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Occurrence of microplastics in fishes from two landing sites in Tuticorin, South east coast of India

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ABSTRACT

Microplastics pollution of the marine environment has been reported worldwide. Here, we investigate the occurrence of microplastics in two species of fishes namely *Rastrilleger kanagurta* and *Epinephalus merra* bought from Thirespuram and Punnakayal fish landing sites at Tuticorin. Out of the total 40 fish, 12 fish showed the presence of microplastic particulates in the intestine. The particulates included microfibers (80%) in red, black and translucent colors and irregularly shaped microplastic fragments (20%). The microplastics were identified as Polyethylene and Polypropylene by Fourier Transform Infrared Radiation analysis. Though microplastics were detected in the gut of the species, the risk of transfer due to consumption can be safely ruled out as the fish are degutted prior to consumption here. Presence of microplastics in the Tuticorin coast is a matter of concern due to its proximity to the Gulf of Mannar, a sensitive coral reef patch already threatened by marine pollution.

1. Introduction

Marine pollution due to microplastics is a rising concern being studied by the scientific community for the past two decades. The term microplastics broadly encompass plastic debris smaller than 5 mm in size (Arthur et al., 2009) and are classified as primary and secondary microplastics. Primary microplastics consist of microbeads which are small particulates used as scrubbing agents in cosmetics (face wash), air blasting pellets and synthetic microfibers from textiles *etc.* (Barnes et al., 2009). Secondary microplastics include plastic particulates originating due to photo or chemical degradation processes of larger plastics such as discarded plastic bags, bottles and lost fishing equipment (Boucher and Friot, 2017). The main concern surrounding microplastics pollution is their ingestion and entanglement inside the organs of marine biota causing suffocation and their eventual death (Laist, 1997; Derraik, 2002; Moore, 2008; Gregory, 2009).

Microplastics ingestion has been described in several marine species, including invertebrates and fish (Thompson et al., 2004; Tanaka and Takada, 2016; Von Moos et al., 2012; Avio et al., 2015). Mismanaged plastic dumping, domestic and industrial runoff, recreational activities in the coast and commercial activities (fishing, cargo, drilling) (Jambeck et al., 2015) form sources of microplastics in the oceans. Based on the specific gravity of the polymer type, these microplastics are present dispersed throughout the ocean water column (Avio et al., 2017; Wright et al., 2013). Polymers lighter than sea water (1.025 g/ cm^3) such as PE, PP float in the surface water while heavier polymers such as Polyvinyl Chloride, Polystyrene and Rayon sink to the sediments. Degradation due to thermal, light induced or chemical oxidation cause changes in polymer topology affecting its average molecular weight and mechanical properties (Singh and Sharma, 2008). Also, the cycle of biofouling (colonization of microorganisms) and defouling of plastics causes changes in its density causing it to sink or float, passing availability of microplastics from pelagic to benthic species promoting availability to the different marine fauna (Wright et al., 2013). Most of these polymers are associated with hazardous monomers, additives and chemical byproducts (Lithner et al., 2011), which are sometimes endocrine disrupting polymers. Also, the high volume to surface ratio of these microplastics make them suitable adsorbents for hydrophobic persistent organic pollutants (Hirai et al., 2011), which pose a threat to the exposed marine biota, especially fish, which unintentionally consume the same (Talsness et al., 2009). These chemicals have been shown to leach into fish tissue on prolonged exposure (Wardrop et al., 2016).

India has an 8000 km long coastline encompassing more than 60 districts in 9 coastal states. About one third of India's population lives in coastal areas (Sibananda and Vijaya, 2014). The coastline of Tamil Nadu that has a length of about 1076 km constitutes about 15% of the total coastal length of India and stretches along the Bay of Bengal, Indian Ocean and Arabian Sea. Tuticorin Bay is situated in the South east coast of India in the Gulf of Mannar along the Tamil Nadu coast.

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Tuticorin is a heavily industrialized area hosting a major harbor, thermal power plant, heavy water plant, and numerous small scale industries (Clara and Sugirtha, 2015). Due to its proximity to the Gulf of Mannar reefs, the coastal areas of Tuticorin are assuming greater importance in pollution analysis owing to increasing human population, urbanization and accelerated industrial activities. The presences of industries, rising pollution and other anthropogenic activities have put tremendous pressure on the fragile coastal environments affecting the Gulf of Mannar and have caused its degradation.

Plastic pollution is on the rise globally with 275 million metric tonnes of plastic waste generated by 192 countries in 2010 and an average of 8.8 million entering the oceans and seas. Out of this, around 0.09 to 0.24 million metric tonnes per year is contributed by India (Jambeck et al., 2015). Microplastics have been distributed ubiquitously, being reported in drinking water samples from New Delhi (Kosuth et al., 2017), along coasts (Veerasingam et al., 2016) and in fish intestines in Kerela (Kripa et al., 2014). Thus, with an increasing prevalence in India with microplastics being reported elsewhere in the country, pollution due to microplastics has gained importance and therefore we investigated its presence in Tuticorin. The aim of this study is to investigate the presence of microplastics and their characteristics in locally consumed fishes from two landing sites in Tuticorin, namely Thirespuram and Punnakayal (Fig. 1).

