



# Tracking the origin of polypropylene and polyethylene bags in coral reefs of the Gulf of Mannar

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Short Communication

## Abstract

The occurrence of polypropylene and polyethylene bags in the coral reefs of the Mandapam group of Islands has become a concern. These plastic bags pose a potential threat to corals, reef-associated animals, and divers. Field surveys were conducted to track the source of origin of these plastics along the islands and mainland beaches. This study indicated that these plastics are carried by the fishers from the mainland and deployed in the reefs around the islands to catch squids. Finding alternative substitutes to replace plastic bags is an important concern without impacting the livelihoods of fishers. Additionally, awareness among fishers regarding the impact of plastics on marine life needs to be generated and encourage their participation in conservation programs.

**Keywords:** Coral reefs, plastic pollution, squid fishery, Gulf of Mannar

## Introduction

Plastic pollution has become a ubiquitous threat affecting micro and macro organisms, including humans. Marine biodiversity is seriously facing threats from land-based sources of plastic substances. This annually contributes 4.8-12.7 million tons of plastic to the global ocean (Haward, 2018). The current statistics show that plastic pieces floating in the oceans have increased up to 250,000 tons (Eriksen *et al.*, 2014). Thus, recent research has focused on the impact of plastic pollution on marine organisms and finding mitigation measures (Vegter *et al.*, 2014). An observational study suggests that macro plastic waste found in the coral reef areas supports the development of different marine animals (Ramesh *et al.*, 2019). In contrast, another study demonstrated that plastic waste in coral reefs promotes

pathogenic microbial growth, which is highly likely to cause coral diseases (Lamb *et al.*, 2018). Therefore, identifying plastic pollution zones around the coastal waters and their impact on marine biota has become a great concern in biodiversity conservation and plastic pollution mitigation. Mainland coastal waters (Vidyasakar *et al.*, 2018) and coral reef islands in the Gulf of Mannar Marine Biosphere receive various marine debris (Edward *et al.*, 2020), which are harmful to reefs and other marine organisms. During several underwater diving, macro polypropylene and polyethylene plastic bags were often encountered on coral reefs in the Gulf of Mannar. Thus, the present study aimed to track the source of these plastics found on the reef flats of the Gulf of Mannar region, Tamil Nadu, on the Southeast coast of, India.

## Material and methods

Surveys were carried out along the coastal areas of the mainland, such as the Mandapam and Keelakarai regions. Underwater dives were conducted on coral reef sites (1.3 m depth) at Hare Island (9° 11' 51.06" N; 79° 04' 24.44" E) under Mandapam region and Periyapattinam Vangala beach (9° 15' 01.29" N; 78° 54' 14.21" E) at the Keelakarai region (Fig. 1). Polypropylene and polyethylene sac bags of transparent, red, and yellow colours were recorded at different reef sites. These plastic bags were collected and identified based on their type and using descriptions printed on the bags. The source of origin of these plastics in the study stations and coastal areas was tracked by frequent field surveys conducted from 2018 to 2019. All photographs illustrated in this study were taken using NIKON cool pix camera. A handheld Garmin GPS navigator was used to record the study locations.

