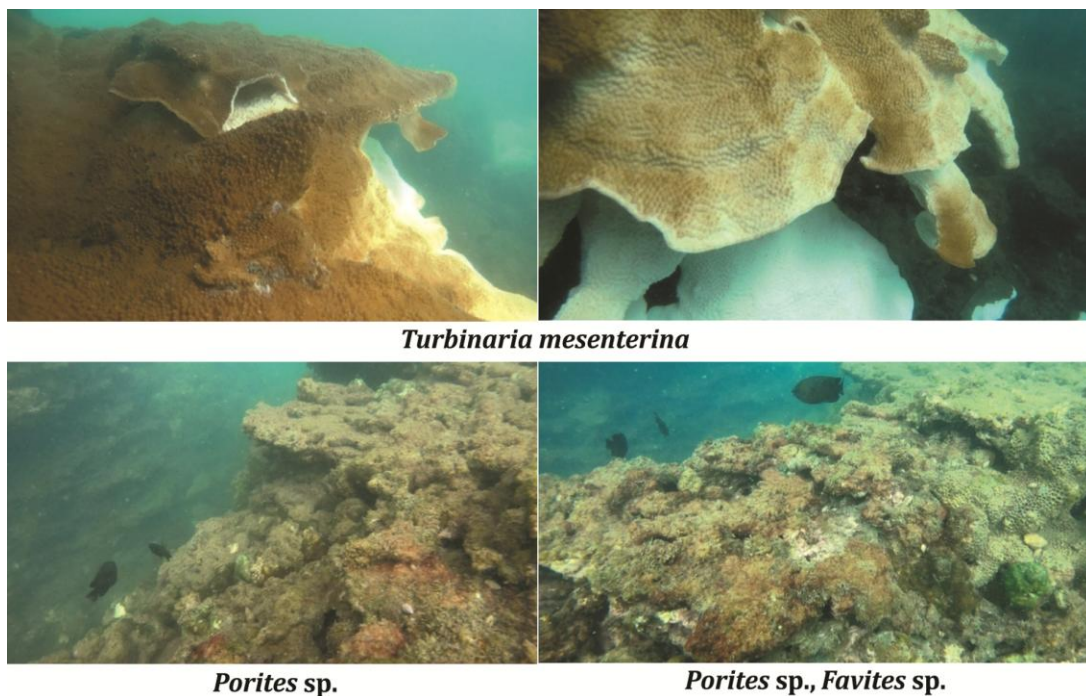


Fig. 2 — Reef building coral species

*Cyphastrea* sp., *Pseudosiderastrea* sp., and two-three soft coral species (*Sinularia* sp., *Sarcophyton* sp., *Lobophytum* sp.) and is dominated by a reef building *Turbinaria mesenterina* (Dendrophylliidae) (Fig. 2), which is considered as a sediment tolerant coral species<sup>8</sup> and hence is a spatially dominant coral species in the nearshore rocky environment.

A total of 25 fish species were recorded from three diving trials (covering 40 minutes each) (Fig. 3). The

Underwater Visual Census (UVC) was used by the diving team following a non-destructive point count method to document the fish assemblage on the reef habitats. The fish communities on the reef patches were enumerated using random transects (4 numbers), of 10 minutes each, covering an area of 300 m in each run. The team consisted of three trained divers (one for reef patch data collection and other two for the fish species enumeration). A total of 25 fish species



Fig. 3 — Fish species assemblage recorded in the patchy coral reef of Terekhol (Fish species in picture: *Abudefduf saxatilis*, *A. bengalensis*, *Chrysiptera* sp., *Chromis* sp., *Dascyllus* sp., *Acanthurus* sp.)

