

Fish diversity in shallow water diving sites in Malvan Marine Sanctuary in Maharashtra

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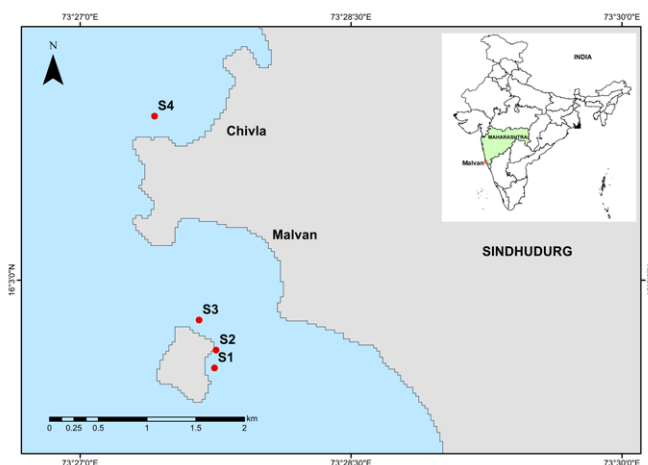
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Tourism has great potential and opportunities for sustainable development and the Maharashtra government is promoting coastal and marine tourism (CMT) with diverse strategies to harness the benefits for economic growth and development of the local population. Sindhudurg District in southern Maharashtra has been widely promoted for CMT with the district declared as “tourism district” in 1997. Malvan (Sindhudurg district) is one of the popular CMT and aqua sports destinations in Maharashtra and one of the nearest getaway locations from the Metro city Mumbai. The affordable aqua sports experience (para-sailing, snorkelling, diving, speed boats, jet-ski, banana and bumper boats, kayaks) and dolphin watch cruises attract a lot of people. Fishing vessels and tourism boats navigate and operate in the same waters and the coastal communities interchangeably work in both sectors. Diving snorkelling and homestays were some of the demand-driven developments in the region. Several small-scale diving enterprises and adventure sports activities developed in the region are mostly concentrated in Malvan and are well established and publicity through social media has often created a rush of tourists to Malvan.

Submerged underwater rocks and reefs provide potential sites for diving which have been identified and accessed by these dive enterprises to enable tourists to undertake the affordable (400-3500 ₹/per dive). Poorly managed CMT-related is risky and unsustainable and awareness on sustainable CMT practices is required (De *et al.*, 2020). The Swadesh Darshan program of Govt. of India, in which a coastal circuit belt connecting the potential tourism villages in Sindhudurg such as Vijaydurg, Mithbhav, Devgad, Tarkarli, Tondavali, Nivati fort, Shiroda, Sagareswar, and Mochemad has been planned, may reduce the current tourism pressure on Malvan. There is an urgent need to manage coastal pollution and evaluate the ecosystem carrying capacity for sustainable coastal tourism development in the region.

In December 2021, an underwater visual census was conducted during recreational diving. Observations were conducted at 4 crowded, high-intensity diving and snorkeling points for 10-20 minutes each at depths of 4-7 m. The number and fish species observed were recorded. Sites 1-3 are in the core zone of the designated Malvan marine sanctuary (MMS) and 4 in the buffer zone of MMS. Dive sites have patches of corals *Porites* spp., *Turbinaria* spp., *Siderastrea* spp. and stations 1 and 2 have good seaweed patches (*Sargassum* spp., *Caulerpa* spp., *Chaetomorpha* spp., *Dictyota* spp., *Ulva* sp., *Porphyra* spp., and *Padina* spp.). Most of the fishes observed at sites are reef-associated fishes (Table 1). A total of 27 fish species were observed from all dive sites, belonging to 13 families and 23 genera. Though a high number of fish species (108) were reported from the Malvan marine sanctuary (Barman *et al.*, 2007), the fish diversity and abundance at current dive sites were very poor (average 13 species) during the observation. The highest diversity in terms of the number of species observed was at Station 1 and the most dominant fish group in numerical abundance was Pomacentridae. The



