

# Micro Plastic Identification and Abundance in the First Marine Protected Area of Pakistan (Astola Island) and Other Nearby Beaches

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## Abstract

Microplastics (MPs) pollution is a most burning concern as they pose threats to marine organisms and their ecosystem. However, there is limited information for MPs availability in the marine environment, especially in Pakistan. The current study was conducted with the objective of investigating microplastic number, shape and color in the water and sediments of Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach and Astola Island. Comparison of MPs contamination in the first marine protected area (Astola Island) and other coastal areas of Balochistan. Our results demonstrated that greater concentration of microplastics in the sediments as compared to water samples. According to this study, the most polluted areas in the following order Astola Island>Ras Juddi>Ormara beach>Pasni creek>Ras zarrin. In water samples the number of micro plastics investigated 9 items/100 L as compared to sediments 103 items/10 g. The dominant colors were black, blue, green, red and white. Size ranges (1 mm to 5 mm) and has shape of fibers and fragments mostly. This research study highlights the need of proper plastic waste management system and should be create awareness to the local residents, tourists and stakeholders about plastic pollution catastrophes in these areas.

**Keywords:** Microplastics • Astola Island • Sediment • Water

## Introduction

Astola Island is the first marine protected area of Pakistan acknowledged on June 15, 2017. This is also known as (Island of seven hills) Jazeera Haft Tallar. It covers an area of 6.7 km<sup>2</sup> in width, above sea level 240 feet and buffer zone of 401.47 km<sup>2</sup>. It is a rich biodiversity hotspot, inhabiting endangered species like Green turtle, Hawksbill turtle, and Arabian Humpback whale. It is the home of a variety of birds e.g., *Lars hemprichii*, *Artic Skua*, *Sooty gull* and *almatian pelican*. Around Kawaja hazard shrine six plant species of Props juliflora are concentrated due to anthropogenic activities. A saw scaled *Russell's viper* is endemic to Island [1]. Marine ecology of Astola Island is affected mainly by plastic pollution. Astola is uninhabited offshore largest island due to high tides, roughness of the sea and fishing off Season Island remains unpopulated mostly from June to August.

Plastics make a rudimentary contribution to our society because of their proficient use and relatively low price. In developing countries, plastic pollution is of prime concern that affects all compartments of the environment, especially water [2]. Plastic enters the marine environment via different routes and due to its high density gets

deposited along the coastal lines and oceanic gyres. Plastic litter varies in quantity and composition in sea waters, beaches and deep seas.

Plastic degrade into (micro plastic<5 mm) fragments and filaments enter into the food web threatening marine species health. Plastic have different shape, color and size ingested mistakenly by animals which cause serious problem in migration, reproduction rate, endocrine abnormalities, internal injuries and even death. Sandy beaches is the most affected area of plastic litter, plastic destructed not only coastal area but also raises sea level. Aquatic organism easily ingested small pieces of broken macro plastic. Macro plastic or either micro plastic both releases different organic chemicals which enter into the body of marine organisms and the physiological integrity of organism and also their ecosystem rattled. Now a day's marine invertebrate species reportedly ingested micro plastic. Almost integral part of the world consists of microplastic pollutants like surface water, ocean, soils, estuary and lakes [3-6]. Despite the many reports on micro plastic identification and adverse impacts on species in world marine protected areas but no study has reported in Pakistan.

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This investigation reports the first identification of micro plastic pollution in the Astola Island and other nearby beaches. The water and sediment samples were examined to determine the shape, color and number of micro plastics that maybe the reason of endangered Green and Hawksbill turtle's species decline [7].

## Materials and Methods

### Study area

The study area was visualized through ArcGIS (10.7.1) to select the sampling sites. Sampling was carried out in March, 2020 and weather conditions were mostly sunny. Samples were collected on five different beaches including Ormara, Jabbal Juddi, Jabbal zareen, Pasni creek beach and Astola Island (first marine protected area). The geographical coordinates of sampling sites were recorded through Global Positioning System (GPS) [8-12]. The areas were chosen due to accumulation of plastic waste and garbage. Figure 1 below shows the sampling collection points for micro plastic identification.