2. Materials and methods

2.1. Study area

The study areas selected fall in the latitudinal and longitudinal extensions of 8°40′ - 8°55′ N and 78°0′ - 78°15′ E on Tamil Nadu. Thirespuram and Punnakayal are the two fish landing sites chosen in present study.

Station 1: Thirespuram.

Thirespuram (80° 48′ 456″ N - 78° 09′ 485″ E) is a coastal village of Tuticorin located 8 km away from the heart of the city. It receives the Buckle Canal (Fig. 4) which brings in wastes from the industrial and domestic areas while flowing through the city. Thermal power station is at 5 to 6 km distance from Tuticorin fishing harbor. Salt pans and small fish processing industries located around this station also release fish wastes and salt pan effluents into the sea at the site.

Station 2: Punnakayal.

Punnakayal estuary (8° 38′ 266″ N - 78° 07′317″ E) is the only perennial estuary in Tuticorin region of Gulf of Mannar. The Tamirabarani River which arises in the Western Ghats and flows through Srivaikundam and Thiruchendur taluks joins the Arabian Sea at Punnakayal. Mangroves are abundant in this area especially *Avicennia* sp. due to high salinity and lack of fresh water inflow except during the monsoon. Punnakayal coast has a number of fish curing centers and a coral reef extending below it.

2.2. Sampling

Two fish species namely *Rastrilliger kanagurta* (Indian Mackerel), *Epinephalus merra* (Honeycomb Grouper) were selected for use in the current study. These species were selected due to their availability throughout the year and heavy consumption among the locals. For each of the selected species, a total of 20 mature individuals were directly bought from the fishers at the selected landing centers.

Following sampling, the fish were brought to the lab on ice under

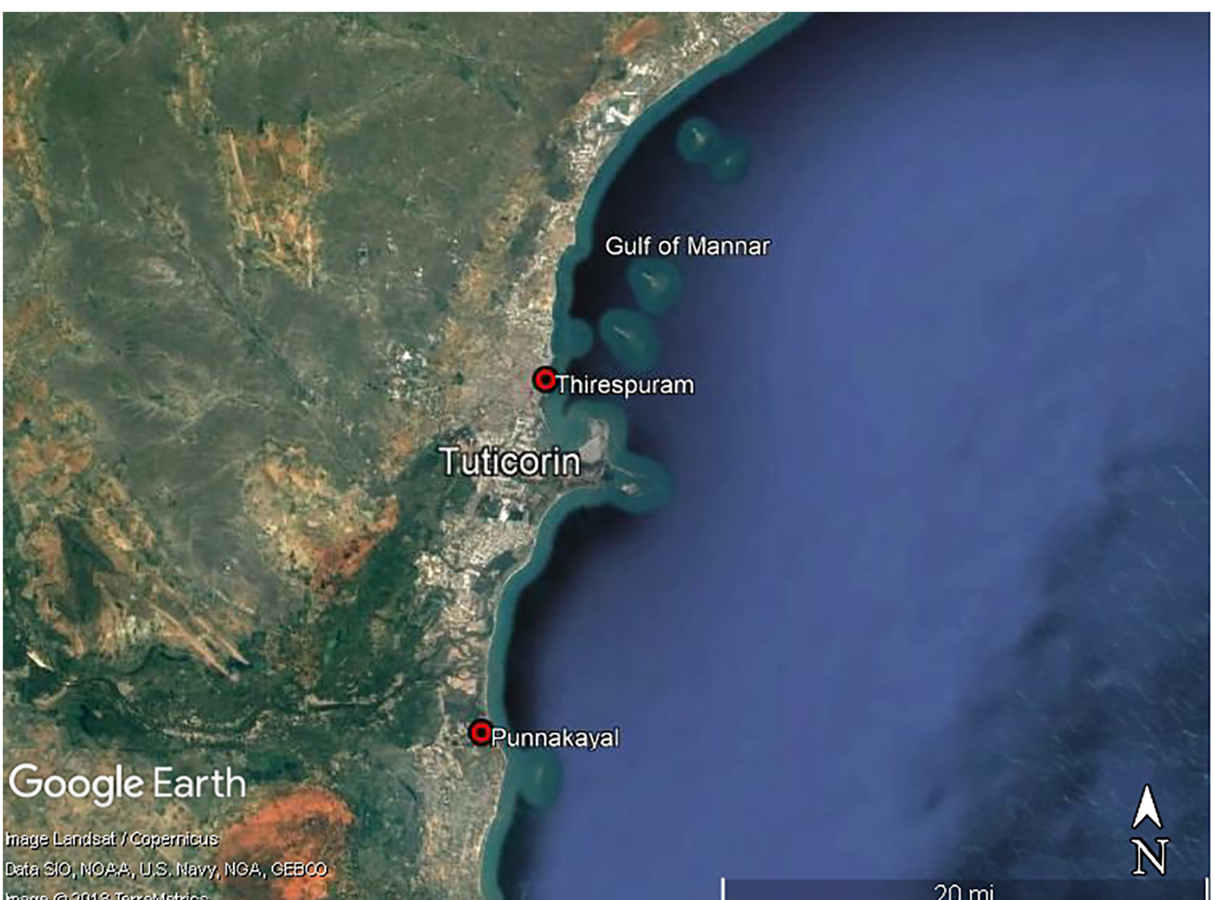

Fig. 1. Map showing Thirespuram and Punnakalyal landing sites.