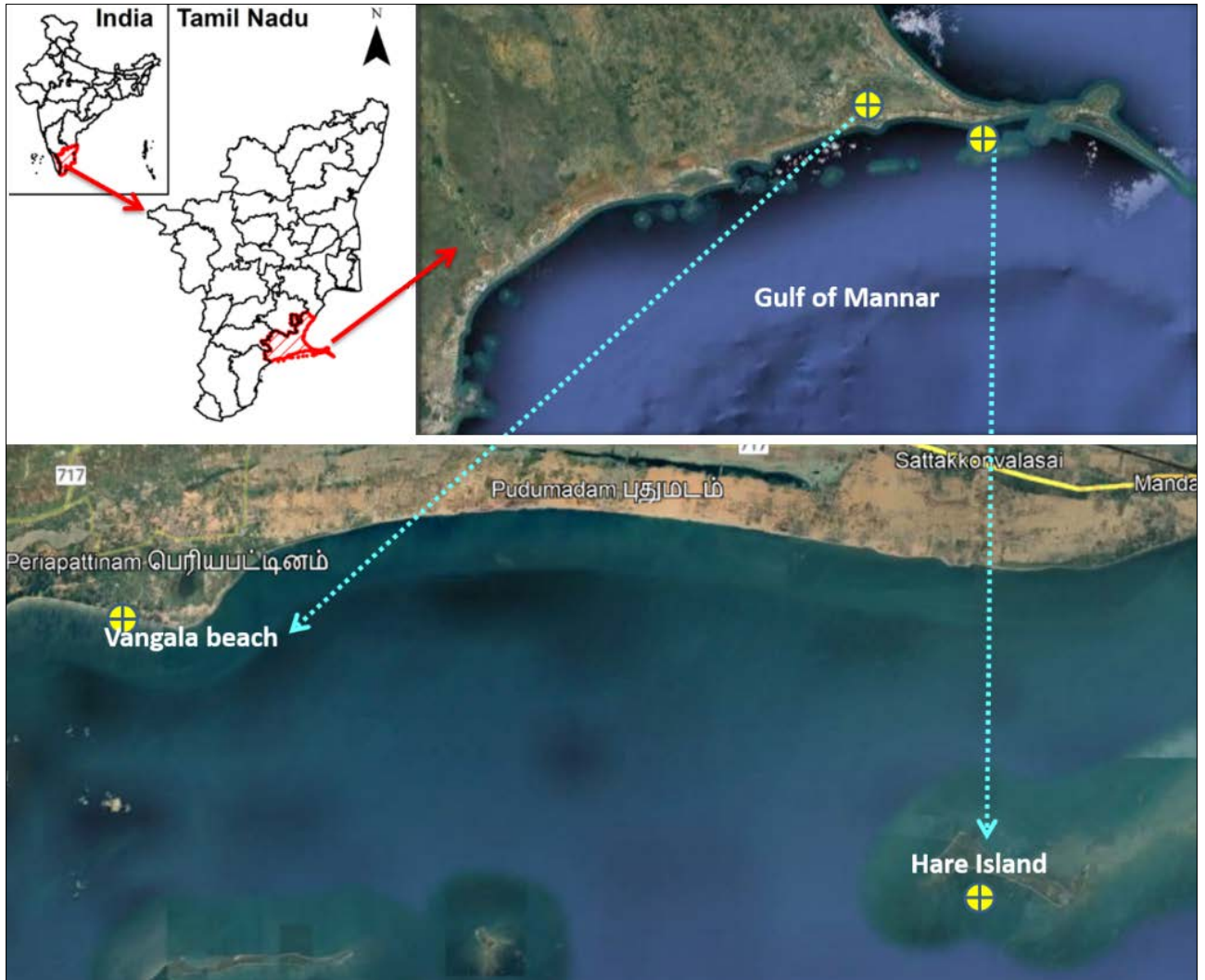


Fig. 1. Map showing the study areas monitored to document the occurrence of polypropylene and polyethylene sack bags in reef environments and mainland coasts

## Results and discussion

During underwater dives, polypropylene and polyethylene bags were encountered entangled on coral colonies and sometimes in a free-floating state at reef flats of Hare Island under the Mandapam region and Periyapattinam coast in the Keelakarai region (Fig. 2). These plastic bags were recorded from the Hare Island, Appa Island, and Periyapattinam coast. These bags were filled with beach sand and used as a stable holdfast to hold date palm, *Phoenix sylvestris*, leaves on which reef squids lay their eggs. A bunch of *P. sylvestris* leaves were tied to each plastic sack bag and were left for a day for colonizing squids. This setup was used to catch bigfin reef squid, *Sepioteuthis lessoniana*, an abundant species available in the Gulf of Mannar region (Fig. 3a-f). Fishermen informed that this setup remains intact on reef flats for up to one to two weeks. Later, *P. sylvestris* leaves start decomposing, and plastic bags also lose sand due