Observation sites in Malvan, Maharashtra



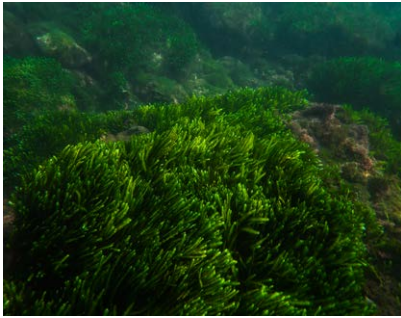
Single-use plastics trapped in a seaweed patch in the core zone of Malvan marine sanctuary



Beached pollutants in the core zone of Malvan marine sanctuary

Table 1. Fishes observed in the high-intensity dive sites in Malvan

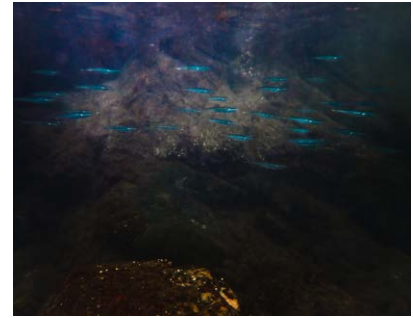
Family	Genus/Species	Station 1	Station 2	Station 3	Station 4	Occurrence status
Epinephelidae	<i>Cephalopholis formosa</i>	*			*	Rare
	<i>Epinephelus malabaricus</i>		*			Rare
Lutjanidae	<i>Lutjanus argentimaculatus</i>	*	*			Rare
	<i>Lutjanus rivulatus</i>	*				Rare
	<i>Caesio</i> sp.				*	Rare
Pempheridae	<i>Pempheris</i> sp.		*			Rare
Sparidae	<i>Acanthopagrus berda</i>	*		*	*	Occasional
Chaetodontidae	<i>Chaetodon collare</i>		*	*		Occasional
	<i>Chaetodon decussatus</i>			*		Rare
	<i>Heniochus acuminatus</i>	*	*			Rare
Pomacanthidae	<i>Pomacanthus annularis</i>	*			*	Rare
Mugilidae	<i>Ellochelon vaigiensis</i>	*	*			Rare
	<i>Chelon</i> spp.			*		Frequent
Pomacentridae	<i>Abudefduf vaigiensis</i>				*	Occasional
	<i>Abudefduf bengalensis</i>	*	*	*	*	Common
	<i>Abudefduf sordidus</i>	*	*			Rare
	<i>Chrysiptera unimaculata</i>			*		Rare
	<i>Dascyllus trimaculatus</i>	*	*	*	*	Rare
	<i>Neopomacentrus cyanomos</i>	*	*	*	*	Common
	<i>Neopomacentrus sindensis</i>	*	*	*	*	Common
<i>Pomacentrus</i> sp.	*	*	*	*	Common	
Scatophagidae	<i>Scatophagus argus</i>	*	*			Rare
Acanthuridae	<i>Acanthurus gahhm</i>	*				Rare
Monodactylidae	<i>Monodactylus argenteus</i>		*	*		Occasional
Scaridae	<i>Scarus ghobban</i>	*				Rare
Labridae	<i>Labroides dimidiatus</i>		*		*	Rare
	<i>Halichoeres</i> cf. <i>nigrescens</i>			*		Rare



Seaweed, *Caulerpa* spp. patches at Station 1



Corals at Station 1



Squids at Station 1



Seaweed, *Sargassum* spp. patches at Station 2



Reef fishes and bleached corals at Station 4

current observations during a single observation dive has limitations and the seasonal and long-term variation of marine life in high anthropogenic impact coastal regions needs to be documented.

When sightings were pooled for all stations, rare (<5 numbers), occasional (5-10), frequent (10-20), and common (>20)