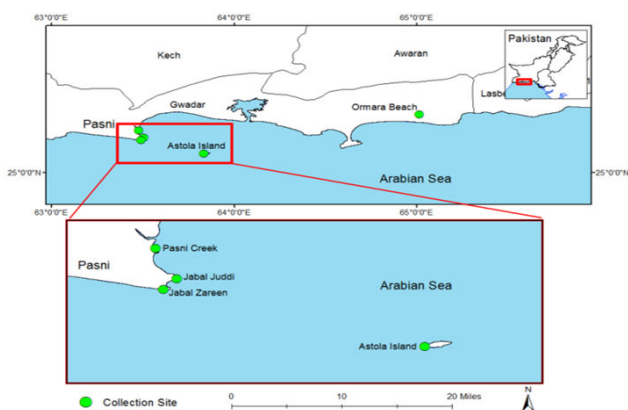


Figure 1. Map shows samples collection points.

### Sampling

Water and sediment samples were collected in Astola Island, Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach during 1<sup>st</sup> week of March, 2020. From different sampling location 20 liters of water from each site were collected into a glass bottles and preserved with 5% formalin solution. The sediments were sampled using a stainless steel box sampler and samples were collected from three different randomly sites. All sediments were stored in an aluminum foil bag and refrigerate at -20°C before analysis. The Sample collected from the area was filtered through seize mesh size of 3 mm to remove sand particles [13]. Debris, predominated by shell pieces was removed manually.

### Micro plastic isolation from water samples

Take 150 ml of water and filter under vacuum filtration assembly using cellulose nitrate filter paper (Pore size 0.45  $\mu\text{m}$ ). Observe under stereomicroscope and count number, observe shape and color of micro plastics.

### Extraction of micro plastics from sediments

In Sediments extraction of micro plastic in accordance with some modifications was performed. At ambient temperature all sediments samples were dried for at least 1 day. For replicate analysis each portion divided into two portions in glass beakers. In each glass beaker, 150 ml of saturated salt solution (NaCl with  $\rho=1.2$  g per ml) was mixed with 10 g of dried sample of sediment and manually stirred with a clean glass rod for one minute. Solution above the sediment layer was carefully removed to another glass beaker after 15 mint of setting. To increase the recovery rate isolation procedure was repeated three times for each glass beaker [14-20]. The clean supernatant was filtered through cellulose nitrate filter paper after 1 day of sedimentation (pore size 0.45  $\mu\text{m}$  under vacuum filtration). Due to adhesion of micro plastic to the wall of filtration apparatus the glass beaker and all the apparatus washed with distilled water many times through the same filter paper to avoid any loss. For microscopic inspection, the filtrate was placed into a petri dish and air dried. For each sampling site there were three replicates. Openings were covered with aluminum foil to prevent contamination from fiber and other particles during all steps of micro plastic extraction of sediment samples.

## Results and Discussion

Micro plastics on the filter papers were observed and photographed with a stereoscopic microscope. Micro plastics were visually identified and measured according to their physical characteristics; the number, shape, color and size of plastics were recorded. Figures 2 and 3 shows abundance of micro plastics in five different places of Balochistan.