Table 1 — Fishes recorded in the UVC

S N	Species	Family	Common name	% Abundance
1	<i>Abudefduf saxatilis</i>	Pomacentridae	Sergeant major	15.0
2	<i>Abudefduf bengalensis</i>	Pomacentridae	Bengal sergeant	
3	<i>Epinephelus coioides</i>	Serranidae	Orange-spotted grouper	2.0
4	<i>Epinephelus erythrurus</i>	Serranidae	Cloudy grouper	1.0
5	<i>Dascyllus</i> sp.	Pomacentridae	Dascyllus	
6	<i>Chromis viridis</i>	Pomacentridae	Blue-green damselfish	45.0
7	<i>Chromis</i> sp.	Pomacentridae	Damselfish	
8	<i>Chrysiptera</i> sp.	Pomacentridae	Damselfish	
9	<i>Heniochus acuminatus</i>	Chaetodontidae	Pennant coral fish	2.0
10	<i>Heniochus singularis</i>	Chaetodontidae	Singular bannerfish	
11	<i>Monodactylus argenteus</i>	Monodactylidae	Silver moony	2.0
12	<i>Odonus niger</i>	Balistidae	Red toothed triggerfish	5.0
13	<i>Lutjanus argentimaculatus</i>	Lutjanidae	Mangrove red snapper	
14	<i>Lutjanus indicus</i>	Lutjanidae	Snapper	5.0
15	<i>Lutjanus lutjanus</i>	Lutjanidae	Big-eye snapper	
16	<i>Gnathanodon speciosus</i>	Carangidae	Golden trevally	2.0
17	<i>Caranx heberi</i>	Carangidae	Bluefin trevally	
18	<i>Acanthurus blochii</i>	Acanthuridae	Ringtail surgeonfish	
19	<i>Acanthurus</i> sp.	Acanthuridae	Surgeonfish	10.0
20	<i>Acanthurus nigroris</i>	Acanthuridae	Blue-line surgeonfish	
21	<i>Chelonodon patoca</i>	Tetraodontidae	Milk-spotted puffer	1.0
22	<i>Plectorhinchus chubbi</i>	Haemulidae	Dusky rubberlip	5.0
23	<i>Pomadasys furcatus</i>	Haemulidae	Banded grunter	
24	<i>Caesio caerulea</i>	Caesionidae	Blue and gold fusilier	5.0
25	<i>Caesio cuning</i>	Caesionidae	Red-belly yellowtail fusilier	

were counted in the UVC and based on the percentage abundance, the major species recorded were *Chromis viridis*, *Chromis* sp., *Dascyllus* sp., *Abudefduf saxatilis*, *Abudefduf bengalensis*, *Acanthurus blochii*, *Acanthurus nigroris*, *Acanthurus* sp., and *Odonus niger* that contributed 80 % of the total fish community (Table 1). Blue green *Chromis* that dominate the reef fish community in Terekhol reef are omnivorous feeding on plankton and seaweeds.

### Discussion

In addition to supporting numerous biological diversity in the ocean and providing suitable living

conditions and food security to millions of people in maritime nations, coral reefs are one of the most threatened ecosystems on the earth, facing high extinction risk due to changing climatic conditions and increasing anthropogenic impacts. The major anthropogenic threats in this region include pollution from domestic sewage, overexploitation of the sand and silt from the estuarine stretch, reclamation of mangrove zones, and sedimentation in the river stretch and coastal areas. These could cause deleterious impacts on the coral reef patches, which is situated very adjacent to the coastline. Therefore, the

management of these anthropogenic stressors require urgent attention to protect the reef and the estuarine ecosystem.

Presence of high fish diversity with large biological assemblage (corals, fishes, algae and other invertebrates) within a small coral patch indicates that they provide functional niche, and serve as a feeding and breeding grounds for important reef fish species. Additionally, coral reefs are known to provide goods and services to the coastal communities, and enhance the overall ecosystem stability<sup>10</sup>. Here, a total of eleven commercial food fish species were recorded from the study area. They harbour the patchy reef ecosystem in substantial densities. Thus, the reef provides a dispersal envelope for these species towards the estuarine region and adjacent coastal areas and thereby supporting the fishery. The discovery of patchy coral reef with fish biodiversity in northern Goa is very significant, considering the increased pressure from the coastal infrastructure development for land reclamation. Fishery in the area (both estuarine and coastal fishery) is dwindling, and there is a significant reduction in total annual fish catches. Coral reefs provide the necessary breeding and nursery grounds for edible and ornamental fishes, therefore, if managed properly, these coastal shallow-water patchy reefs can help in reviving the local fishery and general biodiversity of the region. Moreover, succumbing to the local and global environmental stressors coral reefs are on the decline globally. A proposal for the development of harbour at Reddy, Vengurla (Maharashtra) is already pending with the Maharashtra Government, whereas, the Terekhol river is subjected to large scale sand mining and the sandy beach at the mouth of the Terekhol river is exposed to severe beach erosion. These can result in sedimentation and smoothening of the coral reef patches and ultimately the loss of this precious habitat. Generally, river sand mining harms the marine benthic environment<sup>11</sup>, and harbour activities are considered antagonistic to the coral growth. It is therefore recommended conducting a detailed underwater survey of the area to understand the extent and status of patchy coral reef and map the biodiversity of the area using a GIS platform. To conserve any ecosystem, it is essential to tag the same on a spatial platform and record the same with authentic reports. The documentation and record of the reef area could give identity to the ecosystem in the spatial platform and the stakeholders will be made aware about the existence of the reef habitat. Thus,

the conservation efforts can be planned for the reef by limiting the anthropogenic activities in and around the ecosystem. Further studies, therefore, are required to prepare a coral reef monitoring and management plan.

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### Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Ethical Statement

There are no human subjects in this article and informed consent is not applicable.

### Author Contributions

GBS: Conceived the idea and designed methodology, sampling, data collection and analysis, and writing the first draft; BI: Conceived the idea and designed methodology, writing, reviewing and editing; BP: Designed methodology, sampling and data collection; and EBC: Conceived the idea, final validations, writing-reviewing and editing.

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