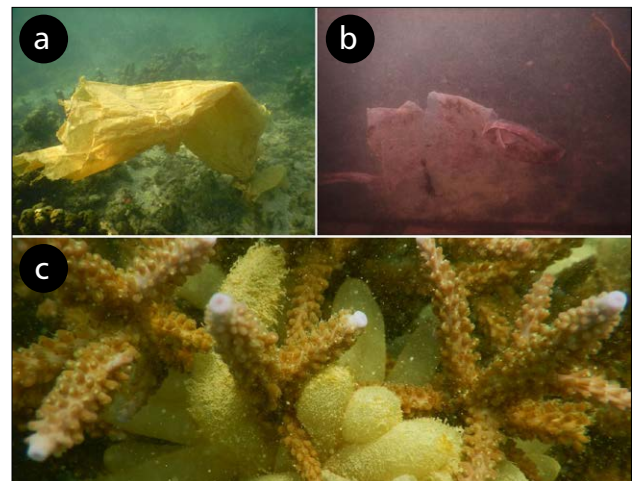


Fig. 2. Free-floating polypropylene (a) and polyethylene bags (b) in reef environment; Eggs of bigfin reef squid, *S. lessoniana* laid on *Acropora formosa* colonies (c)



to waves and currents. Subsequently, these empty bags drift away (Fig. 3a and b) in currents to adjacent islands or mainland coasts. We are unsure whether fisherfolk practice this method in other mainland coastal regions and nearby islands. This report will help researchers understand the origin of these plastic bags in the Gulf of Mannar. Shells collecting net and leaves of toddy palm, *Borassus flabellifer*, on beach seine nets were also found along the mainland beaches (Fig. 3g and h).

If these bags could withstand waves and currents, fishermen replace or install a new set of leaves for attracting squids. At dawn, fishermen catch squids using squid jig from where they have installed these setups. Jigging (such as serial jigging, handline, pole and jigging line gears, and automated jigging machines) is the most widely used method for catching squids

(Arkhipkin *et al.*, 2015). Along the Karnataka coast, fish aggregating device (FAD) made of *Cocos nucifera* spadices (Sasikumar *et al.*, 2006; Sasikumar *et al.*, 2015a), *Casuarina* branches, discarded plastic bottles, and synthetic materials (Sasikumar *et al.*, 2015a), were deployed and a larger number of cephalopods aggregated near FAD deployed sites were caught. The traditional method of squid catch using *P. sylvestris* leaves found in the Gulf of Mannar region is similar to the coconut leaf FAD method (Sasikumar *et al.*, 2015b), but a unique and innovative approach to the old method described in 1954 (Rao, 1954). With just one bunch of *P. sylvestris* leaves, ten to thirty or even more squids were captured. These were also deployed in seagrass beds near Periyapattinam coast in the Keelakarai region. The entire setups were deployed at the depth range of 3 to 15 m. These polyethylene bags start to float free in water



Fig. 3. (a) Date palm, *P. sylvestris* leaves as hard substrates for egg-laying; (b) Polypropylene and (c) polyethylene sack bags filled with sand to hold *P. sylvestris* leaves; (d) Transportation of plastic bags and (e) *P. sylvestris* leaves being transported from the mainland to the island; (f) eggs of the bigfin reef squid, *S. lessoniana* on *P. sylvestris* leaves; (g) net used by local fisherwomen for collecting the molluscan shells for ornamental purpose, livelihood and income generation; (h) dried leaves of toddy palm, *B. flabellifer* attached along the hauling ropes of beach seine net prevents fish from escaping through the sides

upon losing sand by wave and current and get entangled in coral colonies. These free-floating plastic bags damage corals by entanglement and cause tissue damage and shading effect. A study reported shading of coral fragments using different coloured plastics led to tissue necrosis and bleaching due to inhibition of photosynthetic performance of zooxanthellae (Mueller and Schupp, 2020). This indicated that any object that entangles coral fragments, including invasive flora and fauna that overgrew completely or partly on coral tissues can cause localized or complete tissue damage to corals. The chemicals released from plastics can also have adverse effects on organisms and the environment (Teuten *et al.*, 2009), indicating the harmful effect of plastic pollution on marine organisms.

In rare incidents, as observed in this study divers were taken unawares by, the entangling of transparent polyethylene sack bags. Therefore, the use of these bags needs to be regulated in the reef areas. Bricks or heavyweight substances without plastics may be used as alternative holdfasts for tying *P. sylvestris* leaves.

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