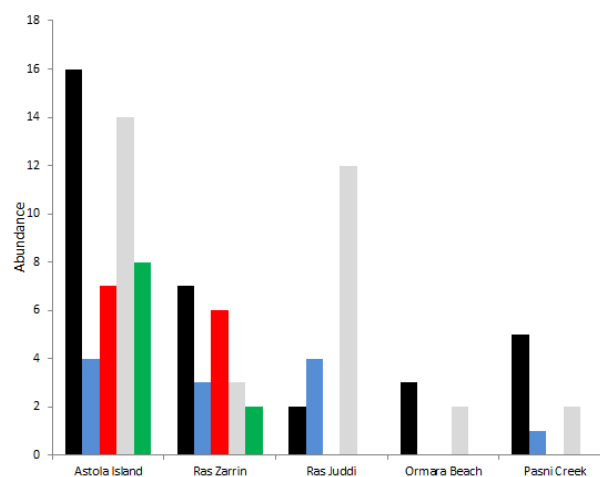
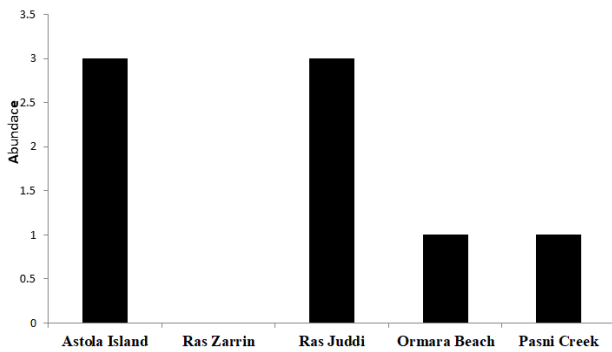
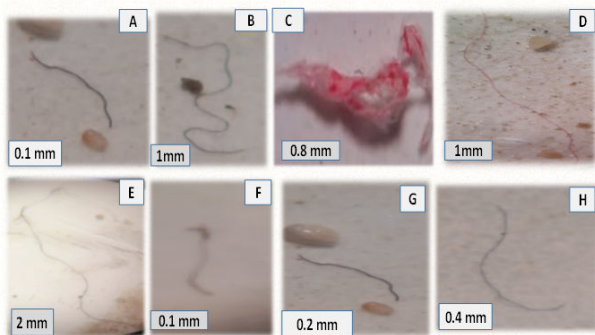


Figure 2. Abundance of micro plastics in the sediments of five different sites of Balochistan.



**Figure 3.** Abundance of micro plastics in the water of five different sites of Balochistan.

We identified microplastic in the water and sediment samples of Astola Island, Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach. This study aims to compare the microplastics contamination level in the Astola Island and other areas (Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach) of Balochistan. In water samples the number of micro plastics investigated 9 items/100 L as compared to sediments 103 items/10 g. The dominant colors were black, blue, green, red and white. Size ranges (0.1 mm to 2 mm) and has shape of fibers and fragments mostly. In Figure 4 microscopic images of fragments and filaments were shown. This study shows that micro plastic is more abundant in the sediments than water samples. There is no micro plastic in the water sample of Ras zarrin. Because micro plastic in the sediments is more stable than flowing water and transported slowly.



**Figure 4.** Microscopic images of microplastic fiber and microscopic fragment in water and sediments of Astola Island, Ras Zareen, Ras Juddi, Ormara beach and Pasni Creek.

Astola Island and Ras juddi have greater concentration of micro plastics in water samples than Ormara beach and pasni Creek. Tourism, improper waste disposal, recreational activities may be the major reasons for the micro plastic contamination of the selected areas.

## Conclusion

Conservation of biodiversity of the Astola Island is necessary through the development of management plan and their implementation. Awareness session should be conducted on regular basis to educate local residents, fishermen and tourist about plastic pollution. Studies show that reduction of fish and other endangered species (Green and Hawksbill turtles) due to plastic pollution. We

suggest that micro plastics monitoring of both phases should be conducted by suitable means, with further studies of the sinking behavior in the Astola Island, Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach being required.

To promote tourism a proper management should be developed and enforced to conserve variety of the Astola Island. We counsel that small plastics observation of each phases ought to be conducted by appropriate suggests that, with more studies of the sinking behavior within the Astola Island, Ras Zarrin, Ras Juddi, Pasni Creek and Ormara beach being needed. Pearl farms established at Astola Island and nearby beaches to generate sustainable livelihood and increase economic opportunities to remote marine communities. Further study needed to identified micro plastic and nano plastic accumulation in fishes, shrimps, mollusks and human feces because to identify plastic damaging effects and connection with different diseases. Awareness sessions should be conducted on regular basis to educate local people about plastic pollution and its consequences.

## Declaration of Interest

The author declares there is no conflict of interest.

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